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GLOSSARY OF TERMS ON ELECTROPLATING AND RELATED PROCESSES

SRI LANKA STANDARDS INSTITUTION

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SRI LANKA STANDARD

GLOSSARY OF TERMS ON ELECTROPLATING AND RELATED PROCESSES

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Sri Lanka Standards Institution on 1985-04-02, after the draft, finalised by the Drafting Committee on Electroplating, had been approved by the Mechanical Engineering Divisional Committee.

This glossary includes terms widely used in the science and industry of electrodeposition and it is to be understood that the interpretations given are those corresponding to the practical usage in other fields and they do not necessarily coincide with those used in these fields. In some cases attention is drawn to this fact by adding the words " ..... in electroplating". In defining electrical terms no account has been taken of the differences between "international" and "absolute" units; this difference is too small to be of any significance in practical plating.

The assistance derived from the publications of the International Organization for Standardization, the Standards Association of Australia and the Indian Standards Institution in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This standard gives definitions of terms relating to electrodeposition and related processes.

2 DEFINITIONS

For the purpose of this standard the following definitions shall apply:

2.1 abrasive : Media used for cutting down surface irregularities. (see also 2.130)

2.2 absorption : The property of a substance to hold within itself relatively large quantities of gases or liquids.

2.3 acid cleaning : The process of removing oxide or other surface films from a metal by immersion in an acid.

2.4 acid dip : An immersion of short duration in a dilute acid solution to condition the metal surface.

2.5 acidimetry : The determination of acid strength by titration with a standard alkali solution.

2.6 activation : The process of removing a passive condition from the surface of a metal.

2.7 activity : The concentration of an ion corrected for deviations from ideal behaviour. The thermodynamic concentration multiplied by activity coefficient.

2.8 activated carbon : Carbon, mostly of vegetable origin and of high absorptive capacity mainly used for solution purification.

2.9 activating agent : An agent used to remove passivity of a surface to be plated.

2.10 addition agent : A material added in small quantities to a solution to modify its characteristics or the properties of the deposit obtained from the solution.

2.11 adhesion : The attractive force existing between a metal coating and its substrate.

2.12 adsorption : The property of a substance to hold a second substance to its surface by physical or chemical attraction.

2.13 alkali metal : In electroplating, this term usually refers to sodium and potasium. Others are lithium, rubidium, caesium and francium.

2.14 alkaline cleaner : An aqueous solution containing alkaline salts used for cleaning articles prior to plating.

2.15 alkaline blackening (black finishing) : Producing a black oxide coating on steel by immersion in a hot alkaline salt solution.

2.16 alloy plate : An electrodeposit containing two or more metals so initimately mixed or combined as not to be distinguishable to the unaided eye.

2.17 ampere : Unit of electric current. The direct current which will deposit 0.001 118 0 g of silver in one second.

2.18 ampere-hour : Practical unit of quantity of electricity. The quantity of electricity flowing per hour through a conductor or an electrolyte when the current is one ampere. Equivalent to 3,600 coulombs.

2.19 amphoteric : Chemically reacting as acidic to strong bases and as basic towards strong acids; e.g. the amphoteric oxide ZnO gives rise to zinc salts of strong acids and zincates of the alkali metals.

2.20 angle of repose : A term used in barrel burnishing to indicate the maximum slope at which any loose solid material will stand without sliding.

2.21 anion : A negatively charged ion; an ion which is attracted towards the anode during electrolysis.

2.22 anode : In electrolysis, the electrode at which negative ions are discharged, positive ions are formed, or other oxidizing reactions occur.

2.23 anode bags : Porous bags used to encase anodes for the purpose of preventing solid particles from the anode contaminating the solution.

2.24 anode corrosion : Dissolution of anode metal by the electrochemical action in the plating cell.

2.25 anode efficiency : Current efficiency of a specified anodic process. (Expressed as the ratio of the mass of the metal dissolved from the anode to the theoretical quantity which should have dissolved).

2.26 anode film : a) The thin layer of a solution which is in contact with the anode and differs in composition from the bulk of the solution.

b) Solid film formed on the anode during operations.

2.27 anode polarization : The collection of reaction products on the anode during electrolysis after the current has been flowing for some time, leading to a reduction in e.m.f.

2.28 anodic cleaning : An electrochemical cleaning process in which the article to be cleaned is made the anode.

2.29 anodic coating : a) A metallic coating less noble than the basis metal.

b) A protective, decorative, or functional coating, formed by conversion of the surface of a metal in an electrolytic oxidation process (see 2.30).

2.30 anodizing (anodic oxidation) : An electrolytic oxidation process in which the surface layer of a metal is converted to a coating having protective, decorative or functional properties.

2.31 anolyte : a) In a divided cell, the portion of electrolyte on the anode side of the diaphragm.

b) The portion of electrolyte in the vicinity of the anode (uncommon usage).

2.32 antidote : Remedy for a particular poison which generally acts upon the poison either neutralizing it, making it insoluble, or otherwise rendering it harmless.

2.33 anti-pitting agent : An agent added to a solution or an electrolyte to prevent gas pitting.

2.34 anti-stress agent : An agent added to an electroplating solution to bring about a reduction of stress in the deposit.

2.35 autocatalytic plating : Deposition of a metallic coating by a controlled chemical reduction that is catalysed by the metal or alloy being deposited.

2.36 average thickness : a) The arithmetic mean of a number of thickness determinations taken at random positions on a significant surface.

b) The thickness obtained by "strip and weight" measurement on a number of samples. Normally determined on small barrel-plated details, for example: screws and nuts.

