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## QUINN PLASTICS LTD

# Technical Information & Installation Guidelines for Quinn SPC Multiwall Polycarbonate Sheets





QUINN PLASTICS LTD

# Installation Guidelines for Quinn Plastics Polycarbonate



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## CHAPTER 1

# General Guidelines

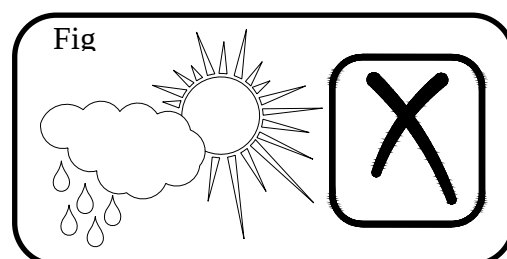
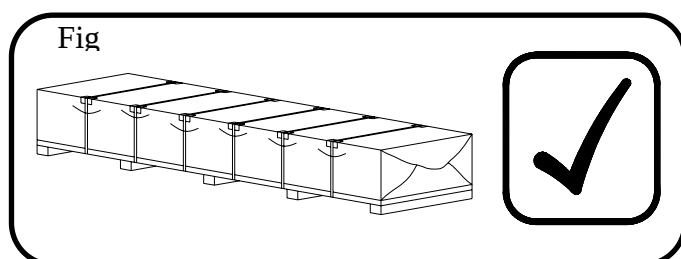
## Introduction

Quinn plastics use the latest production technology to produce polycarbonate sheeting. Quinn SPC is a lightweight multiwall extruded polycarbonate sheet. Polycarbonate is one of the most durable plastics known and is swiftly becoming an excellent contender as roofing material. Extruded as a multi-wall sheet it is immensely stronger than glass and is ideal for replacing old roofs. Because of its strength, light weight and pleasing appearance, polycarbonate is ideal for conservatory roofs and is used by most conservatory manufacturers. Using a built in UV protective layer it provides great protection from the sun whilst still allowing excellent light transmission. Quinn Plastics Polycarbonate sheets come with a standard 10 year limited warranty.

## Storage and Handling

Quinn Plastics SPC multi-wall polycarbonate sheets must be stored and transported horizontally on a suitable pallet, supported along the entire length and width (Fig 1). If sheets of different length require stacking ensure that the longest lengths are on the bottom to avoid unsupported overhangs. Cover the stored sheets with an opaque plastic film sheet to protect from the wind, rain and direct sunlight (Fig 2). Ideally Quinn Plastics polycarbonate sheet should be stored indoors whenever possible.

As with all glazing materials multi-wall polycarbonate sheet is considered fragile, therefore care must be taken during transport and handling to prevent scratches and damage to the edges of the sheets. Quinn Plastics polycarbonate sheets are individually protected using a protective film and the open ends of the sheet are taped to prevent ingress of contaminants. Do not walk across sheets of polycarbonate.



## CHAPTER 2

# Working with Polycarbonate

## Glazing Preparation

**W**hen preparing to cut the multi-wall polycarbonate the effects of expansion and contraction must be considered as to allow for free movement of the sheet. As a rough guide this can be as much as + or - 3mm per linear metre in both longitudinal and latitudinal directions.

Quinn Plastics multi-wall polycarbonate has a UV protective layer and it is vitally important that it is fitted with the correct face toward the sun. This side is identified as the side with the printed film applied.

Quinn Plastics multi-wall polycarbonate should be fitted with the flutes in the same direction as the slope of the roof; this will aid in the drainage of rain and condensed water. Do not remove the protective film until the installation is complete.

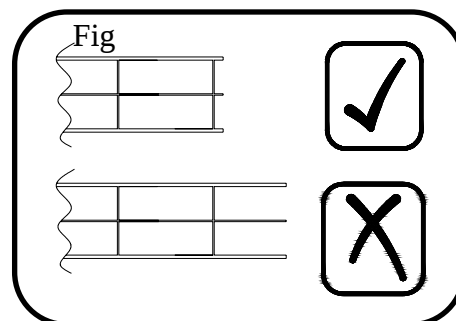
## Cutting and Drilling

Hand or power tools may be used to easily cut Quinn Plastics multi-wall polycarbonate. Normal twist drills may be used to drill holes, however before cutting it is best that the sheet is stored inside for 24 hours. When cutting ensure that the sheet is at room temperature and a fine tooth saw blade is used. This will ensure a nice clean cut.

When cutting or drilling ensure that the sheet is fully supported to reduce vibration and stress to the polycarbonate.

When cutting parallel to the flutes of the polycarbonate sheet endeavour to cut close to an internal wall as indicated in Fig 3.

Before drilling polycarbonate sheet it is advisable to make a small hole using a bradawl to prevent drill travel. All holes must be at least 3mm larger than the diameter of the fixing to allow for expansion and should be at least 45mm from any edge.



## Cleaning

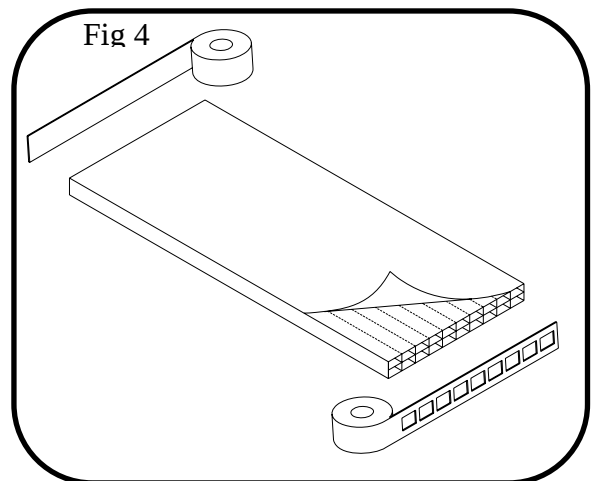
Once the polycarbonate sheet has been cut to size it requires cleaning before it can be sealed. Rough and sharp edges may be removed using a fine file or sandpaper. If the sheet has been cut using saw it will unavoidably produce dust and swarf in the cavities. This must be removed before sealing. A household vacuum cleaner can be used to remove the dust and swarf. If this is unsuccessful use dry compressed air to blow through the flutes. Be careful not to get moisture in the flutes. Do not use water to clean the flutes of the sheet.

## Pre-Installation Sealing

After cutting & cleaning the sheet you must tape off the top of the panel with a non-vented tape and the bottom with a vented tape (Fig 4); this reduces the ingress of contaminants and helps prevent moisture entering the flutes. Usually a finishing trim in the style of a 'U' profile is also used to cover the vented tape.

