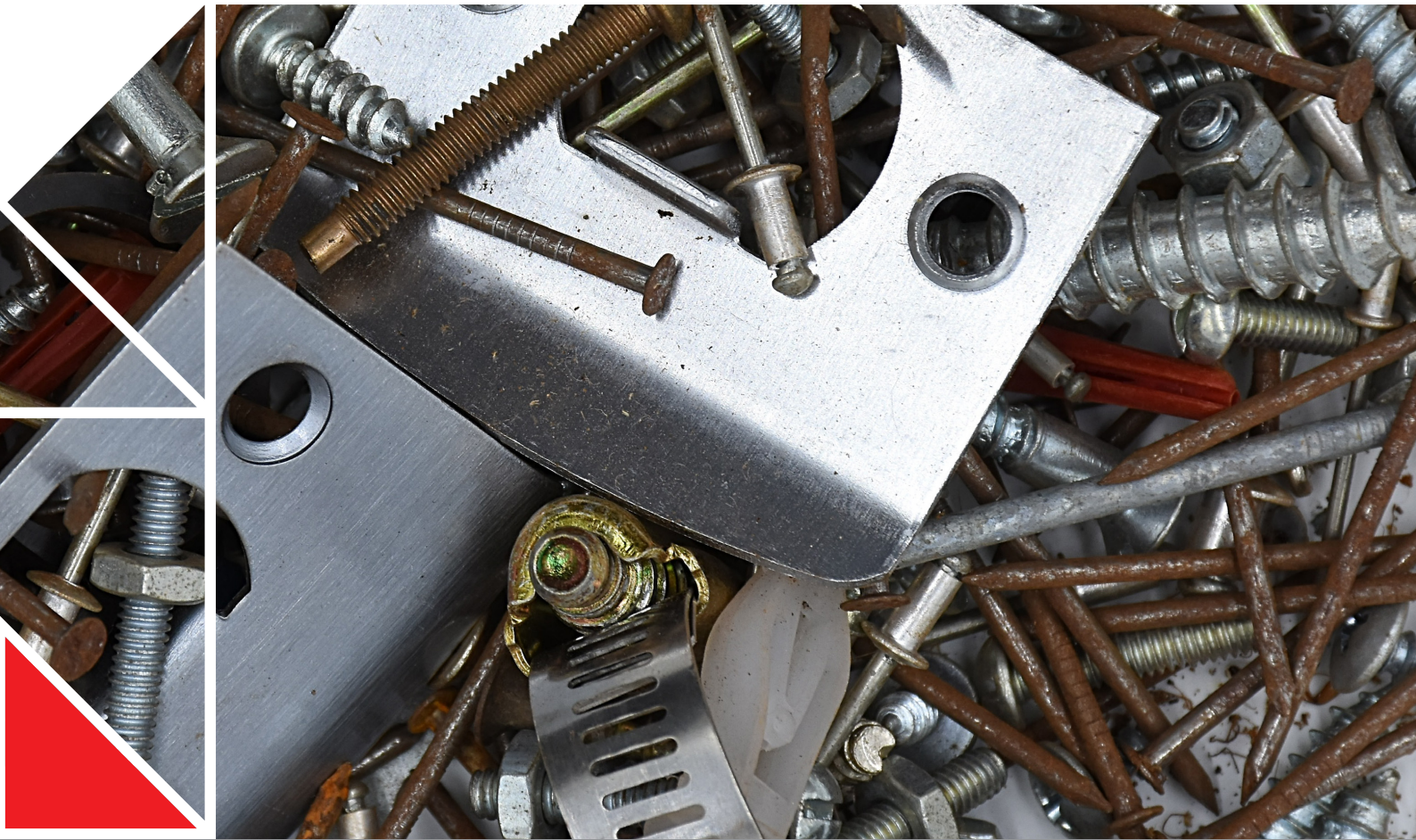


ISSUE 640 **BULLETIN**



METAL COMPONENT TERMINOLOGY

August 2019

- This bulletin provides descriptions of the metal-based materials that are commonly used in the New Zealand built environment and a glossary that explains the terminology associated with these materials.
- Correct specification of metal components is an essential step in meeting the specified durability requirements of New Zealand Building Code clause B2 *Durability*.
- This bulletin updates and replaces Bulletin 490 of the same name.

1 INTRODUCTION

1.0.1 The most common building materials made from metals are produced from carbon steel, stainless steel, zinc, galvanized steel, aluminium and its alloys, lead and copper and its alloys.

1.0.2 For each type of metal, the specification that describes the numerous subclasses of each metal type can have a significant influence over durability expectations. These specifications are discussed in this bulletin for the most common metals and subclasses. This includes those specifically noted within Acceptable Solutions to the Building Code such as E2/AS1, AS/NZS 2312:2014 *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings* and NZS 3604:2011 *Timber-framed buildings*.