2.37 auxiliary anode : A specially shaped anode strategically positioned used in addition to the ordinary anode when plating an article of intricate shape for even distribution of deposit.

2.38 back e.m.f. (Electromotive force of a cell) : The potential set up in an electrolytic cell which opposes the flow of current, caused by such factors as concentration polarization and electrode films.

2.39 ball burnishing : Burnishing by tumbling work in a rotating barrel using hardened steel balls as the burnishing medium.

2.40 barrel plating : A particular example of barrel processing by which electrodeposits are applied to articles in bulk; in contrast to "vat plating" in which articles are individually suspended during the electrodeposition process.

2.41 barrel processing : Mechanical, chemical or electrochemical treatment of articles in bulk in a rotating container.

Examples:

- barrel burnishing
- barrel polishing
- barrel cleaning

2.42 base metal : Opposite of noble metal (not to be confused with basis metal).

2.43 basis metal (or material) : Material upon which coatings are deposited or formed (not to be confused with base metal).

2.44 bath voltage : The total potential difference between the anode and the cathode of an electroplating bath or electrolyte cell during electrolysis.

2.45 batch average thickness : The average thickness of the coating on all the components of a batch as determined on a representative sample.

2.46 baume : A scale used for expressing the density of liquids.

2.47 bent anode : See 2.37.

2.48 binary compound : A chemical compound consisting of two elements only. Denoted by the suffix "ide", for example; calcium carbide CaC_2.

2.49 bipolar electrode : A conductor suspended by an electrically non conducting material in the electrolyte between the anode and the cathode, used for special effects in metal deposition. The current flowing between anode and cathode may pass wholly or in part through the conductor and that part of the conductor nearest the anode acts as a cathode and that nearest the cathode acts as an anode.

2.50 black chromium : This is a non glare finish imparted to chromium plated articles, having heat, corrosion and wear resistance properties, coupled with good paint bonding properties.

2.51 blackening; black finishing; black oxide : See 2.15.

2.52 blasting : A surface cleaning process in which abrasive particles are projected at high velocity against the work piece.

2.53 blistering : The separation of an electrodeposit from the basis metal or undercoats at isolated spots.

2.54 blooming : A haze on an intended bright deposit.

2.55 blum cell : See 2.212.

2.56	**blueing**	: The formation of a very thin blue oxide film on steel either by heating in air or by immersion in concentrated oxidising solutions.
2.57	**bobbing cement**	: Cold setting type adhesive used for bonding of abrasive wheels.
2.58	**bonderizing**	: A proprietary chemical process for producing a thin adherent phosphate coating on steel.
2.59	**BNF jet test**	: A method for determining the local thickness of electroplated coatings in which a jet of etching solution is permitted to impinge, under controlled conditions, on the electroplate under test. The time of penetration is noted and the thickness computed from standard charts calibrated against known thicknesses as determined by microscope measurement.
2.60	**bright dipping**	: Brief immersion in a solution to produce a bright surface on a metal.
2.61	**brightener**	: An agent added to a plating solution to bring about a refining and levelling of the deposit thereby resulting in a brighter deposit.
2.62	**bright finish**	: A finish with a uniform non-directional smooth surface of high specular reflectivity.
2.63	**bright plating (electrolytic)**	: A process that produces an electrodeposit having a high degree of specular reflectivity in the as-plated condition.
2.64	**bright plating range**	: The range of current densities within which an electroplating solution produces a bright deposit under a given set of operating conditions.
2.65	**bright throwing power**	: The measure of the ability of a plating solution under a specified set of plating conditions to deposit uniformly bright electroplate upon an irregularly shaped cathode.
2.66	**brightner**	: An addition agent in an electroplating solution that improves the brightness of an electrodeposit.

2.67 bristle wheels : Polishing wheels constructed with fibre used mainly for polishing of jewellery.

2.68 bronzing : a) The application of a chemical (immersion) finish to copper or copper alloys or, alternatively, to copper or brass plated metals, to alter the colour of the surface (not to be confused with electro-deposition of bronze).

b) See 2.56.

2.69 brush plating : A method of plating in which the plating solution is applied with a pad or brush, within which is an anode and which is moved over the cathode to be plated.

2.70 brush polishing (electrolytic) : A method of electropolishing in which the electrolyte is applied with a pad or brush in contact with the cathode.

2.71 buffer : A substance that when contained in a solution counteracts changes in pH. Each buffer has a characteristic range of pH over which it is effective.

2.72 buffing : The smoothing of a surface by means of a rotating flexible wheel to the surface of which fine abrasive particles are applied in liquid suspension, paste or grease stick form. (See also 2.260).

2.73 building up : Electroplating for the purpose of increasing the dimensions of an article.

2.74 build up : Overplating or undesirable building up of deposit on corners and edges during plating.

2.75 burnishing : The smoothing of a surface by rubbing under pressure essentially without removal of the surface layer. (See also 2.260).

2.76 burnt deposit : A rough unsatisfactory deposit produced by an excessive current density.

2.77 busbar : A rigid conductor for carrying current, for example to the anode and cathode bars.

