

Oil Canning Controls

By Marcy Marro, Editor

While oil canning can't be entirely avoided, there are steps that can help **minimize** its appearance

Photo: Jeff Haddock, AEP Span

This photo shows a very rare side-by-side comparison of oil canning next to a striated panel. The customer wanted a side-by-side mock-up to compare the two options, and ended up going with the striated option, which stiffens up the panel and eliminates the oil canning.

When it comes to metal roofing or wall panels, one of the biggest complaints you're likely to come across is about oil canning.

Oil canning is the visible waviness in the flat areas of a metal roof or wall panel or architectural metal flashing. It is characterized as a moderate deformation or buckling of the sheet material, particularly common on flat metal sheet surfaces.

Oil canning can be viewed as an undesirable aesthetic concern, but in all reality, it is an inherent characteristic of all cold-rolled flat metal and is not a cause for rejection. While many people do not like the look of oil canning, it does not have an adverse effect on the metal's structural integrity or its waterproofing capability.

"The severity of the waviness varies quite a bit depending on the color, finish, time of day, time of year, or even just the angle the metal is viewed from, which is why no real concrete method or scale for measuring it exists," explains Jeff Hock, technical director from Sheffield Metals International, an Ohio-based Mazzella Company.

Jeff Haddock, technical services manager at AEP Span/ASC Profiles, Sacramento, Calif.,

adds, "Oil canning is caused by internal stresses within thin-gauge metals. These stresses can be introduced during production of the coil and fabrication of the panels. Additionally, field installation conditions, installation techniques and construction tolerances can greatly impact the presence of oil canning. Thin-gauge materials will not straighten out or compensate for irregular substrates of misaligned framing members."

Rollforming

Stress to the metal panel system can be introduced during the rollforming process.

"Depending upon material thickness, strip width, rollform design, and how much stress is induced on the material during rollforming will determine if the design will control the induced stress to maintain a uniform shape," says Ben Schmidt, industry sales manager metal building, decking and trim manufacturing equipment, The Bradbury Co. Inc., Moundridge, Kan. "If not, then irregular shape will be exhibited."

During rollforming, steel coils are put through multiple series of rollers to get a final product. "There can be 20 or more roll stations to form a panel, which puts a lot of stress on the coil," says Haddock. "This can accentuate oil

canning if the coil is not tension-leveled prior to the rollforming process."

Tension leveling is a tension-assisted leveling method. "Tension is created before and after work rolls through a set of drag bridle rolls on the front and pull tension rolls on the exit," explains Jim Sugars, industry sales leader, coil processing and leveling equipment, The Bradbury Co. "The coil is put under significant tension between the bridle rolls so that all parts of the material are pulled past the yield point. The full cross section of the material is elongated a fraction of a percent."

"Tension-leveling pushes the stress of the metal to the edges of the sheet so it is not as visible when the sheet gets rollformed into a finished panel," says Dave Landis, technical services manager at Petersen Aluminum Corp., Elk Grove Village, Ill.

As David Rassmussen, director of business development at MG McGrath, Maplewood, Minn., explains, "The metal is stretched to a point where it will not creep back to its previous non-level state. Typically this will provide a flatter surface, which will be less prone to oil canning. Realistically, tension leveling should be done after any secondary manufacturing is done such as slitting."




Photo courtesy of The Bradbury Co.

This photo of coil blanks and rollformed parts shows a flat blank rollformed can have oil canning depending on the design of the panel. If an edge is added to the coil with a leveler, oil canning can be reduced and sometimes eliminated.

Potential Causes of Oil Canning

There are a number of potential causes of oil canning; however, all are attributable to residual stresses, either induced or redistributed, for different reasons.

- Residual stress during coil production can contribute to camber, the deviation of a side edge from a straight line. This longitudinal curving will place additional stress on metal as it is pulled through a roll forming machine, which attempts to form a straight edge on the panel.
- Slitting a master coil can release and redistribute stresses, especially if the slitter blades are out of adjustment or dull.
- Rollforming equipment can cause oil canning. As metal is run through rolling stations, it is placed under stress and can stretch, particularly if the equipment is out of adjustment or operated beyond its limitations.

Despite having a properly adjusted, well-maintained Rollforming machine and good-quality metal, oil canning can still occur when the metal is installed. It can result from temperature fluctuations and cycles; an uneven substrate or irregular bearing on the structural framing; structural movement; or misalignment of clips. 

Source: *The NRCA Roofing Manual: Architectural Metal Flashing and Condensation and Air Leakage Control—2018.*

Metal Thickness

No one type of metal is more susceptible to oil canning than another, and it can happen with Galvalume, aluminum, zinc, copper and stainless steel. However, generally speaking, the thicker the metal, the less likely there will be oil canning. In light-gauge panel systems, Rassmussen says you can introduce a profile break-up such as stiffening ribs on the broad, flat surfaces, which may reduce the appearance of oil canning. "With heavier-gauge metal, you can introduce stiffeners on the back side of a panel profile to help reduce the appearance of oil canning on the face."

