



# ISO 12944

Corrosion protection of steel structures  
by protective paint systems

# Introduction

The purpose of this document is to help you select the correct coating system by Grand Polycoats (GP) to protect your assets against corrosion.

All steel structures, facilities and installations exposed to the atmosphere, submerged under water or in soil, suffer from corrosion. Consequently, they require protection from the harm caused by corrosion during their lifetime. Throughout this document, you will find important information about paint technology along with criteria for the right paint selection and surface preparation requirements.

This document has been prepared in accordance with the latest edition of the International Standard ISO 12944 "Paints and varnishes- Corrosion protection of steel structures by protective paint systems", whose latest version was updated in 2018. GP's own guidelines and recommendations for coating protection technology are also included.



## What is ISO12944?

Unprotected steel in the atmosphere is always subject to corrosion, unless it is protected by a coating. ISO12944 is an industry standard, specifically for corrosion protection of steel structures, by usage of protective paints and coating systems. This standard was originally released in 1998,

with modifications thereafter, and has been compiled by industry experts from all over the world. This has helped to capture a holistic view of practices and atmospheric conditions across the world to create a mutually beneficial standard. Key components such as – environment classification, durability, protective paint systems, laboratory test methods and test methods for offshore structures, have been taken into consideration while developing the system.

## Classification of Environment

When selecting a paint system, it is very important to define the conditions in which the structure, facility or installation is to operate. To establish the effect of environmental corrosion, the following factors must be taken into consideration:

- Humidity and temperature (service temperature and temperature gradients)
- The presence of UV radiation
- Chemical exposure (e.g. specific exposure in industrial plants)
- Mechanical damage (impact and abrasion)

The dampness and pH of the terrain and biological exposure to bacteria and micro-organisms are also of critical importance. In case of presence of water, the type and chemical composition of the water present is also significant.

The nature of the environment and the contributing conditions of corrosion will have an effect on:

- Type of paint used for protection
- Total thickness of a paint system
- Surface preparation required
- Minimum and maximum recoating intervals

Note that the more corrosive the environment, the more thorough the surface preparation required. The recoating intervals must also be strictly observed.



Category	Corrosion Type	ISO 12944
C1	Very Low	Dry or cold with very low pollution
C2	Low	Temperate low pollution
C3	Medium	Temperate, medium pollution, tropical low pollution
C4	High	Temperate with high pollution, tropical with moderate pollution
C5	Very High	Temperate and subtropical with very high pollution and/or significant chloride effects
CX	Extreme	Extreme industrial areas, offshore areas, salt spray
IM1	Fresh Water	River installations and hydro plants
IM2	Sea or Brackish Water	Immersed structures without cathodic protection
IM3	Soil	Buried structures
IM4	Sea or Brackish Water with Cathodic Protection	Immersed structures with cathodic protection

Note: This standard does not have recommendations for IM systems. Should you wish to get more information on the same, please contact your local GP office.

## Durability Required for Paint System

Durability of coating system can be improved with additional technical considerations at the planning and design stage to improve the expected life of its coating system and hence the structure. This can help the user to set up a realistic maintenance program. Main factors influencing the durability choice include:

Atmospheric Conditions

Structure Design

Accessibility of Asset

Application Conditions

ISO 12944 categories for Durability are defined as:

Durability Category	Years to First Major Maintenance
Low (L)	Up to 7 years
Medium (M)	7-15 years
High (H)	15-25 years
Very High (VH)	More than 25 years



# Types of Surface

## I. Steel Surfaces

To guarantee that a coating system delivers long lasting protection, it is essential to ensure that the right surface preparation is carried out before any paint is applied. For this reason, the initial surface condition of the steel needs to be evaluated.

Generally speaking, the condition of steel surface prior to painting falls into one of the three following categories:

- a) Bare steel structure with no previous protective paint coatings
- b) Steel surface coated with a shop primer
- c) Coated steel surfaces that need maintenance

### a) Bare Steel Structure with No Previous Protective Coatings

Steel surfaces that have never been protected by paint coatings may be covered to a varying extent by rust, mill scale or other contaminants (dust, grease, ionic contamination/soluble salts and other residues.) The initial condition of such surfaces is defined by ISO 8501-1 standard: "Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness"

### b) Steel Surface Covered with Shop Primers

Shop primer is a thin film of coating, usually 20-25 micron, which is applied to protect steel plates and structural components used in the prefabrication stage before the main coating system is applied. Steel plates and structural components coated with shop primers can be welded upon safely.

