



'Perspex'® For Signage

'PERSPEX'® FOR SIGNAGE

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Around the world, companies both large and small need high quality signs to portray their image. From international companies, who want to be certain that their signs are consistently recognised worldwide, to smaller shops, factories or offices – they all require a sign that is long lasting, cost effective, eye catching and unique.

'Perspex'® acrylic sheet offers the sign maker an extensive portfolio of colours and surface finishes which enhance the client image and are easy to fabricate and maintain. The variety of colours in the range – transparent, translucent and opaque – provides a wide range of light transmission values to suit all requirements. The 'Perspex'® range possesses outstanding weatherability and resistance to chemical attack, is easily cleaned, and maintains their appearance for many years.

1. INNOVATION

New cast sheet products have been developed to extend further the sign maker's choice of materials and effects:- 'Perspex'® Silk has been developed to provide an attractive anti-reflective surface whilst still retaining a subtle sheen which is aesthetically pleasing and meets the current design trends for a more natural appearance in the sign industry. 'Perspex'® Silk is available on request in any colour. 'Perspex'® CI is an impact modified grade of cast acrylic sheet, specially developed using novel technology, for sign applications which are subject to vandalism. 'Perspex'® CI has an impact strength six times* that of standard cast acrylic yet with little substantial loss of rigidity, light transmission or weathering performance. Also its appearance and fabrication behaviour is virtually identical to standard cast sheet. Unique corporate colours can be produced to meet the requirements of major sign programmes, details of which can be obtained from Perspex SA. Bisigns in 'Perspex'® have been developed to enable hidden messages to be displayed only when required, and by using back projection equipment, the messages can be changed to tell a continuous story. The purpose of a Bisign is to provide a message or instruction at intermittent times during the day or night. Typical examples are car park "Full" signs at entrance gates and Service signs above counters in airports, banks and post offices. 'Perspex'® Bisign (in blue-black / pale blue-grey) provides all the requirements in a single sheet. All that the sign maker needs to do is apply a stencil to produce a Secret Sign. Special anti-reflective glasses are used to produce 'Perspex'® Silk cast acrylic sheet and these are used to produce Bisign. This can be achieved by simply illuminating a conventional sign but in this case the message is still readable when the sign is not illuminated. This can cause confusion particularly in busy locations such as airports where instructions must be clear and easily understood. A true Bisign presents a blank, blue-black reflective screen until illuminated when the message or instruction appears on the screen.

*Measured on a panel 1 metre square.

2. A COMMITMENT TO THE MARKET

2.1 ADAPTABILITY

One of the main advantages of 'Perspex'® for signs is its adaptability and versatility. It can be cut, cemented, thermoformed into panels or letters, embossed, and engraved.

Surface decorated:

Screen printing or spray painting, letters and images can be cut from self adhesive films and adhered to fascia panels in 'Perspex'®.

2.2 A COMMITMENT TO THE MARKET

When you buy 'Perspex'® acrylic sheet it is not only the sheet you are buying but also access to the full technical expertise of a company that has been producing acrylic sheet of the highest quality since 1934. Perspex SA supplies the market with a comprehensive range of products, and has extensive experience in products for the signs sector. For almost 50 years we have been actively involved in developing innovative technology and products which have helped to make the signs industry the success it is today. South Africa is serviced by a comprehensive network of authorized distributors who link with Perspex SA staff to ensure that the 'Perspex'® product range is easily available.

3. PRODUCT DESIGNED FOR SIGNS

'Perspex'® Fabrication Products offer a wide variety of grades which are used in an extensive range of applications. It is important that the right grade is used for an application, and that the differences between 'Perspex'® Cast Acrylic and extruded acrylic sheet variants are understood before you specify or purchase 'Perspex'® acrylic sheet for sign applications.

One of the most fundamental differences between 'Perspex'® Cast and extruded acrylic sheet:

- 'Perspex'® Cell Cast acrylic sheet is made between sheets of high quality glass and polymerised in batches. It has a very high molecular weight and hence is stiffer and more resistant to cracking, stress crazing, solvents and chemicals, making it easier to handle and fabricate large area signs. This method of manufacture allows smaller colour runs and hence greater colour choice for the sign maker.
- Extruded acrylic sheet has a low molecular weight making it more flexible and easier to vacuum form, but does require more care in handling. The extrusion process gives better thickness tolerance than casting and is economically produces in long, single colour runs. Panels up to 9m long are available which are ideal for one-piece sign fascias.

3.1 MAKING THE RIGHT CHOICE

Choosing the right material can mean the difference between success and failure of product performance. Clearly, in sign programmes, this is critical. Perspex SA has developed a number of grades of 'Perspex'® to specifically meet the needs of the sign specifier, designer and manufacturer. Perspex SA has recognised the importance of the sign market and has put together a technical development team who will work with specifiers, sign makers and fabricators. There are few problems that cannot be solved by this powerful alliance.

