CHEMISTRY THAT MATTERS™

FUNCTIONAL FORMS

AESTHETICS+
HYGIENIC

LEXAN™ CLINIWALL™ SHEET FOR INTERIOR WALL CLADDING
At SABIC, we bring to life the visions of our customers to help them realize their ambition for their product – whether it is something stronger, brighter, greener, smarter, or altogether better. We not only create the chemistry that makes things possible, but also we believe that with ingenuity and the best materials technology, almost anything can be achieved.

SABIC’s Functional Forms business offers a highperformance, engineering thermoplastics LEXAN™ sheet and film portfolio and full-service solutions for customers in various segments including mass transportation, consumer electronics, glazing, building and construction.

The company supports OEMs and converters by providing high-performance, proven sheet and foam and film materials, enabling customers to find new solutions to evolving requirements for design, sustainability and fire safety, as well as related challenges of cost reduction. SABIC’s LEXAN sheet portfolio offers high quality polycarbonate monolithic and multiwall sheet products across a wide variety of industries, ranging from building and construction, lamination, signs, to transportation.

The company’s virtually unbreakable, lightweight, fire resistant LEXAN™ sheet portfolio includes a wide variety of structures and it is backed by advanced technical support and application development services to meet our customers’ specification needs with local supply.

SABIC ranks among the world’s top petrochemical companies, and operates in more than 45 countries across the world with 40,000 employees worldwide. It has significant research resources with 19 dedicated technology and innovation facilities in Saudi Arabia, the USA, the Netherlands, Spain, Japan, India, China and South Korea.
As a designer, or a manager in material management or maintenance of public facilities such as hospitals, schools, kindergardens, sport venues or clean rooms, you are likely to be focused on:

PATIENT SAFETY & REGULATORY REQUIREMENTS
- Fire safety and smoke release requirements, based on European standard EN 13501-1 fire regulations for building and construction materials classified as B-s1,d0

INFECTION PREVENTION AND CONTROL
- Regulatory and hygienic standards
- Need for materials that can be anti-bacterial and certified

COMFORT & AESTHETICS
- Materials that can be thermoformed or shaped according to building design

DURABILITY, EASE OF SURFACE CLEANING & MAINTENANCE
Materials with a minimal need for maintenance that offer:
- Impact, scratch and wear resistance
- Resistance to moisture
- Easy to clean
- Resistance to corrosion, decomposing or delamination

EASE OF INSTALLATION
- Materials that are easy to install and that can be implemented in the existing buildings.
LEXAN CLINIWALL sheet is a new thermoplastics material solution for clean room surfaces and interior wall cladding applications in public facilities and hospitals. This opaque, low-gloss PC/ABS blend solid sheet delivers high impact- and wear resistance, and it can help provide long awaited solutions to customer’s needs for materials that can meet European fire regulation for building materials and their sanitation requirements while helping to save significant maintenance costs, resulting in reduced operation costs.

LEXAN CLINIWALL sheet complies with the Restriction of Hazardous Substances (RoHS) directive due to its non-chlorinated and non-brominated flame retardant technology and it meets the current European EN 13501-1 regulation requirements of the most stringent fire and smoke standards, obtaining the best rating for a thermoplastic material.

Compared to high-pressure laminates, ceramics and steel, LEXAN CLINIWALL sheet can significantly lower system costs through consolidation of parts to streamline production, and avoidance of secondary operations such as painting and coating, machining and polishing, and lower shipping costs due to its light weight.

Pre-colored LEXAN CLINIWALL sheet can provide an excellent surface finish for the wall cladding, eliminating the need for painting. Its characteristics also help prevent chipping of the surface if impact occurs.

**POTENTAL ADVANTAGES**

**ENVIRONMENT**
- non-chlorinated and non-brominated PC/ABS based opaque sheet

**ANTI-BACTERIAL PROPERTIES**
- for specific grades

**EXCELLENT RESISTANCE**
- to chemicals, including stain of blood and urine

**EASY TO CLEAN AND DISINFECT**
- withstands repeated cleaning with common hospital cleaning agents

**HIGH IMPACT STRENGTH AND SCRATCH RESISTANCE**
- virtually unbreakable and resistant to abrasion

**EASY TO FORM AND INSTALL**
- even for existing buildings

**FIRE SAFETY AND EXCELLENT SMOKE PERFORMANCE**
- B-s1-d0 rating according to European EN 13501-1 standard

**DURABILITY**
- 10 year written limited warranty

Compared to currently used PVC sheet, LEXAN CLINIWALL sheet shows:

- Better mechanical and thermal properties
- Approximately 20% lower density
- Significant lower smoke toxicity

Compared to high-pressure laminates, ceramics and steel, LEXAN CLINIWALL sheet can significantly lower system costs through consolidation of parts to streamline production, and avoidance of secondary operations such as painting and coating, machining and polishing, and lower shipping costs due to its light weight.

Pre-colored LEXAN CLINIWALL sheet can provide an excellent surface finish for the wall cladding, eliminating the need for painting. Its characteristics also help prevent chipping of the surface if impact occurs.

