

TATA STEEL



Colorcoat HPS200 Ultra[®] technical details

Super durable, guaranteed performance pre-finished steel



Introduction

Colorcoat HPS200 Ultra® is a super durable pre-finished steel product from Tata Steel. It offers exceptional and proven weather resistance and long-term colour and gloss retention. Its performance characteristics, together with the results of its rigorous testing, are detailed in this technical brochure.

Contents

Colorcoat® pre-finished steel	3
Super durable Colorcoat HPS200 Ultra®	4
Robust paint technology	5
Product of sustained evolution	6
Steel substrate	8
Double-sided Colorcoat HPS200 Ultra®	9
Unrivalled Galvalloy® corrosion protection	10
Product performance	12
Abrasion resistance	13
Corrosion resistance	14
Interior performance - corrosion resistance	18
Chemical resistance	21
UV resistance	22
Solar reflectivity	26
Fire performance	28
Confidex® Guarantee	30
Sustainability	32
Colour reassurance	34
Colorcoat® services	35

Colorcoat® pre-finished steel

Expertise

Tata Steel has been developing and manufacturing the Colorcoat® range of pre-finished steel for five decades. Over the years, our developments have been at the forefront of new advances in pre-finished steel resulting in longer lasting products and unprecedented colour ranges.

We continue to apply our knowledge and understanding to ensure that Colorcoat® remains a market-leading brand. We actively engage with architects and other specialists to build on our experience and detailed knowledge of the construction market and to lead the way in developing new products. Sustainability is a key driver for the Construction industry with an increasing demand to build with this in mind. Tata Steel have an in depth knowledge of the environmental impacts of not only Colorcoat® products but also the various roof and cladding systems that they are part of. This understanding means that we are able to support you in designing sustainable building envelope solutions.

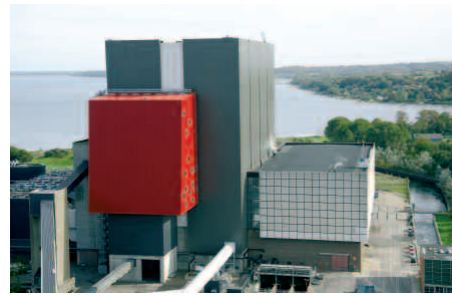
At Tata Steel we are committed to making products that meet the needs of the market and to making them in the most responsible way. Our commitment to sustainability also means we actively manage our impacts and contribution throughout the full life of our products - with our suppliers, within our own operations, through the supply chains we serve and by taking responsibility for recycling steel. Colorcoat HPS200 Ultra® has achieved BES 6001 responsible sourcing certificate which reinforces our commitment to sustainability.

Quality

With a world-class reputation in steel, Tata Steel products and services are widely used in the construction market. Utilising steel produced by Tata Steel in the UK, Colorcoat HPS200 Ultra® is manufactured to exacting standards at Shotton in North Wales.

Our products are subject to carefully monitored processes and comprehensive, independent testing to ensure compliance with the highest and most demanding European standards. The superior and proven long-term performance of our pre-finished steel products means we are able to guarantee Colorcoat HPS200 Ultra® for up to 40 years for industrial and commercial buildings. Colorcoat HPS200 Ultra® is also supported by a comprehensive range of services, technical advice and guidance.

Super durable Colorcoat HPS200 Ultra®



Colorcoat HPS200 Ultra® pre-finished steel combines outstanding performance with exceptional durability. The product is built to last – and exhaustive testing proves that it does. With its market-leading guarantees and excellent sustainability credentials, Colorcoat HPS200 Ultra® is suitable for many different construction applications.

The choice of a pre-finished steel product is fundamental to both the long-term performance and visual appearance of the building envelope. Colorcoat HPS200 Ultra® is designed to withstand the most demanding and aggressive environments – both external and internal, providing exceptional corrosion resistance and outstanding colour and gloss retention.

It has been subjected to comprehensive natural and accelerated testing, often way beyond the required standards. Colorcoat HPS200 Ultra® is used in a wide range of industrial and commercial buildings and these real-life scenarios provide further evidence of the product's super durable qualities.

Colorcoat HPS200 Ultra® features and benefits:

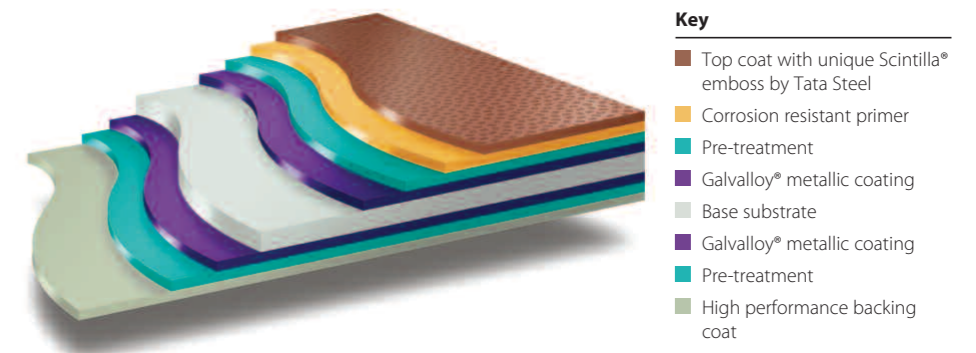
- Optimised Galvalloy® metallic coating for exceptional corrosion resistance and cut edge protection.
- Surpasses requirements of Ruv4 and RC5 as per EN 10169 providing excellent colour and gloss retention and corrosion resistance.
- Scintilla® embossed as a mark of authenticity from Tata Steel.
- Made in the UK for a lower carbon footprint and certified to BES 6001 Responsible Sourcing standard.
- Confidex® Guarantee for up to 40 years for the weatherside of industrial and commercial buildings with no inspection or maintenance to maintain its validity.
- Can be used under photovoltaic (PV) frame modules with no reduction in guarantee length ensuring all parts of the roof are covered for the same duration of the Confidex® Guarantee.
- A project based warranty outside Confidex® zones may be available on a case by case basis for standard cladding applications.
- Exceeds requirements of CPI5 as per EN 10169 demonstrating excellent barrier properties when used internally.
- Available with Confidex Sustain® to offer the world's first CarbonNeutral® building envelope.
- Standard sizes are available on short production lead times.
- BBA certified for durability in excess of 40 years.
- Double-sided option providing a robust barrier on the reverse side of the steel substrate for buildings with demanding internal and external environments.
- Independently tested for liberation of volatile organic compounds (VOC) against EN ISO 16000-9 and achieved an A+ rating.
- Fully REACH compliant and free of chromates including hexavalent chrome.
- Fully recyclable.

Robust paint technology

The multi-layered structure of Colorcoat HPS200 Ultra® incorporates a unique protective layer and the latest polymer technology. This means that Colorcoat HPS200 Ultra® is strong, super durable and maintains its appearance for longer.

Pre-finished steel comprises a number of paint layers and treatments that are applied to the steel in an automated and carefully controlled process. Each layer has a particular function. The synergistic effect of these various layers ensures a material that is robust, versatile and aesthetically pleasing.

Figure 1. Colorcoat HPS200 Ultra® layers illustration



Multi-layered functionality

The functional layers of Colorcoat HPS200 Ultra® combine to deliver super durability and robustness. The Galvalloy® metallic coating, pre-treatment and primer provide unrivalled corrosion resistance even at the cut edges.

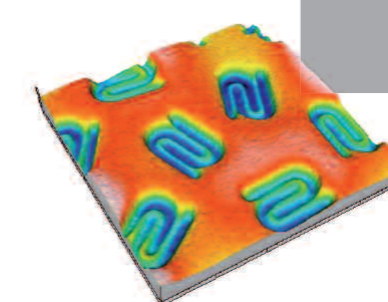
The unique topcoat formulation (nominal 200 microns) utilises leading polymer technology, which provides abrasion, chemical and UV resistance.

Unique Scintilla® emboss

Unique to Colorcoat HPS200 Ultra® the Scintilla® emboss has been developed with a depth of only nominal 50 microns, which makes it less likely to trap dirt than deeper leathergrain embosses therefore making the pre-finished steel easier to clean whilst being more robust.

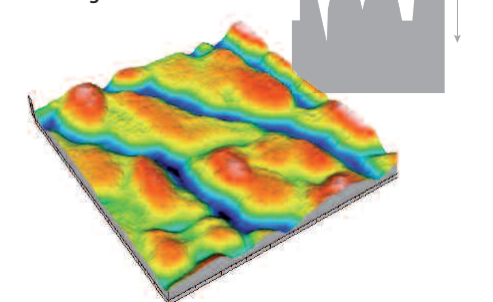
Unlike standard leathergrain patterns the emboss is subtle and does not detract from the overall appearance of the building, looking smooth and creating a modern building appearance from a distance. The Scintilla® emboss provides a unique guarantee of authenticity, and an overall thicker protective topcoat from Tata Steel.

Figure 2. Scintilla® emboss



Nominal depth of only 50 microns. Blue denotes depth of emboss.

Figure 3. Leathergrain emboss



Nominal depth of 70 microns. Blue denotes depth of emboss.

Product of sustained evolution

Colorcoat HPS200 Ultra® is the result of 50 years of sustained research, development and investment. We apply our technical expertise and market knowledge to ensure that our pre-finished steel is innovative and enhanced to meet the demands of an evolving industry.

In the 1960s we were the first company in Europe to develop and manufacture a 200 micron plastisol.

Since then, our team of researchers has continued to lead the way with new developments to improve our products and services. These include long-lasting, guaranteed protection from corrosion through the use of our unique Galvalloy® metallic coating and a step change in topcoat performance through the utilisation of a customised polymer.

Evolution of performance

The development of Colorcoat HPS200 Ultra® has been driven and guided by many factors. These include legislative changes, aesthetic trends, technological advances and increasing demands for robust, long-lasting buildings with low life cycle costs.

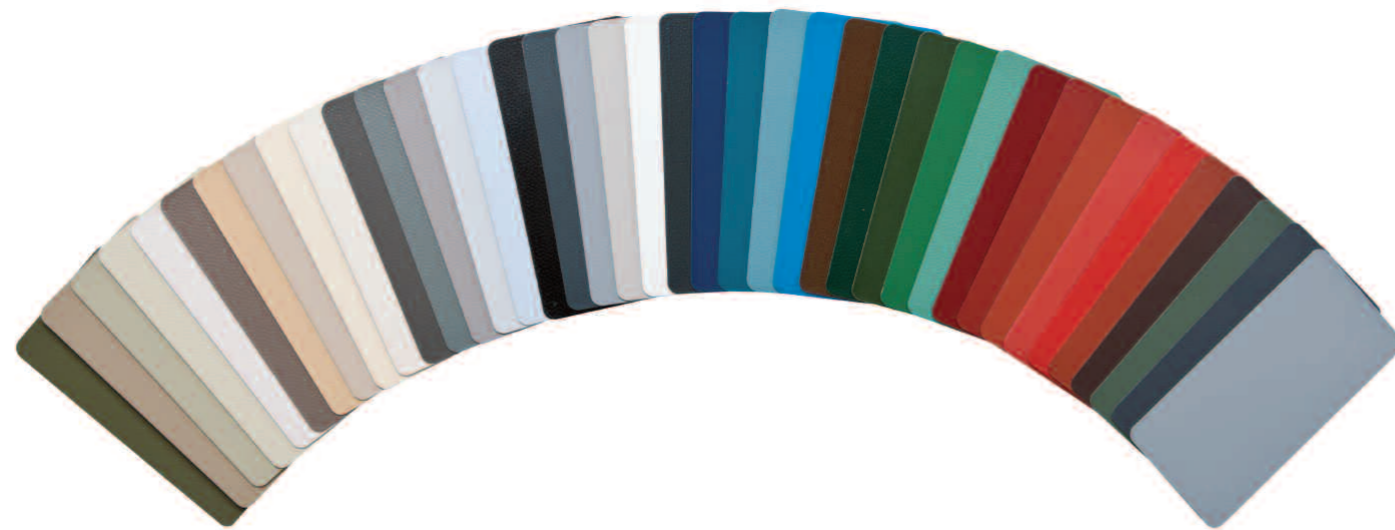
Today's super durable Colorcoat HPS200 Ultra® comes with comprehensive guarantees and offers a sustainable solution for the building envelope where longevity and durability are imperative.

