Design Guidelines

Tech Sheet

Rev. 1/20

Material Selection

Label Material Selection

Vinyl

Pressure sensitive vinyl materials are flexible, durable, moisture resistant, and typically, a lower cost substrate option. They are available in gloss, semi-gloss and matte versions and come in white, clear and a variety of other colors. Vinyl materials have excellent printability and can be printed digitally, screen printed, and flexographic printed. Promotional and intermediate vinyls (6 month to 2 year outdoor durability) are used as a standard but there are premium vinyls available with 5 to 7 year outdoor durability when needed.

Because of vinyl's conformability, it is an excellent choice for curved, uneven or slightly textured surfaces. While vinyl materials are less solvent resistant and less outdoor durable than polyester materials, they still good options due to their weather-ability. Adding an over-laminate can provide increased durability and UV resistance when needed. Because vinyl is less dimensionally stable than polyester, it can shrink by as much as .015" over time, so vinyl should not be used where an exposed edge would become a problem. The normal temperature range for vinyl labels is -40 to 176 degrees F. Some premium vinyls have an upper limit of 225 degrees F. Vinyls can be used for product identity, warning labels, equipment labels, asset labels, and an assortment of other label types.

Vinyl also comes in a rigid or "hard" version, typically white but available in other colors, and in thicknesses from .007" to .060". The white background can mean once less color printed, again making it an economical choice.

Polyester

Pressure sensitive polyester materials are extremely durable both indoor and outdoor, are dimensionally stable, have excellent solvent resistance, and are moisture resistant. Polyester label materials are available in white, clear and silver (bright, brushed, and matte silver versions). They are supplied with top coated surfaces to make them printable via a variety of methods. While they tend to be slightly more expensive than standard vinyls, they are typically less expensive than premium vinyls when extended outdoor durability is required. Although they are already very durable, performance for both UV and other environmental exposures can be improved even more by adding an over-laminate.

Polyester is not as conformable as vinyl so it is not the best option for curved surfaces. On even slightly textured surfaces, a thicker layer of adhesive may be required to provide good contact with the surface and avoid an "orange peel" appearance. One of the advantages of polyester over vinyl is that it can withstand much greater temperature extremes. The typical temperature range is -40 to 302 degrees F. Polyester materials can be used for the same type of labels as the vinyl labels but are a better option for applications in harsher environments.

Over-laminates

Over-laminates are materials that are applied over the printed surface of a substrate to provide protection to the ink as well as adding durability to the label. Another benefit of adding an over-laminate is to increase stability of a thin substrate to make it easier to handle. There are versions of

over-laminates that will provide UV protection and versions that are top coated to allow the end user to add information. Over-laminates can also change the finish of the part because this material comes in gloss, matte and velvet options. When choosing an over-laminate, in addition to thinking about the aesthetics for the part and the durability requirement, it is important to consider the substrate being used to make sure the materials are compatible. For example, if a vinyl material is chosen because the label will be applied to a curved surface, applying a polyester over-laminate will reduce the flexibility of the vinyl material.

Overlay Material Selection

A graphic overlay is a part that is produced on a plastic material, typically printed on the back surface to protect the inks, with an adhesive applied on the backside to affix the part to whatever it will be applied to. There are many different combinations of substrates and adhesives that can be used for overlays, so it is important consider the following when making material selections. For aesthetics, what is the desired look of the finished part? Is glare a concern or will the part have windows that will be placed over LEDs or other electronic displays? Materials come in gloss, matte and textured finishes. Gloss materials enhance colors but may scratch or show fingerprints (although they are easy to clean). Matte finishes reduce glare and do not show scratches as easily. Velvet finishes are the most durable. Even more important than looks, what durability is required of the part? Will it be used indoors or outdoors? Will it be exposed to chemicals or moisture? Will it be exposed to abrasion or impact? What is the temperature range it will experience? What is the expected lifespan? Additionally, what is the surface the part will be applied to? Is it smooth or textured, flat or curved? One last consideration is the budget allowance for the overlay. While performance should be the first consideration, if all things are determined to be equal, what is the more cost effective construction?

Polycarbonate

Polycarbonate is a very durable material. It is resistant to moisture, abrasion, chemicals and is heat resistant. This material is available in standard thicknesses from .005” to .030” and in a variety of finishes. One of the most popular overlay materials is velvet finish polycarbonate which provides an anti-glare, scuff resistant finish to the final part as well as allowing for easy handling during processing. Polycarbonate is easier to emboss and process and is less expensive than polyester but is not as durable, especially for parts with buttons requiring frequent actuations. Due to its easy formability it is the film of choice for many in-mold decoration applications.

