

48 Chemical surface treatment of metals

48a	Electrodeposition: electroforming, electro-refining, electrolytic etching of metals, etc.
48a	(IPC: C23B) Electrolytic surface treatment of or with metals, e.g. electroplating; Electroforming; Coating metals by electrophoresis
48b	Metal coatings: gilding, tinning, galvanising, etc., except electro-refining
48b	(IPC: C23C) Apparatus and processes for covering metals or covering materials with metals for which provision is not made elsewhere; Diffusion processes for surface treatment of metals
48c	Enamelling, glazing of metals
48c	(IPC: C23D) Enamelling of, and applying a vitreous layer to, metals
48d	Chemical surface treatment of metals and corrosion protection of metals
48d1	(IPC: C23F) Chemical surface treatment of metals not covered by 48a – 48c; Inhibiting corrosion of metals by means not otherwise provided for
48d2	(IPC: C23G) Cleaning and de-greasing of metallic objects by chemical methods other than electrolysis)

48a	Electrodeposition: electroforming, electro-refining, electrolytic etching of metals, etc.
	Preparation of the objects for galvanic metalworking (cleaning by mechanical means 48b-1; by sand blasting 67b; by chemical agents 48d-2)
	Cleaning by electrochemical processes
48a-1/03	by electrolytic contact action
48a-1/04	Etching, degreasing, descaling and pickling, by means of electric current from external source
48a-1/05	Electrolytic polishing of heavy metals (of light metals 48a-16/01 – 48a-16/02)
48a-2	Imparting electric conductivity to non-metallic objects prior to coating by electrolytic metal deposition, exclusive of glass (coating glass with metals 32b-10, 32b-17/06, 32b-21/00, 42g-16/01)
48a-3	Production of easily detachable, coherent electrolytic metal deposits and removal of these deposits (removal of deposits in electrometallurgical metal extraction 40c)
	Composition and dissociation conditions of electrolytic baths, also anode compositions (baths for the electrolytic metal extraction 40c-5 – 40c-15; anode and cathode shape 48a-15/01)
48a-5	Composition and dissociation conditions of electrolytic baths in general, also of molten baths
	Especially for deposition
48a-6/01	of light metals
48a-6/02	of zinc and cadmium
48a-6/03	of iron
48a-6/04	of chromium

48a-6/05	of nickel and cobalt
48a-6/06	of tin and lead
48a-6/07	of copper and copper alloys
48a-6/08	of noble metals
48a-6/09	of metals not covered by 48a-6/01 – 48a-6/08
48a-6/50	of alloys in general, with the exception of copper alloys
48a-7	Electroforming of articles in general, e.g. patterns, figures, radiators for cooling of internal combustion engines
48a-8	Electroforming of tubes and tubular articles and simultaneous treatment of the deposit in the bath by pressing and smoothing tools (Elmore method), also electroplating of tubes
48a-9	Devices for the production of metals in the form of wires, strips and sheets by electroforming, also in the form of foils, as well as for electroplating of wire, metal sheets and strips
48a-10	Production of metallic mirrors by electroforming, also the production of protective layers for the metallic coating of glass mirrors by electroforming (manufacture of glass mirrors 32b-10, 32b-17/12, 32b-17/16; of ornaments 75b, 75c)
48a-12	Equipment for batch electroplating, such as drums, tilting and bell apparatus (anodic oxidation of articles in batches 48a-16/01, 48a-16/02; circulating baths 48a-15/03)
48a-13	Contact processes for the production of metal deposits (by friction 48b-8)
48a-14/01	Thermal finishing treatment of electrolytic coatings, production of intermediary layers
48a-14/02	Local strengthening of electrolytic deposits, e.g. on cutlery
48a-14/03	Electrolytic coatings on metals having passive surfaces, e.g. light metals, steels and other-metals and alloys resisting metallisation
48a-14/04	Miscellaneous electrodeposition processes, not covered by other groups
48a-15/01	Anode and cathode shapes, as well as suspension and carrying devices for electrodeposition purposes (anode compositions 48a-5, 48a-6; electrolytic cell structures and accessories also 40c-3)
48a-15/02	Hand anodes and cathodes
48a-15/03	Circulating baths, ring baths, automatic devices, electrode movement, lifting devices
48a-15/04	Devices in general, streamlined diaphragms and heating devices, bath vessels, testing devices and the like when not classified in special groups (cf. also 48a-14/02)
48a-16/01	Processes and devices for the anodic treatment of aluminium and aluminium alloys, also in the form of zipper elements, electrolytic colouring, electrolytic polishing (subsequent treatment, pore filling 48d-4/02; colouring 48d-3)
48a-16/02	Processes and devices for the anodic treatment of magnesium and magnesium alloys, electrolytic colouring, electrolytic polishing (subsequent treatment, pore filling 48d-4/02; colouring 48d-3)
48a-16/03	Production of non-oxide coating layers, e.g. fluoride layers, on light metals
48a-16/04	Anodic and cathodic treatment of heavy-metal surfaces for the production of protective or coloured coatings through chemical transformation of the surface itself or through deposition of metallic oxides or other metallic compounds, as well as other electrochemical processes in which no metal separation occurs, such as cementation, passivation (electrophoretic rubber coatings 39b-1; electrophoretic varnish and synthetic resin coatings 75c)

