

Metallic Effects and CIE *L*a*b Colour Space

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Optical Properties of Metallic Thermoplastic Sheet:

Without the knowledge of how metallic colourants behave (flakes from various sources used to create a metallic appearance in plastic), it is difficult to describe and illustrate the visual changes that are perceived as well as how to accurately measure metallic colours. The optical properties of metallic sheet are determined by a number of individual effects, which could include all of the following characteristics:

- Opacity
- Brilliance (degree of sparkle or gloss reflecting from surface)
- Pigment loading (concentration)
- Flop (observed change in colour/brightness with a change in viewing angle)

These individual characteristics are influenced by properties of the metallic colourants, which include the type of pigment, particle size, particle distribution, smoothness and shape. When all these individual components are introduced into extruded plastic, it makes for a complex combination of possible appearances.

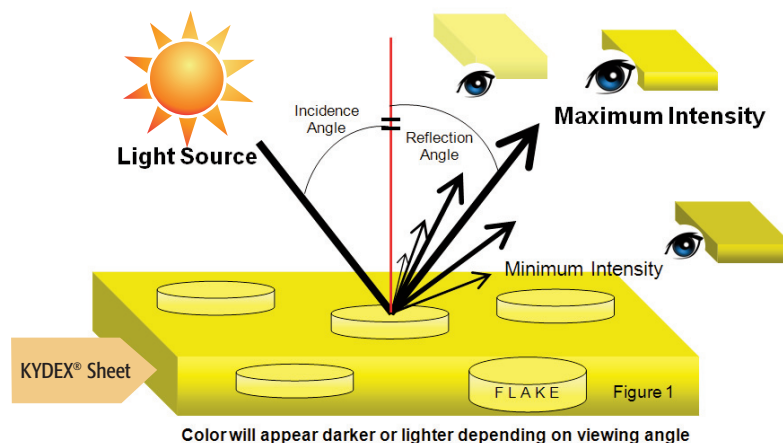
Key Characteristics of Metallic Sheet

Flop (variations in appearance):

Be aware that the same qualities creating depth and brilliance also can cause variations in appearance. Specifically, metallics can have variation in the level of brightness creating dark and light areas. The highly reflective properties of metallic flake mean that the same surface will look different depending on the viewing angle and the intensity and type of the light source. In addition, the general orientation and direction of the metallic flakes in the plastic will affect the brightness of the colour. This is typically an undesirable but necessary reality of metallic colourants, and is sometimes referred to as “flop.”

Metallic flakes act as tiny mirrors, Figure 1. The visual intensity of these pigments change in relation to the viewing angle. Maximum intensity is achieved at the angle of reflection. Minimum intensity is achieved for an angle far away from the reflection angle. The factors affecting flop are the shape and size of the pigment particles, their surface smoothness, particle distribution, and particle orientation.

To help minimize the appearance of “flop”, a directional laser etch, video jet, or sticker is used to indicate the direction of flake orientation. This will help designers and thermoformers to properly match sheet and part directionality for a more consistent appearance.



Color will appear darker or lighter depending on viewing angle

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Key Characteristics of Metallic Sheet

Opacity: To achieve an opaque/solid colour, pigments must absorb sufficient light to prevent it from reaching the substrate, or underlying material thus changing the appearance.

In contrast, to achieve high-quality metallic properties, metallic colourants rely on their lack of opacity (transparency), highly reflective characteristics, and particle orientation. Highly reflective particles create layers in the plastic matrix (Figure 2) that reflect some light but remain translucent enough to allow some light to pass through the surface. The thickness of the sample will determine the visual colour. If thin enough, some of the substrate colour will tint the actual metallic colour.

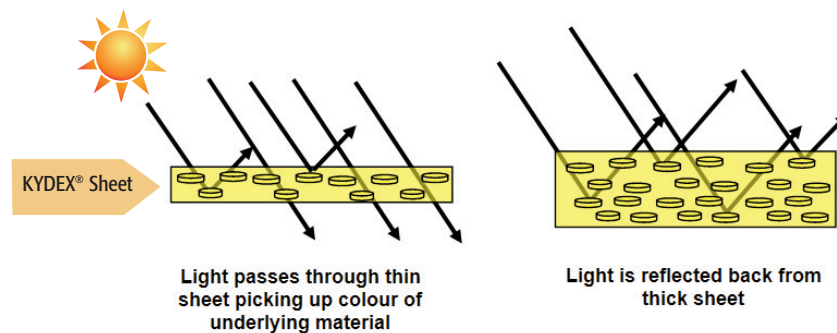


Figure 2

Thin gauges of material can be subject to a colour shift based on the substrate colour. Most metallic colours thicker than 3.2mm (.125") should have minimal colour shift. However, if thermoformed to a thinner gauge, the same phenomenon will occur.

