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Indian Standard

CODE OF PRACTICE FOR PAINTING OF NON-FERROUS METALS IN BUILDINGS

PART I PRETREATMENT

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

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Indian Standard
CODE OF PRACTICE FOR PAINTING OF NON-FERROUS METALS IN BUILDINGS

PART I PRETREATMENT

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Indian Standard
CODE OF PRACTICE FOR PAINTING OF NON-FERROUS METALS IN BUILDINGS

PART I PRETREATMENT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 October 1968, 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 first part of the Indian Standard code of practice for painting of non-ferrous metals in buildings, and deals with pretreatment of non-ferrous metals in buildings before painting. The second part of this standard covers painting schedules. Both the parts together are intended to provide guidance with regard to the painting of non-ferrous metals in buildings.

0.3 The increasing importance and use of non-ferrous metals as structural materials in a variety of conditions and environments had led to an increase in the forms which require painting. Zinc, copper and lead, when used in sheet form for roof covering are rarely painted and in other forms, such as pipes or fittings the areas to be painted are small. The development and extension of the use of non-ferrous metals in the form of claddings and linings for frame buildings and in light gauge sections as structural members call for an appreciation of their painting requirements. Zinc, copper, lead, pure aluminium and some aluminium alloys require painting only when in contact with corrosive materials or atmospheres or for decoration.

0.3.1 The original bright metallic appearance of the non-ferrous metals may be preserved by use of clear finishes, but frequent renewal and maintenance of the coating is necessary.

0.3.2 There has also been an increase in the use of non-ferrous metals, particularly zinc and aluminium, applied in various ways as protective coating on steel. If unpainted, such metallic coatings afford protection to the steel under most conditions, for periods related to the thickness applied. If properly painted and adequately maintained even greater protection is conferred.

0.3.3 Zinc in sheet form or galvanized steel, when new, always requires degreasing before painting; and to ensure adequate adhesion of the paint film the surface should be modified by pretreatment, or by about three months weathering in a clean atmosphere or as an alternative, a special primer may be used.

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. This has been met by referring to B.S. CP 231 :1966 ' Painting of buildings ' published by the British Standards Institution.

0.5 This standard is one of a series of Indian Standards on painting in buildings.

0.6 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.

1. SCOPE

1.1 This standard (Part I) covers pretreatment of non-ferrous metals in buildings before painting.

2. TERMINOLOGY

2.1 For the purpose of this standard definition of terms relating to painting shall be as given in IS : 1303-1963†.

3. NECESSARY INFORMATION

3.1 For efficient planning and execution of painting work with non-ferrous metals, detailed data and information as given below shall be taken into account:

a) Nature of the metal or alloy to be painted;

b) The condition of the metal surface and the presence of harmful materials on it (scale, rust, moisture, greasy dirts, salts, etc);

c) Environments in which the paint coating will have to function; and

d) Information on the nature of previous finish is desirable for repainting during miantenance.

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*Rules for rounding off numerical values (*revised*).

†Glossary of terms relating to paints (*revised*).

4. DESIGN CONSIDERATIONS

4.1 Designing should be done in such a way as to render the surfaces to be painted accessible and suitable for priming and to afford the maximum protection throughout the life of the paint.

4.1.1 Contact faces of metal should be suitably welded or brazed or adequately bedded with suitable gap-filling jointing compound. Buried or hidden faces should be protected from corrosion by priming and applying a further coat of protective paint. Sharp edges shall be slightly rounded to avoid paint receding from them.

4.1.2 In joinery exposed to outdoor conditions all tenons and other concealed areas should be primed before assembly. Door post, sash frames and similar joinery should be adequately primed all over, taking special care to prime any cut surfaces before fixing.

5. SUBSTRATES

5.1 General — It is most important that any substrate, whether it has been painted previously or not, should be in a fit condition to receive paint. To be ready for painting, a surface should be clean, dry and sound, and it should, as far as possible, also have reached a stable state.

5.2 Non-ferrous metals under normal conditions of exposure are much less readily corroded than iron or steel; they are, in fact, often used on this ground and, although in some instances it may be preferred to regard these metals as sufficiently resistant to corrosion and avoid the cost of painting, under conditions of exposure to acidic or marine atmospheres it is essential to protect them from attack. Many of the non-ferrous metals present difficulty in painting because of their tendency to react with the paint, giving rise to poor adhesion, discoloration and poor drying, and it is necessary to take care to prepare the surface correctly and to employ painting systems which are not adversely affected.