**COMPARED TO CURRENTLY USED PVC SHEET**
- LEXAN CLINIWALL sheet shows:
  - Better mechanical and thermal properties
  - Approximately 20% lower density
  - Significant lower smoke toxicity
TYPICAL CLADDING APPLICATIONS
LEXAN™ CLINIWALL™ Sheet is an excellent material option for use in interior wall applications for:

PUBLIC FACILITIES
- Schools
- Kindergardens
- Restrooms
- Airports
- Bus stops and train stations
- Sports centers

HEALTHCARE FACILITIES
- Hospitals
- Clinics
- Homes for the elderly
- Primary care centers
- Sterile rooms
- Laboratories

INDUSTRIAL FACILITIES
- Clean rooms
- Pharmaceutical factories
- Industrial kitchens
- Storage/refrigeration rooms
- Storage areas
- Refrigeration facilities
PROJECT EXAMPLES

Hospital in Madrid, Spain
Medical clinic in Almeria, Spain

Auditory center in Valencia, Spain
Hospital in Murcia, Spain
**PRODUCT PROPERTIES**

**TECHNICAL DATA**
LEXAN™ CLINIWALL™ sheet is a non-chlorinated and non-brominated, fire resistant, opaque, low-gloss PC/ABS blend material which delivers high impact and wear resistance. In addition to excellent stain, blood and urine resistance, it offers ease of processing and installation for internal wall cladding applications.

*These property values have been derived from LEXAN™ resin data for the material used to produce this sheet product. Variations within normal tolerances are possible for various colors. These typical values are not intended for specification purposes. If minimum certifiable properties are required please contact your local SABIC, Specialty Film & Sheet representative. All values are measured at least after 48 hours storage at 23°C/50% relative humidity. All samples are prepared according ISO 294.*

Table 1: Typical property values

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>ISO 1183</td>
<td>g/cm³</td>
<td>1.19</td>
</tr>
<tr>
<td><strong>MECHANICAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield stress 50 mm/min</td>
<td>ISO 527</td>
<td>MPa</td>
<td>&gt;60</td>
</tr>
<tr>
<td>Yield strain 50 mm/min</td>
<td>ISO 527</td>
<td>%</td>
<td>5</td>
</tr>
<tr>
<td>Nominal strain at break 50 mm/min</td>
<td>ISO 527</td>
<td>%</td>
<td>8</td>
</tr>
<tr>
<td>Tensile modulus 1 mm/min</td>
<td>ISO 527</td>
<td>MPa</td>
<td>2500</td>
</tr>
<tr>
<td><strong>IMPACT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Izod impact, unnotched 23°C, 3.0 mm</td>
<td>ISO 180/1U</td>
<td>kJ/m²</td>
<td>NB</td>
</tr>
<tr>
<td>Izod impact, notched 23°C, 3.0 mm</td>
<td>ISO 180/1A</td>
<td>kJ/m²</td>
<td>45</td>
</tr>
<tr>
<td><strong>THERMAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vicat softening temperature, B/120</td>
<td>ISO 306</td>
<td>°C</td>
<td>118</td>
</tr>
<tr>
<td><strong>OPTICAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light transmission 3 mm</td>
<td>ASTM-D1003</td>
<td>%</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>FIRE RATINGS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building &amp; Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>EN13501-1</td>
<td>B-s1,d0</td>
<td>(1.7 mm &amp; 1.5 mm)</td>
</tr>
<tr>
<td>Rail</td>
<td>DIN 5510-2</td>
<td>S4/SR2/ST2(4mm)</td>
<td>S3/SR2/ST2 (3mm)</td>
</tr>
<tr>
<td>Electrical</td>
<td>UL94V</td>
<td>V0</td>
<td>(1.5mm)</td>
</tr>
</tbody>
</table>
ANTIMICROBIAL SHIELD
SABIC’s LEXAN™ CLINIWALL™ sheet offers a specific antimicrobial grade (AB6206) featuring a pioneering thermoplastic material technology for clean room surfaces and interior wall cladding applications for public facilities and hospitals that requires a high level of sanitation.

LEXAN CLINIWALL sheet has been independently tested* for log reduction values – the level of microbes eliminated from a surface – according to the ISO 22196 / JIS Z 2801:2000 test protocol. The independent lab test results demonstrate that the antimicrobial grade of LEXAN CLINIWALL sheet product shows greater than a 99.999 percent reduction in Methicillin-resistant Staphylococcus aureus (MRSA) and E.Coli on the surface of the material over a 24 hour period at 35°C. This antimicrobial material provides a layer of protection to interior wall cladding against the spread and multiplication of potentially harmful bacteria and microbes and therefore can be an excellent material choice for patient care and other hygiene-sensitive clinical operations.

EXCELLENT STAIN RESISTANCE
LEXAN CLINIWALL sheet can be cleaned quickly and effectively, looking as good as new after cleaning, as seen in tests made on blood, iodine, rubber gasket marks and other usual stains that you can come across in hospitals and other public facilities.

