KYDEX® THERMOPLASTIC SHEET FOR THE TRANSPORTATION INDUSTRY

Curbell Plastics, Inc.
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CURBELL PLASTICS

Introduction

After they were first introduced in 1965, KYDEX® Thermoplastics quickly became the materials of choice in the transportation industry due to their durability, light weight, outstanding aesthetics, ease of fabrication, and superior flame retardant characteristics. Over the years, SEKISUI Polymer Innovations, LLC, the manufacturer of KYDEX® Thermoplastics, has expanded on its original version of the material, offering new products with enhanced physical properties, lower heat release, and higher heat distortion temperatures. The company also manufactures ALLEN® Thermoplastic sheet materials, including grades that have exceptional durability and superior weatherability.

Today, KYDEX® and ALLEN® Thermoplastics are widely used in aircraft, bus, subway, and monorail interior applications including seatbacks, tray tables, arm rests, window shrouds, and ceiling coverings.

Window shrouds and tray tables are often made from KYDEX® Thermoplastics.

EXTERIOR VEHICLE APPLICATIONS

A number of materials from SEKISUI SPI's ALLEN® Thermoplastics product line, are suitable for use in exterior vehicle applications including RV and ATV components, tram car skirts, and wheel covers. ALLEN® Thermoplastics can take the harsh abrasive environment that exterior vehicle parts experience. In addition, these materials stand up to many of the aggressive cleaning chemicals that are used to remove road dirt and grime.

A number of ALLEN® Thermoplastics are suitable for exterior vehicle applications.

DURABILITY AND IMPACT STRENGTH

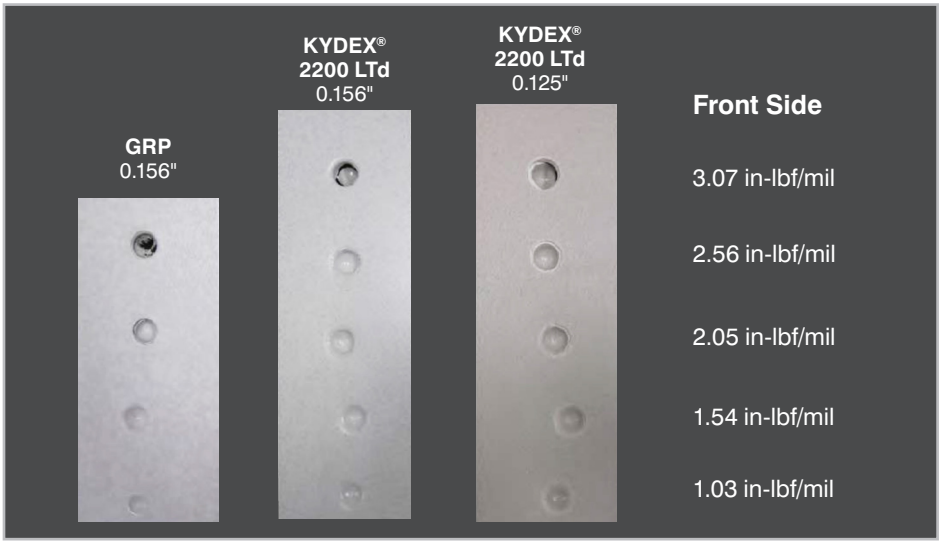
In the transportation industry, durability is extremely important. Vehicle walls, seat backs, storage compartments, and tray tables are constantly being impacted by luggage, computers, books, purses, packages - and even passengers!

GRP (glass reinforced plastic) materials, commonly referred to as fiberglass, were traditionally used in the transportation industry because they are lightweight and relatively stiff. However, GRP panels tend to be brittle and can easily chip, crack, or break when impacted.

Glass reinforced plastics tend to be brittle and can chip, crack, or break when impacted.

KYDEX® Thermoplastics are an ideal choice for seating leg covers, which are subjected to frequent impact.