5.2.1 Aluminium, zinc, cadmium, copper, lead, terne plate, magnesium and tin are susceptible in varying degrees to attack of alkaline building materials, for example, concrete, lime mortar and brickwork, especially under damp conditions and, when they are brought into permanent contact, an alkali-resistant coating for example, bitumen based paints should be applied preferably to both contacting surfaces.

5.2.2 Where aluminium, zinc, cadmium, copper, lead, terne plate, tin and magnesium are in contact with acidic hardwoods, such as oak and chestnut they will be subjected to attack unless adequately protected. Adequate precautions should be taken if these metals are placed so that rain water flows on to them from adjacent wood.

5.2.3 If the metal surface is damp or contaminated with acids or salts at the time of painting the metal may be slowly attacked beneath the paint film with the evolution of hydrogen which will cause blistering and stripping of the paint film; chemical pretreatment of the metal helps to prevent this. It is, therefore, essential with magnesium, aluminium and zinc that the surface should be clean and dry at the time of painting.

5.2.4 In places where there is metal-to-metal joint, corrosion may occur under damp conditions. Where the metals are dissimilar the risk due to corrosion is greatest because of the electro-chemical reaction. Copper, nickel and their alloys are especially dangerous with non-ferrous metals like aluminium and zinc and should be avoided. Whether or not the metals are dissimilar, it is advisable to treat all surfaces to be joined with a jointing compound. Where joints are soldered, welded or brazed, care should be taken to remove fluxing materials before painting.

5.2.5 Zinc and aluminium are used singly or combined for protection of steel. Under normal conditions both metals will corrode more slowly than the steel they protect, and their corrosion products will be less un-sightly than iron rust. They are both anodic to the steel and zinc will give a measure of protection even where the metal coating is disrupted.

5.2.6 The properties of non-ferrous metals applied as protective coatings to the more corrodible iron and steel are somewhat modified from the properties of the same metal in massive-form. For example, a sprayed metal coating is porous and rough, and its requirements both as regards its preparatory and priming treatment may be different from the solid sheet metal. In general, the conditions under which the non-ferrous metal is to be left unpainted are more restricted in the cases where the metal is used as a protective coating than when it is used in sheet or cast form.

5.3 Aluminium and Aluminium Alloys (Including Aluminium Coating on Steel) — Under conditions of exposure in clean atmospheres, aluminium and its alloys will form a protective oxide film. In some situations the oxide film will provide sufficient protection to the metal without painting, but painting will be necessary if the change of appearance which accompanies the formation of the oxide film is unacceptable. In polluted atmospheres the various alloys of aluminium differ considerably in their susceptibility to corrosion and some are very inferior in this respect; in general, exposure to acids, caustic alkalies and salts, especially chlorides, are to be regarded as detrimental to the metal. For all these reasons, in industrial and marine atmospheres or whenever the metal is likely to be exposed to corrosive agents, painting will be necessary. In situations where the metal is exposed frequently or for long periods to damp conditions, such as the undersides of roofing sheets exposed to humid conditions protective treatment may be required.

5.4 Zinc, Including Galvanized and Other Zinc-Coated Steel — In clean atmospheres it may not be necessary to paint zinc or galvanized steel except for decoration, although it may be preferable to paint the sprayed metal coatings. In damp and polluted atmospheres the rate of corrosion will be appreciable and exposure to acids, caustic alkalies or salts should be regarded as detrimental to the metal. Hence, in industrial or marine atmospheres or whenever, the metal is likely to be exposed to corrosive conditions, protection by painting will be necessary. The life of unpainted zinc coatings on steel in a given situation will be proportional to the weight of the zinc coating. Some guidance as to the corrosive nature of the local atmosphere in the past may be obtained by examining specimens of zinc coated steel which have been used in the immediate neighbourhood. If the galvanized coating which is proposed to be painted whether previously painted or not, has been allowed to deteriorate to such an extent that iron rust is beginning to form, it is essential to clean down thoroughly any corroded area of steel to bright metal and apply a suitable primer of a corrosion inhibiting nature.

