
Paints and Varnishes – Specification for powdered cement paint

1. Scope

This ECOWAS Standard specifies the requirements and methods of sampling and test for Portland cement-based paint powder that, when mixed with water, provides decorative and protective coatings for interior and exterior use on porous surfaces of masonry, concrete, cement renderings, bricks, building blocks and asbestos-cement.

It is not applicable to products to be applied on gypsum, wood, metals, bituminous felt or any other surface with appreciable water-soluble sulphate content.

NOTE – In order to test products claiming compliance with this standard, the use of asbestos cement concrete test panels is stipulated, if applicable. Attention is drawn to the hazards associated with asbestos-containing materials and the precautions that should be taken (see Annex B).

2. Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision, and since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below.

2.1 ISO 4618-1:1998, Paints and varnishes – Terms and definitions for coating materials – Part 1: General terms.

2.2 GS 22:2004, Specification for ordinary and rapid hardening Portland cement.

2.3 ISO 1514:2004, Paints and varnishes – Standard panels for testing

2.4 ISO 11507:1997, Paints and varnishes – Exposure of coatings to fluorescent UV and water

2.5 ISO 9117:1990, Paints and varnishes – Determination of through-dry state and through dry time – Method of test

2.6 ISO 2808:1997, Paints and varnishes – Determination of film thickness

2.7 ISO 679:1998, Method of testing cements – Determination of strength.

3. Definition

For the purposes of this standard, the definitions given in ISO 4618-1 shall apply.

4. Requirements

4.1 Description

The product shall be in powder form and free from lumps. It shall also mix with water to form, on simple stirring, a homogeneous paint showing no un-wetted material.

4.2 Composition

The product shall consist essentially of Portland cement that conforms to GS 22, pigments and extenders.

NOTE:

1. Extenders could be hydrated lime, limestone, chalk, silicious material, oyster shell or clam shell.
2. Many commonly used additives can have deleterious effect on durability of the product. Care should therefore be taken in the quantities used.

4.3 Keeping qualities (on drying material)

When the product is stored in its original container and kept between $25\text{ °C} \pm 2\text{ °C}$ for a period of 12 months from the end of the month of manufacture shall comply with the requirements of clauses 4.1 to 4.5.

4.4 Durability

When prepared and tested for normal exposure as given in Annex B, a breakdown of the film prepared shall not occur in less than 18 months.

Note: As a precaution against inadvertent accidents, the outdoor exposure test (Annex K) shall be carried out in duplicate.

4.5 Colour

When a coated test panel, prepared in accordance with Annex B is tested in accordance with Annex D, the colour of the coating shall be uniform and free from streaks, spots, or mottling and shall closely match the agreed reference colour.

NOTE –

1. The colour of a reference colour should be agreed between the supplier and the customer.
2. The pigments commonly used are iron oxides, chrome oxides, carbon black, titanium dioxide and green blue phthalocyanine pigments.

4.6 Film properties

A coated test panel, when prepared in accordance with Annex B and tested in accordance with Annex E, shall show no chalking.

NOTES

- 1 Appearance of lime bloom (i.e. calcium sulphate or carbonate) and efflorescence may occur on cement paint films that have been applied to cement products.
- 2 With products designed to give a textured finish, the texturing material may cause difficulties in interpreting the results of this test. Displacement of the coarse texturing material in the finish and the attachment of this velvet material to the velvet cloth (E-1.2) are not to be considered in relation to this test.

4.7 Additional requirements

The material when mixed with equal volume of water shall also comply with the requirements given in Table 1 when tested in accordance with the relevant method given in the table.

Table 1 – Additional requirements for cement paint

Characteristic	Requirement	Method of test
i) Drying time (Hardening) and recoating properties, max	24 hours	Annex F
ii) Residue on 63 mm sieve (on dry material) % by mass, max	5*	Annex G
iii) Water repellency	To pass test	Annex H
iv) Pot life of mixed paint, max.	1 hour	Annex J
* This value maybe exceeded by products designed to give a textured finish		

5. Sampling and compliance criteria

5.1 Sampling

Samples from the lot shall be selected at random as indicated in Table 2 for determining whether a lot complies with the requirements of this specification. The samples so drawn shall be deemed to represent the lot for the respective properties. The samples shall then be tested for compliance with the requirements of the specification.

Table 2 – Sampling of cement paint

Size of lot (1)	Size of sample (2)	Acceptance (3)
Up to 50	2	0
51 to 500	8	1
501 to 3200	13	2
3201 and over	20	3

5.2 Compliance criteria

The lot shall be deemed to comply with the requirements of this specification if after inspection (4.6) and testing, the number of defectives does not exceed the appropriate acceptance number specified in column 3 of Table 2.

6. Packing and Marking

6.1 Packing

The material shall be packed in suitable containers or as agreed between customer and manufacturer.

6.2 Marking

The container of the product shall be clearly and indelibly marked with the following information:

- a) name of product;
- b) name of manufacturer and/or his trade mark;
- c) colour (or colour code) ;
- d) identification or batch number;
- e) date of manufacture;
- f) instructions for use (mixing and application instruments) ;
- g) country of manufacture;
- h) storage conditions; and
- i) net weight in kg.

ANNEX A (Informative)

Recommendations for use of powder cement paints

A-1 General

A-1.1 Powder cement paints may be used for decorative purposes to give a matt finish. They may also be used to improve the resistance to penetration by rain by choking any fine fissures and blocking wide pores. It should be noted that certain colours are liable to become lighter in exposed situations and are better restricted to use on dry and sheltered walls. If colour fastness is of importance, the paint manufacturer should be consulted.