48a (IPC: C23B) Electrolytic surface treatment of or with metals, e.g. electroplating; Electroforming; Coating metals by electrophoresis

48a-1/00	Electrochemical processes and apparatus for removing non-metallic substances from metal articles, including pickling (48a-5/68 takes precedence; cleaning or pickling by chemical means 48d2)
48a-1/02	. with electrical contact between the article and another metal in a solution and without externally applied e.m.f.
48a-1/04	. Electrolytic degreasing
48a-1/06	. Electrolytic pickling

48a-3/00 Electrolytic etching or polishing

- 48a-3/02 . Etching
- 48a-3/04 . . locally
- 48a-3/06 . Polishing
- 48a-3/08 . . heavy metals
- 48a-3/10 . . light metals
- 48a-3/12 . Apparatus (48a-5/68 takes precedence)

48a-5/00 Electrolytic deposition of metals (electroforming 48a-7/00)**Note:****Group 48a-5/02 takes precedence over 48a-5/04 to 48a-5/46**

- 48a-5/02 . Contact electroplating processes (by rubbing 48b)
- 48a-5/04 . of iron
- 48a-5/06 . of chromium
- 48a-5/08 . of nickel or cobalt
- 48a-5/10 . of zinc or cadmium
- 48a-5/12 . . from acid baths
- 48a-5/14 . of tin
- 48a-5/16 . of lead
- 48a-5/18 . of copper
- 48a-5/20 . . from acid baths
- 48a-5/22 . of light metals
- 48a-5/24 . of noble metals
- 48a-5/26 . . of silver
- 48a-5/28 . . of gold
- 48a-5/30 . of metals not mentioned before
- 48a-5/32 . of alloys
- 48a-5/34 . . containing more than 50% of copper
- 48a-5/36 . . . of brass
- 48a-5/38 . . of alloys containing more than 50 % tin
- 48a-5/40 . . of alloys containing more than 50 % lead
- 48a-5/42 . . of alloys containing more than 50 % gold
- 48a-5/44 . . of alloys containing more than 50 % silver
- 48a-5/46 . in the presence of organic brightening agents
- 48a-5/48 . Special features in the process
- 48a-5/50 . . Depositing more than one layer of the same or of different metals
- 48a-5/52 . . Thermal after-treatment
- 48a-5/54 . . Making coatings with varying thickness
- 48a-5/56 . . Electroplating tubes
- 48a-5/58 . . Electroplating wire or metal bands
- 48a-5/60 . . for coating articles having surfaces to which coatings cannot be readily applied
- 48a-5/62 . . . by pre-treatment of the articles
- 48a-5/64 Applying conductive coatings to non-metallic articles for electroplating purposes (metal coatings on glass 32b)
- 48a-5/66 . . Using protective surface layers on electrolytic baths
- 48a-5/68 . Apparatus specially adapted for electroplating purposes (apparatus for continuously conveying articles in baths, automatic conveyers 81e)
- 48a-5/70 . . Suspending or supporting devices; Racks
- 48a-5/72 . . Electrodes
- 48a-5/74 . . . Shape
- 48a-5/76 . . . for electroplating by hand
- 48a-5/78 . . Horizontal barrels; Oblique barrels; Oscillating cradle plates

48a-7/00 Electroforming

- 48a-7/02 . Making tubes
- 48a-7/04 . Making wire, bands, or foils
- 48a-7/06 . Making wholly-metallic mirrors
- 48a-7/08 . Making easily-removable coatings; Removing the coatings