Polyester

Strongest and most durable of the overlay material options, it is the best option for keypads and switches that will have frequent actuations or are exposed to harsher environments. Polyester materials are available in thicknesses from .003” to .010” and in gloss, anti-glare and textured finishes. Polyesters are also available in hard coated options. While there are not flame retardant options, polyesters provide better long-term high temperature exposures than polycarbonates.

Characteristic	Polyester	Polycarbonate
Flame Retardant	No	Available
Outdoor	Yes	Available
Flex life (actuations)	Excellent	Good
Chemical resistance	Excellent	Good
Abrasion resistance	Excellent	Good – excellent with velvet finish materials
Window Clarity	Good	Excellent
Embossability	Good	Excellent
High temp range	302 F	290 F
Finishes available	Few	More
Color brilliance	Good	Excellent
Hard coated options	Yes	Yes
Durability	Excellent	Great

Specialty Films

Co-blend

Co-blends are materials that are blends of two materials. For example a polycarbonate/polyester blend. The advantage of using this type of material is that it offers the strength and stability of polyester with the cold formability of a polycarbonate. Work with a DuraTech Project Manager when investigating co-blend material options.

Co-polyester

Co-polyester is a specific co-blend polyester material that has been modified by adding other chemicals to it. It has excellent heat and chemical resistance, in addition to excellent clarity and general toughness. The material has dimensional stability, is easy to process, and is typically less expensive than polycarbonate material. It is available in thicknesses from .010" to .060" and comes in matte and gloss finishes.

Adhesive Characteristics

All adhesives are not the same because all surfaces are not the same and all applications are not the same. There are many factors that can affect how an adhesive will work: surface energy, surface shape and texture, initial bond, and environment. There are also options for the type of adhesive that can be used: high tack, medium tack, low tack, repositionable, removable and channeled (allows trapped air to escape when applying larger labels). The following are things to consider when making an adhesive choice that will ensure labels and overlays stick the way they are expected to.

Surface Energy – A simple way to understand surface energy is comparing a waxed car to an un-waxed car. When water is dropped on an un-waxed car, the water puddles on the hood because the surface energy is high. It is pulling down on the water causing it to flow. On a waxed car, the surface energy is low so the water beads up and doesn't flow out as much. The higher the surface energy, the more "attraction" there will be between the materials, which will increase the contact and facilitate better adhesion. In order to ensure that a label or overlay will adhere to a surface, it is important to know what the surface energy is of the material that it will be applied to. Surface energy is measured by dynes per centimeter. The higher the dyne level, the higher the surface energy. The following chart lists the dyne levels of a variety of common substrates.

Surface Energy Chart

Metals	**Dynes/cm**
Copper	1103
Aluminum	840
Zinc	753
Stainless Steel	700 – 1100
Tin	526
Lead	458
Glass	250 – 500
High Surface Energy Plastic	
Kapton	50
Phenolic	47
Nylon	46
Alkyd Enamel	45
Polyester	43
Epoxy Paint	43
Polyurethane Paint	43
ABS	42
Polycarbonate	42
PVC	39
Noryl	38
Acrylic	38
Polane Paint	38
Low Surface Energy Plastics	
PVA	37
Polystyrene	36
Acetal	36
EVA	33
Polyethylene	31
Polypropylene	29
Tedlar	28
Teflon	18

Another consideration that needs to be taken into account when looking at surface energy, is not necessarily the material itself, but any coatings or paints that are applied to the material. A common example is powder coated paint. Powder coated paints tend to have low surface energy characteristics, so it is also important to be aware of the types of coatings or paints that may be on the surface the label or overlay will be applied to. Adhesives have been chemically engineered to work with specific surface energies. Adhesives that have been formulated for high surface energy applications, like the 3M 200MP and 220 adhesive families, will work very well on surfaces like the metals and high surface energy plastics noted in the chart above, but will not be good choices for low surface energy applications. On the other hand, adhesives that are designed for low surface applications will adhere to both low and high surface energy substrates.

Surface Shape and Texture – In order for a label or overlay to stick, the adhesive needs to have adequate surface contact. A flat surface with little or no texture requires only a thin layer of adhesive, while a rougher surface requires a thicker layer of adhesive that will allow it to not only adhere to the peaks of the substrate surface, but to also flow into the cracks and crevices.

