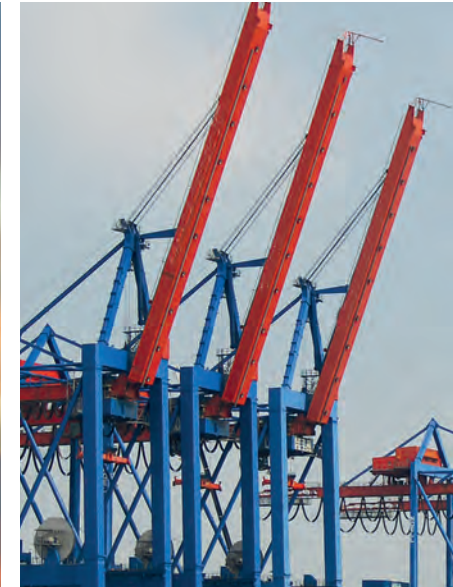


# mipa

*Professional Coating Systems*



***Corrosion Protection***

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Since the use of metals, corrosion has preoccupied mankind. Today's scope of corrosion protection ranges from the protection of a yard gate to famous examples of architecture like the Eiffel Tower or the Golden Gate Bridge. Examples like these prove that the life of constructions at risk of corrosion can be significantly extended by proper corrosion protection treatment.

Economic and ecological aspects are the driving factors in opting for anti-corrosion coatings. Our corrosion inhibiting coatings contribute considerably to a sustainable protection and to a reduction of damage amounting to billions.

For more than 60 years, corrosion protection has been one of the core businesses of the Mipa Group. Thanks to our many years of experience and our modern research laboratories, we de-

velop innovative and reliable products that are user-oriented for various application areas. From synthetic resin primers to solvent-free coating systems – we offer a perfect solution for your requirements.

Factory coating or maintenance and renovation of corrosion protection: Our products comply with various national and international standards and factory standards.

This brochure serves as a guideline and assistance for the successful implementation of your corrosion protection project. Our experts will be happy to provide you with individual advice.

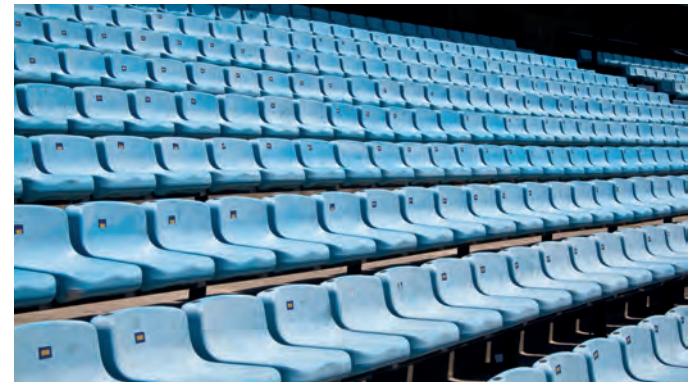
## Substrate Preparation

A durable corrosion protection coating depends on the right substrate preparation, the selection of the right coating system and the professional execution of the coating. The most important information and details can be found in the European standard EN ISO 12944 „corrosion protection of steel constructions by protective coating systems“.

A thorough substrate pre-treatment is an important prerequisite for a long-lasting corrosion protection. Irrespective of the degree of contamination, we recommend thorough cleaning of steel surfaces; that is, rolling skin/scale, rust, old coatings and foreign matters must be removed. Any residual contamination must be firmly adherent and may remain at best only visible as slight stains in the form of spots or stripes.

Depending on the intended use, suitable preparation procedures are dry blasting, wet blasting, flame cleaning, high pressure water jetting, spot blasting, sweep blasting, acid pickling or alkaline cleaning. After cleaning, the substrate must have the minimum degree of cleanliness of Sa 2.5 as defined in EN ISO 12944-4 as well as an average maximum roughness depth of 40-80 µm according to EN ISO 8503-1.

