

Assessing the appearance of metals and finishes

This Technical Note is one of three on assessing appearance. The series comprises:

TN 34 Assessing the appearance of new curtain walling

TN 35 Assessing the appearance of glass

TN 36 Assessing the appearance of metals and finishes

Introduction

The quality of metals and finishes in curtain walling is often assessed by visual inspection, and disputes sometimes arise over the associated procedures and acceptance criteria. This is particularly the case where a specification is not sufficiently detailed.

Metals may be finished in various ways including mill finish, polishing, chemical conversion, such as anodising, and application of a coating or coating system. Finishes may be primarily protective or decorative.

This Note is confined to visual aspects that are commonly queried on new construction and does not cover condition surveys after a period in service. It should be read in conjunction with TN34 'Assessing the appearance of curtain walling'.

Factors affecting appearance

Final appearance is dependent upon the quality of the base metal with issues such as flatness of panels and quality of manufacture, (including processes such as welding) having a major influence upon the final visual standard achieved. When finishing such as anodising, galvanising or the application of an organic coating is required, control of preparation prior to surface treatments is critical to avoid a situation where the finish is technically compliant with the specification but the appearance is considered visually unacceptable. This is a subjective judgement and control samples must be

approved prior to production to avoid disagreement on the standard required. After finishing of the components any damage to the surface during handling or installation, such as dents and scratches (particularly on panels), will also affect the appearance.

Table 1 gives details of factors affecting the appearance of metals and tolerances for metalwork. Table 2 gives guidance on visual appearance of finishing involving conversion of the substrate metal and Table 3 gives guidance on visual appearance of organic finishes applied to the substrate metal.

Viewing criteria for finishes

The inspection criteria for finishes given in the following standards are suitable for use on site for final visual acceptance, primarily to check for on site damage.

It must however be appreciated that potential defects such as peeling of organic coatings or chalking of soft anodic films cannot be identified prior to exposure by visual assessment and comprehensive quality control inspection at the finishing plant, with appropriate independent inspection, is therefore critically important to avoid the wasted effort and significant cost of installing defective components.

BS6496 Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy

extrusions, sheet and preformed sections coated with powder organic coatings

This standard requires, "That the finish on significant surfaces shall show no scratches through to the substrate. When the finish on significant surface is illuminated as described in BS3900-D1 and is examined at an oblique angle with normal or corrected vision, no blisters, craters, pinholes or scratches shall be visible from a distance of about 1m."

CWCT Standard

Clause 5.5.7 of the CWCT Guide to good practice for facades states 'There should be no 'seeding' of the cured film which should be dense and consistent. The coating should be free of pin holes, blisters, tears, damage and other coating defects when evenly illuminated by diffuse daylight and viewed using normal corrected vision from a distance of one metre.'

BS 3987 Specification for anodic oxidation coatings on wrought aluminium for external architectural applications

This standard requires that anodised articles shall be free from visible defects on the significant surfaces when viewed from a distance of not less than 5 m for external architectural applications or 3 m for internal architectural applications. The agreed samples used to produce colour and texture limits should, where possible, be duplicates of production components, but should in any case be shaped so as to facilitate comparison with the production component.

BS6497 Specification for powder organic coatings for application and stoving to hot-dipped galvanized hot-rolled steel sections and preformed steel sheet for windows and associated external architectural purposes and for the finish on galvanized steel sections

and preformed sheet coated with powder organic coatings

This standard requires, "That the finish on significant surfaces shall show no scratches through to the substrate. When the finish on significant surface is illuminated as described in BS3900-D1 and is examined at an oblique angle with normal or corrected vision, no blisters, craters, pinholes or scratches shall be visible from a distance of about 1m."

"The finishes on galvanized coatings on hot-rolled steel sections are not as smooth as those on continuously galvanized steel sheet. There can be some unevenness of the substrate and this should be allowed for when assessing the surface appearance. "

Summary

This Technical Note gives advice on assessing the appearance of metals and finishes and provides guidance on sources of information for such inspections. This Note is confined to visual aspects that are commonly queried on new construction and does not cover condition surveys after a period in service. It should be read in conjunction with TN34 'Assessing the appearance of curtain walling'.

In this Note viewing criteria given in relevant standards are summarised and guidance is provided in tabular format on the following:

- Appearance of metals and tolerances for metalwork
- Guidance on visual appearance of finishing involving conversion of the substrate metal
- Guidance on visual appearance of applied organic coating

References and bibliography

BS6496 *Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and*

performed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and performed sections coated with powder organic coatings, British Standards Institution, London.

BS 3987:1991 *Specification for anodic oxidation coatings on wrought aluminium for external architectural applications*, British Standards Institution, London.

