Technical data sheet

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Metal ceilings and corrosion protection

Information for building designers, installers and system manufacturers

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Contents

1. General information regarding metal ceilings and corrosion protection

For the designer, installer and system manufacturer it is difficult to combine the many requirements with the required corrosion protection. In addition, the cost effectiveness of customised corrosion protection, by both purchase as well as planned maintenance during the life span, is also an important factor for metal ceilings.

The materials aluminium and steel can, with appropriate measures, fulfil all corrosion protection requirements.

Where necessary, when determining the corrosion protection, expected changes in corrosive requirements should be included. These can be a result of a change in building use or changes in the site related corrosive requirements.

Project specific influences, user defined characteristics and last but not least system related properties shall be taken into account during the planning stage.

The modular design of metal ceilings is particularly well suited for the simple, factory application of the required corrosion protection system with reliable quality assurances.

Safety always comes first.

The reliability of the loading-bearing strength is of the utmost importance. The aesthetic appearance is of course also to be considered.

The aim should always be to provide cost-effective corrosion protection for the economic life span of the building.

The following statements are to be regarded as a general guide for the proper use and application of corrosion protection for metal ceilings.

2. Standards for metal ceilings and corrosion protection

2.1 EN 13964 - 2004 + A1:2006 (D) Suspended ceilings – requirements and test methods

EN 13964 requires classification into defined exposure classes according to ambient conditions. Furthermore, a classification of the metal components into corrosion protection classes is assigned.

The avoidance of contact corrosion is also required.

2.2 EN ISO 12944 Corrosion protection of steel structures by protective paint systems

Comprehensive regulations for corrosion protection are herein set out in 8 standard parts. The scope of application however relates to sheet steel from 3mm material thickness.

2.3 EN 10169 parts 1-2-3 Continuously organic coated (coil coated) steel flat products

Part 1 - General information (definitions, materials, tolerances, test methods)

Part 2 - Products for building exterior applications

Part 3 - Products for building interior applications

2.4 DIN 55634 draft March 2008 Paints, varnishes and coatings – Corrosion protection of supporting components made of steel

This draft standard applies to load bearing thin-walled components made from non-alloyed or low alloyed steels with nominal sheet thickness up to 3mm. The standard can also be used for non load bearing thin-walled components. As the intended standard can differ from the present edition, the use of the draft standard, including the issue date, should be agreed separately. The standard will apply to coil coatings and piece work coatings. Coil coatings, powder coatings and liquid coatings are dealt with. The classification of corrosion influences relates to the corrosion categories specified in EN ISO 12944-2. Reference is made to the corrosion protection classes given in DIN 55928-8, as these are also indicated in various applicable standards.
The draft is also considered by TAIM as a possible future replacement for DIN 55298-8.

2.5 EN 1396, February 1997 Coil coated aluminium strip for general applications

This European standard specifies the special requirements of coil coated sheets and strips made of aluminium and aluminium alloys for general applications. These products are generally supplied in thicknesses up to 2mm but thicknesses up to 3mm are also available.

2.6 DIN 17611 Anodized products of wrought aluminium and wrought aluminium alloys

This standard specifies the technical demands on delivery of anodized products made of aluminium and wrought aluminium alloys. As a result of anodic oxidation, an oxide layer is created on the surface of the aluminium resulting in an increased resistance to corrosive influences.

2.7 EN 12206-1 Paints and varnishes - Coating of aluminium and aluminium alloys for architectural purposes

This part of EN 12206-1 specifies requirements and test methods exclusively for organic coatings produced with powder coating of semi-finished sheet metal and pre-moulded parts of aluminium and aluminium alloy for architectural purposes.

3. The key points in EN 13964 - metal ceilings and corrosion protection

For corrosion protection, EN 13964 requires the classification into defined exposure classes according to the expected humidity and temperature conditions in accordance with table 7.

In table 8 the respective classes are assigned with consideration of the materials and their different properties.

Extract from EN 13964, table 7 – Classes of exposure

Figure 1

Class	Conditions
A	Building components exposed to varying relative humidity up to 70% and varying temperature up to 25°C, but without corrosive pollutants.
B	Building components exposed to varying relative humidity up to 90% and varying temperature up to 30°C, but without corrosive pollutants.
C	Building components exposed to varying relative humidity up to 95% and varying temperature up to 30°C and accompanied by a risk of condensation but without corrosive pollutants.
D	More severe than the above

EN 13964 states under 4.8.4 that, "Metal framing components, suspensions and connecting elements shall be protected against corrosion according to table 8".

Table 8 contains precise guidelines for the exposure classes.