LEXAN CLINIWALL sheet has been tested* for blood and urine stains. No obvious staining was observed with the naked eye on LEXAN CLINIWALL sheet with either blood or urine after 24 hours and 48 hours incubation at 37°C. Additionally, LEXAN CLINIWALL sheet was subjected to iodine and black rubber gasket staining tests. Iodine stains were made with Betadine and the marks of black rubber gasket impacts were made with a black rubber. Each sheet sample was marked with a different stain and then stored in an oven at 37°C for 24 hours and 48 hours. After the storage time, both stain spots on the sheets were cleaned by hand, using hot water and a paper towel. The test showed that no stains were observed with the naked eye on any of the sheet samples.

FIRE SAFETY
The European standard EN 13501-1 provides a number of performance criteria to measure the fire characteristics of building products. These cover spread of flame and contribution to fire as well the generation of smoke and the production of burning droplets. Combustible building materials with a very limited contribution to fire are classified as class B. ‘s’ indicates smoke emission level during combustion, values range from 1 (absent/weak) to 3 (high). ‘d’ indicates production of flaming droplets during combustion, values range from 0 (absent) to 2 (high). LEXAN CLINIWALL sheet complies with the European fire test standard EN 13501-1 for wall linings with B-s1,d0 classification based on tests done by an independent agent.

EXCELLENT CHEMICAL RESISTANCE
LEXAN CLINIWALL sheet has been independently tested* for chemical resistance against Isopropanol (rubbing alcohol) which is a common disinfectant. LEXAN CLINIWALL sheet samples of tensile bars were stored under 0 and 1.0% strain in contact with Isopropanol for 7 days at 23°C. After 7 days their appearance was checked and their tensile properties were measured. The test samples that were observed with the naked eye, showed no visual defect on their surface after this 7 days exposure.

SABIC’s product was also tested* for its chemical resistance towards common hospital cleaning agents. LEXAN CLINIWALL sheet test samples were evaluated under different strain levels at 23°C for one week. After 7 days the appearance was checked and tensile properties are measured. Test results showed that, except for acetone, nearly all substances (see Table 2 for the list of referred cleaning substances) are compatible with the LEXAN CLINIWALL Sheet.

Please note, depending on the cleaning agent, repeated cleaning may have an effect on the mechanical performance of the sheet product. Please contact SABIC for additional information.

Table 2: Cleaning test overview of LEXAN CLINIWALL sheet by using various cleaning agents, presenting the retention of the original state of the product after testing.

<table>
<thead>
<tr>
<th>STRAIN</th>
<th>Elongation @23°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• ≥80% Retention</td>
</tr>
<tr>
<td></td>
<td>! 60 - 80% Retention</td>
</tr>
<tr>
<td></td>
<td>X ≤60% Retention</td>
</tr>
<tr>
<td>No chemical</td>
<td>STD</td>
</tr>
<tr>
<td>Sodium hydroxide 10%</td>
<td>•</td>
</tr>
<tr>
<td>Neutral Soap</td>
<td>•</td>
</tr>
<tr>
<td>Acetone</td>
<td>X</td>
</tr>
<tr>
<td>Sodium sulphate 10%</td>
<td>•</td>
</tr>
<tr>
<td>Bleach</td>
<td>•</td>
</tr>
<tr>
<td>Phosphoric acid 30%</td>
<td>•</td>
</tr>
<tr>
<td>Nitric acid 10%</td>
<td>•</td>
</tr>
<tr>
<td>Hydrochloric acid 20%</td>
<td>•</td>
</tr>
<tr>
<td>Citric acid 10%</td>
<td>•</td>
</tr>
<tr>
<td>Acetic acid 10%</td>
<td>•</td>
</tr>
<tr>
<td>Hydrogen Peroxide 30%</td>
<td>•</td>
</tr>
<tr>
<td>Ammonium Chloride 10% **</td>
<td>•</td>
</tr>
<tr>
<td>Formaldehyde 1%</td>
<td>•</td>
</tr>
<tr>
<td>Ethanol 99.8%</td>
<td>•</td>
</tr>
</tbody>
</table>

* Please contact SABIC to receive a copy of this test result of LEXAN CLINIWALL sheet.
** Concentration was 10 times higher as requested.
PRODUCT OPTIONS

LEXAN™ CLINIWALL™ sheet is offered in various thicknesses and colors. You can find information about our product offerings below. Please contact SABIC, if you require a color other than mentioned below.

TEXTURES
- Polished/Suede (product code - LEXAN CLINIWALL B6206 sheet)
- Polished/Silk Matte (product code LEXAN CLINIWALL B6205 sheet) on request with protective masking

COLORS
<table>
<thead>
<tr>
<th>COLOR</th>
<th>COLOR CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>WH6G057</td>
</tr>
<tr>
<td>Beige</td>
<td>BR8G038</td>
</tr>
<tr>
<td>Light grey/beige</td>
<td>GY8G179</td>
</tr>
<tr>
<td>Mint green</td>
<td>GN6G033</td>
</tr>
<tr>
<td>Light blue</td>
<td>BL8G090</td>
</tr>
<tr>
<td>Dark blue</td>
<td>BL1G038</td>
</tr>
<tr>
<td>Dark grey</td>
<td>GY1G140</td>
</tr>
<tr>
<td>Light grey</td>
<td>GY7G160</td>
</tr>
<tr>
<td>Off white</td>
<td>86183</td>
</tr>
</tbody>
</table>

All other colors are available on request.