1.0.3 The corrosivity category is a technical characteristic that provides a basis for the selection of materials and protective measures in atmospheric environments subject to the demands of the specific application, particularly with regard to service life. The corrosivity categories are defined by the first-year corrosion rates of standard metal specimens. See Table 1 for a comparison of corrosion zones and categories used in relevant national and international standards.

1.0.4 This bulletin updates and replaces Bulletin 490 of the same name.

2 GENERAL PROPERTIES OF COMMON METALS

2.1 CARBON STEELS

2.1.1 Carbon steels are the most common type of steel – mild steel is one type of carbon steel. They normally contain approximately 0.05–0.25 wt.% carbon. As they

are not alloyed, they do not contain large amounts of other elements besides iron, such as chromium, copper, molybdenum or silicon.

2.1.2 Mild steels have a relatively low cost and good strength, stiffness and toughness.

2.1.3 Mild steels will corrode on contact with oxygen and moisture.

2.1.4 Mild steels may be designed for durability by the use of a sacrificial thickness of steel based on a corrosion rate applied over the design life of the element or by the use of appropriate protective coatings or paintings.

2.1.5 Protective coatings are usually required for external use of carbon steels.

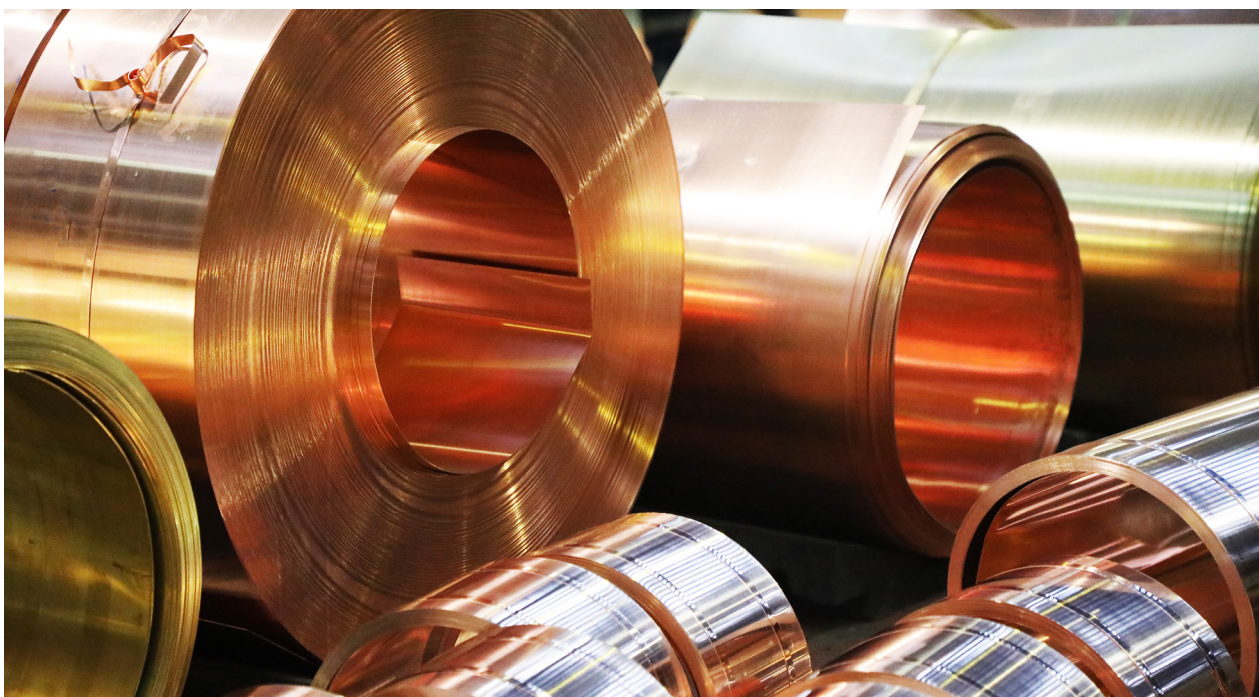
2.2 STAINLESS STEELS

2.2.1 Stainless steel is the generic name for a number of different steels that have a minimum percentage of 10.5 wt.% chromium. [When describing stainless steel, the term grade as used here or AISI or type may be used in front of the number.]

2.2.2 Stainless steels resist corrosion with a different mechanism to mild steels. When exposed to oxygen, they spontaneously form a very thin chromium-rich oxide layer that is impermeable and acts as a barrier to ongoing corrosion of steel beneath the oxide layer under favourable in-service conditions.

