SRI LANKA STANDARD 322:1974
UDC 621.357·76:621.7.02

# CODE OF PRACTICE FOR CLEANING OF METALS PRIOR TO ELECTROPLATING

BUREAU OF CEYLON STANDARDS

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SLS 322 : 1974

Gr.5

~~Price Rs. 8/00~~

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SRI LANKA STANDARD

# CODE OF PRACTICE FOR CLEANING OF METALS PRIOR TO ELECTROPLATING

## FOREWORD

This Sri Lanka Standard has been prepared by the Drafting Committee on Electroplating. It was approved by the Mechanical Engineering Divisional Committee of the Bureau of Ceylon Standards and was authorised for adoption and publication by the Council of the Bureau on 1974-12-10.

All standard values in this specification are in SI units with the imperial equivalents given within brackets.

Cleaning is generally understood to be a process used for removal of oil and grease and associated mechanically held contaminants by the use of solvent of alkali cleaner immediately prior to electroplating. The surface of the metal to be electroplated should be chemically active for subsequent plating process, so that presence of any interfering film of soil does not reduce or destroy adhesion of the electro-deposited coating.

Cleaning of the basis metal should be carried out in such a manner that it does not substantially affect the dimensions of the basis metal and also does not reduce the brightness of the buffed surface. This code of practice describes the procedure for cleaning metal surfaces to be electroplated taking into account various factors such as the nature of the basis metal, soil, availability of heating, chemicals, equipment. The process for removing heavy rust, scale, residues from heat treatment, welding and allied processes by pickling are not included in this code of practice.

In order to guide the electroplaters in cleaning of metals prior to electro-deposition, the recommended composition of the cleaning solvent etc, is given in the Appendices A, B and C.

This Sri Lanka Standard Code of Practice is one of the series of Sri Lanka Standards relating to electroplating. The other standards in this series are:

Code of Practice for Polishing of Basis Metals for Electroplating*

Code of Practice for Electroplating*.

The publications of the Indian Standards Institution were consulted in the preparation of this standard and the assistance gained therefrom is acknowledged

## 1 SCOPE

1.1 This code recommends procedure for cleaning of metal surfaces prior to electroplating to obtain good adhesion of electrodeposited coatings.

## 2 FACTORS TO BE CONSIDERED IN THE SELECTION OF THE CLEANING PROCESS

The cleaning process should be carefully selected to give maximum efficiency and economy taking into account the availability of chemicals and equipment.

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**Under preparation.*

## 2.1 Basis metal

**2.1.1** The composition, chemical, and physical properties of the basis metal shall be considered, when selecting the cleaning process. The chemical activity of the metal is governing factor in cleaning. Steel parts are not attacked by strong alkaline solutions, whereas aluminium and zinc are sensitive to pitting attack. Zinc and brass are readily tarnished. Die-castings have surfaces that require special care because of sensitivity to attack by cleaning solutions.

**2.1.2** Part design, size and softness of metal are some determining factors in selecting rack design and handling methods.

## 2.2 Nature of the soil

**2.2.1** Soil is the term used in the trade to designate oil, grease and buffing compounds, which may be put on the surface for facilitating metal working, polishing, buffing or to prevent corrosion. Since the soil interferes with the plating process it has to be removed from the metal surface to be electroplated. Some of the soils most commonly encountered in electroplating are:

a) Solid buffing compounds,
b) Liquid buffing compounds,
c) Drawing and stamping compounds,
d) Machine oils,
e) Finger prints,
f) Dry dirt from storage or dry pickling smut formed during derusting by pickling and
g) Rust or oxide scales formed on the surface.

**2.2.2** The choice and use of cleaner for removing soils depend on the composition and condition of the soil as well as its chemical properties.

## 2.3 Rinsing

Water hardness, acidity or alkalinity, agitation, flow and impurities are important factors in rinsing. Soft and clean water should be used. Boiler condensate may be used but demineralized water is preferable. Rinses should have adequate overflow rate and skimming troughs of good design made of suitable materials. Spray rinsing is good but it is preferable to couple it with soak rinsing.