Evolution of colour

Over time, we have utilised topcoat and pigment technology for the continuous improvement of both colour performance and choice. Tests show that Colorcoat HPS200 Ultra® exceeds the highest European standards for both colour and gloss retention.

The extensive colour range provides exceptional choice - offering scope for both bold and subtle design statements. Colorcoat HPS200 Ultra® is available in 40 standard colours and to make the colour selection process easier the palette is grouped by Signature, Classic and further extended Matt colours

To view the full standard colour range or to order samples visit www.colorcoat-online.com/samples or call the Colorcoat Connection® helpline on +44 (0) 1244 892434 to order a colour card.



Today's super durable Colorcoat HPS200 Ultra® is the result of continuous development and improvement over 50 years

1960s

Colorcoat® launches in 12 colours – first in Europe with 200 micron plastisol.

1970s

Colorcoat® further developed for improved colour and gloss retention.

1980s

Colorcoat HP200® brings more colour choice with performance level increased to 20 years.

1990s

Confidex® Guarantee, Galvalloy® metallic coating and Scintilla® emboss introduced. Improved colour and gloss with extended 28 shade colour palette.

2000s

Colorcoat HPS200 Ultra® with advanced topcoat technology and phthalate free formulation. Guarantee extended up to 40 years. New colour palette and launch of Repertoire® for bespoke colours.

2010s

Super durability and sustainability are key benefits as Colorcoat HPS200 Ultra® is tested beyond the limits. Now an ideal product for demanding internal environments too.

Figure 4. Evolutionary development

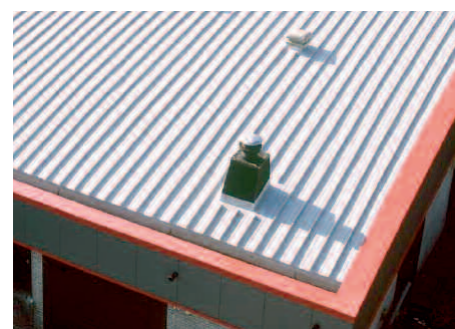


Steel substrate

With a world class reputation in steel, Tata Steel products and services are widely used in the construction market. The steel substrate for Colorcoat HPS200 Ultra® is manufactured by Tata Steel.

Strong, versatile and truly recyclable, steel is a compelling choice for the building envelope.

Steel has one of the highest strength-to-weight ratios of any building material – producing strong, lightweight structures enabling fast build programs that are cost effective without any compromise on quality.



Steel provides:

- Functionality, versatility, strength and flexibility.
- Ability to work well with other materials.
- Excellent environmental performance – offering high recyclability and re-use potential.
- Ability to be pre-fabricated off-site and constructed quickly and accurately on-site.
- Excellent durability and performance in use.

Designing with steel

The gauge of the steel plays a vital role in the physical properties and performance of the roof or wall cladding that is manufactured from it. Incorrect specification may, in the worst cases, have safety implications such as roof fragility.

The European standard EN 10143:2006 defines the tolerances for different grade, width and gauge material for normal and special tolerance categories. In the case of Colorcoat HPS200 Ultra®, the gauge is measured as the steel substrate plus the Galvalloy® metallic coating.

Tata Steel supplies pre-finished steel to normal and special tolerances according to EN 10143:2006 to ensure that the cladding performs as designed.

Incorrectly specifying gauge or gauge tolerances can affect:

1. Structural performance, including in service load capacity and purlin spacings as well as safety implications during construction and maintenance.
2. Building visual appearance, lighter gauge material is more prone to damage during installation, and distortion of the profile around fasteners due to slight misalignment of the primary/secondary structure.



Double sided Colorcoat HPS200 Ultra®

Colorcoat HPS200 Ultra® is available double sided. This option is ideal for complex or demanding applications where an increased level of protection is required on both sides of the steel substrate.

For double sided Colorcoat HPS200 Ultra®, the same unique topcoat formulation topcoat and corrosion-resistant primer is applied to the reverse side of the product. This provides a robust barrier on the reverse side of the steel substrate for buildings with demanding internal environments. These include leisure facilities with high levels of humidity and manufacturing plants where chemical agents are used.

The application of our unique Galvalloy® metallic coating and corrosion resistant primer on both sides of the steel substrate ensures a superior cut edge performance for double sided products.

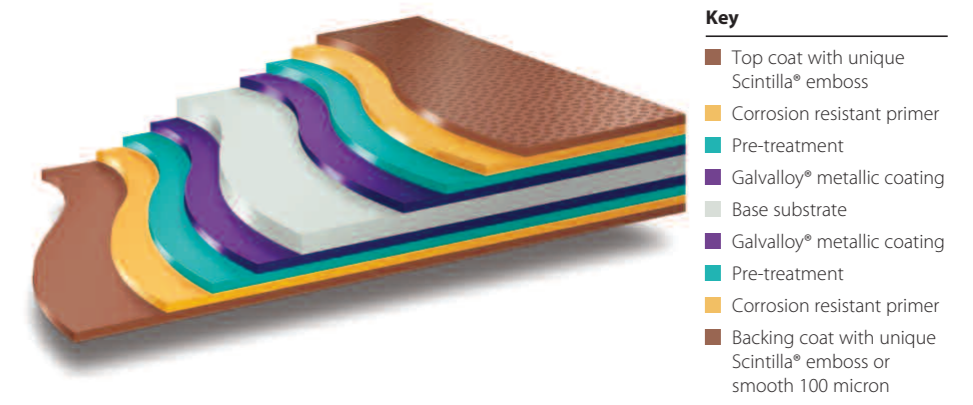
Both the topcoat and the reverse coat are available in any colour from the Colorcoat HPS200 Ultra® colour range and are a nominal 200 microns. For the 200 micron reverse side, this is embossed with the unique Scintilla® emboss. A further option of 100 micron smooth reverse side is also available.

Table 1. Product options

Topcoat (DFT)	Reverse (DFT)	Reverse Emboss	Reverse Colour
200	200	Scintilla	Any
200	100	Smooth	Any



Figure 5. Double sided Colorcoat HPS200 Ultra® by Tata Steel



Unrivalled Galvalloy® corrosion protection

Colorcoat HPS200 Ultra® uses our unique Galvalloy® metallic coating, a special mix of Zinc and Aluminium that provides unrivalled corrosion protection, even at cut edges.

How does Galvalloy® work?

The metallic coating is essential to the performance of the pre-finished steel. Traditionally, pre-finished steel products have used a Zinc metallic coating which is often referred to as Hot-Dipped Galvanised Steel (HDG). This HDG coating does provide improved corrosion protection, in comparison with uncoated steel, but often leaves cut edges vulnerable to increased rates of corrosion and will ultimately lead to peeling and/or premature paint delamination.

To address this problem, Colorcoat HPS200 Ultra® uses the unique and proven Galvalloy® metallic coating. Galvalloy® is made with a special mix of 95% Zinc (Zn) and 5% Aluminium (Al) that conforms to EN 10346:2015.

The carefully developed proportions of Zinc and Aluminium (Zn-Al) in Galvalloy® offer a combination of increased barrier and sacrificial protection when compared with conventional HDG coatings.

The sacrificial protection results from preferential corrosion of the Zinc over the steel, and the barrier protection results from the presence of a stable Aluminium oxide layer on the surface of the Galvalloy® coating, both of which inhibit and slow the rate of anodic undercutting compared to conventional HDG metallic coatings.

The Aluminium in the metallic coating of Galvalloy® and the manufacturing parameters are optimised to give a very fine two-phase microstructure compared with the uniform microstructure of HDG.

A typical microstructure of Galvalloy® is shown in figure 7 where the primary Zinc dendrites make up approximately 20% of the bulk microstructure and the Zinc/Aluminium eutectic the remaining 80%.

For a product using conventional HDG, the corrosive attack will dissolve all of the metallic coating at the same rate – leading to obvious peeling of the paint system as the paint has nothing to adhere to.

For the same time period, the optimised Galvalloy® microstructure has a major advantage in that the corrosion will occur in two stages.

Initially, the Zinc phase will be corroded preferentially to the Zinc/Aluminium eutectic. As the paint adheres to the eutectic structure, no edge peel is observed.

Over time, the eutectic structure will corrode – but at a greatly reduced rate when compared with HDG coatings and thus results in longer durability.

In addition to exhaustive artificial testing, Galvalloy® has been subjected to prolonged and independent natural weather testing since its introduction in 1998. Its proven, superior performance means that Galvalloy® lasts for a longer time period than HDG and remains the preferred metallic coating for our latest generation of super durable pre-finished steel, Colorcoat HPS200 Ultra®.

The micro cross-section of Galvalloy® illustrates the before, figure 8, and after, figure 9, corrosion process. It clearly shows the Zinc dendrites corroding at a faster rate than the Zinc and Aluminium eutectic composition. The protective Zinc and Aluminium phase is left behind and remains adhered to the organic coating providing improved corrosion protection.

Figure 6. Galvalloy® and Hot Dip Galvanised comparison

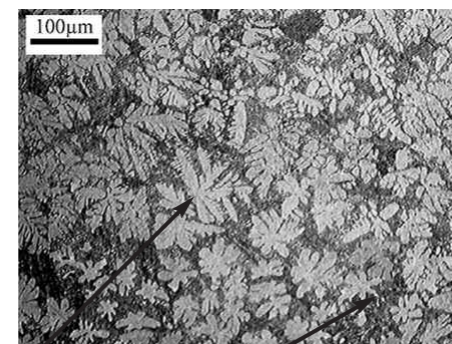


Colorcoat HPS200 Ultra® with Galvalloy® roof after 7 years.



Leathergrain alternative on hot dip galvanised steel substrate roof after 7 years.

Figure 7. Typical Galvalloy® microstructure



Primary Zinc dendrites Zn-Al eutectic

Figure 8. Galvalloy® microstructure before corrosion

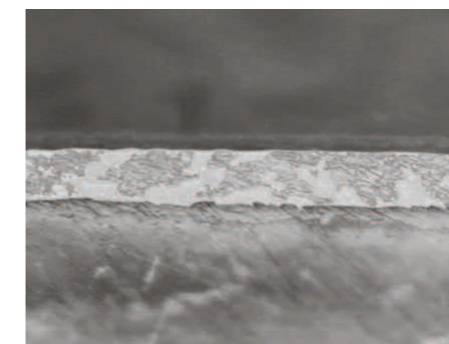


Figure 9. Galvalloy® microstructure after corrosion



Figures 8 and 9 illustrate how, as the lighter coloured Zinc dendrites ultimately corrode, the unique microstructure of the Galvalloy® layer ensures that the surface coating remains adhered to the eutectic surface.

Product performance

Exposure to the elements, pollutants and abrasives will affect the performance and durability of the building envelope. Colorcoat HPS200 Ultra® is protected and has been tested and proven in a wide range of demanding environments.

Table 2. Typical properties

Colorcoat HPS200 Ultra®		Test standard
Nominal organic coating thickness	(µm)*	200 EN 13523-1
Specular gloss (60°): Non-matt colours	%	20-40 EN 13523-2
Matt colours	%	<10 EN 13523-2
Scratch resistance	(g)	>5000 EN 13523-12
Abrasion resistance (Taber, 250 rev, 1 kg)	(mg)	<12 EN 13523-16
Flexibility: Minimum bend radius	(T)	0T(16°C) EN 13523-7 1T(0°C) EN 13523-7
Reverse impact	(J)	≥18 EN 13523-5
Adhesion (cross hatch)	(%)	100 EN 13523-6
Maximum cont. operating temp.	(°C)	60
Corrosion resistance: Salt spray	(h)	1000 EN 13523-8
Humidity	(h)	1500 EN 13523-26
Corrosion resistance category		RC5 EN 10169
UV resistance category		Ruv4 EN 10169
Internal environment classification		CPI5 EN 10169

*µm = micron

Notes

- The figures contained in this table are typical properties and do not constitute a specification. Tested in accordance with EN 13523. For details on test methods visit www.colorcoat-online.com
- For health and safety datasheets contact the Colorcoat Connection® helpline on +44 (0) 1244 892434.



