



BENDING OF CONTINUOUSLY ANODISED ALUMINIUM

Background

Continuous anodised aluminium has been produced for more than 40 years and has been used for many applications where the aluminium needs to be bent or folded.

However, continuously anodised aluminium should only be bent under certain conditions and with the appropriate know-how.

Anodic film – crazing

The anodic film is the transformation of aluminium in aluminium oxide up to a certain depth or film thickness (e.g. 15 µm). Because in continuous anodising the aluminium has to be rewound in coil form after treatment, a special flexible film was developed. Such a film is impossible with batch anodising.

If continuously anodised aluminium is folded, the anodic film of aluminium oxide will crack and 'crazing' will be formed.

This crazing is not a problem for the corrosion resistance and should not be a problem in terms of aesthetics if the bending is executed properly.

No filiform corrosion – natural oxidation

Contrary to organic coatings or paints, continuously anodised aluminium is pure aluminium and aluminium oxide. The anodic film is integral with the core material. If the anodised surface is cracked by folding this is not really a problem because this zone will be re-oxidised immediately by the oxygen present in the atmosphere and no corrosion or filiform corrosion will be generated.

Studies on buildings using continuously anodised aluminium produced by Coil which are over 30 years old show no long term damage to the surface as a result of bending.

Aesthetic effect

The only real area of concern can be the aesthetic effect in the bending zone.

Crazing occurs as fine white lines and may cause whitening effect in the bent zones. The objective is to contain the cracking in the folded area only and to not affect the rest of the panel.



Bending recommendations

Film

The surface must be protected by a protective film to avoid any marks of the folding machine jaws on the surface (black lines)

Equipment

The quality of the equipment is fundamental, adaptive folding machines are recommended

Bending radius

The selection of the bending radius is a key factor of success. The challenge is to find a good balance between the aesthetic and mechanical characteristics.

To limit the crazing inside the bending area, it is recommended to use a bending radius as small as possible. However, the use of a small bending radius can affect the mechanical resistance of the material. So, a good balance has to be found in each case.

The EN-485-2 standard contains the minimum 'recommended' bending radius per alloy and temper at which no cracking (of the metal) is observed. Severe cracking may cause real deterioration in the metal strength around the bend (so it is not just an optical phenomenon).

Coil recommends the use of the smallest bending radius possible as specified in the EN 485-2 standard (see the table).

| Alloy 5005 H14/H24 | Folding at 90 ° | Folding at 180° |
|--------------------|------------------------------|-----------------|
| EN 485-2 | 1t | 2.5 t |
| | Radius according to EN 485-2 | |
| 2 mm | 2 mm | 5 |
| 3 mm | 3 mm | 7.5 |

If the visual appearance at the bent radius specified in the norm is not satisfactory, a smaller radius can be considered. But then, the strength of the metal on the bend must be evaluated, checked and accepted. The application to which the aluminium is to be employed will determine whether the decreased strength around the bending area is acceptable or not. In extreme cases, the cracking may become so severe at smaller bending radii that the metal will simply break in two, so caution is advised.

Test Results

Coil undertook tests where a radius of 1 mm was used: it meant 0.5 t for 2 mm sheet and 0.3 t for 3 mm sheet for a 90° bend. At this bending angle discoloration (whitening due to the cracking of the anodic layer) was observed inside the bending area, but not outside. Also



the whitening was only visible from 0.5 m but not from 3 m distance (which is the standard for architectural applications).

Conclusions

- The crazing will result in a whitening of the surface and will be, therefore, the more visible the darker the color (e.g. dark bronze or black).
- The visibility of the crazing depends also on the viewing distance, the shorter this distance is, the more visible the micro-cracks will be.

Recommendations

- The thinner the metal, the better bending results will be achieved.
- Protect the surface with an appropriate protection film before bending.
- Depending on the metal substrate, there will be a difference in bending behavior between bending parallel and opposite to the rolling direction.