Prior to the application of the coating system, shop primer must be partially or completely removed from the surface. This is determined by two key factors:

- The compatibility of an already applied shop primer and the finishing paint system
- The surface profile achieved during preparation prior to a shop primer application, i.e. whether the profile is suitable for a finishing paint system

### c) Steel Surface Coated with a Paint System that Needs to be Maintained

The condition of an existing paint system must be assessed before maintenance work is carried out. During assessment, it is decided whether partial removal or complete removal of existing system is to be done.

## II. Hot Dipped Galvanized Steel, Aluminum and Stainless Steel Surfaces

In addition to standard steel, other non-ferrous materials can be used in construction, such as hot dipped galvanized steel, aluminum or high-alloy steels. All of them require a separate approach in terms of surface preparation and the selection of a paint system.

### a) Hot Dipped Galvanized Steel

When galvanized steel is exposed to the atmosphere, zinc corrosion residue forms on its surface. These products vary in their composition and adhesion and therefore influence the adhesive properties of applied paint systems. Pure zinc (zinc within hours of the galvanization process) or seasoned zinc, is considered the best surface for painting. For stages in between, it is recommended that the zinc corrosion products are removed by washing the surface with mixture of water and an alkaline detergent.

The mixture must be applied to the surface and then rinsed off after half an hour, preferably at high pressure. If it is necessary then washing should be combined with scrubbing using a special hard nylon bristle brush, abrasive paper or cleaning with abrasive glass balls and sand. For coating systems in lower corrosion classes, special adhesion primers are recommended. For coating systems in higher corrosion classes, surface preparation should include mechanical preparation of the surface, preferably by abrasive sweep blasting with a mineral abrasive.

### b) Aluminum and Stainless Steel

In the case of aluminum and stainless steel, to obtain better adhesion of the paint system, it is recommended that abrasive sweep blasting is carried out with a mineral abrasive.



# Surface Preparation

There are many ways to classify steel surface preparation grades but this study focuses on those outlined below.

## Grades of a surface according to the ISO 8501 standard

Standard surface preparation cleanliness standard as per ISO 8501	
<b>Sa 3</b>	<b>Blast-cleaning to visually clean steel</b> When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and shall be free from mill scale, rust, paint coatings and foreign matter. It shall have a uniform metallic colour.
<b>Sa 2 ½</b>	<b>Very thorough blast-cleaning</b> When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from mill scale, rust, paint coatings and foreign matter. Any remaining traces of contamination shall show only as slight stains in the form of spots or stripes.
<b>Sa 2</b>	<b>Thorough blast-cleaning</b> When viewed without magnification, the surface shall be free from visible oil, grease and dirt and from most of the mill scale, rust, paint coatings and foreign matter. Any residual contamination shall be firmly adhering.
<b>Sa 1</b>	<b>Light blast-cleaning</b> When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter.

Standard preparation grades for primary surface preparation by hand cleaning	
<b>St 2</b>	<b>Thorough hand and power tool cleaning</b> When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter.
<b>St 3</b>	<b>Very thorough hand and power tool cleaning</b> As for St 2, but the surface shall be treated much more thoroughly to give a metallic sheen arising from the metallic substrate.



# Laboratory Test Methods

Category	Low (<7years)	Med (7-15years)	High (15-25years)	Very High (25+years)
C2	Non-Cyclic Testing Durations as 1998 (E) revision ISO 6270/ ISO 9227			Non-Cyclic Testing: Linear Durations TBC ISO 6270/ ISO 9227
C3				As C5 High: Phased Cyclic Testing: 10 Cycles
C4				As C5 High: Phased Cyclic Testing: 10 Cycles
C5	Non-Cyclic Testing Durations as 1998 (E)	Phased Introduction of ISO 12944-9 Cyclic Testing: 10 Cycles Non Cyclic Testing valid for 5 years		Immediate Introduction of Cyclic Testing: 16 Cycles
CX	25 cycles			

## A Selection of Our Systems

For all of its recommended systems, Grand Polycoats conducts rigorous on-field and in-house tests to assess the performance of its systems. Over and above these tests, GP also conducts testing at either ISO 17025 certified third-party laboratories or laboratories that carry global accreditations for the most common environmental conditions. Apart from the recommended products, there are new and unique products that are tested and introduced to deliver a better product performance to our customers. A complete list of products and their testing can be provided by contacting your local GP representative.

Disclaimer: All suggested systems are educational in nature and should not be taken as a specific recommendation made by GP. The exact system specification will depend on a number of factors. Unless GP has made a specific recommendation after being consulted, GP will not accept any liability arising out of the use of the systems suggested in this brochure.