## 2.4 Cleaner

2.4.1 A cleaner may do an excellent job of soil removal, but if it attacks or even slightly etches the surface, it is undesirable. Certain cleaners most suitable for one metal, may be very effective for one group of soils, but may be very poor for other soils. The following factors influence the selection of the type and operation of cleaners:

a) Type and condition of the metal;
b) Soil;
c) Quality of water;
d) Time agitation and availability of heating;
e) Rinsing technique;
f) Jigging technique;
g) Plating process and finish desired;
h) Availability of chemicals and equipment; and
j) Operating personnel.

2.4.2 It is desirable to perform a cleaning operation as soon as possible after metal forming, polishing or buffing to reduce the demands on subsequent cleaning operations, because many soils are more easily removed when fresh.

2.4.3 Cleaners cannot work effectively forever. They have a certain life. The effective life of a cleaning bath shall be estimated and baths discarded when exhausted. It should be replaced a few days before the deterioration of the bath starts. Pure soft water or demineralized water should be used in preparing cleaners.

## 3 CLEANING PROCESS

3.1 The cleaning procedure may be divided into the following main stages:

a) Precleaning with a solvent to remove the bulk of the soil, and

b) Final electrocleaning to remove residual soils and smuts from the components.

*NOTE.– Depending on the finish desired and on type of the work, for example : as with some jewellery plating, the articles may be cleaned by abrasive methods, such as tumbling, burnishing, sandblasting followed or preceded by bright dipping. This may be done either before or after the precleaning stage.*

### 3.2 Precleaning

3.2.1 Precleaning is designed to remove large excess of soil, such as stamping and buffing compound or grease. It is also useful in reducing the viscosity of waxes and heavy oils to enable final cleaning easier and also to protect the final electrocleaner from being heavily contaminated. The following are the main type of precleaners, which either alone or in appropriate combination may be used.

### 3.2.2 *Solvent cleaner*

Chlorinated solvents (for example, trichlorethylene or perchlorethylene) though generally used in vapour degreasing units are also used in a soak, hand spray or vapour operation. Often a vapour-spray-vapour cycle is given in either a manually operated or mechanized vapour degreasing plant. Inhibited chlorinated solvents shall be used to prevent the formation of free hydrochloric acid which may be formed in the presence of moisture or active metals, such as aluminium and zinc. Hydrochloric acid, if present, may attack the basis metal.

### 3.2.3 *Emulsifiable solvent cleaner*

Organic solvents containing emulsifying agents are used to soften and remove the soil. If emulsifiable solvents are used, it is important to have a thorough rinsing before the next sequence of operation, otherwise it may result in a patchy, dull and non-uniform deposit. These materials require minimum equipment.

### 3.2.4 *Diphase emulsion cleaner*

It comprises two separate immiseible liquids, one floating on top of the other, both of which are made to contact the soil simultaneously. The top phase is a hydro-carbon solvent which dissolves oils and greases. The lower phase is aqueous and dissolves inorganic soils. Detergents are also incorporated to effect rapid removal of insoluble soils. The cleaning is applied either by immersion with agitation or by spray. Composition varies from 1 per cent to 10 per cent in water with temperature varying up to 80 °C.

### 3.2.5 *Alkaline cleaner*

Alkali and alkali-base cleaners are mostly used for the removal of soils. A wide variety of formulations is available. These are composed of alkalis, buffers, water-softeners, complexing agents, for bringing down undesirable ions, surfactants (wetting agents, emulsifying agent and detergents) and inhibitors. There are light duty cleaners, which contain little caustic alkali for corrodible and tarnishable metals, medium duty cleaners of buffered alkalinity for general purpose and the heavy duty high alkaline cleaners for steel.

A good alkaline cleaner shall have the following properties:

Capacity to dissolve solid soils; to saponify vegetable or animal fatty acids forming soluble soap; to wet the metal in order to remove the soil; to emulsify soils, fats, oils, etc. which are removed by saponification; to deflocculate and disperse the soil into fine particles; to sequester undesirable ions forming chelates or complexes. It should be stable, free from toxicity and should possess good rinsing.

**3.2.5.1** Keeping the above properties in view, the cleaner is formulated. It may be used either as a spray or soak cleaner. Spray and soak cleaning may be used jointly also. Soak cleaning is usually carried out with 25 g/l to 65 g/l (0.25 lb/gal to 0.65 lb/gal) alkaline salts at 80 °C or at boiling point for two minutes to 15 minutes.

