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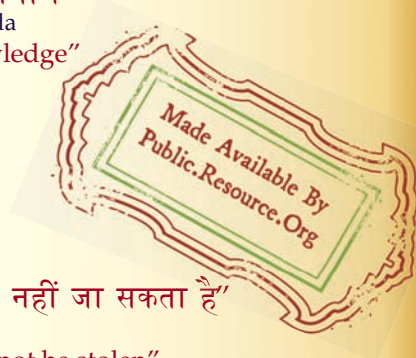
IS 1477-2 (1971): Code of practice for painting of ferrous metals in buildings, Part 2: Painting [CED 13: Building Construction Practices including Painting, Varnishing and Allied Finishing]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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IS: 1477 (Part II) - 1971

Indian Standard
**CODE OF PRACTICE FOR
PAINTING OF FERROUS METALS
IN BUILDINGS
PART II PAINTING
(First Revision)**

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

Indian Standard

CODE OF PRACTICE FOR PAINTING OF FERROUS METALS IN BUILDINGS

PART II PAINTING

(First Revision)

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Indian Standard
CODE OF PRACTICE FOR
PAINTING OF FERROUS METALS
IN BUILDINGS
PART II PAINTING
(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part II) (First Revision) was adopted by the Indian Standards Institution on 25 March 1971, after the draft finalized by the Painting, Varnishing and Allied Finishes Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard is the second part of IS: 1477 'Code of practice for painting of ferrous metals in buildings', and deals with the details of the painting operation and the paint schedules. The first part deals with the pretreatment of the ferrous surfaces before it is actually painted. These two parts are intended to give guidance for obtaining good protection under local climatic conditions to ferrous metals by painting.

0.3 This standard (Part II), which was first published in 1963, is now being revised and the salient features of the revision are as follows:

- a) The various painting operations to be done after the pretreatment of ferrous surfaces are described in detail.
- b) Application of primer, intermediate and finishing coats are covered in detail.
- c) Maintenance painting has been dealt precisely.

0.4 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard (Part II) lays down the details of painting operations and paint schedules applicable to ferrous metals in buildings. It also covers the use of tools and equipment in the work.

1.2 The provisions of the standard may also generally be applied to painting work in situations other than buildings, such as tanks and chimneys.

2. NECESSARY INFORMATION AND FACILITIES

2.1 For the efficient design and operation of the work, the following information shall be taken into account:

- a) The condition of surface to be finished,
- b) Previous treatments given,
- c) Location, and
- d) Climatic conditions.

2.2 Arrangements shall also be made for the proper exchange of information among those engaged in painting work and all those whose work affects or is likely to be affected.

2.3 The time schedule for the overall work shall provide for the completion of the following items of work prior to the application of the paint:

- a) All welding work;
- b) Fastening with bolts or rivets;
- c) Erection; and
- d) Grinding of welds, if required on interiors or exteriors of tanks.

3. PROCEDURE AFTER PREPARATION/PRETREATMENT — FUNCTION OF PAINT

3.1 With preparation and possible pretreatments as described in IS: 1477 (Part I)-1971, the metal surface is ready for painting. It is essential that immediately after the completion of the pretreatment process, the first primer coat shall be applied within the shortest possible interval. This is particularly important in coastal areas with high humidity. The successful painting of iron and steel depends, to a great extent, on the preliminary work explained in detail in Part I of this standard and if it is not immediately followed by at least one protective paint coat, the results achieved might lose their desired value.

3.2 The application of the paint film has two main purposes. The first one is to protect the steel from corrosion and the second for decorative appearance. A painting which gives the steel adequate protection over a

long period of time together with good appearance shall, therefore, be adopted. Such a specification shall also make it possible to adopt a schedule of repainting which is comparatively inexpensive, that is, as is possible to carry out without too high a preparation cost and at intervals as long as possible.

3.3 A paint film comprises of coats of primer, filler, undercoating and finishing paints. For satisfactory performance of a paint film, under the conditions in which they are required to perform, selection of the right type of paints and their adjuncts is of utmost importance. Therefore, it shall be carefully considered whether the paint film has to withstand continuous exposure to exterior weather conditions or is required to withstand a corrosive atmosphere or is required to perform on indoor surfaces. There does not still exist an all purpose paint finish but satisfactory paint finishes are available for practically any particular condition of exposure. There are a number of published Indian Standard specifications for interior and exterior enamels and paints and their adjuncts, namely, primer, fillers, undercoating and finishing enamels/paints. For paints to perform under special conditions it is recommended that the paint manufacturer may be consulted.

4. PRIMER COATS

4.1 Type of Primers—Primers are applied on steelwork to inhibit corrosion and hence called anti-corrosive primers. They should adhere to the surface firmly and offer a key to the subsequent coats. Anti-corrosive primers may be lead-based or lead-free types. For spray application lead-free primers shall be used. The primer coats for ferrous surfaces shall be provided using one of the primers conforming to IS:102-1962* or IS:104-1962† or IS:2074-1962‡. Other anti-corrosive primers such as zinc rich primer, also called 'cold galvanizing', may be used in accordance with the manufacturers' recommendations.

4.2 It is strongly recommended that a primer is employed for which long-term experience under the specific climatic conditions is available and to insist that it shall conform to the relevant Indian Standard specifications.

4.3 The primer coat shall be applied soon after completion of precleaning or pretreatment in order to prevent contamination of the surfaces in any way. Primer paints may be applied by the usual brushes and spray guns. Primers containing lead pigments shall not be applied by spray.

NOTE—Opinion has been expressed by technologists that the primer coats on steel should, in preference, always be brushed, as only a brush is capable of 'working in' the paint into the minute depressions on the non-absorbent steel surface thus ensuring a film, free from 'holidays'. Brush application is also stated to give better adhesion. With these points in view, even where the finishing coats are applied by spray, the specifications in many instances require brush application of the two primer coats.

*Specification for ready mixed paint, brushing, red lead, nonsetting, priming (*revised*).

†Specification for ready mixed paint, brushing, zinc chrome, priming (*revised*).

‡Specification for ready mixed paint, red oxide-zinc chrome, priming.

4.4 Two coats shall be applied allowing a drying time so that the first coat is quite hand dry before the second coat is applied or according to the manufacturer's instructions. In the case of red lead, after the second coat of primer, sufficient time shall be allowed for the red lead to dry thoroughly. Experience has shown that under conditions obtaining in hot and humid parts of India, a minimum of two or preferably three days' drying time for red lead gives good hardness to the film.