Standard pressure sensitive label materials are supplied with an adhesive thickness that will work well on smooth surfaces. They are also available with adhesives thick enough to work on somewhat textured surfaces. If a pressure sensitive label will be adhered to a textured surface, keep in mind that the anomalies of the surface may show through the label due to the thinness of the material. Overlay materials come in thicker material options and offer the flexibility to have a variety of adhesive types and thicknesses applied to them, allowing them to adhere to either smooth or textured surfaces.

Curved surfaces require a combination of a label or overlay material that is flexible enough to match the curve and an adhesive that is strong enough to maintain the hold of the curve and keep it adhered, so the label edges don't lift up or "flag". If the surface has a compound curve, not only does the adhesive need to be strong enough but the substrate must be able to conform in more than one direction.

Surface contact is fundamental to adhesive performance on any surface. In order to maximize the surface contact, the surface should be dry and clean (recommend prepping surface with isopropyl alcohol), firm pressure must be applied to increase the contact and flow of the adhesive to the surface, and time and appropriate temperature will increase the surface contact and adhesion values.

Bond – Initial bond is how strong the adhesive sticks to the surface the moment the label or overlay is applied. Ultimate bond is the strength of the adhesion after the adhesive has fully set. Good initial bond strength would be important for applications that require immediate handling (like an assembly line setting), whereas an option where the initial bond is not as strong is helpful when a label or overlay may need to be repositioned without damaging the part (for parts where alignment is critical). Ultimate bond strength is achieved when the dwell time has allowed the adhesive to completely flow and the adhesive is considered set. As mentioned earlier, adhesives come in a variety of both initial and ultimate bond strengths so consider how the label will be applied as well as the expected performance when evaluating an adhesive's bond strength.

Environmental Concerns – Different adhesives are designed to withstand different environments. Some have better resistance to moisture, to temperatures (both high and low), to UV exposure and resistance to solvents and chemicals. Acrylic adhesives tend to be more expensive but are much higher performing than rubber based versions which, while cheaper, tend to have poor UV resistance, may fail when exposed to water/humidity and have little chemical resistance.

Adhesive Recommendations - The following can be used as a guide for specifying 3M transfer adhesives that can be added for overlay applications. While 3M products are often times specified and quoted, DuraTech can also offer lower cost, comparable options if needed.

3M 200MP adhesives provide outstanding adhesion to metals and high surface energy surfaces with short term repositionability. They provide short term heat resistance up to 400 degrees F and have excellent solvent resistance. These adhesives provide excellent shear strength, resists slippage and edge lifting. It is a relatively smooth adhesive which allows it to be used in backlit applications.

3M 220 adhesives are an economical version of the 200 MP adhesives with many of the same characteristics. They provide short term heat resistance to 350 degrees F, have good shear strength and chemical resistance and adhere well to most metal and high surface energy materials.

3M 300LSE adhesives are the best option for low surface energy applications and powder coated paints but can also be used on high surface energy materials. They provide short term heat resistance up to 300 degrees F and have good chemical and humidity resistance. Because of the somewhat free flowing nature of this adhesive type, they provide excellent initial bond strength. Due to this characteristic, it is not recommended to have a split liner (adhesive may ooze) or be used for kiss cut labels.

Label Format	3M 200MP .002"	3M 200MP .005"	3M 220 .002"	3M 220 .005"	3M 300LSE .002"	3M 300LSE .0035"	3M 300LSE .005"
Individual w/ or w/out split	467MP	468MP	9502	9505	9471LE	9453LE	9472LE
Individual with tab or on carrier	9667MP	9668MP	9502HL	9505HL	9671LE	9653LE	9672LE
Individual or sheet kiss cut to liner	9667MP	9668MP	9502HL	9505HL	9671LE	9653LE	9672LE
Selective adhesive	7962MP	7965MP	9552HL	9555HL	8132LE	8153LE	N/A

UL/CSA Requirements

DuraTech can offer several UL approved constructions and a limited number of CSA recognized constructions for labels and overlays. These constructions are tested and approved based on application surface, temperature ranges and indoor and/or outdoor usage. This information will need to be provided at the quoting stage in order for DuraTech to verify that there is a designation that meets the customer requirement. If a UL logo is to be printed on a part, DuraTech will need to receive authorization from UL to do that at the time of order. Customers should work with their UL or CSA representative with questions they may have.

Product Life Expectancy

Life expectancy of a product is affected by its end usage and the environment it is in. Materials and adhesive used, as well as the inks and colors printed, can also determine the life span of a part. Under general indoor use, the life span of labels and overlays are almost limitless. Exposure to chemicals and solvents, moisture, temperature changes and the amount of handling and physical abuse the part endures can all affect product life span.