Corrosivity categories	Exterior environment	Interior environment
<b>C1</b> very low	–	< 60 % relative humidity, heated buildings with neutral atmospheres, e.g. offices, shops, schools, hotels
<b>C2</b> low	Atmospheres with low level of pollution, dry climate, mostly rural areas	Uninsulated buildings where condensation may occur, e.g. warehouses, gymnasiums
<b>C3</b> medium	Urban and industrial atmospheres with an average SO <sub>2</sub> contamination level or moderate coastal climate, low salinity	Rooms with relatively high humidity and some air pollution, production rooms, e.g. laundries, breweries
<b>C4</b> high	Industrial areas and coastal areas with moderate salinity	Chemical plants, swimming pools, boathouses on seawater
<b>C5</b> very high	Industrial areas with high humidity and aggressive atmosphere and coastal areas with high salinity	Buildings and areas with almost permanent condensation and with high pollution
<b>CX</b> extreme	Offshore areas with high salinity and industrial areas with extreme humidity and aggressive atmosphere as well as subtropical and tropical atmosphere	Industrial areas with extreme humidity and aggressive atmospheres
Immersion categories	Environments	Examples
<b>Im 1</b>	Fresh water	River structures, hydroelectric power station
<b>Im 2</b>	Sea or brackish water	Steel structures immersed in water without cathodic corrosion protection
<b>Im 3</b>	Soil	Tanks in the soil, steel sheet piles, steel pipes
<b>Im 4</b>	Sea or brackish water	Steel structures immersed in water with cathodic corrosion protection



From corrosivity category **C2 (low corrosivity)** onwards, the prescriptions regulating the duration of protection, the binders to be used and the required layer thicknesses begin.

In this area, 1-component coating materials are still frequently used, but the proportion of 2-component coating materials is increasing.

Category C2 covers the following fields of application:

#### **Outdoor area:**

- dry climate
- rural climate
- low pollution

#### **Indoor area:**

- unheated buildings
- temporary condensation
- storehouses
- gymnasiums
- production hall

## Coating systems for corrosivity category C2

System number	priming coat			finishing coat			complete coating		expected duration of protection			
	product group	number of coats	NDFT $\mu\text{m}$	product group	number of coats	NDFT $\mu\text{m}$	number of coats	NDFT $\mu\text{m}$	low	medium	high	very high
<b>Table C2 Corrosivity category C2 for low-alloyed steel, surface pre-treatment: blast cleaning to Sa 2.5, rust grades A, B or C (see ISO 8501-1)</b>												
C2.01	1K AK Primer	1	40 – 80	1K AK Topcoat 1K AK MIO	0 – 1	0 – 40	1 – 2	80				
C2.02	1K AK Primer	1	40 – 100	1K AK Topcoat 1K AK MIO	0 – 1	0 – 60	1 – 2	100				
C2.03	1K AK Primer	1	60 – 160	1K AK Topcoat 1K AK MIO	0 – 1	0 – 100	1 – 2	160				
C2.04	1K AK Primer	1	60 – 80	1K AK Topcoat 1K AK MIO	1 – 2	120 – 140	2 – 3	200				
C2.05	2K EP Primer 2K PU Primer	1	60 – 120	2K EP Topcoat 2K PU Topcoat 2K PU MIO	0 – 1	0 – 60	1 – 2	120				
C2.06	2K EP Primer 2K PU Primer	1	80 – 100	2K EP Topcoat 2K PU Topcoat 2K PU MIO	1	80 – 100	2	180				
C2.07	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60				1	60				
C2.08	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat 2K PU Topcoat 2K PU MIO	1	80 – 100	2	160				
<b>Table G2 Corrosivity category C2 for hot-dip galvanized steel</b>												
G2.01	2K EP Topcoat 2K PU Topcoat 2K PU MIO	1	80				1	80				
G2.03	2K EP Primer 2K PU Primer	1	80 – 120	2K EP Topcoat 2K PU Topcoat 2K PU MIO	0 – 1	0 – 40	1 – 2	120				

NDFT = Nominal Dry Film Thickness



The advanced corrosion protection begins with corrosion protection category **C3 (moderate corrosivity)**. In this case, 2-component products are mainly used, which meet the increasing requirements.