4.5 The practice of leaving primer exposed for a long time prior to applying the finishing coats shall be discouraged as the usual two coats application is too thin to give adequate protection for long periods.

5. INTERMEDIATE AND FINISHING COATS

5.1 Filler Coats— Filler coats are applied to fill deep dents and to obtain a smooth finish wherever necessary, the degree of filling depending upon the finish desired. Only factory prepared filler suitable for steelwork shall be used. Fillers prepared by whiting and linseed oil by craftsmen at site shall never be used as such fillers may be unbalanced and incompatible with the primer, undercoating and finishing coats.

5.1.1 Application— Correct application of filler requires a good 'putty knife' and skill. It is an operation for a skilled workman who obtains good results by experience. It is essential that filler applied shall be just sufficient to fill the depression or unevenness and it shall be restricted to the minimum. It shall be applied in thin layers. In filling deep depressions or unevenness, as many coats as are necessary may be applied allowing each layer to dry hard. The hardened filler surface shall be cut down by wet rubbing before the subsequent coat is applied. Where necessary, filler coats may be applied over the undercoats also.

5.1.2 Ready-Mixed Filler— To fill up surface scratches or similar fine dents all over the surface, application by brush or spray of coats of ready-mixed filler is recommended. Each coat shall be hard-dry and wet rubbed to a smooth finish before the next coat is applied.

5.2 Undercoating— After application of the primer, a coat of undercoating is recommended where a high class finish is required. The purpose is to provide a smooth and level foundation for the finishing coat, hide the primer/filler coats and give a full bodied colour in conjunction with the finishing coat. Undercoating paints shall conform to the relevant Indian Standard specifications (*see* Table 1 on P 10). The undercoating may be applied by brush or spray. Application by spray gives a smoother finish than by brush. Application by brush should be done by a skilled workman using good quality brush. After the film of undercoating is hard dry, wet rub to a smooth finish before the first coat of finishing is applied.

5.3 Finishing Coats—The finishing coat gives the desired finish to the article. This is the coat which comes in direct contact with the weather and has to protect the underlying coats, which in turn protects the painted article. Choice of the finishing paint shall be made after carefully considering the conditions under which it has to perform. Finishing paints/enamels conforming to the relevant Indian Standard specifications shall be employed (see Table 1). The finishing coats may be applied by brush or spray. For brush application good quality brushes shall be used. Normally two finishing coats are recommended. These cond coat may be applied after the first coat is hard dry and its gloss is knocked off by scuffing with a very fine cutting device.

5.4 Compatibility—Before considering the application of intermediate and finishing coats, it shall be made sure that those selected are compatible with each other. If a non-elastic finishing coat is applied over an elastic primer coat, it may lead to cracking or 'alligatoring' of the finishing coat and the primer coat may become visible through cracks in the finishing coat. Similarly if the finishing coat contains a strong solvent, it may attack the primer coat and lead to shrivelling (wrinkling) of the entire paint structure. As a general rule, it is safer to use primer, filler, undercoating and finishing paints made by the same manufacturer.

5.5 Drying Time—For the paint film comprising of the primer coats, the finishing coats with filler coats and undercoating where necessary, to perform in unison, it is essential that each coat shall be thoroughly dry before the subsequent coat is applied. Otherwise, defects in the film may appear soon after exposure due to the shrinking of anyone of the coats. An interval longer than the drying time specified in the relevant product specification may be necessary depending upon the material used, for example, red lead primer to IS:102-1962* requires a fairly long drying time.

5.6 Flatting Down—Cutting of primer coat, undercoat and first finish coat is essential to provide a key for subsequent coats in order to improve the intercoat adhesion. The primer coat with or without putty shall be dry cut and the undercoat with or without putty for spot work shall be wet cut with waterproof emery paper No. 220/240. In the case of undercoatings without putty, prior to finishing coat shall be wet cut with waterproof emery paper No. 280/320. The first finish coat shall be wet cut with waterproof emery paper No. 320/400. The surface should be dry, clean and free from dust before subsequent coat is applied.

5.7 Mixing Before Application—It is essential that a paint is applied only after the contents of the drum have been thoroughly mixed. Some paints, such as the red lead primer and zinc primers, after long storage

*Specification for ready mixed paint, brushing, red lead, nonsetting, priming (revised).

show settling of the pigment at the bottom of the drum and, therefore, more than ordinary stirring is required in order to suspend the pigment once again fully in the medium. As stirring of the settled pigment is time-consuming, it will help considerably to adopt the following procedure:

A day or two before application, the drums shall be turned over to stand on their heads. When opening a drum, about half the contents shall be poured into another drum and then the sediment stirred into the remaining medium; when this is fully done and there are neither lumps nor sediment left, the two lots shall be mixed together and thoroughly stirred. The paint, while in use, shall be stirred from time to time to ensure that the pigment remains in suspension. The usual procedure of slightly stirring a 5-gallon drum and pouring the contents into the painter's bucket may result in most of the pigments remaining at the bottom of the drum and being eventually thrown away with the result that the paint actually applied will contain only a smaller percentage of the pigments which have so carefully been incorporated by the paint manufacturer.

5.7.1 Addition of Thinners — Thinners (such as mineral turpentine) shall not be added to paints on the feeling that the consistency of the paint supplied by the manufacturer is too thick. If the paint has been manufactured to conform to Indian Standard specifications, and has been subjected to control tests in a manufacturer's laboratory, the paint shall have the correct consistency and shall not require further dilution. If there is any doubt, the viscosity of the paint may be checked (*see 8.5.1.1*). If a slight adjustment of viscosity is necessary, use the thinner recommended by the manufacturer.

5.8 Importance of Environmental Conditions and Dryness of the Surface — Painting operation should be carried out in a well ventilated place, free from dust. Draughts and direct sunlight should be avoided as it will result in poor flow and a patchy finish. It is essential that the surface to be painted shall be dry, free from moisture as otherwise corrosion and or other paint defects may result due to moisture getting trapped in the paint film. Correct timing for the application of the primer as well as other coats is important.

5.8.1 In coastal regions and areas with moderate or high humidity with appreciable difference in day and night temperatures, it is generally not safe to paint exterior steel work early in the morning due to the settlement of dew on the surface. In such places painting should be started later in the mornings after dew has evaporated. For the same reasons, painting during monsoon shall be avoided even indoors as the humidity is very high and drying will be affected resulting in paint defects.