A-1.2 The products complying with this standard are suitable for most climates and are designed to limit the rate at which the film is eroded from a two-coat application. The paint may, however, become soiled in heavily polluted atmospheres and erosion will be more rapid in strongly acid atmospheres.

A-1.3 The paint is suitable for use on porous building materials such as brickwork, stonework, concrete, cement renderings, building blocks, brick and asbestos-cement, but not on metal, timber products, gypsum plaster or bituminous felt. Since it is resistant to the alkali in cement and permits moisture in the wall to dry out freely, it is particularly suitable for immediate decoration of cement products. Its use on non-absorbent surfaces, on dense bricks or tiles where substantial quantities of sulphates are present, or on walls which will be continuously wet (for example, below the damp course level) is not generally advised but the paint manufacturer should be consulted about particular cases.

A-2 Preparation of the surface

A-2.1 The surface should be porous and should absorb water freely. Surfaces which do not absorb water may need special treatment and in these cases, the paint manufacturer should be consulted. The surface should be free from loose matter, dirt, dust, oil or grease and from previous coatings of cement paint which show chalking, and should be brushed with a bristle brush (not a wire brush), scrubbed or washed down or otherwise prepared to ensure this. A wall previously painted with other types of paints is generally not suitable for decoration with cement paint.

A-2.2 Where algae or fungal growths are present, they should be destroyed with a suitable proprietary fungicide and when dry, the dead growths should be removed by brushing with a bristle brush. After the new coat of cement paint is hard, it may be advantageous to apply a fungicide wash to retard re-growth.

A-3 Mixing

A-3.1 The manufacturer's direction should be followed exactly. It is essential to avoid using two separate mixings where a junction is conspicuous since there may be slight variation in shade.

A-3.2 For use on coarse textured concrete block, either a cement paint in which sand has been incorporated by the manufacturer can be used to fill the gaps at the intersections, or a clean fine sand may be added to the cement paint.

A-3.3 Alternatively, cement/sand slurry can be worked well into the surface before painting. In all cases the paint manufacturer should be consulted beforehand.

A-4 Application

The surfaces should be wet in order to assist in the hardening of the cement, but there should not be free water on the surface when the paint is applied. Application should not be carried out in direct sunlight. It is recommended that the first coat should be thoroughly brushed or scrubbed into the surface, preferably with a stiff bristle brush. A second coat is usually necessary to achieve the best appearance and should be applied not less than 24 h later, after re-wetting the surface as necessary, but removing any free water. The second coat may be applied by brush, spray or roller. If application is by spray, provision for stirring the paint in the pot is required, and it will be necessary to check that the nozzle is suitable for use with cement paint. For the rate of application, reference should be made to the manufacturer's literature. It is recommended that cement paints should not be applied under freezing or wet weather conditions.

A-5 Curing

To obtain the optimum properties, it is essential that the cement paint remains moist during the curing period. The wetting of the substrate surface before painting is normally sufficient to ensure this, provided that the surface is in the shade when the paint is first applied. In exceptional drying conditions; it may be necessary to apply a fine mist of clean water from time to time during the first 24 h after application.

A-6 Stripping

Coatings of cement paint may be removed by mechanical means as grinding or grit blasting. If the substrate may be damaged by this procedure, the paint may be removed by careful use of a dilute acid (e.g dilute hydrochloric acid solution). An acid cleaning agent should not be applied to pre-stressed concrete structures or pebbledash finishes. If an acid cleaning agent is used, the following procedure should be used, after protecting any adjacent surfaces which could be affected.

A-6.1 Thoroughly wet the surface to be cleaned with potable water and apply the cleaning agent with a brush.

A-6.2 After not less than 10 min and normally not more than 30 min, thoroughly brush the surface and rinse off the agent, using a high pressure water jet.

CAUTION – Both the mechanical and chemical stripping methods can be hazardous to some degree, so adequate safety precautions should be taken. These should include the provision of suitable breathing apparatus and/or protective clothing, and measures to protect the public.

The acid-treated surface should not be allowed to dry before rising. However, if this should occur accidentally, it is better to make a fresh application of the acid cleaning agent rather than attempt to wash off the previous coat.

In some cases it may be necessary to apply the chemical agent a second time to obtain a clean surface.

ANNEX B (Normative)

Determination of durability

B-1 Principle

The durability of the material is determined by ascertaining actual behaviour of suitability prepared test panels to normal outdoor exposure test for a specified period. Evaluate the results of this exposure by a suitable method of rating for various characteristics of the film.

B-2 Test panels and their preparation

B-2.1 Panels used for all tests, unless otherwise shall be prepared as follows:

B-2.1.1 Concrete Panels – of size 150 mm × 150 mm × 12, 5 mm, prepared as follows:

Cement (conforming to GS 22)	450 g
ISO Standard reference Sand (see ISO 679, CL.5.1.2)	900 g
0,625 cm blue metal jelly	450 g
Water	18 g

Cast the mix into a mould 30 cm × 30 cm × 1, 25 cm in size, suitably partitioned to give four panels. Trowel cut the top surface of the block after compacting and leveling with a wooden float, taking care that all the material remains in the mould. The blocks are allowed to harden in air for 24 hours and then cured in water for 14 days. They are ready for use after this, and shall be stored in a place from chemical fumes.