Category C3 covers the following fields of application:

#### Outdoor area:

- urban and industrial areas with moderate pollution by sulphur oxide
- coastal areas with low salinity

#### Indoor area:

- production rooms with high humidity and some air pollution like e.g laundries, breweries
- industrial facilities
- dwelling house
- roofs

## Coating systems for corrosivity category C3

System number	priming coat			finishing coat			complete coating		expected duration of protection			
	product group	number of coats	NDFT $\mu\text{m}$	product group	number of coats	NDFT $\mu\text{m}$	number of coats	NDFT $\mu\text{m}$	low	medium	high	very high
<b>Table C3 Corrosivity category C3 for low-alloyed steel, surface pre-treatment: blast cleaning to Sa 2.5, rust grades A, B or C (see ISO 8501-1)</b>												
C3.01	1K AK Primer	1	80 – 100	1K AK Topcoat 1K AK MIO	0 – 1	0 – 20	1 – 2	100				
C3.02	1K AK Primer	1	60 – 160	1K AK Topcoat 1K AK MIO	0 – 1	0 – 100	1 – 2	160				
C3.03	1K AK Primer	1	60 – 80	1K AK Topcoat 1K AK MIO	1 – 2	120 – 140	2 – 3	200				
C3.04	1K AK Primer	1	60 – 80	1K AK Topcoat 1K AK MIO	1 – 3	180 – 200	2 – 4	260				
C3.05	2K EP Primer 2K PU Primer	1	80 – 120	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	0 – 1	0 – 40	1 – 2	120				
C3.06	2K EP Primer 2K PU Primer	1	80 – 160	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	20 – 80	2	180				
C3.07	2K EP Primer 2K PU Primer	1	80 – 160	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	2	80 – 160	2 – 3	240				
C3.08	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60				1	60				
C3.09	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80 – 100	2	160				
C3.10	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	120 – 140	2 – 3	200				
<b>Table G3 Corrosivity category C3 for hot-dip galvanized steel</b>												
G3.01	2K EP Topcoat 2K PU Topcoat 2K PU MIO	1	80				1	80				
G3.02	2K EP Topcoat 2K PU Topcoat	1	80 – 120	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	0 – 1	0 – 40	1 – 2	120				
G3.04	2K EP Topcoat 2K PU Topcoat	1	80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80	2	160				

NDFT = Nominal Dry Film Thickness



The corrosivity category **C4 (high corrosivity)** requires high performance from the paint components used. For these areas, basically 3-layer coating structures are applied. In case of 2-layer systems, only high-build coating structures are used.

Category C4 covers the following fields of application:

#### Outdoor area:

- industrial areas with permanent exposure to industrial atmosphere and coastal areas with moderate salinity
- industrial areas, industrial facilities and dwelling houses in coastal areas with moderate salinity, like e.g. chemical plants, bridges

#### Indoor area:

- chemical plants
- swimming pools
- coastal shipyards
- boat harbours



## Coating systems for corrosivity category C4

System number	priming coat			finishing coat			complete coating		expected duration of protection			
	product group	number of coats	NDFT $\mu\text{m}$	product group	number of coats	NDFT $\mu\text{m}$	number of coats	NDFT $\mu\text{m}$	low	medium	high	very high
<b>Table C4 Corrosivity category C4 for low-alloyed steel, surface pre-treatment: blast cleaning to Sa 2.5, rust grades A, B or C (see ISO 8501-1)</b>												
C4.01	1K AK Primer	1	60 – 160	1K AK Topcoat 1K AK MIO	0 – 1	0 – 100	1 – 2	160				
C4.02	1K AK Primer	1	60 – 80	1K AK Topcoat 1K AK MIO	1 – 2	120 – 140	2 – 3	200				
C4.03	1K AK Primer	1	60 – 80	1K AK Topcoat 1K AK MIO	1 – 3	180 – 200	2 – 4	260				
C4.04	2K EP Primer 2K PU Primer	1	80 – 120	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	0 – 1	0 – 40	1 – 2	120				
C4.05	2K EP Primer 2K PU Primer	1	80 – 160	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	20 – 80	2	180				
C4.06	2K EP Primer 2K PU Primer	1	80 – 160	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	80 – 160	2 – 3	240				
C4.07	2K EP Primer 2K PU Primer	1	80 – 120	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 3	180 – 220	2 – 4	300				
C4.08	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60				1	60				
C4.09	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80 – 100	2	160				
C4.10	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	120 – 140	2 – 3	200				
C4.11	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	2 – 3	180 – 200	3 – 4	260				
<b>Table G4 Corrosivity category C4 for hot-dip galvanized steel</b>												
G4.01	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80				1	80				
G4.02	2K EP Primer 2K PU Primer	1	80 – 120	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	0 – 1	0 – 40	1 – 2	120				
G4.04	2K EP Primer 2K PU Primer	1	80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80	2	160				
G4.06	2K EP Primer 2K PU Primer	1	80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	120	2 – 3	200				

NDFT = Nominal Dry Film Thickness



The corrosivity category **C5 (very high corrosivity)** stands for a very demanding corrosion protection at the highest level. 2-component paint systems are used almost exclusively to achieve high coating thicknesses.