Colorcoat HPS200 Ultra® is protected:

- Unique Galvalloy® metallic coating for unrivalled corrosion resistance even at cut edges.
- Corrosion-resistant pre-treatment and primer to deliver optimum durability.
- Unique topcoat formulation - providing aesthetics together with another barrier and resistance to corrosion, UV light and abrasion.
- Subtle and unique Scintilla® emboss.

Colorcoat HPS200 Ultra® is tested:

- Natural weather testing in a range of climates around the world.
- Testing at UKAS accredited laboratories to European standards.
- Extended accelerated testing way beyond the industry norm.
- Comprehensive regimes to test performance against corrosion, effects of sunlight, chemical attack and abrasion.

Colorcoat HPS200 Ultra® is proven:

- Test results show that it meets and excels highest European standards. See pages 13 – 25 of this brochure for details.
- Real life building applications of Colorcoat HPS200 Ultra® in operation around the world underline its exceptional performance.

Abrasion resistance

The super durability of Colorcoat HPS200 Ultra® derives from its Galvalloy® metallic coating, high performance primer and thick, durable barrier topcoat which provides excellent scratch and abrasion resistance. Testing of products is carried out in UKAS accredited laboratories to European Standards.

Testing has shown that Colorcoat HPS200 Ultra® benefits from high levels of scratch and abrasion resistance, the advantages are:

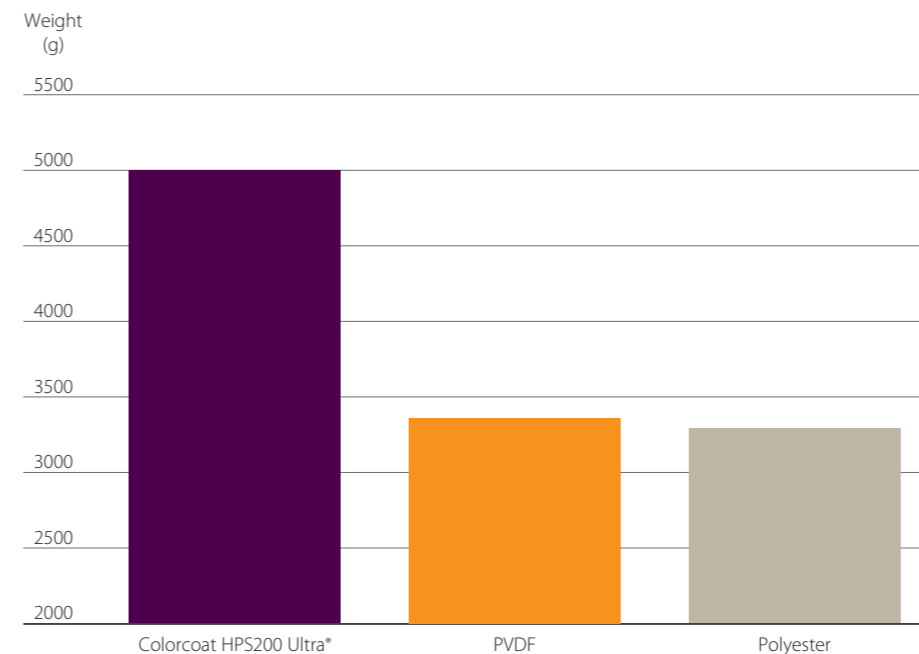
- Less susceptible to damage during storage, handling and construction.
- Longer life of the completed building envelope due to superior resistance to wind-blown material and site damage.
- Robustness of the top coat reducing the requirement for filming before profiling.

Scratch tests

The scratch test method is a technique that applies critical loads to a sample to test at what point failure appears – testing the cohesive and/or adhesive properties of pre-finished steel. Colorcoat HPS200 Ultra® has been tested alongside a typical PVDF and a polyester product. During the test, samples of Colorcoat HPS200 Ultra® were scratched with a needle which was drawn at a constant speed under a progressive load. The test was concluded when sufficient weight was added to cut through the Colorcoat HPS200 Ultra® sample revealing the metallic coating. The more weight recorded the greater the resistance of the topcoat.

The unique topcoat formula meant that considerably more weight was required to expose the metallic coating on Colorcoat HPS200 Ultra® when compared to other coating types as shown in figure 10.

Figure 10. Scratch resistance of pre-finished steels (EN 13523-12)

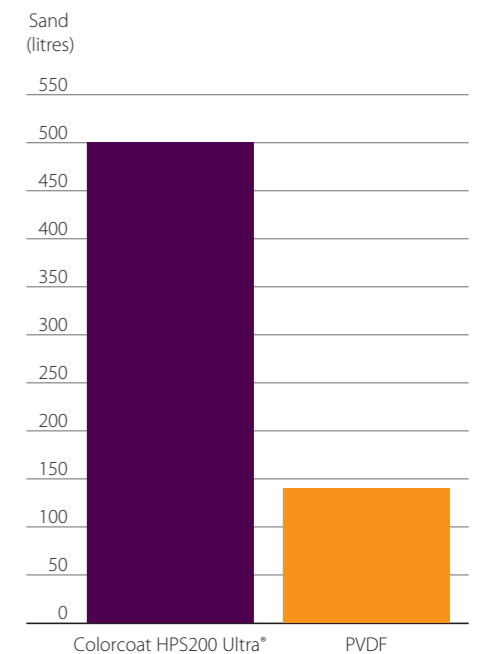


Falling sand test

Abrasion resistance is commonly tested by the 'falling sand' test to ASTM D968:2001. This test measures the stream of falling sand required to erode a paint system - to determine the topcoat's resistance.

Colorcoat HPS200 Ultra® was tested against a typical PVDF product. Results showed that more than twice as much sand was required to expose the metallic coating of Colorcoat HPS200 Ultra® compared to alternative products tested.

Figure 11. Abrasion resistance comparison (ASTM D968:2001)



Corrosion resistance

Natural weather testing is an essential part of testing the corrosion resistance of a pre-finished steel product. Colorcoat HPS200 Ultra® has undergone a comprehensive program of testing in key weathering climates around the world – achieving the highest classification possible.

Exposure sites for Colorcoat HPS200 Ultra® were chosen to provide the full spectrum of weathering zones - from equatorial and tropical climates to urban, rural, industrial and coastal locations.

Samples of Colorcoat HPS200 Ultra® have been tested and remain exposed at weathering sites in USA (Florida, Arizona, Ohio), Australia, China, India, Dubai, Sweden (Bohus Malmon), France (Brest) and sites across the UK. This has enabled us to build up a comprehensive assessment of the corrosion resistance of Colorcoat HPS200 Ultra® in a wide-range of extreme climates.

Highest corrosion classification

Colorcoat HPS200 Ultra® has undergone extensive corrosion testing in accordance with the European Standard EN 10169:2010 'Continuously organic coated (coil coated) steel flat products'. Samples of Colorcoat HPS200 Ultra® were exposed to the extreme coastal environment of Brest on the west coast of France to assess corrosion resistance.

The European Standard requires the samples to have more than two years exposure at the site. During this time they must be able to resist blistering, coating damage and edge peel (containing any edge peel to less than 2mm) in order to achieve the highest corrosion resistance classification of RC5.

After independent assessment, The French Corrosion Institute concluded that Colorcoat HPS200 Ultra® achieves RC5 corrosion rating in accordance with EN 10169:2010. An example of one of the Colorcoat HPS200 Ultra® test panels is shown in figure 13. This shows no edge peel and no surface damage or blisters after more than two years exposure at Brest, France.

Colorcoat HPS200 Ultra® utilises the optimised Galvalloy® metallic coating, which is an essential element of its super durable properties. We have gone beyond the two year testing period required for European standards to examine products dating back to the 1990's when the unique Galvalloy® metallic coating was first introduced to the market, to assess its superior performance qualities over Hot-Dipped Galvanised Steel metallic coating.

Figure 13. A Colorcoat HPS200 Ultra® test panel after more than 2 years exposure at Brest



Figure 14. Tata Steel weathering site, Brest C5 marine site



Figure 12. RC5 Certificate for Colorcoat HPS200 Ultra®

	Technopôle de Brest Iroise 220, Rue Pierre Rivoalon - 29220 Brest, France. Tel : +33 (0)298 051 552 - Fax : +33 (0)298 050 894	TATA Steel UK Research, Development & Technology Swinden Technology Centre Moorgate, Rotherham S60 3AR UK			
Classification of Natural Weathering [Type of Panels 2 – EN 13523-19]					
Panel Identification No & Description	Start of Exposure	Date of Inspection	Accumulative Time of Exposure (months)	Exposure Site & Corrosivity Category (EN ISO 12944-2)	Orientation of Exposed Panel
9KR097 – ZA255 / Colorcoat HPS200 Ultra (Goosewing grey)	05/10/2009	05/10/2011	24 months	Sainte Anne BREST (France) Carbon Steel – C5 (Very High) Zinc – C3 (medium)	90° North
Average Edge Delamination (mm)		Damage on Bend		Blistering	
Conforms to RCS requirements		Conforms to RCS requirements		Conforms to RCS requirements	
Corrosion Resistance Category (as defined by EN 10169)					
The coil coated material ref 9KR097 (ZA255 /Colorcoat HPS200 Ultra (Goosewing grey)) may be classified RC5 according to standard EN10169					
Brest, October 5 th , 2011					
Written by Jean-Michel Hamoinon 	Approved by Nathalie Le Bozec 	Stamp 			

Long-term weathering

In 1998 Galvalloy® metallic coating was used with an earlier generation of the product – Colorcoat HPS200®. Samples of this product were exposed at Bohus Malmon (figure 15) and Rye (figures 16 and 17) to evaluate the performance of the Galvalloy® metallic coating and corrosion resistance primer.

Bohus Malmon is a C4/C5 classified site (high / very high corrosivity) as per EN 10169:2010 on

the West coast of Sweden, Rye is situated in the UK within 50 metres of the sea in the south of England and would typically be a C3 site (moderate corrosivity).

After more than 13 years of exposure at Rye and 10 years at Bohus Malmon there is virtually no edge delamination (measured as less than 2mm), blistering or any other surface degradation of Colorcoat HPS200®.

This long-term exposure demonstrates the excellent performance of the Galvalloy® metallic coating combined with the optimised corrosion-resistant primer.

The performance of the corrosion resistance primer is further demonstrated by the evaluation of Colorcoat HP200® that was produced in 1993, that has been exposed for more than 18 years at Rye.

Figure 15. Colorcoat HPS200® with Galvalloy® metallic coating – 10 years exposure at Bohus Malmon, Sweden.



Figure 17. Colorcoat HPS200® with Galvalloy® metallic coating – 13 years exposure at coastal weathering site at Rye, England.



Figure 16. Colorcoat HPS200® with Galvalloy® metallic coating – 6 years exposure at coastal weathering site at Rye, England.



Figure 18. Colorcoat HP200® 18 years exposure at coastal weathering site at Rye, England.



Corrosion resistance accelerated testing

Natural weathering testing of corrosion resistance can be greatly accelerated through the use of specially designed weathering chambers. The super durable properties of Colorcoat HPS200 Ultra® have been proven through extensive and aggressive accelerated corrosion tests.

Accelerated corrosion tests

Samples of a representative selection of the Colorcoat HPS200 Ultra® colour range were put through a series of rigorous tests designed to predict the corrosion resistance of the product in different environments – coastal (salt spray), humidity, prohesion (cyclic wet and dry), water soak and Kesternich (acid rain). The tests are symbolic and often are far more aggressive than would be seen in real world situations.

Samples of Colorcoat HPS200 Ultra® - with one edge exposed and a cross scribed into the coating to simulate site damage, were placed in UKAS accredited test chambers for the required test duration. The results of these accelerated corrosion tests are given in table 3.