A drop dart test is used to measure the impact strength of materials. The test consists of a dart which is dropped from increasing heights until it breaks the material. The energy required to break the test specimen is then calculated and reported in inch-pounds. The photograph below shows dropped dart test results for KYDEX® Thermoplastics and GRP sheet, which demonstrates the superior impact resistance of KYDEX® sheet compared with GRP.

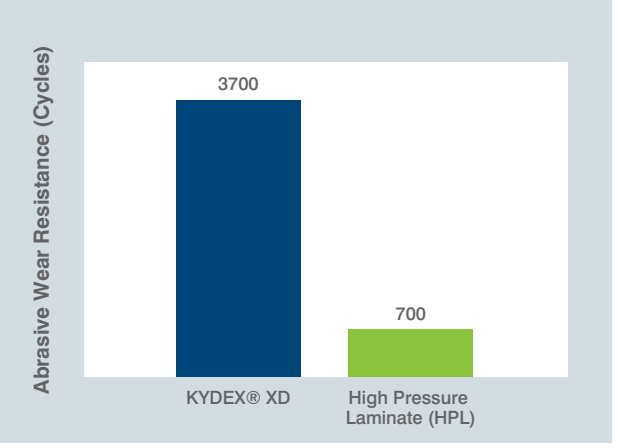


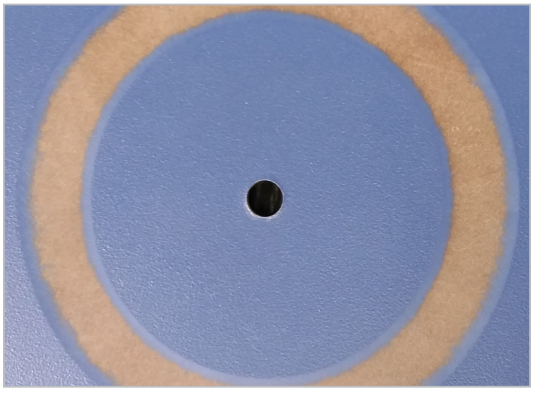
Dropped Dart Test Coupons of KYDEX® sheet and GRP. Test method adapted from the Gardner Drop Dart test, ASTM D5420.

ABRASION AND SCRATCH RESISTANCE

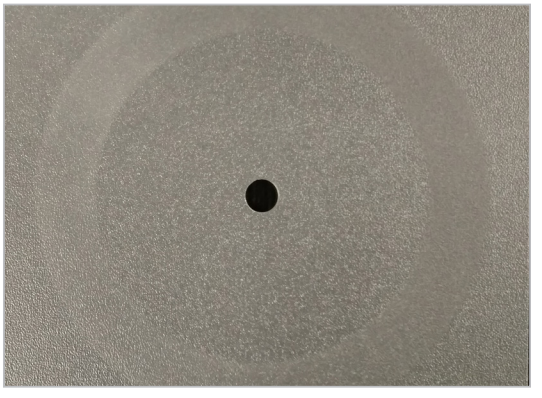
The decorative surfaces of high pressure laminates and gel coated glass reinforced plastics have relatively poor abrasion resistance, which results in short service life for vehicle interiors made from these materials. As shown in the graph and pictures below, KYDEX® Thermoplastics have outstanding abrasion resistance when tested per section 3.13 of NEMA LD 3-2005. KYDEX® sheet lasted 3700 cycles during abrasive wear testing compared with only 700 cycles for high pressure laminate.

Abrasive Wear Resistance
per LD3.13 of NEMA LD 3-2005





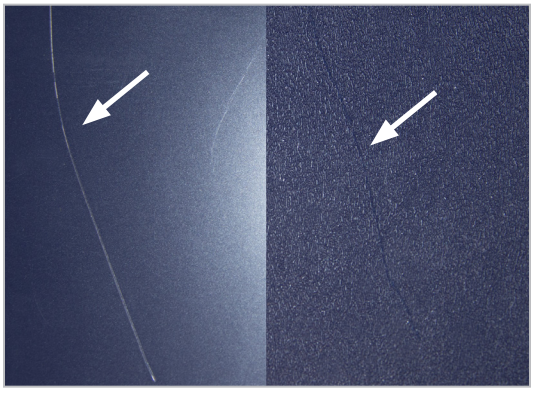
High Pressure Laminate



KYDEX® Thermoplastic Sheet

KYDEX® Thermoplastics have color all the way through the material. This results in KYDEX® sheet having superior abrasion resistance compared with high pressure laminates.