5.5 Cadmium Coated Steel — The metal cadmium is somewhat reactive, and it may be pretreated before painting.

5.6 Copper and Copper Alloys — Difficulty in painting copper and copper alloys arises from chemical reaction between the metal and the drying oil used in the paint, and also from the fact that the polished surface offers a poor key for paint. This may be overcome by the use of an etch primer which will both seal the metal, preventing interference with the drying of any subsequent coats of paint and at the same time secure their good adhesion. Care should be taken to remove the copper dust formed on the surface where an abrasive has been used in preparing the surface, and to see that none remains on neighbouring paint work or masonry, since otherwise there is a risk of stains developing owing to the formation of verdigris. Where factory preparation is possible, an electro-deposited coating of tin is useful in preparation for painting

5.7 Lead — Lead possesses good weathering properties and normally need only be painted for decorative purposes. New lead surfaces do not offer a good key for paint but, like zinc, they hold paint much better after a period of weathering. On new lead surfaces it is often advantageous to use an etch primer. Paint on lead tends to embrittle through interaction between metal and the paint, with the lead acting as additional driers, so that pretreatment of the surface and correct selection of primer is necessary to ensure satisfactory results. Primer paints containing graphite as pigment should be avoided.

5.8 Lead-Tin (Terne Plate) — As terne plate holds paint well, no special restrictions are necessary except that graphite shall be avoided in the primer. Where difficulty in painting is experienced in a particular environment, an etching treatment may prove beneficial.

5.9 Tin — Depositions of tin take paint very well. Attention shall be given to degreasing and roughening the surfaces in order to obtain good adhesion.

5.10 Magnesium and Its Alloys — The painting requirements of magnesium and its alloys are, in many respects, no more difficult than those of many other metals, and conventional paint sytems may be used provided good painting practice is followed. Magnesium is a highly reactive metal and the oxidation product is alkaline. These features require attention for obtaining the best results from painting.

5.10.1 In clean indoor atmospheres, magnesium and its alloys corrode more slowly than iron and steel, becoming coated with an adherent white film and in clean outdoor atmospheres, a similar film forms more quickly. In acidic atmospheres or where it is in contact with metallic salts, especially chlorides, such as those in sea water, magnesium is attacked very rapidly. Although compared with aluminium, it is relatively resistant to attack by alkalies, it is generally advisable and sometimes essential to protect the metal either by painting alone or, preferably, by painting in conjunction with chemical pretreatment of the metal surface.

5.10.2 Painting problems may arise because of the development of alkaline reaction products formed by the moisture which penetrates the paint film. It is not therefore sufficient to neutralize the alkalinity of the metal before commencement of painting, for the alkali condition will recur, but best results are likely to be obtained on these metals with paint films which are more resistant to the passage of water.

6. SURFACE PREPARATION AND PRETREATMENT

6.1 Pretreatment and priming of non-ferrous metals under controlled conditions at the factory gives the best results and it is, therefore, advisable to adopt this method whenever possible. The object of such treatment is to preserve and maintain the metal surface during transport, storage, and erection and to minimize the ‘ on site ’ preparation for final painting. Much will depend upon the time between the factory treatment and erection, the care with which the materials have been stored and handled during that period and the protective quality of the treatment applied.

6.1.1 Application of a suitable priming coat should follow pretreatment without delay. Subsequent coats of paint may be applied on the site after cleaning down the primer and touching up with the primer paint any damaged parts.

6.1.2 Pretreatment processes are dealt with under two heads for different substrates:

a) Factory pretreatment, and
b) On-site pretreatment.

6.2 Aluminium and Alloys

6.2.1 *Factory Pretreatment* — This method covers the following:

a) Mechanical treatment,
b) Solvent cleaning,
c) Chemical treatment, and
d) Anodic treatments.

6.2.1.1 *Mechanical treatments*

a) *Hand or power wire brushing or other abrasive treatment* — This roughens the surface and mechanically improves the anchorage of paint films. The disadvantages are that the natural oxide film on the metal is disrupted and oil or grease films and other foreign matter are not completely removed.

b) *Sand blasting* — This should be carried out at relatively low pressures and with a fine silica sand. Where used, it should be followed by an inhibitive chemical treatment.

