

# TUFFAK - EXTRUDED POLYCARBONATE SHEETS



## DESCRIPTION

PLASKOLITE EXTRUDED POLYCARBONATE (PC) SHEETS are produced according to the ISO 11963:2012 and EN 16240:2013 standards and can be used both indoor and outdoor for a wide variety of purposes, such as building and automotive industry, safety and others.

TUFFAK® extruded PC sheets provide long-life products with high transparency, outstanding impact strength, weathering and ageing resistance with one or two sides UV protective layer, safe and easy fabrication and handling.

TUFFAK® extruded PC sheets are available in a wide range of thicknesses, colors, textures and special effects.

## TYPICAL PROPERTY

Properties	Method	Units	Value
<b>General</b>			
Density	ISO 1183	g/cm <sup>3</sup>	1.2
Water Absorption	ISO 62 (1)	%	0.15
<b>Mechanical</b>			
Tensile Strength at Yield	ISO 527-2	MPa	60
Elongation at Yield	ISO 527-2	%	6
Elongation at Break	ISO 527-2	%	> 100
Tensile Modulus	ISO 527-2	MPa	2300
Flexural Strength	ISO 178	MPa	90
Flexural Modulus	ISO 178	MPa	2300
Impact Resistance (Charpy unnotched)	ISO 179/1fu	kJ/m <sup>2</sup>	No Break
Impact Resistance (Izod notched)	ISO 180/1A	kJ/m <sup>2</sup>	> 65
<b>Optical</b>			
Refractive Index	ISO 489		1.585
Light Transmission (thickness dependent)	ASTM D1003	%	81-90
Haze (3 mm transparent sheet)	ASTM D1003	%	< 1
<b>Thermal</b>			
Vicat Softening Temp.(50N)	ISO 306	°C	144
Heat Deflection Temp. (1.82 MPa)	ISO 75-1	°C	130
Coeff. of Linear Thermal Expansion (0-500C)		µm/m°C	6.5
Thermal Conductivity	ASTM C177	W/mK	0.2
Maximum Continuous Service Temp.		°C	85
Maximum Short Time Service Temp.		°C	120
Minimum Continuous Service Temp.		°C	-25
Minimum Short Time Service Temp.		°C	-40
<b>Electrical</b>			
Dielectric Constant (50Hz)	DIN 53483		3.0
Dissipation Factor tanδ (100Hz)	DIN 53483		0.0006
Dissipation Factor tanδ (1 MHz)	DIN 53483		0.009
Volume Resistivity	IEC 60093	Ohm.cm	>10 <sup>14</sup>
Surface Resistivity	IEC 60093	Ohm	>10 <sup>15</sup>

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## DIMENSIONS

Thickness, mm	Width, mm	Length, mm
0.5 - 19.0	1000, 1220 and 2050	600 - 6000

Sheets are also available cut-to-size according to customer requirements.

## TOLERANCES FOR DIMENSIONS

Sheet Thickness, mm	Thickness Tolerances, %	Width Tolerances, mm	Length Tolerances, mm	Diagonals Tolerances, mm	Flatness Tolerances
<1.5	± 8	Sheets cut in production: -0.0 /+3.0	Sheets cut in production: -0.0 /+3.0	Sheets cut in production: Length ≤ 4000 mm - ≤ 2 Length ≥ 4000 mm - ≤ 4	Max allowed bowing - 0.5% from linear dimensions. Max allowed bowing across the width of the sheet - ≤ 5 mm per meter of width. Max allowed bowing along the length of the sheet - ≤ 5 mm per meter of length.
≥ 1.5, < 2.0	± 4				
≥ 2.0, < 15.0	± 3	Sheets cut to size: ± 0.50	Sheets cut to size: ± 0.50	Sheets cut to size: ≤ 0.5	
≥ 15.0, < 19.0	± 5				

## COLORS

TUFFAK® sheets are naturally colorless and clear, however, pigments can be added to obtain a wide range of tints and colors. The light transmission of TUFFAK® colored sheets varies depending on thickness.

For a list of updated colors, please contact PLASKOLITE Technical Support.

## DEFINITIONS

### SHRINKAGE

After heating, PC extruded sheets will shrink during the cooling process. The shrinkage is higher in the extrusion direction. This characteristic of TUFFAK® should be taken into account when planning the final sheet's dimensions.

Sheet Thickness, mm	Standard Grade	
	Shrinkage M.D**, %	Shrinkage T.D**, %
≥ 1.80, < 2.30	6 - 7	0.5
≥ 2.30, < 3.50	5 - 6	0.5
≥ 3.50, < 4.00	3 - 4	0.5
≥ 4.00, < 6.00	2 - 3	0.5
≥ 6.00	2	0.5

\* M.D. - Machine (extrusion) direction

\*\* T.D. - Transverse (perpendicular to extrusion) direction

# TUFFAK - EXTRUDED POLYCARBONATE SHEETS

## UV PROTECTION

TUFFAK® sheets have excellent filtering of UV radiation. They completely block the harmful UV radiation while transmitting visible light and parts of the IR radiation. However, the PC itself is not resistant to UV radiation and must be stabilized or protected using UV absorbing additives.

A coextruded UV layer which is an integral part of the sheet, protects the sheets from degradation from solar ultraviolet radiation. The effectiveness of this protection has been confirmed by field and laboratory durability testing of Yellowness Index (YI), Light Transmission (LT) and Maintaining Mechanical properties.

TUFFAK® polycarbonate sheets are guaranteed against loss of physical, mechanical and optical properties during the guarantee period.

Details are available at the PLASKOLITE website ([www.plaskolite.com](http://www.plaskolite.com)).