2.2.3 Physical performance will vary with the exact composition of the material.

2.2.4 The 304, 316 and 2205 grades of stainless steel [from AS/NZS 4673:2001 *Cold-formed stainless steel structures*] will outperform mild steel, zinc, galvanized





steel and some aluminium alloys when used fully exposed to oxygen. However, only grade 2205, a duplex stainless steel, should be used in locations where oxygen is scarce such as where crevices are formed. Stainless steels can undergo rapid and very localised corrosion known as pitting. This is also the case in a high chloride ion environment – for example, near the sea.

2.2.5 Stainless steel is commonly used in building and construction as roofing, cladding, windows, façades and fixing components.

2.2.6 For the corrosion performance of the various grades of stainless steel, see Appendix C to AS/NZS 4673:2001.

2.3 ZINC

2.3.1 Zinc is a bluish grey metal. While zinc sheeting is used as a wall and roof cladding, it is most commonly used for coatings on other metals, such as galvanized steel and thermally sprayed zinc and as a pigment in zinc-rich primers. Zinc-based coatings are often alloyed with aluminium, magnesium, silicon or tin.

2.3.2 In exposure zone C of NZS 3604:2011, aluminium-zinc [type AZ of AS 1397-2011 *Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium*] alloyed coatings generally perform better than pure zinc-galvanized coatings.

2.3.3 Barrier paint coatings, when correctly applied, may improve the durability of galvanized and other zinc-based metal components. Such a system [known as a duplex coating by AS/NZS 2312:2014] can offer a design life greater than that of the two systems acting alone provided that the appropriate coating is provided. Guidance is given in AS/NZS 2312.2:2014 section 5.3.6.

2.4 ALUMINIUM AND ITS ALLOYS

2.4.1 Aluminium is variously alloyed with copper, magnesium, silicon, manganese and chromium to improve physical performance and corrosion resistance.

2.4.2 Aluminium can be wrought [includes extrusions] or cast.

2.4.3 Aluminium and its alloys are used in the building and construction industry for a wide spectrum of applications, including roof and wall cladding, windows, doors, architectural hardware and guttering.

2.4.4 As with stainless steel, the corrosion resistance of aluminium is due to the formation of a very stable and impermeable oxide layer on its surface. This corrosion-resistant oxide layer can be further enhanced with surface treatments such as anodising.

2.4.5 Not all aluminium alloys are ideal for atmospheric exposure in aggressive locations.

2.5 COPPER AND ITS ALLOYS

2.5.1 Copper and its alloys are some of the most versatile engineering materials with a combination of strength, electrical conductivity, corrosion resistance, machinability and ductility.

2.5.2 The building and construction industry is the largest single consumer of copper and its alloys. Typical applications include roofing, rainwater systems, water pipes and fittings.

2.5.3 Physical properties and corrosion resistance are improved by alloying with zinc, tin, aluminium, lead and silicon. The best-known copper alloys are brass and bronze.

2.5.4 The general corrosion resistance of copper-based materials is better when compared to steel and zinc in most common atmospheric environments as copper is more stable. The corrosion resistance comes mainly from the formation of adherent and relatively impervious films on their surfaces.

2.5.5 Most copper alloys develop a blue-green patina of corrosion products when exposed to the atmosphere. Some copper alloys may darken after prolonged exposure and show a brown to black colour.