Most pressure sensitive label products are warranted for anywhere from six months to two years outdoor life. However, by selecting premium materials like cast vinyl, or adding a UV resistant over-laminate, a label product life could easily be extended to five to seven years or longer.

Neither polycarbonate nor polyester overlays are recommended for extended outdoor use unless a weatherable material option is used. These materials tend to yellow, chalk or become brittle with

extended outdoor exposure. There are standard polycarbonates that have UV stabilizers which will allow for intermittent exposure and limited outdoor use. There are also UV resistant options for both polyesters and polycarbonates, which can be used for longer term outdoor uses, but do come at a higher cost.

For outdoor applications, non-fading colors should be considered when extended life is needed. Certain pigmented colors will fade faster. Colors like reds and yellows can fade within two to three years. Florescent colors can fade in as quickly as three to six months. If using colors other than black, a printed UV clear coat or UV over-laminate can increase the lifespan of the color integrity by years. Humidity and moisture have little effect on labels and overlays once applied but if salt spray or dirt is a concern, a part should have an over-laminate or be printed second surface on a polyester or polycarbonate.

The life expectancy of an overlay with buttons is dependent on the number of actuations and whether or not the buttons are embossed. Polyester has more than 20 times the flex life of polycarbonate, so it is the best choice for a longer life span of a highly active keypad overlay. A polyester overlay with buttons that aren't embossed can exceed 10,000,000 actuations (vs. 500,000 for polycarbonate). A polyester overlay with embossed buttons can take over 1,000,000 actuations (vs. 500 to 100,000 for polycarbonate).

Embossing Guidelines

Embossing is basically a forming process that raises areas of a label, overlay or nameplate to provide functional and/or aesthetic features to a part (the opposite of embossing is de-bossing, which creates depressed areas rather than raised areas and would also follow these guidelines). A few functional examples are embossed buttons on a keypad which create a tactile feel, raised LED window areas for better visibility, and braille copy. Aesthetically, copy, logos or other graphics can be embossed to create dimension and a higher quality look to parts.

There are a few different ways to emboss material. The two typical methods that DuraTech uses are either to utilize a two part tool that has a male and a female component (most common) or by hydroforming, which uses fluid pressure to move material. Because there are different advantages (and costs) to each, the method and tooling to be used to process a part is determined by what the embossing requirements are – emboss height, shape, substrate being used etc.

Embossing Considerations

Material type and thickness – There are a variety of materials that can be embossed. Labels produced on 2 mil pressure sensitive polyesters and foils can be decoratively embossed. Overlay materials like polycarbonates and polyesters in thicknesses up to .015" can be both decoratively and functionally embossed. Aluminums up to .032" thick can all be embossed using standard embossing processes and tooling. Polycarbonates and polyesters 20 mil or greater will typically be embossed using hydro-forming (these thicker materials can also be embossed using thermoforming, which uses heat to move the material). When determining a material thickness to be used for an overlay, consider the required height of the embossed areas as maximum embossing height for polycarbonate should be no greater than 1.5 times the material thickness and no more than 1 times the material thickness for polyesters.

Excessive emboss heights may result in material failure. Greater emboss heights can be reached with polycarbonate materials but should not be done for functional applications due to this risk.

Embossing tolerances – The standard registration of emboss to printing is +/-.015" and embossing to cut edge is +/- .020". The tolerance for emboss height is dependent on the tooling and process used. The standard process of using a two part magnesium die has a tolerance of +/- .005" for the height of the embossing with a minimum emboss height of .003".

Design considerations for embossing – There are different types of embossing that can be utilized in a design include rail/rim, pad/pillow, dome and multi-level. Rail embossing is used for embossed copy, as well as to create a tactile ring around a button. To prevent cracking or warping the minimum width of the rail should be 5 times the material thickness (example: material thickness is .010" thick, minimum rail width should be .05" wide). Pad embossing creates an area that is raised and flat on top while dome embossing raises an area that has a curved profile. Multi-level embossing is more expensive due to the need for multiple or special tools, but may be worth the cost when there is a need to have areas of a part raised to different levels.

It is difficult to emboss sharp corners because the integrity of the material is impacted, so it is suggested to use a slight radius on all areas that are to be embossed. It is important to consider this when designing the printed graphics to make sure they align well with the embossed areas. For rail embossed buttons, it is suggested to use a minimum radius of .06" for all inside and outside corners. The minimum spacing between embossed areas in a layout should be a minimum of 3 times the emboss height. Typically the more embossed area there is on the part, the more distortion there is of material but by following these guidelines, any warping should be kept to a minimum.