Another way to consider the practical abrasion resistance of a material is to evaluate its appearance when scratched. The photograph below illustrates how scratched surfaces look on painted metal (left) and KYDEX® sheet (right). KYDEX® Thermoplastics tend to hide scratches because unlike metal, the color is present all the way through the material. The textured surface of KYDEX® sheet also helps to hide scratches.



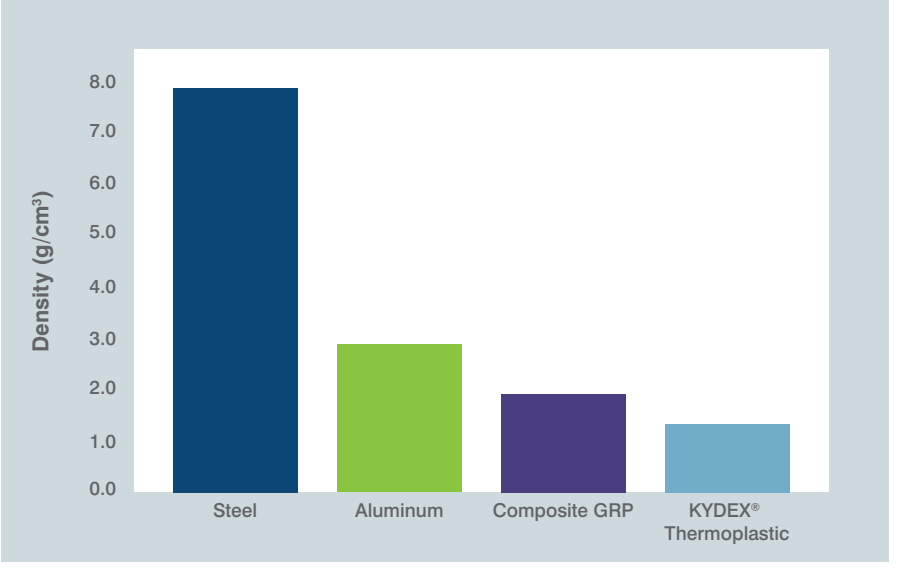
Painted metal (left) shows pronounced scratching. The textured surface and complete coloration of KYDEX® sheet (right) helps hide scratches.

Unlike KYDEX® Thermoplastics, painted metal shows scratches when used in high traffic areas.

WEIGHT SAVINGS

Reducing weight is critical for designing fuel efficient vehicles, and KYDEX® Thermoplastics are the clear choice for weight savings. The graph below illustrates the weight savings that can be achieved by using KYDEX® sheet in lieu of traditional materials such as steel, aluminum and glass reinforced plastics.

Density of KYDEX® Thermoplastics
Compared with other materials used in transportation applications

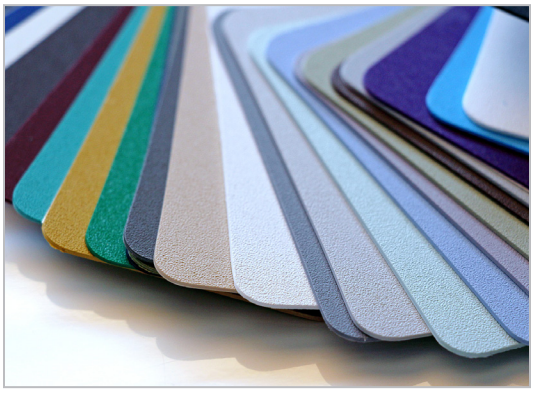


COLORS, PATTERNS, AND TEXTURES

KYDEX® sheet is available in over 50 standard colors designed for the transportation industry. KYDEX® sheet is also available in woodgrain finishes, pearlescent colors, and shimmering metallics. Don't see the color you need on the standard palette? No problem! SEKISUI SPI's color technicians and engineers can formulate almost any color of your choosing at their in-house designLab™.