3 GLOSSARY

302 stainless steel	Grade 302 austenitic stainless steel is not regarded as being as durable as grade 304 or grade 316. Grade 302 contains 17–19 wt.% chromium, 8–10 wt.% nickel, 2 wt.% manganese and 1 wt.% silicon.
304 stainless steel	Grade 304 stainless steel contains 18–20 wt.% chromium, 8–10.5 wt.% nickel and 2 wt.% manganese. It is the most common austenitic stainless steel. This material has proven to perform well as a fastener material when embedded in wet timbers containing copper-based preservatives [such as copper chrome arsenate, alkaline copper quaternary and copper azole] in the majority of atmospheric exposures. In these situations, the degree of resistance to externally influenced corrosion [sea salt] is often a secondary issue to the durability of the embedded material. In marine areas, there is a likelihood that superficial corrosion or ‘tea staining’ will occur when the surface is not washed regularly.
304L stainless steel	Grade 304L stainless steel is a low-carbon version of grade 304 and has a maximum carbon content of 0.03 wt.%. The ‘L’ signifies low carbon content. This low-carbon stainless steel should be used if welding is required and eliminates the need for annealing.
316 stainless steel	Grade 316 austenitic stainless steel contains 2–3 wt.% molybdenum in addition to 16–18 wt.% chromium, 10–14 wt.% nickel and 2 wt.% manganese. Grade 316 is suitable for use in all areas where grade 304 is used, with additional alloying elements, particularly molybdenum, contributing to a higher resistance to localised attack by sea salt. Accordingly, 316 stainless steel retains its appearance for longer near the sea when not maintained.
316L stainless steel	As for 304L stainless steel, grade 316L stainless steel has less carbon [<0.03 wt.%] in it than grade 316.
444 stainless steel	A typical example of a ferritic stainless steel, grade 444 has low levels of nickel and does not currently appear in any Acceptable Solutions to the New Zealand Building Code. Grade 444 contains 17.5–19.5 wt.% chromium, 1.75–2.5 wt.% molybdenum, up to 1 wt.% manganese and 1 wt.% silicon with traces of titanium and niobium [to improve mechanical properties]. Suitable for use in NZS 3604:2011 exposure zone C only.
2205 stainless steel	Also known as duplex stainless steel, this grade has the highest corrosion resistance of the commonly available grades and also has very good strength. It is suitable for use in AS/NZS 2312:2014 zone C5-M [marine] and for many C5-I [industrial] applications [see Table 1], although expert advice should be sought for the latter. Grade 2205 contains 21–23 wt.% chromium, 4.5–6.5 wt.% nickel, 2.5–3.5 wt.% molybdenum, <2 wt.% manganese and <1 wt.% silicon.
AISI	American Iron and Steel Institute.
alkaline or ammoniacal copper quaternary	A water-based timber preservative comprising mixtures of copper salts and didecyldimethyl ammonium chloride [DDAC]. It contains higher levels of copper relative to equivalent copper chrome arsenate [CCA] treatment.
alloy	Material containing significant contributions of one or more metallic elements other than the base material – for example, stainless steels and brasses.
aluminium	A silvery-white soft ductile metal that has a high corrosion resistance in many natural environments due to the formation of a passive film on its surface.
anodising	An electrochemical treatment applied in order to reinforce and thicken the naturally formed protective films on aluminium and other metals, such as titanium and magnesium. Surface colour can be introduced during anodising with the addition of pigments during the processing sequence.
atmospheric corrosivity category	The system for determining the severity applying to a specific surface in AS/NZS 2312:2014. HERA Report R4-133 New Zealand Steelwork Corrosion Coatings Guide gives a design method to calculate the atmospheric corrosivity category and/or the ISO 9223 corrosion category for almost any steel surface at any location in New Zealand. Also covered in NZS 3604:2011 and SNZ TS 3404:2018 <i>Durability requirements for steel structures and components</i> .
austenitic stainless steel	A class of stainless steels primarily containing a specific type of iron-based crystalline structure known by metallurgists as austenite. Typical examples are grades 304 and 316 stainless steels.
AZ alloy	Metallic coating materials typically composed of around 50–60 wt.% of aluminium with the remainder zinc. May contain some minor additives such as 1–2 wt.% of silicon. AZ coatings are usually applied by a continuous in-line hot-dip procedure onto a prerolled coil of mild steel [see <i>in-line processes</i>], and their design life is given in AS/NZS 2312:2014. They usually achieve the same design life in marine-influenced environments as galvanized coatings but with less coating thickness. However, they are not suitable for surfaces onto which wet concrete will be cast, and they should not be in direct contact with cured concrete or other alkaline materials.
AZ150 and AZ200	Classification of the coating weights of in-line coated AZ-galvanized metallic coatings on sheet/strip to AS 1397-2011. See also <i>coating weight</i> and <i>AZ alloy</i> .
brasses	Alloys of copper and zinc that are used extensively in plumbing and general hardware. Alloys with less than 85 wt.% copper can be susceptible to de-zincification [also known as de-alloying, de-metalification or selective leaching].
bright steels	Also known as carbon steels and mild steels, they are low-alloyed materials based on iron. Although the terms bright steel, carbon steel and mild steel tend to be used interchangeably, they are technically slightly different.