2.78	**calomel electrode (calomel half cell)**	:	A half cell containing a mercury electrode in contact with a solution of potassium chloride of specified concentration and saturated with mercurous chloride (calomel).
2.79	**carbonate control**	:	Normally referred to the control of sodium or potasium carbonate in cyanide plating solutions.
2.80	**carbon treatment**	:	The removal of organic impurities from plating solutions by the use of activated carbon.
2.81	**carburizing**	:	A process involving the heat treatment of steel to increase the carbon content of the surface layer. Generally followed by a heat-treatment process to harden the case.
2.82	**case hardening**	:	The process of surface hardening ferrous alloys.
2.83	**CASS test**	:	Copper-acetic acid-salt spray test, used for assesment of corrosion resistance.
2.84	**catalyst**	:	A substance which can control the speed and/or products of a chemical reaction without undergoing any change in itself.
2.85	**cataphoresis**	:	See 2.182
2.86	**cathode**	:	In electrolysis, the electrode at which positive ions are discharged, negative ions are formed or other reducing reactions occur.
2.87	**cathode efficiency**	:	Current efficiency of a specified cathodic process (proportion of the total cathode current which is used in depositing the metal concerned).
2.88	**cathode film**	:	The thin layer of solution which is in contact with the cathode and differs in composition from the bulk of the solution.
2.89	**cathode polarization**	:	See 2.259
2.90	**cathodic cleaning**	:	See 2.100.3
2.91	**cathode current efficiency**	:	See 2.87

2.92 cathodic protection	:	See 2.279
2.93 catholyte	:	a) In a divided cell, the portion of electrolyte on the cathode side of the diaphragm. b) The portion of electrolyte in the vicinity of the cathode. (Uncommon usage).
2.94 cation	:	A positively charged ion.
2.95 chelate compound	:	A compound in which the metal atom forms part of a ring-structure and is not readily ionized.
2.96 chelating agent	:	An organic compound capable of forming a chelate compound with a metal ion. (See 2.95.)
2.97 chemical polishing	:	Immersion in a solution to improve the surface smoothness of a metal, (Not to be confused with bright dipping).
2.98 chroffles	:	Floatable polymeric material shapes used upon the solution surface to reduce spray and subsequent loss of solution from plating baths. These layers reduce the heat losses too.
2.99 chromating	:	Forming a conversion coating on a metal surface by means of a solution containing chromium compounds usually in the hexavalent form.
2.100 cleaning	:	The removal of organic and other foreign materials from a surface.
2.100.1 alkaline cleaning	:	Cleaning by means of alkaline solutions.
2.100.2 anodic (reverse) cleaning	:	Electrolytic cleaning in which the work piece to be cleaned is made the anode.
2.100.3 cathodic (direct) cleaning	:	Electrolytic cleaning in which the work piece to be cleaned is made the cathode.
2.100.4 disphase cleaning	:	Cleaning by means of a liquid system that consists of an organic solvent layer and an aqueous layer. Cleaning is effected both by solvent and emulsifying action.
2.100.5 direct cleaning	:	See 2.100.3

2.100.6	**electrolytic cleaning**	:	Cleaning in which a current is passed through the solution, the work piece to be cleaned being one of the electrodes.
2.100.7	**emulsion cleaning**	:	Cleaning by means of an emulsified liquid system that consists of an organic solvent, a water phase and emulsifying agents.
2.100.8	**immersion cleaning**	:	Cleaning by immersion without the use of current, usually in alkaline solution.
2.100.9	**reverse cleaning**	:	See 2.100.2
2.100.10	**soak cleaning**	:	See 2.100.8
2.100.11	**solvent cleaning (solvent degreasing)**	:	Cleaning by means of organic solvents.
2.100.12	**solvent vapour**	:	Degreasing by solvent vapours condensing on the work pieces being cleaned.
2.100.13	**spray cleaning**	:	Cleaning by means of spraying with a cleaning solution.
2.100.14	**ultrasonic cleaning**	:	Cleaning by any chemical means aided by ultrasonic vibration.
2.101	**colloidal particle**	:	An electrically- charged particle, generally smaller in size than 200 nm, dispersed in a second continuous phase.
2.102	**colloidal solution or suspension**	:	A mixture of two or more phases, at least one of which consists of colloidal particles dispersed in one of the other phases.
2.103	**colouring**	:	A chemical immersion process producing decorative coloured finishes excluding black finishes on steel and colours obtained by the use of organic due-stuffs (Not to be confused with colouring off).
2.104	**colouring off**	:	Light final buffing for the purpose of producing a high lustre.
2.105	**complexing agent**	:	A compound that will combine with metallic ions to form complex ions.

2.106	**complex salt**	:	A compound of two single salts which orystallize together in a simple molecular ratio. An aqueous solution of the salt gives reactions which are quite distinct from those of the component single salts, for example potassium silver cyanide.
2.107	**composite electroplate**	:	See 2.239
2.108	**conditioning**	:	Preparation and activation of a surface prior to application of a chemical or electrotechnical finish.
2.109	**conducting salt**	:	A salt added to an electrolyte in order to increase its electrical conductivity.
2.110	**conductivity (electrical)**	:	The reciprocal of resistivity or specific resistance of a conductor. Measured in reciprocal ohms or mhos per centimetre cube.
2.111	**conductivity (thermal)**	:	Rate of transfer of heat along a body by conduction. Measured in calories flowing per second across a centimetre cube of the substance having a temperature difference of 1 deg C on opposite faces.
2.112	**contact plating**	:	The deposition of a metal coating upon a basis metal, by immersing the latter in contact with another metal in a solution containing a compound of the metal to be deposited. (Not to be confused with immersion plating)
2.113	**contact potential**	:	The potential difference at the junction of two dissimilar metals.
2.114	**contact wheels**	:	Wheels employed to ensure effective contact between the articles and the abrasive belt.
2.115	**continuity test for anodized coating**	:	A test which points out the discontinuities in anodized coatings, based on the fact that anodized coating is electrically non-conducting.