STANDARD DIMENSIONS
- Grade B6205: Gauges 1.2 and 1.5 mm, W – L = 1250 – 3050mm
- Grade B6206: Gauges 1.5 and 1.7mm, W – L = 1250 – 3050mm
LEXAN™ CLINIWALL™ sheet is easy to form and install, even in pre-existing buildings. Whether it is a sheet directly glued on the prefabricated wall or it is fixed on profiles anchored to the brick wall with mechanical fixing, installation is easy and economical. Can be thermoformed for corner elements, bumper rails, and door frames.

To reach optimal results, the sheet materials need to be heated with sandwich type heating systems to reach uniform heat uptake. Pre-drying of this material is necessary. Pre dry LEXAN CLINIWALL sheet at 100°C for 2 hours/mm thickness. Please note that the improper installation of the material may have effects on aesthetic performance of the product.

**PREPARATION**
- Store sheets in a room away from direct sunlight, and place them on a flat surface.
- Bring the sheet to room temperature for 24-36 hours prior to installation.
- Make the wall smooth by removing peaking spots and filling dents.
- Clean and dry the surface as it is recommended on page 29.
- Cut the panels and profiles to dimensions needed for the intended surface.

The following guidelines relate to the corresponding figures 1a-f:

1a. Select the proper adhesive type based on the wall construction according to the instructions of the glue manufacturer. Apply the adhesive on the back of the LEXAN CLINIWALL sheet around the perimeter of the panel and in the center of the sheet with beads each approx. 250 mm or apply the adhesive directly with a notched trowel on the wall.

1b. Position and attach a trimmed U base or a profile to the wall.

1c. Attach the first LEXAN CLINIWALL sheet to the wall and profile.

1d. Remove trapped air and check good adhesion by applying pressure to the entire sheet.

1e. Place the H section base and give at least a 2 mm gap for expansion. Repeat steps a-d.

1f. See “Grooving and Bending for Corner Installation” on the next page to prepare grooves for internal and external corners.
GROOVING AND BENDING FOR CORNER INSTALLATION
The following guidelines relate to the corresponding figures 2a-e:

2a Measure the distance between the sheet edge and the corner. Place the sheet on a working surface and secure it as it’s shown in the figure 2a.

2b Mark the bending point on the back side of the LEXAN™ CLINIWALL™ sheet by drawing a line.

2c Prior to bending, it is recommended to prepare a groove on the backside along the marked line. The depth is maximum half the thickness of the sheet panel and does not exceed this thickness.

2d To create internal corners, place the groove over a straight table corner and use an industrial hot blower to soften the groove. Make sure that temperature of the panel doesn’t not exceed 70°C. Once the groove softened, bend down to the desired angle.

2e To create external corner, place the groove over a straight table corner and use a hot industrial blower to soften the groove. Once the groove softened, bend up to the desired angle.
PROFILE OPTIONS

CORNER PROFILE
Grade name = CWP30C
Standard colors = White (WH6G057), Grey (GY7G160), Blue (BL8G009),
Profile length = 3mtrs
# profiles per bag = 33
Minimum Order quantity = 1 Bag

CONNECTION PROFILE
Grade name = CWP127C
Standard colors = White (WH6G057), Grey (GY7G160), Blue (BL8G009),
Profile length = 3mtrs
# profiles per bag = 33
Minimum Order quantity = 1 Bag

TOP U-PROFILE
Grade name = CWP69T
Standard colors = White (WH6G057), Grey (GY7G160), Blue (BL8G009),
Profile length = 3mtrs
# profiles per bag = 33
Minimum Order quantity = 1 Bag

H-PROFILE
Grade name = CWP30U
Standard colors = White (WH6G057), Grey (GY7G160), Blue (BL8G009),
Profile length = 3mtrs
# profiles per bag = 33
Minimum Order quantity = 1 Bag

Any other profile color will be on request.
Please contact SABIC regarding lead-times and prices.
FABRICATION
The following section discusses the techniques and processes used to fabricate finished products from polycarbonate LEXAN™ sheet, including LEXAN™ CLINIWALL™ sheet, and provides recommendations and advice on how to achieve the best results.

**CUTTING AND SAWING**

LEXAN sheet products can be cut and sawn accurately using standard workshop equipment. Circular saws, band saws, jig saws and common hacksaws can all be used successfully. However, certain important guidelines should be followed. General guidelines are listed below with specific recommendations outlined in each cutting section.

**CAUTION** should be taken and required safety equipment should be worn when cutting and sawing. When working with thermoplastics sheet, always consider safe and careful handling. Please keep in mind that plastics will lose heat more slowly than metals. Avoid localized overheating.