**3.2.5.2** Spray cleaning is usually carried out with 4 g/l to 25 g/l (0.04 to 0.25 lb/gal) at a temperature of 70 °C to 80 °C for 60 seconds to 180 seconds, with spray pressure of 70 kPa to 400 kPa (10.2 lbf/in$^2$ to 58.0 lbf/in$^2$).

**3.2.5.3** Barrel cleaning with alkaline solutions are performed at a concentration of 6 g/l to 40 g/l (0.06 lb/gal to 0.40 lb/gal). Temperature is usually lower than in the soak or spray cleaning. Time and speed are varied according to size and design of the component.

### 3.2.5.4 *Cleaning efficiency*

The following factors influence the cleaning efficiency of alkaline cleaner:

*a) Concentration*

Concentration above 75 g/l (0.75 lb/gal) should not be normally required. If substantially better cleaning is obtained at a very high concentration, probabilities are that the wrong cleaner or an inadequate precleaner is used.

*b) Temperature*

Best results are obtained at a high temperature which reduces the viscosity of soils and provides agitation.

*c) Time*

Reasonable time should be allowed for better reaction. With very good agitation it can be reduced. A period of about 300 seconds time in a soak cleaner should be given.

*d) Agitation*

A good agitation always helps in cleaning and it is desirable.

### 3.3 Final electrocleaning

The purpose of final electrocleaning is to remove residual solids, dry dirt and pickling smut.

### 3.3.1 *Types of cleaners*

Alkaline cleaners are used either as a cathodic or an anodic cleaner.

### 3.3.1.1 *Cathodic*

The work is made cathodic with steel plate as anodes. Profuse gas is evolved and hydrogen is liberated at the cathode. Gas scrubbing loosens the soils. Any components critical to hydrogen embrittlement should be cleaned carefully. The voltage used will vary according to the resistance offered by the cleaner, the articles being cleaned and the nature of storage racks. The data as given in Table 1 may be found useful.

#### 3.3.1.2 *Anodic*

The electrolyte is generally more dilute than the electrolyte of a cathodic cleaner. The work is made anode and a shorter time and current density are applied. This "reverse current" causes certain soils to 'plate off'. It prevents hydrogen occlusion and embrittlement. Moreover it has a higher tolerance for chromic acid contamination. The following data as given in Table 1 may be found useful.

**TABLE 1 Data of cathodic and anodic cleaning**

*(3.3.1.1 and 3.3.1.2)*

| | Cathodic | Anodic |
|---|---|---|
| Time | 30 s to 300 s | 10 s to 60 s |
| Temperature | 70 °C to 95 °C | 60 °C to 95 °C |
| Voltage | 4 V to 8 V | 3 V to 8 V |
| Current density | 200 $A/m^2$ to 500 $A/m^2$ | 200 $A/m^2$ to 500 $A/m^2$ |

**3.3.2** The same electrolyte may be used for both the cathodic and anodic cleaning but separate baths are preferred.

## 4 CRITERIA OF CLEANLINESS

### 4.1 Water-break test

This involves a visual observation after a final rinse in clear cool water. A continuous sheet of water on the surface formed after a drainage time of 30 seconds indicates a clean surface. Sometimes the test may be a little misleading as it is difficult to rinse off all the alkali or wetting agents. In such cases, give a dip in clean dilute acid (for example, 1 per cent to 2 per cent sulphuric acid) after water rinse and re-examine after another good water rinse.

4.2 Part entering the plating bath, should be free from smuts; and when wiped with a clean white cloth, there should be no darkening of the cloth.

## 5 ACID TREATMENT AND SURFACE CONDITIONING

5.1 The metal, after final electrocleaning, is immersed (or anodically treated) in an acid solution to remove oxides and haze caused by alkaline cleaners, to activate the surface and produce slight etching. A microetch of the surface to increase adherence of deposit is also provided. The alkaline cleaning method used, determines the type of acid bath and the immersion time required. When dipping time is limited to 5 seconds, 5 per cent to 10 per cent solution of cold hydrochloric or hot sulphuric acid is used. With longer time, the concentration may be as low as 1 per cent to 2 per cent. Sulphuric, hydrochloric, nitric and citric acids are generally used (sulphuric acid will not be suitable for conditioning lead or leaded brass because of the formation of insoluble lead sulphate). Precautions shall be taken to prevent the carry-through of the acids (specially hydrochloric acid) into the other plating solutions.