### C2

Durability	Layer 1			Layer 2		
	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)
L	EP	GP Prime 216	80-100	PUR	GP Bond 144 HBHS	50-60
M	EP	GP Prime 216	100-120	PUR	GP Bond 144 HBHS	50-60
H	EP	GP Prime 216	120-140	PUR	GP Bond 144 HBHS	50-60
VH	EP	GP Prime 216	140-160	PUR	GP Bond 144 HBHS	50-60

### C3

Durability	Layer 1			Layer 2			Layer 3		
	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)
L	EP	GP Prime 216	80-100	PUR	GP Bond 144 HBHS	50-60	-	-	-
M	EP	GP Prime 216	100-140	PUR	GP Bond 144 HBHS	50-60	-	-	-
H	EP Zn	GP Prime 205 HV	50-60	EP / EP MIO	GP Prime 216	120-140	PUR	GP Bond 144 HBHS	50-60
VH	EP Zn	GP Prime 205 HV	50-70	EP / EP MIO	GP Prime 216	120-160	PUR	GP Bond 144 HBHS	50-70

# C4

Durability	Layer 1			Layer 2			Layer 3		
	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)
L	EP Zn	GP Prime 205 HV	40-50	EP / EP MIO	GP Prime 216	100-120	PUR	GP Bond 144 HBHS	50-60
M	EP Zn	GP Prime 205 HV	40-50	EP / EP MIO	GP Prime 216	120-140	PUR	GP Bond 144 HBHS	50-60
H	EP Zn	GP Prime 205 HV	50-75	EP / EP MIO	GP Prime 216	150-180	PUR	GP Bond 144 HBHS	50-60
VH	EP Zn	GP Prime 205 HV	50-75	EP / EP MIO	GP Prime 216	180-200	PUR	GP Bond 144 HBHS	60-80

# C5

Durability	Layer 1			Layer 2			Layer 3		
	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)
L	EP Zn	GP Prime 205 HV	40-50	EP	GP Prime 216	60-80	PUR	GP Bond 144 HBHS	50-60
M	EP Zn	GP Prime 205 HV	40-50	EP / EP MIO	GP Prime 216	140-160	PUR	GP Bond 144 HBHS	50-60
H	EP Zn	GP Prime 205 HV	50-75	EP / EP MIO	GP Prime 216	180-200	PUR	GP Bond 144 HBHS	60-80
VH	EP Zn	GP Prime 205 HV	50-75	EP / EP MIO	GP Prime 216	220-240	PUR	GP Bond 144 HBHS	60-80

# CX

Layer 1			Layer 2			Layer 3		
Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)	Chemistry	Product	DFT (µm)
EP Zn	GP Prime 205 HV	60-75	EP	GP Primeguard 235	250-280	PUR	GP Bond 144 HBHS	60-80
ESI Zn	GP Prime 402	60-75	EP	GP Primeguard 235	250-280	PUR	GP Bond 144 HBHS	60-80

## GLOSSARY

**L** = Low

**H** = High

**EP Zn** = Epoxy Zinc Rich Primer

**EP** = Epoxy High Build Primer / Intermediate Coat

**PUR** = Acrylic Aliphatic Polyurethane

**M** = Medium

**VH** = Very High

**ESI Zn** = Inorganic Ethyl Zinc Silicate Primer

**EP MIO** = Epoxy High Build MIO Intermediate Coat



**Note:**

- 1) GP Prime 205 HV can be replaced with GP Prime 402 where Inorganic Zinc Silicate is required.
- 2) GP Primeguard 235 is recommended as an alternate to GP Prime 216 for all the above applications.
- 3) If MIO is specified or required as an intermediate coat then apply one coat of GP Prime 216 or GP Primeguard 235 in solid color and one coat in MIO.
- 4) GP Bond 177 HBHS may be used as a replacement for GP Bond 144 HBHS for higher volume solid requirement.

\* Please contact Grand Polycoats representative for any variation in system or to customize system as per project consultant's requirement.

## An Easy Guide to Selection Through the Given Example:

Follow the three step guide below to identify the correct coating requirement selection for your project.



