

Key points

- Steel durability can be specified using Table 4 of I.S. EN 1995-1-1
- EN 14592 is a harmonised standard and covers dowel type fasteners
- Where a harmonised standard exists, products must be CE marked and have a Declaration of Performance (DoP)
- PrEN 14592 has a new and more accurate method of specifying corrosion resistance for fasteners
- The publication of PrEN 14592 has been held up because of legal issues rather than technical issues but still offers a better method of considering corrosion resistance of fasteners

Fasteners – Corrosion Resistance

Introduction

Guidance on the corrosion resistance of fasteners is specified in the design standard I.S. EN 1995-1-1 Design of timber structures – Part 1-1: General – Common rules and rules for buildings (commonly called Eurocode 5 or EC5). However, EC5 specifies corrosion resistance by service class i.e. effectively the atmospheric relative humidity and indirectly by the moisture content of the timber.

EC5 does not cover corrosion requirements in detail for example it is widely known that some timbers and copper based preservatives can accelerate corrosion of steel products and this is not covered in EC 5, neither is the accelerated corrosion caused by coastal environments specifically mentioned (see note ^b in the table below).

EN 14592 Timber Structures – Dowel type fasteners - Requirements was revised in late 2019 and it introduced a more accurate way of specifying corrosion resistance of fasteners through two corrosion categories; a C class system based on atmospheric conditions and a T class system based on the corrosivity of timber and timber treatments. The new standard (currently designated prEN 14592:2019) has passed the voting stage but has not formally been published and is one of many standards held up in CEN because of legal rather than technical concerns; the technical content is correct and it is hoped it will soon be published. A further difficulty is that EC5 is undergoing a revision but will not be published for perhaps 4 or 5 years meaning that there will be a discrepancy between EN 14592 and EC5 until the new EC5 is published; the discrepancy is that the T and C classifications will only be in EN 14592. The current draft revision of EC5 is in its final stages and refers to the new C and T classes.

EN 1995-1-1 Corrosion resistance

The current EC5 requirements are reproduced below and were taken from Table 4.1 - Examples of minimum specification for material protection against corrosion for fasteners of the standard (related to ISO 2081).

Table 1: Examples of corrosion resistance taken from Table 4.1 of EC5

Fastener	Service class ^b		
	1	2	3
Nails and screws with d<=4mm	None	Fe/Zn 12c ^a	Fe/Zn 25c ^a
Bolts, dowels, nails and screws with d>4mm	None	None	Fe/Zn 25c ^a
Staples	Fe/Zn 12c	Fe/Zn 12c ^a	Stainless steel
Punched metal plate fasteners and steel plates up to 3mm thickness	Fe/Zn 12c	Fe/Zn 12c ^a	Stainless steel
Steel plates from 3mm up to 5mm in thickness	None	Fe/Zn 12c ^a	Fe/Zn 25c ^a
Steel plates over 5mm thickness	None	None	Fe/Zn 25c ^a

^a If hot dip zinc coating is used, Fe/Zn 12c should be replaced by Z275 and Fe/Zn 25c by Z350 in accordance with EN 10147.

^b For especially corrosive conditions consideration should be given to heavier hot dip coatings or stainless steel.

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COFORD
 Department of Agriculture, Food and the Marine, Agriculture House, Kildare Street, Dublin 2, Ireland.
 Telephone: +353 1 607 2487
 Email: fsd@agriculture.gov.ie
<http://www.coford.ie>

Notes

In the table c stands for a chromate coating, all FE/Zn designations above require a chromate coat.

The Fe/Zn 12c and Fe/Zn 25c refer to electroplated zinc coating referred to in ISO 2081.

- Steel designated Z275 should have a minimum coating mass of 275g/m² over both surfaces, this roughly equates to a thickness of 20µm per surface.
- Steel designated Z350 should have a minimum coating mass of 350g/m² over both surfaces, this roughly equates to a thickness of 25µm per surface.
- Steel designated Z12 should have a minimum thickness of 12µm per surface, the replacement of this by Z275 results in an increase in the thickness of the zinc coating.
- Steel designated Z25 should have a minimum thickness of 25µm per surface.
- There is effectively no guidance on ‘especially corrosive condition’ and the level of corrosion resistance that might be appropriate for these conditions. EN 14592 addresses these two weaknesses of EC5. The Table shows that a fastener with a diameter greater than 4mm does not need to be protected against corrosion but this ignores ‘especially corrosive conditions’.
- Steel designated Z275 or Z350 is a more suitable way for designating zinc on flat sheets rather than fixings.