The method and the purpose that you choose to utilize our products are beyond our control. Therefore, it is imperative that you test our products to determine to your own satisfaction whether our products, technical assistance and information are suitable for your intended use and application. This application-specific test must at least include analysis to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by SABIC. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale, which are available upon request.

For further technical assistance and recommendations, please contact SABIC’s Functional Forms business, for which you can find the SABIC contact details on the back page of this brochure.

- The sheet must always be securely clamped to avoid undesirable vibration and rough cut edges.
- All tools should be set for cutting plastics, with fine toothed panel blades.
- The protective masking should be left on the sheet to prevent scratching and other surface damage.
- When finishing the edges of all LEXAN sheet products should be clean and free of notches.
- If possible swarf and dust build-up should be blown away with a compressed air supply.

**Table 04: Cutting and Sawing Recommendations**

<table>
<thead>
<tr>
<th></th>
<th>Circular Saw</th>
<th>Bandsaw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearance Angle</td>
<td>20°-30°</td>
<td>20°-30°</td>
</tr>
<tr>
<td>Rake Angle</td>
<td>5°-15°</td>
<td>0°-5°</td>
</tr>
<tr>
<td>Rotation Speed</td>
<td>1800-2400 m/min</td>
<td>600-1000 m/min</td>
</tr>
<tr>
<td>Tooth Spacing</td>
<td>9-15 mm</td>
<td>1.5-4 mm</td>
</tr>
</tbody>
</table>
Figure 04: Circular Saw

A tungsten carbide tipped saw blade suitable for cutting Lexan sheet

Details of a typical saw:
Diameter 400 mm
Tooth spacing 12 mm
Gullet depth 11 mm
Shaft speed 4000 rev/min

DRILLING
Standard high speed steel twist drills or drills with an angular wedged bit can be used for drilling LEXAN sheet products. Carbide-tipped drills can also be used since they retain their sharp cutting edge. The most important factor to consider when drilling LEXAN sheet products is the heat generated during the actual process. In order to produce a clean, well-finished hole that is stress-free, the heat generated must be kept to an absolute minimum. By following a few basic guidelines, clean, stress-free holes can easily be produced.

- The drill hole must be cleared frequently to prevent swarf build-up and excessive frictional heat.
- The drill must be raised from the hole frequently and cooled with compressed air.
- The sheet or product must be adequately clamped and supported to reduce vibration and ensure a correctly sized hole.
- Holes should not be drilled closer to the edge of the sheet than 1-1.5 times the diameter of the hole.
- All holes must be larger than the bolt, screw or fixing to allow for thermal expansion and contraction.
- For long production runs the use of carbide-tipped twist drills is recommended.

Drilling feeds and speeds are outlined in Table 05 with the various drill configurations in Figures 07 to 09.

REMARK:
Please consult suppliers for drilling, cutting, cooling fluids, which are recommended for polycarbonate.

Table 05: Front view drill bit

<table>
<thead>
<tr>
<th>Hole Diameter</th>
<th>Speed (rev/min)</th>
<th>Feed (mm/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1750</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>1500</td>
<td>100</td>
</tr>
<tr>
<td>9</td>
<td>1000</td>
<td>75</td>
</tr>
<tr>
<td>12</td>
<td>650</td>
<td>50</td>
</tr>
<tr>
<td>18</td>
<td>350</td>
<td>25</td>
</tr>
</tbody>
</table>

Figure 05: Guillotine Saw

Figure 06: Guillotine Saw

Recommended drill angles:
- Clearance Angle A 15°
- Rake Angle B 0°-5°
- Included Tip Angle C 120°-160°
- Helix Angle D 30°
MECHANICAL FASTENING DEVICES

With a few exceptions, all mechanical assembly techniques involve some form of additional fastening device. The choice of device is often dependent upon the nature of the fastening required. Whilst rivets tend to be permanent, screws and nuts can be made detachable and some of the spring clips types can be either permanent or separable. There are many different types of mechanical fastening systems which can be used to successfully assemble plastic sheet components. Within the limitations of this publication only a small number can be discussed.

For simplicity they are divided into three groups:

- Screws, nuts and bolts
- Rivets
- Spring clips and other fastening devices

Two important factors need to be considered with all these fastening systems. Firstly, allowance needs to be made for thermal expansion and contraction. All holes, slots and cut-outs must be machined over-size to allow for the dimensional changes as a result of temperature changes. Secondly, the distribution of tightening torque should be equal. With the aid of compatible rubber washers and large screw and rivet heads, the tightening torque should be spread over as wide an area as possible and should not be excessive.

