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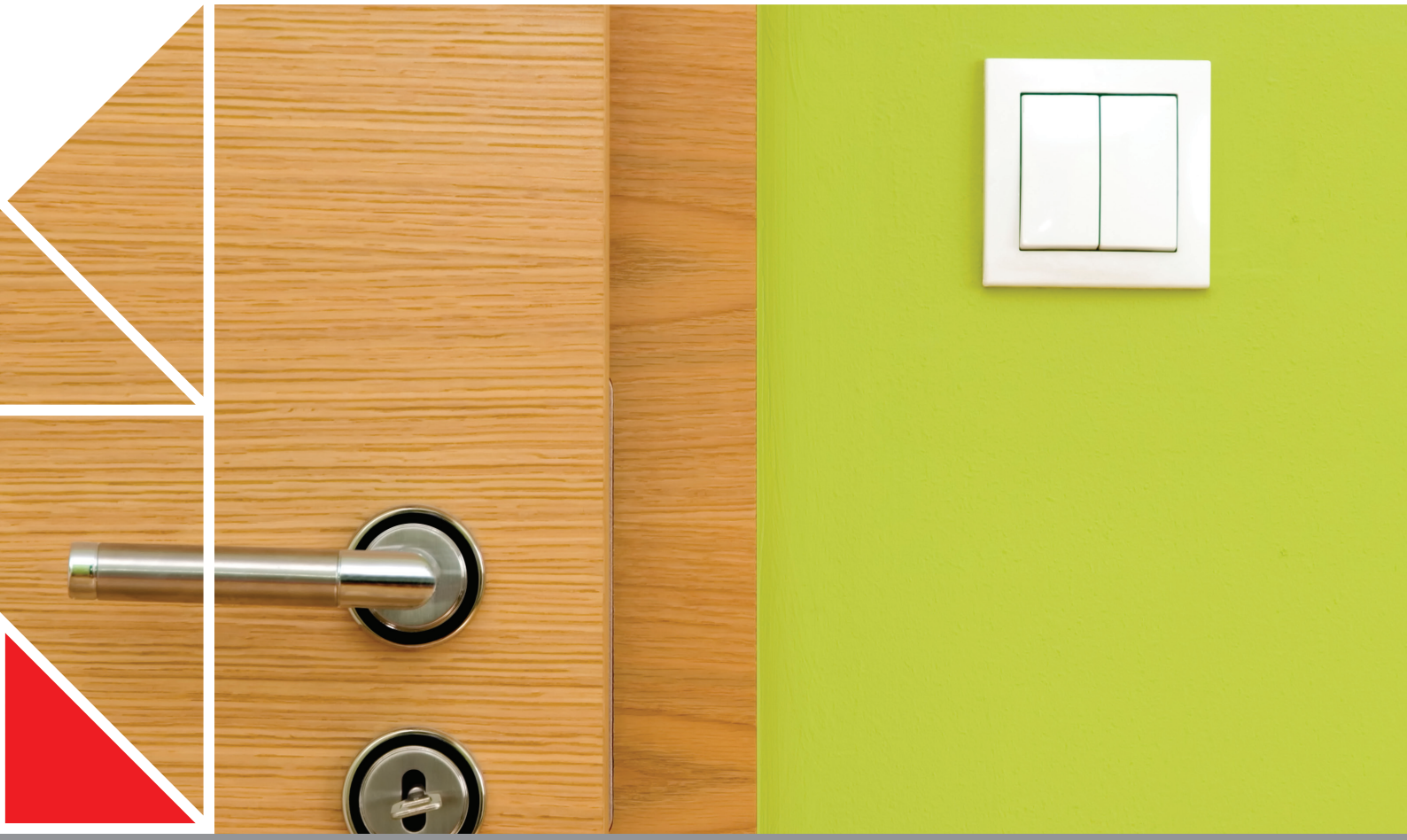
ISSUE 638 BULLETIN



FINISHES ON ARCHITECTURAL HARDWARE

June 2019

Architectural hardware describes fittings for doors, windows, furniture, bathroom accessories and electrical components.