2.116 conversion coating : A superficial coating produced by chemical or electrochemical treatment on a metallic surface and consisting of a compound of the metal treated.

2.117 corrodkote test : An accelerated corrosion test for testing primarily, nickel, copper-nickel chromium or nickle-chromium coatings on steel, zinc or aluminium basis metals, A slurry consisting of kaolin, cupric nitrate, ferric chloride and ammonium chloride is painted on surfaces being tested before exposure to controlled conditions of temperature and humidity.

2.118 corrosion : Surface chemical action, especially on metals, by the action of moisture, air or chemicals.

2.119 corrosive sublimate : Mercuric chloride.

2.120 coulomb : The unit quantity of electricity. That quantity of electricity transferred when a current of 1 ampere flows for 1 second. One coulomb will deposit 0.0011180 g of silver.

2.121 counterflow rinse : The process of rinsing articles with economical use of water by allowing water movements to take place through a series of tanks in a direction opposite to the flow of articles.

2.122 coulometer : An electrolytic cell arranged to measure the quantity of electricity produced by chemical action in accordance with Faraday's laws.

2.123 covering power : The ability of an electroplating solution under a given set of conditions to deposit metal on the surfaces of recesses or deep holes. (To be distinguished from throwing power).

2.124 crack : A physical discontinuity in an electrodeposit brought about by release of high internal stress.

2.125 crack-free chromium : A bright chromium deposit, free of cracks produced by modification of chromium plating conditions and achieved at thicknesses greater than 0.75 μm.

2.126	**cream of tartar**	:	Potassium bitartrate
2.127	**critical current density**	:	Current density above or below which new and sometimes undersirable reactions occur.
2.128	**current density**	:	Current expressed in amperes per unit area.
2.129	**current efficiency**	:	The proportion, usually expressed as a percentage, of the current that is effective in carrying out a given process in accordance with Faraday's law.
2.130	**cutting down**	:	Polishing for the purpose of removing gross surface roughness or irregularities.
2.131	**deburring**	:	The removal of burrs, sharp edges, or fins by mechanical, chemical or electrochemical means.
2.132	**decantation**	:	The process of separating a solid from a liquid by allowing the former to settle and pouring off the latter.
2.133	**decomposition potential**	:	The minimum potential (exclusive of the potential drop due to resistance of) at which an electrochemical process can take place at an appreciable rate.
2.134	**degreasing**	:	The removal of grease, oils etc. from a surface. a) Solvent degreasing - see **2.100.11** b) Vapour degreasing - see **2.100.12**
2.135	**deionization**	:	The removal of ions from a solution by ion exchange.
2.136	**deliquescent**	:	Having the property of absorbing water from the atmosphere to the extent of dissolving in the water.
2.137	**de-mineralization**	:	a) Removal of hardness in water, for example by cation exchanger. b) Synoymous with deionization which is the preferred term.
2.138	**depolarization**	:	A decrease in the polarization of an electrode.

2.139	**depolarizer**	:	A substance used to reduce the effects of polarization.
2.140	**deposition range**	:	See 2.185
2.141	**detergent**	:	A surface - active agent that possesses the ability to assist in cleaning soiled surfaces.
2.142	**diaphragm**	:	A porous separator dividing anode and cathode compartments of an electroplating tank from each other or from an intermediate compartment.
2.143	**dielectric**	:	A medium having the property whereby the energy required to establish an electric field is recoverable, in whole or in part, as electrical energy.
2.144	**dielectric constant**	:	That property of a dielectric which determines the electrostatic energy stored per unit volume for unit potential gradient.
2.145	**dielectric strength**	:	The maximum potential gradient that a dielectric material can withstand without rupture.
2.146	**diffusion coating**	:	Composite electrodeposited coating which is subsequently interdiffused by application of heat.
2.147	**dispersing agent**	:	A material which when added to a dispersion increases the stability of particles in suspension in the solution.
2.148	**dispersed phase**	:	The constitutent of a dispersed system corresponding to the dissolved substance in solution.
2.149	**dissociation**	:	The separation of chemical compounds into positive and negative ions in solution.
2.150	**divided cell**	:	A cell containing a diaphragm or other means for physically separating the anolyte from the catholyte.
2.151	**double layer**	:	Deposition of two layers of a metal in succession, each layer having different chemical and physical properties.

2.152 double salt : Two salts that crystallize together in stoichiometric proportions but give the reactions of the ions of the constituent single salts in aqueous solution, for example Rochelle salt.

NOTE - Certain compounds or mixtures of salts used under this name in electroplating industry are not always "double salts" in the strictly chemical sense; for example, "copper double salt" is sodium copper cyanide. This usage is not recommended.

2.153 drag-in : The liquid carried into a bath by the objects introduced therein.

2.154 drag-out : The liquid carried out of a bath by the objects removed therefrom.

2.155 ductile deposit : A deposit which will undergo plastic deformation without cracking.

2.156 ductility : That property of a deposit which permits plastic deformation of flow before fracture.

2.157 dull finish : A finish virtually lacking both diffuse and specular reflectance.

2.158 dummy (or dummy cathode) : A cathode used for removal or decomposition of impurities from electroplating solutions.

2.159 duplex : Depositions of two layers of the same metal in succession to procure variation in properties of the layer.

2.160 dyeing : Imparting a colour to plated articles by the use of organic dyestuffs.

2.161 eddy current : A current induced in a mass of conducting material by a varying magnetic field.

2.162 effluent : A generic term applied to liquid or gaseous industrial wastes.