bronzes	Bronzes are usually available as copper alloyed with tin [approximately 12 wt.%]. Other elements [such as nickel, aluminium, phosphorus and silicon] can also be used in order to improve corrosion resistance and physical properties.
casting	A process involving the manufacture of metal or plastic objects using a mould into which a molten material is poured.
centrifuging	A process of spinning applied after hot-dip galvanizing to remove excess coating material. Centrifuging will produce a smoother surface finish on smaller items such as nails. However, this process can reduce the final coating thickness/weight to below acceptable levels if not done carefully.
chromating	See <i>conversion coatings</i> .
chrome plating	Electrochemical coating of materials with chromium in order to improve appearance and/or to enhance corrosion resistance. The process is commonly applied to plumbing hardware such as brass taps and pipes.
chromium	Chromium is an extremely hard and brittle metal. When exposed to the air, it is passivated by oxidation, forming a very thin and protective surface layer. The creation of stainless steels and chrome plating account for 85% of the available chromium's commercial usage. The relative high hardness and corrosion resistance of unalloyed chromium makes it a reliable metal for surface coating. It is still the most popular metal for sheet coating with its above-average durability compared to other coating metals.
coating	A layer or multiple layers of material deposited onto or converted from a substrate. Coatings can be metallic [for example, galvanized], inorganic [passivated] or organic [painted]. Coatings are used to achieve decorative finishes or to improve corrosion resistance and durability. See HERA Report R4-133 for a description of most of the coating systems applicable to carbon steel.
coating thickness	The dimension of a metallic or paint layer on a substrate, usually given in microns (μm) or millimetres (mm). For paint coatings, typically the dry film thickness (DFT) is specified.
coating weight	Quantity of metallic coating present on a substrate in terms of grams per unit area of metal substrate [$\text{g}\cdot\text{m}^{-2}$ or g/m^2]. For coatings on sheet materials to AS/NZS 1397-2011, the coating weight is expressed as the sum of the total mass of the coating on both sides of the sheet. For some structural hollow sections, the coating weight may apply only to the external surface. See details in AS/NZS 2312.2:2014 for each of the differently designated coatings systems.
coil coating	Continuous in-line application of organic layers to metallic sheet/strip materials [coiled aluminium or steel strip] on one or both sides of the material. Organic layers are based on either liquid paints or powder coatings. Factory-painted products have a quality of finish that is usually difficult to reproduce on site. There are a number of atmospheric corrosion severity classifications in AS/NZS 2728:2013 <i>Prefinished/prepainted sheet metal products for interior/exterior building applications – Performance requirements</i> , which describes the expected performance of coil-coated products. In Table 3 of this standard, product types are explained with regard to acceptance for use within the atmospheric corrosivity zones of AS/NZS 2312:2014, NZS 3604:2011 and ISO 9223. See also <i>in-line processes</i> for the application of metallic coatings.
conversion coating	A coating that is normally used on metals, such as aluminum and zinc, in which the metallic substrate surface is turned into a coating through a chemical or electrochemical process. Typical examples include chromate and phosphate coatings. The process can give an iridescent or coloured hue to the coating product. Conversion coatings normally provide an improved corrosion protection and enhance surface hardness. However, they should not be relied upon to greatly improve long-term durability in aggressive environments.
corrosion	A chemical or electrochemical process usually facilitated by agents such as water and oxygen in the environment. Corrosion can lead to dissolution, degradation or failure of metallic materials.
copper	A reddish brown soft malleable ductile metal with very high thermal and electrical conductivity.
copper azole [CuAz]	A water-based timber preservative comprising mixtures of copper salts and triazole fungicide. It contains higher levels of copper relative to the equivalent copper chrome arsenate [CCA] treatments.
copper chrome arsenate [CCA]	A water-based timber preservative containing copper, chromium and arsenic salts or oxides. It is the most widely used timber preservative in the world.
de-alloying	The selective removal of one element from an alloy by corrosion processes. A typical example is the preferential leaching and removal of zinc from unstabilised brass.
de-metalification	As for <i>de-alloying</i> .
de-zincification	Typically, the loss of elemental zinc from copper/zinc [brass] alloys. De-zincification may also apply to aluminium bronzes. In these instances, zinc can be preferentially leached from the matrix of the alloy. See also <i>de-alloying</i> .
duplex coatings	Products that support both a metallic layer [zinc-galvanized or AZ-coated] and a paint layer [see Figure 1]. The design life of duplex coatings is given in Tables 7.1 and 7.2 of AS/NZS 2312.2:2014 or can be determined from section 7.2.2 of HERA Report R4-133 for combinations not specified in AS/NZS 2312:2014.
durability	A measure of an object's ability to endure or maintain function within a specific environment.

