Coating Systems for the Nuclear Industry

As a long term supplier of high technology, high performance coating systems to the aerospace and allied industries, Indestructible Paint have built up a portfolio of engineering coatings that can be used across many diverse engineering industries.

Recent developments in our company strategy have resulted in our growing involvement with the Nuclear Industry, to build on our experience of supply of coatings to the nuclear division of a major UK plc.

Coatings for use in the many areas of manufacturing covered by the Nuclear Industry will be quite diverse, and range from high temperature, high corrosion resistant sacrificial, chemical and corrosion resistant coatings, through low friction coatings/dry film lubricants to fire resistant and intumescent. This brochure gives a taster of the types of coatings that can be considered.

Surface Preparation

Any coating system used in any industry will only be as good as the surface preparation, and this will be especially so in high performance industries. The minimum requirement is a full degrease to remove all surface contaminants and to allow correct wetting of the surface by the coating. This will allow a minimum of good adhesion, but will provide little to the performance of the total system.

On steels, it is more usual to include either grit blasting or shot blasting as a preparation method on technical and heavy duty components. In heavy duty industries, shot blasting to 'Swedish Standard SA2½' would be typical. On engineering components it is more usual to grit blast using 120/220 aluminium oxide grit. In both cases any surface contaminants and loose, flaking metal is removed, and an even surface is provided for subsequent coating. Where a higher quality decorative finish is specified, a 'phosphate' pre-treatment system can be employed where a chemical treatment to the surface of the steel after degreasing is conducted which deposits a thin chemical layer to enhance adhesion and corrosion resistance.

For aluminium and magnesium, it is usual to utilise a chemical surface treatment, either by simple immersion or anodic process. Traditionally these have been chromate containing chemical solutions, but recent legislation, and a need to be more environmentally aware, has seen the introduction of chrome free alternatives. Use of a wash (or etch) primer would be a minimum. Both chrome and chrome free variants are available.
IP9064-4853/4 chromate or **IP3-4853/4 chrome free** are suitable for this use.

Pre-treatment of composites and plastics before application of a surface coating are less involved, and usually only require a simple cleaning and degreasing, but it needs to be remembered that solvent degreasing of plastics needs care to ensure the solvent does not attack the grade of plastic.

Temperature and Corrosion Resistant Coatings

The definition of high temperature resistant coatings can mean different things to different industries. In some cases, 150°C is regarded as high temperature, whilst certainly in aero engineering, temperatures of up to 900-1000°C can be considered normal.

In several cases, this high temperature performance can be allied to a requirement for high corrosion resistance, and several systems have been formulated to meet these two needs.

Diffusion coating, **Ipal IP1041** is an inorganic based aluminium/silicon coating, which on processing diffuses with the outer 'skin' of the base metal to leave a coating resistant to temperatures above 850°C in sour gas atmospheres.

Similar inorganic chemistry is used as the base for the **Ipcote Range** of sacrificial aluminium coatings, but with lower temperature processing these coatings are highly chemical and corrosion resistant up to temperatures of 600-650°C.

Operating up to similar temperatures, but acting as a barrier coating, **IP9029** is an organic alternative, which provides lower, but still effective, corrosion resistance, with the benefit of being processed at a much lower temperature.

Where it is impractical to use baking or stoving products there are alternatives that will air dry, or cure at room temperature. **IP9138** is an air drying aluminium coating that will work up to 350°C with good corrosion performance. The **IP46 Range**, which is also an air drying product, will run continuously at 400°C, with short exposure 'peaks' of up to 600°C. However, the resin system used will provide little corrosion protection.

At lower temperatures, there is a wider range of products that can be selected. Up to 180-200°C, the **Rockhard Range** of both **single component baking** and **two component 'room temperature' cure** materials are an obvious choice. These provide exceptional resistance to a wide range of industrial chemicals, and when used with the relevant anti-corrosive primer, will also provide high corrosion resistance.

Chemical and Corrosion Resistance

Although as noted above, a majority of our coatings will offer chemical and corrosion resistance in addition to high temperature performance, there will be instances where either or both chemical or corrosion resistance will be the driver in the coating selection.

By correct use of an anti-corrosive primer, allied to compatible topcoats, systems with excellent performance are readily achieved.