Category C5 covers the following fields of application:

#### Outdoor area:

- industrial areas with high air humidity and aggressive atmosphere and coastal areas with high salinity, e.g. crane installation in harbours

#### Indoor area:

- buildings and areas with almost permanent condensation and with high pollution

## Coating systems for corrosivity category C5

System number	priming coat			finishing coat			complete coating		expected duration of protection			
	product group	number of coats	NDFT $\mu\text{m}$	product group	number of coats	NDFT $\mu\text{m}$	number of coats	NDFT $\mu\text{m}$	low	medium	high	very high
<b>Table C5 Corrosivity category C5 for low-alloyed steel, surface pre-treatment: blast cleaning to Sa 2.5, rust grades A, B or C (see ISO 8501-1)</b>												
C5.01	2K EP Primer 2K PU Primer	1	60 – 160	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	20 – 120	2	180				
C5.02	2K EP Primer 2K PU Primer	1	80 – 160	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	80 – 180	2 – 3	240				
C5.03	2K EP Primer 2K PU Primer	1	80 – 240	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 3	60 – 220	2 – 4	300				
C5.04	2K EP Primer 2K PU Primer	1	80 – 200	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	2 – 3	160 – 280	3 – 4	360				
C5.05	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80 – 100	2	160				
C5.06	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	120 – 140	2 – 3	200				
C5.07	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	2 – 3	180 – 200	3 – 4	260				
C5.08	2K EP Zinc rich primer 1K ESI Zinc rich primer	1	60 – 80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	2 – 3	240 – 260	3 – 4	320				
<b>Table G5 Corrosivity category C5 for hot-dip galvanized steel</b>												
G5.01	2K EP Primer 2K PU Primer	1	80 – 120	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	0 – 1	0 – 40	1 – 2	120				
G5.02	2K EP Primer 2K PU Primer	1	80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1	80	2	160				
G5.04	2K EP Primer 2K PU Primer	1	80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	120	2 – 3	200				
G5.05	2K EP Primer 2K PU Primer	1	80	2K EP Topcoat / 2K PU Topcoat 2K PU MIO	1 – 2	160	2 – 3	240				

NDFT = Nominal Dry Film Thickness



In the atmosphere, in water and in the soil, untreated steel is exposed to corrosion, which causes considerable damage. Steel structures are coated to prevent this damage. To determine the suitable coating materials, it is of great importance to take into account the planned service life and the expected stress level (corrosivity categories).



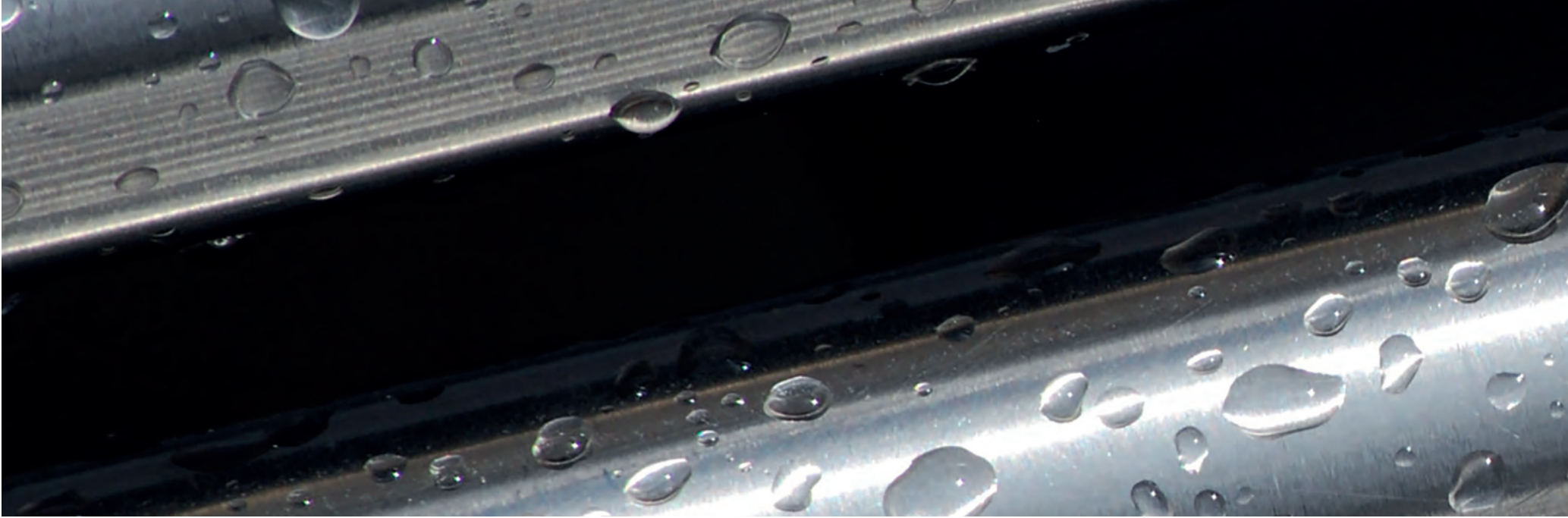
In order to be able to assess the properties of various products and coating structures better and faster, a number of different test procedures have been laid down in EN ISO 12944-6. The successful performance of these tests, partially supplemented by practical test (e.g. outdoor storage), is the prerequisite for the suitability for the environment in question.