6. PAINTING SCHEDULES

6.1 Preparation of Surfaces — The surface preparation shall be done in accordance with 6, 7 and 8 of IS: 1477 (Part I) - 1971*.

6.1.1 The surface shall be cleaned and degreased in accordance with one or more of the methods given in 7 and 8 of IS: 1477 (Part I) - 1971*.

6.1.2 Wherever necessary, the surface shall be derusted and descaled by either mechanically or chemically by one or more of the methods given in 7 and 8 of IS: 1477 (Part I) - 1971*, namely:

- a) 1) Wire-brushing,
2) Scraping and chipping, and
3) Sandpapering or cleaning with steelwool or abrasive paper;
- b) Power tool cleaning;
- c) Flame cleaning;
- d) Sandblasting or shotblasting; and
- e) Chemical rust removal.

6.1.2.1 While cleaning with power wirebrush, care shall be taken not to do it excessively, since mill scale easily gets burnished to a smooth even surface to which paint does not adhere, and this will be detrimental to the performance of paint. All accessible weld flux and splatter shall be removed by power tools.

6.2 Painting — The painting operations given in 6.2.1 to 6.2.4 shall be in conformity with the provisions of 3, 4 and 5 of this standard. The selection of paints for the paint systems shall be in accordance with Table 1.

6.2.1 *Primer Coats*

6.2.1.1 Immediately after preparation of the surface, apply the first coat of primer by spray or brush, preferably the latter, working in the paint into the fine dents and ensuring a continuous film without 'holidays'.

6.2.1.2 After the first coat is hard dry, apply a second coat so that a film free from 'holidays' is obtained.

6.2.2 *Filler Coats*

6.2.2.1 After the second coat of primer is hard dry, rough sand the surface without scratching or in anyway damaging the primer coats and clean free from dust.

*Code of practice for painting of ferrous metals in buildings: Part I Pretreatment (first revision).

TABLE 1 PAINTING SCHEDULES FOR FERROUS SURFACE

(Clause 5.2 and 6.2)

SL No.	FINAL FINISH REQUIRED	PRIMER	UNDERCOAT	FINISHING COAT	NUMBER AND THICKNESS OF COATING
(1)	(2)	(3)	(4)	(5)	(6)
A. For Interiors					
i)	Full gloss (enamel gloss)	IS : 102-1962 (see Note 1) IS : 2074-1962	*IS : 133-1965 (B) *IS : 2933-1964 (B,S)	*IS : 133-1965 (B) *IS : 2933-1964 (B,S)	For optimum results, two coats of primer, one undercoat and two finishing coats are recommended. The total film thickness shall not be less than 100 microns
ii)	Oil gloss	Same as for (i)	IS : 113-1950 (B) or IS : 114-1950 (S)	IS : 129-1950	
iii)	Egg-shell gloss	IS : 102-1962 (see Note 1)	IS : 137-1965	IS : 871-1956 or IS : 872-1956	
iv)	Flat	IS : 102-1962 (see Note 1)	IS : 137-1965	IS : 137-1965	Same as for (i)
v)	Metallic finishes	Same as for (i)	—	IS : 2339-1963 (B) IS : 2339-1963 (S) or Bituminous aluminium paints	One coat of primer and two finishing coats if bituminous aluminium paint is used, three coats will be necessary
vi)	Bitumen coating	Same as for (i)	—	IS : 158-1968	

B. For Exteriors

vii) Full gloss (enamel gloss)	IS : 102-1962 (see Note 1) IS : 2074-1962	*IS : 2933-1964 *IS : 2932-1964	*IS : 2933-1964 *IS : 2932-1964	} For optimum results, two coats of primer, one under-coat and two finishing coats are recommended. The total film thickness shall not be less than 100 microns
viii) Oil gloss	Same as for (vii)	IS : 112-1950	IS : 117-1964 to IS : 128-1962	
ix) Egg-shell gloss	—	—	—	—
x) Flat	IS : 102-1962 (see Note 1)	IS : 115-1950 or IS : 116-1950	—	—
xi) Metallic finishes	Same as for (vii)	—	IS : 2339-1963 or, Bituminous aluminium paint	} One coat of primer and two finishing coats; if bituminous aluminium paint is used, three coats will be necessary

NOTE 1 — Paint primer conforming to IS : 102-1962 may be used only where special precautions for drying of the primer coat are taken and where satisfactory drying is ensured before application of further coats.

NOTE 2 — The order in which paints are listed in the table is not necessarily the order of preference and the choice may vary according to circumstances.

NOTE 3 — Evaluation of various degrees of gloss and classification in terms of 45° angular gloss meter readings is under investigation.

NOTE 4 — Titles of Indian Standards referred to in this table are given in Appendix D.

*Each of these specifications cover both undercoating and finishing paints, and paints appropriate for the function shall be used.

(B) = Brushing; and (S) = Spraying.

6.2.2.2 Fill deep dents with paste filler using a good putty knife, pressing firmly into the dents and applying an optimum layer. Allow to hard dry and cut down by wet rubbing to a smooth finish. Allow the water to evaporate.

6.2.2.3 Apply as many coats of paste filler as are required to get a smooth surface, allowing each layer to hard-dry, then wet-rubbing to a smooth finish and allowing the water to dry off before the next layer is applied.

6.2.2.4 After the last coat of paste filler is hard-dry and wet-rubbed, where necessary, apply a coat of R/M filler by brush or spray to fill fine dents and scratches on the metal, allow to hard-dry and wet-rub to a smooth finish.

6.2.2.5 Apply the requisite number of coats, either in local patches or all over the surface as required, allowing each coat to dry-hard, wet-rubbed and water allowed to dry off before the subsequent coat is applied.

6.2.3 Undercoats

6.2.3.1 Wet rub the entire surface, cutting down to a smooth uniform surface. Allow the water to evaporate. Apply an optimum coat of undercoating by brush or spray, with minimum brush marks. Allow the film to hard-dry. Wet-rub, cutting down to a smooth finish (ensuring that at no place the undercoat is completely removed). Allow the water to evaporate.

6.2.4 Finishing Coats

6.2.4.1 Apply the first finishing coat by brush or spray. Allow to dry.

6.2.4.2 Gently remove the gloss for the entire surface. Dust off and apply the second finishing coat.

6.3 The use, conditioning and maintenance of brushes for painting shall conform to the requirements given in Appendix A.

6.4 The use and maintenance of spraying equipment shall conform to the requirements given in Appendix B.

7. MAINTENANCE PAINTING

7.1 The breakdown of a paint film is a progressive one starting with the topmost coat, gradually going downwards to the primer coat. The object of maintenance painting is to renovate the paint film periodically, checking the progress of breakdown and maintaining the protective and decorative value of the paint film, thus prolonging its effective life. The principles of maintenance painting are summarized in Table 2.