Depending upon processing capability, a choice of systems is available.

Where baking/stoving up to a processing temperature of 180-190°C can be achieved, the Rockhard range of single component coatings will meet most requirements.

Both chromate and chrome free primers are available; **700-155-003 chrome** and **IP985-6500 chrome free** are widely used on various grades of aluminium in the aerospace and allied industries and meet the performance requirements of internationally recognised standards. When over-coated with **IP985 Range topcoats**, systems with excellent chemical and corrosion resistance are produced.

For magnesium, it is more usual to use a sealant as a first coat, which on application will penetrate the pores of the magnesium casting or pressing, and prevent moisture ingress and thus corrosion. Two versions are available: **576-450-002-R1** cures to a deep chocolate brown, whilst **IP985-547** remains 'water white'. Typically a multi-coat process of up to 3 coats of either sealer is used, but either can be over-coated with primer and/or finish coats if colour identification is required.

Where it is necessary to use air drying, or room temperature cure materials, two component epoxy coatings would be the choice. The **IP9064 Range** of standard VOC and the **IP3 Range** of low VOC materials will give similar performance.

Both chromate and chrome free primers are available in both ranges. In the standard VOC range, chromate primer **IP9064-6362** and chrome free primer **IP9064-6500** would be over-coated with **IP9064 Range** topcoat products, available in a wide range of colours and gloss levels. Low VOC primers **IP3-6362** chromate and **IP3-6700**-chrome free would similarly be over-coated with **IP3 Range** topcoats.

Illustrative charts showing the chemical resistance of both baking and air drying versions are available. Please consult our Sales Department for more information.

Extra Durability

In several cases, coatings are required that will give durability in external applications, including resistance to UV, rain, erosion etc. Whilst epoxy systems will give excellent chemical and corrosion resistance, they are susceptible to ultra violet light and will eventually 'chalk' and breakdown.

The **IP6 Range** of low VOC polyurethanes, when applied over either **IP9064** or **IP3** primers, will give high exterior durability. Based on coatings specified for the external surfaces of both military and commercial aircraft, this system will provide chemical and corrosion performance allied to retention of colour and gloss.

Variants of the system are available to provide increased resistance to both particle and rain erosion.

Intumescent Coatings

Intumescent coatings are used in a multitude of areas to protect the coated item in a fire. In building applications, 'thick film' systems are used to protect steel work etc across a wide variety of building uses.

In engineering, a 'thin film' system, comprising of a primer coat, intumescent coat and finish/seal coat, is more commonly used.

On metals, it is normal to apply an epoxy anti-corrosive primer, whilst on composites an epoxy sealer would be a suitable choice. For composites, **IP2439** two component sealer would be an ideal choice.

The intumescent coating, **IP9189A/B**, is again a two-component material, which is applied as a multi-coat system. The coating thickness is a factor in performance; for fire resistance up to 5 minutes, a coating of 350-400 microns would be sufficient; for 15 minutes fire proof up to 600-800 microns would be required.

A seal/finish coat is often applied over the intumescent coat. For chemical resistance, our **IP3 Range** epoxy would be ideal. For external durability, we would recommend our **IP6 Range** polyurethane.

Dry Film Lubrication

The reduction of fretting and galling is a major issue within many industrial applications, as wear created by either similar or dissimilar metals rubbing can cause machinery downtime and cost.

The use of lubrication to prevent these types of issues is well proven, but the use of liquid lubricants requires regular maintenance.

