CMT
CONTRARIAN MICRO TEXTURES
by Rigidized® Metals Corporation

Technical Information

Flatness of Sheet Metal

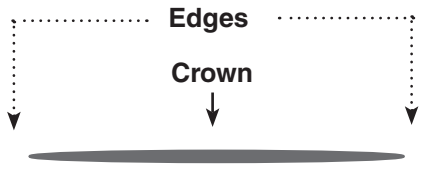
DFW Airport International Terminal D - InvariGrain Stainless Steel

Metal flatness is a big issue in architectural panel work. If the incoming material has errant shape, the panel manufacturer or fabricator cannot avoid producing a panel that exhibits oil canning (repeating undulations in the panel surface), concave or convex profiles or buckles at the corners.

Architects and building owners have been more or less forced to accept these conditions since ASTM standards allow sufficient shape deviation to create these visual disturbances. Most sheet metal applications do not require superb flatness (stamped parts, welded tubes, industrial equipment, etc.) Therefore, most commercial products available on the market have enough shape deviation to result in visually unattractive panels. However, the the extent possible, Contrarian Micro Textures supplies shape corrected material, which has been coil stretched. This gives fabricators the flattest possible incoming material.

There is a natural tendency for flat rolled metals to have an edge wave. The thickness of the strip must be greater in the center to keep the material tracking properly in the rolling equipment (see Figure 1). If this "crown", as its called, is not present, the metal will tend to slip from side to side with potentially catastrophic results. Since the edges are thinner and subjected to the same reduction in thickness as the crown, the percentage of reduction on the edges is greater, causing the edges of the strip to be slightly longer than the center. The edges then, will undulate at a certain frequency to compensate for their greater length. The greater the percent crown (usually 2 - 4% thicker than the edges), the greater the edge wave will be.

Figure 1 Cross Section of a Metal Sheet



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There are other shape distortions that can occur, caused by offset crowns and uneven rolling pressures across the width of the strip. Modern levelers (which are used to cut coiled sheet metal to length) can do a lot to improve flatness, but they do so by putting stresses into the material. Once these leveled sheets are sheared down and formed, the uneven stresses that were applied to get the sheet to lay flat can be relieved somewhat, causing shape deviation to occur. Even without this manifestation, sheets that are processed on a leveler alone are not sufficiently flat to make a distortion-free panel. Table I shows the ASTM standard flatness tolerances for cold rolled stainless steel sheet. Other metals carry similar tolerances. Even sheets produced to half standard tolerance will cause visual distortions in architectural panels. This "variation from flat" as outlined in Table I can come in the form of edge wave, full center, buckle or some combination.

TABLE I (Measurements shown in inches)

THICKNESS	WIDTH	VARIATION FROM FLAT
≥ .062	≤ 60	1/2
< .062	> 36	1/2
< .062	36 - 60	3/4

Stretch Leveled Flatness

Contrarian Micro Textures employs shape correction on most of its flat rolled products. This is done on a coil stretching line. Essentially, the material is stretched longitudinally to ensure that the length of the material is the same from edge to edge (typically, the center crown is stretched out to equal the length of the edges). As a result, the stretched coil has superb shape. In cutting to length, the leveler only needs to remove the coil set (tendency for the metal to remain in a coiled condition) to create a perfectly flat sheet. We guarantee stretched material to conform to a flatness tolerance of five I-units. The formula for calculating I-units is as follows:

Flatness in I-units = $(\pi H/2L)^2 \times 10^5$
Where H = Height of the deviation
L = Length between deviations
Formula assumes a sinusoidal wave shape

If we use an example from Table 1 of the standard commercial allowance for .060 x 48 x 120" sheet, or 1/2" variation from flat, and assume the deviation repeats only twice, or every 60", we can calculate the allowable I-units as follows:

Flatness in I-units = $(3.14(.5)/2(60)^2 \times 10^5 = (1.57/120)^2 \times 10^5 = .000171173 \times 10^5 = 17$

If the deviation repeats more frequently than every 60", the I-units value would be much higher. If we were to apply this formula to a sheet that had a deviation of 1/16" that repeats every 6" (more apt to reflect a commercial quality sheet and very likely to manifest as an oil-canned architectural panel) we arrive at a calculated I-unit value of 27. In summary, the vast majority of flat rolled metals available on the market are not produced to flatness standards that are restrictive enough to be fabricated into dimensionally correct, visually uniform, flat panels. Where possible, Contrarian Metal Resources supplies flat rolled material giving panel manufacturers every opportunity to make a perfectly shaped panel. that has been shape corrected to five I-units of flatness giving panel manufacturers every opportunity to make a perfectly shaped panel.