B-3 Preparation of paint for testing

B-3.1 Using a suitable measure takes one measure of the material and add the material to half a measure of water. To the cement paint, add small quantity of water at a time and mix thoroughly until a smooth, uniform paste is obtained. Then add another half a measure of water stirring all the while. Allow this mixture to stand for 15 minutes.

Apply this by stiff fibre brush ensuring that the application is completed within one hour.

B-4 Preparation of painted panels

B-4.1 Thoroughly wet with water the concrete panels prepared by immersing in water for one hour and allow to drain until no free water remains on the surface. Apply the mixed paint by brushing with a stiff fibre brush to the top surface of the concrete panel. Place the panel in an air draught and fume-free area.

B-4.2 Apply two coats, with a minimum interval of 24 hours in between coats, keeping the panel wet throughout this period. It is essential to keep the surface wet after the final coat for about 2 days by frequent splashing of water to get the best performance.

B-5 Normal outdoor exposure test

B-5.1 Subject the samples for registration to normal outdoor exposure test in the manner described in B-5.2 to B-8.

B-5.2 Prepare the test panels and the paint as prescribed under B-2/B-3. Three coats of the paint are applied as prescribed under B-4.

B-5.3 Expose one set of panels facing east and another south, vertically. The panels are exposed for 18 months. Commence the exposure not earlier than third week of January and not later than the first week of April.

B-5.4 Examine the conditions of the exposed films at an interval of 6 months for the following characteristics:

- a) Colour,
- b) Flaking,
- c) Cracking, and
- d) Chalking.

B-5.4.1 For the above examination, wash the right hand half of the surface of test panels by pouring water and then wiping with soft cloth. Examine the same half of the test panels for the above characteristics. The sample shall be considered satisfactory if the condition of the film in both the halves, the one washed periodically as well as the one washed only for the final examination, is satisfactory by the method of evaluation described in B-6. Stray film failure due to extraneous causes other than climatic shall be ignored.

B-6 Method of rating

The film of the unexposed panel shall be rated with the following basic values for the respective characteristics:

- | | |
|--|----|
| a) Processing correct colour | 25 |
| b) Freedom from flaking (loss of adhesion and hence lifting) | 25 |
| c) Freedom from cracking | 25 |
| d) Freedom from chalking | 25 |

B-7 Evaluation of exposed films

In recording the condition of exposed films at each examination; express the observed relative values of different characteristics in percentage of the basic value allotted to each characteristic under B-6. The allotment of performance value should be multiples of the 10 for arriving at an assessment multiply the basic value for each characteristic (see B-6) by the percentage awarded for the performance in the test and divide the product so obtained by 100 to obtain the percentage award for the observed value of each characteristic. Take the sum total of these resulting values as the overall assessment.

B-7.1 Table 3 is intended to serve as an example for the assessment of a cement paint film after exposure:

Table 3, Assessment of cement paint film after exposure

Characteristic (1)	Basic value (2)	Performance value (3)	assessment (4)
a) Possessing correct colour	25	70	17,50
b) Freedom from flaking (loss of adhesion and hence lifting)	25	70	17,50
c) Freedom from cracking	25	60	15,00
d) Freedom from chalking	25	10	2,50
			52,50

B-8 Result of exposure

Reckon the period for general breakdown of the exposed film from the date of commencement of exposure to the time when the overall assessment falls below 50 percent of when the performance value of any one characteristic falls below 25 percent of the basic value adopted for that characteristic. In the example given above although the overall assessment is 52,50 percent, yet the film is to be regarded as having generally broken down, because the performance value of chalking has fallen below 25 percent of its basic value.

ANNEX C (Normative)

Analysis of cement paint

C-1 Outline of the methods

The analysis consists of determination of Portland cement, total hydrated lime and unhydrated calcium oxide and magnesium oxide in hydrated lime.

C-2 Apparatus

C-2.1 Beakers

C-2.2 Long-Necked Flasks

C-2.3 Reflux Condenser – of suitable size.

C-2.4 Platinum Crucible or Silica Crucible – of 20 to 30 ml capacity.

C-2.5 Gooch Crucible

C-2.6 Carbon Dioxide Absorption Train

C-2.7 Electric Furnace

C-3 Reagents

C-3.1 Ammonium Chloride

C-3.2 Bromine Water – prepared by saturating freshly distilled water with bromine

C-3.3 Ammonium Hydroxide Solution

C-3.4 Ammonium Oxalate Solution – saturated

C-3.5 Sulphuric Acid, dilute – Mix one volume of sulphuric acid with 5 volumes of water.

C-3.6 Standard Potassium Permanganate Solution – 0,1 M.

C-3.7 Neutral Glycerine – Alcohol Solution – 1:5.

Mix 1 part by volume of glycerine with 5 parts by volume of absolute alcohol. To each litre of solution add 2 ml of phenolphthalein indicator solution. It is necessary that the glycerine-alcohol solution should be neutral. If the solution is colourless after addition of indicator, add dilute solution of alcoholic sodium or potassium hydroxide until the pink colour appears and first remove this by addition of alcoholic ammonium acetate solution in drops. If the initial colour is pink, remove it by addition of alcoholic ammonium acetate solution.

C-3.8 Standard Ammonium Acetate Solution (1 ml = 0,005 g; calcium oxide)

Prepare the solution by dissolving 16 g of crystalline ammonium acetate (see note) in one litre of ethanol. Standardize this solution by titrating against pure calcium oxide that is freshly prepared by calcining pure calcium carbonate or calcium oxalate in a platinum crucible at 900° to 1000°C to constant weight. When the calcined calcium oxide has cooled in a desiccator, perform the operations described under C-2.8.1 in quick succession.