The tape used must have good weathering resistance without suffering loss of adhesion. Quinn Plastics recommend tape with a BBA assessment report.

To do this the protective film will have to be peeled back 50mm to 75mm to allow access; do not remove the protective tape before cutting, or installation.



## Installation Safety

Polycarbonate sheeting is not intended to support the weight of a person, therefore suitable ladders and crawling boards must be used in accordance with current health and safety legislation. Never at any time walk on the polycarbonate.

## CHAPTER 3

# Physical Properties

## Light Transmission

QUINN polycarbonate sheeting has an excellent light transmission value of up to 72% (based on 16mm thick clear triple wall) and with its built in UV protective layer its almost opaque to radiation in the UV and infra red regions. Having such properties helps protect delicate materials such as fabrics when placed behind Quinn Plastics Polycarbonate. Below is a table indicating the different light transmission percentages for all of the Quinn Plastics range.

Table 1

|                   | % Light Transmission<br>(ASTM D1003) |        |      |                 |                 |                 | Thermal<br>Insulation<br>U Value<br>(BS EN<br>10211:1996) | Minimum<br>temperature<br>factor |
|-------------------|--------------------------------------|--------|------|-----------------|-----------------|-----------------|-----------------------------------------------------------|----------------------------------|
| Thickness<br>(mm) | Clear                                | Bronze | Opal | Arctic<br>Pearl | Bronze<br>/Opal | Silver<br>/Opal | W/m <sup>2</sup> K <sup>-1</sup>                          | f <sub>cRsi</sub>                |
| 10mm,<br>2 Wall   | 88%                                  | 37%    | 45%  | N/A             | N/A             | N/A             | 2.9                                                       | N/A                              |
| 16mm,<br>3 Wall   | 72%                                  | 21%    | 18%  | 20%             | 26%             | N/A             | 2.6                                                       | 0.81                             |
| 25mm,<br>5 Wall   | 62%                                  | 17%    | 14%  | 16%             | 17%             | 7%              | 1.7                                                       | 0.81                             |
| 32mm,<br>7 Wall   | 51%                                  | 11%    | 29%  | N/A             | 18%             | 8%              | 1.4                                                       | 0.85                             |
| 35mm,<br>7 Wall   | 51%                                  | 11%    | 29%  | N/A             | 18%             | 8%              | 1.3                                                       | 0.87                             |

## U Values

To calculate the U values of its multi-wall polycarbonate, Quinn Plastics has tested its products to a new more relevant standard BS EN 10211:1996. This standard is basically a method in which to calculate the theoretical U value of a given product. Tests performed in recent years utilised BS 6993-1:1989 which was used to calculate U values for single and multiple glazed windows hence this standard did not take into account thermal bridging, heat flows etc & therefore could often mislead as to the true performance of a product. This standard was withdrawn from use in February 2003.



## Temperature

The properties that protect us from the harmful rays of the sun, also in reverse help to increase the temperature on the inside of the building. The visible spectrum of light entering the building is absorbed by the internal furnishings which in return produces infra red energy. The insulating properties of Quinn Plastics Polycarbonate preclude heat from escaping faster than it is created causing a temperature increase, hence the Greenhouse Effect. This heat increase can be controlled by venting the building and/or using special tinted Quinn Plastics polycarbonate.

## Temperature Control

Polycarbonate in its most transparent form can have a light transmission of up to 72% (dependent on thickness). This may not be suitable for buildings that are affected by sun. Other tinted translucent Quinn Plastics sheets may be used to physically reduce the solar heat build up, which help maintain a more comfortable temperature.

## Condensation Risk

The minimum temperature factors of the Quinn SPC sheet, given in Table1 exceed the critical temperature factor for limiting the risk of surface condensation in dwellings, residential buildings, and schools implied in BRE information paper IP17/01 *assessing the effect of thermal bridging at junctions and around openings*. The risk of surface condensation in these building types is, therefore, acceptable. The acceptability in specific buildings of other types may be determined in accordance with EN ISO 13788: 2001.

In common with all glazed roof structures, the environmental temperature to which the sheet is exposed can be 6°C or more below the design air temperature, because of temperature reduction under night-time winter sky radiation condition. Under such condition the risk of surface condensation will be correspondingly higher than for vertically-mounted sheet.

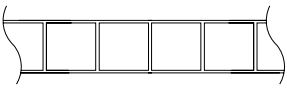
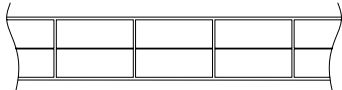
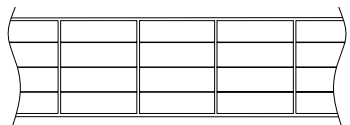
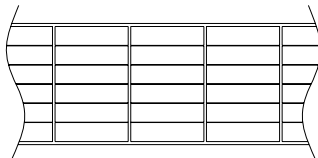
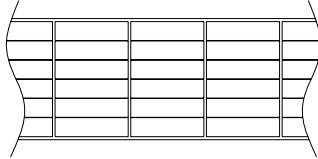
In a conservatory the effects of any condensation will be minimised by the use of background heating to maintain the internal temperature between 3°C and 4°C above the external ambient temperature. Any occurrence of condensation should be slight and temporary provided the environment in the conservatory is maintained within the normal domestic band of 10°C to 25°C and 40% to 65% RH.

## Installation Temperatures

Quinn Plastics multi-wall polycarbonate can be used for many applications and its physical performance can remain stable between -40 to +100°C.



## Product Range & Dimensions

| Product                                                                             | Structure   | Thickness<br>(tolerance) | Width<br>(tolerance)         | Length<br>(tolerance) | Weight<br>(tolerance)        |
|-------------------------------------------------------------------------------------|-------------|--------------------------|------------------------------|-----------------------|------------------------------|
|    | Rectangular | 10mm<br>± 0.5mm          | 2100mm<br>0mm +6mm           | ≤7000<br>0mm +15mm    | 1.7Kg/m <sup>2</sup><br>± 3% |
|    | Rectangular | 16mm<br>± 0.5mm          | 2100mm<br>0mm +6mm           | ≤7000<br>0mm +15mm    | 2.7Kg/m <sup>2</sup><br>± 3% |
|    | Rectangular | 25mm<br>± 0.5mm          | 1800mm<br>2100mm<br>0mm +6mm | ≤7000<br>0mm +15mm    | 3.5Kg/m <sup>2</sup><br>± 3% |
|   | Rectangular | 32mm<br>± 0.5mm          | 1800mm<br>2100mm<br>0mm +6mm | ≤7000<br>0mm +15mm    | 3.6Kg/m <sup>2</sup><br>± 3% |
|  | Rectangular | 35mm<br>± 0.5mm          | 1800mm<br>2100mm<br>0mm +6mm | ≤7000mm<br>0mm +15mm  | 3.8Kg/m <sup>2</sup><br>± 3% |

The above table indicates standard sheet sizes only. Custom sizes can be manufactured based upon minimum order quantities and machine capability. These standard width sheets can be made on line as close-close end. Any custom sizes will have open-close or open-open end.