48a-9/00 Forming oxide layers on metals by anodising

- 48a-9/02 . on aluminium or aluminium alloys

48a-9/04	. . on sliding-clasp fasteners
48a-9/06	. on magnesium or magnesium alloys
48a-11/00	Forming non-metallic layers including metal oxide layers on metals by electrochemical processes
48a-11/02	. on light metals
48a-13/00	Coating of metals by electrophoresis
48b	Metal coatings: gilding, tinning, galvanising, etc., except electrorefining
48b-1	Preparation and cleaning of metal objects to be coated with metal by mechanical means, e.g. brushes; cleaning of objects coated with metal (cleaning by chemical agents 48d-2; electrolytically 48a-1/03, 48a-1/04; by sand blasting 67b)
48b-2	Devices for the production of metallic coatings from melts and general processes (coating of glass with metal 32b-10, 32b-17/06, 32b-17/12, 32b-21/00)
48b-3	Removal of the excess coating metal in the production of metallic coatings
48b-4	Coating of wire, strips, tubes and metallic gauze with metals (electrolytically 48a-9)
	Metal coating by dipping the objects to be coated in molten metal or metallic salt solutions (by electro-refining 48a-6/01 – 48a-6/50)
48b-5	Lead-coating of metallic objects (by electro-refining 48a-6/06)
48b-6	Galvanising of metallic objects (by electro-refining 48a-6/02)
48b-7	Tinning of metallic objects (by electro-refining 48a-6/06)
48b-8	Production of metallic coatings by frictional contact with metallic salts and amalgams, by boiling and the like (contact process 48a-13)
48b-9	Production of metallic coating on light metals and of light-metal coatings on other metals (by electro-refining 48a-6/01)
48b-10	Production of metallic coating, not covered in 48b-5 – 48b-9
	Metal coating by atomising, also production of separate bodies
48b-11/01	by mechanical spraying, metal-spraying methods (metalizing of threads 8n-5/04; production of metal powders 40c, 49l-3)
48b-11/03	by thermal evaporation (on glass 32b-10, 32b-17/06)
48b-11/04	by thermal dissociation of metal-liberating compounds
48b-11/10	Methods and devices for the cathodic atomising of metals in connection with the formation of the deposit and metallurgical constitution of deposit
48b-11/20	Methods and devices for the cathodic atomising of metals in connection with the electrical means utilised
48b-12	Apparatus for the production of metal coatings by atomising
48b-13	Metallic coatings obtained by diffusion, e.g. Sherardising
48b	(IPC: C23C) Apparatus and processes for covering metals or covering materials with metals for which provision is not made elsewhere; Diffusion processes for surface treatment of metals
48b-1/00	Covering by treatment with liquid metal, e.g. hot dipping processes (metal spraying 48b-7/00)
48b-1/02	. Covering with zinc or cadmium or alloys thereof
48b-1/04	. Covering with tin or alloys thereof
48b-1/06	. Covering with lead or alloys thereof
48b-1/08	. Covering with aluminium or alloys thereof
48b-1/10	. Covering with other metals or alloys
48b-1/12	. Fluxes or coverings for molten metal baths
48b-1/14	. Apparatus
48b-1/16	. Rubbing the surface with the molten metal

48b-3/00	Covering with metals by treatment with solutions or suspensions of metal compounds
48b-3/02	. in the presence of reducing agents
48b-3/04	. followed by thermal decomposition of the metal compound
48b-5/00	Cladding (mechanical part 49I-5, 49I-3/00)
48b-7/00	Metal spraying (spray guns 75c)
48b-9/00	Cementation by diffusion processes using solids or liquids
48b-9/02	. Box coating with metals, i.e. heating the workpiece in metal dust
48b-9/04	. Box coating with substances other than metals
48b-9/06	. Box carburising
48b-9/08	. . of iron
48b-9/10	. Cementation by hot dipping in molten salts, e.g. carburising, nitriding, carbo-nitriding
48b-9/12	. . Carburising iron
48b-9/14	. . Nitriding iron
48b-9/16	. . Carbo-nitriding iron
48b-11/00	Gas plating by thermal decomposition or reduction of gases on heated surfaces or by glow or arc discharge followed by diffusion into the surfaces
48b-11/02	. to form metal coatings, e.g. by carbonyl processes
48b-11/04	. . Chromising
48b-11/06	. . Siliconising
48b-11/08	. to form coatings of inorganic compounds of metals
48b-11/10	. Gas carburising
48b-11/12	. . of iron
48b-11/14	. Gas nitriding; Gas carbo-nitriding
48b-11/16	. . Nitriding iron
48b-11/18	. . Carbo-nitriding iron
48b-13/00	Forming coatings on metals by condensation of vapours, e.g. in vacuo; Forming coatings on materials by condensation of metal vapours
48b-13/02	. coatings of metals
48b-13/04	. coatings of materials other than metals
48b-13/06	. Making contoured surfaces, e.g. shadow casting
48b-13/08	. Apparatus
48b-13/10	. . for continuous working
48b-13/12	. . Vapour sources, e.g. filament heaters, crucibles, electron bombardment heating apparatus (for gettering in electric discharge tubes 21f-82)
48b-15/00	Cathodic sputtering; Apparatus therefor
48b-17/00	Methods not covered elsewhere for coating materials with metals
48b-17/02	. by reducing non-metallic coatings to metal
48b-19/00	Production of objects with small amounts of additives using the methods covered by 48b-1/00 – 48b-17/00
48c	Enamelling, glazing of metals
48c-1	Production of enamel coatings and glazes on metals in general (glazes on glass 32b-8, 32b-1/00, 32b-9/00; on ceramic objects 80b-23/03 – 80b23/04; enamel coatings, general 75c-5; for insulation 21c-7/01 – 21c-7/02)
48c-2/01	Chemical composition of the enamel in general
48c-2/02	Agents for the opacification of enamel (opacification of glass 32b-2, 32b-1/04, 32b-5/05)
48c-3	Other processes and devices for enamelling, except enamel applying machines and ovens
48c-4	Enamel removal
48c-5	Production of mottled enamel on metals
48c-6	Enamel applying machines