NOTE – Ammonium acetate is generally sold in a damp condition and should be as dry as possible. It may be dried by placing over a dehydrating agent, such as, sulphuric acid or fused anhydrous calcium chloride contained in a desiccators for two week or more.

C-3.8.1 Grind it in an agate mortar, weigh out 0,05 to 0,06 g into a dry 200 or 250 ml Erlenmeyer flask, and add 60 ml of the glycerol ethanol solvent to the flask (see note 1). In order to minimize the danger of hydration and carbonation, separate samples of pure calcium carbonate may be calcined in small sized platinum capsules. The calcium oxide thus produced is cooled in a desiccator, re-weighed for a check and introduced in the flask. The grinding of oxide may be unnecessary if original calcium carbonate is in a finely powdered form. Disperse the calcium oxide in the solution by shaking the flask and attach a reflux condenser (see Note 2). Boil the mixture. The ebullition should be positive but not so violent as to cause bumping or excessive evaporation. Then remove the condenser and immediately titrate the solution, while near boiling, with the standard ammonium acetate solution. Replace the condenser and boil the solution again. Repeat the titration at interval (see Note 3). Shake the flask frequently between titrations to shorten the time required for the boiling. The titration is complete when no further colour appears in the solution during continuous boiling for one hour (see Note 4). Calculate the calcium oxide equivalent of the ammonium acetate solution in grams per milliliter by dividing the mass of calcium oxide used by the volume of solution required.

NOTES

1 Sometimes pure calcium oxide will take on the bottom of the flask, particularly if the glycerol is anhydrous. This trouble may be avoided by putting a few grams of clean, dry quartz sand in the flask before the introduction of calcium oxide and solvent.

2 If a new stopper is used and has white powder on it, it should be thoroughly washed before using. A glass tube about 6 mm in diameter and 50 to 100 cm in length because a loss of alcohol is liable to occur through evaporation. In such a case it is necessary to add neutralized ethanol from time to time to maintain the same proportion of glycerol to ethanol. If the proportion is greater than one to three, a partial decomposition of cement may take place. Instead of an ordinary flask, plain tubing and a stopper, a flask with a ground-in glass stopper and condenser tube may be used, preferably one with a standard taper joint. A water-cooled condenser is the most satisfactory and it may be as short as 30 cm. Some loss of alcohol may also occur through dripping from the condenser during the titrations and should be compensated for by the addition of neutralized ethanol.

3 In general, the intervals may be of 20 minutes but they will chiefly depend on the rapidity of the dissolution of calcium oxide. They may be of 5 to 10 minutes in the beginning and then be increased to 30 minutes or one hour in the end. If the solution contains a large amount of dissolved calcium oxide and the boiling is continued a long time without titration, crystals (probably of calcium glyceride) may form which dissolve slowly and increase the time required for the completion of the titration.

4 The end point will not be the same for a hot solution and a cold solution, especially when a large amount of calcium acetate is present. The titration should always be carried out while the solution is boiling hot. If the end point is determined accurately the solution will turn pink upon cooling, and this can serve as evidence that the end point has not been greatly overstepped.

C-3.9 Hydrochloric Acid – 1:2

Mix 1 volume of hydrochloric acid with 2 volumes of distilled water.

C-3.10 Ammonium Phosphate Solution

Saturate freshly distilled water with dibasic ammonium phosphate.

C-3.11 Ammonium Hydroxide Solution

C-3.12 Potassium Chromate Indicator Solution

Dissolve 5 g of potassium chromate in 100 ml of water.

C-3.13 Standard Silver Nitrate Solutions

C-4 Procedure

C-4.1 Carry out the analysis on the material as received.

C-4.1.1 Total calcium oxide

Weigh accurately about 0,5 g of the material and mix with 0,5 g of ammonium chloride in a 50 ml beaker. Add 5 ml of hydrochloric acid, cover the beaker and heat over a water bath for 15 minutes. Transfer the gel completely to a Gooch filter and wash the insoluble residue thoroughly with hot water. Discard the residue and preserve the filtrate. To the filtrate add 8 to 10 g of ammonium chloride. Bring to near boiling, add a few milliliters of bromine water and make alkaline with ammonium hydroxide solution. Allow the precipitate to settle, filter and wash thoroughly with hot water. Concentrate the boiling 25 to 30 ml, adding a few drops of ammonium hydroxide. Boil and add while boiling 25 to 30 l of hot saturated ammonium oxalate becomes granular. Set aside over a water bath for one hour. Filter and wash the precipitate with small amounts of hot water. Preserve the filtrate for magnesium oxide determination (C-3.1.3). Transfer the moist precipitate to a 400-ml beaker by means of a stream of water from a wah bottle, dissolve the precipitate adhering to the filter paper with warm dilute sulphuric acid and catch it in the beaker. Add to the beaker 20 ml of dilute sulphuric acid, dilute to 300 l with hot water and titrate the hot solution against standard potassium permanganate solution.

Calculate the amount of calcium oxide (as CaO) present in material using the following formula:

1 ml of 1 M potassium permanganate = 0,0028 g of calcium oxide.

C-4.1.2 Free Lime

The method does not differentiate between free calcium oxide and free calcium hydroxide, thus any free calcium hydroxide that may be present will be included in the determination and calculated as free calcium oxide.

Weigh one gram of material into flask, for the determination of free calcium oxide and add 60 ml of solvent to the flask and proceed as in the standardization of the ammonium acetate solution (see C-2.8). The end point is considered to have been reached when the content of free calcium oxide in the sample does not increase by more than 0,05 percent during the last two hours of boiling.