Measuring Metallic Colours

The inability to accurately measure metallic colours has long been a problem. Conventional spectrophotometers for determining solid colours cannot handle texture differences as well as the optical properties of metallic sheet. Formulators, therefore, have relied mainly on their eyes to measure colour. At KYDEX, LLC metallic colours are measured with a standard spectrophotometer instrument as well as visually by a trained technician. Every metallic run is measured utilizing CIE *L*a*b colour space, but the final decision is based on a visual check. For more information on CIE *L*a*b and reading colour, please refer to Technical Brief 177 – Understanding CIE *L*a*b Colour Space, <http://www.kydex.com/briefs/177.pdf>

Colour measurement is based solely on the energy that is reflected and returned to the instrument sensors. Energy from the source light of the instrument will pass through translucent metallic samples with differing results based upon thickness (Figure 2 above). Thin sample measurement varies the most due to bleed-through from substrate colour or sample holder.

Not only does transparency influence colour measurements, gloss and texture can interact as well to produce various effects on the primary surface of the sheet. Large differences in gloss will affect the colour measurement; a higher gloss produces a superior metallic effect. On the contrary, mechanical matting typically reduces the quality of the effect. To minimize this perceived difference, KYDEX® 110 is run as a high-gloss product, which minimizes the mechanical matting from the texture rolls. Other textures may differ greatly between the primary and secondary surface colour readings, but look visually similar. Because of this, comparisons for quality purposes are done using the secondary surface. The secondary surface is the same for every lot, which minimizes differences between the machine and transverse directions.

Note: thermoforming KYDEX® 110 will change the thickness, texture, and gloss level creating a slightly different appearance from the unformed flat sheet.

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Machining Considerations

Metallic colourants added to KYDEX® 110 have an effect on the machining characteristics of the material. These colourants make KYDEX® 110 notch sensitive which may act as a crack enabler when the sheet is fabricated improperly. This makes the material more susceptible to cracks and chips when compared to KYDEX® T, KYDEX® 100 and other KYDEX® sheet grades.

It is very important to use proper cutting and machining techniques to prevent cracks and chips. Sharp blades and tools along with slower machining speeds prevent most issues. It is equally important to ensure the material is properly secured during the machining process. Vibration or movement of the material may notch the material which creates a stress point for the formation of cracks and chips. For more information on the cutting and machining of KYDEX® sheet, please refer to Technical Brief 127 - Cutting and Machining KYDEX® Thermoplastic Sheet, <http://www.kydex.com/briefs/127.pdf>.

General Cleaning Procedure

KYDEX® 110 can be easily cleaned with common household cleaners. Due to the smooth, high gloss/metallic effect of KYDEX® 110, cleaners can leave behind a visible residue that appears as streaks or swirls. These streaks can be avoided through a few simple steps, as outlined below.

- 1) Apply one of the recommended cleaners below by means of spraying or a wipe-on application (i.e. a diluted bucket mixture). Clean as usual with sponge or wet rag.
- 2) Directly following the cleaning process, wipe the area with a clean dry rag before the liquid cleaner has a chance to dry thoroughly.

Once dry, the residue can still be removed with extra wiping or with the addition of water or extra cleaner, followed by a clean dry rag.

*The whole sheet may have to be cleaned in order to avoid patchy differences of cleanliness.

Recommended Cleaners

Product & Manufacturer	On the Web	In the U.S. Call
"Formula 409®" - All Purpose Cleaner	http://www.formula409.com/	1-415-847-6100
"Simple Green®" All Purpose Cleaner	http://www.simplegreen.com/	1-800-228-0709
"fantastik®" - All Purpose Cleaner	http://www.fantastik.com/	1-800-494-4855

Cleaners to avoid

Citrus based cleaners: These cleaners tend to leave behind a streaky/oily residue that is more difficult to remove than the recommended cleaners.

Citrus cleaners do a very good job of removing adhesive and other sticky residues but should then be followed with one of the recommended cleaners to remove the citrus cleaner residue. For more information on cleaning KYDEX® sheet, please refer to Technical Brief 114 – Cleaning KYDEX® Thermoplastic Sheet, <http://www.kydex.com/briefs/114.pdf>.

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