Representative photographs of Colorcoat HPS200 Ultra® in Goosewing Grey after 1000 hours testing in this suite of accelerated tests are shown in figures 19-22.

Both saltspray (continuous fog of sodium chloride) and prohesion (cyclic phases of sodium and ammonium chloride fog followed by a drying cycle) are extremely aggressive accelerated corrosion tests. Despite this, the UKAS tests showed that the extent of paint delamination at both the cut edge and scribe is minimal.

The Kesternich test (moist/humid sulphur dioxide test) is designed to simulate the damaging effects of harsh environments, particularly sulphur dioxide contaminants and acid rain.

Table 3. Accelerated corrosion tests showed minimal delamination and surface degradation

Corrosion test	Test duration	Test standard	Maximum average edge delamination (mm)	Maximum average scribe delamination (mm)	Test panel surface degradation
Salt Spray	1000 hours	EN 13523-8	<2mm	<1mm	No other panel degradation
Prohesion	1000 hours	ASTM G85A5	<2mm	<2mm	No other panel degradation
Water soak	1000 hours	EN 13523-9	0mm	0mm	No other panel degradation
Humidity	1000 hours	EN 13523-26	0mm	0mm	No other panel degradation
Kesternich	20 cycles	EN 13523-23	<3mm	<3mm	No other panel degradation

Note: The figures in this table are typical properties and do not constitute a specification.

Figure 19. Test panel after saltspray 1000 hours



Figure 20. Test panel after prohesion 1000 hours



Figure 21. Test panel after humidity 1000 hours



Figure 22. Test panel after Watersoak 1000 hours



Colorcoat HPS200 Ultra® showed minimal (less than 3mm) edge and scribe delamination following repeated cycles of testing.

Following 1,000 hours of humidity and water soak tests, no blistering or significant paint delamination was observed on the Colorcoat HPS200 Ultra® panels. This demonstrates

excellent paint adhesion between the Galvalloy® metallic coating and the organic layers of Colorcoat HPS200 Ultra®. In figures 21, 22 and table 4 the topcoat has been removed to clearly show absolutely no creep at the scribe, or cut edge.

Extended accelerated tests

Again we have tested Colorcoat HPS200 Ultra® beyond the industry standards subjecting the samples to 5000 total hours accelerated corrosion testing with salt spray, water soak and humidity tests. Colorcoat HPS200 Ultra® samples were compared to generic PVDF and 25 micron polyester pre-finished steel. Two types of test panel were used:

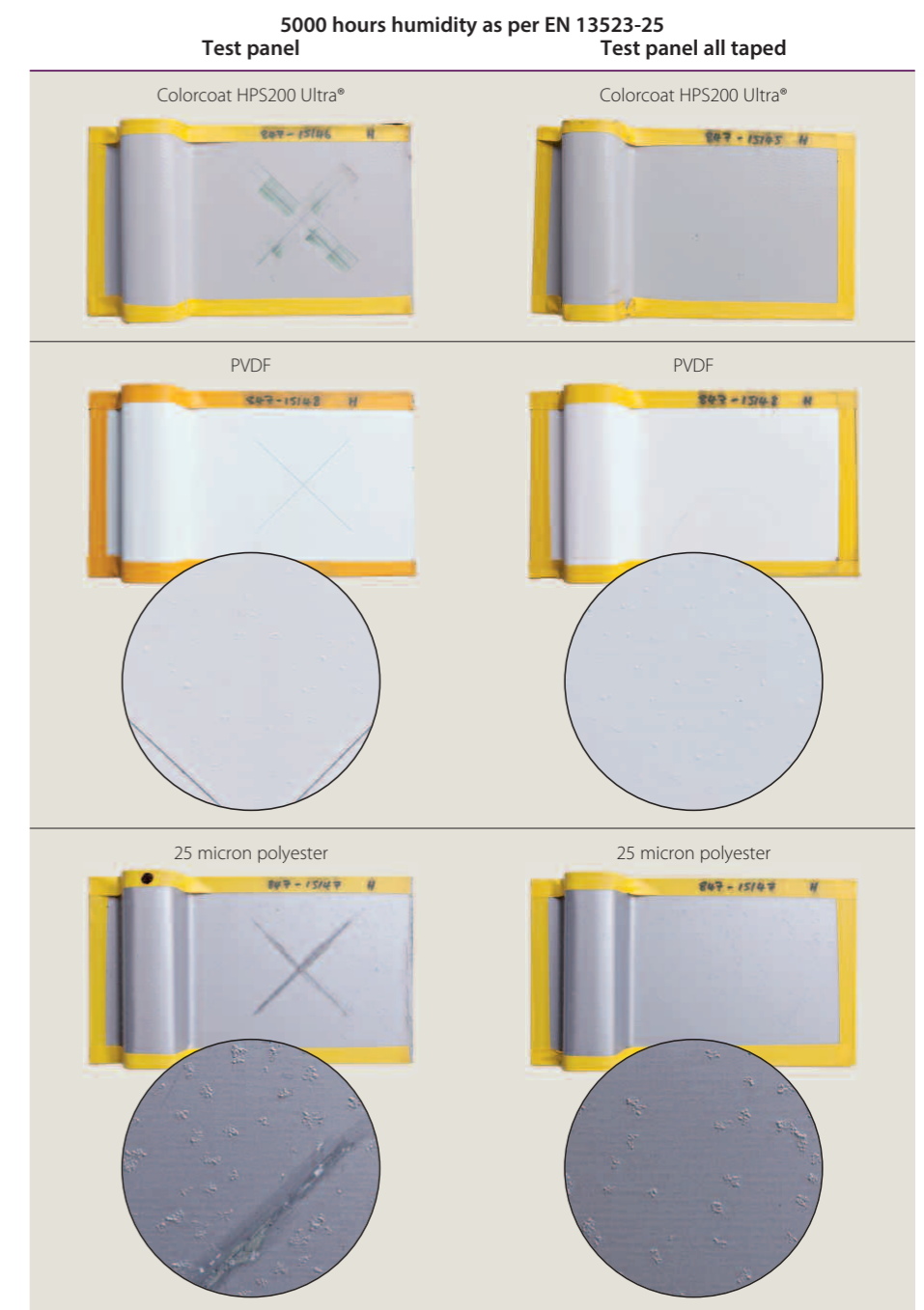
- Standard WA6 corrosion panels with one edge exposed and a cut scribe.
- WA6 corrosion panels with all sides taped and no cut scribe.

The panel configurations were chosen to demonstrate both:

- The superior corrosion resistance of Colorcoat HPS200 Ultra® provided by the Galvalloy® metallic coating, pre-treatment, corrosion-resistant primer and the topcoat paint system.
- The barrier properties of the Colorcoat HPS200 Ultra® topcoat compared to generic pre-finished steel products.

The results of testing Colorcoat HPS200 Ultra® versus generic PVDF and 25 micron polyester following 5000 total hours in the humidity test as per EN13523-25 using both test panel configurations are shown in table 4. Even after 5000 hours testing, the test results clearly show no evidence of blistering, surface degradation or creep at both the edge or scribe for the Colorcoat HPS200 Ultra® sample. Both the generic PVDF and 25 micron polyester pre-finished steels exhibit extensive blistering in the samples with all 4 sides taped. The exposed edge and scribe also exhibit significant creep and blistering when compared to Colorcoat HPS200 Ultra®.

Table 4. Colorcoat HPS200 Ultra® comparisons



Interior performance - corrosion resistance

In the internal environment of a building, corrosion factors can be increased by the creation of a microclimate. Colorcoat HPS200 Ultra® has been tested and proven to provide the highest level of corrosion protection for internal environments.



Increased corrosion factors

In normal external atmospheres the rate of corrosion is accelerated by the following factors: an increase in relative humidity; frequency of condensation (time of wetness); the amount of pollution and rising temperatures.

In the internal environment (ambience) of a building these corrosion factors can be greatly enhanced by the creation of an internal microclimate as a result of activities carried out inside the building such as manufacturing, waste processing or swimming pools.

A building's internal environment can be classified according to its corrosivity. The principal factors that determine the corrosivity of internal environments are the risk of condensation (time of wetness) and the aggressiveness of any chemicals present and cleaning operation. Table 5 provides guidance on different levels of aggressiveness for each of these factors.

Table 5. Definitions and criteria

Corrosive criteria	
Non aggressive	No chemical aggressivity. Neutral cleaning less than once a month.
Low aggressive	No chemical aggressivity. Neutral cleaning less than once a week.
Medium aggressive	Low chemical aggressivity. Cleaning pH 5-9 less than once a week.
Aggressive	Chemical aggressivity or risk of mould. Cleaning pH 5-9 less than once a day.
Very aggressive	High chemical aggressivity or high risk of mould. Cleaning pH 5-9 once a day.

Cleaning criteria	
Routine upkeep	Periodical cleaning with neutral products. No pressure washing.
Non-intensive cleaning	Periodical cleaning with neutral products at less than 30°C. Low pressure spraying.
Intensive cleaning	Cleaning with products pH 5-9 at less than 40°C and at pressure.

Humidity criteria	
Low hygrometry	$W/n \leq 2.5g/m^3$
Medium hygrometry	$2.5g/m^3 < W/n < 5.0g/m^3$
High hygrometry	$5.0g/m^3 < W/n < 7.5g/m^3$
Humid	High hygrometry and risk of condensation.
Very humid	Very high hygrometry and frequent risk of condensation.*

W – Quantity of vapour produced inside the building in g/m³/h.
 n – Hourly air renewal rate.
 * – Condensation is considered frequent if it can be detected daily on interior surfaces but the duration of humidity is generally short, < 2 hours.

These factors are considered in the EN10169:2010 classification of internal ambience types. The five categories range from 'non-aggressive' to 'very aggressive'. Very aggressive environments include those with high chemical aggressivity levels where cleaning agents with a pH of 5–9 are used daily and environments with a high and permanent risk of condensation.

Internal certification

Coil coating standard EN10169:2010 classifies the suitability of organic coatings for use in interior environments. Excellent test results mean that Colorcoat HPS200 Ultra® is classified as a CPI5 product. This is the highest classified level of corrosion protection for interiors and means that Colorcoat HPS200 Ultra® is suitable to be used in the most demanding internal environments such as swimming pools and sewage treatment plants.

For added reassurance of long-term internal performance, Colorcoat HPS200 Ultra® has been tested to 5,000 hours humidity - far in excess of the 1,500 hours stipulated in EN10169:2010. Test results showed that even in this extended test the product still achieved the CPI5 performance requirements.

The classification of Colorcoat HPS200 Ultra® as a category CPI5 product means it has been proven suitable to provide corrosion protection in 'very aggressive' internal environments as well as having proven chemical resistance properties.

Colorcoat HPS200 Ultra® either single or double sided is the most suited and recommended pre-finished steel product for demanding and corrosive internal environments. Depending on the specific building details, internal warranties can be provided for Colorcoat HPS200 Ultra® when used as the internal product on a case by case basis. For case studies of where Colorcoat HPS200 Ultra® has been used internally go to www.colorcoat-online.com/projects

Table 6 below provides examples of building types with increasing aggressive/corrosive internal environments (A1 to A5) and the recommendations as to which Colorcoat® pre-finished steel product is best suited for the internal application.

If the building has a requirement for a foodsafe product (indirect contact only) then a pre-finished steel product from the Advantica® range by Tata Steel is recommended.

CPI5 Rating

Pre-finished steels for use in building interiors can be classified into corrosion protection categories CPI in accordance with EN 10169:2010. The classifications are from the lowest category CPI1 to the highest category CPI5. To obtain CPI5 samples should be tested for a minimum of 1500 hours humidity in accordance with EN 13523-26 with blistering less than category 2 (S2) of EN ISO 4628-2.

The test panel shows:

- Blistering less than category 2 (S2) of EN ISO 4628-2.
 - No edge creep or other surface degradation.
- N.B. Topcoat removed at both scribe and cut edge to clearly show no corrosion.

These results confirm that Colorcoat HPS200 Ultra® meets the requirements of CPI5 as per EN 10169:2010.



Table 6. Internal environments table.