NOTE – Avoid unnecessary exposure of the sample to the atmosphere.

C-4.1.2.1 No excess of ammonium acetate shall be added at any time because an excess of it may react with calcium aluminates and silicates. To avoid such excess, use a small burette or measuring pipette fitted with a glass stopcock or rubber pinchcock and small tip which deliver about 50 drops per milliliter. If the titrations are far apart and the reagent evaporates in the tip, a few drops may be discarded before each titration and the drops used in titration may be counted and converted in terms of milliliters. It is good precaution to allow a slight pink colour to remain in the solution after each of the early titrations.

Vigorous boiling is more essential with cement with pure calcium oxide and, if possible, should be so conducted that it is not necessary to shake the flask vigorously at intervals. The flask should not be shaken vigorously while it is disconnected from the condenser

because the solvent, if superheated, may boil, expel alcohol vapour and then draw in air carrying water and carbon dioxide. A good procedure is to bring the solution and sample to boiling rapidly over a Bunsen flame in the beginning before placing the flask on a hot plate and connecting it with the condenser. If there is a tendency to bump, it may be reduced by adding glass beads or pure quartz sand to the flask or putting a thin mat of asbestos between the flask and the hot plate.

If in the final titration there is doubt as to the exact end point, add a drop of the phenolphthalein indicator to the quiescent liquid in the flask and carefully observe the point where the indicator strikes the liquid. If not colour appears, the end point has been reached. If the sample settles during boiling and leaves a partially clear layer of solution, another way to overcome difficulty in discerning a change in the colour of the solution is to swirl the flask after the addition of the solution of ammonium acetate so as to avoid the dispersion of the sample. A strong daylight lamp with a reflector may be used as an aid in the discernment of the end point. The contents of the flask may be matched with similar contents in another flask which contains an excess of ammonium acetate.

If it is necessary to leave the determination incomplete, remove the flask, add just enough ammonium acetate to discharge the pink colour and stopper the flask tightly. When renewing the determination, boil the mixture before repeating the titrations.

Calculate the percent of free calcium oxide to the nearest 0.1 as follows:

Free calcium oxide (CaO), percent

$$= EV \times 100$$

Where

E – CaO equivalent of the ammonium acetate solution in grams per millilitre, and

V = millilitres of ammonium acetate solution required by the sample.

C-4.1.3 Total Magnesium Oxide

Acidify the filtrate obtained from C-3.1.1 with hydrochloric acid, concentrate the solution over a water-bath to about 150 ml and make slightly alkaline with ammonium hydroxide solution. Boil and filter to remove traces of iron, aluminium and calcium. Cool, acidify with hydrochloric acid, add 10 ml of saturated ammonium phosphate. Add ammonium hydroxide drop by drop with constant stirring. When the crystalline ammonium magnesium phosphate has been formed, add 10 ml of the ammonium hydroxide in excess. Set aside over night in a cool place, filter and wash with 2,5 percent ammonia solution. Dissolve the precipitate in a small quantity of hot solution and ammonium hydroxide drop by drop with constant stirring, until the precipitate is again formed. Allow the precipitate to stand for 2 hours, filter and wash. Place the filter paper with contents in a weighed platinum crucible, char the paper slowly and carefully burn off the resulting carbon. Ignite the precipitate to constant weight over a suitable burner. Cool and weigh the precipitate. Calculate the amount of magnesium oxide by multiplying the mass of precipitate obtained by 0,362.

C-4.1.4 Carbon Dioxide

Weigh accurately about 5 g of the material and transfer to a small long-necked flask. Put this flask in a carbon dioxide train consisting of an upward incline condenser, U-tubes containing calcium chloride, anhydrous cupric sulphate and calcium chloride, then a U-tube filled with porous soda lime, a U-tube containing half soda lime and half containing only calcium chloride. Pour some hot water to the material in the long-necked flask, connect the flask to the train and pass a current of carbon dioxide free air through all the train except soda lime

tubes. Weigh and attach the soda lime tubes. Add some dilute hydrochloric acid into the flask slowly. When any apparent action has ceased, heat the flask gradually to boiling and continue boiling until no more gas is evolved. Cool, pass a current of carbon dioxide-free air throughout the experiment. Detach and close the soda lime tubes, let stand in a balance case, weigh them at 30 minutes intervals until two successive weighings agree within 0,5 mg. Record the gain in mass of soda lime tubes as the mass of carbon dioxide.

C-4.1.5 Chlorides

Weigh about 2 g of the material accurately into a 100-ml beaker and add about 20 ml of water, stir well and set aside for 30 minutes. Filter the contents through a filter paper into a 250-ml volumetric flask. Wash the residue on the filter a few times with water, catch the washings also in the volumetric flask and make up to the mark. Pipette out 50 ml of the solution into a conical flask and add 3-4 drops of methyl orange (0,1 g in 50 ml of rectified spirit and made up to 250 ml with water). Add potassium nitrate solution (1 : 10 by volume in water) in such a quantity so that red colour is obtained. Add solid calcium carbonate in such a quantity that red colour disappears and yellow (or yellowish white) colour is obtained. Add 1 ml of neutral potassium chromate indicator solution. Titrate the solution against standard silver nitrate solution slowly swirling the contents of the flask constantly until the first colour change from yellow is observed. The titration is continued further by adding the silver nitrate solution in drops to a faint re-brown colour which persists even after brisk shaking. Calculate the amount of chloride present in the material as follows:

Chloride (as Cl)

$$\text{Percent by mass} = \frac{V \times N \times 17.75}{W}$$

Where

V = volume, in ml, of standard silver nitrate solution used;

N = normality of standard silver nitrate solution; and

W = mass, in g, of the material taken for test.

