## 48 Chemical surface treatment of metals

### 48a Electrodeposition: electroforming, electro-refining, electrolytic etching of metals, etc.

| 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

- for electrolytic metal extraction 40c-5 – 40c-15
- anode and cathode shape 48a-15/01

### 48b Metal coatings: gilding, tinning, galvanising, etc., except electro-refining

| 48b-1 | by mechanical means 48b-1; by sand blasting 67b; by chemical agents 48d-2 |

#### Cleaning by electrochemical processes

### 48c Enamelling, glazing of metals

| 48c-1 | (IPC: C23D) Enamelling of, and applying a vitreous layer to, metals |

### 48d Chemical surface treatment of metals and corrosion protection of metals

| 48d-1 | by electrolytic contact action |
| 48d-2 | Etching, degreasing, descaling and pickling, by means of electric current from external source |
| 48d-3 | Electrolytic polishing of heavy metals (of light metals 48a-16/01 – 48a-16/02) |
| 48d-4 | 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) |
| 48d-5 | 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

- for electrolytic metal extraction 40c-5 – 40c-15
- anode and cathode shape 48a-15/01

### 48d-6 Composition and dissociation conditions of electrolytic baths in general, also of molten baths

- Especially for deposition
- of light metals
- of zinc and cadmium
- of iron
- 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-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
The German Patent Classification, Class 48

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 49l-5, 49l-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)
  Composition of the pickling liquors
  Protective additives, also for other metal-corroding liquids
  Pickling devices
  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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>48d1-11/12</td>
<td>. . . oxygen-containing compounds</td>
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<tr>
<td>48d1-11/14</td>
<td>. . . nitrogen-containing compounds</td>
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<td>48d1-11/16</td>
<td>. . . compounds containing sulphur or phosphorus</td>
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<td>48d1-11/18</td>
<td>. . using inorganic inhibitors</td>
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<td>48d1-13/00</td>
<td><strong>Inhibiting corrosion of metals by anodic or cathodic protection</strong> (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)</td>
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<td>48d1-14/00</td>
<td><strong>Inhibiting incrustation in apparatus for heating liquids for physical or chemical purposes</strong></td>
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<td>48d1-14/02</td>
<td>. by chemical means</td>
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<tr>
<td>48d1-15/00</td>
<td><strong>Other methods of preventing corrosion or incrustation</strong></td>
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<tr>
<td>48d1-17/00</td>
<td><strong>Multi-step processes for chemical and/or physical, i.e. non-mechanical, surface treatment of or with metals</strong></td>
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<tr>
<td>48d2</td>
<td><em>(IPC: C23G)</em> <strong>Cleaning and de-greasing of metallic objects by chemical methods other than electrolysis</strong> <em>(polishing compositions 22g, 22h; detergents in general 23e, 23f, 22g)</em></td>
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<td>48d2-1/00</td>
<td><strong>Cleaning or pickling metals with solutions or molten salts</strong> <em>(with organic solvents 48d2-5/02)</em></td>
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<td>. Regeneration of waste pickling liquors</td>
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<td>48d2-3/00</td>
<td><strong>Apparatus for cleaning or pickling metals</strong> <em>(apparatus for continuously conveying articles into baths 81e)</em></td>
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<tr>
<td>48d2-3/02</td>
<td>. for cleaning wires, strips, filaments continuously</td>
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<tr>
<td>48d2-3/04</td>
<td>. for cleaning pipes</td>
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<td>48d2-5/00</td>
<td><strong>Cleaning or de-greasing metals by other methods</strong></td>
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<tr>
<td>48d2-5/02</td>
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