The lighter the gauge of material, the more likely it is to display or give the appearance of oil canning. "Specifying thicker gauge materials such as 22- or 20-gauge versus 24- or 26-gauge can greatly aid in stiffening up the profile and help reduce the appearance of oil canning," Haddock says. "Another aspect to consider is the width of the material used. Specifying narrower width trims and panels can help alleviate the appearance of oil canning as well. Wide, flat, light-gauge steel will almost always produce some degree of oil canning."

Paints and Coatings

The type of paint used on metal panels can play

a role in how visible oil canning is. Different types of paint finishes, clear coats and metals can be highly reflective and bright, making distortions more apparent, leaving the visual effects of oil canning to be intensified by changing or varying light conditions. The time of year, angle of which the sun is striking a surface, as well as a person's viewing angle can all affect the ability to discern oil canning.

Choosing a low-gloss or matte finish on metal panels can reduce reflectivity, therefore decreasing the visibility of oil canning. "The eye perceives reflection of light, which is why oil canning on a lower gloss surface is less perceptible than a higher gloss surface," says Rassmussen. "Low-gloss finish systems or embossed surfaces may reduce the visual perception of oil canning seen in light-gauge metals."

According to Haddock, metallic finishes and darker colors tend to accentuate, or make oil canning appear more prevalent. "Earth-tone colors hide oil canning the best. Bright colors, such as reds and blues, show imperfections more than other colors," adds Landis.

Panel Clip Types

Panel clips are designed with thermal movement of

the panel system in mind, says Haddock. "They are intended to allow the panels to expand and contract, which helps alleviate the appearance of oil canning, and allow the panels to perform as designed. Using the incorrect clip or a clip that is not intended to be used with the panel that is being installed can create huge problems, not only from an appearance standpoint but also a performance standpoint."

There are two main types of clips: fixed and expansion. When it comes to oil canning, Hock says one main concern is the clip not being installed correctly and over driving fasteners causing a stress point along fastener lines, and also not using the right clip to allow for thermal expansion and contraction. "Metal is going to expand and contract, and if this is not accounted for it can cause stress points while the metal is moving, therefore causing oil canning," he says. "The first problem is pretty simple to correct by installing the clips/fasteners properly, while the second has a bit more to it."

Fixed clips, which do not provide any movement for the panel, are used with snap lock panels so the panel can expand and contract independently of the clip. Fixed clips can also be used in shorter length mechanically seamed panels that are 20 feet or less because they should only expand and contract slightly, if at all. "Keep in mind that aluminum panels



Photo courtesy of The Bradbury Co.

This is a Hydraulic Leveler, similar to a model that would be used to spec a standing seam or architectural panel line.

A striation pass in a standing seam panel.