	Defining atmospheric criteria			Typical building use	Colorcoat® PE 15 & Colorcoat® PE 25	Colorcoat® PVDF	Colorcoat HPS200 Ultra®
	Corrosiveness	Cleaning	Humidity				
A1	Non aggressive	Routine upkeep	Low hygrometry	Offices, Schools and Residential buildings (excluding kitchens and bathrooms)	✓	✓	✓
A2	Low aggressive	Routine upkeep	Medium hygrometry	Sports Halls and Supermarkets	✓	✓	✓
A3	Medium aggressive	Non-intensive cleaning	High hygrometry	Industrial buildings and Factories using dry processes			✓
A4	Aggressive	Non-intensive cleaning	Humid – Low risk of condensation	Factories using wet processes and Swimming Pools			✓
A5	Very aggressive	Intensive cleaning	Very humid – High risk of condensation	Papermills, Seafood processing, Mushroom cultivation, Cheese factories			✓

Interior performance barrier properties

The thick topcoat of Colorcoat HPS200 Ultra® provides an extra barrier between the atmosphere and the steel substrate – considerably delaying the onset of corrosion. Permeability tests prove the superior performance of the product.

Atmospheric corrosion is an electrochemical process that takes place in a thin film of water on the steel surface. Both water and oxygen are required to instigate corrosion.

Pre-finished steels, apart from the aesthetic benefits, provide a barrier that blocks the passage of water and oxygen reaching the metal surface and hence slows the corrosion risk. Top coats on pre-finished steel are generally semi permeable to water and oxygen transmission and the greater their ability to restrict transmission - the more durable the pre-finished steel overall.

Colorcoat HPS200 Ultra® has been developed to ensure an effective and long-lasting barrier between the internal atmosphere and the steel substrate – deferring the onset of corrosion. The robust topcoat plays a vital role alongside the Galvalloy® metallic coating and primer in preventing corrosion.

Recent test results show low levels of water and oxygen permeability of Colorcoat HPS200 Ultra® when compared to other generic paint systems.

Water permeability

Samples of Colorcoat HPS200 Ultra® were subjected to water vapour transmission/ vapour permeance tests undertaken by the Paint Research Agency. The tests were carried out in accordance with ASTM D1653 using test method B – wet cup method, condition A. Within this test method, samples of the freepaint film are sealed over a vessel containing water which are placed in a test chamber with a controlled atmosphere. Regular weighings of the vessel are made to determine the rate of water movement through the paint film. The purpose of this test was to obtain values for water vapour transfer through the different coating types and provide a relative rating of the coatings when they are tested under the same closely controlled conditions.

Table 7. Permeability to Water vapour and Oxygen

	Colorcoat HPS200 Ultra®	PVDF	Polyester
Nominal Topcoat coating thickness	200	25	25
Water Vapour Transmission (g/m ² /24 hours)	10.17	23.17	124.72
Oxygen permeability (m ² /sec/Pa)	2.609 E-17	1.345 E-16	1.578 E-16

N.B: Results obtained using freepaint films prepared in the laboratory by paint suppliers.

The results presented in the table below clearly show that the thicker barrier topcoat of Colorcoat HPS200 Ultra® was considerably less permeable to water vapour than other generic pre-finished steel.

Oxygen permeability

All paints and polymers are oxygen-permeable but tests conducted by Smithers Rapra confirmed that the thick barrier topcoat of Colorcoat HPS200 Ultra® was significantly less permeable to oxygen than other generic pre-finished steel products. All paint films were tested using the constant volume method as detailed in BS ISO 2782:2006. The temperature of the test was maintained to 23°C and conducted using oxygen at 1 Bar.

Chemical resistance

Due to its tough, less permeable topcoat Colorcoat HPS200 Ultra® also provides excellent chemical resistance. Along with a high level of resistance to humidity, this makes the product the ideal choice for aggressive internal environments.

When Colorcoat HPS200 Ultra® is used for interiors including double sided applications, its super durable topcoat provides excellent chemical resistance – when in direct contact with the chemical and also when exposed to chemical vapour.

Chemicals and pollutants accelerate corrosion by attacking the chemical bonds that make up the topcoat polymers. In aggressive internal environments, where chemicals are present, this can result in discolouring and degradation of the topcoat. The information provided below relates to the effects of chemicals on Colorcoat HPS200 Ultra®. Any exposed steel such as cut edges must be protected with a suitable lacquer or protective coating system.

Independent testing under strict laboratory conditions has proven the impressive chemical resistance levels of Colorcoat HPS200 Ultra® in the vast majority of tests.

Chemical resistance performance is rated on a red, amber, green scale. Green is acceptable, amber requires further advice from Tata Steel and red means it is unsuitable for use with this chemical.

Independent tests show that:

- Dilute acids at room temperature do not normally attack the top coat of Colorcoat HPS200 Ultra®; only concentrated acids attack the topcoat – normally after a prolonged period of exposure.
- Aqueous solutions of alkalis such as ammonia and caustic soda do not attack Colorcoat HPS200 Ultra® except in high concentrations at elevated temperatures.

Table 8. Chemical resistance levels of Colorcoat HPS200 Ultra®

Chemical	Exposure duration	Continuous contact		Vapour	
		Visual	Adhesion	Visual	Adhesion
30% Sodium Hydroxide	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
30% Ammonium Solution	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
10% Ammonium Sulphate	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
10% Ammonium Nitrate	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
30% Hydrogen Peroxide	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
10% Hydrochloric Acid	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
37% Hydrochloric Acid	15 minutes	Red	Red	Red	Red
	24 hours	Red	Red	Red	Red
10% Nitric Acid	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
30% Nitric Acid	15 minutes	Red	Red	Amber	Amber
	24 hours	Red	Red	Amber	Amber
10% Sulphuric Acid	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
30% Sulphuric Acid	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
Sunflower oil	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
Engine oil	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
Diesel	15 minutes	Green	Green	Green	Green
	24 hours	Amber	Amber	Amber	Amber
Petrol	15 minutes	Red	Red	Red	Red
	24 hours	Red	Red	Red	Red
Methanol	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Amber	Amber
Ethanol	15 minutes	Green	Green	Green	Green
	24 hours	Amber	Amber	Amber	Amber
Isopropyl Alcohol (IPA)	15 minutes	Green	Green	Green	Green
	24 hours	Amber	Amber	Amber	Amber
Ethyl Acetate	15 minutes	Red	Red	Green	Green
	24 hours	Red	Red	Red	Red
Fuel Oil Gel	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green
10% Acetic Acid	15 minutes	Green	Green	Green	Green
	24 hours	Green	Green	Green	Green

Notes:
 Colorcoat HPS200 Ultra® resists oils but the surface can swell and soften slowly over a period of many years.
 Colorcoat HPS200 Ultra® is unsuitable for direct contact with organic solvents such as aliphatic hydrocarbons, chlorinated hydrocarbons, ketones and esters.
 Mastics and sealants cured by acetic acid should not be used with Colorcoat HPS200 Ultra® as the acid will attack the metallic coating and steel base.
 % shown are concentration levels.

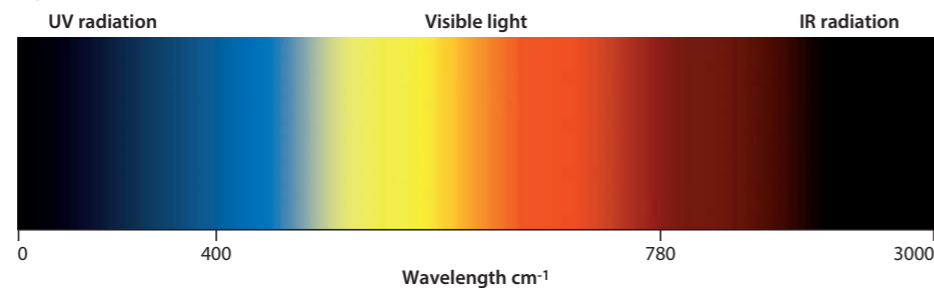
UV resistance

A pre-finished steel must resist the damaging effects of the sun's emissions including Ultra-Violet and Infra-Red radiation. Exposure to solar radiation can cause a deterioration of colour and gloss retention, both of which are precursors of paint cracking and delamination. Colorcoat HPS200 Ultra® is classed as Ruv4 - the highest classification of UV resistance. This proven and superior UV resistance means outstanding colour and gloss retention, resulting in a superior product that lasts longer.

Sun and pre-finished steel

The sun emits a spectrum of light energy (figure 23) including invisible ultraviolet (UV), visible light and infrared radiation (IR). The shorter wavelengths of UV radiation - which include UVB and UVA radiation - are the most destructive on polymer materials. The UV light is absorbed directly by the polymer and pigment at the molecular level, ultimately leading to the breaking of chemical bonds. This results in loss of colour and gloss, chalking, brittleness and, eventually, loss of topcoat adhesion. The length of time that this takes depends on the durability of the pre-finished steel, as depicted in figure 24.

Figure 23. Solar radiation spectrum



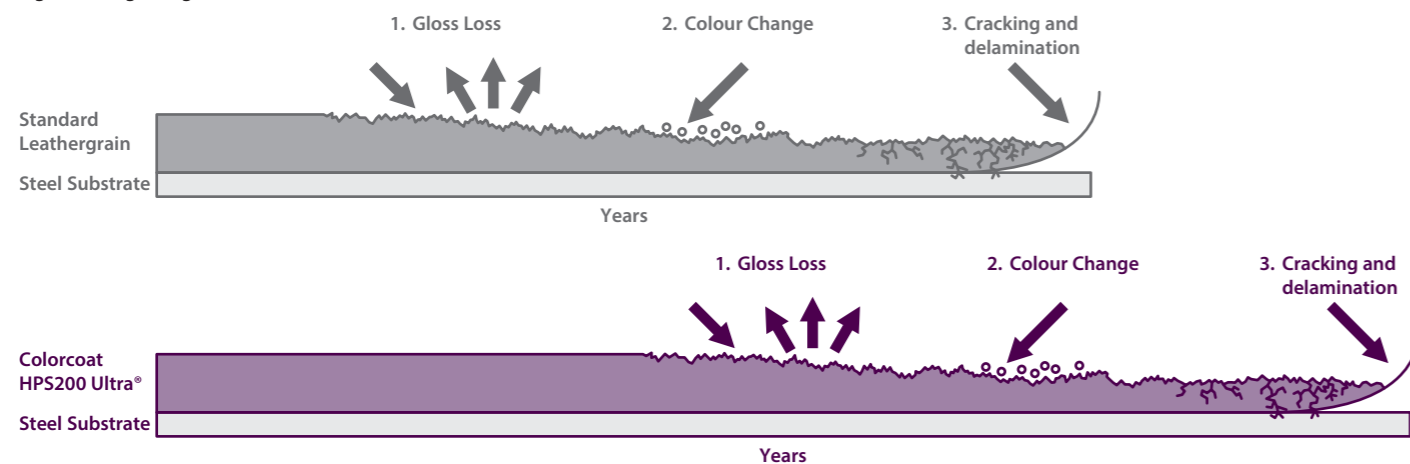
Colorcoat HPS200 Ultra® has been developed to offer outstanding UV resistance through incorporation of the latest polymer technology in its durable topcoat. This 200 micron topcoat contains specially developed heat and UV stabilisers which mitigate any degradation caused by the absorption of UV radiation together with advanced plasticisers that increase the durability of Colorcoat HPS200 Ultra® compared to alternative pre-finished steel products.

The IR radiation is also absorbed at the molecular level (solar absorption) which results in the topcoat heating up. Such solar absorption can cause thermal degradation of the polymer chemical bonds. The extent of this IR absorption is dependant on a combination of the colour pigments used and

other constituents within the paint that can reflect certain proportions of this radiation. The incorporation of an advanced package of heat stabilisers in combination with the latest pigment technology within the topcoat of Colorcoat HPS200 Ultra® reduce the affect of IR radiation damage resulting in a product that maintains its colour and gloss for longer.

