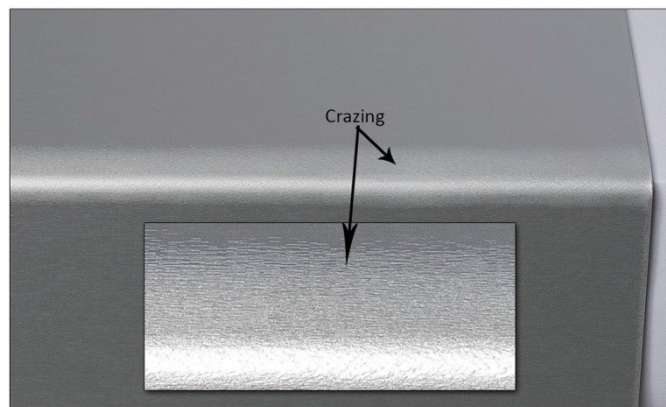


Forming Anodized Aluminum

OVERVIEW

There is a belief in the metal construction industry that crazing negatively affects the aesthetic appeal of anodized aluminum, degrades protective properties of the anodic layer, and that forming anodized aluminum is complicated. Crazing, the microfracturing of the anodic layer, will not affect the performance of the anodized aluminum. However, there may be a desire to minimize the appearance of crazing when forming anodized aluminum. Forming anodized aluminum is generally a much simpler operation provided certain techniques are used in the processing of the material. This paper provides information on the proper forming techniques and tooling required to effectively form anodized aluminum.



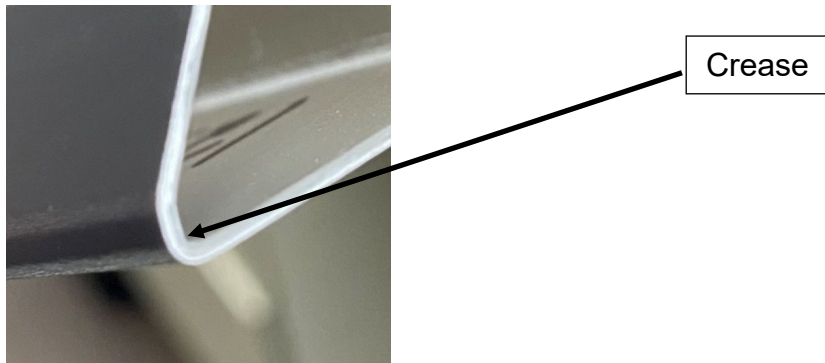
For a number of reasons, 5000 series (alloy) aluminum is generally used for anodizing. There are a variety of aluminum series available that have different mechanical properties; however, 5000 series is typically used due to surface granular quality and the absence of visual elemental imperfections.

DISCUSSION

Forming Effects and Recommendations

Anodized aluminum performs better, both visually and functionally, when held tightly against the tooling as opposed to using an air bending technique. This helps prevent creasing of the anodized aluminum. When air bending the material, there is little restraint to focus the bend in a clean radius allowing a crease line to form along the fold line. When anodized aluminum is air bent, the surface tension of the anodized layer can cause the base aluminum to crease. This is due to the fact that the

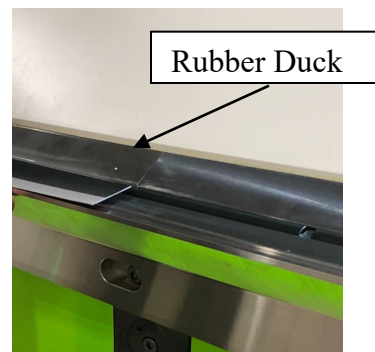
anodic surface layer has a higher surface tension when compared to the aluminum substrate that it is built from. So, when the anodic surface changes shape, the aluminum substrate wants to change more. If there is little restraint on the aluminum, as there is in the case of air bending, the bend will not have a force to counteract the sudden change of potential to kinetic energy resulting in a crease line forming along the fold line. This visual crease is more often observed with bends using an aluminum sheet less than 0.040" in thickness.



Fabrication trials have shown that a minimum 2 mm (0.079") interior radius yields the best results regardless of the equipment being utilized to make the bend. Samples formed using an interior radius less than 2 mm showed more pronounced crazing than samples formed using a 2 mm radius.

Several pieces of equipment, roll formers, folders, and press brakes were used in these trials and each piece of equipment provided a somewhat different finished appearance due to the process in which metal is formed. For example, folders have a more elliptical path of travel for the metal as compared to a press brake which draws metal more evenly to create the bend angle. This difference was exhibited through surface crazing, and the trials found that crazing could be minimized by making minor adjustments in forming the bend angle.

There are instances where a 2 mm interior radius is not available due to the type of equipment being used. When appropriate tooling is not available, a "rubber duck" can be manufactured in-house to enlarge the interior radius. The rubber duck acts as a shim and should be made from the same material that is being formed. The rubber duck fits over the nose of the die in the case of a press brake or the upper clamping beam in the case of a folder. In each case, the rubber duck increases the radius of the tooling to the minimum 2 mm dimension.



Example of a "rubber duck" for a folder

The fabrication technique is often referred to as “hemming” or “the hem of the panel.” The level of material crazing may be impacted by whether the material has an open hem or a closed hem.



Open Hem



Teardrop Closed Hem

The reason the hem type affect crazing is that the material does not need to be completely “crushed” and forced into contact with itself in an open hem. A closed, or teardrop, hem narrows the interior bend radius. If a closed hem is required, a teardrop hem is recommended.

Heavier gauge aluminum, greater than 0.040”, will have more pronounced crazing than the lighter gauges of the same interior radius. This is because the exterior surface radius is stretched more as the material thickness increases.

A poly film (masking) is recommended between the metal surface and the forming equipment whenever possible to avoid fabrication marks on the anodized aluminum. Fabrication oil is to be avoided.

SUMMARY

Crazing, the anodic layer microfracturing, does not affect the functional performance of the anodized aluminum surface. To minimize the visual appearance of crazing, it is important to utilize proper forming techniques. Often, these techniques are specific to the type of equipment being used to form the material. Basic considerations—such as keeping the anodized aluminum as close to the tooling as possible when forming and maintaining a minimum 2 mm interior radius—are critical to quality of the finished product. Sometimes, due to the equipment being used, the interior radius must be increased from the actual tooling radius to a minimum 2 mm radius using a rubber duck.

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