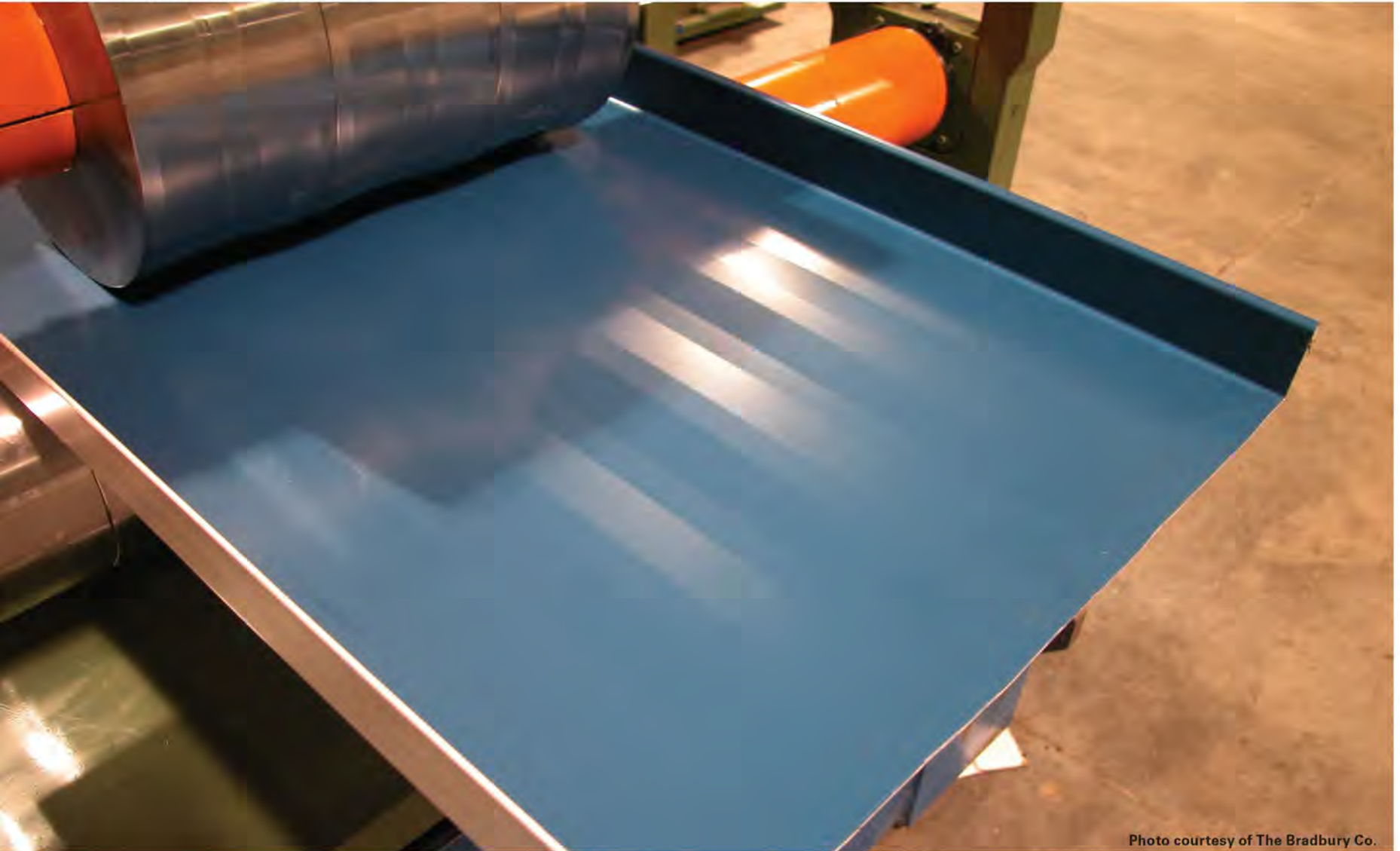


Photo courtesy of The Bradbury Co.

will expand more than steel panels," Hock notes.

Also known as slider or butterfly clip depending on the style, an expansion and contraction clip is fastened to the deck and has a movable sliding piece that attaches to the male leg of the panel before seaming occurs, which allows for the thermal movement the metal roofing system requires.

"Keep in mind that the amount of expansion and contraction a panel will experience will depend on its length and the material it is made out of," Hock says. "You should always refer to the manufacturer guidance when it comes to components in a metal roof system."

Temperature Fluctuations

Making sure you are using the right type of clip will help prevent oil canning as the panels naturally expand and contract. As Landis notes, "Extreme cold or extreme heat will impact the appearance of oil canning, such as temperatures below freezing or above 80 F ambient air temperature."

Because metal expands as it heats up and contracts when it gets cooler, Hock says the appearance of oil canning on a metal roof can change throughout the day, as well as how the sun shines on the panels. "If your roof system is

designed to accommodate the thermal movement in your area, i.e., daily temperature change, proper clips, hem spacing at eaves/cleats to allow for expansion/contraction, etc., then thermal movement can be accounted for."

The surface temperature of exposed panels cycle throughout the year and even fluctuates daily. According to Rassmussen, the range and cycle depend on many variables such as project location and building orientation, cloud cover, surface finish or color, solar absorption characteristics. "As the panel surface temperature fluctuates, panels expand or contract. Surface temperature may be more than 100 degrees higher than ambient air temperature," he explains. "Fasteners, clips and perimeter connections should be designed and installed to accommodate the anticipated thermal movement of the panel. If panel expansion/contraction is inhibited by perimeter flashing conditions or inadvertent 'dual pinning' at other details, the result can be seen as oil canning. Waviness caused by thermal forces differs from the other forms of oil canning in that waves can appear and disappear daily as the panel temperature varies due to solar absorption or radiation."

Usage and Handling

In addition to the thickness of the material used,

the type of coatings and the clips and fasteners all used in a metal roofing system, the proper usage and handling of the panels are key to keeping oil canning at bay. It's important panels are handled carefully throughout manufacturing, crating, shipping and installation. And, always follow the manufacturer's recommendations in all situations. "Improper storing, handling and/or carrying and installing panels can contribute to oil canning," Rassmussen says. "Twisting, buckling and other mishandling of panels can introduce oil canning into a previously flat panel."

There are a number of uncontrollable factors that contribute to oil canning, and no manufacturer, fabricator or installer can ensure the total prevention on any given project. "If you pay attention to the production, material selection, panel design, handling and installation, oil canning can be minimized," Rassmussen explains. "If oil canning is caused by external factors that cannot be controlled by the manufacturer and/or the installer, the root cause would need to be addressed. Oil canning is generally an aesthetic issue. Structural integrity is typically not affected. In the absence of specific contract requirements, oil canning is not grounds for panel rejection." 