The UV resistance of Colorcoat HPS200 Ultra® has been extensively tested and independently verified with a suite of natural and accelerated tests that range in their severity. Samples have been exposed and remain exposed at weathering sites that cover the full spectrum of weathering zones such as Florida, Arizona, Prescott Arizona, Dubai, China, India, Australia and sites within the UK.

Figure 24. Light degradation over time



UVA testing

To meet the requirements of Ruv4, samples are exposed to artificial UVA radiation for a total of 2,000 hours as well as two years at an accredited weathering site with a cumulative UV radiation in excess of 4,500 MJ/m² per year. Colorcoat HPS200 Ultra® has been subjected to both of these testing conditions.

EN 10169:2010 stipulates that, for Ruv4 classification:

- The percentage gloss retention (% GR) must be greater than 80% after each test and the extent of colour change (ΔE) must be less than 2 ΔE for artificial UV testing and less than 3 ΔE following natural weathering exposure.

In both tests, Colorcoat HPS200 Ultra® easily meets these requirements in terms of the stipulated colour and gloss retention which provides clients with even greater reassurance that their buildings will retain their true colour for longer.

Figure 26. ΔE for Colorcoat HPS200 Ultra® in UVA

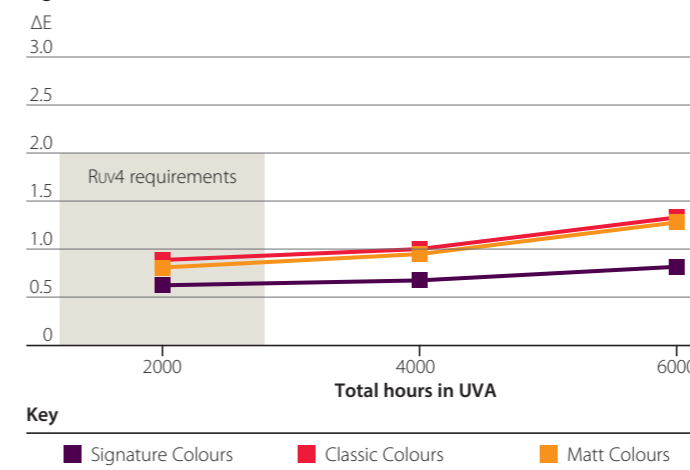
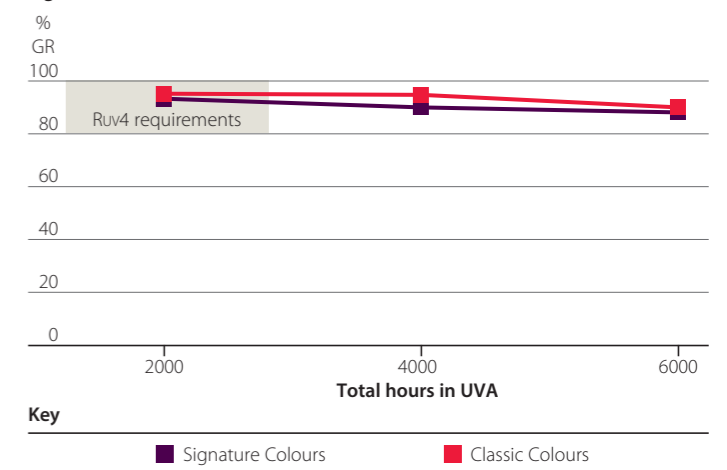


Figure 27. % Gloss Retention for Colorcoat HPS200 Ultra® in UVA



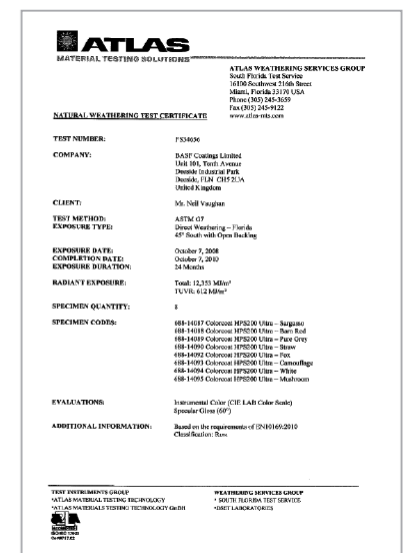
The superior UV resistance of Colorcoat HPS200 Ultra® has been independently verified by ATLAS following exposure at the Florida weathering facilities. Figure 25 is the Ruv4 certificate for Colorcoat HPS200 Ultra®.

Extended testing

In addition to the standard tests for Ruv4 classification, samples of Colorcoat HPS200 Ultra® have completed more than 6,000 hours of exposure to artificial UVA radiation – three times the required length of testing. Even after this extended testing period, Colorcoat HPS200 Ultra® still met the requirements of Ruv4. The tests showed that Signature colours had a ΔE of less than 1.0 and the Classic and Matt colours had a ΔE of less than 1.5.

Extended testing: All colours had a percentage gloss retention greater than 80% even after this accelerated test. The Matt colours had a gloss retention greater than 100% and as such are not represented in the graph.

Figure 25. Ruv4 Certificate



Extended UV testing

Continuing with testing the product beyond industry standards. Colorcoat HPS200 Ultra® has been subjected to extended UV testing and long term natural weathering.

UVB testing

Due to the short wavelengths of radiation in UVB testing it is more damaging to polymers than UVA artificial testing. Samples of Colorcoat HPS200 Ultra® have also been exposed to artificial UVB radiations for 6000 total hours. Even after this extended exposure in this harsh testing environment, Colorcoat HPS200 Ultra® Signature colours have a ΔE of less than 1.5 and a percentage gloss retention greater than 50 per cent, with no delamination between the topcoat and substrate. When Colorcoat HPS200 Ultra® is compared to standard leathergrain pre-finished steel exposed for 2000 total hours in the UVB test, performance in terms of colour and gloss retention are superior.

Figure 28: Standard leathergrain product shows significant colour and gloss loss compared to Colorcoat HPS200 Ultra®.

Figure 29: Standard leathergrain product shows not only colour and gloss loss but the topcoat has delaminated exposing the metallic substrate. Colorcoat HPS200 Ultra® is still exhibiting excellent adhesion.

Figure 28. Anthracite standard leathergrain and Colorcoat HPS200 Ultra® after 2000 total hours in UVB test



Figure 29. Heritage Green standard leathergrain and Colorcoat HPS200 Ultra® after 2000 total hours in UVB test



Long term natural weathering

Xenon testing

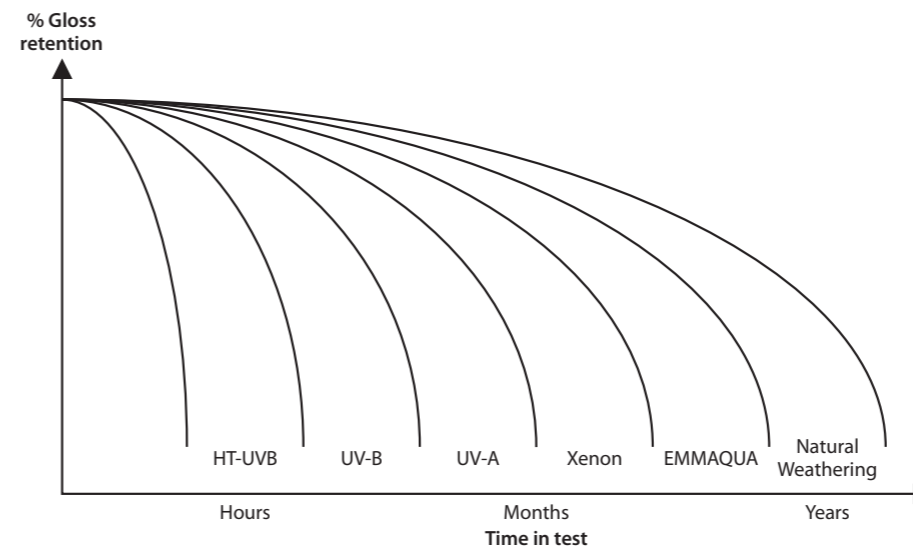
In addition to UVA and UVB artificial testing, Colorcoat HPS200 Ultra® has undergone Xenon testing – a whole-spectrum test designed to simulate natural sunlight. Xenon testing closely follows the full sun spectrum from typically 300 to 3000nm wavelength and therefore covers all UV, visible and IR radiation.

The average colour and % GR results for Colorcoat HPS200 Ultra® Signature and Classic colours tested after 2000 light hours (2400 total hours) is a ΔE of 1.7 and a % GR > 80 per cent with no delamination.

Table 9. Xenon test results

	ΔE	% GR
1000	1.5	95.6
2000	1.7	81.2

Figure 30. Suite of natural weathering and accelerated UV tests.



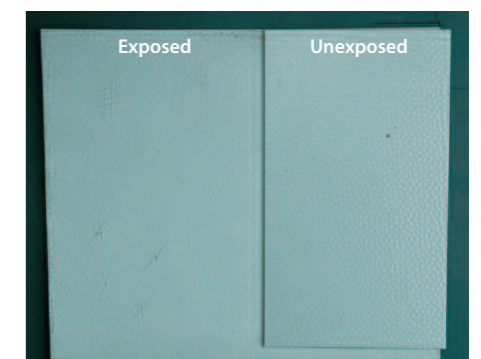
Natural weathering

In addition to the accelerated weathering programme, Colorcoat HPS200 Ultra® has been exposed to full scale testing at our natural weathering facilities, which confirms the proven performance and super durable properties of the product.

By the end of 2011, initial production samples of Colorcoat HPS200 Ultra® had been subjected to more than three years of exposure at the ATLAS weathering facilities in Florida.

The UV resistance demonstrated by Colorcoat HPS200 Ultra® under these natural weathering conditions provides further proof of its durability and excellent colour and gloss retention. After three years exposure in Florida the colour change was approximately 1.0 ΔE with a % GR approximately 80 per cent.

Figure 31. Colorcoat HPS200® after 8 years exposure in Florida



A year's exposure to sunlight in Florida can equate to four to seven years of exposure in Northern Europe. Based on the test results to date, Colorcoat HPS200 Ultra® has had UV exposure equivalent to up to 21 years exposure in Northern Europe with excellent gloss and colour retention.

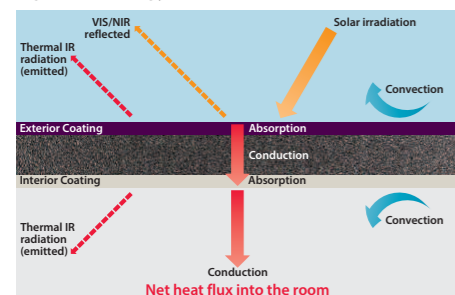
A whole suite of natural weathering and accelerated tests are used to assess the UV performance of Colorcoat HPS200 Ultra®. As indicated in figure 30 this suite of tests range in both exposure time and aggressivity of the test environment. The collated test data provides an understanding and reassurance on the performance of Colorcoat HPS200 Ultra® in different world wide climates. This super durable UV performance quality has enabled Colorcoat HPS200 Ultra® to be used on prestigious projects throughout the world with Tata Steel backed warranties issued on a case by case basis.

Solar reflectivity

Understanding reflectivity and emissivity of pre-finished steel is important, to evaluate their affect on thermal loading and the urban heat island effect.

The sun's infrared (IR) light is absorbed by materials, causing an increase in surface temperature that can be greater than the surrounding air temperature. The ability of a pre-finished steel system to reflect IR light can have a significant effect on the building's temperature, decreasing the need for high energy consumption in air conditioning, and the amount of thermal expansion of the cladding profile. Colour has a significant effect on the Total Solar Absorption (TSA) of IR radiation with a black roof reaching a far greater surface temperature than a white roof under the same climatic conditions.

Figure 32. Energy transfer mechanisms



The Solar Reflective Index (SRI) and Steady State Surface Temperature (SSST) has been determined for all standard colours of Colorcoat HPS200 Ultra® according to ASTM E 1980 using the medium wind speed coefficient and values for reflectivity and emissivity. Solar reflectivity or reflectance is the ability of a material to reflect solar energy from its surface back into the atmosphere, where the higher the SRI value the greater the ability of the Colorcoat HPS200 Ultra® colour to reflect the solar radiation.