electrochemical	A chemical process facilitated by the transfer/exchange of positive and negative charge. Electrochemical processes may either occur spontaneously [for example, corrosion] or require the use of an external energy source [for example, electroplating].
electroplating	An electrochemical process for the application of a thin layer of metallic coating to a substrate. When this layer is zinc, it is known as electrogalvanizing. The design life of electrogalvanized systems is given in Table 6.2 of AS/NZS 2312.2:2014 Electroplated zinc coatings are rarely used outdoors.
exposure zones	Areas of atmospheric corrosivity mapped for New Zealand in NZS 3604:2011 Figure 4.2. Corrosivity increases from exposure zone B to exposure zone C to exposure zone D. See also <i>atmospheric corrosivity category, geothermal hot-spot and sea spray zone</i> .
extrusion	A process used for manufacturing of objects of complex cross-sectional profiles with the use of a press and a die. Extrusion process can be done hot or cold, continuous or semi-continuous. Commonly extruded materials include metals [particularly aluminium], polymers and ceramics. See also <i>wrought</i> .
factory painting	A painting process normally carried out in a well controlled environment. As for <i>coil coating</i> .
ferritic stainless steel	A class of stainless steels containing a specific type of iron-based crystal structure known in metallurgy as ferrite. See also <i>grade 444 stainless steel</i> .
G1, G2, G3, G250 etc.	Grades of mild steel sheet or strip as described in AS 1397-2011. Grading is based on either formability [G1, G2 and G3] or yield strength [G250, G350, G450, G500 and G550].
galvanizing	A process of applying metallic coatings to steel substrates using baths of molten zinc. This approach, which includes both piece-dipping and continuous/in-line molten zinc dipping, can produce the most durable zinc-based coatings. Some preformed items such as gun nails will need to be centrifuged after hot-dip galvanizing in order to obtain a smoother finish. Hot-dip zinc coatings will also contain some iron, especially at the zinc/substrate interface for the formation of strong metallurgical bonding. See the design life of galvanized coatings in AS/NZS 2312.2:2014 and further details in HERA Report R4-133.
geothermal hot-spot	An area within a close radius that surrounds a point source of geothermal surface activity that may release corrosive gases into the environment [defined in NZS 3604:2011 and HERA Report R4-133].
hot-dip galvanizing (HDG)	As for <i>galvanizing</i> .
in-line processes	The continuous factory application of metallic or organic coatings [usually from a coil]. See also <i>coil coating</i> .
macroclimate	The general corrosivity conditions applicable at a site. Maps of the macroclimate conditions for New Zealand expressed in terms of the first-year corrosion rate of carbon steel are given in NZS 3604:2011 and SNZ TS 3404:2018, which are based on BRANZ research.
microclimate	Local environmental effects, often specific to a surface, which will alter the macroclimate. Microclimatic effects could increase the surface specific corrosivity conditions and must be always considered. A detailed description is given in section 4 of NZS 3604:2011, and guidance is given in section 4 of HERA Report R4-133 for external steelwork and in section 5 for internal steelwork.
mechanical plating	A non-hot-dip procedure, which is applied to more delicate, threaded items such as screws. Zinc is mechanically adhered to the surface of mild steel substrates by physical forces. The durability of the coating should be assumed to be less than that of hot-dip galvanized layers of equivalent thickness.
metal spraying	The procedure of applying a metallic coating [zinc or aluminium] by either a wire or powder through a combustion or electrical arc discharge process. Can be used post-construction or as a remedial measure. Metal-sprayed systems offer the most durable solution of all coatings systems, as seen from the design life tables in SNZ TS 3404:2018. However, their durability is heavily dependent on the amount and uniformity of metal deposited, and this must be carefully specified and applied.

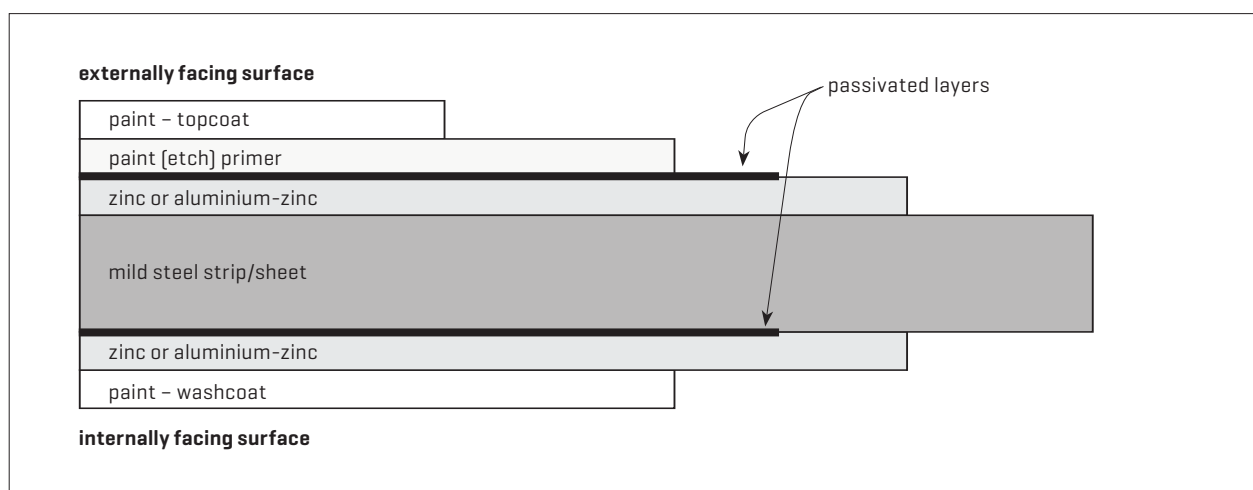


Figure 1. Typical components of a duplex coating on mild steel sheet/strip [not drawn to scale].