Table 06: Milling Recommendations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearance Angle</td>
<td>5°-10°</td>
</tr>
<tr>
<td>Rake Angle</td>
<td>0°-10°</td>
</tr>
<tr>
<td>Cutting Speed</td>
<td>100-500 m/min</td>
</tr>
<tr>
<td>Cutting Feed</td>
<td>0.1-0.5 mm/rev.</td>
</tr>
</tbody>
</table>

Table 07: Coefficient of Thermal Expansion

<table>
<thead>
<tr>
<th>Material</th>
<th>m/m °C x 10^-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEXAN sheet</td>
<td>6.7</td>
</tr>
<tr>
<td>Glass</td>
<td>0.7 - 0.9</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2.1 - 2.3</td>
</tr>
<tr>
<td>Steel</td>
<td>1.2 - 1.5</td>
</tr>
</tbody>
</table>

MILLING

LEXAN sheet (polycarbonate) products can be machined using conventional milling machines fitted with standard high speed knife cutting tools. Once again the importance of suitable clamping cannot be over-emphasised. Mechanical jigs and fixtures, or vacuum chucks provide a suitable clamping medium. Table 06 outlines appropriate cutting speeds and feeds with a typical cutting tool illustrated in Fig. 10. Forced-air cooling enables higher cutting rates. However, care should be taken not to over-heat the material. The use of cutting fluids to lubricate or cool the sheet is not recommended.

Computerised trimming is a fully automatic milling process. It is extremely accurate and operates horizontally as well as vertically. The use of a vacuum-operated jig avoids vibration of the part ensuring a smooth cut. Standard high speed, two-sided cutting routers with tungsten carbide tips are recommended, with a cutting speed of approximately 250 m/min at 25,000/30,000 RPM at a sheet thickness of 4 mm.
MACHINE SCREWS
The majority of these screws are made from steel, but other metals and alloys are used for specialised applications. Several examples of this type of fastening system are shown on this page. Figures 10 and 11 illustrate sheet fastening devices known as ‘blind screw’ and ‘blind nut’ anchors.

SELF-TAPPING SCREWS
Self-tapping screws are widely used within the plastics industry. Basically they produce their own thread as they are driven into a hole and may be considered whenever an assembly is likely to be dismantled and re-assembled. Whilst the majority of these screws are designed for plastic mouldings, with the aid of spring clips and washers they can be adapted for sheet applications. Fig. 12 show a typical fastening system.

CAUTION
If the application calls for a screwed assembly, it is vitally important that the following recommendations are considered.

- Do not use countersunk head screws, as the ‘wedging’ action of the countersunk head causes excessive hoop stress on the sheet. This can lead to part failure.
- Be sure that all oil, grease and other coatings are removed from the screws before assembly. Certain oils and greases can cause environmental stress cracking.

Figure 10: Blind Nut and Blind Screw Anchor

Figure 11: Other Typical Fastening Systems

Figure 12: Hex Cap Screw Connection
**RIVETING SYSTEMS**

Certain guidelines should always be followed when considering this type of assembly method. Riveting can induce both radial and compressive stresses in the plastic sheet and precautions should be taken to distribute these forces over as wide an area as possible. In a plastic-to-plastic assembly a metal back-up washer with laminated rubber is recommended to reduce the compressive stresses. If the diameter of the rivet with a rubber washer is slightly bigger than the hole diameter, then the hoop stresses will be transmitted to the washer rather than the plastic sheet.

For plastic-to-metal joints, the head of the rivet with a rubber washer should be against the plastic, and the hole in the sheet should be large enough to allow for thermal movement. Holesize is $1.5 \times$ expanded rivet diameter. Rivet diameters should be as large as possible and spacing should be between 5-10 times their diameter. SABIC recommends the use of aluminium, brass and copper rivets. There are several different types of riveting systems, the most popular for which is the ‘pop-rivet’. This type of rivet provides the means to assemble two components together with access restricted to one side only. Figures 13 and 14 illustrate typical rivet assemblies.

**Figure 13: Rivet Assembly**

**Figure 14: Typical Pop-Rivet Assembly**
MISCELLANEOUS FABRICATING TECHNIQUES
Many different techniques are used to cut and fabricate LEXAN sheet products.

These techniques include:
• Shearing
• Punching
• Tapping
• Laser Cutting
• Water Jet Cutting

Whilst these techniques are used, they are not recommended since they either induce unnecessary stress on the finished part or result in a poor surface finish. With both shearing and punching the process involves a shearing action with a guillotine or a punch which tends to leave a roughly cut surface. This surface often contains micro-cracks which may lead to premature failure. Tapping is possible in LEXAN sheet. However, the process is usually restricted to moulded parts. Self-tapping screws or machine screws require a minimum depth to achieve the necessary holding power and sheet products do not have the necessary thickness.

Laser cutting of SABIC sheet products is not recommended due to the following disadvantages:
• Rough cutting edges
• Carbon deposition on cutting edges
• Stress level increase in thick sheets
• Discoloration

With water jet cutting, the following considerations should be taken into account:
• No stress at any sheet thickness
• Cutting edge requires further finishing
• Limited cutting speed
• Expensive equipment

For further technical assistance and recommendations, please contact SABIC’s Functional Forms business, for which you can find the contact details on the back page of this brochure. When working with LEXAN sheet, always consider safe and careful handling. The method and the purpose that you choose to utilize our products are beyond our control. Therefore, it is imperative that you test our products to determine to your own satisfaction whether our products, technical assistance and information are suitable for your intended use and application. This application-specific test must at least include analysis to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by SABIC. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale, which are available upon request.
CHEMICAL RESISTANCE

The chemical resistance of a thermoplastic is dependent upon five major factors:
1. Stress level in the application
2. Temperature
3. Exposure time
4. Chemical concentration
5. Type of chemical involved

LEXAN sheet has a good chemical resistance, at room temperature, to a variety of dilute organic and inorganic acids. Water, vegetable oils, solutions of neutral salts, aliphatic hydrocarbons and alcohols are also included in this category. When a thermoplastic is attacked by a chemical it usually takes one of three forms. In the first case the chemical is absorbed into the plastic, and plasticisation and/or crystallisation occurs.