## Fire Regulations

All of our 10mm, 16mm, 25mm, 32mm and 35mm thick Polycarbonate sheets have been independently tested to BS476: Part 7. All tests were given a class 1Y rating, the best possible rating for this material. The material can also be regarded as having an AA designation.



# Mechanical Properties

## Typical Properties of Polycarbonate Resin

Table 3

|                                                | Typical Value | Unit              | Standard       |
|------------------------------------------------|---------------|-------------------|----------------|
| <b>MECHANICAL</b>                              |               |                   |                |
| Tensile Stress at Yield, 50mm/min              | 60            | MPa               | ISO 527        |
| Tensile Stress at break, 50mm/min              | 55            | MPa               | ISO 527        |
| Tensile Strain at Yield, 50mm/min              | 6.0           | %                 | ISO 527        |
| Tensile strain at break, 50mm/min              | 95            | %                 | ISO 527        |
| Tensile Modulus 1mm/min                        | 2250          | MPa               | ISO 527        |
| Flexural Strength at yield 2mm/min             | 95            | MPa               | ISO 178        |
| Flexural Modulus 2mm/min                       | 2250          | MPa               | ISO 178        |
| Hardness, H358/30                              | 100           | MPa               | ISO 2039/1     |
| <b>IMPACT</b>                                  |               |                   |                |
| Izod Impact, notched 80*10*4 +23°C             | 14            | kJ/m <sup>2</sup> | ISO180/1A      |
| Izod Impact, notched 80*10*4 -30°C             | 10            | kJ/m <sup>2</sup> | ISO180/1A      |
| Izod Impact, notched 63.5*12.7*3.2 +23°C       | 70            | kJ/m <sup>2</sup> | ISO180/4A      |
| Izod Impact, notched 63.5*12.7*3.2 -30°C       | 12            | kJ/m <sup>2</sup> | ISO180/4A      |
| Charpy V-notch edgew. 80*10*4 s=62mm +23°C     | 14            | kJ/m <sup>2</sup> | ISO 179/1eA    |
| Charpy V-notch edgew. 80*10*4 s=62mm 30°C      | 10            | kJ/m <sup>2</sup> | ISO 179/1eA    |
| <b>THERMAL</b>                                 |               |                   |                |
| Thermal Conductivity                           | 0.20          | W/m°C             | ISO 8302       |
| Coeff. Of Lin. Therm. Exp. Flow 23 ÷ 80°C      | 7.0 E-5       | 1/°C              | ISO 11359-2    |
| Coeff. Of Lin. Therm. Exp. xFlow 23 ÷ 80°C     | 7.0 E-5       | 1/°C              | ISO 11359-2    |
| Ball Pressure Test, 125°C ± 2°C                | PASSES        | -                 | IEC 60695-10-2 |
| Vicat B/50                                     | 142           | °C                | ISO 306        |
| Vicat B/150                                    | 145           | °C                | ISO 306        |
| HDT/Be, 0.45 MPa edgew. 120*10*4/s = 100 mm    | 136           | °C                | ISO75/Be       |
| HDT/Be, 1.8 MPa edgew. 120*10*4/s = 100 mm     | 128           | °C                | ISO75/Ae       |
| Max service temperature for continuous use     | 115           | °C                |                |
| Minimum service temperature for continuous use | -40           | °C                |                |
| <b>OPTICAL</b>                                 |               |                   |                |
| Light Transmission                             | >87           | %                 | ASTM D1003     |



# Solar Properties

| Table 4                 |       | Standard ASTM E424-71 |       |                  |                  |      |
|-------------------------|-------|-----------------------|-------|------------------|------------------|------|
| Sheet Type              | %ST   | %SR                   | %SA   | %ST <sub>t</sub> | %SR <sub>t</sub> | SC   |
| 16mm Clear              | 70.05 | 22.53                 | 7.43  | 72.00            | 28.00            | 0.83 |
| 16mm Bronze             | 27.37 | 10.96                 | 61.68 | 43.61            | 56.39            | 0.50 |
| 16mm Opal               | 29.49 | 31.73                 | 38.78 | 39.70            | 60.30            | 0.46 |
| 16mm Bronze/Opal        | 33.25 | 13.05                 | 53.70 | 47.40            | 52.60            | 0.54 |
| 16mm Arctic Pearl       | 33.17 | 36.06                 | 30.77 | 41.28            | 58.72            | 0.47 |
| 25mm Clear              | 60.66 | 32.12                 | 7.22  | 62.56            | 37.44            | 0.72 |
| 25mm Bronze             | 22.47 | 15.17                 | 62.36 | 38.90            | 61.10            | 0.45 |
| 25mm Opal               | 23.60 | 37.39                 | 39.01 | 33.88            | 66.12            | 0.39 |
| 25mm Bronze/Opal        | 23.63 | 14.10                 | 62.27 | 40.03            | 59.97            | 0.46 |
| 25mm Silver/ diffuse    | 7.68  | 26.81                 | 65.51 | 24.94            | 75.06            | 0.29 |
| 25mm Arctic Pearl       | 27.74 | 37.81                 | 34.45 | 36.81            | 63.19            | 0.42 |
| 32/35mm clear           | n/a   | n/a                   | n/a   | 55.00            | n/a              | n/a  |
| 32/35mm Bronze          | n/a   | n/a                   | n/a   | 14.00            | n/a              | n/a  |
| 32/35mm Opal            | n/a   | n/a                   | n/a   | 35.00            | n/a              | n/a  |
| 32/35mm Bronze/opal     | n/a   | n/a                   | n/a   | 22.00            | n/a              | n/a  |
| 32/35mm Silver /Diffuse | n/a   | n/a                   | n/a   | 8.00             | n/a              | n/a  |

## %ST (Direct Solar Transmission)

The amount of solar light, from the light spectrum 300nm to 2500nm, that passes through an object.

## %SR (Solar Reflection)

The amount of solar light, from the light spectrum 300nm to 2500nm, that is reflected by an object.

## %SA (Solar Absorption)

The amount of solar light, from the light spectrum 300nm to 2500nm, that is absorbed by an object.

## %ST<sub>t</sub> (Total Solar Transmission)

The total amount of solar light transmitted through an object including solar energy that is absorbed and radiated inwards.