5.2 Suitable inhibitors and wetting agents may be used, after ensuring that they do not interfere with the quality of the subsequent electrodeposit.

## 6 PRECAUTIONS

6.1 The following precautionary measures should be taken to make cleaning easier.

6.2 Overheating during buffing of the metal should be avoided. Excessive polishing compound should not be left on the work. It should be buffed 'clean'.

6.3 The metal should be cleaned as soon as possible after buffing and polishing to avoid chemical interaction between buffing compound and basis metal and caking of polishing compound.

6.4 During and after final buffing, the polished articles, should not be touched by hand. Clean gloves should be used for handling.

6.5 A liason should be kept between the plater and fabricator in selecting and formulating lubricants from the view-point of cleanability.

6.6 The work should be plated as soon as possible for cleaning.

6.7 Solvent with low flash point, for example; less than 70 °C, shall be used carefully.

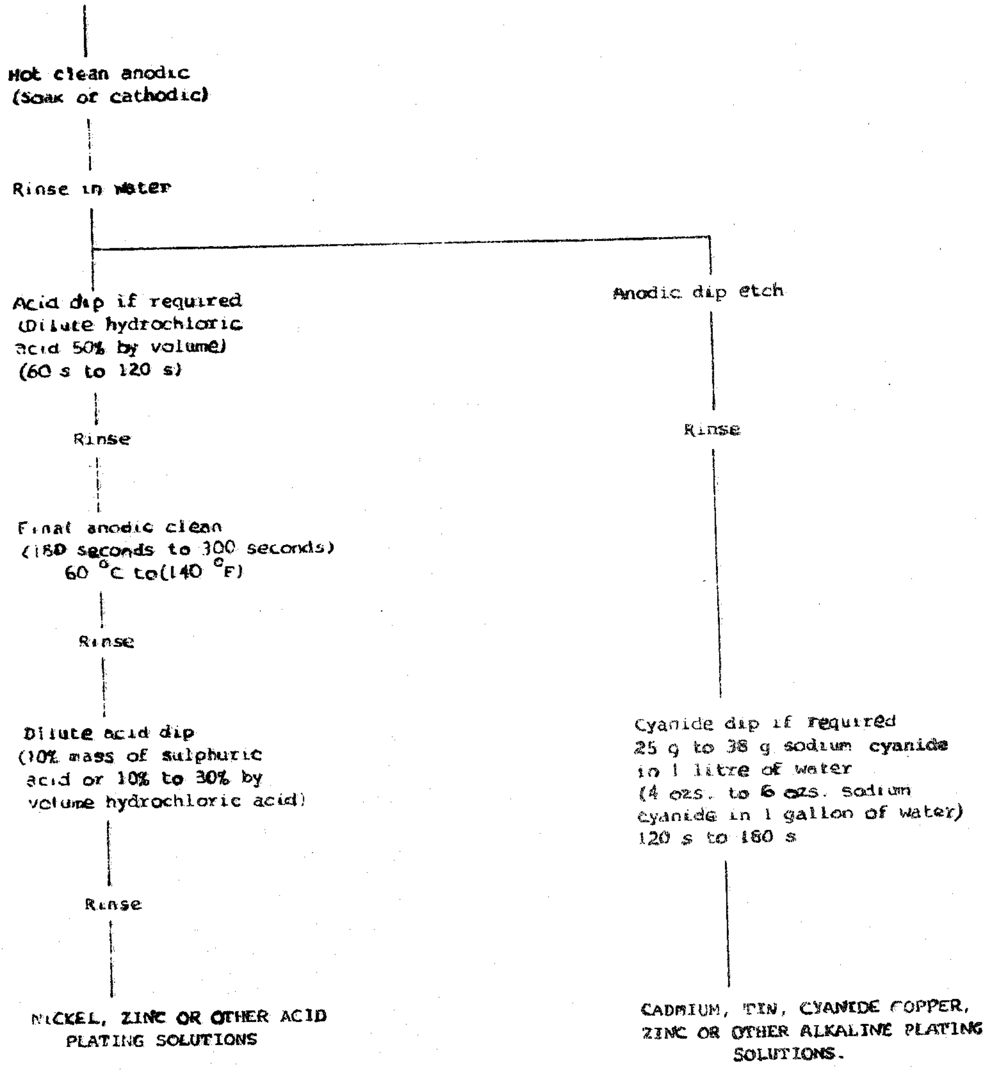
6.8 Proper ventilation should be made and fumes should not be accumulated. Arrangements should be made for removal of toxic vapours.