These are available in a range of metallic and paint finishes providing different levels of corrosion resistance and wear characteristics. Some finishes are essential for protection while others are for decorative purposes only.

This bulletin describes the most commonly used substrate materials and finishes for hardware available in New Zealand. It replaces Bulletin 362 of the same name.

1 INTRODUCTION

1.0.1 Architectural hardware describes the fittings used for windows, doors, furniture, electrical and bathroom components. It includes:

- door fittings – handles, knobs, locks, latches, bolts, kick plates, closers, hinges
- window fittings – stays, catches, locks, hinges
- furniture fittings – handles, catches, locks, hinges, drawer runners
- bathroom fittings – taps, faucets, shower roses, shower controls, towel rails, toilet roll holders, soap trays, grab rails, robe hooks
- electrical fittings – light fittings, switch plates, socket outlets.

1.0.2 Most architectural hardware is manufactured from a range of metals. Plastic is commonly used for electrical fittings (such as light switch and socket plates), cupboard door pulls and knobs. Door knobs and pulls may also be made from timber, glass or ceramic.

1.0.3 This bulletin describes the most commonly used substrate materials and finishes for hardware available in New Zealand. It covers the durability, corrosion resistance and appearance but not the mechanics of hardware. It replaces Bulletin 362 of the same name.

2 ARCHITECTURAL HARDWARE CATEGORIES

2.0.1 Both the interior and exterior of buildings require hardware fittings. The differing locations means that hardware must be able to withstand a wide range of conditions. This includes high internal moisture levels in wet areas such as kitchens, bathrooms and laundries and external climatic conditions such as salt-laden air and the effects of ultraviolet (UV) light.

2.0.2 When specifying hardware, it is essential to select the correct type of finish for the location. Considerations when selecting hardware include the:

- desired appearance
- appropriateness for use and location
- ability to retain the finished appearance
- ability to withstand exposure corrosion levels.

2.0.3 Table 1 describes the duty categories for hardware ranging from light duty (interior, low likelihood of damage) to coastal and special (subject to corrosive climatic conditions).

3 METALS USED FOR ARCHITECTURAL HARDWARE

3.0.1 The metals typically used for architectural hardware are:

- copper and copper alloys – brass and bronze
- zinc and zinc alloys
- aluminium and aluminium alloys
- steel
- stainless steel
- cast iron.

3.0.2 Some metals can be left natural, while other metals require a protective finish. Table 2 sets out the substrates and whether an applied finish is required.

3.1 PROPERTIES OF METALS

3.1.1 Metals have unique properties that influence

Architectural hardware in bathrooms and kitchens needs to be able to withstand high moisture levels.

Table 1. Duty categories for hardware.

Category	Description	Example
Light duty interior (LDI)	· Low likelihood of damage · Protected from weather · Not subjected to wetting	· Dwellings · Offices
Medium duty interior (MDI)	· Occasional use · Moderate likelihood of damage · Protected from weather · Suitable for wet areas	· Bathrooms and laundries · Restaurants · Shops · Offices
High duty interior (HDI)	· Frequent use · Protected from weather · Maintenance unlikely to be done · High likelihood of damage · Suitable for wet areas	· Public buildings · Schools · Hospitals
Light duty exterior (LDE)	· As for LDI but exterior use · Exposure to weather	· Exterior of dwellings
Medium duty exterior (MDE)	· As for MDI but exterior use · Exposure to weather	· All building exteriors
Heavy duty exterior (HDE)	· As for HDI but exterior use · Exposure to weather	· All building exteriors
Coastal and special (C/S)	· Exterior use within 1 km from the coast · Exterior use in areas with corrosive atmosphere	· Coastal areas · Geothermal areas · Industrial areas

the type of hardware that can be manufactured from different metals:

- Ductility is the ability to deform under tensile stress. For metals, this means the ability to be drawn or stretched into a wire or thread without breaking.
- Malleability is the ability for metals to be shaped by hammering, stamping or pressing without applying heat. Malleable metals can be beaten into thin sheets.
- Brittleness means metals are non-malleable and non-ductile, but they can be cast into different shapes by heating and pouring the molten metal into moulds.