Forming Guidelines

Like embossing, forming is a process of moving material from a flat state to a 3 dimensional state. DuraTech typically uses a process that utilizes heat and pressure to form parts. The formed products produced by DuraTech are parts used for in-mold decoration, in-mold electronics or other 3-D types of applications. For projects to be formed, please refer to DuraTech's Forming sell sheet or information at www.duratech.com/capabilities/forming

Design Considerations

When designing a label or overlay it is helpful to understand the limitations and advantages related to materials and processes to ensure that the resulting parts will meet the required performance and quality expectations. The following are areas of consideration for designing printed parts.

Printing

How screen printing works

The image to be printed is broken down into color separations. Each color to be printed requires its own screen and its own print pass. Registration must be held to make sure the colors align as expected. The more colors to be printed, the more cost to the part. The screen is a piece of mesh that is stretched tightly across a frame and the image to be printed is processed onto the screen so ink will

only pass through in the desired areas. Inks are formulated for each of the colors to be printed and the ink is then loaded into the screen. A squeegee passes over the surface of the screen, forcing the ink through the openings in the mesh onto the substrate. The ink is then cured and the sheet is ready for further processing. There are a many variables that can affect the quality of screen printed parts. By taking the following into consideration during the design phase, potential processing issues can be reduced.

Registration – For multiple color parts, each color is registered to the one previously printed – typically printing from lightest color to darkest for first surface printing and darkest to lightest for second surface printing. Because exact registration of color to color is not possible throughout a production run, in any areas where the different colors touch, the artwork is created with a very slight overlap (also referred to as trapping and bleeding) of the colors as they are printed. The smaller the bleed, the more difficult it is to hold registration (the standard tolerance for color to color registration is +/-.015″).

The tautness of the screen will affect the registration of the image. If there is any screen stretch throughout the process, the printed image at the end of the run will be slightly different then the image at the start. The more passes of the squeegee over the screen, the more opportunity for screen stretch, so this is a consideration for high quantity orders. Press set up, type of press being used, registration of the material in the press, and dimensional stability of material are all variables that can affect registration of the printed colors. Small graphics, multiple colors, embossed areas, tight cutting tolerances are all things that can affect and be affected by registration issues.

Color and Opacity –Screen printing offers the widest color options and thickest ink lay down of any of the print processes used at DuraTech, but there are many factors that can affect the color and opacity of the printed ink. The type of ink, the color formulation and viscosity of the ink, the screen mesh (the finer the mesh, the less ink that can be forced through the screen causing a thinner lay down), the type of squeegee being used as well as the pressure and speed of the squeegee as it moves across the screen, and the color of the substrate are the typical things that can be controlled. Some colors are able to be printed with inks straight from the can but custom colors require a formulation of ink with colors added to achieve the desired colors to be printed. There are colors that are more difficult to match than others so the selection of colors in the graphic design can impact the ease or difficulty of printing the part. In some situations a color may require two print passes of that color to achieve opacity or color integrity and in other situations, another color is printed behind it (most often white) to achieve the color integrity or opacity required. It is helpful to know the color of the surface the part will be applied to. For example, if the part is applied to a light colored surface, it may not be necessary to incur the cost of an additional print pass for opacity.

Printability – The smaller and finer a graphic is, the more difficult it can be to print a clear image. The screen mesh, ink formulation, font size, type and line width can all have an impact on printing clear, legible graphics. Halftones and fades can be difficult to screen print. Artwork has to be specially designed to ensure that they will print as expected.

How Digital Printing Works

An electronic art file is created and the image is ink jet printed using CMYK colors with the addition of green, orange and violet to expand the color spectrum. White is also available as a digitally printed color. DuraTech also offers another digital print option that prints using thermal transfer foils. This process is less expensive, but the colors and materials available are much more limited. For more information on DuraTech's digital printing capabilities refer to the Digital Printing sell sheet. The following are design considerations for digitally printed (ink jet) parts.

Registration – Because digital printing does not require each color to be printed in a separate print pass, the color to color registration issues of screen printed parts is not the same. Digital printing is the optimal method for printing four color process images. Any print registration issues on digitally printed parts are typically caused by the quality of the print file that has been created or misalignment of print heads. High quality artwork can help ensure good print files.

Color and Opacity – Digitally printed inks are more transparent than screen printed inks. The lay down of ink is much thinner than screen printing so digitally printed colors will not be as opaque. If opacity is required, a blocker color can be screen printed behind the digitally printed image (for more information go to https://www.duratech.com/duratech-benefits-of-combing-digital-and-screening/. Because the digitally printed colors are CMYK, the color integrity is not the same as a screen printed ink. The addition of the green, orange and violet to the color pallet expands the available color spectrum but there are times when colors, especially large areas of solid color, will not have the same color quality as screen printed parts.