In order to obtain approvals, a recognised institute must carry out the prescribed tests. Upon satisfactory conclusion of the tests, the official test report can be used to provide proof of the anti-corrosion properties or, if necessary, to apply for official approval from the relevant bodies.

## Test methods for paint systems for steel EN ISO 12944-6

Corrosivity category according to ISO 12944-2	Level of durability	ISO 2812-2 Water immersion method	ISO 6270-1 Water condensation test	ISO 9227 Effects of salt spray	Periodic aging test
		h	h	h	h
C2	low	–	48	–	–
	medium	–	48	–	–
	high	–	120	–	–
	very high	–	240	480	–
C3	low	–	48	120	–
	medium	–	120	240	–
	high	–	240	480	–
	very high	–	480	720	–
C4	low	–	120	240	–
	medium	–	240	480	–
	high	–	480	720	–
	very high	–	720	1440	1680
C5	low	–	240	480	–
	medium	–	480	720	–
	high	–	720	1440	1680
	very high	–	1200	2160	2688
Im 1	high	3000	1440	–	–
	very high	4000	2160	–	–
Im 2	high	3000	–	1440	–
	very high	4000	–	2160	–
Im 3	high	3000	–	1440	–
	very high	4000	–	2160	–



## The dew point (in °C)

The dew point temperature is the temperature at which the air is saturated with water vapour. The lower the temperature, the less water vapour can be absorbed by the air. The water vapour condenses when the temperature decreases to the dew point temperature e.g. on cold steel substrates.

- Air humidity = amount of water vapour in the air
- Absolute air humidity = grams of water per m<sup>3</sup> of air
- Maximum air humidity = highest amount of absolute air humidity without precipitation of water in liquid form
- Relative air humidity = depending on the temperature, different ratio between absolute and maximum humidity

On substrates, microscopically dispersed moisture can lead to defective coatings („coating on water“) due to e.g. dew, mist or condensing air humidity.

The moisture content of the air has furthermore an impact on the drying process of paint and coating materials.