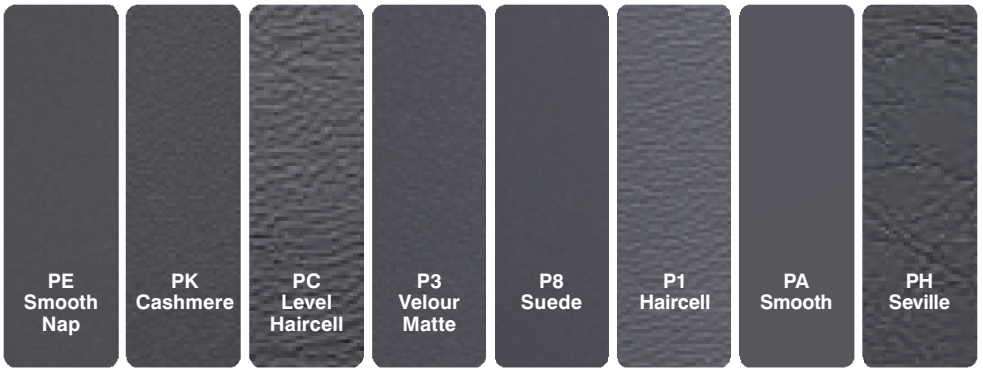
Most manufacturers of plastic sheet require large minimum order quantities for custom colors. SEKISUI SPI can make most custom colors with a minimum production run of just 600 pounds. And because SEKISUI SPI has their own in-house designLab™, they have short lead times for custom color development.

In addition to a wide variety of colors, KYDEX® sheet is available in eight different surface textures. PK-Cashmere is the most common, but PH-Seville (a leather-like surface) is gaining in popularity.



KYDEX® Thermoplastics are available in many different standard colors and textures. They can also be formulated in custom colors with low minimum orders.

KYDEX® Thermoplastic Textures



KYDEX® Thermoplastics are offered in eight textures.

DESIGN FREEDOM AND EASE OF FABRICATION

Transportation interiors often require complex part geometries, which can be difficult and expensive to produce with metals or GRPs. KYDEX® sheet is the ideal material for producing complex parts via a number of different thermoforming processes, including vacuum forming and pressure forming.

Thermoforming processes offer the benefit of low tooling cost and the ability to manufacture very large parts that would be impractical to produce by other methods. For parts requiring enhanced strength and stiffness, ribs can be formed into the material during the thermoforming process.

KYDEX® sheet forms beautifully using traditional vacuum forming techniques, and pressure forming can be used to achieve more complex geometries. The pressure forming process can produce parts with accuracy and definition similar to parts manufactured via injection molding or rotational molding.

Vacuum Formed KYDEX® Thermoplastic tray table

Pressure forming is an outstanding process for manufacturing parts, such as these ceiling panels, that require sharp definition.

KYDEX® sheet forms more consistently than most other thermoplastics and it resists tearing during forming. This results in lower rejection rates compared with other plastic materials. KYDEX® Thermoplastics can be formed with rapid cycle times and low forming temperatures which saves energy and labor costs. Unlike many plastics, KYDEX® sheet does not require pre-drying prior to forming.

Thermoformed KYDEX® parts are easy to trim using standard woodworking equipment such as saws and routers.

RESISTANCE TO CLEANING CHEMICALS AND CORROSION

Preventing the spread of disease has always been a top concern for emergency vehicle designers. High traffic and frequent contact with surfaces produce scuff marks, dirt and germs. Cleaning these surfaces requires strong cleaners that can damage a vehicle's interior.

Unlike many other materials, KYDEX® Thermoplastics will not craze or discolor when exposed to most common cleaners and disinfectants. KYDEX® Thermoplastics are also inherently anti-microbial. This makes KYDEX® sheet the perfect choice for emergency vehicle interiors.