4. A COMPLETE SERVICE

4.1 TECHNICAL SUPPORT

In addition to the technical development team already mentioned, Perspex SA also offers training courses that can be tailored to meet the specific needs of sign designers, specifiers and manufacturers either individually or in groups.

4.2 ADHESIVES

To complement our range of 'Perspex'® acrylic sheet, cements have been developed that are tailor made for fabricating 'Perspex'®, TENSOL® No. 7 and 2000 are ideal for external applications and TENSOL® No. 12 is suitable for internal applications that do not require as strong a joint. NB: TENSOL® No. 12 IS NOT RECOMMENDED FOR EXTERNAL APPLICATIONS. TENSOLS® N0.30 and 17 ARE SPECIFICALLY FOR BONDING EXTRUDED ACRYLIC.

5. SIGNS – BETTER BY DESIGN

When designing a sign for today's demanding market, there are a number of factors that need to be considered to ensure success. Legislative requirements (local and National), Product Properties and Fabrication Technique all have a part to play in determining the correct specification of material, colour and design for a particular sign application.

5.1 LEGISLATIVE REQUIREMENTS

Environmental Issues

These are high on everyone's agenda and Perspex SA is no exception. 'Perspex'® acrylic sheet is one of the few sign making materials that can be fully recycled / reclaimed. Please contact Perspex SA for further details.

Building Regulations

Fire regulations controlling the use of 'Perspex'® acrylic sheet in building applications differ widely from country to country. You are advised to consult local building regulations on all applications involving signs as part of your preliminary design considerations.

In the UK a new British Standard BS 5588: Part 10 now allows the use of cast 'Perspex' for signs in enclosed shopping malls. Please ask Perspex SA for further information.

HS(G)41 regulations for UK petrol retail forecourts- in the UK, under the conditions of the HS(G)41 regulations issued by the HSE, extruded acrylic sheet cannot be used for signs or other items of construction on petrol filling stations. The regulations only permit the use of materials with a surface spread of class 1, 2 or 3 when tested to BS 476: part 7: 1987. Only cast 'Perspex'® acrylic sheet from the Perspex SA Product Range will meet this requirement.

5.2 ILLUMINATION

Lighting an internally illuminated sign made from 'Perspex'® acrylic sheet requires careful consideration to achieve maximum visual impact. With the wide range of colours of 'Perspex'® and the many different types of lamp which are now available it is not possible to present a single set of rules which assures the most effective results for every individual design of sign. For most types of sign, however, the method of lighting is predictable and general guidelines are given in this booklet which will enable the designer to create an aesthetic appeal combined with a suitable level of luminance. Where a sign is of unusual design it may be necessary to construct an experimental prototype first in order to establish the most effective means of illumination.

For details of lamps, electrical gear and additional technical support on lighting design, the lamp manufacturers should be consulted.

Luminance

The term luminance is used to describe the brightness of a surface measured under laboratory conditions. Of the various photometric concepts luminance is the one which is most relevant to the design of an illuminated sign. In the following discussion the concept of luminance and its applications are described in practical rather than theoretical terms.

Luminance as described above is physical brightness - that is the measured brightness of a point on a surface viewed in a given direction. For the purpose of considering glare in relation to luminance it is best to consider luminance as simply brightness in a general sense.

The degree of glare caused by a sign depends on factors including the brightness of the sign. These include size, its position relative to the direction from which it is seen, the brightness of its surroundings, surface finish and colour.

Some colours of the same nominal light transmittance as others seem brighter. A sign in a well lit city street will appear less glaring than the same sign seen in the darkness of the countryside. The sign must be bright enough to attract attention but not so bright to cause annoyance to nearby residents or distract the attention of the motorist from the road and traffic signals.

To decide on the very complex problem of how bright a particular design of sign should be when sighted in a particular area, reference should be made to a report entitled "Brightness of Illuminated Advertisements". Copies of this report can be obtained from the Institution of Lighting Engineers, Lennos House, 9 Lawford Road, Rugby, CV21 2DZ. The report gives recommended levels of maximum luminance in particular areas. See Table 1.