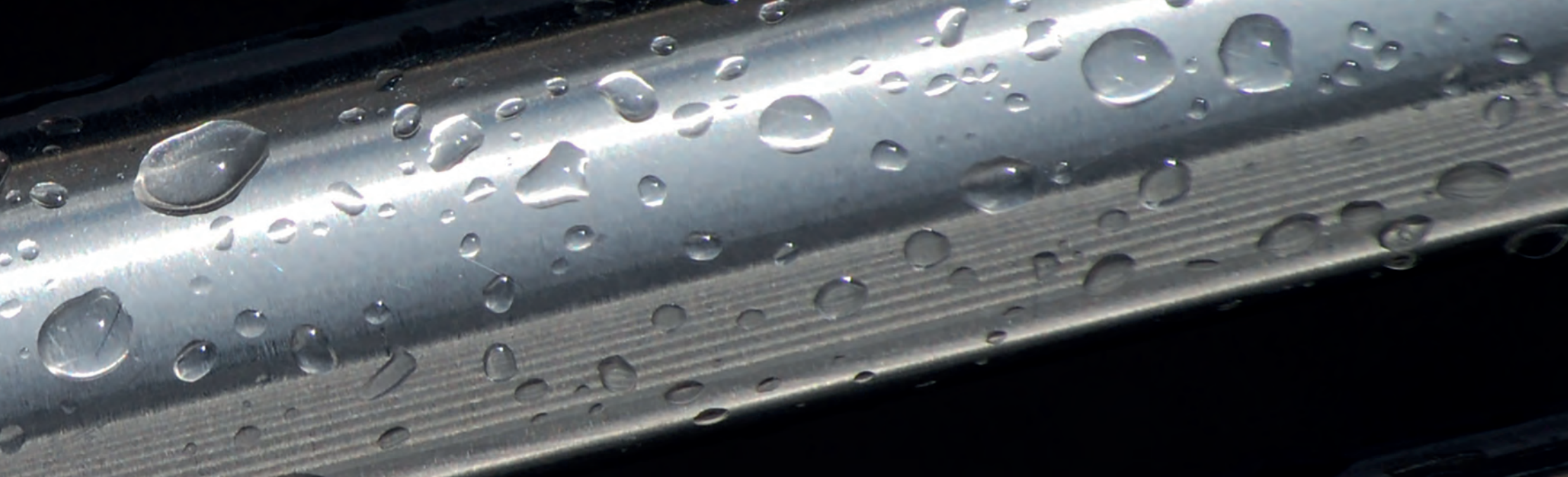
## Dew point table

The dew point table indicates the substrate temperatures at which condensation occurs on the surface as a function of air temperature and relative humidity.

Example:

At an air temperature of 22°C and a relative air humidity of 65 %, condensation will occur on non-absorbent substrates with substrate temperature below 15°C. As a rule, the substrate temperature during coating and drying should be at least 3°C above the dew point temperature, i.e. 18°C in this example.

The detailed dew point table can be found on the penultimate page of this brochure.



## Selecting an appropriate coating system

Once the substrate has been prepared accordingly, the appropriate coating system must be selected according to the requirements of EN ISO 12944. First, it is important to specify the environmental conditions of the surface to be coated. For details, see the tables „Corrosivity categories C2 to C5“ on pages 4 – 11. The desired working life of the system must then be determined.

The standard defines the following four level of durability:

low	up to 7 years
medium	7 – 15 years
high	15 – 25 years
very high	more than 25 years

Note: These levels of durability do not correspond to a warranty period, but are a technical consideration that can help the owner set up a maintenance program.

As soon as the category and the durability are determined, the question of an adequate coating system arises. A 3-layer structure consisting of a primer, intermediate and top coat is often applied. The priming coat is of crucial importance as it contains pigments providing passive corrosion protection. The primer is furthermore the base, the adhesion to the substrate as well as the adhesion promoter for the following layers.

The subsequent intermediate coating forms a barrier to penetrating corrosion-promoting substances. This barrier effect is achieved by coat thickness and often also by lamellar pigments. This layer, which can be adjusted according to the requirements, also levels out minor irregularities on the surface.

The top coat puts the finishing touch to the object. It provides a further barrier to corrosion-promoting substances and an attractive finish. In addition, the top coat offers protection against stresses such as UV-radiation, weathering, aggressive atmosphere as well as chemical agents and/or mechanical stress.

In this brochure, you will find various recommendations for coating structures based on the tables C2 – C5 and G3 – G5 of EN ISO 12944-5. Please note that the following recommendations for coating structures are only options. Individual requirements may also need to be taken into account. Therefore, other products may be more suitable to meet client-specific aspects such as particular mechanical, chemical and weathering resistances or other requirements regarding e.g. gloss or surface feel. If you need expert help and advice in choosing the right product, please contact us.

## Application of the coating

The surface must be prepared for coating by following the procedures for surface preparation as described in EN ISO 12944-4. Before applying the coating, please observe the instruction in our technical data sheets. If you have any further questions regarding application, please feel free to contact our application engineers.