3.2 METALS AND ALLOYS

3.2.1 Metals may be used in their pure form, but most metals are combined with small quantities of one or more other metals or non-metals to enhance the properties of the principal metal – the amount added is expressed as a percentage of total mass (wt.%). The result is called an alloy. Copper and zinc are two metals whose alloys are used extensively in architectural hardware.

4 COPPER AND COPPER ALLOYS

4.0.1 Copper comes in a range of finishes and can be polished to a high lustre for use with architectural fittings. On exposure to the atmosphere, raw copper will oxidise to create a unique surface patina.

4.0.2 The most well-known copper alloys are brass

Table 2. Hardware requiring an applied finish.

Substrate metal	Finish required	Typical use
Brass	No but it is used as a base for other finishes	· Door hardware · Tap components – particularly tap body
Bronze	No	· Not often used for architectural hardware, may be used for trims or rails
Zinc alloy	Yes	· Door hardware · Tap components
Aluminium	No but it is used as a base for other finishes	· Light switch and socket plates · Towel rails · Door and widow hardware
Steel	Yes – base for galvanizing or electroplating	· Exterior use hinges and catches · Door and window hardware
Stainless steel	No	· Door hardware · Hinges – exterior/interior · Grab/support rails – exterior/interior
Cast iron	No	· Exterior door and gate fittings

and bronze. The principal component of both is copper, and the different metals added produce a range of characteristics to the alloys.

4.1 BRASS

4.1.1 Brass consists of copper with up to 40 wt.% zinc added to it. The resulting alloy is strong and has excellent corrosion resistance, making it suitable for use in heavy-duty or wet environments in both interior and exterior situations.

4.1.2 Brass is commonly used for:
- door lever handles
- knobs and pulls
- hinges
- window catches and stays
- cupboard door catches
- plumbing fittings such as taps and tap components
- decorative items such as letter plates, numbers and door knockers.

4.1.3 Brass may be left natural and only polished, but it will eventually tarnish to form a green/brown patina. Although it remains stable, it no longer has the appearance of brass. For this reason, brass may have a finishing coat applied by electroplating or clear powder coating.

4.1.4 Heavy-duty brass hardware is typically forged – brass is heated to a proper forging temperature, then beaten or pressed into the desired shape – while decorative brass items are often cast.

4.1.5 Although it generally has good corrosion resistance, brass with more than 15 wt.% zinc should not be used in high salt-content marine environments unless alloying elements such as tin are added to the alloy.

4.2 BRONZE

4.2.1 Bronze is an alloy of copper with tin added. A typical composition consists of 88 wt.% copper and 12 wt.% tin. Small quantities of other elements such as silicon, aluminium, manganese, nickel or zinc may also be added to give particular properties.

4.2.2 Where other elements are added to bronze, the material is generally named for the additional element – for example, silicon bronze contains silicon.

4.2.3 Bronze is a pink-coloured metal but oxidises to form a green or brown patina when exposed to air.

4.2.4 Bronze has very high resistance to corrosion so in the past has been used for architectural components such as door and window hardware and railings. However, bronze is relatively brittle and can break easily so has seldom been used for hardware.

4.3 DIFFERENCES BETWEEN BRASS AND BRONZE

4.3.1 Today, copper is mixed with varying amounts of other elements and metals to produce specialised bronze or brass alloys. As there are so many different elements combined with copper to create a range of alloys, it is difficult to visually tell the difference between bronze and brass.