Extract from EN 13964, table 8
Figure 2

EN 13964:2004 + A1:2006 (D)

Table 8 - Classes of corrosion protection of metal substructure components and membrane components

Class (according to table 7)	Profiles, suspensions, connecting elements and membranes	
	Components made of steel	Components made of aluminium
A	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to EN 10327[bc]. Products with electroplated zinc coating flat ZE25/25 according to EN 10152[c]. Continuously organic coated (coil-coated) products of corrosion protection (interior) category CPI2 for the exposed side according to EN 10169-3[f] (e.g. coating system ZE15/15-HDP25-2T-CPI2).	No additional corrosion protection required
B	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to EN 10327[bc]. Products with electroplated zinc coating flat according to EN 10152 with or without an additional organic coating [d] as follows [c] : ZE25/25 + 40 µ m per face [d] , ZE50/50 + 20µ m per face [e] or ZE100/100 without OC. Continuously organic coated (coil-coated) products of corrosion protection (interior) category CPI2 for the exposed side according to EN 10169-3[f] (e.g. coating system ZE15/15-HDP25-2T-CPI2).	No additional corrosion protection required or coil coating according to EN 1396:1996: corrosion index 2a
C	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to EN 10327[bc] with an additional organic coating [d] of 20 µ m per face. Products with electroplated zinc coating flat according to EN 10152 with an additional organic coating [d] as follows [c]: ZE25/25 + 60 µ m per face [e], ZE100/100 + 40µ m per face.	Anodising[c] (15 µ m < s < 25 µ m) or coil coating according to EN 1396 corrosion index 2a
D	Special measures depending on use and corrosion action. Minimum corrosion protection according to Class C. Additional measures as required.	Anodising (s > 25 µ m) or coil coating according to EN 1396 corrosion index 2b

[a] Round steel wire used as a hanger or hanger component, must fulfil the requirements according to EN 10244-2 (round steel wire coated with zinc or zinc alloy)
[b] EN 10327 replaces EN 10142 (zinc), EN 10214 (zinc - aluminium) and EN 10215 (aluminium - Zinc).
[c] Any equivalent corrosion protection leading to a similar level of protection is permitted.
[d] Coating of exposed parts with zinc compatible organic coating according to EN ISO 12944-3 applied by a post-painting process or equivalent coil coating according to EN 10169-3.
[e] Applies only to membrane components.
[f] Applies only to "capping" material for substructure components

4. Summary of standards overview for INTERIOR APPLICATIONS
Metal ceilings and corrosion protection with the most important classes and conditions

This summary only applies to modular metal ceilings with an accessible ceiling plenum.

TAIM recommends a useful life span of at least 15 years - this corresponds to the class long (L) according to EN ISO 12944-5, section 5.5 or high (H) according to DIN 55634, section 5.3.

Figure 3

Material	Steel	Steel	Steel	Al	Al	Al	
EN 13964, table 7+ 8	**EN ISO 12944, part 2**	**EN 10169-3**	**(E) DIN 55634, Table 2**	**EN 1396 Table C1 category**	**DIN 17611 table 2 class**	**EN 12206-1**	**Example of conditions** (only for info)
A	C1	CPI2*	C1	2a interior	10	**	Heated building with a neutral atmosphere e.g. offices, shops, schools, hotels.
B	C2	CPI3*	C2	2a interior	15	**	Unheated building where condensation can occur e.g. warehouses, sports halls.
C	C3	CPI4*	C3	2a interior	20	**	Production rooms with high humidity and some air pollution e.g. food processing plants, laundries, breweries, dairies.
D	≥ C4	CPI5*	≥ C4	2b interior	25	**	Chemical plants, swimming pools, boat houses over sea water.

* only partly comparable – as only tested according to ISO 6270 – test according to ISO 7253 missing – consultation with the manufacturer is recommended.

** see EN 12206-1 section 5.11 - 5.12 and 5.13

The standards used in figures 3 and 4 are:

→ EN 13964, February 2007 Suspended ceilings – requirements and test methods

→ EN ISO 12944, July 1998 part 2 Corrosion protection of steel structures by protective paint systems

→ DIN 17611, December 2000
Anodised products of wrought aluminium and wrought aluminium alloys

→ EN 10169, Continuously organic coated (coil coated) steel flat products

Part 1 - General information (definitions, materials, tolerances, test methods)

Part 2 - Products for building exterior applications

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→ (D-Draft) DIN 55634, March 2008
Paints, varnishes and coatings – Corrosion protection of supporting thin-walled components made of steel up to 3mm material thickness

→ EN 1396, February 1997
Coil coated sheet and strip for general applications made of aluminium

→ EN 12206-1 Paints and varnishes - Coating of aluminium and aluminium alloys for architectural purposes

5. Summary of standards overview for EXTERIOR APPLICATIONS Metal ceilings and corrosion protection with the most important classes and conditions

This overview only applies to modular metal ceilings with an accessible ceiling plenum.