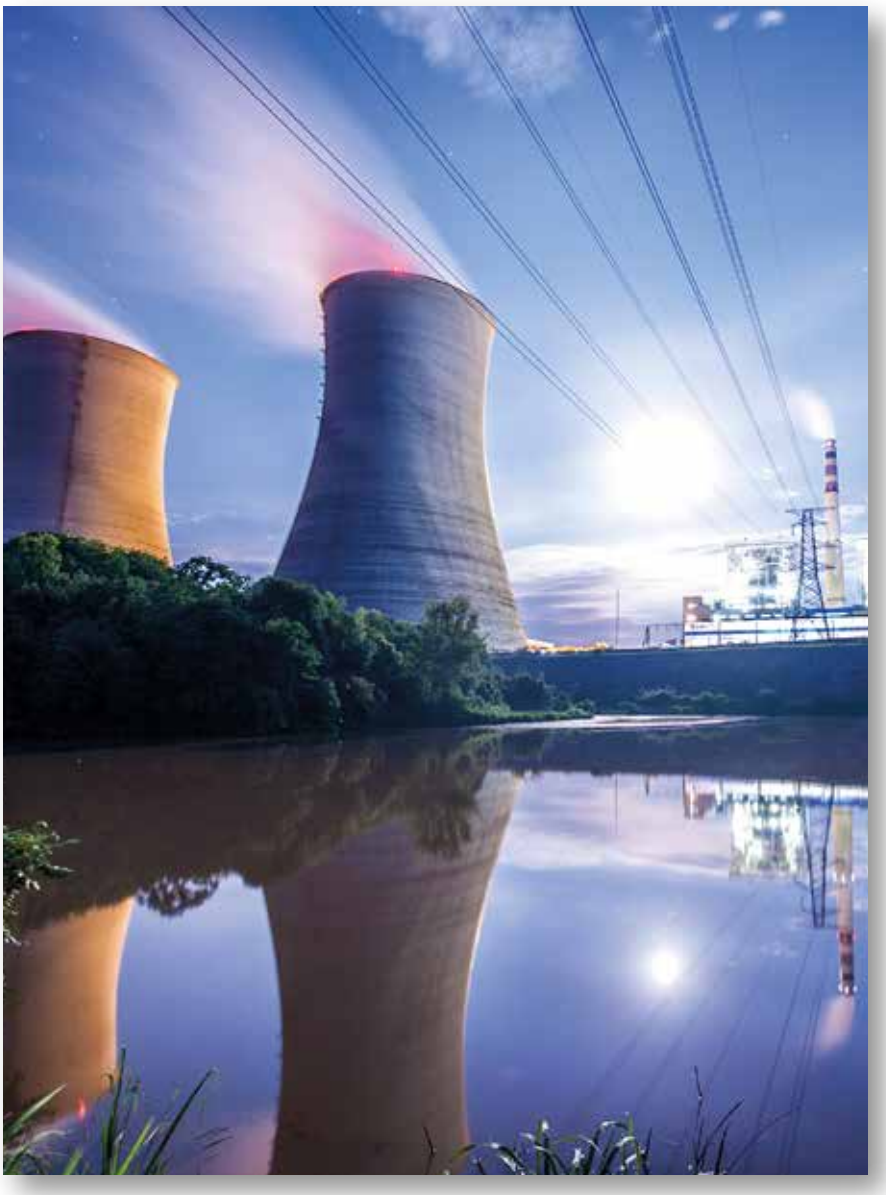
By implementing a dry film lubrication system, most of these concerns are reduced or even eliminated.A range of products is available, depending upon the application and use requirements, which includes, in addition to lubrication, resistance to increasing temperatures and chemical and corrosion resistance.

For lubrication at low temperature, up to 180-200°C, the use of PTFE would be typical. Two systems are available; our IP9286 Range, where the lubricant is carried in a polyimide system is used across a wide range of applications and gives excellent higher temperature resistance. For greater chemical resistance, the IP7985 Range would be more applicable, where the PTFE is carried in a baking epoxy system. An additional advantage of the IP7985 Range is the ability to supply white and pastel colours as required.

As operating temperature requirements increase, the next choice would be PL237, which uses a MoS_2 lubricant, again carried in a baking epoxy base; this will operate at temperatures up to 300°C, again with good chemical resistance. Moving higher in temperature, the use of graphite in a higher temperature operating binder is IP9136, which will allow use at temperatures up to 450°C.

The graphite lubricant is carried in a silicone/epoxy matrix which provides excellent temperature and chemical resistance.

At temperatures above 450°C, the use of Boron Nitride would be the choice. At these elevated temperatures, most organic binders would fail, so this product, PL181, is formulated using an inorganic silicate system. Whilst this will provide lubrication up to 600°C, chemical resistance will be lower than with lower temperature suitable coatings.



For more detail on any of the coatings discussed, please contact our Technical Sales Team at our Birmingham, UK office.

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