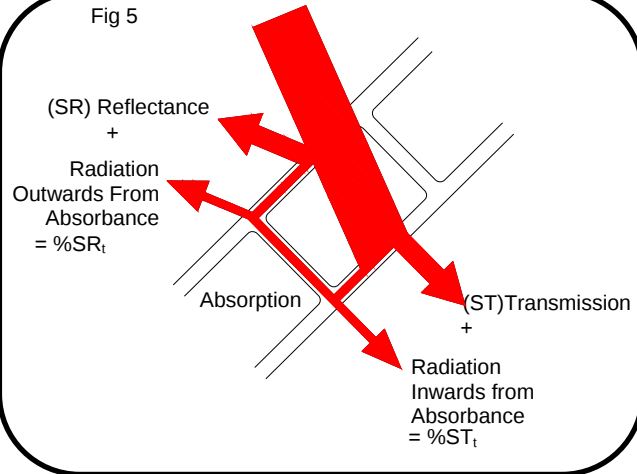
## %SR<sub>t</sub> (Total Solar Reflectance)

The total amount of solar light reflected by an object including solar energy that has been absorbed and radiated outwards.

SC (Shading Coefficient) is the ratio of the total solar heat gain through a specific material to the total solar heat gain through a sheet of normal glass under the same set of conditions. The shading co-efficient is expressed as a number between 0 and 1. The closer the number is to 0, the better it will be at blocking solar heat gain. Clear glass has shading coefficient of 1.0.



Fig 5



# Installation Guidelines

## Supporting Polycarbonate

**A**s mentioned in Chapter 2 when cutting polycarbonate sheet you must cut as close as possible to the internal web. Although we accept this is not always workable you should ensure that the glazing bars provide adequate engagement to support the polycarbonate when under load. Because polycarbonate sheet has a larger linear thermal expansion than other traditional glazing materials it requires more room to expand and contract. For Quinn SpC multi-wall polycarbonate of any thickness it is necessary to allow 3mm per metre of polycarbonate. This applies to both directions, length and width. If enough room is not allowed it is possible for the sheet to bow from compression.

## Fitting Polycarbonate

Quinn SPC Polycarbonate sheeting can be used either vertically for cladding or glazing i.e. a greenhouse, or more traditionally as a roofing material i.e. conservatory roofs. When used for roofing it is crucial that the roof has a minimum slope of 2.5°. The steeper the angle the better the water drainage hence less chance of water seepage through fixings and glazing bars.

When using glazing bars and covering trims to install SPC sheets it is said that mechanical fixings may not be required. We strongly recommend that in areas with high wind speeds mechanical fixings are used to provide extra safety.



Below are some diagrams illustrating glazing methods:-

### 1) Plastic Glazing Bars

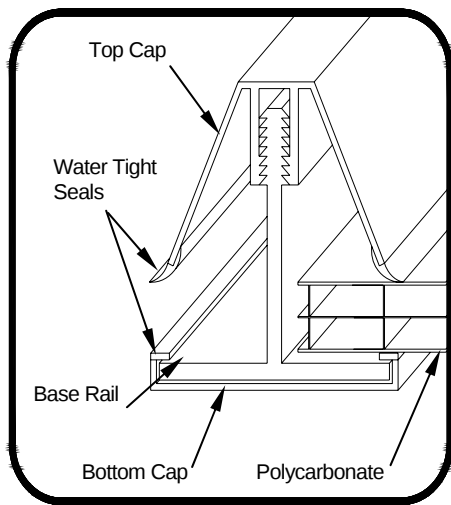


Fig 6

Glazing bars vary in materials, shape and size but effectively they all do the same thing. The more modern type consists of an aluminium profile which is either supported at both ends (self-supporting) or sits directly on to a rafter/purling. The adjoining sheets then sit on the edge of the aluminium profile. A top cap is fitted which normally has a ratchet system that then clamps the polycarbonate in position. If the glazing bar is self supporting a plastic trim is normally clipped on the underside of the profile to disguise the glazing bar. The sheet must always be clamped between water tight seals. This method of installation is only recommended for roofs. This method is normally used when the polycarbonate is secured on two sides only.

### 2) Wooden/Plastic Glazing Frames

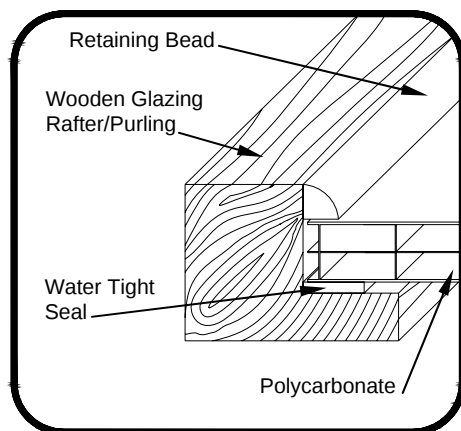


Fig 7

Wooden/Plastic glazing frames are mainly used for vertical applications. A length of timber is rebated to allow for the polycarbonate and a retaining bead, as shown in the diagram. The rebate can be on both sides of the timber to allow for adjoining sheets. The polycarbonate sheet is placed into the rebate on top of a water tight seal and a retaining bead is nailed or screwed to the wooden glazing bar to secure the polycarbonate. The retaining bead must be placed on a water tight seal. If used in the vertical application the polycarbonate must be secured on all four sides.

### 3) Jointing Strips

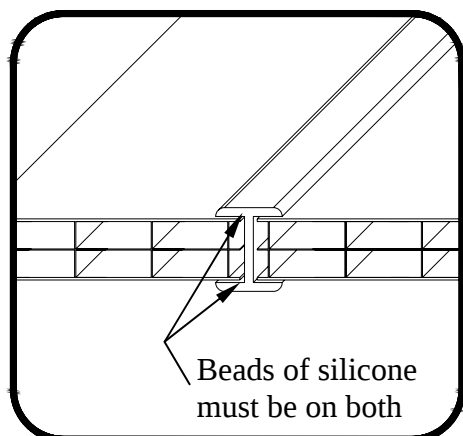


Fig 8

Where polycarbonate is placed directly on to a wooden frame for cladding or roofing a glazing bar may not be required. As a simple method of joining two polycarbonate sheets a jointing strip may be used as illustrated on the left. To ensure a water tight fixing is achieved a bead of silicone must be on the internal corners of the jointing strip before the polycarbonate is inserted. The jointing strip must always run in the direction of the slope. This type of jointing strip does not secure the polycarbonate in any form and mechanical fixings are required. For details on mechanical fixing please see the next section.