6.9 Personal protective equipment such as gloves, goggles, aprons etc., of the correct types should be provided to those handling strong acids, alkalis, and toxic chemicals.

# APPENDIX A

## RECOMMENDED PROCESS CHART

### A.1 STEEL AND IRON*



Hot clean anodic
(Soak or cathodic)

Rinse in water

Acid dip if required
(Dilute hydrochloric acid 50% by volume)
(60 s to 120 s)

Rinse

Final anodic clean
(180 seconds to 300 seconds)
60 °C to(140 °F)

Rinse

Dilute acid dip
(10% mass of sulphuric acid or 10% to 30% by volume hydrochloric acid)

Rinse

NICKEL, ZINC OR OTHER ACID PLATING SOLUTIONS

Anodic dip etch

Rinse

Cyanide dip if required
25 g to 38 g sodium cyanide in 1 litre of water
(4 ozs. to 6 ozs. sodium cyanide in 1 gallon of water)
120 s to 180 s

CADMIUM, TIN, CYANIDE COPPER, ZINC OR OTHER ALKALINE PLATING SOLUTIONS.

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*Where an article has already been chromium plated, the plating should be striped with a caustic soda solution - 100 g caustic soda in 1 litre of water (1 lb caustic soda in 1 litre of water).

## A.2 ZINC BASE ALLOY

(Die castings)