# GP Products for ISO 12944 Coating Systems

## Zinc Primers

### GP PRIME 402

Two-component, moisture-curing zinc (ethyl) silicate coating

- Complies with the compositional requirements of SSPC-Paint 20, Level 1
- Suitable as a system primer in various paint systems based on binders
- Provides excellent corrosion protection for steel substrates with a suitable top coat

### GP PRIME 205HV

Two-component, high solids, zinc rich epoxy primer

- Designed as a system primer in various paint systems for aggressive environments
- Quick-drying, can be over coated after a short interval
- Complies with the compositional requirements of ISO 12944-5

## Primers and Intermediate Coats

### GP PRIME 216 HBHS

Two-component, high solids, zinc phosphate epoxy primer and intermediate coat

- Provides excellent corrosion resistance to atmospheric exposure conditions
- Cures at temperatures down to 5°C
- Speed curing in steel fabrication

### GP PRIMEGUARD 235

Two-component, high solids, epoxy primer cum intermediate coat

- Cures at low temperatures up to 5°C
- High performance, self-priming universal epoxy
- Provides surface tolerance and resistance to abrasion

### **GP PRIMEGUARD 235 MIO**

Two-component, high solids, high-build, epoxy intermediate coat

- General-purpose epoxy intermediate coat in protective coating systems, for steel and concrete structures exposed to atmospheric land or marine conditions
- Can be recoated with various two-component and conventional coatings, even after long weathering periods
- Easy application by airless spray

### **GP SUPERGUARD GLASS FLAKE**

Two-component, high-build, polyamine adduct-cured epoxy glass flake coating

- Primarily designed for use in offshore splash zone maintenance and internal of tank coating
- Protects against environmental deterioration
- Provides long-term protection in a single-coat application

## **Topcoats**

### **GP BOND 144 HBHS**

Two-component, medium solids, aliphatic acrylic polyurethane top coat

- 57% volume solids
- Product conforms to ISO 12944-5 for all C2 to CX system
- Provides high resistance against adverse environmental conditions

### **GP BOND 177 HBHS**

Two-component, high solids, aliphatic acrylic polyurethane top coat

- 65% volume solids
- Provides high resistance against adverse environmental conditions

# **Products for Pipeline and Mounded Bullets**

### **GP TOUGHGUARD 5000**

Two-component, fast curing, 100% solid, polyurea elastomeric coating

- Application by dual-component tip mixing impingement spray gun
- Mixing ratio 1:1
- Balanced elongation and tensile properties
- Product exhibits excellent abrasion and corrosion resistance
- Designed for concrete structure, sewage channel, truck bed liner, and cooling towers
- Provides long-term protection in single coat application



### **GP TOUGHGUARD 5001**

Two-component, 100% solid, polyurethane elastomeric coating

- Application by dual-component airless spray machine with static mixer arrangement
- Mixing ratio 3:1
- Product exhibits excellent abrasion, corrosion and chemical resistance
- Designed for external of pipeline
- Provides long-term protection in single coat application
- Preferred product for on-site application
- Fast drying

### **GP TOUGHGUARD 5002**

Two-component, 100% solid, highly cross-linked polyurethane elastomeric coating

- Application by dual-component airless tip mixing spray gun with static mixer arrangement
- Mixing ratio 2.5:1
- Conforms to AWWA C222 standard
- Product exhibits excellent abrasion, corrosion and chemical resistance
- Designed for external of pipeline
- Provides long-term protection in single coat, high film built application
- Ultra-fast drying

### **GP HBSL EPOXY COATING**

Two-component, air-drying, solvent-less epoxy coating for internal of water pipeline

- Conforms to BS6920 and WRAS standard
- Recommended product for potable water pipeline and storage tanks
- Product exhibits excellent chemical, solvent, and water resistance coupled with excellent abrasion resistance
- Product conforms to 21 CFR 175-300 of US FDA

### **GP PRIME 1005**

Two-component, fast curing, 100% solid, polyurethane primer for elastomeric coating application

- Application by airless spray gun
- Mixing ratio 3:1
- Provides excellent adhesion to metal and subsequent coat
- Designed for metal structure

### **GP PRIME 708**

Two-component, fast curing, 100% solid, primer for polyurea coating

- Application by airless spray gun, brush, and roller
- Mixing ratio 3:2
- Provides excellent adhesion to substrate and subsequent coat
- Recommended for concrete, metal, wood and other porous substrate

Apart from the above system, Grand Polycoats also offers a variety of highly specialized technologies such as:

- Isocyanate Free Polyurethane Coatings
- Highly Durable Polysiloxane Coatings
- Hard yet Flexible Polyaspartic Coatings for a Variety of Applications
- Extremely Durable Fluorocarbon FEVE Products
- Variety of Floor Coatings and Special Polymer Coatings for Specific Application Requirement

**To know more, please refer our website [www.grandpolycoats.com](http://www.grandpolycoats.com) or contact your local GP representative.**