2.163 electrochemical equivalent of an ion : The mass of an ion liberated or deposited by one coulomb.

2.164 electrochemistry	:	A science dealing with chemical processes making use of electrolysis.
2.165 electrode	:	In electrolysis the conductor which carries electricity into the electrolyte or out of the electrolyte (A term denoting anode or cathode).
2.166 electrode efficiency	:	The ratio of the quantity of metal deposited in an electrolytic cell to the quantity which should theoretically be deposited according to Faraday's laws (See also **2.25** and **2.87**).
2.167 electrodeposit	:	The coating applied during electroplating.
2.168 electrodeposition	:	Deposition of a metal or substance upon articles by electrolysis.
2.169 electrode potential	:	The difference in potential between an electrode and the immediately adjacent electrolyte, referred to some standard electrode potential as zero.
2.169.1 dynamic E.P.	:	The electrode potential measured when current is passing between the electrode and the electrolyte.
2.169.2 equilibrium E.P.	:	An electrode potential measured when the electrode and the electrolyte are in equilibrium with respect to a specified electrochemical reaction.
2.169.3 standard E.P.	:	An electrode potential measured for an electrode in contact with an electrolyte in which one or more specified ions have a specified ion activity.
2.169.4 static E.P.	:	The electrode potential measured when no current is flowing between the electrode and the electrolyte.
2.170 electrofacing	:	The process of coating a metal surface with a harder metal by electrodeposition to improve wear resistance.
2.171 electroforming	:	The production of metallic objects by electrodeposition.
2.172 electrogalvanising	:	A generic term used to describe zinc plating on ferrous basis metals.

2.173	**electrogilding**	:	The electrodeposition of a decorative coating of gold on metallic objects.
2.174	**electroless plating**	:	Term in use, but not recommended, for autocatalytic plating.
2.175	**electrolysis**	:	Chemical decomposition of substances by the passage of an electric current through the substance in a dissolved or molten state.
2.176	**electrolyte (colloquial use in electroplating)**	:	Any conducting solution used for plating or anodizing baths.
2.177	**electrolytic cell**	:	A unit of apparatus designed for carrying out an electrochemical reaction. A cell basically consists of a container, two or more electrodes, and one or more electrolytes.
2.178	**electrolytic cleaning (electro cleaning)**	:	See 2.100.6
2.179	**electrometric titration**	:	A method of titration which utilizes changes in the potential property of an electrode in a cell to determine when the end-point of a chemical reaction has been reached.
2.180	**electromotive series**	:	A systematic arrangement of metals in terms of their activity ranging from inert or noble metals, for example: gold, to those that will react with water, for example: sodium or potassium.
2.181	**electromotive-osmosis**	:	The movement of fluids through a porous diaphrgm under the application of an electric field.
2.182	**electrophoresis**	:	The migration of colloidal particles under the influence of an electric field.
2.183	**electroplating**	:	The electrolytic deposition of adherent metallic coatings upon an article (cathode) for the purpose of imparting a surface with properties, appearance or dimensions differing from those of the basis metal.

2.184	**electroplating bath**	:	The solution (electrolyte) contained in a tank to be used for the electrodeposition process.
2.185	**electroplating range**	:	The current density range over which a satisfactory electrodeposit can be obtained.
2.186	**electroplating vat (electroplating tank)**	:	A container in which electroplating is carried out.
2.187	**electropolishing**	:	The smoothing or brightening of a metal surface by making it anodic in an appropriate solution.
2.188	**electrotype**	:	A printing plate produced by electroforming.
2.189	**electro-wining**	:	The recovery of metal from a solution of ores or minerals by electrolysis.
2.190	**emulsifying agent; emulsifier**	:	A substance used to produce a stable emulsion.
2.191	**epitaxy**	:	The phenomenon of taking the same grain formation as the basis metal by electrodeposited metals.
2.192	**etch**	:	a) to roughen the surface of a metal by selective dissolution. b) The solution used for etching (also called etchant).
2.193	**filter aid**	:	An inert, insoluble material more or less finely divided, used as a filter medium or to assist in filtration by preventing excessive packing of the filter.
2.194	**filter press**	:	An apparatus used for filtration, consisting of a series of frames holding the filtering media through which the mixture to be filtered is pumped.
2.195	**finish**	:	See 2.157, 2.232 and 2.281
2.196	**flash (flash plate)**	:	A very thin electrodeposit produced in a short time.
2.197	**flocculate**	:	To aggregate into larger agglomerates, to increase in size to the point where precipitation occurs, or to facilitate precipitation.

2.198 frosting : Imparting the fine matt surface on articles.

2.199 galvanic cell : An electrolytic cell capable of producing electrical energy by electrochemical action.

2.200 galvanic series : A list of metals and alloys arranged according to their relative potentials in a given environment (See also 2.180).

2.201 galvanizing : The application of a coating of zinc usually to a ferrous metal, frequently applied by the hot-dip process.

2.202 gassing : Visible evolution of gases from electrodes during electrolysis.

2.203 gilding : The process of coating an article with gold. (See also 2.173).

2.204 glass electrode : An electrode having a thin walled bulb of special conducting glass used in conjunction with a reference electrode to measure pH. (See also 2.78, 2.209 and 2.246).

2.205 glass bead blasting : A process whereby small spherical glass beads are propelled against a metallic surface for the purpose of cleaning that surface. It is carried out in either the wet or dry state.

2.206 glazing wheels : Abrasive wheels having worn out abradents used for glazing of articles.