### 4) Mechanical Fixings

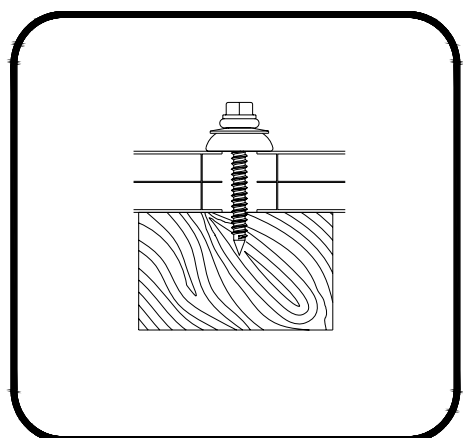


Fig 9

When using screws to secure polycarbonate sheet ensure that the correct cladding screws are used. Because the holes are 3.0mm larger than the screw diameter special washers are used to ensure a water tight seal around the head of the screw. Screws must be screwed in perpendicular to the surface. Avoid over tightening the screws as this could cause premature failure of the internal walls and possible leaks. Always use corrosive resistant screws.

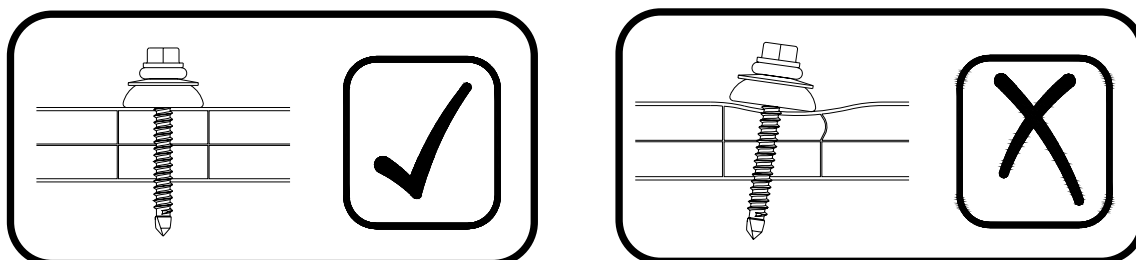


Fig 10

## Wind and Snow Loading

Throughout Britain different areas are affected by individual wind environments. For example, the winds speeds in Northern Scotland are much higher compared to those in Central England. The higher the wind speed the greater the force exerted on buildings.

In addition to a general wind load for certain areas other factors also play a part in wind loading. Local geography, topography, position against other buildings, direction of wind and the architecture of the building all contribute to the effects of wind loading.

The side of a building that is windward will encounter positive loads (1). Eddy currents are formed as the wind passes around the building and the opposite side will encounter negative loads, known as suction loads (2). The diagram below shows the effect that wind has on a building.

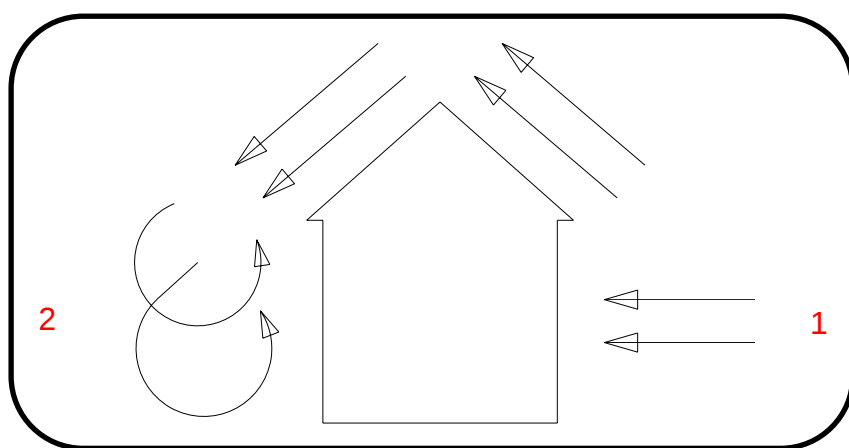


Fig 11

Wind loading must be taken into account for every building using Quinn SPC Polycarbonate sheets.

Another form of positive loading is snow loading. As snow settles on the roof the polycarbonate will be under a positive load and will naturally deflect.

The tables on the following pages give the maximum span of supporting members for various glazing methods and various loads. These loads are based upon structural experience and are given as a guideline only. These figures should never take precedence over structural engineering calculations.

The effect of wind loading should be calculated in accordance with BS 6399: Part 2: 1997 and snow loadings in accordance with BS 6399: Part 3: 1988, for each case.

## Supporting Framework for Polycarbonate

- 1) Supporting Polycarbonate When Used For Glazing and Cladding (Secured on all four sides)

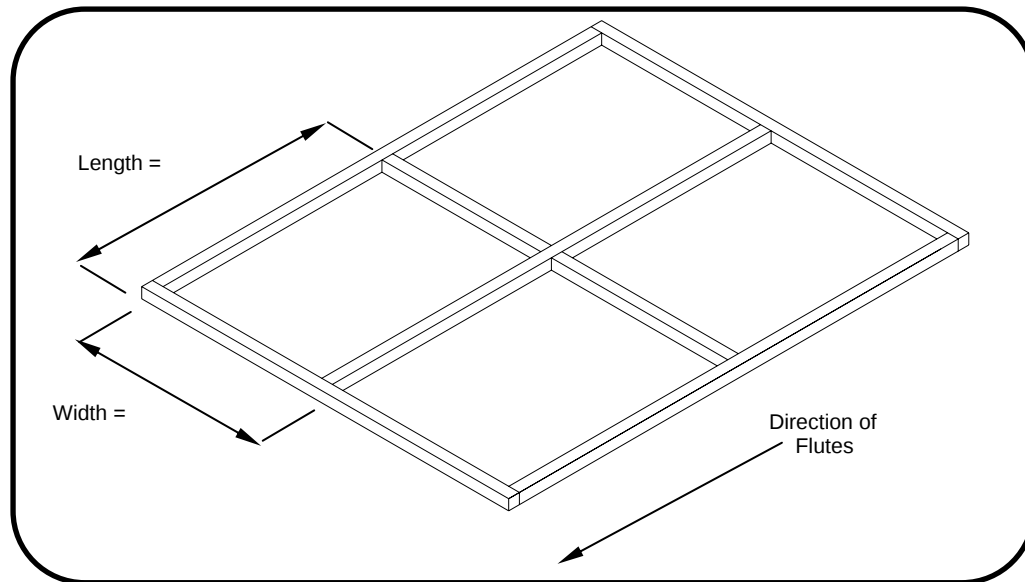


Fig 12

Wooden/Plastic glazing frames, or screwing the polycarbonate to wooden rafters can be used to secure the polycarbonate on all four sides. The graphs on page 13 can be used as a guide for the recommended distance between the supporting members when the polycarbonate has been secured on all four sides.

## Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 16mm Polycarbonate Supported On All Four Sides

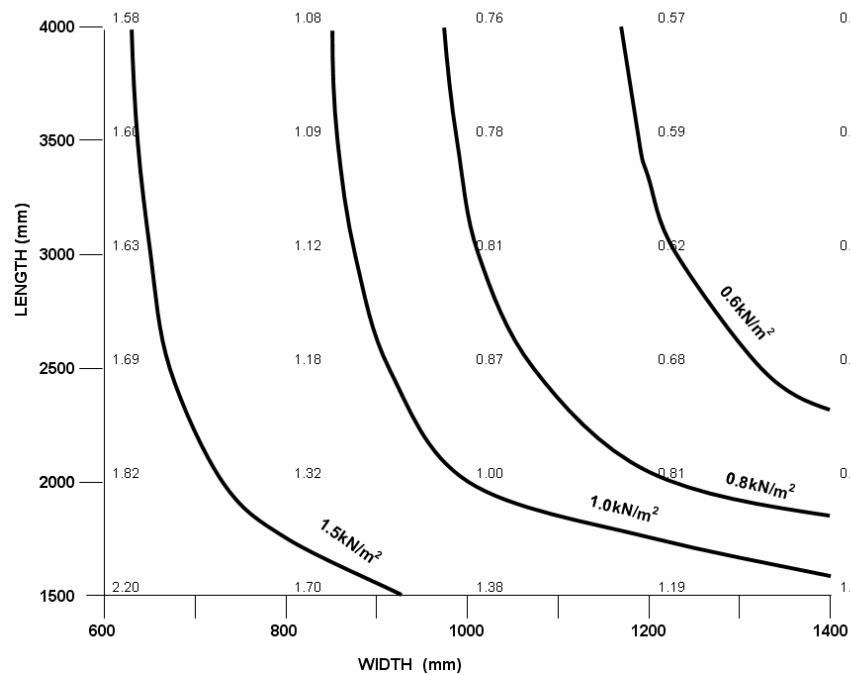


Fig 13

## Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 25mm Polycarbonate Supported On All Four Sides

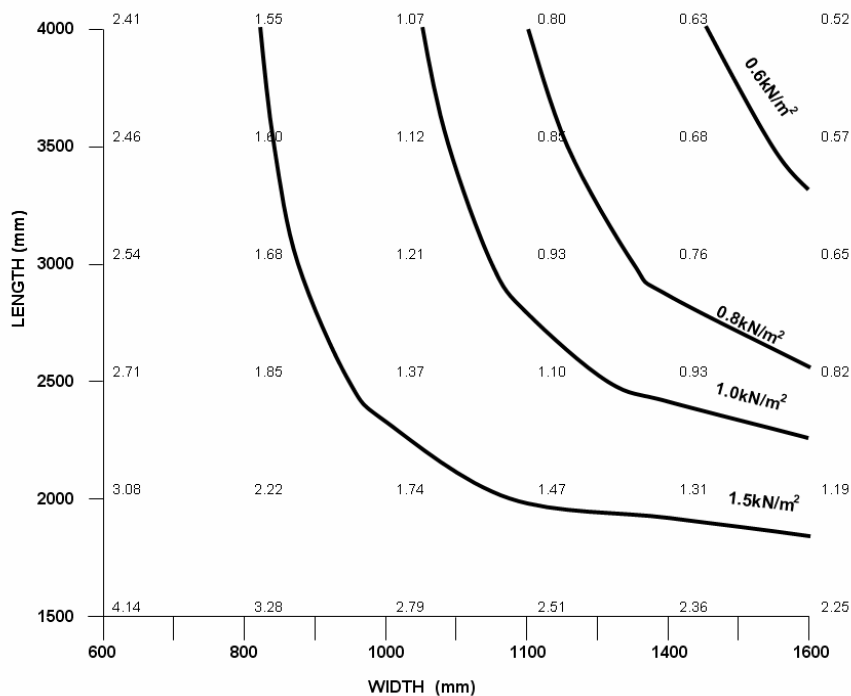


Fig 14

### Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 32mm Polycarbonate Supported On All Four Sides

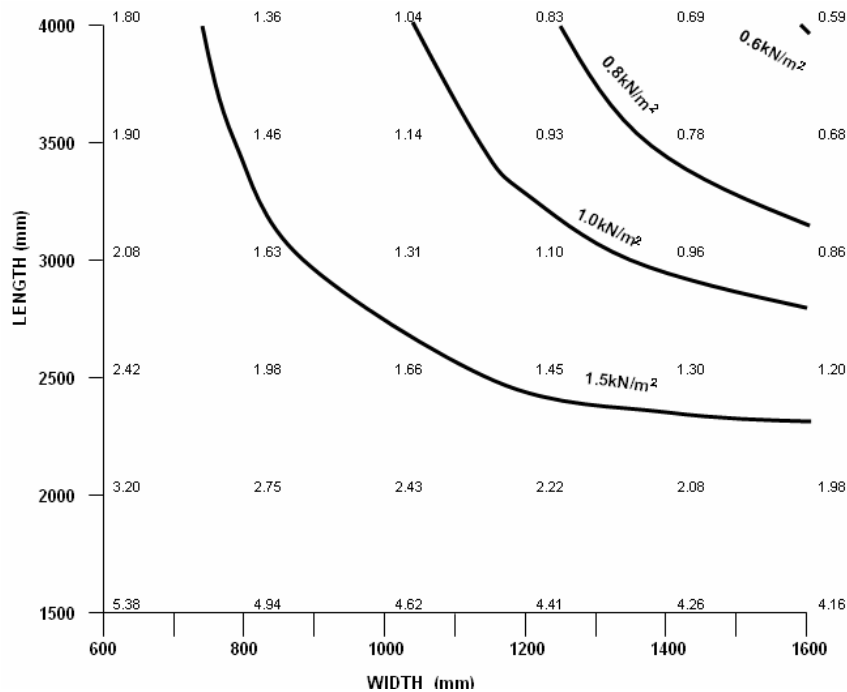


Fig 15

### Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 35mm Polycarbonate Supported On All Four Sides