- 48c-7 Enamelling furnaces and accessories, such as charging equipment, grates, etc. (muffle furnaces also 18c, 24a, 32a-28 – 32a-32, 32b-23/00 – 32b-35/00, 40a, 40d, 80c)
- 48c-8 Enamelling of sheet metal utensils
- 48c-9 Methods for producing enamel with a rough surface (writing slates for children 70e-1)
- 48c (IPC: C23D) Enamelling of, and applying a vitreous layer to, metals (chemical composition of the enamels 32b)**
- Melting and fritting the enamels**
- 48c-1/00 Melting or fritting the enamels; Apparatus and furnaces therefor**
48c-1/02 . Granulating the melt; Drying the granules
- Coating with the enamels**
- 48c-3/00 Chemical treatment of the metal surfaces prior to coating** (cleaning and de-greasing of metallic objects 48d2)
- 48c-5/00 Coating with enamels or vitreous layers including applying fused refractory layers**
48c-5/02 . by wet methods
48c-5/04 . by dry methods
48c-5/06 . producing designs or letters
48c-5/08 . Applying enamels non-uniformly over the surface
48c-5/10 . with refractory materials
- 48c-7/00 Treating the coatings, e.g. drying before burning**
- Firing the enamels**
- 48c-9/00 Ovens specially adapted for firing enamels**
48c-9/02 . Non-electric muffle furnaces
48c-9/04 . Non-electric tunnel ovens
48c-9/06 . Electric furnaces
48c-9/08 . Supporting devices for burning-bars
48c-9/10 . Loading or unloading devices
- 48c-11/00 Continuous processes; Apparatus therefor**
- After-treatment**
- 48c-13/00 After-treatment of the enamelled articles**
48c-13/02 . Removing defects by local re-melting of the enamel; Adjusting the shape
- 48c-15/00 Joining enamelled articles to other enamelled articles by processes involving an enamelling step**
- 48c-17/00 De-enamelling**
- 48d Chemical surface treatment of metals and corrosion protection of metals**
- 48d-1 Etching of metals by means of chemicals, especially acids, also devices for etching of photomechanical printing forms and plates, sharpening of files by etching (methods for the production of printing patterns and forms in general 15b, electrolytic etching 48a-1/04)
- Methods and devices for pickling, cleaning and removing grease from metallic objects by means of chemicals, also in conjunction with mechanical means (electrolytic pickling 48a-1/04)
- 48d-2/01 Composition of the pickling liquors
- 48d-2/02 Protective additives, also for other metal-corroding liquids
- 48d-2/03 Pickling devices
- 48d-2/10 Cleaning and degreasing by means of aqueous solutions, e.g. alkalis

48d-2/20	Cleaning and degreasing by means of organic solvents
48d-3	Colouring of metals (by electrolysis 48a-16/04)
	Production of non-metallic coatings by diffusion, oxidation or phosphatation, also rust protection without coating (corrosion protection by painting 22g-7)
48d-4/01	on iron (decarburising, carburising, nitriding 18c-3)
48d-4/02	on nonferrous metals
48d-5	Miscellaneous methods and devices, e.g. corrosion protection by means of electric currents