Printability – Digital printing offers the most accurate complex image printability option but because the image is printed in dots, if graphics are very small, have a thin line weights or require hard crisp edges, there may be print issues. Converting text to outlines and using high resolutions in art files can improve the printability of digitally printed graphics. Digital printing offers the ability to print variable graphics such as bar-codes or serial numbers.

How Flexographic Printing Works

Like screen printing, the image to be flexographic printed is broken down into layers per the colors to be printed. For the flexographic process, each color to be printed requires a separate print plate on which the image to be printed is raised from the surface. Each print plate is mounted on a separate cylinder and must be registered so that as each color is printed, and it aligns with the one printed before it. The substrate is fed through the press in roll form and as it passes by each print plate the plates rotate, each picking up its ink to be transferred to the substrate, which is then cured before passing to the next print plate. Because the printing is done in-line and in roll form, it is faster and more efficient than any of the other printing processes, making it a cost effective option. Even though the flexographic process is different than screen printing, it has some of the same design concerns of screen printed parts.

Registration –Because each color is printed by a separate print plate, it is important to set up the print plates so they align correctly. Like screen printing, it is next to impossible to ensure 100% accurate registration of color to color so artwork for the print plates has to be created with slight overlap of any colors that touch, to compensate for the print tolerance of +/-.010".

Color and Opacity – The color options for flexographic printing are about as varied as screen printing, but the opacity is less due to the amount of ink that can be laid down by the print plate. Factors that can affect the quality of the color that is printed are ink formulation and viscosity, the amount of ink picked up by the print plate, substrate color and the speed of processing.

Printability - Flexo shares some of the same printability issues as screen printing – small/fine graphics may be difficult to print. It is superior to digital printing in that it prints vibrant, sharp images.

Screen Printed Part Design Recommendations

Graphics requiring critical placement - If an overlay has graphics where their relative placement is critical, for example, a window with corresponding keypad buttons, using the same printed color for them both will ensure that their printed registration will always align. Many designers will outline both with the same color or use the color surrounding the window as the background color for the buttons.

Borders – Borders separating two colors should be at least .020" thick, preferably .030" to allow for the necessary overlap of color when printing to ensure accurate registration of colors. This also applies to outlines and drop shadows. Borders that are lighter in color than the background color can cause print issues. Because of the typical print order of colors, the lighter color border may be created by the negative space created by printing the abutting darker colors which could lead to greater variances in the border thickness, or may have color variation if the darker colors are bled behind it. It is recommended to avoid borders around cutouts or around the perimeter of the part wherever possible, as any variation in the cut tolerance will be more visible because borders on one side of the part will be thicker or thinner than the other. If using perimeter borders, a minimum thickness of .030" should be used (the thicker the better).

Registration of colors - When designing graphics, avoid any areas where colors cannot be slightly overlapped without impacting their color integrity. For example, having a red and a green abut on a layout will cause a dark edge to show on whichever color is printed second. When two colors will be printed next to each other, either choose colors where one is significantly darker than the other or print a dark dividing line where the two colors meet. This will cover any overlap of colors. When printing a selective texture to a window edge, either print the texture so it bleeds slightly into the window on all four sides (DuraTech's standard practice is to print .010" into the window on all sides) or pull the texture back slightly away from the window (not the suggested method as it will leave a thin sliver of shiny material around the window which will stand out much more than the texture bled into the window).

Printability – Small text, serifs and thin lines should be avoided in graphics to be printed whenever possible. The minimum recommended type point size is 5 point. Lines should be at least .010" wide to ensure consistent print quality. Smaller graphics can be printed but the risk of copy either blurring together or not printing clearly, or at all, increases as the size decreases. When designing parts with a printed fade, it is not possible to screen print a fade of 100% to 0%. The graphic should be designed with a fade from 90% to 10% scale. Images with halftones and 4-color process graphics need to be reviewed on a case -by -case basis to determine the best artwork, screen mesh, dot pattern and color range to be used. Typically, printing is done at 76 or 86 DPI (dots per inch) but with prior review, a range of 56 DPI to 102 DPI may be possible.

Opacity - If parts are going to be backlit, there are certain considerations that need to be made in part design. Light color printed outlines of any areas that will be backlit should be avoided as they can create "halos" to appear around LED windows or backlit graphics. Shadow colors can be added to diminish the affect, which add cost the parts, but will not completely eliminate the issue. If the part will be applied to a dark surface, it is recommended to avoid using light color background colors, as the color may appear different when the part is adhered. Also, anomalies in the application surface are more apparent through a light color background. Additional print passes may be required to create enough opacity that the background color won't be affected.