Aluminum and steel may corrode when subjected to high humidity. Corrosion can occur more rapidly when the protective coating on the metal is breached and corrosion forms underneath the paint.

KYDEX® sheet is non-metallic and color is present throughout the entire sheet. For most vehicle applications, paints and coatings are not necessary and corrosion is not an issue.

KYDEX® sheet is anti-microbial and durable, making it an ideal choice for emergency vehicle interiors.

Unlike ALLEN® Thermoplastics, painted metal parts often corrode.

FLAMMABILITY REQUIREMENTS FOR MASS TRANSIT AND AEROSPACE

In the mass transit industry, flammability and smoke toxicity development are always a concern. KYDEX® sheet is the material of choice in the mass transit industry because of its flame resistance, low smoke generation, and toxicity compliance.

In the aerospace industry, SEKISUI SPI has long been the leader in the development of thermoplastic sheet products that meet the stringent requirements of:

- FAR25.853 (a) for interior compartments
- FAR25.853 (d) Parts IV and V, ABD-0031 (Airbus requirements) and Boeing BSS-7239 for toxicity.

Two KYDEX® Thermoplastic formulations are on the Qualified Product List for Bell Spec 299-947-508:

- KYDEX® 100 for Type I, Class 1
- KYDEX® 6185 for Type I, Class 2

For railcar and bus interiors, certain grades of KYDEX® sheet meet the NFPA 130 standard and the FMVSS 302 standard, respectively.

SUMMARY

With over 50 years of polymer technology leadership, KYDEX® sheet is the premier material for the aviation and mass transit industries. KYDEX® Thermoplastics meet the demand for safety, fuel efficiency and durability, while providing endless design options for the next generation of mass transit vehicles.

For more information on KYDEX® Thermoplastics, or to shop, or obtain color and texture samples, visit curbellplastics.com.

Have a question about a transportation application or KYDEX® sheet? Ask a Plastics Expert online or call 1-800-553-0335. We're here to help with your application challenges.

ABOUT THE AUTHOR

Liz Grimes is a Senior Business Development Manager for Curbell Plastics, Inc. She has a Bachelor of Science Degree in Chemistry and over 30 years of experience in the plastics industry. Liz has expertise with a wide variety of polymer materials including acrylic, polycarbonate, and KYDEX® Thermoplastics. Her work at Curbell involves collaborating with customers to solve technical problems and develop new plastic part applications.

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TECHNICAL EXPERTISE

Curbell white papers are intended to provide engineers and designers with basic information about the engineering polymers available as sheet, rod, tube, and film stock from Curbell Plastics. We invite you to contact Curbell via e-mail at **technicalsupport@curbellplastics.com** to discuss applications in detail.

ABOUT CURBELL PLASTICS

For 76 years, Curbell Plastics has been one of the nation's leading providers of plastic sheets, rods, tubes, and films, as well as fabricated parts, adhesives, and prototyping materials. Our customers range from small local businesses to large Fortune 500 companies and government agencies. We partner with organizations in dozens of industries, including aerospace, pharmaceutical, machinery manufacturers and sign fabricators. At Curbell, we understand the unique demands of each market and we have the expertise to help you meet your business needs. Whether your objective is to reduce manufacturing costs, improve productivity, or increase product reliability, Curbell can help.

OUR CAPABILITIES

Our branch network includes sales and warehouse locations throughout the United States. We offer a number of value-added services including custom cutting, fabrication, packaging, and kitting, as well as warehousing for just-in-time delivery. With Curbell, you get the plastics you want and the peace of mind you need, from technical support and design assistance at the earliest stages of product design, through production and after-sale support for each product we sell.

PUT US TO WORK FOR YOU

At Curbell, we are committed to providing the highest level of service to our customers. We recognize the urgency of customer needs, and we pride ourselves on providing quick and proactive solutions. Our tag line says it all – we appreciate the opportunity to earn your business and we invite you to "***Put us to work for you***."

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