metallic coatings	Metal-based layers applied to a substrate through processes such as hot-dip galvanizing, mechanical plating and [thermal] metal spraying.
mild steel	See <i>bright steel</i> .
mill finished aluminium	Aluminium products that receive no further surface treatment after the extrusion processing, therefore showing the natural colour of aluminum [silver grey].
organic coatings	Polymeric materials produced from the application of paints or powder coatings. They are applied to a substrate for corrosion resistance, decorative purposes or specific technical properties.
passivation	A process that makes a material more resistant to environmental attack. It normally involves the creation of an outer layer either by chemical reactions with the base material [conversion coating or anodisation on aluminium] or by spontaneous oxidation in the air [stainless steel]. See also <i>conversion coatings</i> .
phosphating	A process that uses solutions containing phosphoric acid and phosphate salts to form an insoluble, crystalline phosphate layer on the material surface for corrosion resistance, lubricity, subsequent coating or painting. Phosphate conversion coatings can be used on steel, aluminium or zinc. See <i>conversion coatings</i> .
polyvinylidene fluoride	A stable organic polymeric material that is relatively resistant to ultraviolet [UV] light. Also known as PVF2 and PVDF.
powder coating	A process where dry powders [thermoplastic or thermoset polymer] are applied electrostatically and cured under heat to form a hard and tough coating on aluminium, metals or other materials.
PVDF and PVF2	See <i>polyvinylidene fluoride</i> .
rust	The iron-rich product of corrosion on steel, sometimes used to describe all corrosion products. Depending on the chemical composition of the metal corroding, the rust layer will have different levels of solubility, hardness, colour and protection.
sea spray zone	A relatively aggressive corrosion zone, which is a default 500 m from the shoreline of New Zealand or 100 m from tidal estuaries and sheltered inlets. Described in NZS 3604:2011 as exposure zone D. An alternative definition is given in HERA Report R4-133.
sherardizing	The formation of a corrosion-resistant, zinc-iron alloy coating, on the surface of steel or iron by heating the object in an airtight container of zinc powder. A thermal diffusion process occurs and the zinc diffuses into the object's surface, forming the zinc-iron alloy coating layer.
silicon bronze	A copper alloy containing approximately 3 wt.% silicon. Silicon bronzes have a good resistance to corrosion, especially when used as fastenings in contact with high copper-containing timber preservatives.
stainless steel	The generic name for a number of different classes of stainless steels that have a minimum of 10.5 wt.% chromium and a maximum of 1.2 wt.% carbon.
tea staining	Brown surface rust that may reduce the aesthetic appeal of some stainless steels within marine-influenced environments, such as exposure zones C and D in NZS 3604:2011.
thermal spraying	As for <i>metal spraying</i> .
weathering steel	A high-strength low-alloy steel that, in suitable environments, may be left uncoated/unpainted because it forms an adherent protective rust patina that greatly reduces the corrosion rate. The alloys compose 2 wt.% of specific alloying elements such as copper, chromium, nickel, silicon and in some cases phosphorous. It is not an ideal choice for thin steel products in marine environments. To determine suitable zones, refer to HERA Report R4-97 <i>New Zealand Weathering Steel Guide for Bridges</i> , which, in conjunction with HERA Report R4-133, gives the process for determining the corrosivity applicable to a specific steel surface and the design loss of material from that surface.
weld decay	Accelerated corrosion surrounding areas of certain types of stainless steels that have been welded if the required welding procedures and post-weld treatments have not been properly applied. It is one of the forms of intergranular corrosion, caused by the depletion of chromium in the grain boundary areas affected by the welding process. See <i>304L stainless steel and 316L stainless steel</i> .
wrought	A process commonly used to shape metallic materials using hammers or other tools at high or low temperatures. See also <i>extrusion</i> .
wt.%	Percentage of total weight.
Z100, Z275 etc.	Classification of the coating weight of in-line zinc-galvanized coatings on sheet/strip to AS 1397-2011. For example, with Z100, the total mass of coating on the metal is 100 g/m ² for both sides or 50 g/m ² on each side.
zinc-metal products	Claddings, flashings and rainwater products produced from sheet zinc-metal will outperform hot-dip galvanized steel in terms of durability. Zinc can be alloyed with other metals, such as titanium, to improve mechanical properties and corrosion resistance. Structural properties of zinc, however, will be inferior relative to zinc-coated mild steel.
zinc-rich aerosols	Sprays that replicate the protective mechanism of zinc-rich primers if applied with equivalent dry film thickness.
zinc-rich primers	There are two broad types of zinc-rich primer, which are classified according to the binder used in the paint – inorganic zinc primers and organic zinc primers. Both coatings take advantage of the sacrificially protective nature of zinc [initially present in the paint as a metallic dust pigment]. This pigment will degrade in preference to the underlying steel, which will be protected. During application, good contact must be made with the steel substrate. Refer to AS/NZS 2312.1:2014 for more detail.