2.207 grinding : The removal of surface material by means of rotating rigid wheels containing abrasive.

2.208 grit blasting : Abrasive blasting with small angular pieces of steel or cast iron for the purpose of cleaning and roughening.

2.209 half cell : An electrode immersed in a suitable electrolyte, designed for measurements of electrode potential. It may be designed to offer a known constant potential for example: the calomel electrode, against which unknown potentials may be measured. (See 2.78).

2.210 hard anodizing : The development of a relatively thick, hard, wearresisting oxide coating on aluminium or its alloy by an anodic process.

2.211 hard chromium : Electrodeposited chromium used for hard, wearresisting purposes rather than for decorative applications.

2.212 haring cell : A rectangular box of non-conducting material, with principal and auxiliary electrodes so arranged as to permit estimation of throwing power or electrode polarizations and potentials between them.

2.213 highlights : Raised portions of a metal surface brought into prominence by buffing or polishing operations.

2.214 hull cell : A trapezoidal box of non-conducting material with electrodes arranged to permit observations of cathodic or anodic effects over a wide range of current densities.

2.215 hydrogen embrittlement : Embrittlement of a metal or an alloy caused by absorption of atomic hydrogen, for example during a pickling, cleaning or plating process.

2.216 hydrogen overvoltage : The extent of cathode overpotential due to polarization which occurs in an electrolytic cell when bubbles of hydrogen gas just begin to appear at the electrode.

NOTE - Compare oxygen overvoltage at anodes as a result of oxidation.

2.217 immersion cleaning : See 2.100.8.

2.218 immersion deposit : A metallic deposit produced by a displacement reaction in which one metal displaces another from solution, for example:

$$Fe + Cu^{2+} \longrightarrow Cu + Fe^{2+}$$

2.219 immersion plating : The production of an immersion deposit.

2.220 inert anode : See 2.222.

2.221 inhibitor : A substance used to reduce the rate of a specified chemical or electrochemical reaction, for example: pickling inhibitor.

2.222 insoluble anode : An anode which does not contribute metal ions to the electrolyte during electrolysis.

2.223 ion exchange : A reversible process by which ions are interchanged between a solid and a solution without substantial structural changes of the solid.

2.224 jacquet layer : The layer of electrolyte adjacent to anodic metal surfaces during electropolishing. It consists of a thick diffusion layer rich in metal ions.

2.225 lamellar deposits : a) Multiple electrodeposits which occur in layers with low adhesion between the layer.

b) Electrodeposits which appear to have a lamellar or banded structure when examined metallographically.

2.226 levelling : The ability of an electroplating solution to produce a surface smoother than that of the substrate.

2.227 levelling agent : An agent added to an electroplating solution to promote the growth of a smooth and even electrodeposit over a rough basis metal surface. (See also 2.61)

2.228	**limiting current density**	:	a) Cathodic - The maximum current density at which satisfactory deposits are obtained. b) Anodic - The maximum current density at which the anode behaves normally, without excessive polarization.
2.229	**liquid honing**	:	See 2.331.
2.230	**mandrel**	:	a) A form used as a cathode in electroforming; a mould or matrix. b) Support used in bending tests.
2.231	**masking**	:	The process of covering a portion of an electrode surface by an insulating and chemically resistant film to prevent the deposition of metal on or dissolution from that area during electroplating.
2.232	**mat finish**	:	A uniform finish of a fine texture virtually lacking specular reflectivity.
2.233	**matrix**	:	See 2.230.
2.234	**metal distribution ratio**	:	The ratio of the thickness of deposited metal upon two specified areas of a cathode. (See 2.315).
2.235	**metalising**	:	Application of a thin metallic film on non-metallic materials.
2.236	**microthrowing power**	:	The ability of an electroplating solution under a specified set of conditions to deposit metal in pores or scratches.
2.237	**mopping**	:	See 2.72.
2.238	**mould**	:	See 2.230.
2.239	**multilayer deposit**	:	An electrodeposit consisting of two or more layers of metal of different nature or composition deposited successively.

2.240 noble metal : A metal that does not readily tend to furnish ions, and therefore does not dissolve readily, nor easily enter into such reactions, as oxidation, etc. The opposite of base metal.

2.241 nodule : A growth which forms a rounded projection on a cathode during electrodeposition.

2.242 non-cathodic plating : Deposition of a metallic coating by a controlled chemical reduction, that is not catalysed by the metal or alloy being deposited (as distinguished from autocatalytic plating).

2.243 orange peel : A finish resembling the dimpled appearance of an orange peel.

2.244 oxidation : A reaction in which electrons are removed from a reactant. Sometimes, more specifically, the combination of a reactant with oxygen.

2.245 oxidizing agent : A compound that causes oxidation, thereby itself becoming reduced.

2.246 pH : The negative logarithm of the hydrogen ion activity of a medium as determined by indicators or electrometric means.

$$pH = -\log_{10} \left[H^+\right]$$

Used as a measure of the acidity or alkalinity of a solution.

$$pH = -\log_{10} \left[H^+\right]$$

2.247 passivating : Imparting passivity to a metal surface usually by dipping it into a medium (such as preparations containing chromic and/or phosphoric acid) forming a very thin protective surface film.

2.248 passivity : The condition of a metal that retards its normal reaction in a specified environment and associated with the assumption of a potential more noble than its normal potential.

2.249 peeling : The detachment or partial detachment of an electrodeposited coating from a basis metal or undercoat.

2.250 periodic reverse plating : A method of plating in which the current is reversed periodically. The cycles are usually no longer than a few minutes and may be much less.