BS 6497:1984 *Specification for powder organic coatings for application and stoving to hot-dipped galvanized hot-rolled steel sections and performed steel sheet for windows and associated external architectural purposes and for the finish on galvanized steel sections and performed sheet coated with powder organic coatings*, British Standards Institution, London.

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Factor	Technical guidance	Specification	Site inspection
Grain & texture	The surfaces of metals, including stainless steel and aluminium, can exhibit a directional effect, grain or texture. The satisfactory appearance of cladding may require the grain of all components to run in the same direction if the surfaces are not finished with a paint coating. On unpainted surfaces, unavoidable variations in appearance may occur if components are formed using different techniques eg: extrusion, sheet and casting.	Any specified requirements regarding grain and texture should be appropriate to the method of metal formation and the surface treatments to be deployed. The specification should recognise that variations in appearance will occur if a number of methods of material formation are used. Control samples should also be specified.	Grain direction and surface texture should be consistent with the specification and agreed control samples.
Oil canning	On stainless steel formed in two directions (eg: curved, standing seam stainless steel), ripples occur due to the difficulty in bending the hard material in two directions. Thus curved stainless steel should not be selected until suitable trials have been undertaken to verify that acceptable visual standards can be achieved.	Need to consider practical aspects of fabrication and select size/thickness and condition of material to enhance workability and service performance characteristics.	
Flatness	Lack of flatness of surfaces is often most obvious from the distortion of reflections. All surfaces will exhibit some deviation from plane and expecting optically flat surfaces is unreasonable. This distortion may be inherent due to processing of the material or may be induced by forming of the panel, such as folding of the edges. Tighter tolerances will lead to increased costs due to more expensive manufacturing control and/or greater number of failures.	Specify flatness tolerances and confirm with the proposed manufacturer before an order is placed. For many materials flatness tolerances are given in British Standards, which can be referred to in the specification. For large panels it may be necessary to consider separate stiffening devices.	

Table 1 – Visual features of extruded and sheet metals

Factor	Technical guidance	Specification	Site inspection
Anodising.	<p>It is possible to achieve exceptional visual uniformity on anodised aluminium of the appropriate quality but because anodising can reveal or accentuate lack of homogeneity or differences in metallurgical condition of the aluminium this is a key issue. Non-uniformity can occur on different areas of the component and/or between different batches of material of the same specification particularly where localised heat processes, such as welding, have not been adequately controlled.</p> <p>With colour anodising in particular, the metal composition, form and surface texture, as well as the viewing angle, can have a profound effect on the subjective impression of colour. Co-operation and material control between metal supplier, anodiser and purchaser is necessary to optimise appearance and minimise variation within acceptable limits. It is also sometimes possible, on close inspection or from certain viewing angles, to observe variations in brightness, banding, streaking and other visual effects on the significant surfaces. These do not impair the protective performance of the anodising.</p>	<p>The specification should include a requirement for samples covering the full range of acceptable appearance to be provided before manufacture is commenced. The manufacturer and the Client should formally agree these.</p>	
Weldlines	<p>One specific form of surface irregularity that can occur during extrusion of hollow sections, is the weld line created when the aluminium re-welds after flowing around the supporting webs for the central core of the die.</p>	<p>The specification should require all weldlines to be at corners or on surfaces that will not be visible in service.</p>	
Galvanising	<p>Roughness/ lumpiness /pimples/ bare spots</p>		

Table 2 visual appearance of finishing involving conversion of the substrate metal

Factor	Technical guidance	Specification	Site inspection
Colour of surface coatings.	Colour variation of coatings may occur for a variety of reasons. Colour matching of components of different materials can be a particular problem and deliberate contrast may avoid the problem.	The specifier should specify the coating(s) required using recognised British Standard or RAL colour references. The specifier should require tenderers to identify proprietary paint systems offered, examples of buildings where the coatings may be seen, and to provide samples and details of tolerances.	In the event of a dispute, scientific means can be used to measure tolerances in colour variation and sheen. The variations can then be checked against the licensed applicator's quality control limits.
Orange peel of surface coatings	<p>All oven baked finishes may display a degree of 'orange peel' texture to the cured surface dependent on thickness and flow of the coating during the hot cure process. Permissible limits should be agreed by means of samples.</p> <p>This effect can also occur in other coating systems if coating conditions are not ideal.</p>		
Opacity	Coatings require sufficient thickness to cover the substrate and give uniform colour. The required thickness will depend on the colour of the coating and the nature of the substrate. Substrates may need to be controlled to enable uniform appearance to be achieved. In particular the degree of spangle on galvanised surfaces must be limited.	The required paint thickness can be determined from tests on samples and production control can then be based on measurement of paint thickness.	

Table 3 – visual appearance of organic finishes applied to the substrate metal.