C-4.1.7 Loss on Ignition

Heat 1,00 g of the sample for 15 minutes in a weighed and covered platinum crucible (a porcelain crucible may also be used) of 20 to 25 ml capacity by placing it in a muffle furnace at a temperature of between 900°C and 1 000°C; cool and weigh. Check the loss in mass by a second heating for 5 minutes and re-weigh. Record the loss in mass as the loss in ignition and calculate the percent loss on ignition to the nearest 0.1. Calculate the percent loss on ignition as below:

$$\text{Percent loss on ignition} = \text{loss in mass} \times 100$$

C-4.1.7 Free or Extraneous Water

Weigh about 1 g of the material accurately into a tared platinum crucible and dry the material in a suitable electric furnace at 350°C for 30 minutes. Cool in a desiccator and weigh immediately. The loss in mass gives the free or extraneous water.

C-5 Report

C-5.1 Compute the percentages of Portland cement, hydrated lime and the percent of the sum of unhydrated calcium oxide and magnesium oxide in the hydrated lime in the material as given in C-4.1 to C-4.1.2.14.

C-5.1.1 Portland Cement

Compute the amount of calcium oxide combined with carbon dioxide (C-3.1.4) and also with chloride (C-3.1.5) and add to the amount of free lime (C-3.1.2). Subtract this sum from the total calcium oxide (C-3.1.1) and multiply the difference by 1,56 (Note) Report this value as the percentage of Portland cement.

NOTE – The factor 1, 56 is based on the assumption that Portland cement contains an average of 64 percent of calcium oxide.

C-5.1.2 Total Hydrated Lime, and Percent of Unhydrated Calcium Oxide and Magnesium Oxide in Hydrated Lime

From the total magnesium oxide value (C-3.1.3) subtract 3,0 percent of computed Portland cement (C-4.1.1) to determine magnesium oxide in the hydrate lime.

NOTE – The factor 3,0 percent is to make allowance for magnesium oxide which may be present in Portland cement to a maximum of 6 percent.

C-5.1.2.1 From the loss of ignition (C-3.1.6) subtract the sum of free water (C-3.1.7) and carbon dioxide (C-3.1.4) to determine the percentage of combined water.

C-5.1.2.2 Multiply the free lime (C-3.1.2) by 0,321 to determine the percentage of water combined with calcium oxide.

C-5.1.2.3 If the value in C-4.1.2.2 is less and the combined water (C-4.1.2.1), proceed as in C-4.1.2.4 to C-4.1.2.9 inclusive. If the value in C-4.1.2.2 is greater than the combined water (C-4.1.2.1) proceed as in C-4.1.2.10 to C-4.1.2.13 inclusive. If the value in C-4.1.2.2 is equal to combined water (C-4.1.2.1), compute total lime as in C-4.1.2.8 and unhydrated lime as in C-4.1.2.14

C-5.1.2.4 Subtract the value obtained in C-4.1.2.2 from combined water C-4.1.2.1. This gives the percentage of water combined with magnesium oxide.

C-5.1.2.5 Multiply the value obtained in C-4.1.2.4 by 2,238 to determine the percentage of hydrated magnesium oxide.

C-5.1.2.6 Subtract the percentage of hydrated magnesium oxide (C-4.1.2.5) from magnesium oxide in the hydrated lime (C-4.1.2) to obtain the percentage of unhydrated magnesium oxide.

C-5.1.2.7 Compute carbon dioxide to calcium carbonate by multiplying by 2,27.

C-4.1.2.8 The sum of free lime (C-3.1.2), calcium carbonate (C-4.1.2.7) magnesium oxide in hydrated lime (C-4.1.2) and combined water (C-4.1.2.1) gives the total hydrated lime.

C-5.1.2.9 The percentage of unhydrated magnesium oxide (C-4.1.2.6) divided by total hydrated lime (C-4.1.2.8), multiplied by 100 gives the percentage of unhydrated magnesium oxide and calcium oxide in the mixture.

C-5.1.2.10 Multiply the percentage of combined water (C-4.1.2.1) by 3, 11 to get the percentage of hydrated calcium oxide.

C-5.1.2.11 To determine the percentage of unhydrated calcium oxide and magnesium oxide, subtract the percentage of hydrated calcium oxide (C-4.1.2.10) from the sums of free lime (C-3.1.2) and magnesium in hydrated lime.

C-5.1.2.12 The sum of free lime (C-3.1.2), Calcium carbonate (C-4.1.2.7), magnesium oxide in hydrated lime (C-4.1.2) and combined water (C-4.1.2.1) gives the total hydrated lime.

C-5.1.2.13 Divide the percentage of unhydrated calcium oxide and magnesium oxide (C-4.1.2.11) by total hydrated lime (C-4.1.2.8) to obtain the percentage of unhydrated calcium oxide and magnesium oxide in the mixture.

C-5.1.2.14 Divide magnesium oxide in hydrated lime (C-4.1.2) by total hydrated lime (C-4.1.2.8) to obtain percentage of unhydrated calcium oxide and magnesium oxide in mixture.

C-5.1.3 Report the percentages of Portland cement, hydrated lime, etc, as obtained by the above calculations.

ANNEX D (Normative)

Colour comparism

D-1 Principle

The colour of films of paints or allied materials is compared against a standard (either a reference standard or a freshly prepared standard) using either diffuse daylight or artificial daylight.