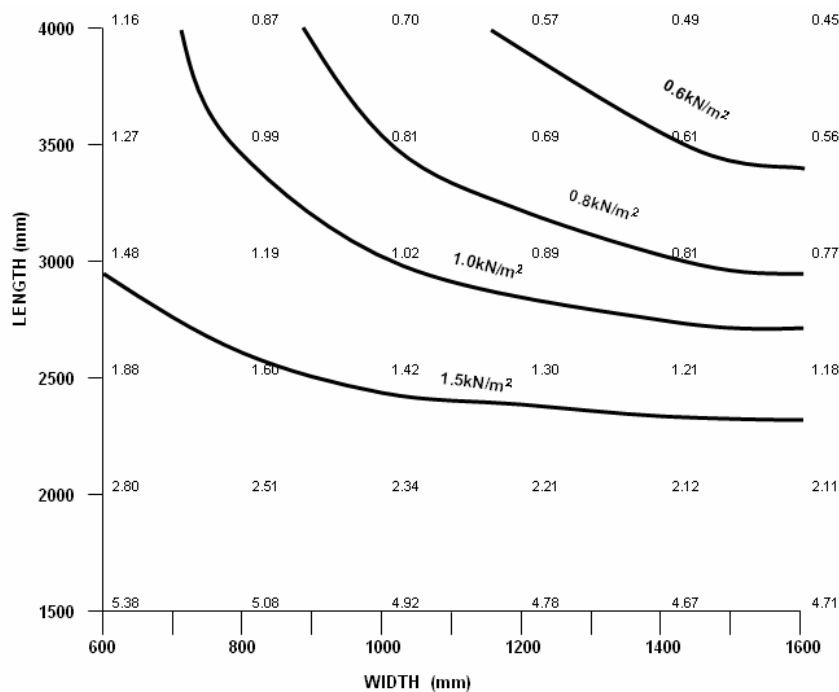


Fig 16

## 2) Supporting Polycarbonate When Used For Roofing (Secured on two sides)

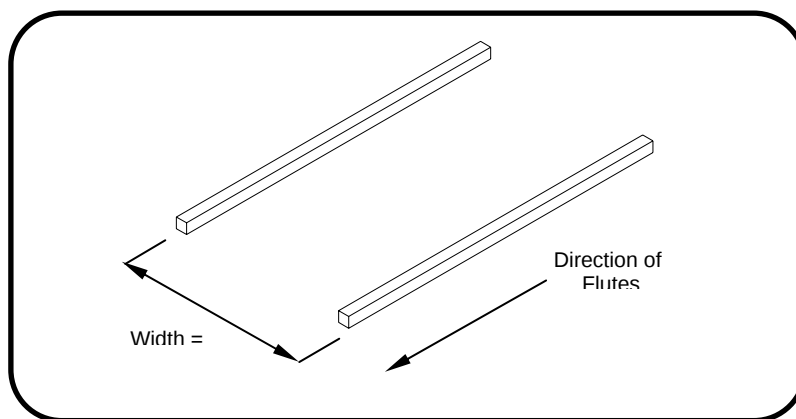


Fig 17

When using plastic glazing bars the polycarbonate is normally supported along the length of the sheet. The graphs below can be used as a guide for the recommended distance between the supporting members across the width.

**Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 16mm Polycarbonate Supported Along the Length.**

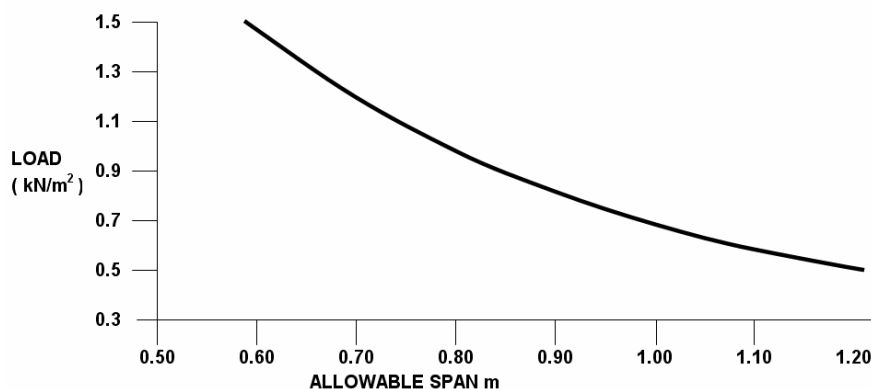


Fig 18

**Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 25mm Polycarbonate Supported Along the Length.**

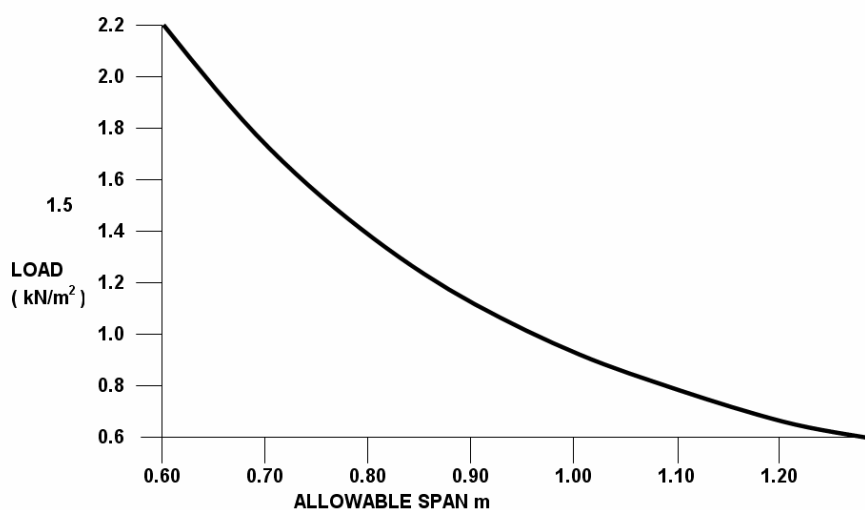
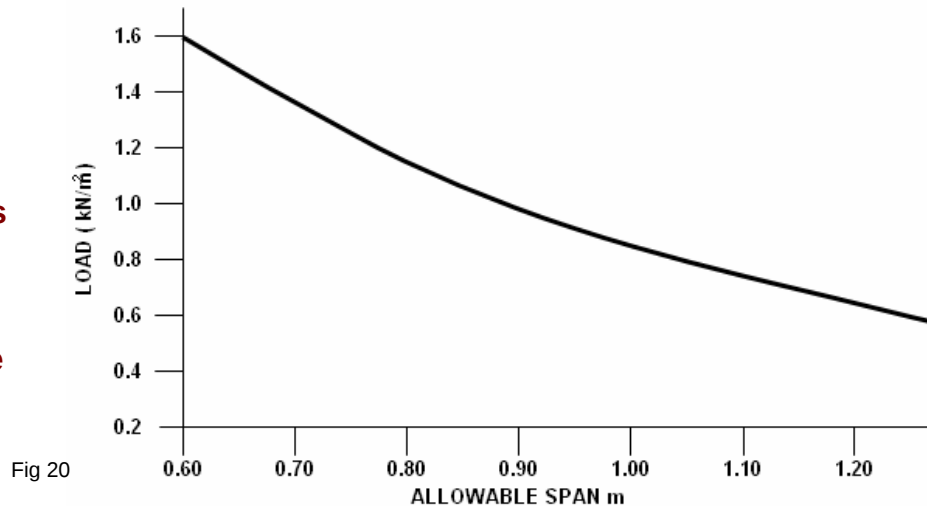
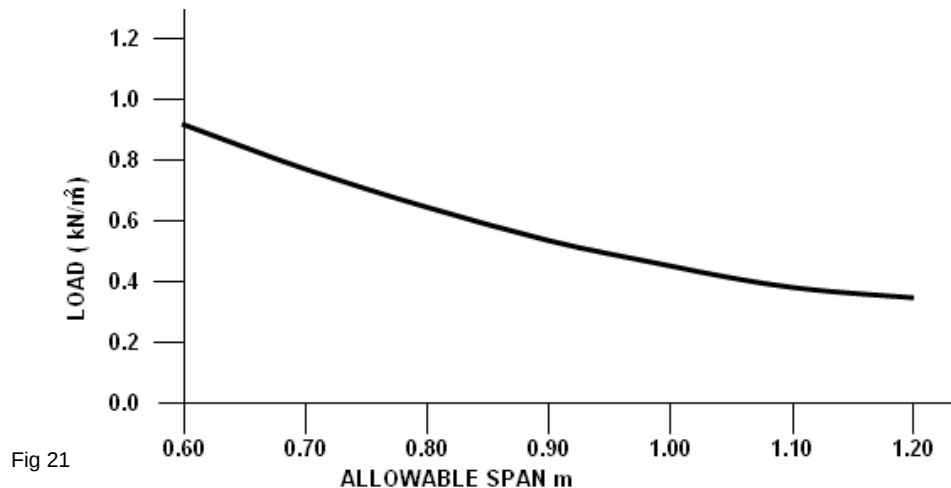