DuraTech Capabilities

DuraTech has a wide variety of in-house processing capabilities. We have also established partnerships with key strategic suppliers to handle any production requirements outside of those capabilities. The following are in-house processing capabilities.

Artwork

DuraTech has a fully computerized in-house graphic art department. We can work with customer artwork, blueprints, sample parts, or can assist the customer in designing a layout based on a customer sketch. Artwork can be submitted by either emailing artwork@duratech.com, by uploading through the website www.duratech.com or mailed on a flash drive or CD. DuraTech can work with a variety of file types. Refer to our website for a list or email artwork@duratech.com to verify if a file type is useable.

When submitting prints or artwork, fonts, linked images and supportive files should be included. Dimensions, colors to print, typestyles, location of features (cutouts, windows, buttons etc.) and any other critical areas should be specified. DuraTech can provide electronic proofs at time of order and can create prints for future use if requested.

Color Matching

There are some circumstances when the colors to be printed on a part are not critical and standard colors can be used. Other situations require the color to be a very specific color and colors need to be matched. Utilizing standard colors whenever possible will provide cost savings to a project. Standard colors samples are available upon request. For situations where custom colors are necessary, DuraTech has in-house color matching capabilities for both screen printing and digital printing. Advanced color matching equipment like a spectrophotometer and a spectroradiometer are utilized to create and check colors. Color integrity, density and opacity are all measured. This equipment ensures colors are initially matched accurately and stores information so that the color is consistent from run to run and from part to part when the same color is specified. Because materials and print surfaces can affect color, different formulations may be required for the same color printed on different materials. For example, PMS 485 red printed first surface on white vinyl will need a different formulation than that same color printed second surface on a .010" velvet polycarbonate. Customers can specify a color to match on the artwork or print. PMS, Federal Standard, ANSI and Munsell colors can all be matched. RGB and CMYK values need to be converted to PMS colors for screen printing. A color chip or a previously printed part can be submitted for color match as well. This will be the most accurate way to achieve the expected color. When color matching is critical, it is important to know the type of light the part will be viewed in (daylight, fluorescent lighting, incandescent lighting, etc.), and if it will be backlit. Knowing what that light source is can help ensure that the color meets the customer's expectations.

Custom colors are formulated, mixed, checked and then checked throughout the printing process to verify the color is within tolerance. Each time the color is printed, the formulation is reviewed and the same process followed to ensure consistent printing of the color, hence the additional cost for color matching.

Cutting

Tolerances – One of the most commonly overlooked, and many times misunderstood areas in designing of an overlay or label, are the tolerances associated with the printing and cutting of the part. Designing a part with tolerances tighter than necessary can add unnecessary cost or production issues and using tolerances to broad can create fit or performance issues. The stability of the materials, the number and type of processes needed to produce a part, and the method of cutting the parts all can impact the tolerances that can be applied to a part. Generally, the tighter the tolerances, the higher the cost of the tooling and the larger potential fallout related to producing the part. By utilizing the following industry standards tolerances, additional cost and processing issues can be avoided.

Cut Tolerance	Cut method	Comment
+/- .060"	Shear cut using a guillotine	Low cost method of cutting parts with square corners, printed with common spacing
+/- .030"	Shear cut	Used to cut metal photo processed sheets down to single parts
+/-.020"	Economy steel rule tool	Also standard tolerance for digitally printed parts cut on a Gerber Edge
+/- .015"	Standard steel rule tooling	Materials in thicknesses up to .030"
+/- .010"	Steel rule tooling I-cut (electronic knife plotter cutter)	Tightest tolerance that can be held using steel rule tooling – for materials up to .015" thick
+/- .005"	Hard tool for punch press	To be used when fit of part is critical - tooling cost is significantly higher than steel rule tooling

Print to cut tolerance	+/- .015"	Industry standard
Print tolerance	+/-.010" when registration is created by one color	For screen printing and flexo printing. Does not apply to digital printing.
	+/- .020" when registration is created by more than one color	For screen printing and flexo printing. Does not apply to digital printing.

