

STAINLESS STEEL IN COLOUR – the INOX-SPECTRAL® - Process

1. General Information

1.1. Stainless steels for colouring

Austenitic, ferritic and in some degree also martensitic stainless steels can be coloured by the INOX-SPECTRAL®-Process. To get good colouring results the alloy has to have a minimum content of 50% iron and 17% of chromium. On stainless steel with a chromium content between 13 and 17% only a reduced range of colours can be achieved, predominantly brown and grey. There are limitations in maximum content of other alloy components. Best results are obtained on austenitic stainless steels. Relatively high standards are set with regard to homogeneity of structure and alloy concerning the surface quality of the material to be coloured. Only first quality material provides uniformly coloured surfaces.

1.2. Colours

On austenitic and ferritic stainless steels with a chromium content of at least 17% the following colours can be achieved:

Bronze, cobalt-blue, steel-blue, gold, champagne, red, green, anthracite and black.

Due to the mechanism of lightwave interference which generates the colours, stainless steel surface especially when coloured red and green show changes in colour depending on the angle under which they are looked at. This effect should be taken into account for actual application. Proven standardised colours are bronze, cobalt-blue, gold and black.

1.3. Range of delivery

Sheets coloured one side or both sides with maximum dimensions of 6000 x 2000mm and thickness between 0.5 and 3.0 mm. All colours can be achieved on bright annealed, patterned, moulded, ground, electropolished and pickled surfaces. Tubes, profiles and bars up to a maximum length of 6m. Mass produced parts like screws and fasteners on special enquiry.

2. Resistance

2.1. Corrosion resistance

The corrosion resistance of the coloured surface basically depends on the corrosion resistance of the stainless steel itself. In view of corrosion resistance the chromium oxide layer applied by the INOX-SPECTRAL®-Process chemically strengthens the passive layer of the stainless steel. Therefore coloured stainless steel normally shows a higher resistance against corrosion than the uncoloured material. If the stainless steel itself is not durable against corrosion attack, corrosion will also occur on the coloured surface in a retarded and reduced manner. Therefore the quality of the material to be coloured has to be selected according to the corrosive environment to be expected.

2.2. Temperature resistance

The temperature resistance of coloured stainless steel depends mainly on the actual alloy. Coloured stainless steel will withstand long-time heat-exposure up to 200 degree. Normally short times of higher temperature up to 300 degree are not detrimental. If the higher temperature lasts for longer time oxidation will cause a growing thickness of the oxide layer which produces discoloration. New tests with black coloured low chromium-grade stainless steel (type 409) demonstrated a temperature resistance up to 400 degree and more. Very high temperature caused by welding or soldering will destroy the coloured surface.

2.3. Resistance of light, weather and ageing

The surface of coloured stainless steel does not contain pigments or colouring substances which could be bleached or changed by ageing or influences of light and weather. Long-time exhibition to different atmospheric conditions during 25 years have shown no visible changes on coloured stainless steel. The surface of coloured stainless steel does not crack or peel and is resistance to ageing.

2.4. Mechanical resistance

The film of chromium which creates the colours is very ductile and homogeneously connected with the stainless steel. Deformations which do not affect the basic material also will not impair the coloured surface. Bending, tilting, pressing and even deep-drawing can be done without affecting the colour and without cracking or peeling of the coloured surface. The resistance against mechanical wear is limited due to the extremely low thickness of the interference layer which lies between 0.05 and 0.3µm. Its hardness is somewhat higher than the hardness of the uncoloured surface. Abrasive wear which affects the uncoloured stainless steel surface will also destroy the coloured surface. For the application of coloured stainless steel in areas with high abrasive wear special surfaces have been developed using desinated or patterned surfaces, the surfaces of which are mechanically ground after colouring. The abrasive wear then only affects the blank protruding areas, whilst the coloured surface in the recessed areas is protected against mechanical wear.

3. Processing

3.1. Mechanical Treatment

Provided that the surface is adequately protected (protective film) coloured stainless steel can generally be mechanically shaped and worked like uncoloured stainless steel.

3.1.1. Machining, Shaping, Cutting

In view of machining like drilling, sawing and milling the same recommendations are to be obtained as for working the uncoloured steel. Especially when thin sheets are cut, punched or nibbled, it occurs that partially the coloured surface is drawn over the blank cutting edge, so that it is less visible than might be expected.

3.1.2. Forming

An appropriate surface protection provide (protective film) coloured stainless steel can be formed like uncoloured material by bending, canting, chasing, pressing, stamping, rolling and drawing. Normally there is no deterioration of the coloured surface. Too intense deformation locally may cause changes in gloss of surface.

3.2. Bonding

3.2.1. Mechanical Bonding

Mechanical bonding techniques like bolting, riveting or clamping are applicable to coloured stainless steel with out restrictions. The recommendations for uncoloured stainless steel are valid.

3.2.2. Welding

When welding coloured stainless steel generally the recommendations for welding of stainless steel must be followed. In the area of high temperature at the welding seam discoloration will take place. Subsequent colouring of these discoloured areas is not possible. Therefore weldings should be avoided or placed into areas out of the welding seams as decorative elements. For this purpose they are placed symmetrically as far as possible and subsequently discoloured by grinding and pickling in a uniform strip with an accurate line of demarcation (masking). In this way one creates a decorative contrast between the coloured and the uncoloured surface areas. Appropriate execution provided, on the back side of coloured stainless steel sheets thicker than 0.5mm fasteners can be applied by pinwelding without visible impairment of the coloured surface. It is important to reduce welding time and energy input as much as possible.

3.2.3. Brazing and soldering

For brazing the same restrictions are valid as for welding. Soldering is performed with special solders which contain at least 40% of tin. Special pastes or phosphoric acid in a concentration of 50% are used as flux. Fluxes containing hydrochloric acid would tend to affect the surface and cause traces which cannot be removed. Residual flux is to be washed immediately with a solution of soda or alkaline degreasing.

3.2.4. Adhesive Bonding

Compared to uncoloured surface adhesive bonding can be used on coloured stainless steel without limitations. Cold as well as warm curing bonding agents can be used, if the baking temperature does not exceed 200 degree.

3.3. Pickling, Etching, Electropolishing

Chemical and electrochemical processes of surface treatment like pickling, etching and electropolishing which affect the surface of stainless steel will destroy the coloured surface. Therefore these processes can be used for application of letters and patterns into coloured stainless steel. For that purpose the areas in which the coloured surface is to be preserved are masked by an acid-resistant resist (photoresist, screen-printing or offset printing resist) and subsequently the areas not so prepared are discoloured.

3.4. Cleaning

The surface of coloured stainless steel is water- and dirtrepellent. It can be cleaned by using a non-abrasive cleaning agent. Wiping with a clean, soft towel or washing with water containing a commercial detergent is often sufficient for cleaning. Special advice for cleaning of coloured stainless steel using industrial cleaners is available.