Table 1: Recommended levels of illuminance for signs made from 'Perspex'® in various locations (cd/m²)

ILLUMINATED AREA (m ²)	ZONE 1	ZONE 2	ZONE 3	ZONE 4
	RECOGNISED DISPLAY AREAS	MAJOR SHOPPING CENTRES	SECONDARY SHOPPING CENTRES	RESIDENTIAL AREAS AND UNIT TRAFFIC ROUTES
UPTO 0.5	No Limit	2900	2000	1000
0.5 – 2.0	No Limit	2300	1600	800
2.0 – 5.0	No Limit	2000	1200	600
5.0 – 10.0	No Limit	1500	1000	600
Over 10.0	No Limit	1200	800	400

The luminance of any internally illuminated sign or fascia is determined by five factors:

1. Lamps - their number, type, light output, colour and position within the sign case.
2. Materials - the light transmission, reflection, absorption and diffusion factors of the particular grade and thickness of 'Perspex' used.
3. The Sign Case - its dimensions, particularly its depth and the reflection factor of the paint or other finish used on the inside of the case.
4. Light Absorption – the effect of absorption of light by the lamps and associated gear within the case.
5. Maintenance – the reduction in the light output of the lamps with increasing life and the effect of dirt on the inside and outside of the sign.

All these points have to be taken into consideration in the design of sign fascia for a particular location. Opal and most coloured translucent grades of 'Perspex'® are ideal for the luminous areas of signs, because careful balance has been achieved between their diffusion characteristics and light transmission.

Light Transmission

It is currently the practice for some planning authorities to use a simple formula which requires a value for the light transmittance of the components of an internally illuminated sign to assess whether it comes within the agreed limits for brightness.

Diffusion Factor

When designing signs made from 'Perspex'®, consideration must be given to the diffusion factor of the 'Perspex'®. A uniform diffusor can be described as a surface which when illuminated by direct or transmitted light, will scatter the light uniformly in all directions. In fact, no material will produce absolute uniformity of scattering or diffusion, but some materials and surface finishes come close to the ideal. When light is scattered uniformly in this way the luminance is independent of the angle of view.

$$\text{The diffusion factor} = \frac{B_{20} + B_{70}}{2B_5}$$

Where B₅, B₂₀ and B₇₀ are the values of luminance of the surface when viewed at the right angles of 5°, 20° and 70° to the normal respectively. (The normal being the position at right angles to the surface being measured).

The diffusion factors for the range of opal 'Perspex' grades are given in Table 6.

If a material has a diffusion factor between 0.82 and 0.89 it can be considered to have maximum degree of diffusion. Only specially prepared laboratory specimens may exceed the value of 0.89. Most grades of opal 'Perspex'® have excellent diffusion properties.

Practically all 'Perspex'® translucent colours have a diffusion factor above 0.80 and therefore their performance will compare with one or other of the opal grades.

Lamp Spacing Ratio

Uniformity of luminance is dependent upon the diffusion factor of the 'Perspex'® and the lamp spacing. Generally if the diffusion factor is over 0.8, a lamp spacing ratio of 1 to 1.5 should prove satisfactory. This ratio is calculated as follows:

$$\text{Lamp spacing ratio} = \frac{\text{Distance between lamp centres}}{\text{Distance from lamp centre to 'Perspex'®}}$$

If a number of different colours are used in one sign then no fixed rule can be applied to obtain the level and uniformity of luminance required and a prototype unit will need to be constructed to obtain the desired effect.

All illuminated advertising signs must comply with local planning laws and approval sought from the local authority before any sign is erected.

5.3 PRODUCT PROPERTIES

Weathering

Most grades of 'Perspex'® acrylic sheet have outstanding resistance to outdoor weathering and can be classed amongst the best of all polymeric materials in this respect. Under normal conditions of exposure, correctly fabricated self coloured signs made from 'Perspex'® will not lose mechanical strength over a typical design lifetime of 10 years exposure outdoors.

All 'Perspex'® colours are carefully formulated from pigments and dyes of known outdoor exposure stability and every effort is made to ensure that 'Perspex' sign colours neither fade nor change during the life time of a sign.

Optical Properties of Coloured Sheet

'Perspex'® is produced to the highest standards and has quality systems in place in accordance with registration to ISO 9001, which ensure consistency of colour from sheet to sheet and batch to hatch. It has exceptional resistance to weathering and, as the colour extends through the entire thickness of the sheet, scratches and scuffs have little effect on the appearance of illuminated signs.

On any light transmitting colour, the actual thickness of the sheet produced affects the perceived transmitted colour. Most 'Perspex'® colours are formulated to give the same transmitted colour irrespective of nominal sheet thickness.

Factors affecting perceived colour

Thickness tolerance - Cast acrylic sheet has a manufacturing thickness tolerance which may reveal some variation in colour by transmitted light between extremes of the tolerance. In general there is a smaller thickness variation within a sheet of extruded acrylic sheet that in the same size of 'Perspex' cell cast acrylic sheet. This thickness variation affects colours by transmitted light.