Several Signature colours have exceptional reflective properties in that virtually all of the sun's radiation is reflected – resulting in a coating that does not heat up compared to other pre-finished products. The total solar reflectance index (SRI) and emittance values quoted in the table are beneficial when undertaking whole building assessments such as LEED which give additional credits for solar reflective products.

Table 10. SRI, SSST and Emissivity data for Colorcoat HPS200 Ultra® as per ASTM E 1980

Signature	SRI	SSST (°C)	Emissivity
White	94	47	0.87
Goosewing Grey	46	65	0.86
Alaska Grey	24	73.3	0.9
Anthracite	1	81.9	0.88
Black	0	82.9	0.9
Ice Blue	71	55.4	0.88
Albatross	60	59.7	0.87
Pure Grey	19	75.2	0.88
Merlin Grey	10	78.8	0.87
Ardenne	5	80.6	0.9
Marlstone	77	53.3	0.88
Honesty	75	54	0.86
Mushroom	44	65.7	0.88
Straw	48	64.2	0.88
Mole Brown	11	78.2	0.9
Hamlet	69	56.5	0.88
Meadowland	57	60.7	0.87
Moorland Green	34	69.6	0.89
Svelte Grey	22	74	0.89
Olive Green	5	80.5	0.88
Classics			
Chili	41	66.9	0.9
Petra	47	64.6	0.89
Terracotta	42	66.4	0.9
Barn Red	35	69	0.86
Burano	34	69.6	0.89
Jade	20	75	0.86
Heritage Green	6	80	0.88
Juniper Green	2	81.7	0.89
Ivy	23	73.8	0.9
Van Dyke Brown	5	80.6	0.9
Solent Blue	33	69.9	0.87
Wedgewood Blue	24	73.6	0.86
Ocean Blue	8	79.3	0.89
Sargasso	28	71.9	0.87
Raven	0	82.4	0.88
Matts			
Alaska Grey Matt	23	73.7	0.88
Anthracite Matt	1	81.9	0.88
Green Grey Matt	7	79.8	0.89
Oxidised Matt	3	81.2	0.89
Terracotta Matt	46	65.2	0.88

Compliance with REACH

Tata Steel has long been at the forefront of responsible sourcing. Colorcoat HPS200 Ultra® is fully compliant with REACH regulations regarding the use of chemical substances including pigments.

REACH (Registration, Evaluation and Authorisation of Chemicals) is a European Regulation. It addresses the production and use of chemical substances and their potential impacts on both human health and the environment. It requires manufacturers and importers to gather information on the properties of their chemical substances and to register the information in a central database run by the European Chemicals Agency (ECHA) in Helsinki.

At Tata Steel we do not utilise lead chromate based pigments in the Colorcoat HPS200 Ultra® colour range.

Tata Steel is the first pre-finished steel producer to achieve BES 6001 (very good rating) in recognition of responsible sourcing.

With almost every business in Europe having a responsibility under REACH legislation, specifying Colorcoat HPS200 Ultra® provides clients with the confidence that they are meeting their corporate social responsibility (CSR) obligations and using a product that is fully compliant.

Colorcoat HPS200 Ultra® is fully compliant with all current REACH legislation and is free of chromates including hexavalent chrome. To assist customers, updates on REACH obligations, together with product health and safety data sheets, are available.



Fire performance

Fire performance is a fundamental requirement when considering the performance of a building in a potential fire situation for Building Regulations and insurance requirements.

UK Building Regulations

The 2019 revision of Approved Document B is written with reference to European Standards although performance to British Standard tests may also be acceptable.

Wall applications

Fire resistance of external walls and internal compartmentation

BS 476 Part 22 'Fire resistance of non-load bearing elements' test measures the performance of a wall when exposed to heat on one face from a furnace with a defined temperature characteristic. Colorcoat HPS200 Ultra® can be used in wall cladding systems which are assessed according to BS 476 Part 22.

European Standard tests

Euroclassification - Reaction to fire

Reaction to fire classification is carried out in accordance with EN 13501-1. Colorcoat HPS200 Ultra® has been tested to the following European test standards.

EN 13823, often referred to as the single burning item test.

EN 11925, a small flame ignitability test.

EN 1716, measurement of calorific value.

Colorcoat HPS200 Ultra® has been tested to EN 13823 and EN 11925-2 and can be classified in accordance with EN13501-1 as C-s2,d0. This classification is valid for material $\geq 0.46\text{mm}$ and for all colours on the colour card for single sided product.

Roof applications

European Standard tests

Euroclassification - External fire performance for roofs/roof coverings

EN 1187 defines a number of different test methods for assessing the performance of roofs/roof coverings. EN 1187 test method 4 is based on BS 476 part 3 and is the only method accepted in the UK.

EN 1187 test methods 1, 2 and 3 are usually specified in Europe, dependant upon the location.

EN 1187 test method 1 German test.

EN 1187 test method 2 Nordic test.

EN 1187 test method 3 French test.

The product or system is then classified according to EN13501-5 from B_{ROOF} (best) to F_{ROOF} (worst).

External fire performance for roof covering products

Colorcoat HPS200 Ultra®, when used as part of a roof covering can be classified as B_{ROOF}(t1), B_{ROOF}(t2), B_{ROOF}(t3), without further testing, in accordance with Commission Decision 2005/403/EC for all material greater than or equal to 0.4mm gauge and for all colours in the product range for single sided and 200/100 product.

Colorcoat HPS200 Ultra® has been tested to EN 1187 test method 4 and can be classified according to EN 13501-5 as B_{ROOF}(t4) for all material greater than or equal to 0.4mm gauge and for all colours in the product range for single and double sided products.



Insurance requirements

Insurance companies often specify additional fire performance criteria and/or tests which building components and cladding systems must meet. Cladding systems that meet the requirements of these tests are seen as presenting a lower level of fire risk.

The Association of British Insurers (ABI) which uses the Loss Prevention Certification Board (LPCB) assessment, and FM Global who have their own FM Approvals, are the two main bodies that undertake testing.

ABI and Loss Prevention Certificate Board (LPCB) The LPCB specifies two separate standards:

- LPS 1181 Fire growth tests.
- LPS 1208 Fire resistance.

FM Global and FM Approvals

FM Approvals is the testing and certification body for FM Global. It applies to two separate standards for assessment of wall systems and panel roofs:

- 4881 Approved Standard for Class 1 Exterior Wall Systems.
- 4471 Approved Standard for Class 1 Panel Roofs.

The standards cover a number of key performance criteria including fire, wind, traffic, hail and water-tightness.

Colorcoat HPS200 Ultra® can be used in roof and wall cladding systems which can meet the requirements of the LPCB and FM approvals assessments.

CE marking

Under the Construction Products Regulations (CPR), all construction products which come under a harmonised European Standard (hEN) must be CE marked. Pre-finished steel sheet and coil does not fall into this category, however self-supporting double skin metal faced insulating panels (hEN14509), fully supported metal sheet and strip for roofing, external cladding and internal lining (hEN 14783) and self-supporting metal sheet for roofing, external cladding and internal lining (hEN14782) do qualify under this Regulation and fire performance must be declared on the CE mark according to European Standards.

Confidex® Guarantee

Peace of mind

Once your building project is completed you need peace of mind that if anything does go wrong with your pre-finished steel you can get things fixed.

Confidex® is the product performance guarantee for the weatherside of Colorcoat HPS200 Ultra®, when used in an external conventional building envelope application, namely roof and wall cladding using single skin, built-up or composite panel construction in industrial and commercial buildings.

Confidex® offers the longest and most comprehensive guarantee for pre-finished steel available in Europe with Colorcoat HPS200 Ultra® being guaranteed for up to 40 years. Dramatic and unrivalled improvements in colour stability and gloss retention are translated into a durable product with great longevity. We are so confident in our product that we cover the cut edges for the entirety of the guarantee. With no mandatory inspections or maintenance, we remove the need to go on to the roof to maintain the validity of the guarantee – Confidex® is the only pre-finished steel guarantee on the market that offers this.

We also include cover for Colorcoat HPS200 Ultra® that is situated under a photovoltaic (PV) frame module. Providing the building owner with the confidence that installing a PV array will not have a detrimental effect on the performance of the pre-finished steel. PV modules can be installed at any point throughout the Confidex® Guarantee Period, providing it was registered, and will be covered for the remainder of the guarantee period.

The Confidex® Guarantee is project specific and upon registration online - provides a contractual relationship between Tata Steel and the building owner meaning that in the

case of a claim the contact with Tata Steel is direct rather than having to go through the supply chain, saving time and money.

The Confidex® Guarantee is transferable, so should the building owner change it is simply a case of filling in the form on the back of the guarantee certificate and posting back to Tata Steel.

Who registers?

Usually the building owner, cladding contractor or the cladding system manufacturer, but anyone in the supply chain can apply online at: www.colorcoat-online.com/registration

If you want to check your building has been registered, contact the Colorcoat Connection® helpline on +44 (0) 1244 892434.



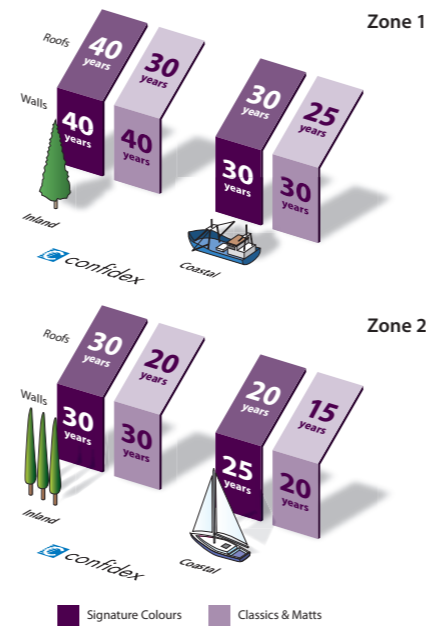
■ Northern Europe – Zone 1 ■ Southern Europe – Zone 2
■ For areas outside of Confidex® zones please contact Tata Steel for more information.

Other warranties

Whilst Confidex® has always been restricted to the weathering performance of the external cladding, we have recognised the growing emergence of demanding internal environment projects, such as energy from waste plants, and may offer a non-Confidex® warranty on a case by case basis for Colorcoat HPS200 Ultra® used internally.

Application specific warranties are also available for non-standard cladding applications; i.e residential roofs, flashings and sectional roller shutter doors. Please contact the Colorcoat Connection® helpline for guarantees associated with such applications.

Figure 33. Diagram of Confidex® Guarantee periods for Zone 1 and 2.



Notes

- Figures under the Coastal heading are for buildings within 1km of any coast.
- Full terms and conditions of the Confidex® Guarantee are on the online application form, available at www.colorcoat-online.com/registration
- Confidex® must be registered within 3 months of the building completion date for the guarantee to be valid.
- The Confidex® Guarantee periods on the diagram above are applicable to Zone 1 and Zone 2. For more information visit www.colorcoat-online.com/confidexmap
- Anthracite Matt is available with a Confidex® Guarantee of up to 40 years in Zone 1 and up to 30 years in Zone 2.



Table 11. Comparison of guarantees

Area	Confidex® Guarantee	Other guarantees
Headline guarantee and cut edges	Headline guarantee statement of up to 40 years including factory cut edges.	Cut edges may only be covered for 10 years.
Rectification costs	Full remedial action so all rectification costs covered.	Some limit the claim to the invoice value of the Steel, which may offer the full value at the beginning but can reduce over the duration of the guarantee.
Inspection and maintenance requirements	Confidex® does not specify mandatory inspections or maintenance to maintain the validity of the guarantee except when Colorcoat HPS200 Ultra® is used on a roof that has a photovoltaic (PV) installation.	Some claim to be maintenance free but require regular inspection logs to be kept.
Non standard colours	Solid colours specified through Repertoire® are covered by the Confidex® Guarantee.	Do not generally provide any guarantee for non standard colours.
Guarantee transfer	Can easily be transferred should building ownership change.	Some suggest transferring ownership is possible but at the discretion of the supplier i.e. the transfer is not assured.
In the event of a coating failure	Building owner contacts Tata Steel directly to address claim.	Some require the building owner to contact the supply chain with the cladding manufacturer ultimately making contact with the steel supplier to pursue claim.
Roof pitches	Covers roof pitches down to 1°.	Higher roof pitches drain more easily so not all guarantees cover pitches below 6°.
Processing of pre-finished steel	Tata Steel requires the product to have been used within 18 months of manufacture, and the Confidex® Guarantee registered within 3 months of building completion.	Some guarantees require the product to have been used within 4 weeks of manufacture.
Application process	Simple, short online form.	Lengthy paper based questionnaire to complete.
Coastal environments	0-1km.	0-3km.