D-2 Supplementary information

D-2.1 The method of test described below requires to be completed, for any particular application, by the following supplementary information. This information is to be derived from this Ghana Standard or other specification for the material under test or, where appropriate, is to be the subject of agreement between the customer and supplier.

- 1) Nature of substrate.
- 2) Method of application of test coating to substrate.
- 3) Thickness in μm of dry coating (ISO 2808:1987) and whether it is to be a single film or a coating system.
- 4) Conditions and duration of drying of coated panel (or conditions of stoving if applicable) before testing.
- 5) Whether the comparison of colour is to be against a reference standard or against a freshly prepared standard.
- 6) Whether the comparison is to be made by daylight or artificial daylight.

D-3 Preparation and Coating of Test Panel

D-3.1 Use panels of tinplate, hard aluminium or mild steel burnished or otherwise, as specified in accordance with ISO 1514. The panels shall not be smaller 150 mm \times 100 mm.

D-3.2 If comparing against a standard paint, coat one panel with the standard paint or system and one panel with the material or system under test, by the appropriate method. If comparing against a reference colour standard it is only necessary to coat a panel with the material under test.

D-3.3 Allow the paints to dry in the specified manner and for the specified time. If normal drying conditions are specified, these should be interpreted as a temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and a relative humidity of 60% to 70% with free circulation of air and not exposed to direct sunlight.

D-4 Colour Matching Booth

The colour matching booth shall be an enclosed from which extraneous light is excluded and which is illuminated by a source of light complying with BS 950, Part 1. The interior of the booth shall be painted a matt neutral grey with a luminance factor of about 15%.

The level of illumination at the colour matching position in the booth shall be between 750 lx and 3200 lx, a figure towards the upper end of the range being desirable for darker colours.

NOTE 1 When mainly light colours and near-whites are to be compared, the interior of the booth may be painted so as to have a luminance factor of 30% or higher in order to give a lower contrast with the colour to be examined. When mainly dark colours are to be compared the interior of the booth may be painted matt black.

NOTE 2 If a diffusing screen is used to avoid the reflection of an image of the lamp from the test panel the screen used should have a neutral transmission so as not to modify the spectral distribution.

D-5 Procedure

D-5.1 Colour comparison

View the two panels, or the panel and the colour standard, either in good diffuse daylight with an illumination of at least 2000 lx or in artificial daylight in the colour matching both as agreed under D-2.1(6). Place the panels side by side, touching or overlapping and in the same plane, at a distance of about 500 mm from the eyes. Compare the colour of the paint film prepared from the material under test with that of the reference standard of freshly prepared standard.

To improve accuracy of comparison, compare the colours with the positions of the panels reversed between the parties.

NOTE 1 – When films of widely different levels of gloss are to be compared special viewing techniques are required. The panels may be viewed either (a) at an angle which minimizes gloss differences, e.g. from a nearly normal direction so that the specula reflection does not reach the eye, or (b) under completely diffuse illumination, an approximation to which may be obtained by reflection from a sheet of white paper held at an angle of 45° to the panel or by transmission through a white diffusing sheet of glass or plastics material, e.g. ground glass.

NOTE 2 – It is especially important that direct sunlight should be avoided when comparing all but the darkest colours. When comparing black films, however, the under stones arc shown up considerably by viewing in direct sunlight.

NOTE 3 – When comparing a paint film against a reference colour standard the latter should preferably be of similar size to the test panel.

NOTE 4 – The observer should have normal colour vision, and should avoid eye fatigue. Viewing of pastel or complementary colours immediately after bright colours should be avoided. When comparing bright colours, if a decision cannot be made rapidly, the observer should look at the neutral grey of the cabinet interior for a few seconds before attempting a further comparison.

NOTE 5 – If the standard and test panels contain dissimilar pigment mixtures they may match under the standard source but not under another light. This phenomenon is known as metamerism and is discussed in D-7. As a test for metamerism it is recommended that facilities be available for changing from the standard illuminant to a tungsten lamp.

D-6 Report of test

D-6.1 The test report shall contain at least the following information:

- a) Identification of material under test
- b) Ghana Standard, product specification or other document setting out the supplementary information required for the test (D-2)
- c) Any deviation, by agreement or otherwise, from the standard test procedure.
- d) The results of the test including any metamerism noted and whether the comparison has been carried out against a freshly prepared standard or against a reference colour standard.
- e) Whether the comparison of colour has been carried out using daylight or artificial daylight.
- f) Date of the test.

D-7 Additional information (Metameric Matches)

D-7.1 When two paints have identical spectral reflection curves they will be a visual match under any illuminant irrespective of its spectral characteristics; this is termed a 'spectral match'.

D-7.2 However, it is possible for two paints having different spectral reflection curves to match visually under a given light source but not to match under another light source with significantly different spectral characteristics; such matches are termed 'metameric'.

D-7.3 Where the pigments in two matching paints are different some metamerism inevitably occurs; there may be, in certain cases, a small degree of metamerism even when the same pigments are used.

D-7.4 A small degree of metamerism whether arising with the same or with different pigments may be acceptable, depending on the particular circumstances, as the importance of metamerism for any supply of paint depends very much on the use for which the paint is intended. Where close colour matching in different lighting conditions is important, the acceptable degree of metamerism, if any, should be agreed between the customer and the supplier.