4 CODES AND STANDARDS

NEW ZEALAND BUILDING CODE CLAUSES

B1 Structure
B2 Durability
E2 External moisture

STANDARDS

It is recommended to check which version of a standard is called up in the Building Code. The most recent standard currently issued as listed below is not necessarily the one cited – using the latest version of the standard is considered prudent.

AS 1214:2016 *Hot-dip galvanized coatings on threaded fasteners [ISO metric coarse thread series]* – not quoted in the Building Code Handbook

AS 1397-2011 *Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium*

AS 3566.1-2002 *Self-drilling screws for the building and construction industries – General requirements and mechanical properties* – not quoted in the Building Code Handbook

AS/NZS 2312:2014 *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings* – not called up directly in the Building Code Handbook, but the 2002 version [with Amendment No 1:2004] is in NZS 3604:2011.

AS/NZS 2699.1:2000 *Built-in components for masonry construction – Wall ties* – quoted for the Simple House Acceptable Solution and referenced in NZS 3604:2011

AS/NZS 2699.3:2002 *Built-in components for masonry construction – Lintels and shelf angles [durability requirements]* – cited for the Simple House Acceptable Solution

AS/NZS 2728:2013 *Prefinished/prepainted sheet metal products for interior/exterior building applications – Performance requirements* – quoted in E2/AS1

AS/NZS 4534:2006 *Zinc and zinc/aluminium-alloy coatings on steel wire*

AS/NZS 4673:2001 *Cold-formed stainless steel structures* – not quoted in the Building Code Handbook

AS/NZS 4680:2006 *Hot-dip galvanized [zinc] coatings on fabricated ferrous articles*

NZS 3604:2011 *Timber-framed buildings* – quoted in B1/AS1 and B2/AS1

SNZ TS 3404:2018 *Durability requirements for steel structures and components*

OTHER DOCUMENTS

HERA Report R4-97:2005 *New Zealand Weathering Steel Guide for Bridges*, HERA, Manukau City, New Zealand.

HERA Report R4-133:2011 *New Zealand Steelwork Corrosion Coatings Guide*, HERA, Manukau City, New Zealand.



Table 1. Comparison of corrosion zones and categories

Description of corrosivity	AS/NZS 2728:2013 product type	NZS 3604:2011 exposure zones	E2/AS1 exposure zones	AS/NZS 2312:2014 atmospheric corrosion categories [1]	ISO 9223 categories [1]
Very low	1	-	-	C1	C1
Low	2	Zone B	B	C2	C2
Medium	3	Zone C	C	C3	C3
High	4	Zone D [2]	D	C4	C4
Very high - industrial	5	SED [3]	-	C5-I	C5
Very high - marine and geothermal [4]	6	SED [3]	E	C5-M	C5
Extreme				CX [5]	CX

[1] Refer to HERA Report R4-133 to determine the AS/NZS 2312:2014 or the ISO 9223 categories for a very wide range of external and internal applications and steel in non-atmospheric environments. This is especially important when in the sea spray zone of as the regions encompassed by that zone cover atmospheric corrosion categories C3 to C5 from AS/NZS 2312:2014, depending on the mix of macroclimate and microclimate conditions.

[2] In NZS 3604:2011, exposure zone E, equivalent to C5 of ISO 9223, is defined for beachfront areas subject to rough sea and surf beaches. Corrosion protection requirements for structural fixings in zones D and E are identical.

[3] In addition to exposure zones, NZS 3604:2011 also considers microclimates and has three typical circumstances - industrial contamination and corrosive atmospheres, contamination from agricultural chemicals or fertilisers and geothermal hot-spots (defined as being within 50 metres of a bore, mud pool, steam vent or other source). These microclimatic conditions require specific engineering design (SED).

[4] Atmospheric corrosivity in areas approximately 500 metres from a geothermal source/spot were found to be influenced by many factors (refer to BRANZ Study Report SR393 Materials within geothermal environments). That said, corrosivity could range up to ISO 9223:2012 CX [extreme] and also demonstrate considerable variation.

[5] This can be found in some surf beach shoreline areas with very high salt deposition, in severe acidic industrial environments and also in some areas with strong geothermal emissions.



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