EN 14592 Corrosion resistance

There are two classification systems, the T class covering timber and the C class covering atmospheric conditions; these allow a more accurate consideration of corrosion resistance.

The minimum zinc thicknesses in the standard are based on the upper limit of the average steady corrosion rate for zinc in the first 20 years of EN ISO 9224:2012 linearly extended to 50 years.

T classes

The new EN 14592 T classes are described in Table 2.

Table 2: Timber T classes

Timber category ^a	T1	T2	T3(15)	T3	T4	T5 ^b
Annual average moisture content ω (%)	ω <10	10 ≤ ω ≤ 16		16 < ω ≤ 20		Permanent ω >20
Treatment/ timber acidity			Untreated and pH>4		Treated or pH≤4	All
Examples of species	All	All	Larch, Pine, Birch, Spruce, Fir		Oak, Chestnut, Red cedar, Douglas fir, Beech	All
Examples of treatment					Any compositions with chlorides, copper and fire retardants	
Minimum zinc thickness		10µm	20µm		55µm	
Stainless steel specification			CRC II		CRC III	CRC III

Table 2 is based on Table B.3, Table 1 and Table 3 of EN 14592.

The standard gives the assignment of the stainless steel Corrosion Resistance Class (CRC) according to EN 10088-14:2014 and EN ISO 3506-1:2009 (table 1) as:

CRC II -

1.4301 (A2), 1.4307 (A2), 1.4567 (A2), 1.4541 (A3), 1.4318, 1.4306, 1.4311, 1.4482

CRC III -

1.4401 (A4), 1.4404 (A4), 1.4578 (A4), 1.4571 (A5), 1.4362, 1.4062, 1.4162, 1.4662, 1.4429, 1.4432, 1.4435

The numbers relate to EN 10088-1 while the alphanumeric values in brackets relate to EN ISO 3506-1.

C Classes

Table 2 of EN 14592 gives minimum zinc thicknesses for the atmospheric classes as shown in Table 3.

Table 3: Minimum pure zinc thickness coating and hot-dipped galvanizes coating for C classes

C1	C2nw	C2w	C3	C4	C5
	10µm	20µm	55µm	110µm	n.a.

EN 14592 describes the C categories depending on whether the fasteners are weathered (w – exposed to rain) or not weathered (nw). These are described in Tables 4 and 5.

Table 4: Atmospheric categories for weathered fixings (exposed to rain)

Atmosphere category	Climate/ humidity	Exposure to chlorides		Exposure to polluting agents	
		Exposure to chlorides	Cl deposition rate (mg/m ² .d)	Typical environment	Level of pollution/SO ₂ content µg/m ³
C1 Very low	Dry or cold, infrequent condensation	Regions far from coastline	Approximately 0	Some deserts, central Arctic/ Antarctica	Very low, approx. 0
C2w Low	Temperate, Infrequent condensation	>10km from coastline	<=3	Low polluted rural areas, small towns	Low <5
C3 Medium	Temperate, occasional condensation	~10 to 3m from coastline	3 to 60	Medium polluted urban & industrial areas	Medium 5 to 30
	Subtropical, tropical	Low pollution of chlorides and other contaminants (like C2)			
C4 High	Temperate, frequent condensation	3 to 0,25km from coastline without sea spray	60 to 300	High polluted urban and industrial areas	High 30 to 90
	Subtropical, tropical	Medium pollution of chlorides and other contaminants (like C2)			
C5 Very High	Temperate, permanent frequency of condensation	<0,25km from coastline, occasional sea spray	300 to 1500	High industrial pollution	Very High 90 to 250

Table 5: Atmospheric categories for not weathered fixings (not exposed to rain)