D-7.5 The simplest method of determining whether match made under an artificial light source conforming to this standard is metameric or not is to inspect it also under the light from a tungsten filament lamp and it is recommended that this be done unless it is known that identical pigments have been used. If the match is maintained under the tungsten lamp it is unlikely to be metameric; if the paints no longer match, but the degree of mis-match is not obvious then it is unlikely that any greater degree of mis-match will occur under most generally used natural or artificial illuminants with continuous spectra. However this may not be the case for illuminants with line emission such as sodium and mercury vapour lamps.

D-7.6 A metameric match made under an artificial light source conforming to this standard, may not match under certain daylight conditions (e.g. north light from a blue sky or sunlight from a low sun), but it will match under the most frequently occurring phases of daylight. It must be noted, however that when the degree of metamerism is severe, the differences in normal colour vision of individual observers may result in two paints being a visual match for some observers, but a mis-match for others.

ANNEX E (Normative)

Determination of film properties

E-1 Apparatus and materials

E-1.1 Hard-drying time apparatus, complying with ISO 9117

E-1.2 Velvet cloth, of 'best quality' black velvet (or white velvet for dark colours). Use a new piece of velvet for each test.

E-1.3 Artificial weathering apparatus, complying with ISO 11341

E -2 Procedure

E-2.1 Carry out the procedure described in E-2.2 and E-2.3 in triplicate.

E-2.2 Using the method described in ISO 9117 but with a piece of velvet cloth (E-1.2) on the plunger of the apparatus, apply the cloth to the middle of a coated test panel prepared as described in Annex B. Examine the velvet cloth for signs of chalking.

E-2.3 Using the procedure described in ISO 11341, expose a second panel in the artificial weathering apparatus (E-1.3) for a total of 1000 h. Remove the panel and allow it to stand at 25 °C ± 2°C for 24 h. Carry out the test as given in E-2.2 and examine for signs of chalking.

ANNEX F (Normative)

Determination of drying time and re-coating properties

F-1 Principle

A concrete panel (B-2.1.1) is coated with the material uniformly and its drying time determined. A second coat is applied over the first coat at the end of the specified period and the ability to take the second coat is examined.

F-2 Procedure

F-2.1 Prepare a panel as prescribed in B-4 and apply one coat of the paint uniformly observing all the precautions. Allow the film to air-dry noting drying time. At the end of the specified period, apply another coat of the paint and examine the ability of the paint to take the second coat.

NOTE – Drying time denotes time for hydration and hardening of the paint film and not for evaporation of moisture.

F-2 The paint shall be deemed to have complied with the requirements of this standard, if it dries within the stipulated time and if a second coat of the same paint can be applied over the first without lifting, working, rolling up or softening it.

ANNEX G (Normative)

Determination of residue on sieve

G-1 Principle

The material is made into a thin paste with water and passed through a 63-micron sieve.

G-2 Procedure

G-2.1 Weigh accurately not less than 50 g of the sample and transfer to a 250 ml beaker. Mix the material to a thin paste with water. Thoroughly mix the contents of the beaker and break up the lumps with the flattened end of a stirring rod without grinding action. The test should be completed within one hour of making the paste as otherwise the material will thicken up in the process of setting. Then transfer the contents of the beaker to a 63-micron sieve, using a wash bottle containing water. Remove with a camel-hair brush any small particles of the material that may be retained on the stirring rod or the sides of the beaker. Wash the residue left on the sieve with water and gently brush with the camel-hair brush until the water passing over the residue and through the sieve is clear and free from solid particles. When the washing is complete, dry the sieve for one hour at $100^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and weigh the residue.

G-2.2 Calculate and express the result as percent by mass of the material taken for the test.

ANNEX H (Normative)

Determination of water repellency

H-1 Principle

The painted film is subject to a spray of water for one hour and the amount of water absorbed is determined.

H-2 Procedure

H-2.1 Prepare a concrete panel (see B-2) of size 450 mm × 350 mm and condition it for 48 hours at room temperature. Apply two coats of the material at an interval of 24 h and wetting in between the coats.

After second coat, allow to cure for 7 days (by keeping the panel moist during these days). Seal the edges and back of the panel with wax and weigh the panels. Keep the panel inclined at an angle of 30° to 45° and allow 135 litres of water to be sprayed at a constant rate for one hour at the central area of the panel, through a nozzle placed 60 cm away and 60 cm above the panel. At the end of the stipulated period remove the panel. Carefully drain away all the surface water and determine its mass.

H-2.2 The material shall be taken to have passed the test if the water absorbed by the concrete panel is not more than 200 g/m².

**ANNEX J
(Normative)**

Determination of pot life of mixed paint

J-1 Procedure

J-1.1 Prepare a mix of the material as given in B-3 and allow it to stand for 30 minutes. At the end of this period, examine the mix for any settling.

J-1.2 The material shall be deemed to have passed the test if the degree of settling of the mix is not such as to affect the easy application of the material.

ANNEX K (Normative)

Determination of resistance to dry rubbing

K-1 Principle

The painted panel is rubbed with a piece of white or black cambric cloth and compared against a registered sample tested similarly at the same time for soiling.

K-2 Procedure

K-2.1 Prepare the panel as prescribed under B-4.1 and apply two coats of paint as prescribed under B-4.2. Allow the panel to cure for 24 hours after second coating. Rub the film with a piece of white or black soft cambric cloth according to the colour of the material. Carry out the test under similar conditions and at same time on a registered sample.

K-2.2 The material shall be deemed to have passed the test if the test cloth is not soiled by the film prepared from the material to a greater extent than that prepared from the registered sample when both are tested by the same person in the same manner at the same time.