**TABLE 2 RECOMMENDED PAINTING PRACTICE FOR
MAINTENANCE WORK**

(Clause 7.1)

SL No.	CONDITION OF SURFACE				CLEANING AND PAINTING PROCEDURE
	Rusting	Cracking	Checking	Chalking	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Nil	Nil	Nil	Yes	Clean; rub with sandpaper; apply one reviver coat
ii)	Nil	Nil	Yes Fine checking	Nil	Flat down to remove check- ed film; clean; apply one or two reviver coats
iii)	Nil	Yes Not reach- ed the surface below	—	Nil	Treat as in 7.5.1.2
iv)	Yes	Nil	Nil	Yes	Treat as in 7.5.1.5
v (a)	Localized	Nil	Nil	Yes	Treat as in 7.5.1.5
v (b)	Localized	Nil	Yes	Nil	Treat as in 7.5.1.5
v (c)	Localized	Yes	—	—	Completely remove paint to bare metal and paint with full schedule
vi)	Heavy rusting	—	—	—	Completely remove paint to bare metal and paint with full schedule

7.2 The symptoms of paint breakdown are chalking, hairline cracking, deep checking, fine checking, peeling, blistering, and rusting. They may be present either alone or along with others depending upon the degree of breakdown. The breakdown normally starts from the top coat. Generally, when there is chalking, checking and cracking do not appear and the breakdown is a gradual process of erosion. This type of failure is most desirable as the protective value of the film is retained over a longer period and renovation is easier.

7.3 The symptoms given in 7.2 may appear all over the surface or it may appear in certain areas in patches. Blistering is another symptom of breakdown. Checking, cracking, blistering and peeling expose the primer coat and the surface underneath to the weather and corrosion is the result. Therefore, such a breakdown is to be remedied quickly.

7.4 If the specification of the painting operation is known, maintenance painting may be easier and more effective as it is possible to renovate by using the same quality of paints as used earlier. If this is not known,

maintenance painting has to be carried out on the overall strength of the existing film and renovated by using the best material required to perform under the conditions of exposure.

7.5 Renovation

7.5.1 *Where Specification of Painting is Known*

7.5.1.1 If the paint film is only chalking and otherwise the film is in good condition, wipe off the chalked film with a wet rag or preferably wash the film with water, remove gloss, allow the water to dry off and apply one coat of finishing all over the surface. If the chalking is in patches, apply one coat at the chalked areas and after it is dry, apply another coat all over the surface.

7.5.1.2 If fine checking and/or hairline cracking have appeared and the film underneath is firm, without symptoms of rust, cut the paint film by wet rubbing, removing all the cracked film, wash, allow the water to evaporate, and apply one or two coats of the finishing paint or enamel. If the defects are noticed in certain areas only as patches, after cutting down the film in these patches, apply one coat of the finishing paint/enamel on this area and then follow with a coat all over the surface.

7.5.1.3 If the cracking is deeper, with or without flaking, reaching up to the primer, without any symptoms of rust and the primer coat is in a good condition, proceed as follows:

- a) If the defect is all over the surface, cut down the top coats up to the primer by wet rubbing, allow the water to dry off, touch up the primer coat wherever necessary, and build up the entire film by applying fillers, undercoating and finishing coats as required.
- b) If the defect is noticed only in patches in certain areas, cut down the top coats only in these areas feathering off the top coats, build up film in these patches ending with one finishing coat and apply a coat of finishing all over the surface.

7.5.1.4 If blistering with or without flaking is noticed and the primer coat is sound, follow the procedure as in **7.5.1.3** (a) and (b).

7.5.1.5 If rust spots are noticed in certain areas only with or without any of the other symptoms of breakdown, cut down the film in those spots to the metal, feathering off the top coats, apply two coats of primer and build up the film following the schedules. Rough sand the entire surface, wash off if necessary and apply a reviver finishing coat.

7.5.1.6 If (a) the rusting is noticed all over the surface, or (b) rusting is severe or, (c) cracking and blistering has damaged the primer coat exposing the metal and is noticed all over the surface or, (d) the paint film has eroded badly; then scrape off the entire paint film to the base metal and carry out fresh painting.

7.5.2 Where Specification of Painting is not Known—Follow the procedure given in 7.5.1.1 to 7.5.1.6. Renovate with the best quality materials to perform under the conditions of exposure.

7.6 Removal of Old Paint for Repainting

7.6.1 Caution should be exercised while removing the old paint. Paint removers of the alkali based or solvent type are available and if proper care is not taken, they may do more harm than good. While washing down after using alkali type, other structures, such as wood, may be adversely affected. For the solvent type, the fume and fire hazard is to be counted. They contain waxes and removal of last traces of wax is essential as otherwise adhesion of the paint coats may be adversely affected.

7.6.2 Burning off of old paint carried out with caution is better than using paint removers.

7.6.3 Removal of the old paint by mechanical method of chipping and scraping is the best.

7.7 Precautions Against Fungi—Exterior painted surfaces may develop fungi which shall be removed and ammoniacal copper solution (*see Note*) shall be applied to the surface and allowed to dry thoroughly before repainting.

NOTE—A recommended composition and concentration of the ammoniacal wash shall consist of 7 g of copper carbonate dissolved in 80 ml of liquor ammonia and diluted to one litre with water. Alternatively, 2.5 percent of magnesium silicofluoride solution may be used.

8. INSPECTION AND TESTING

8.1 General—The aim of inspection and testing is to ascertain whether the recommended practice is being employed during every stage of application and whether the final results fulfil the object of painting. Inspection, therefore, means a close supervision while the work is in progress. Any test carried out should be of non-destructive nature or, if of a destructive nature, should be either restricted to areas which can be restored without marring the general appearance, or be such that it is possible to restore easily without necessitating a complete repetition of the work.

8.2 Inspection of Surfaces Prior to Painting—Inspection methods will depend on whether an article is to be painted for the first time or is to be repainted.