6.2.1.2 *Solvent cleaning* — Solvent cleaning does not disturb the natural oxide film on the metal and may prove adequate for some applications, such as ambient indoor or very mild service conditions. Where possible, solvent cleaning should be followed by chemical treatment or anodic treatment (*see* **6.2.1.3** and **6.2.1.4**). The following methods may be employed:

a) Manual scrubbing with mineral spirit or a high flash solvent naphtha. With this method it is extremely difficult to prevent accumulation of contaminants on the swab or in the solvent. This method is recommended when other treatments are impractical.

b) Solvent spray cleaning.

c) Vapour degreasing in special equipment employing solvents like trichloroethylene vapour.

d) Suitable alkaline cleaners free of caustic soda may be used hot (80-100°C) followed by thorough rinsing in water.

6.2.1.3 *Chemical treatments* — The aluminium surfaces should be freed of oil, grease or other foreign material by means of the procedure described in **6.2.1.2** (c) or (d) or any other suitable methods given below:

a) *Alkaline etch* — Alkaline solutions based on caustic soda etch the metal, thus destroying the natural oxide film. They are followed by an acid treatment, preferably nitric or phosphoric acid. These are not generally recommended unless followed by a conversion treatment.

b) *Sulphuric-chromic acid etch* — This treatment produces a passive surface suitable for painting under mild exposure conditions and where clear finishes are to be applied.

c) *Phosphoric acid cleaners* — These may be applied by swabbing or dipping at room temperature or hot followed by the rough rinsing with clean water. A very thin phosphate film is formed which tends to protect the metal and promote paint adhesion under mild exposure conditions.

d) *Acid fluoride deoxidizer* — This process uses nitric or sulphuric acid with chromic acid and a fluoride. It provides a clean and uniform surface. The deoxidizing solution is generally used at 35 to 55°C by immersion followed by a water rinse.

e) *Crystalline phosphate treatment* — This consists of reacting the aluminium surface in a zinc-acid-phosphating solution to form a crystalline phosphate coating of the proper texture adopted to inhibit corrosion and increase the adherence and durability of any applied paint film. The phosphate process may be carried out by immersion or spray application.

f) *Amorphous phosphate treatment* — This process comprises treatment of clean aluminium surfaces by immersion, spray or roll coat in aqueous solution containing phosphoric, chromic, hydrofluoric acids or solutions thereof. The aluminium surface is converted to a thin, adherent amorphous coating iridescent green to gray green in colour which inhibits corrosion and increases the adherence and durability of applied paint films. This method is recommended for use under the more severe conditions of service.

g) *Carbonate chromate treatment* — This process comprises treatment in a hot dilute solution of sodium carbonate and potassium chromate followed by a water rinse. This forms a thin, adherent, conversion coating increasing the corrosion resistance of the metal and promoting paint adhesion.

h) *Amorphous chromate treatment* — This comprises treatment in aqueous chromic acid solutions with fluoride containing accelerators. This surface is converted to an adherent, amorphous, mixed metallic oxide coating iridescent golden to light brown in colour which increases the corrosion resistance and the adherence and the durability of any applied film. The coating process may be carried out by immersion, spray or roll-coat. It may be necessary to precede the treatment with a deoxidizer [*see* (d)].

j) *Etching or wash primers* — This treatment is based on the deposition of an acid-bound resinous film on the aluminium surface in such a manner as to enhance the adhesion of subsequently applied paint coatings. The film may be applied by brush, spray or dip. The film has good adhesion to the metal substrate.

6.2.1.4 *Anodic treatment* — Anodic treatments in either chromic or sulphuric acid electrolyte will provide a protective and inert oxide coating which increases the corrosion resistance of the metal and promotes paint adhesion. It is recommended where maximum corrosion resistance is desired. Anodic treatments should not be used on assemblies of dissimilar metals.

Materials and procedures employed in the methods of treatment given above are available from a number of sources as proprietary compounds or methods and where they are used, processes recommended by suppliers should be followed.