The visible signs of this type of attack are swelling or surface whitening. LEXAN resin is affected in this way by partial solvents such as low molecular weight aldehydes and ethers, ketones, esters, aromatic hydrocarbons and perchlorinated hydrocarbons. In addition, chemical attack ranging from partial to complete destruction of LEXAN sheet occurs in contact with alkalines, alkali salts, amines and high ozone concentrations.

The third type of attack is often the most difficult to predict since environmental conditions dictate whether or not the plastic will be affected. Combinations of certain environments, coupled with stress and/or strain upon the material, cause stress cracking or crazing of the polycarbonate. Crazing can be induced at moderate to high stress levels by low molecular weight hydrocarbons. Products such as acetone and xylene may cause stress cracking even at very low stress levels and should therefore be avoided.

Taking into account the complexity of chemical compatibility, all chemicals which come into contact with polycarbonate should be tested. For sheet products the most common contact is with sealants, gaskets and the various cleaning media. Chemical compatibility testing, table 08, is an on-going process at SABIC’s Specialty Film and Sheet Businesses and many standard products have already been tested. A complete list of recommended cleaners, gaskets and sealants is available upon request. However, a shortened list of some of the more common compounds is outlined in the respective sections in Table 08.

### Table 08: LEXAN sheet chemical compatibility summary

<table>
<thead>
<tr>
<th>Chemical class</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids (Mineral)</td>
<td>No effect under most conditions of concentration and temperature.</td>
</tr>
<tr>
<td>Alcohols</td>
<td>Generally compatible.</td>
</tr>
<tr>
<td>Alkalis</td>
<td>Acceptable at low concentration and temperature. Higher concentrations</td>
</tr>
<tr>
<td></td>
<td>and temperatures result in etching and attack as evidenced by decomposition.</td>
</tr>
<tr>
<td>Aliphatic Hydrocarbons</td>
<td>Generally compatible.</td>
</tr>
<tr>
<td>Amines</td>
<td>Surface crystallisation and chemical attack.</td>
</tr>
<tr>
<td>Aromatic Hydrocarbons</td>
<td>Solvents and severe stress-cracking agents.</td>
</tr>
<tr>
<td>Detergents and Cleaners</td>
<td>Mild soap solutions are compatible. Strongly alkaline ammonia materials</td>
</tr>
<tr>
<td></td>
<td>should be avoided.</td>
</tr>
<tr>
<td>Esters</td>
<td>Cause severe crystallisation. Partial solvents.</td>
</tr>
<tr>
<td>Fruit Juices and Soft Drinks</td>
<td>Compatible at low stress levels. Some concentrates not recommended.</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Not compatible at elevated temperatures and stress levels.</td>
</tr>
<tr>
<td>Greases and Oils</td>
<td>Pure petroleum types are generally compatible. Many additives used with</td>
</tr>
<tr>
<td></td>
<td>them are not, thus materials containing additives should be tested.</td>
</tr>
<tr>
<td>Halogenated Hydrocarbons</td>
<td>Solvents and severe stress-cracking agents.</td>
</tr>
<tr>
<td>Ketones</td>
<td>Cause severe crystallisation and stress-cracking. Solvents.</td>
</tr>
<tr>
<td>Silicone Oils and Greases</td>
<td>Generally compatible up to 80°C.</td>
</tr>
</tbody>
</table>
PAINTING

Be it simple or complex, decorative or functional, hand-controlled or automatic, painting LEXAN™ sheet products offers the designer the freedom to create a dramatic effect in a sign or a simple colour code for instructions. Provided certain basic recommendations are followed, most techniques used to apply paint to wood, metal, building materials and other plastics can be used for LEXAN sheet products. The important factor is once again one of compatibility. Only approved paint systems should be used. Some paint and thinner systems are not compatible with LEXAN sheet products and can cause stress cracking and a reduction in impact performance. Paint systems for LEXAN sheet should be flexible. Combinations of flexible primers and hard top coats could also work. Any paint system should be flexible at subzero temperatures.

PAINTING RECOMMENDATIONS

• Clean the sheet and remove static with a damp chamois cloth or ionised air treatment.
• Avoid too high a delivery rate and too heavy a wet coat thickness.
• Allow adequate drying before applying spray mask to painted areas.
• Do not expose painted faces to a low temperature and high humidity environment during drying.
• Use dry air in all compressed air lines. Drain water taps frequently.
• Paint solvents should be evaporated from the paint surface as quickly as possible by providing appropriate air circulation.
• Follow recommended machining and trimming practices for finishing post-decorated faces.