## Coating material

Product group	Product
<b>1K AK Primer</b>	Mipa AK 105-20
<b>1K ESI Zinc rich primer</b>	Mipa 1K-ESI-Zinkstaubprimer High Zinc
<b>2K EP Primer</b>	Mipa EP 100-20   Mipa EP 164-20   Mipa EP 140-30   Mipa EP 564-20
<b>2K PU Primer</b>	Mipa PU 100-20   Mipa PU 164-20   Mipa EA 100-20
<b>2K EP Zinc rich primer</b>	Mipa 2K-Zinkstaubfarbe
<b>1K AK DTM</b>	Mipa AK 225-30   Mipa AK 231-50
<b>1K AK MIO</b>	Mipa AK 555-20
<b>1K AK Topcoat</b>	Mipa AK 230-30   Mipa AK 235-90   Mipa AK 240-90   Mipa AK 255-xx   Mipa AK 260-70   Mipa AK 232-xx
<b>2K EP Topcoat</b>	Mipa EP 200-xx
<b>2K EP MIO</b>	Mipa EP 500-20
<b>2K PU Topcoat</b>	Mipa PU 240-xx   Mipa PU 250-xx   Mipa PU 255-xx   Mipa PU 264-xx   Mipa PU 265-xx   Mipa PU 266-xx   Mipa PU 300-xx
<b>2K PU MIO</b>	Mipa PU 500-20



Air temperature in °C	Dew point temperature (rounded) in °C at a relative air humidity of														
	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
<b>50</b>	28	30	33	35	37	39	40	42	43	44	46	47	48	49	50
<b>45</b>	23	26	28	30	32	34	35	37	38	40	41	42	43	44	45
<b>40</b>	19	22	24	26	28	29	31	32	34	35	36	37	38	39	40
<b>35</b>	15	17	19	21	23	25	26	27	29	30	31	32	33	34	35
<b>30</b>	11	13	15	17	18	20	21	23	24	25	26	27	28	29	30
<b>29</b>	10	12	14	16	18	19	20	22	23	24	25	26	27	28	29
<b>28</b>	9	11	13	15	17	18	20	21	22	23	24	25	26	27	28
<b>27</b>	8	10	12	14	16	17	19	20	21	22	23	24	25	26	27
<b>26</b>	7	9	11	13	15	16	18	19	20	21	22	23	24	25	26
<b>25</b>	6	9	11	12	14	15	17	18	19	20	21	22	23	24	25
<b>24</b>	5	8	10	11	13	14	16	17	18	19	20	21	22	23	24
<b>23</b>	5	7	9	10	12	14	15	16	17	18	19	20	21	22	23
<b>22</b>	4	6	8	10	11	13	14	15	16	17	18	19	20	21	22
<b>21</b>	3	5	7	9	10	12	13	14	15	16	17	18	19	20	21
<b>20</b>	2	4	6	8	9	11	12	13	14	15	16	17	18	19	20
<b>19</b>	1	3	5	7	8	10	11	12	13	15	16	16	17	18	19
<b>18</b>	0	2	4	6	7	9	10	11	13	14	15	15	16	17	18
<b>17</b>	-1	1	3	5	7	8	9	10	12	13	14	15	15	16	17
<b>16</b>	-1	1	2	4	6	7	8	9	11	12	13	14	14	15	16
<b>15</b>	-2	0	2	3	5	6	7	9	10	11	12	13	13	14	15
<b>14</b>	-3	-1	1	2	4	5	6	8	9	10	11	12	12	13	14
<b>13</b>	-4	-2	0	1	3	4	6	7	8	9	10	11	11	12	13
<b>12</b>	-5	-3	0	0	2	3	5	6	7	8	9	10	10	11	12
<b>11</b>	-5	-3	-2	0	1	2	4	5	6	7	8	9	9	10	11
<b>10</b>	-6	-4	-3	-1	0	1	3	4	5	6	7	8	8	9	10
<b>8</b>	-8	-7	-5	-3	-2	0	1	2	3	4	5	6	6	7	8
<b>6</b>	-10	-8	-7	-5	-3	-2	-1	0	1	2	3	4	4	5	6
<b>4</b>	-12	-10	-8	-7	-5	-4	-3	-2	-1	0	1	2	2	3	4
<b>2</b>	-14	-12	-10	-9	-7	-5	-4	-3	-3	-2	-1	0	1	1	2
<b>0</b>	-15	-14	-12	-10	-8	-7	-6	-5	-4	-3	-2	-2	-1	0	0

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