8.2.1 New Work (Not Previously Painted)—The following shall be decided by inspection:

- a) The method of precleaning feasible or recommended;

- b) The intermediate protective treatments to be applied, if found necessary;
- c) The painting schedule and the specifications for the paint for ensuring the particular performance required; and
- d) The method of application, whether by brush, roller, or spray.

8.2.2 Old Work (Which Requires Repainting)—The following shall be decided by inspection:

- a) Whether the entire existing paint requires removal; and
- b) Whether repainting without paint removal would be adequate.

8.2.2.1 For ascertaining whether the old paint has deteriorated to such an extent that its complete removal is necessary, the following test for embrittlement should be employed:

A square coin such as a 5-Paisa coin shall be pressed with the straight edge on an angle of 45° against the paint film. This will result in a chip of paint breaking loose from the surface if the paint has embrittled, lacks adhesion and requires removal. If the paint is not embrittled, it will curl or shrivel up under such pressure. The square coin test should be combined with an examination of the paint film through a magnifying glass to observe the extent of crazing. A suitable magnifying glass is the thread counter employed in the textile trade. It has a 10 magnification, and a paint film which does not show fine hair cracks under it may be considered as perfectly sound.

8.3 Inspection During Preparation of Surfaces

8.3.1 Cleaning and Degreasing—At the work-site a visual and physical inspection is adequate. A degreased steel surface is duller in appearance than one which is even slightly oily. Wiping the surface with a piece of white cloth will show if minute traces of grease and dust have been left on the surface. When steel is being degreased by wiping the surface with mineral turpentine (or any other solvent), it is important to watch that the cleaning rags are washed or changed regularly.

8.3.2 Derusting and Descaling

- a) **Sandblasting**—The most satisfactory method of removing rust and scale is by sandblasting. The criterion of inspection should be that the steel after sandblasting has a greyish white metallic appearance. The surface should be uniform in colour and slightly rough. Only such a uniform appearance ensures that the surface has been thoroughly cleaned.

- b) *Hand-scraping* — No definite method of inspection may be laid down for hand-scraping. It is unreasonable to expect hand-scraped surfaces to be perfectly clean, and for purposes of inspection, all loose rust or scale (and all loose paint in case of repainting) shall have been removed.
- c) *Chemical rust removal* — In the case of chemical rust removal (pickling), inspection shall make sure that washing after pickling has removed all traces of acid. All work pieces shall be inspected particularly in inaccessible corners.

8.4 Inspection Before and During Intermediate Protective Treatments — It is important to inspect the work to make sure that no time is allowed for fresh rust or other contamination to take place between the precleaning and the intermediate protective treatment. Inspection of the various suggested intermediate protective treatments shall be carried out to ensure conformity with the recommended practice as laid down in this standard and in accordance with manufacturer's recommendations.

8.5 General Inspection Before and During Painting — When inspecting general painting work while in progress, it should be ensured:

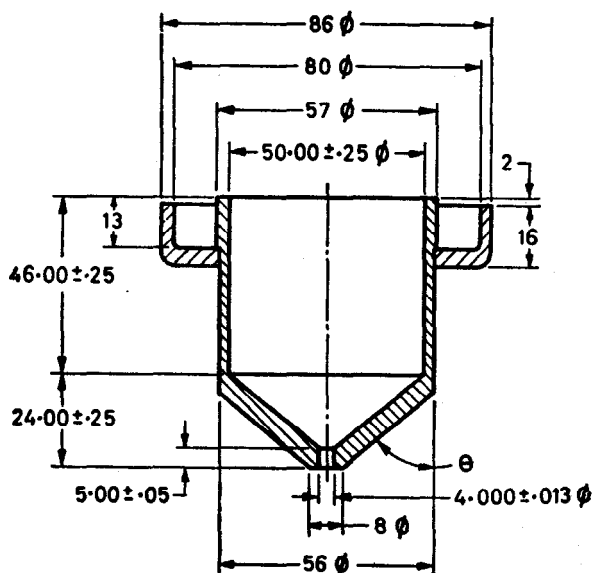
- a) that painting follows immediately after precleaning or pretreatments; that any contamination which may occur in the interim period is removed, that special precautions are taken when painting after galvanizing;
- b) that no painting is carried out when there is danger of dew;
- c) that tools used are clean and not excessively worn;
- d) that the paint in the drums is thoroughly mixed prior to application; that drums are inspected to make sure that no sediment is left in them;
- e) that if paint has thickened because of long storage or because of the evaporation of the solvents, its viscosity is adjusted as recommended by the paint manufacturer;
- f) that each coat is allowed to dry sufficiently but not excessively before applying the following coat; that manufacturer's instructions for drying time are adhered to properly; and
- g) that every individual coat is properly applied, reasonably level and smooth, and free from runs and 'holidays' (minute uncovered areas).

The field tests mentioned in 8.5.1 and 8.5.2 may be carried out for facility of inspection during and after painting.

8.5.1 Viscosity Test of Paints — A simple check is to verify the viscosity of the paint with its original value at least once during the course of its use. This may be done by comparing the times of efflux of the paint

when filled level in a viscosity cup of standard dimensions and provided with an orifice of standard flow characteristics. The procedure of the test is as in 8.5.1.1.

8.5.1.1 The sample of paint to be tested shall be homogeneous and free from any foreign material. All measures with the standard viscosity cup (see Fig. 1) shall be done at a place free from draughts, preferably with the air temperature within the range $30 \pm 5^\circ\text{C}$. During the test, the cup shall be held so that it may be filled level, full without meniscus or overflow at one side. The orifice shall be closed with the finger and the cup filled with the paint until it just begins to overflow into the gallery, pouring slowly to minimize formation of air bubbles. If bubbles are present, allow them to rise and then remove them from the surface. The time from the moment when efflux starts as the orifice is opened by removing the finger, until the first break in the stream, shall be observed nearest to 0.2 second and noted as the time of efflux.



All dimensions in millimetres.

FIG. 1 FLOW CUP

8.5.2 Thickness Test—The thickness of primer paints as well as the total film thickness of all coats applied shall be verified with a suitable instrument. It is important that the setting of the thickness meters is checked prior to the test and for this purpose standardized test bits are supplied with every instrument. It should be noted that instruments like

the 'Elcometer' contain a delicate magnet and that the storage and handling of such instruments needs care to ensure that they retain their accuracy.

8.6 Inspection of General Appearance of Finished Work—Inspection of finished work, although not possible by definite standards, may best be judged by experience and commonsense.