For painting systems please consult technical centre.

SCREEN PRINTING

Silk-screen printing is a well-established process that offers a wide variety of options for a decorative finish. However, in most cases the printing must be accomplished prior to installation, since the process is basically a horizontal one and is generally restricted to small-to-medium part sizes. The process involves forcing viscous inks through a very fine, thin screen that is treated in such a way as to allow the ink only through to the patterned area. Special inks are required, which are formulated so that they will pass through the mesh, while being sufficiently viscous to prevent run-out. This type of finishing operation is often used in the sign industry and a wide variety of screen printing inks and thinners are available. Once again the importance of chemical compatibility cannot be over-emphasised and only paints and thinners recommended for use with LEXAN sheet products should be used.

SCREEN PRINTING RECOMMENDATIONS

• Use only approved paints and thinners.
• Do not mix different paints and inks.
• Do not substitute spray thinners for screen thinners.
• Do not add solvents such as toluene, xylene, cellulose acetate, methylethylketones or other related chemicals to the inks.
• Use water-moistened chamois or soft cloths to avoid abrasion or scratching during cleaning prior to printing.
• Use the correct colour of paint to achieve opacity required.
• Provide good air circulation and ventilation during drying.

For more information, regarding screen printing inks please contact SABIC’s Innovative Plastics business, for which you can find contact details on the back page of this brochure.
STAIN RESISTANCE AND CLEANING
The following table shows how to clean typical stains if that occurs on LEXAN sheet.

Table 09: Cleaning

<table>
<thead>
<tr>
<th>Stain Substance</th>
<th>Removed With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soda</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Mustard</td>
<td>Dry Cloth</td>
</tr>
<tr>
<td>Lemon Juice</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Fruit Preserve</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Milk</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Tea</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Hot Chocolate</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Coffee</td>
<td>Dry Cloth</td>
</tr>
<tr>
<td>Newspaper Print</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Pencil</td>
<td>Warm Water</td>
</tr>
<tr>
<td>Ball Point Pen</td>
<td>Isopropyl Alcohol (IPA)</td>
</tr>
<tr>
<td>Neutral Marker</td>
<td>Dry Cloth</td>
</tr>
<tr>
<td>Water Resistant Marker</td>
<td>Isopropyl Alcohol (IPA)</td>
</tr>
</tbody>
</table>

CLEANING RECOMMENDATIONS
Periodic cleaning of all LEXAN™ polycarbonate sheet products can be accomplished easily and without the need for specialised cleaning agents. However, precautions need to be taken to avoid any aggressive cleaning agents. The basic cleaning agent for all LEXAN sheet products is a solution of lukewarm water with mild soap or household detergent, using a soft cloth or sponge to loosen any dirt and grime. All surfaces are then rinsed with cold water and dried with a soft cloth to prevent water spotting caused by lime-scales. However, in some cases this may not be sufficient and certain solvent cleaners may be needed to remove stubborn stains, graffiti, etc. In these cases the following list of cleaning agents are approved for use at room temperature:
- Methyl alcohol
- Ethyl alcohol
- Butyl alcohol
- Isopropyl alcohol
- White spirit
- Hexane
- Petroleum ether (BP 65°)
- Hydroxide peroxide (1% H2O2)

CLEANING PRIOR TO FORMING
It is necessary to clean LEXAN sheet prior to forming. It is recommended that the dust is blown off with an ionising air gun or the sheet is wiped with a soft cloth dipped in water or a mixture of isopropanol and water.

Points to remember:
- Don’t use abrasive or highly alkaline cleaners such as acetone and avoid contact with such substances.
- Never scrape the sheet with squeegees, razor blades or other sharp instruments. This may cause aesthetic damage on the surface of the product.
- Don’t clean LEXAN sheet products in the hot sun or at elevated temperatures as this can lead to staining.
SABIC’s Functional Forms business operates a worldwide network of sales, distribution, research, manufacturing and technical service facilities. With all twelve ISO 9001 certified manufacturing sites across the USA, Canada, the Netherlands, Italy, Austria, China, Malaysia, India and Brazil, the company serves customers around the world in a broad spectrum of industries and applications. As a business unit of SABIC, Functional forms benefits from global cross-business resources and expertise. From its network of technical centers in in the United States, the Netherlands, Saudi Arabia, China, Japan, Korea and India, the company provides a variety of services. These include hands-on engineering and technical support that extends from correct material selection to characterization of mechanical, thermal, UV/heat aging data, advanced light measurements, optical modeling, to part design and installation guidelines. The company also offers a local team, complete supply chain and distribution organization to provide its customers with materials wherever their manufacturing site is located.

SABIC ranks among the world’s top petrochemical companies, and is a global market leader in the production of polyethylene, polypropylene, advanced thermoplastics, glycols, methanol and fertilizers. SABIC operates in more than 45 countries across the world with 40,000 employees worldwide. It has significant research resources with 9 dedicated technology and innovation facilities in Saudi Arabia, the USA, the Netherlands, Spain, India and China.