TAIM recommends a useful life span of at least 15 years - this corresponds to class long (L) according to EN ISO 12944-5, section 5.5 or high (H) according to DIN 55634, section 5.3.

Figure 4

Material	Steel	Steel	Steel	Al	Al	Al	
EN 13964, table 7 and 8	**EN 12944, part 2**	**N EN 10169-2**	**E DIN 55634, table 2**	**EN 1396 Table C1 category**	**DIN 17611, table 2 class**	**EN 12206-1**	**Example of conditions** (only for info)
D	C2	RC2	C2	3a	15	**	Atmospheres with low pollution. Mainly rural areas.
D	C3	RC3	C3	3a	20	**	Urban and industrial atmospheres, moderate sulphur dioxide levels. Coastal areas with low salinity.
D	C4	RC4	C4	3a	20	**	Industrial areas and coastal areas with moderate salinity.
D	C5 I	RC5	C5I	4a	25	**	Industrial areas with high humidity and aggressive atmospheres
D	C5 M	RC5	C5 M	4b	25	**	Coastal and offshore areas with high salinity.

** see EN 12206-1 section 5.11 - 5.12 and 5.13

It should be noted that EN 13964 (explicitly, formally stated) does not apply for external ceilings with accordingly high requirements for corrosion protection.

Additional measures are to be agreed in cases of direct sunlight and/or influence of humidity from direct rain contact.

For special edge configurations:
It should be noted that the corrosion protection coating can be lower in grooves, cavities or in areas with special edge configurations. Appropriate measures are to be taken.

6. Corrosion protection – an important criterion for building designers

The data in table 8 of EN 13964, in terms of corrosion protection classes, serves only in classifying the hitherto existing building regulation requirements to the new European classification system of corrosivity categories and duration of protection. When determining the corrosion protection class, the higher requirement has priority.

The feasibility of control and remedial maintenance measures for the assumed accessible areas must be taken into account during planning. For very high corrosive exposure, longer protection duration and special influences such as those stipulated in “table 8 class D of EN 13964”, the corrosion protection classes are not always applicable. With such influences and conditions it is recommended for the required measures to be determined in each individual case by the building designer.

6.1 Substructure components and reverse sides of ceiling membranes must also be observed

When determining the corrosion protection, the risk of corrosion on the reverse side of ceiling membranes as well as substructure components in the ceiling plenum must be considered.

7. Important terms - used in connection with corrosion protection for metal ceilings

7.1 Protection period

The term "protection period" is defined in EN ISO 12944-1, 3.5 and 4.4 as the service life until the first major maintenance.

Short: 2 to 5 years
Medium: 5 to 15 years
Long: over 15 years

This is the time period – calculated from the start of exposure – up until the functional protective effect is no longer maintained – not the aesthetic effect – when suitable measures must be taken in order to extend the service life of the corrosion protection system and therefore the durability of the component.

Duration of protection and warranty

The duration of protection is not a “warranty period“. The duration of protection is a technical term that can help the client to determine a maintenance program.

The warranty is a legal term that is subject to the contract conditions. The warranty period is generally shorter than the duration of protection. There are no regulations which interconnect both terms.

To avoid premature failure, inspections at regular intervals and when necessary maintenance, are to be carried out.

The intervals must be considered in conjunction with the type of atmosphere and the system specific construction components as well as the degree of use.

Repair work may be necessary sooner than expected by the declared duration of protection due to fading, chalking, contamination, wear or aesthetic reasons.

7.2 Inspection and maintenance

A service life of many years is expected from the selected ceiling system in conjunction with the intended corrosion protection. As different influences are unavoidable, it is necessary to carry out regular inspections.

The areas for inspection, the components to be inspected and their connections as well as the inspection intervals are to be determined by the building designer.

7.3 Cut/exposed edges – cathodic protection

Metallic, zinc coatings activate the “cathodic protection effect” on cut/exposed edges of the metal and in areas of light damage. Scratches in the metallic coating and cut areas up to 1.5mm thickness are therefore protected against corrosion without any additional measures.

The “cathodic protection” is based on the fact that zinc lies lower in the electrochemical series as steel. Therefore, zinc is able to protect the “precious" steel core on the basis of electrochemistry.

White rust (zinc patina) acts as a protective layer and is not a quality defect.

7.4 Contact corrosion is to always be avoided

EN 13964, section 4.8.5. shall be complied with.

7.5 Cleaning

The cleaning recommendations of the manufacturer shall be respected.