Fig 19

**Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 32mm Polycarbonate Supported Along the Length.**



**Graph Indicating Recommended Distance between Supporting Members for Various Loads When Using 35mm Polycarbonate Supported Along the Length.**



The span for recommended support centres is purely configured around professional understanding of polycarbonate sheeting. These calculations are based on 5% deflection of the whole length/width. Although Polyex polycarbonate can withstand higher loads the deflection is greatly increased and in most cases this is totally unacceptable. Where the roof pitch is greater than 20° the deflection can be less than that of a roof at 2.5°, hence wider spans may be possible. At no point should these recommended dimensions supersede given dimensions from local structural building codes or a structural engineer. All loading details are calculated using theoretical calculations from figures gained by actual test results from performing uniformly distributed load tests. All structural testing was autonomous to Quinn Plastics Ltd. Copies of the testing brief are available upon request.



## 10 Year Limited Warranty

1. Quinn Plastics limited warranty covers for a limited period of 10 years all of the Quinn SPC Multi-wall range in all available colours when it has been used as a sloped, vertical or cold curved glazing material and stored, handled, processed and installed using the guidelines laid down by the Quinn Plastics Technical Manual. In all circumstances the polycarbonate sheet must be fitted with the UV coated face being the only face exposed to direct sunlight and the influences of the weather.
2. This warranty is void if the sheet is cracked, scratched, damaged because of exposure to corrosive materials or chemicals, if the UV protective layer is damaged or if the sheet has been thermoformed.
3. 3.1 We shall make good either by reimbursement of the whole or part of the price or by repair or replacement, as per section 4, on presentation of the original sales receipt, in the event of:
  - I. Any failure by the Goods to correspond with their specification at the time of delivery;
  - II. Any defect developing under normal use in the Goods and due solely to faulty design (except where supplied by or on behalf of the Customer) materials and/or Workmanship;Provided that:
  - 3.1.1 Any failure to meet specifications is notified in writing to us within 14 days from the date of delivery.
  - 3.1.2 Any such defect in design, material workmanship shall have appeared within 12 months of delivery and shall have been thereupon promptly notified to us in writing;
  - 3.1.3 We shall be under no liability in respect of any defect in the Goods arising from any drawings, design or specification supplied by you;
  - 3.1.4 We shall be under no liability in respect of any defect arising from fair wear and tear, wilful damage, negligence, lack of proper maintenance or servicing, abnormal working conditions, failure to follow our instruction (whether oral or in writing), misuse (it being understood that our instructions are for guidance only and that you or your customers are responsible for ensuring that the Goods are used in proper and responsible manner) or alteration or repair of the Goods without our approval.
  - 3.1.5 Any Goods alleged to be defective are promptly made available to us for inspection in situ if we request and, if so required by us are promptly returned to us at your risk and expense for inspection, and we shall in our reasonable opinion consider them to be defective solely by reason of faulty design, materials and/or workmanship.
  - 3.1.6 The colour fastness & physical properties of PC products are expected to remain reasonably stable for a period of 10 years from the date of manufacture in accordance with the compound manufacturers'



technical specifications which are available on request, provided that they are used in Middle or Northern Europe.

3.1.7 This warranty does not cover re-installation or any other costs which may arise from a claim.

3.2 All other warranties, condition or other terms as to merchantable quality, fitness for purpose or which otherwise relate to the quality of the Goods provided are (save for the statutory rights of customers) hereby excluded. We shall (save as provided herein) have no liability whatsoever, howsoever arising or arisen including without limitation in negligence for any such matters. You hereby acknowledge that such exclusion is reasonable in light of the fact that it is not practicable for us to obtain insurance for consequential loss arising from the failure of the product at a cost which it could pass on to you.

3.3 We shall be under no liability under the warranties in Condition 6.1 until any monies due from you under the Contract have been paid.

3.4 Notwithstanding and without limitation to any other provision hereof in no event will we be liable under any terms of or otherwise in connection with the Contract (including without limitation in negligence) for the loss of profits or any other incidental or consequential damages.

4. If there is reason for valid claim under this limited warranty Quinn Plastics will reimburse the purchaser as per section 3.1 in accordance with the following schedule:

| Time Elapsed from Original Purchase | Replacement Percentage |
|-------------------------------------|------------------------|
| Up to 4 Years                       | 100%                   |
| 5 to 6 Years                        | 75%                    |
| 7 to 8 Years                        | 50%                    |
| 9 to 10 Years                       | 25%                    |