Hot clean cathodic or soak

Rinse

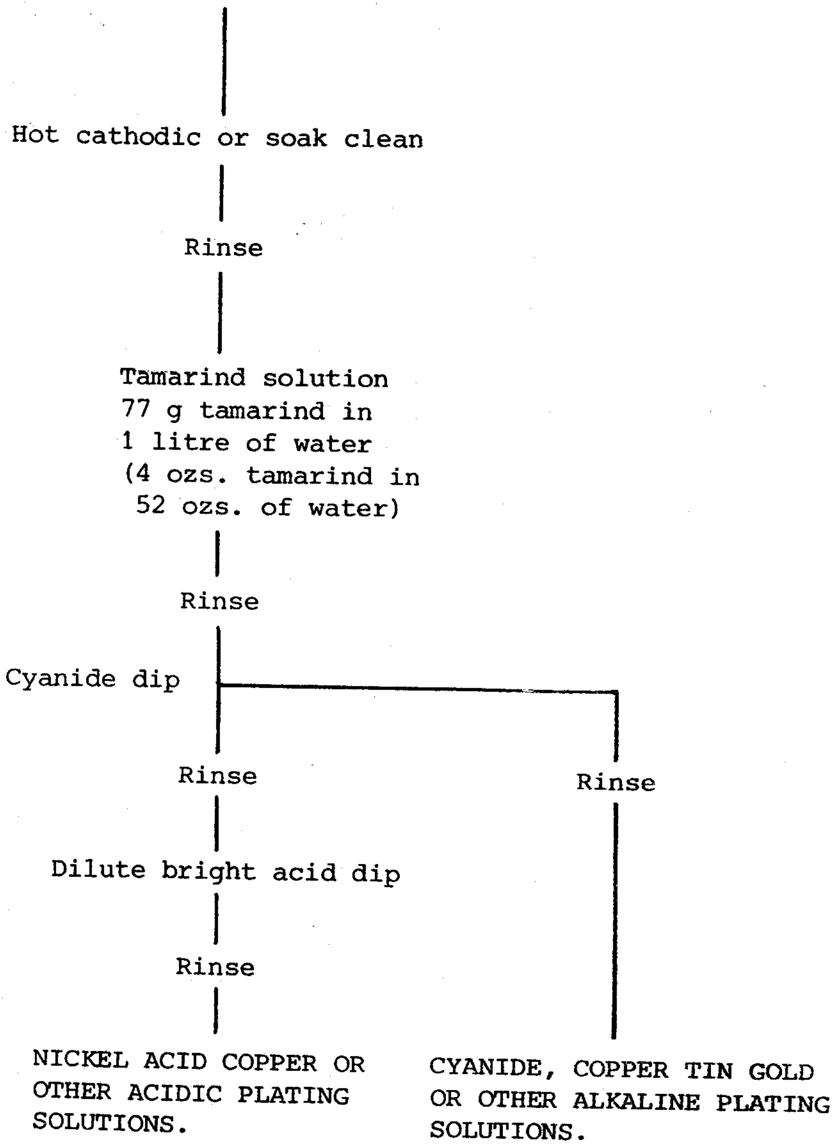
Final anodic or cathodic clean

Dilute acid dip

Rinse

CYANIDE COPPER PLATING SOLUTION

## A.3 COPPER, BRASS, NICKEL-SILVER AND OTHER ALLOYS



Hot cathodic or soak clean

Rinse

Tamarind solution
77 g tamarind in
1 litre of water
(4 ozs. tamarind in
52 ozs. of water)

Rinse

Cyanide dip

Rinse

Dilute bright acid dip

Rinse

NICKEL ACID COPPER OR
OTHER ACIDIC PLATING
SOLUTIONS.

Rinse

CYANIDE, COPPER TIN GOLD
OR OTHER ALKALINE PLATING
SOLUTIONS.

# APPENDIX B

## RECOMMENDED FORMULAE FOR PICKLING OR DIPPING AGENTS

### B.1 IRON AND STEEL

For light scale as a pickle

| | |
|---|---|
| Hydrochloric acid | 1 part (concentrated). |
| Water | 5 parts. |

Immersion at room temperature from 5 minutes to 30 minutes depending on the type of scale or if oil is to be removed.

### B.2 STAINLESS STEEL

| | |
|---|---|
| Nickel chloride | 1.8 l (38 fluid ounces) |
| Hydrochloric acid | 400 ml (14 fluid ounces) |
| Water | 4.5 l (1 gallon) |

This is an anodic and cathodic cleaner at room temperature for 2 minutes to 3 minutes with the surface anodic and thereafter 3 minutes to 6 minutes with the surface cathodic.

For outer electrodes only nickel anodes should be used.

Where anodic method cannot be adopted in place of anodic treatment, immersion in the solution without current for 15 minutes before being made cathodic for 3 minutes to 6 minutes will suffice.

## B.3 BRIGHT FINAL DIP FOR BRASS AND OTHER ALLOYS

*(Dilute bright acid dip)*

| | |
|---|---|
| Sulphuric acid | 2.3 l (80 fluid ounces) |
| Hydrochloric acid | 850 ml (30 fluid ounces) |
| Common salt | 7 ml (0.25 fluid ounce) |
| Water | 4.5 l (1 gallon) |

Dipping time is a few seconds at room temperature.

All articles either iron, steel, brass etc. must undergo a Diluted Acid Dip prior to plating in an acid Electroplating Solution.

Similarly all articles must undergo a Cyanide Dip prior to Electroplating in a Cyanide or Alakline solution.

# APPENDIX C

## RECOMMENDED FORMULAE FOR ALKALINE CLEANERS

### C.1 HEAVY DUTY *(For anodically use on ferrous metals)*

| | g/l | (oz/gal) |
|---|---|---|
| Caustic soda | 37.5 | (6) |
| Soda ash | 25 | (4) |
| Tribasic sodium phosphate | 6.2 | (1) |
| Wetting agent | 1.5 | (0.25) |
| Temperature | 80 °C to 90 °C | 180 °F to 200 °F |

## C.2 MEDIUM DUTY

| | g/l | (oz/gal) |
|---|---|---|
| Tribasic sodium phosphate | 25 | (4) |
| Sodium metasilicate | 25 | (4) |
| Wetting agent | 0.75 | (0.13) |
| Temperature | 80 °C to 90 °C | 180 °F to 200 °F |

## C.3 LIGHT DUTY *(For cathodically use on aluminium and zinc base alloys)*

| | g/l | (oz/gal) |
|---|---|---|
| Tribasic sodium phsophate | 12.5 | (2) |
| Sodium metasilicate | 25 | (4) |
| Wetting agent | 0.75 | (0.13) |
| Temperature | 80 °C to 90 °C | 180 °F to 200 °F |

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Printed at the Sri Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha,
Colombo 08.