Steel rule tooling is typically used for plastic materials in thicknesses from .001" to .040" and aluminum materials from .002" to .032" thicknesses. The part shapes to be produced are cut into a die board (made of birch plywood) and then razor-sharp steel rule is bent and then inserted into the die boards (pre-made punches can be used for some cutout areas). A layer of rubber or die plates are then added to the die to push the die cut part out of the tool after cutting. Due to the nature of the rule, it will dull

over time and need to be sharpened or replaced. The thicker or harder the material being cut, the sooner and more often maintenance, or replacement will need to be done. Because steel rule cutting basically crushes material until it cuts through (think of a knife cutting bread) and material is not technically removed, there can be issues with burred edges or crimping of material depending on part geometry or material thickness. Consideration needs to be made to the closeness of cutout features to each other or their relativeness to the part edge to ensure that parts can be cut with steel rule tooling Standard minimum spacing is 10 times the material thickness. DuraTech will store and maintain steel rule tooling for customers. Because it is considered temporary tooling, the die is considered the property of DuraTech. When a tool requires re-ruling or replacement due to use, the customer will be billed accordingly.

Hard tooling can provide a tighter tolerance, cleaner cut edges and a much longer cutting life but it comes with a significantly higher price tag. The cost of a very simple hard tool is upwards of $2,500. The tools are stored at DuraTech but are the property of the customer. Any repair or maintenance costs will be the responsibility of the customer.

Cut Formats – Parts can be supplied in many different format options. Consideration should be made to methods of application, assembly processes, stocking areas and how inventory is done when selecting the preferred cut format. If no format is specified during the quoting process, the most practical or economical format will be quoted.

Format	Definition	Advantage/considerations
Individual/Single	Parts are supplied cut to size as individual parts and can be packaged in a pre-determined quantity.	• Ability to divide parts between multiple people or locations. • Keeps larger parts flat.
Individual with split liner	Same as Individual with the addition of a split in the liner. If split location is not designated, parts are typically split down the middle.	• Split in liner makes removing the liner easier. • Recommended for materials .015" or thinner. • Suggested for larger parts as it allows the liner to be removed a section at a time to make application easier. • There is not a tolerance that can be held for split location due to the type of process used. • Not recommended for parts with clear back-grounds, as the slight split line in the adhesive may possible show on the part when applied depending on the application surface.
Individual with tab	Parts are supplied cut to size with a kiss-cut tab area extending off one of the sides.	• Tab helps with liner removal. • P/N or other information can be printed on the tab. • Material with a heavier liner is required for better processing. • Tooling is more costly.
Individual on a carrier	Parts are cut to size but supplied kiss-cut on a liner that is slightly larger than the label.	• Carrier helps with liner removal. • P/N or other information can be printed on scrap area or scrap area can be weeded away. • For special shape labels, makes packaging and storage easier as carrier is a rectangular shape.
Pre-spaced	Individual letters, numbers or graphics are cut to size, kiss-cut to the liner and supplied on a carrier with an application tape over the top.	• Application tape maintains spacing between the labels. • Carrier can be custom cut so the shape of the application tape can be used to align the label accurately when applied.
Strip/Sheet	Labels are cut to size but kiss-cut to the liner and supplied in either a single row strip or a multi-row sheet.	• Easier to peel small labels off of a sheet than to remove the individual liner. • Easy to package, store and count for inventory. • Can have P/Ns or other information printed in scrap area. • Typically lower cost due to less processing requirements. • An ideal format for a group of parts that will be utilized on a common piece of equipment – the set of labels will be on a common sheet and P/Ns or application instructions can be printed in the scrap area.
Weeded strip/sheet	Same as strip/sheet with the matrix of the scrap material removed.	• Weeding the scrap adds a bit of cost but makes label removal even easier. • Recommended for strip/sheet form labels that have free flowing adhesives that may "ooze back".
Roll	Supplied in a continuous strip of labels, wound around a central core – typically 1" or 3" diameter core. Can designate how many labels per roll.	• Easy to package and store. • Works well with some automated processes. • Can have perforations added between labels so desired quantity to be used can be torn off and rest of the roll left in storage. • Suggested for labels that will be applied by hand.

Set, Kits and Combos

DuraTech offers some price reduction options to customers in the way that parts are purchased. When a piece of equipment has multiple labels on common materials, ordering those labels as a set can provide a significant cost savings. If an assembly area has a number of different parts that are utilized on a common piece of equipment, ordering the parts as a kit may reduce cost and will provide purchasing ease due to one part number to order and inventory rather than having to individually purchase and maintain inventory for each of the components. Reviewing the various parts to be purchased in a time frame and ordering them at the same time may allow for similar parts to be able to be produced on common work orders, reducing set ups and cost. Please refer to The DuraTech Tech Sheet Sets, Kits and Combos or work with your Sales Rep or Customer Service Representative for more information on these cost saving options.