8.6.1 Time of Inspection—Inspection of a finished work in the open shall not be carried out during mid-day or in bright sunlight as defects are more clearly visible in slightly diffused light. When inspecting interior painting, the sun should not shine directly on the surfaces to be inspected. The best time for inspection is in the early morning.

8.6.2 Appearance—The finished job shall have a clean, uniformly coloured appearance. If paint is applied by a spray gun, a smooth finish will be obtained. If paint is applied by a roller, the finish will have a light texture effect. If paint is applied by brush, light brush marks will be permissible to the naked eye at a distance of not more than 4 m. Brush marks depend on the type of paint, the quality of brushes used and, above all, the skill of the workmen applying the paint. It would be unreasonable to expect perfection when applying paint by brush. If paint, applied by brush, has been stippled, no brush marks will be visible but there will be a slight texture effect instead; stippling is not required except on large surfaces, or surfaces likely to be viewed from a short distance.

8.6.3 Colour—Correct colour matching should be judged against a sample panel having the same type of surface as that to which the paint has been applied. The effect of colour is influenced by the texture or the method of application of the paint. Colour appears different during mid-day, in the evening or in the morning, and in artificial or natural light; colour will change under a tungsten-filament lamp, a fluorescent lamp or a mercury lamp (vapour). Application by brush gives a slightly different surface texture than application by spray or roller and the colour will, therefore, differ slightly. To avoid confusion at the time of inspection, the sample panel prepared from an identical material and painted by the same method should be placed as near as possible to the article to be inspected so that the incidence of light is the same.

8.6.4 Gloss—The extent of gloss should be agreed upon prior to commencement of painting. As the extent of gloss is generally not of major importance, the gloss of the final job may best be judged by preparing test panels prior to the application of the paint on the bulk of the work and making a comparison with them; such test panels may also be asked for from the paint supplier. It should be noted that gloss will vary with application by spray, brush or roller and will further vary considerably with the type and nature of the surface; the smoother the surface the higher will be the gloss.

APPENDIX A

(Clause 6.3)

BRUSHING OF PAINT

A-1. GENERAL

A-1.1 Clean brushes shall be used, and it shall be ensured that the paint does not show objectionable pulling under the brush. The brush shall be such that the paint does not show lapping streaks and works satisfactorily under it.

A-1.2 The paint brush shall not be dipped deep into the paint, as the bristles get overloaded, and the heel gets filled with paint; thereby the brush loses its flexibility and shape. As a general rule, the brush shall be dipped to three-fourths of the total length of the bristles. After the brush is initially dipped, the end is wiped against the walls of the container to ensure that paint does not dribble off the ends of the bristles when painting is started. The paints shall be mixed periodically during brushing.

A-1.3 For keeping paint in small quantities during application by brush, use of a paint container may be found advantageous. These containers are filled about three-fourths during application. Cleaning of these containers is done only with paint thinners which are compatible with the paint to be filled.

A-2. BRUSH APPLICATION

A-2.1 While applying paint with a brush, the brush shall be held at an angle of approximately 45 degrees to the vertical surface, and several light strokes applied in the area to be painted, so as to first transfer the paint to the surface. During painting, the brush shall also be turned around through 180 degrees in order to ensure that the paint on both the faces of bristles is utilized completely. The paint is then spread with gentle pressure so as to hide the surface and produce a uniform coating. Ensure that *the ends and not the sides of the bristle come into contact with the surface during painting.*

A-2.2 The paint shall be applied, first using vertical strokes until the surfaces are covered, and then brushed cross-wise for complete coverage with light strokes, so as to smooth out laps and brush marks, and finally laid off with vertical strokes.

A-2.3 During painting, every time after the paint has been worked out of the brush bristles or after the brush has been unloaded, the bristles of the brush (which are drawn together due to the high surface tension of the small quantities of paint left in between the bristles) shall be opened up by striking the brush against a portion of the unpainted surface with the

end of the bristles held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into the paint container.

A-3. CONDITIONING AND MAINTENANCE OF BRUSH

A-3.1 A new bristle brush is properly conditioned by suspending it in raw linseed oil for a period of 24 hours. The oil soaks into the bristles which makes it further impervious to paint pigments.

A-3.1.1 Before use, the linseed oil is removed from the brush by washing it in a thinner compatible with the paint subsequently used.

A-3.2 After each day's work, the brush shall be cleaned in mineral turpentine or any other suitable thinner, ensuring that the paint and pigment are completely removed from the heel of the brush.

A-3.2.1 Warm water and soap shall be used to clean the brushes used in water-bound paints or emulsions.

A-3.3 After cleaning, the brushes are wrapped in heavy paper of waterproof paper for storage. If it is to be used the next day, it shall be hung in a thinner or linseed oil in a container. On no account, shall brushes be made to stand on the bristles.

A P P E N D I X B

(Clause 6.4)

SPRAYING OF PAINT

B-1. PREPARATION OF PAINT FOR SPRAYING

B-1.1 Generally, paints are available ready for use for spraying. If thinning is absolutely necessary, it should be kept down to a minimum.

NOTE — Nitrocellulose lacquers (enamels) are not usually supplied in spraying consistency. They have to be thinned with special thinner to proper consistency before application.

B-2. SPRAYING PROCEDURE

B-2.1 During spraying the spray-gun shall be held perpendicular to the surface to be coated (*see* Fig. 2) and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment

shall be tried so as to obtain the best application with the minimum wastage of paint. The air pressures shall not be kept too high as otherwise the paint will fog up and will be wasted.

B-2.1.1 Spots that are inaccessible to the spray pattern shall be touched up by brush after spraying.

B-2.2 The possible causes of defects in spray painting work are detailed in Appendix C, and the suggested remedies shall be followed for satisfactory workmanship.