2.251 phosphating : a) Forming a layer of insoluble phosphates on metal surface. (General usage)

b) Passivating an electroplated article using an agent containing phosphoric acid and/or phosphates.

2.252 pickling : Removal of oxides or other compounds of the basis metal surface by chemical or electrochemical action.

2.253 pit : A small depression or cavity produced in a metal surface during electrodeposition or by corrosion.

2.254 plastisol : An insulating material used for insulation of plating jigs, racks, tanks etc. This consists of dispersions of finely divided resin particles (often polyvinyl chloride or co-polymer) in a plasticizer or a mixture of plasticizers. After application by spraying, dipping or tro-welling the coating is backed, when the plasticizer diffuses into and softens the resin particles which fuse to a continuous film without significant loss of volatile matter.

2.255 plating cycle : The sequence of operations through which an article is processed in the course of electroplating to achieve its final state.

2.256 plating out : A method of removing metallic impurities from a used solution by plating on to dummy cathodes (usually corrugated) at specified low current densities.

2.257 plating period : The total time of electrodeposition in a plating solution.

2.258 plating range : See 2.185

2.259 polarization : The change in the potential of an electrode during electrolysis, such that the potential of an anode always becomes more noble and that of a cathode less noble than their respective static potentials. Equal to the difference between the static potential and the dynamic potential.

2.260 polishing : a) General term - The smoothing of a metal surface.

b) Particular term - The preliminary stages of smoothing a metal surface by the action of abrasive particles. These particles are most commonly attached by adhesive to the surface of wheels or endless belts.

2.261 pore (in a coating) : Essentially circular micro-discontinuity in the surface extending through to the underlying coating or to the basis metal.

2.262 porosity : A condition of an electrodeposit or its substrate in which pores are present.

2.263 primary current distribution : The distribution of the current over the surface of an electrode in the absence of polarization.

2.264 pumice : A sponge like material of volcanic origin commonly used as a light abrasive.

2.265 quicking : The deposition of a thin film of mercury on metals by simple immersion in a dilute solution of mercuric salt prior to plating.

2.266	**quinhydrone electrode**	: A half cell with a bright platinum or gold electrode in contact with a solution saturated with quinhydrone.
2.267	**rack;plating rach (jig)**	: A frame for suspending and carrying current to articles during electroplating and related operations.
2.268	**rectifier**	: A device that converts alternating current into direct current by virtue of a characteristic permitting appreciable flow of current in only one direction.
2.269	**reducing agent**	: A chemical compound which causes reduction, thereby itself becoming oxidized.
2.270	**reduction**	: Reactions involving gain of one or more electrons, loss of oxygen or gain of hydrogen. The reaction which takes place at the cathode in an electrolyte.
2.271	**reflowing**	: The melting of an electrodeposit, followed by resolidification so that the surface takes on the appearance of having been "hot-dipped" rather than electroplated.
2.272	**relieving**	: The removal of material from selected portions of a coloured metal surface by mechanical means to achieve a multicoloured effect.
2.273	**resist**	: a) A material applied to a part of a cathode or plating rack to render the surface non-conductive. b) A material applied to a part of the surface of an article to prevent reaction of metal in that area during chemical or electrochemical processes.
2.274	**reverse plating**	: A form of anodic electrolysis performed in the electroplating tank to brighten deposits and improve levelling. It includes controlled systems such as periodic reverse current (PRC) plating.

2.275 rinsing (swilling) : A washing process used to remove residual solution from one operation before passing the article into another.

2.276 rippie (d.c.) : Regulator modulations in the d.c. output wave of a rectifier unit, or a motor-generator set, originating from the harmonics of the a.c. input system in the case of a rectifier, or from the harmonics of the induced voltage of a motor-generator set.

2.277 robber : See 2.314

2.278 rouge : Iron compounds in fine form used as an abrasive.

2.279 sacrificial protection : The form of cathodic corrosion wherein one metal corrodes in preference to another, thereby protecting the latter from corrosion.

2.280 sand blasting : Abrasive blasting with sand or related hard material of similar particle size.

2.281 satin finish : a) A fine matt finish which is lustrous without directional texture.

b) A lustrous finish having a fine directional texture.

2.282 scale : An adherent oxide coating that is thicker than the superficial film referred to as tarnish.

2.283 scretch brushing : A finishing process using fine, soft, rotating wire brush by the application of low pressure. For the production of satin finishes and for bronze finishes, scratch brushing is generally carried out dry. For cleaning prior to plating and for the brushing of plated finishes, the operation is normally carried out wet.

2.284 sealing of anodic coating : A process which, by absorption, chemical reaction or other mechanisms to bring about sealing of pores of an anodic coating to prevent staining and corrosion. This improves the durability of colours produced in the coating or imparts other desirable properties.

2.285 selective deposit : An electrodeposit plated over a specified surface of an article thereby producing contrast with the basis metal.

2.286 sensitizing : Surface treatment of an article used to promote deposition of a metal coating.

2.287 sequester : A sequestering agent forms soluble complex ions (or sequesters) with a simple ion, thereby inhibiting the activity of that ion. Thus in water treatment, the effects of hardness may be suppressed by adding agents to sequester calcium and magnesium. (See also 2.96).

2.288 shield : a) A non-conducting barrier positioned so as to alter the current distribution on an anode or a cathode.

b) To alter the current distribution on an anode or a cathode by the interposition of a non-conductor.

2.289 shot blasting : A process whereby hard, small, spherical objects (such as metallic shot) are propelled against a metallic surface for the purpose of cleaning or descaling that surface.