The British Board of Agrément Certificate

Don't just take our word for it, Colorcoat HPS200 Ultra® has been assessed by the British Board of Agrément (BBA) which is the UK's major authority offering approval of construction products, systems and installers.

The BBA awards Agrément Certificates to a product only after it has successfully passed

a comprehensive assessment involving laboratory testing, on-site evaluations and inspections of production.

Colorcoat HPS200 Ultra® has been awarded Agrément Certificate 91/2717 by the BBA for industrial, commercial, retail and leisure use and for residential and non-residential dwellings.

The BBA states: "Colorcoat HPS200 Ultra® coating and metal treatment will protect the steel substrate against corrosion for a period in excess of 40 years in normal industrial, urban, suburban and rural environments."



Sustainability

Reducing embodied energy

Tata Steel has an ongoing commitment to reduce CO₂ emissions associated with pre-finished steel manufacture and we work with leading experts to ensure that both the Colorcoat® products and the roof and wall cladding systems that it is part of, contribute to sustainable building envelope solutions - now and in the future.

Colorcoat HPS200 Ultra® is manufactured at Tata Steel's Shotton site in North Wales. At Shotton we have already delivered significant reduction in CO₂ emissions and material waste through strategies such as a move from road to 100% rail transport for all feedstock coming from Tata Steel in South Wales; installation of variable speed drives and energy-efficient lighting; reclaim and recycle our Zinc pot waste; and reuse of solvents used for washdowns.



Responsible Sourcing

Responsible sourcing provides an approach to managing a product from the point at which a material is mined or harvested in its raw state through manufacture and processing, use, re-use and recycling.

Tata Steel is leading the way as the first pre-finished steel manufacturer to secure BES 6001 certification for its Colorcoat® products manufactured at Shotton including Colorcoat HPS200 Ultra®, and have achieved a 'Very Good' rating.



Colorcoat HPS200 Ultra® is exclusively from Tata Steel and, as such, is fully traceable. Our manufacturing site has an environmental management system which has been certified to ISO 14001.

For a copy of our latest certification contact the Colorcoat Connection® helpline on +44 (0) 1244 892434

Sustainable design and use

A key part of sustainable design is specifying products that offer long-term performance. The super durable properties of Colorcoat HPS200 Ultra® are unsurpassed in the industry and are backed by the Confidex® Guarantee for up to 40 years.

However, the life of Colorcoat HPS200 Ultra® can be extended almost indefinitely over and above the Confidex® Guarantee period by using appropriate maintenance and remedial action such as over-painting.

End of life and recycling

If corrective action is not an option there is a well established and very efficient infrastructure which ensures that all steel collected at end of life goes back into steel manufacture without any loss of quality. This means that the investment in steel-making is never wasted, making steel the most sustainable construction material.

Life cycle assessment

To demonstrate environmental impacts and to allow you to make detailed comparisons and informed decisions when purchasing construction products, Tata Steel has carried out comprehensive life cycle assessments on a wide range of cladding systems using Colorcoat HPS200 Ultra®.

Environmental product declaration (EPD)

Tata Steel have published an Environmental Product Declaration (EPD) for Colorcoat HPS200 Ultra® that complies with EN 15804 and ISO 14025.

Please visit www.colorcoat-online.com/epd for further details.

Operational efficiency

We have worked closely with one of the leading architectural schools at Oxford Brookes University to study the operational impacts of a building and identify the contribution that pre-finished steel cladding can make to its efficient running.

Optimising the building envelope efficiency through insulation, high air-tightness levels and the minimisation of linear thermal bridging can reduce the operational impacts.

We have provided best practice advice and guidance on detailing in our Colorcoat® technical papers so that cladding systems manufactured using Colorcoat HPS200 Ultra® can reduce the associated heat losses from the building envelope.

All Tata Steel supply chain partner roof and wall cladding systems in the UK have details that have been designed and modelled to improve the thermal performance of the building.

For more information visit www.colorcoat-online.com/technical

System environmental assessment

In the UK all roof and wall systems using pre-finished steel achieve a Green Guide A+ rating. Manufacture and processing of Colorcoat HPS200 Ultra® into building envelope products, through our approved supply chain, can maximise credits assessed through BREEAM.

Photovoltaics

To demonstrate Tata Steel's commitment to the environment and renewable energy offerings, Colorcoat HPS200 Ultra® includes cover through the comprehensive Confidex® Guarantee for the pre-finished steel that is under the photovoltaic (PV) frame modules on a roof.



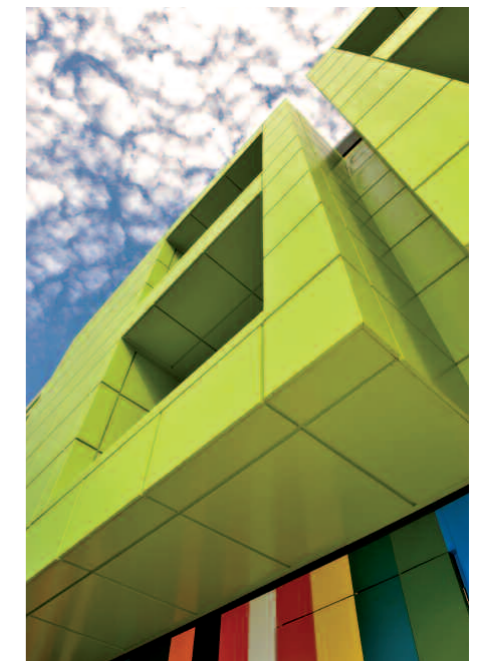
This provides the building owner with the confidence that installing a PV array will not have a detrimental effect on the performance of the pre-finished steel, and that the product is guaranteed to perform for the same duration of the guarantee up to 40 years.

For advice and guidance on PVs and the Confidex® Guarantee contact the Colorcoat Connection® helpline on +44 (0) 1244 892434.

Investing in sustainable building envelopes

Tata Steel, together with partners such as the Low Carbon Research Institute, Welsh Assembly Government, and Swansea University has invested in the creation of the Sustainable Product Engineering Centre for Innovative Functional Industrial Coatings (SPECIFIC).

The aim of the research is to develop a portfolio of products that will turn buildings into power stations to generate over one third of the UK's requirement for renewable energy.



Colour reassurance

When sourcing material for your building envelope, consideration should be given to colour availability, consistency and matching components. Colorcoat HPS200 Ultra® provides the widest colour choice on the market with short production lead times.

We recognise the importance of colour performance and choice in building envelope design. In addition to its superior gloss and colour retention, Colorcoat HPS200 Ultra® is readily available in a wide choice of Signature, Classic and Matt colours.

Colour availability

Common sizes are available in all standard colours on short production lead times in Europe and in small quantities from our Tata Steel accredited distributors in the UK.

To check the quickest colour availability for your project, contact the Colorcoat Connection® helpline on +44 (0) 1244 892434 or your local representative.

Repertoire®

As an additional service, whether you want your building to stand out or blend in with the surroundings, we can create a unique identity for your building.

Through our Repertoire® Colour Consultancy service, available in Zone 1 and Zone 2 areas in Europe, we can match almost any solid colour for roof or wall cladding. We require a minimum order quantity of 2500 m² and can work from either physical swatches or reference standards.

Metal hand samples

Metal hand samples are available for all colours. For a true representation of colour and effect, please obtain metal hand samples from the Colorcoat Connection® helpline or online at www.colorcoat-online.com/samples

Colour consistency

If tonal consistency is critical, all cladding for a single elevation should come from the same production batch. To discuss your requirements, please contact the Colorcoat Connection® helpline on +44 (0) 1244 892434 or your local representative.

Matching components

If accessories made from other materials are to be colour-matched to the roof or wall cladding, the best reference is the actual profiles or panels delivered to site or, material from the same batch.



Colorcoat® services

The Colorcoat® brand is recognised as the exclusive Tata Steel mark of quality and metal envelope expertise. Colorcoat® products are supported by a comprehensive range of services, technical advice and guidance.

Colorcoat® Business Development Team

The team is readily available to advise you on the design, specification and construction of your metal building envelope.

Call the Colorcoat Connection® helpline or visit www.colorcoat-online.com to find out who the representative is for your area.

Colorcoat Connection® helpline

This dedicated helpline offers immediate and easily accessible advice and guidance on a wide range of construction issues. Contact us on +44 (0) 1244 892434.

Colorcoat® technical papers

We have produced a number of technical papers that can help you address key issues for UK building design and construction, from low carbon building design to fire performance.

For a full list of downloadable papers, visit www.colorcoat-online.com/technical

RIBA Approved CPDs

Our expertise and knowledge extends to the following CPD Seminars run by our Colorcoat® Business Development team:

1. RIBA 2030 climate challenge: How steel building envelope solutions contribute.
2. Pre-finished steel standing seam systems for roof and wall cladding.
3. Steel building envelope systems for non-domestic buildings.
4. Steel for roof and wall cladding.
5. Sustainable refurbishment solutions for non-domestic buildings.
6. Building Integrated Renewable Technologies for non-domestic buildings.
7. Part L 2014: The role of the building envelope in compliance for buildings other than dwelling.
8. CDM regulations 2015 and their impact on steel building envelope specification.
9. Colour in the built environment.
10. Factory tour - Colorcoat® manufacturing lines, laboratories & innovation centre at Shotton Works.

Visit www.colorcoat-online.com/cpd to book a CPD or call the Colorcoat Connection® helpline.

Colorcoat® supply chain

Colorcoat® products are available through our market-leading supply chain partners. We recommend their CE-marked and SCI-assessed systems for the very highest quality and service in the UK and worldwide.

For further details on our supply chain partners in the UK, please visit www.colorcoat-online.com/SCP

Colorcoat® accredited distributors

Our Colorcoat® accredited distributors in the UK can provide you with any colour from the Colorcoat HPS200 Ultra® range in small quantities. These are ideal for small projects, flashings, soffits, louvers, fascias, canopies and corner details.

For details of Colorcoat® accredited distributors visit www.colorcoat-online.com/distributors

www.colorcoat-online.com

Trademarks of Tata Steel UK Limited

Colorcoat, Colorcoat Connection, Colorcoat HPS200 Ultra, Confidex, Confidex Sustain, Galvalloy, Repertoire and Scintilla are trademarks of Tata Steel UK Limited.

CarbonNeutral is a registered trademark of the CarbonNeutral Company.

Care has been taken to ensure that the contents of this publication are accurate, but Tata Steel Europe Limited and its subsidiaries, (including Tata Steel UK Limited), do not accept responsibility or liability for errors or information that is found to be misleading. Suggestions for, or descriptions of, the end use or application of products or methods of working are for information only and Tata Steel Europe Limited and its subsidiaries accept no liability in respect thereof.

Before using products or services supplied or manufactured by Tata Steel Europe Limited and its subsidiaries, customers should satisfy themselves as to their suitability.

Printed with biodegradable vegetable inks on material sourced from responsible managed forests, certified in accordance with the FSC. Contains 10% recovered fibre, diverting waste from landfill.

Sales Contact Details

Tata Steel

Shotton Works, Deeside
Flintshire CH5 2NH
United Kingdom

Colorcoat Connection® helpline

T: +44 (0) 1244 892434
E: colorcoat.connection@tatasteeleurope.com

Copyright 2020 Tata Steel, Registered Office: 30 Millbank, London SW1P 4WY, Registered in England No. 2280000

Language English 0720