4.3.2 Traditionally, a copper alloy containing zinc was called brass, while a copper alloy containing up to 12 wt.% tin was called bronze.

4.3.3 Other names are historical – for example, architectural bronze is actually a brass alloy as it contains zinc. A typical composition for architectural bronze is approximately 57 wt.% copper, 40 wt.% zinc and 3 wt.% lead. Architectural bronze has been used for door and window frames and hardware, trims and furniture hardware.

4.3.4 Real bronze metal antique (RBMA) is solid bronze that is aged by stoving (heating) to provide a hardwearing finish for all conditions.

5 ZINC AND ZINC ALLOYS

5.0.1 Zinc is used to make a wide range of alloys with high corrosion resistance and acceptable strength.

5.0.2 Zinc alloys are readily formed by die-casting. They have a high dimensional accuracy during manufacture, which means they can be cast to closer tolerances than other metals and in a thin wall form. They are used for a wide range of hardware items including:
- door lever handles
- door knobs and pulls
- window catches
- cupboard door catches and pulls
- parts of plumbing fittings.

5.0.3 Zinc alloys may be left natural and polished or have an electroplated and powder coated applied finish.

6 ALUMINIUM AND ALUMINIUM ALLOYS

6.0.1 Pure aluminium is a lightweight, malleable, ductile and corrosion-resistant metal, but it is also relatively soft and wears easily. It is therefore often combined with small quantities of other elements such as copper, magnesium, manganese, silicon, tin or zinc to create a range of alloys. These retain many of the properties of aluminium but are stronger than the pure metal.

6.0.2 Aluminium and its alloys can be readily formed into complex shapes by casting, extrusion and forming. They are used for the manufacture of:
- door handles
- pulls and knobs
- window stays and catches
- balustrades and handrails
- light fitting components
- bathroom fittings such as towel rails.

6.0.3 A characteristic of both aluminium and aluminium alloys is passivity – a very thin oxide layer forms spontaneously over the surface of the metal to protect it from corrosion. Aluminium and aluminium alloys can therefore be left natural or be chemically brightened. Finishes can be applied by anodising, powder coating and electroplating. (See BRANZ Bulletin 634 *Finishing aluminium* for more information.)

7 IRON ALLOYS

7.0.1 Iron alloys are alloys in which iron is the principal constituent. Common iron alloys include steel, stainless steel and cast iron.

7.1 STEEL

7.1.1 Carbon steel consists of iron with a maximum of 2.1 wt.% carbon. Mild steel contains up to 0.25 wt.% carbon and small amounts of other elements, such as manganese and silicon. Other alloying elements such as chromium, molybdenum, nickel, titanium or vanadium may also be added with low contents to modify mechanical properties such as strength, malleability and ductility. Steel is widely used in construction because of its strength and relatively low cost, but it is subject to rapid corrosion (rust) in aggressive environments if its surface is not protected appropriately.

7.1.2 Steel has a limited architectural hardware use and is generally only used for architectural hardware where strength is required such as:
- exterior door and gate hinges
- door hinges
- door closers
- handrails and balustrades.

7.1.3 Protection can be provided by applying a range of different finishes including:
- zinc coating by electroplating or hot-dip galvanizing
- zinc phosphating and oiling
- powder coating
- painting.

7.2 STAINLESS STEEL

7.2.1 Stainless steel consists of iron containing a maximum of 1.2 wt.% carbon and a minimum of 10.5 wt.% chromium. Small quantities of other elements such as nickel, molybdenum, titanium, silicon or aluminium may also be added to stainless steel to give the metal specific properties. Stainless steel has excellent corrosion resistance as it forms a thin, protective oxide layer over the surface.

7.2.2 Stainless steel is available in a range of different grades based on composition. The most commonly used in building and construction are:
- grade 304, which has 18 wt.% chromium and 8 wt.% nickel added
- grade 316, which is like grade 304 but has 2–2.5 wt.% molybdenum added.