6.2.2 *On-Site Pretreatment*

6.2.2.1 Details of surfaces untreated or protected with a temporary protective are given below:

a) Temporary protective materials are often applied to aluminium sheet to protect it during storage, transport and erection. These materials should be removed with suitable solvent as a preliminary to other preparatory treatments.

b) Lubricants used in the rolling of aluminium sheet may be particularly tenacious and may have undesirable effects on paint adhesion. The use of abrasive paper wetted with suitable solvent, is effective in removing the worst effects of these materials. Where joints are welded, soldered or brazed care should be taken to remove fluxing material before painting. This may be effected with a 10 percent aqueous solution of formic acid followed by thorough washing, or with suitable solvents.

c) Surfaces which are protected with a temporary protective shall be treated by the use of wash or etching primers preceded, if necessary, by the removal of the temporary protective.

d) In the case of heat hardened alloys the surface shall be treated by mechanical roughening combined with degreasing. Such work should be carried out as thoroughly as possible to ensure that the paint will adhere well and give protection and durability. The surface should be well scrubbed or swabbed with a suitable solvent, then abraded with abrasive paper and finally rinsed with successive portions of clean solvent on clean swabs. This method should not be used on composite sheets which depends on a very thin lining of pure aluminium for corrosion resistance.

e) Proprietary compositions are designed to etch the surface after degreasing, but care should be taken unless the manufacturers specify otherwise, to remove all residues by washing before painting and also to ensure that the compositions do not contaminate other parts of the structure.

f) Casting in aluminium alloys may often be painted without any pretreatment other than removal of grease. The surface usually provides a good key on sprayed aluminium coating usually without pretreatment.

g) Where it is required to paint aluminium which has been left unpainted and which has acquired a surface layer of corrosion products, this layer shall be removed. Removal may be difficult if the corrosion is considerable. Mechanical means of removal include the use of stainless steel wire brushes, but ordinary steel wire brushes should not be used. The latter may leave embedded particles of steel which encourage further corrosion. If adequate safety precautions may be ensured, chemical removal may be adopted using special inhibited acid solution, but thorough subsequent rinsing and drying of the surface is essential.

6.2.2.2 Surfaces already factory pretreated and/or primed should be carefully inspected and damaged areas should be thoroughly degreased by clean solvent swabbing, any corrosion products formed should be thoroughly removed and touched up with a coat of wash or etching primer or suitable chemical pretreatment solutions. The rectified areas should then be brought forward with appropriate primer, putty, finish coats, etc.

6.3 Zinc

6.3.1 Sheet zinc and galvanized steel, when new, should be degreased before painting to ensure adequate adhesion of the paint film. Even when this is done the paint may adhere satisfactorily only if the surface is modified by chemical treatment or by the action of the weather, or if the recommended priming paints are used. This is because zinc may react with many types of conventional paint to form water sensitive, brittle compounds at the paint/metal interface and the various forms of preparatory treatment prevent these interactions taking place. In some cases wash primers/ calcium plumbate primer may be used without special surface treatments.

6.3.2 *Factory Pretreatment* — The surface should be freed of oil, grease or any foreign contaminant by means of the procedure described in solvent cleaning method (*see* **6.2.1.2**) before applying any of the treatments recommended below:

a) *Crystalline zinc phosphating treatment* — The zinc surface is converted to a crystalline zinc phosphate to inhibit corrosion, increase adherence and durability of paint film. The treatment may be provided by dip, spray or brush application.

b) *Chromate treatment* — This consists of a dip or spray with a dilute solution of a mixture of chromic and other acids to provide a thin amorphous chromate coating that increases corrosion resistance and paint adhesion.

c) *Aqueous chromic organic treatment* — Certain water soluble resins with chromium compounds may be applied to zinc surfaces by roller coat or other suitable means, such as by dip or squeeze rolls. The resultant coating provides a corrosion resistant film that increases the adhesion of applied paint film.

d) *Etching or wash primers* — This treatment should be carried out on the lines given in **6.2.1.3**(j).