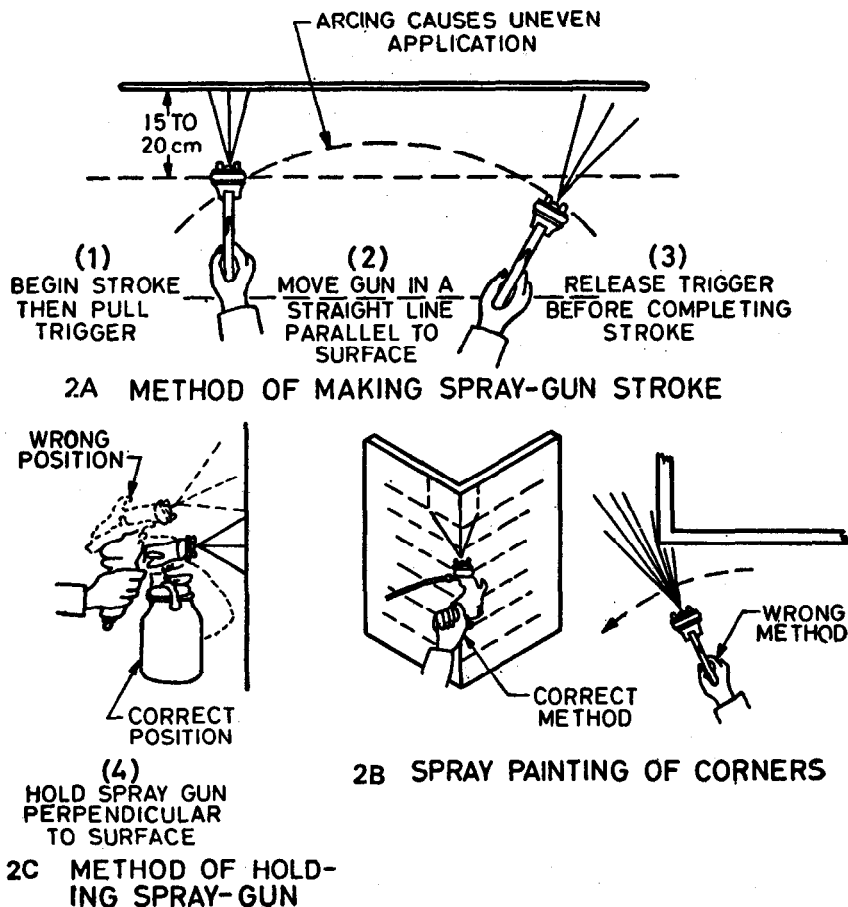


FIG. 2 FUNDAMENTALS OF GOOD SPRAYING TECHNIQUE

B-3. MAINTENANCE OF SPRAYING EQUIPMENT

B-3.1 At the end of the job, the spray-gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats. Caustic solutions shall not be used for cleaning purposes as it will deteriorate the spray-gun.

APPENDIX C*(Clause B-2.2)***SPRAY PAINTING DEFECTS : CAUSES AND REMEDIES****C-1. DEFECTS IN FINISH****C-1.1 Sags***Possible Causes*

- i) Dirty air cap and fluid tip (distorted spray pattern)
- ii) Gun stroked too close to the surface
- iii) Trigger not released at end of stroke (when stroke does not go beyond object)
- iv) Gun stroked at wrong angle to surface
- v) Paint applied too heavily
- vi) Paint thinned too much

Suggested Remedies

- Remove air cap, and clean tip and air cap carefully
- Stroke the gun 150 to 250 mm from surface
- Operator should release the trigger after every stroke
- Gun should be stroked at right angles to surface
- Regulate flow of paint
- Add the correct amount of solvent by measure

C-1.2 Streaks*Possible Causes**Suggested Remedies*

- i) Dirty air cap and fluid tip (distorted spray pattern)
 - ii) Insufficient or incorrect overlapping of strokes
- Remove air cap and clean tip and air cap carefully
 - Follow the previous stroke accurately to deposit a wet coat

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Possible Causes

- iii) Gun stroked too rapidly ('dusting' of the paint)
- iv) Gun stroked at wrong angle to surface
- v) Stroking too far from surface
- vi) Too much air pressure

Suggested Remedies

- Avoid 'whipping' and use deliberate slow strokes
- Gun should be stroked at right angles to surface
- Stroke 150 to 250 mm from surface
- Use least air pressure as necessary

C-1.3 Orange Peel

Possible Causes

- i) Paint not thinned out sufficiently
- ii) Not depositing a wet coat
- iii) Gun stroked too rapidly ('dusting' of the paint)
- iv) Insufficient air pressure
- v) Using wrong air cap or fluid nozzle
- vi) Gun stroked too far from the surface
- vii) Overspray striking a previously sprayed surface

Suggested Remedies

- Add the correct amount and the right type of solvent by measure
- Check solvent. Use correct speed, overlap and stroke
- Avoid 'whipping'. Use deliberate slow strokes
- Increase air pressure or reduce fluid pressure
- Select correct air cap and nozzle for the material and feed
- Stroke the gun 150 to 250 mm from surface
- Spray detail parts first. End with a wet coat

C-2. DEFECTS IN WORKMANSHIP

C-2.1 Excessive Paint Loss

Possible Causes

- i) Not 'triggering' the gun at each stroke
- ii) Stroking at wrong angle to surface
- iii) Stroking gun too far from the surface

Suggested Remedies

- It should be a habit to release trigger after every stroke
- Gun should be stroked at right angles to surface
- Stroke the gun 150 to 250 mm from the surface

Possible Causes

- iv) Wrong air cap or fluid tip
- v) Air pressure too high

Suggested Remedies

- Ascertain and use correct set up
- Use the least amount of air as necessary

C-2.2 Excessive Spray Fog, Surface Haze or Bloom

Possible Causes

- i) Too high air pressure
- ii) Spraying past surface of the product
- iii) Wrong air cap or fluid tip
- iv) Gun stroked too far from the surface
- v) Material thinned out too much
- vi) Too humid an atmosphere

Suggested Remedies

- Use least amount of compressed air as necessary
- Release trigger when gun passes target
- Ascertain and use correct set up
- Stroke the gun 150 to 250 mm from surface
- Add the correct amount
- Spray during dry periods; if not, use retarders or slow evaporating solvents as advised by the manufacturers

C-2.3 Paint will not Come from Spray Gun

Possible Causes

- i) Out of paint (gun begins to sputter)
- ii) Settled, caked pigment blocking gun tip
- iii) Grit, dirt, paint skins, etc blocking gun tip, fluid valve or strainer

Suggested Remedies

- Add paint, correctly thinned out, and strained
- Remove obstruction, strip paint thoroughly
- Clean spray gun thoroughly and strain the paint; always strain paint before using it

C-2.4 Paint will not Come Due to Defects Arising from Pressure Tank

Possible Causes

- i) Lack of air pressure in the pressure tank
- ii) Air intake opening, inside of pressure tank lid, clogged by dried up paint
- iii) Leaking gaskets on tank over

Suggested Remedies

- Check for leaks or lack of air entry
- This is a common trouble. Clean the opening periodically
- Replace with a new gasket