# About the Company

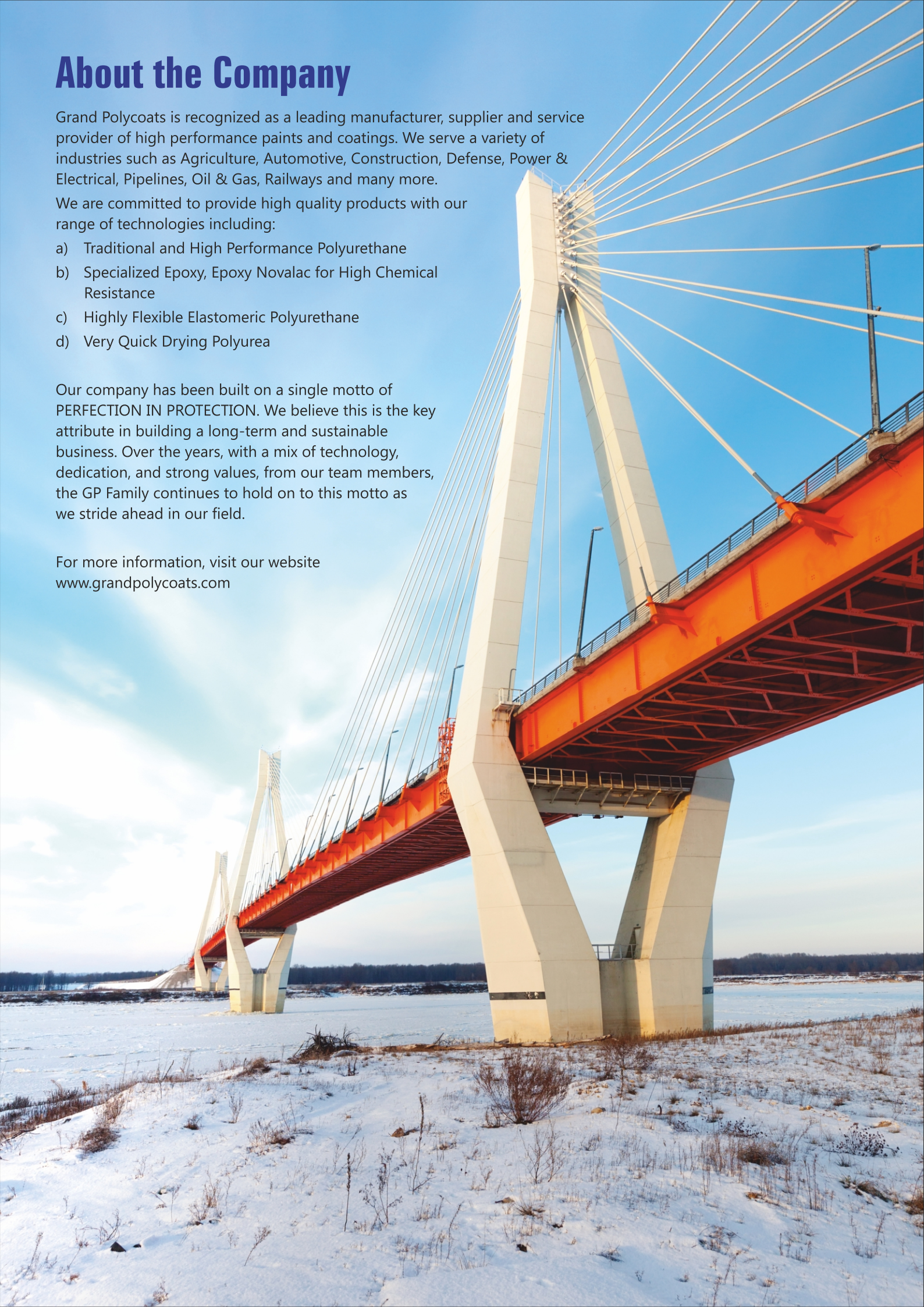
Grand Polycoats is recognized as a leading manufacturer, supplier and service provider of high performance paints and coatings. We serve a variety of industries such as Agriculture, Automotive, Construction, Defense, Power & Electrical, Pipelines, Oil & Gas, Railways and many more.

We are committed to provide high quality products with our range of technologies including:

- a) Traditional and High Performance Polyurethane
- b) Specialized Epoxy, Epoxy Novalac for High Chemical Resistance
- c) Highly Flexible Elastomeric Polyurethane
- d) Very Quick Drying Polyurea

Our company has been built on a single motto of **PERFECTION IN PROTECTION**. We believe this is the key attribute in building a long-term and sustainable business. Over the years, with a mix of technology, dedication, and strong values, from our team members, the GP Family continues to hold on to this motto as we stride ahead in our field.

For more information, visit our website  
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