7.2.3 Grade 304 has good resistance to corrosion if kept clean (such as being rain washed in an external environment). Grade 316 has better corrosion resistance and pits less than grade 304 in coastal areas and marine environments due mainly to the addition of molybdenum.

7.2.4 Stainless steel is generally left natural and finished by mechanically polishing to bright, satin or matt finishes. For highest corrosion resistance, it can also be electropolished – an electrochemical process that removes material from the metal surface.

7.2.5 Stainless steel is used for a wide range of architectural hardware including:
- lever door handles, pulls and knobs
- lock and latch sets
- window stays and catches
- kick and push plates
- grab rails
- hinges.

7.3 CAST IRON

7.3.1 Cast iron consists of iron with more than 2 wt.% carbon to produce a hard, highly corrosion-resistant metal. As its name suggests, it can be readily cast into shapes and can also be machined by cutting and grinding.

7.3.2 Cast iron is brittle and cannot be forged or rolled. A more malleable alloy may be created by altering the composition or by annealing (heat treating). Annealing is done after casting. The carbon content, which causes the brittleness of the cast iron, is chemically modified to produce a stronger metal. Malleable cast iron is used for a range of decorative hardware such as:
- strap hinges
- latches
- door knockers
- casement stays and catches
- historic markers and plaques
- decorative fittings such as filigree brackets.

8 OTHER MATERIALS

8.1 PLASTIC

8.1.1 Plastic use for hardware is limited and generally only for cupboard door fittings such as knobs and pull handles.

8.1.2 Nylon is reasonably abrasion-resistant, easily moulded and machined and available in a wide range of colours and is used for almost all plastic hardware. Plastic hardware may be metal coated by a vapour deposition process. ABS (acrylonitrile butadiene styrene) plastic, which is an opaque thermoplastic (can become liquid), can be electroplated.

8.1.3 Plastic hardware is not suitable for exterior use as it becomes brittle when exposed to UV light.

8.2 CERAMIC

8.2.1 Ceramic hardware is normally made from clay that has been kiln-fired and glazed with either a colour or a pattern. It is generally only used to make knobs, which are combined with metal rims and spindles. Although ceramics wear extremely well, they will break under impact because of brittleness.

8.3 TIMBER

8.3.1 Timber is sometimes used for hardware components such as door knobs and pull handles. A range of timbers may be used, and they are generally finished with clear polyurethane lacquer or a high-grade paint system.

It is essential to select the correct type of finish for the conditions of the intended location.

9 FINISHES FOR METAL HARDWARE

9.0.1 Metals and alloys that do not require an applied finish include:

- brass
- aluminium
- stainless steel
- cast iron
- bronze (seldom used for architectural hardware).

9.0.2 Where an applied finish is required or desired, a number of different options are available including:

- anodising
- powder coating
- electroplating
- hot-dip galvanizing
- painting.

9.1 ANODISING

9.1.1 Anodising is an electrochemical process commonly applied to aluminium and aluminium alloys to increase the thickness of the natural oxide layer. The process hardens the metal surface and improves corrosion and wear resistance.

9.1.2 Anodising produces a clear or coloured finish. Colours are achieved by the addition of pigments or metal oxides to the electrolytic solution. Metal oxides produce bronze and black colours only, while pigments can produce a wide range of colours. As the colours are an integral part of the oxide layer, they are only weakly affected by UV light.

9.2 POWDER COATING

9.2.1 Powder coating is most often used to provide a decorative or coloured finish to aluminium and steel, but most metals as well as timber and plastic can be powder coated.

9.2.2 It is applied by spraying an object with an electrically charged powder. The object is then heated, causing the powder to melt and form an even film over the surface. The powder coating is left to cure, resulting in a durable and stable coating to the object.