Atmosphere category	Climate/ humidity	Exposure to pollutions	Examples of environment
C1 Very low	Dry climate, low RH	Insignificant pollution	Heated spaces
C2nw Low	Varying temperature and RH, low frequency of condensation	Low pollution	Unheated spaces (storage, sports halls, heated and unheated stables with no condensation and pollution has no access
	Like outdoor climates C2-C3 but not weathered and rare condensation		Halls/storage areas/parking which are open to the outside
C3 Medium	Elevated RH/ moderate condensation frequency	Moderate pollution from production process	Food-processing plants, laundries, breweries, dairies, unheated stables
	Like outdoor climates C2-C3 but not weathered occasional or infrequent condensation	Moderate pollution	Parking decks open to the outside (frame construction)
C4 High	Elevated RH/ high condensation frequency	High pollution from production process	Industrial processing plants, heated stables
	Extreme elevated RH/ frequent condensation	Elevated pollution	Damp or wet spaces
	No elevated RH/ infrequent condensation	High level of hygroscopic salt in the air	Salt storage, pools with salty water in ventilated spaces
	Approximately 30°C and max. 60% RH/ condensation	Treatment with disinfection, high levels of chlorides	Swimming pools
C5 Very high	High RH/ very high condensation frequency	High pollution from production process	Unventilated spaces in subtropical and tropical zones in extreme contaminated environments or close to coastline

Comment

Dowel type fixings include nails, screws, staples as well as dowels. The designer will need to decide what timber and atmospheric category is appropriate to the fixings being used. At present prEN 14952 could be used to specify or check the required stainless steel or galvanising level as it deals more effectively with fastener corrosion than Table 4 of Eurocode 5.

The current version of EN14592:2008+A1:2012 does not have the T and C categories mentioned above and this is the version listed in the European Journal, it is a harmonised standard and a manufacturer is required to CE mark their product and provide a Declaration of Performance (DoP). As yet WTI is not aware of any new DoPs referring to the T and C classes but once the new version of EN 14952 is published then manufacturers and specifiers will probably start to use the T and C class system. As a DoP is purely the responsibility of the manufacturer, they can vary in layout and the information provided.

It would probably be more flexible if a DoP covered durability by specifying the stainless steel or the level of galvanizing/zinc by thickness or by weight (but then whether the weight was over one or two surfaces would need to be known). However, once the T and C class system is introduced it should simplify the specification of fastener durability. While a manufacturer may declare NPD (no performance determined) against durability it is unlikely that many would do so. If NPD is declared against durability then the user should consider alternative fixings.

EN 14592 allows alternative protective coatings provided they have been tested, the evaluation of alternative coatings is outside the scope of this information sheet and complicated by the level of Assessment and Verification of Constancy of Performance (see below).

The level of Assessment and Verification of Constancy of Performance (AVCP) is related to testing and Factory Production Control (FPC) amongst others. AVCP level 3 is appropriate for dowel type fasteners, however, the Construction Products Regulation (CPR) allows micro enterprises adopt the requirements of AVCP 4 where AVCP 3 would normally apply, more information is given in Article

37 of the CPR. If the manufacturer declares an AVCP level of 3 then the Factory Production Control (FPC) does not need to be monitored by a notified body, however, a notified laboratory would be involved in the testing of the fasteners. If an AVCP level of 4 is declared then there is no requirement for the involvement of any external body in any aspect of the manufacture of the fasteners.

There are other protections that are not directly covered by EN 14592;

- Sherardizing refers to where component are tumbled in heated drums with a mixture of zinc dust and other elements. The coating is generally thinner than with hot dipped galvanizing but is resistance to wear.
- Electro galvanizing results in low thicknesses of zinc being deposited but they may still be adequate for the intended purpose but not perhaps for more corrosive environments.

Further advice on coatings and levels of zinc can be sought from CREST, Technological University, Dublin (<https://www.crestdit.com>); if needed CREST also offer a testing service.

This information sheet is for general guidance only and is based on information available at the time of writing; users should ensure that it is relevant to their specific circumstances. It may be advisable in certain cases to engage professional advice. While every effort has been made to ensure the information provided is accurate, WTI or the Department of Agriculture, Food and the Marine do not accept any responsibility or liability for errors of fact, omission, interpretation or opinion that may be present, nor for the consequences of any decisions based on this information. Standards, regulations and information are subject to changes which may not be reflected in this information sheet.