7.6 Metal ceilings with other composite materials

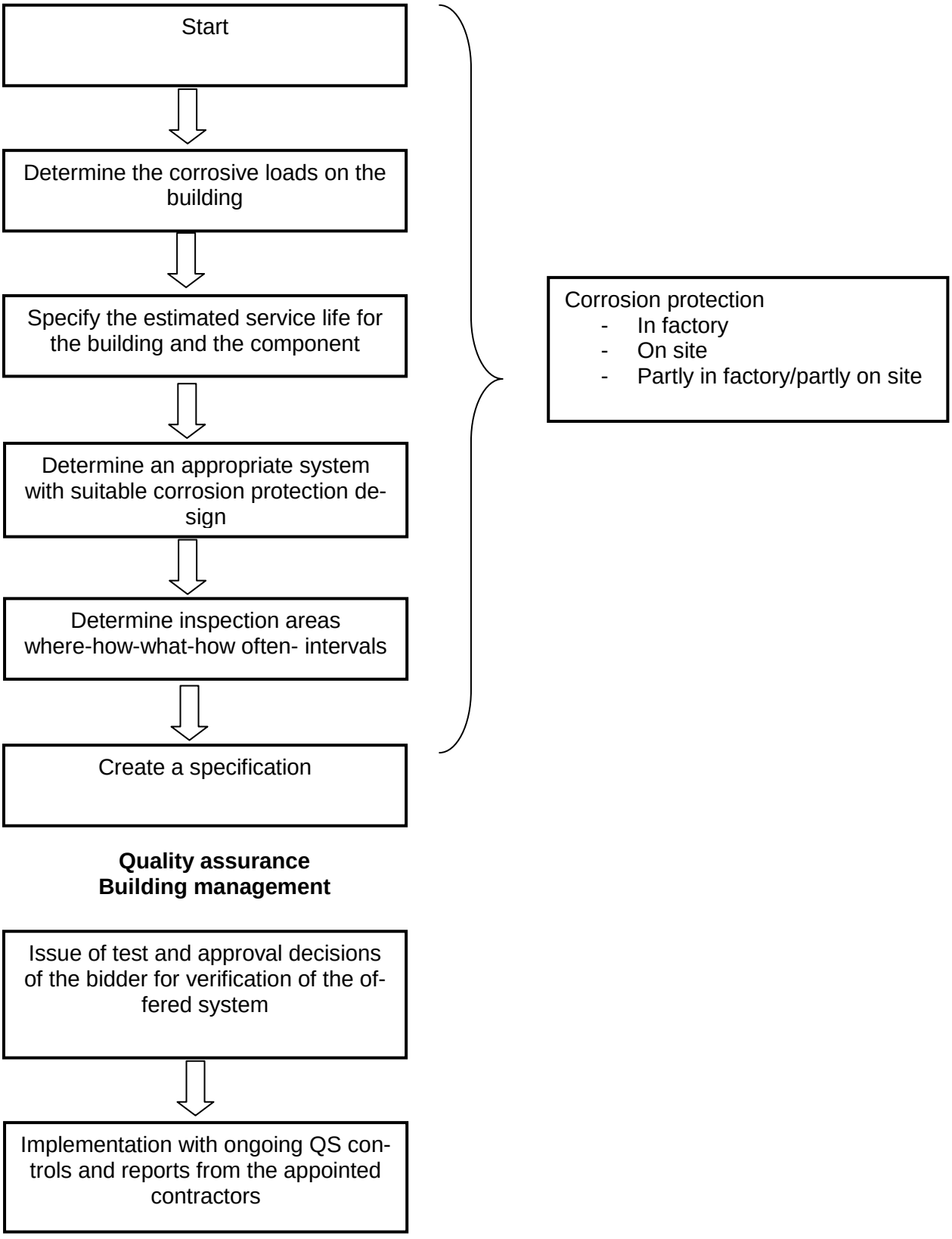
All of the above remarks apply to metal ceiling systems without additional components or fixtures; which must, where necessary be considered separately.

The following remarks apply to common products:

Acoustic fleeces, mineral wool overlays as well as plasterboard tiles are applicable together with metal ceilings up to exposure class B – tables 7 and 8 according to EN 13964.

Further additional requirements are to be agreed with the system manufacturer.

8. Design process of corrosion protection for metal ceilings



9. Summary

As with many other requirements, an almost incomprehensible range of literature is available, regarding national and European guidelines and standards, for designers and installers about corrosion protection.

For assured planning, it is essential to state the requirements and the required performances on technically based principles during the planning phase.

The overviews in figures 3 and 4 provide according to the opinion of TAIM, a good basis for the design of corrosion protection systems of modular metal ceilings taking into account the key standards according to the current state of technology.