2.290 shot peening : A process whereby hard, small, spherical objects (such as metallic shot) are propelled against a metallic surface for the purpose of hardening, or decorating, that surface.

2.291 skin deposits : Metal deposited for the purpose of removal as a skin shell.

2.292 smut : A deposit of carbon or carbides remaining on the surface of high carbon steels or cast irons during etching. Also applied to residues similarly formed on non-ferrous alloys.

2.293	**soak rinsing**	:	See 2.100.10
2.294	**softening of water**	:	Removal of hardness in water, for example by cation exchange.
2.295	**soil**	:	A term used to describe mechanical surface contamination.
2.296	**spalling**	:	The chipping or fragmenting of a surface coating caused, for example, by differential thermal expansion or contraction.
2.297	**speculum**	:	A whitish copper-tin alloy which is capable of taking a high polish.
2.298	**spotting out**	:	The delayed appearance of sopts and blemishes on plated or finished surfaces.
2.299	**spray cleaning**	:	See 2.100.13
2.300	**spray rinsing**	:	See 2.100.13
2.301	**stopping off**	:	The application of a resist to any part of a cathode, anode, or rack.
2.302	**stalagmometer**	:	An apparatus which measures surface tension of liquids in terms of mass of a drop leaving the specified orifice.
2.303	**stray current**	:	Current through paths other than the intended circuit, such as through heating coils or the tank.
2.304	**striated deposit**	:	Linear markings on the surface of a deposit, due to abnormal electroplating conditions.
2.305	**strike**	:	a) A thin film of electrodeposited metal which improves the deposition of subsequent coatings. b) A solution specially formulated to obtain this film. c) To electroplate for a relatively short time either in a bath of a composition or at operating conditions different from those of the subsequent process.

2.306	**strip**	:	a) A process or solution used for the removal of a coating from a basis metal or an undercoat. b) To remove a coating from the basis metal or undercoat.
2.307	**substrate**	:	Basis material on which a coating is deposited.
2.308	**superimposed a.c.**	:	A form of current in which an alternating current is superimposed on the direct current, in order to get a higher current density.
2.309	**surface active agent**	:	A substance that affects markedly the interfacial or surface tension of solutions even when present in very low concentrations.
2.310	**surface tension**	:	That property, due to molecular forces, that exists in the surface film of all liquids and tends to prevent the liquid from spreading.
2.311	**swilling**	:	See 2.275
2.312	**tank voltage**	:	See 2.44
2.313	**tarnish**	:	a) The dulling, staining, or discoloration of metals due to superficial corrosion. b) The film so formed.
2.314	**thief**	:	An auxiliary cathode so placed as to divert to itself some current from portions of the work which would otherwise receive too high a current density.
2.315	**throwing power**	:	The improvement of the coating (usually metal) distribution overt the primary current distribution on an electrode (usually cathode) in a given solution, under specified conditions. The term may also be used for anodic processes for which the definition is analogous.

2.316	**total cyanide**	:	The total quantity of cyanide radical present in a solution, usually expressed as sodium or potassium cyanide.
2.317	**transference (or transport or migration)**	:	The movement of ions through the electrolyte associated with the passage of the electric current.
2.318	**transference number (transport number)**	:	The proportion of the total current carried by the ions of a given kind.
2.319	**trees**	:	Branched or irregular projections formed on a cathode during electrodeposition, especially at edges and other high current density areas.
2.320	**tripoli**	:	Friable and dustlike silica used as an abrasive.
2.321	**tumbling**	:	Bulk processing in barrels, either in the presence or absence of abrasives or burnishing shot, for the purpose of improving the surface finish.
2.322	**ultrasonic cleaning**	:	See 2.100.14
2.323	**underplate (undercoat)**	:	A preliminary coating of appreciable thickness applied to alter the characteristics of the basis metal before a final coating is applied.
2.324	**vacuum metallizing**	:	A process carried out in a vacuum chamber in which the material to be deposited is vapourized.
2.325	**vacuum sputtering**	:	In vacuum sputtering the article is made cathodic (in relation to the vaporized material) with a relatively high potential thereby causing the vaporized material to be attracted towards the surface on which it is to be deposited.
2.326	**vapour blasting**	:	See 2.331
2.327	**ventilated wheels**	:	Wheels constructed in such a manner that air drawn through them will prevent excessive heating of the articles being polished.

2.328 viena lime : Lime with high content of magnesium for high fat absorbing quality used as an abrasive.

2.329 voltaic cell : See 2.199

2.330 water break : The appearance of a discontinuous film of water on a surface signifying non-uniform wettability usually caused by a surface contamination.

2.331 wet blasting : A process for cleaning or finishing by means of a slurry of abrasive in water directed at high velocity against the work pieces.

2.332 wetting agent : A substance that reduces the surface tension of a liquid, thereby causing it to spread more readily on a solid surface.

2.333 whiskers (in electroplating) : Metallic filamentary growths, often microscopic, formed sometimes during electrodeposition and sometimes spontaneously during storage or service, after finishing.

2.334 wire-brushing : A technique for treatment of metal surfaces with hard wire brushes used in a dry condition. Normally the brushes are in circular form and applied at high surface speed to the metals. The method is frequently employed to remove surface contamination such as surplus solder deposits, carbonized scales and unwanted paint. (See also 2.283)

2.335 zincate : A solution of sodium or potassium hydroxide containing dissolved zinc oxide. Zincate solutions of various compositions are frequently used to deposit a film of zinc on aluminium by immersion plating before electroplating.

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