6.3.3 *On-Site Pretreatment*

6.3.3.1 *Surfaces untreated*

a) The surface should be thoroughly degreased by solvent wipe by applying the wash or etching primers.

b) The surface should be thoroughly degreased by solvent wipe by applying an etching solution. Some of these are similar in action to the phosphating solutions mentioned above, while others are based on acids or other mordants. The use of mordants containing copper is not recommended since the last traces of copper, which are difficult to remove, stimulate corrosion. After using any etching solution the surface should be thoroughly rinsed with clean water to remove acids and salts, which might be deleterious if allowed to remain.

c) If the zinc or galvanized steel is allowed to weather up till the bright spangles disappear before painting, it attains a condition suitable to receive paint without the necessity of degreasing or etching; it will be necessary, however, to clean down to remove dirt, corrosion products, etc. Since the galvanizing alone, if of reasonable thickness is sufficient to protect the steel from corrosion for some years in normal atmospheres, the few months delay before painting is not likely to result in corrosion.

d) An alternative process is to abrade the surface thoroughly with emery cloth lubricated with a suitable grease solvent to produce a uniform, fine matt surface, and subsequently wash with successive portions of clean solvent. This process is laborious and suitable only for small areas.

6.3.3.2 *Surfaces already factory pretreated and/or primed* — Such surfaces should be treated on the lines given in **6.2.2.2**.

6.4 Magnesium

6.4.1 Chemical pretreatment of the metal may not be done easily on the building site and it should, therefore, be carried out at the works before the metal parts are delivered.

6.4.2 *Factory Pretreatment* — Mechanical (abrasive) treatments, solvent cleaning, alkaline solution treatments, and acid pickles not resulting in protective conversion coatings are suitable preliminary treatments only for metal to be exposed under mildly corrosive (indoor) conditions. When a high degree of corrosion protection and paint adhesion are desired, as in many outdoor environments, surface preparation by a suitable conversion coating treatment, such as the dichromate method shall be adopted. Certain anodic treatments simultaneously produce conversion coatings on, and remove contamination from, magnesium ~~alloy~~ surfaces.

6.4.2.1 Wash or etching primers may also be applied on previously cleaned surfaces. Etching primers are less efficacious on magnesium than on most other metals and special attention should be given to the risk of acid attack by the phosphoric acid, with hydrogen evolution, leading to bubbling and pinholing of the paint films. Best results may be obtained when the etching primer film has been stoved at low temperatures.

6.4.3 *On-Site Pretreatment* — The most satisfactory method is to apply etching primer after degreasing the surface by a solvent cleaner or preferably an etch cleaner based on phosphoric acid. The combination of etching pretreatment and etch primer gives better results than if either were used alone.

6.4.3.1 If the surface had already been factory treated and primed, application of further coats of paint should be followed in the usual manner after suitable rectification of damaged areas, if any.

6.5 Cadmium — Similar to zinc except that weathering is not required.

6.6 Copper and Copper Alloys — The surface should be thoroughly cleaned with an organic solvent and then roughened with fine abrasive paper and applied with one coat of etching primer. Care should be taken to remove from the surface the copper dust thus formed and to see that none remains on neighbouring paintwork or masonry, since otherwise there is a risk of stains developing owing to the formation of verdigris. Where factory preparation is possible an electro-deposited coating of tin is useful in preparation for painting.

6.7 Lead — New lead surface should be weathered or pretreated before painting, the latter being preferable because of the inter-action between lead and many conventional paints. The application of etching primer is satisfactory as a pretreatment for bright lead. An alternative is to treat the surface with a diluted solution (about 20 percent by volume) of orthophosphoric acid followed by thorough washing and drying.

6.8 Lead-Tin (Including Terne Plate) — The main preparation required for these surfaces is thorough degreasing with white spirit or other suitable solvent, followed by a washing with hot water. An etching procedure which has been recommended where maximum adhesion is required is to swab with a solution of 5 parts concentrated hydrochloric acid in 95 parts methylated spirit until a crystalline pattern is seen (about 10 seconds) and washed in hot water.

6.9 Tin — The painting of tin applied by methods other than hot dipping present no difficulties, but adhesion may be defective on hot dipped coating, which should be roughened or treated with etch primer prior to painting.

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 331 01 31, 331 13 75

Telegrams: Manaksanstha
(Common to all Offices)

Regional Offices:		*Telephone*
Central	Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	331 01 31 331 13 75
*Eastern	1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054	36 24 99
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*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 — 27 68 00

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 — 89 65 28

‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, Bangalore 560002 — 22 36 71

Reprography Unit, BIS, New Delhi, India