9.2.3 Powder coatings must only be applied to a steel substrate if the surface of the steel has been correctly prepared and is completely rust-free. If not, the coating will be undercut by rust and separate from the substrate. Powder coatings on steel are generally not suitable for damp internal or external conditions.

9.2.4 The powder coating process does not release any solvents into the atmosphere – the process is considered almost totally pollution free.

9.2.5 Thermosetting powders are generally used for coating architectural hardware:

- Polyesters have good resistance to UV and chemical attack so are suitable for external use. They have a typical gloss level of 80%.
- High-performance polyesters retain colour and gloss better than standard polyesters but are not available in bright colours (particularly reds, yellows, oranges and pinks).
- Epoxies have high levels of abrasion and chemical resistance but poor resistance to UV light (they tend to chalk). They are generally more suited for indoor use unless appearance is unimportant and/or excellent chemical resistance is required.
- Fluoropolymers have the highest durability for external use but lower gloss levels. They are generally available as purpose-made powders.

9.2.6 There are other thermosetting powders available based on polyurethanes, acrylics and blends of these, but they are generally not used for hardware components.

9.3 ELECTROPLATING

9.3.1 Electroplating is the application of a metallic coating to a metallic or other conducting material in an electrochemical process. The item to be electroplated is immersed in a solution containing the plating metal ions, and an electric current is passed through the solution. This causes the plating metal ions in the solution to be reduced and deposited on the surface of the item.

9.3.2 Most metals will accept electroplating, although some substrates require a chemical pre-treatment of their surfaces before they can be electroplated. For example, zinc alloy objects must have an undercoat of copper/nickel plating.

9.3.3 Table 3 sets out the most commonly used platings for architectural hardware.

Table 3. Commonly applied platings to substrates.

Plating	Suitable substrate	Characteristics
Satin chromium plating (SCP)	Brass Zinc alloy[1] Steel Aluminium Plastic Copper alloy	· This is the most widely used plating process for decorative finishes and also for moderate to heavy wear resistance. · Plating thicknesses range from 0.05 microns (µm) to 0.5 µm. Commonly, a thickness of 0.13 µm or 0.25 µm is specified. · Plating is usually applied over bright nickel plating. · Its subtle appearance provides a modern look and a contemporary metal finish for locks, door handles, light fittings and power sockets.
Bright chrome plating (BCP)	Brass Zinc alloy Steel	· It may include several sub-plating layers such as copper and nickel before a thin layer of chromium. · Not only for decorative purposes, it can provide increased corrosion resistance and surface hardness.
Black chrome	Brass Steel Stainless steel Zinc alloy	· Usually achieved by electroplating over bright or dull nickel to provide a hard surface with corrosion and wear-resistant characteristics. · Available in a variety of finishes. · Usually waxed, oiled or polished finish.
Florentine bronze	Aluminium Brass Stainless steel Zinc alloy	· A dark brown colour with golden or orange highlights and visible brush marks. · Florentine finishes are created by using different oxidation methods, generally with brass or copper to give varied effects and patinations. · Brass items are normally polished and brushed using a satin wheel. The items with a brushed look are then dipped or coated in a liquid to give a dark brown colour. A high-quality clear lacquer is further applied to protect and maintain the finish. · Most commonly used on door hardware, light fittings and bathroom and kitchen hardware. · Usually lacquer finish.
Antique bronze	Brass Zinc alloy	· Softer than florentine bronze and usually lacquer finish.
Satin nickel	Brass Zinc alloy	· Available in a number of finishes suitable for most decorative uses. · It is also available in different levels of brightness, dullness and pearlescence as well as aged finishes. · It is considered a durable finish with reasonably good corrosion resistance.
Brushed nickel	Aluminium Stainless steel Zinc alloy	
Bright nickel	Zinc alloy	
Black nickel	Aluminium Brass Bronze Stainless steel Zinc alloy	· An electrolytic nickel plating with a secondary treatment to turn the surface black. · Usually waxed or polished finish.
Gold plating	Brass Zinc alloy	· Typically applied to nickel plate to produce a bright gold finish. · Finishes available can include matt gold, satin gold, brushed gold, rose gold, matt rose gold and satin rose gold. · Gold plating can offer good reflectance and brightness. Gold is often specified for tapware and in marine hardware applications as it does not tarnish like brass. · Gold is inert (does not corrode) but is expensive, so gold plating is typically in a very thin layer that can wear away.
Zinc plating (sometimes called electrogalvanizing)	Steel[2]	· Applied to protect steel only. It is not for decoration.· · The most common use is interior door hinges.