48d1 (IPC: C23F) Chemical surface treatment of metals not covered by 48a – 48c; Inhibiting corrosion of metals by means not otherwise provided for (painting 75c; inhibiting corrosion by softening and cleaning water 85b)

48d1-1/00 Etching metals by chemical means (manufacture of printing surfaces 15b; electrolytic etching 48a-3/00)

- 48d1-1/02 . Local etching
- 48d1-1/04 . . Chemical milling
- 48d1-1/06 . Sharpening files
- 48d1-1/08 . Apparatus, e.g. for photomechanical printing surfaces (photomechanical reproduction 57d)

48d1-3/00 Brightening metals by chemical means

- 48d1-3/02 . light metals
- 48d1-3/04 . heavy metals

48d1-5/00 Forming coloured layers on metal surfaces (48d1-7/00 takes precedence)

- 48d1-5/02 . with inorganic colouring matters
- 48d1-5/04 . with organic colouring matters

48d1-7/00 Forming non-metallic layers on metals by surface reactions (diffusion processes 48b)

- 48d1-7/02 . Forming oxide layers
- 48d1-7/04 . . on iron or steel
- 48d1-7/06 . . on light metals
- 48d1-7/08 . Forming phosphate layers
- 48d1-7/10 . . on iron or steel
- 48d1-7/12 . . on copper, brass, zinc, or tin
- 48d1-7/14 . . on light metals
- 48d1-7/16 . . . on magnesium
- 48d1-7/18 . Forming oxalate layers
- 48d1-7/20 . . on iron or steel
- 48d1-7/22 . . on light metals
- 48d1-7/24 . Forming sulphide layers
- 48d1-7/26 . Forming chromate layers

48d1-9/00 Passivating metals

- 48d1-9/02 . iron or steel

48d1-11/00 Inhibiting corrosion by applying inhibitors to the surface in danger of corrosion or adding them to the corrosive agent (adding inhibitors to mineral oil, fuels, or lubricants 10, 12r, 23b, 23e; adding inhibitors to pickling solutions 48d2)

- 48d1-11/02 . in air or gases by adding vapour phase inhibitors
- 48d1-11/04 . in markedly acid liquids
- 48d1-11/06 . in markedly alkaline liquids
- 48d1-11/08 . in other liquids
- 48d1-11/10 . . using organic inhibitors

Note:**A compound is classified here in the last appropriate place.**

48d1-11/12	. . . oxygen-containing compounds
48d1-11/14	. . . nitrogen-containing compounds
48d1-11/16	. . . compounds containing sulphur or phosphorus
48d1-11/18	. . using inorganic inhibitors
48d1-13/00	Inhibiting corrosion of metals by anodic or cathodic protection (of electric conduits 21c-4/20; of cables 21c-19/09; of pipes 47f-27/20, 47f1-58/00; of hulls of vessels 65a1-19, 65a-59/00)
48d1-14/00	Inhibiting incrustation in apparatus for heating liquids for physical or chemical purposes
48d1-14/02	. by chemical means
48d1-15/00	Other methods of preventing corrosion or incrustation
48d1-17/00	Multi-step processes for chemical and/or physical, i.e. non-mechanical, surface treatment of or with metals
48d2	(IPC: C23G) Cleaning and de-greasing of metallic objects by chemical methods other than electrolysis (polishing compositions 22g, 22h; detergents in general 23e, 23f, 22g)
48d2-1/00	Cleaning or pickling metals with solutions or molten salts (with organic solvents 48d2-5/02)
48d2-1/02	. with acid solutions
48d2-1/04	. . using inhibitors
48d2-1/06	. . . organic inhibitors
48d2-1/08	. . iron or steel
48d2-1/10	. . other heavy metals
48d2-1/12	. . light metals
48d2-1/14	. with alkaline solutions
48d2-1/16	. . using inhibitors
48d2-1/18	. . . organic inhibitors
48d2-1/20	. . heavy metals
48d2-1/22	. . light metals
48d2-1/24	. with neutral solutions
48d2-1/26	. . using inhibitors
48d2-1/28	. with molten salts
48d2-1/30	. . using inhibitors
48d2-1/32	. . heavy metals
48d2-1/34	. . light metals
48d2-1/36	. Regeneration of waste pickling liquors
48d2-3/00	Apparatus for cleaning or pickling metals (apparatus for continuously conveying articles into baths 81e)
48d2-3/02	. for cleaning wires, strips, filaments continuously
48d2-3/04	. for cleaning pipes
48d2-5/00	Cleaning or de-greasing metals by other methods
48d2-5/02	. using organic solvents
48d2-5/04	. . Apparatus