C-2.5 Gun Sputters Constantly

Possible Causes

Suggested Remedies

- | | |
|--|--|
| i) Fluid nozzle not tightened to spray gun | Tighten securely, using a good gasket |
| ii) Leaky connection on fluid tube or needle packing (suction gun) | Tighten connections; lubricate packing |
| iii) Fluid pipe not tightened to the pressure tank lid | Tighten; check for defective threads |

C-2.6 Paint Leaks from Spray Gun

Possible Causes

Suggested Remedies

- | | |
|--|-------------------------------|
| i) Fluid needle packing nut too tight | Loosen nut; lubricate packing |
| ii) Packing for fluid needle dry | Lubricate this part daily |
| iii) Foreign particle blocks fluid tip | Remove tip and clean |
| iv) Damaged fluid tip or needle | Replace both tip and needle |
| v) Wrong size needle | Use correct combination |

APPENDIX D

(Note 4 under Table 1)

INDIAN STANDARDS ON PAINTS AND ENAMELS

D-1. The titles of Indian Standards on paints and enamels referred to in Note 4 in Table 1 are given below:

IS:102-1962 Specification for ready mixed paint, brushing, red lead, nonsetting, priming (*revised*)

IS:113-1950 Specification for ready mixed paint, brushing, undercoating, interior, to Indian Standard colours

No. 101 Sky blue
No. 216 Eau-de-nil
No. 352 Pale cream

No. 358 Light buff and white
No. 443 Salmon pink
No. 632 Dark admiralty grey

IS: 114-1950 Specification for ready mixed paint, spraying, under-coating, interior, to Indian Standard colours

No. 101 Sky blue	No. 358 Light buff and white
No. 216 Eau-de-nil	No. 443 Salmon pink
No. 352 Pale cream	No. 632 Dark admiralty grey

IS: 115-1950 Specification for ready mixed paint, brushing, under-coating, exterior, to matt finish, to Indian Standard colours

No. 352 Pale cream	No. 632 Dark admiralty grey
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IS: 116-1950 Specification for ready mixed paint, spraying, undercoat-ing, exterior, matt finish, to Indian Standard colours

No. 352 Pale cream	No. 632 Dark admiralty grey
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IS: 117-1964 Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes to Indian Standard colours

No. 101 Sky blue	No. 365 Vellum
No. 102 Turquoise blue	No. 384 Light stones
No. 103 Peacock blue	No. 385 Light biscuits
No. 104 Azure blue	No. 386 Champagne
No. 169 Traffic blue	No. 387 Sunshine
No. 174 Oriental blue	No. 388 Beige
No. 216 Eau-de-nil	No. 397 Jasmine yellow
No. 217 Sea green	No. 410 Light brown
No. 219 Sage green	No. 442 Light salmon pink
No. 275 Opaline green	No. 443 Salmon pink
No. 278 Light-olive green	No. 444 Terra cotta
No. 280 Verdigris	No. 628 Silver grey
No. 281 Apple green	No. 629 Quaker grey
No. 283 Aircraft grey green	No. 630 French grey
No. 352 Pale cream	No. 631 Light grey
No. 353 Deep cream	No. 632 Dark admiralty grey
No. 354 Primrose	No. 633 R.A.F. Blue grey
No. 358 Light buff	No. 634 Slate
No. 359 Middle buff	No. 635 Lead
No. 360 Deep buff	No. 692 Smoke grey
No. 361 Light stone	No. 693 Aircraft grey
No. 362 Middle stone	No. 694 Dove grey
No. 363 Dark stone	No. 697 Light admiralty grey
No. 364 Portland stone	(revised)

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IS:118-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colours (*revised*)

No. 355 Lemon

No. 557 Light orange

No. 356 Golden yellow

No. 591 Deep orange

No. 368 Traffic yellow

IS:119-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colours (*revised*)

Class A

No. 218 Grass green

No. 224 Deep bronze green

No. 220 Olive green

No. 267 Traffic green

No. 222 Light bronze green

No. 284 Indian green

No. 223 Middle bronze green

Class B

No. 221 Brilliant green

No. 226 Middle brunswick green

No. 225 Light brunswick green

No. 227 Deep brunswick green

IS:120-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colours (*revised*)

No. 537 Signal red

No. 541 Maroon

No. 538 Post office red

No. 570 Traffic red

No. 540 Crimson

No. 574 Indian saffron

IS:121-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colour No. 414 Golden brown (*revised*)

IS:122-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colours (*revised*)

No. 411 Middle brown

No. 413 Nut brown

No. 412 Dark brown

IS: 1477 (Part II) - 1971

IS: 123-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colours (*revised*)

No. 445 Venetian red

No. 449 Light purple brown

No. 446 Red oxide

No. 451 Chocolate

No. 448 Deep Indian red
and red oxide (colour
unspecified)

No. 473 Gulf red

IS: 124-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colour No. 105 Oxford blue (*revised*)

IS: 125-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colour No. 106 Royal blue (*revised*)

IS: 126-1962 Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes, to Indian Standard colour No. 671 Middle graphite and dark graphite (*revised*)

IS: 127-1962 Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes, white (*revised*)

IS: 128-1962 Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, black (*revised*)

IS: 129-1950 Specification for ready mixed paint, brushing, finishing, interior, oil gloss for general purposes, to Indian Standard colours (for colours No., *see* IS: 117-1950)

IS: 133-1965 Specification for enamel, interior (a) undercoating (b) finishing, colour as required (*revised*)

IS: 137-1965 Specification for ready mixed paint, brushing, matt or egg-shell, flat, finishing, interior, to Indian Standard colours as required (*revised*)

IS: 158-1968 Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and heat resisting, for general purposes (*second revision*)

IS: 871-1956 Specification for ready mixed paint, brushing, finishing, egg-shell gloss, for interior use, to Indian Standard colours

Class A

No. 218 Grass green

Class B

No. 221 Brilliant green

IS : 1477 (Part II) - 1971

IS:872-1956 Specification for ready mixed paint, brushing, finishing, egg-shell gloss, for interior use, to Indian Standard colours

No. 412 Dark brown

No. 413 Nut brown

IS:2074-1962 Specification for ready mixed paint, red oxide-zinc chrome, priming

IS:2339-1963 Specification for aluminium paint for general purposes in dual container

IS:2932-1964 Specification for enamel, synthetic, exterior, type 1, (a) undercoating, (b) finishing, colour as required

IS:2933-1964 Specification for enamel, exterior, type 2, (a) undercoating (b) finishing, colours as required.

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