Notes:
[1] All zinc alloy substrates must have an undercoat plating of copper/nickel.
[2] Steel can be plated with all of the metals listed above, but very little hardware is manufactured in steel.

Regular cleaning is necessary to keep architectural hardware in good working condition and maintain its appearance.

9.3.4 Zinc plating, a specific electroplating process, is commonly used on thin or small parts such as hardware items rather than sheet metal to provide a low level of corrosion protection.

9.3.5 Zinc plating normally provides a coating with a thickness typically ranging from 3–12 µm, which may vary if the surface is not uniform.

9.4 HOT-DIP GALVANIZING

9.4.1 Hot-dip galvanizing is a hot chemical process commonly used to coat iron or steel with zinc. Components are dipped into a bath of molten zinc to form a dull grey, fairly strong and adherent coating that provides protection to the steel or iron underneath from corrosion in many environments.

9.4.2 Hot-dip galvanizing can produce thick coatings, and the normal commercial coating is around 50 µm thick.

9.4.3 The thicker the zinc coating, the more durable the protection. However, the thickness of the zinc coating is based on the thickness of the steel being coated, and repeated dipping will not increase the zinc thickness.

9.5 PAINTING

9.5.1 Painted finishes for hardware typically consist of a spray-applied paint finish (suitable for application over metal or timber) followed by a lacquer or a spray-applied epoxy finish.

10 CLEANING AND MAINTENANCE

10.0.1 Architectural hardware should be cleaned regularly, particularly if exposed to the weather, to keep it in good working condition and maintain the appearance. Specific manufacturers' maintenance requirements should be included with the mandatory maintenance information that must be supplied at the end of a building contract.

10.0.2 General rules for cleaning hardware:

- Use a non-abrasive, mild household detergent. Alternatively, some surfaces may be cleaned and protected using a proprietary or wax-based polish.
- Remove lime scale deposits from chrome and nickel-plated taps and spouts using a proprietary scale-removal solution or a mild abrasive cleaner.
- For metal finishes such as electroplated coatings, clean with a metal polish as required. Avoid using an abrasive polish as this may reduce the coating thickness.
- Use a soft, damp cloth with a mild soap to wipe lacquer or clear-coated finishes.

10.0.3 Because the coatings are thin and the metal polish will wear them away, do not use a metal polish on:

- metal-coated plastic
- gold plate
- lacquer or clear-coated finishes.

10.0.4 Avoid using paint thinners and strong cleaning agents on hardware finishes as they are likely to cause damage.

10.1 CLEANING AND MAINTAINING BRASS

10.1.1 Clean bright polished brass regularly with a metal polish.

10.1.2 An application of clear lacquer will help maintain the polished finish, but this must be protected by regularly applying wax polish.

10.1.3 Brass that is allowed to tarnish naturally will form a green patina that will then remain very stable.

10.1.4 Polished brass may be supplied with a clear polyester powder coat to give a harder-wearing finish than a lacquer finish.

10.1.5 Some manufacturers offer durable polished finishes with 10-year or even lifetime guarantees, but these are likely to be more expensive than other coatings. Also, it is not possible to be sure what such a finish consists of as the process used is not always disclosed.

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ISSN 1178-4725 (Print) 2537-7310 (Online)