## FIRE TEST PERFORMANCE

PC is a thermoplastic therefore it will eventually melt and burn under the intense heat of fire. However, PC is considered a self-extinguishing material meaning that it will stop burning when the fire source is removed. TUFFAK® sheets, unlike other materials do not produce toxic or corrosive gases when burning.

TUFFAK® extruded PC sheets are classified:

- HB according to UL94 for thin gauge sheets
- V2 according to UL94 for higher gauge sheets
- V0 for fire retardant "F" grades
- B-s1,d0 according to UNE-EN ISO 13501 (specific thicknesses)

## NOISE REDUCTION

TUFFAK® sheets are used widely as noise-reduction barriers along roads and highways and comply with the following standards:

EN-14388:2005 - Road Traffic Noise Reducing Device

EN-1793 - Road Traffic Noise Reducing Device — Acoustic Properties

EN-1794 - Road Traffic Noise Reducing Device — Non-Acoustic Properties

## CHEMICAL RESISTANCE

TUFFAK polycarbonate sheets can be safely used with most chemical materials and components, however, some common materials are not compatible with polycarbonate. The chemical stability depends on many factors such as concentration of the chemical agents, internal stresses and exposure temperature.

Because of the complexity of chemical compatibility all materials which are intended for contact with the polycarbonate sheets should always be tested.

A list of compatible and non-compatible materials is available for download at the PLASKOLITE website ([www.plaskolite.com](http://www.plaskolite.com)).

## ENVIRONMENTAL STRESS CRACKING

Environmental Stress Cracking (ESC) is a result of the combination of stress and exposure to chemicals. The level of stress needed for ESC is lower than the normal failure mechanical stress of PC in a chemical-free environment. Stresses can be created during forming and fabrication and can be controlled by an annealing process. Stresses can be created also by improper installation. Cold bended sheets under permanent induced stress or sheets under periodic stress (fatigue) are also susceptible to ESC.

# TUFFAK - EXTRUDED POLYCARBONATE SHEETS

## GENERAL GUIDELINES

### STORAGE

TUFFAK® sheets must be stored with their original protective masking in a dry, shady and well ventilated area, with NO EXPOSURE to direct sunlight, wind, dirt or hard objects. Avoid storage in areas with excessive heat or aromatic cleaning solvents.

Sheets should be stored horizontally on their delivery pallets and placed on a soft material (such as cardboard) to prevent damage. DO NOT store sheets under flexible PVC coverings, as flexible PVC is not compatible with polycarbonate and can cause serious damage to the sheets. Pay attention to avoiding pressure on the unsupported areas.

### PROTECTIVE FILM

Both surfaces TUFFAK® sheet are protected by a fully recyclable polyethylene (PE) film. Keep this film in position as long as possible and remove it immediately after installation. Sharp objects, sharp particles or even small chips can penetrate the protective PE masking, and damage the surface therefore always place TUFFAK® on a clean smooth surface.

TUFFAK® protective film is suitable for thermoforming. High-heat deep-draw thermoforming applications can cause the PE film to adhere more strongly. Printed film must be removed before thermoforming, to avoid transfer of the printing ink to the sheet's surface.

### CLEANING & MAINTENANCE

TUFFAK® sheets are produced in a “clean-room” environment and do not need to be cleaned before use. However, cleaning may be needed after fabrication, before sensitive processes such as vacuum metallization or printing or for maintenance during use.

Polycarbonate sheets will give longer and more effective service life by cleaning by warm soapy water using a mild liquid dish soap. If any dirt remains, gently wipe off with a soft cloth.

- Commercial liquid cleaners may not be compatible with polycarbonate and are not recommended.
- Sponges, squeegees, brushes or sharp instruments should not be used for cleaning sheets as they can damage the protective UV coating and / or causes scratches in the sheet surface.

### ENVIRONMENTAL ADVANTAGES

TUFFAK® sheets are environmental friendly. The sheets and their polyethylene protective layers are fully recyclable. They do not contain any toxic materials or heavy metals which may cause environmental damage or health risks. Ozone Depleting Substances (ODP) are not used in the manufacture of TUFFAK® sheets and they do not release pollutant substances into the environment during manufacture. They do not produce toxic or corrosive gases upon burning, fires can be extinguished with water.

TUFFAK® sheets can be used for energy recovery and chemical or mechanical recycling.

TUFFAK® scrap is not classified as hazardous waste, small amounts can be disposed as household refuse. Large quantities should be disposed by recycling.

# TUFFAK - EXTRUDED POLYCARBONATE SHEETS

## RE-WORKING

### - HANDLING:

TUFFAK® sheets can be cut, sawn, drilled, milled and bent easily using standard workshop equipment for wood or metal. However, it is always recommended to use specific tools specially designed for plastics.

Machining, Assembling, Forming, Glazing and Signage Installation recommendations can be refer to the TUFFAK® Guidebook.

### - COLD BENDING:

TUFFAK® sheets are ductile and can be cold-bent in a straight line.

When cold bending TUFFAK® sheets, a plastic permanent deformation is induced in the bending line, this deformation causes a reduction of the mechanical properties in the bent area.

Also, plastic deformation causes frozen-in internal stresses that reduce the chemical resistance of the sheet in the bent area and increase the susceptibility to ESC attack. Annealing may cause a partial improvement of the mechanical and chemical resistance.

For TUFFAK® sheets up to 6 mm, the recommended minimum bent angle is 90°. For higher thicknesses, up to 12 mm, the recommended minimum bend angle is 135°.

Hard coated sheets cannot be bent.

These suggestions and data are based on information we believe to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determines the suitability of our materials and suggestions before adopting them on a commercial scale.

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