This effect, inherent in the cell-cast manufacturing process, can reveal a noticeable change in hue particularly with blues and greens, when viewed by transmitted light even though the actual difference in thickness is very small. When two sheets are butted against each other the effect of a difference in their thickness of 0.125 mm may be seen. If a plain butt joint must be used, for example, in a sign fascia, sheets should be checked carefully for thickness discrepancies to ensure the smallest possible shade variation between adjacent panels.

It is also strongly recommended that sheets should be checked side by side on a full sized light box to ensure transmitted colour uniformity before any fret cutting or cementing of the panels is carried-out.

Sheet thickness – With standard colours an increase in sheet thickness can be used to reduce the brightness of a sign to meet local authority luminance regulations. Alternatively, the power of the lamps may be reduced. Some colour change will occur as a result of the increase in sheet thickness. This change is minimal when examined under conditions of reflected light but can be quite significant in terms of transmitted light.

Surface finish – Patterned grades of 'Perspex'® cast sheet can be used in sign fascias for aesthetic appearance and to reduce light reflectance. However, care should be taken when using more than one panel as these sheets can exhibit a directional pattern when viewed from certain angles. Also because 'Perspex'® Silk has a light-scattering effect, colours will be slightly lighter than the standard gloss colours.

Effect of heat on colour- Some colours and grades of 'Perspex'® will change colour temporarily when heated due to properties of some of the ingredients. These effects will disappear when the sheet/moulding cools to room temperature.

5.4 MECHANICAL PROPERTIES

Engineering Design Data

When designing a sign using 'Perspex'® acrylic sheet it is important that the mechanical characteristics of the material are taken into account. No attempt is made here to cover all aspects of sign design and only outlines of important features particular to the product have been included.

It is important, especially when designing large signs and fascias, that due consideration is given to wind-loading on vertical surfaces and an allowance must be made not only for normal conditions but also for exceptional short term wind forces that may occur once or twice during the design life of the sign. Wind loading of exterior signs should be determined by the method described in BS CP3, Chapter V, Part 2 or other similar local Code of Practice.

Most of the formulae available to Design Engineers make two assumptions:

1. The material has a linear stress/strain curve and
2. The deflections involved are small

These conditions may be reasonably satisfied with 'Perspex'® provided that certain restrictions additional to those normally required in design are imposed. It will be seen from Figure 1 and 2 that the design stress and design modulus of 'Perspex'® are markedly dependent on temperature. Consequently the expected maximum temperature of the sign must be known before it can be satisfactorily designed.

Figure 1: Design Modulus for 'Perspex'® as a function of Temperature

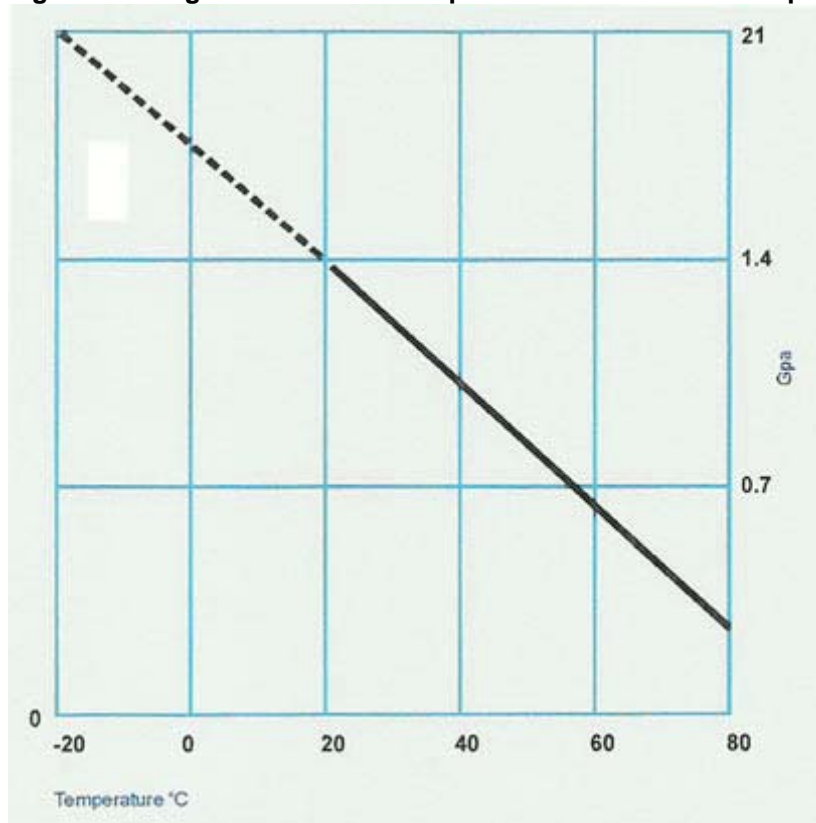
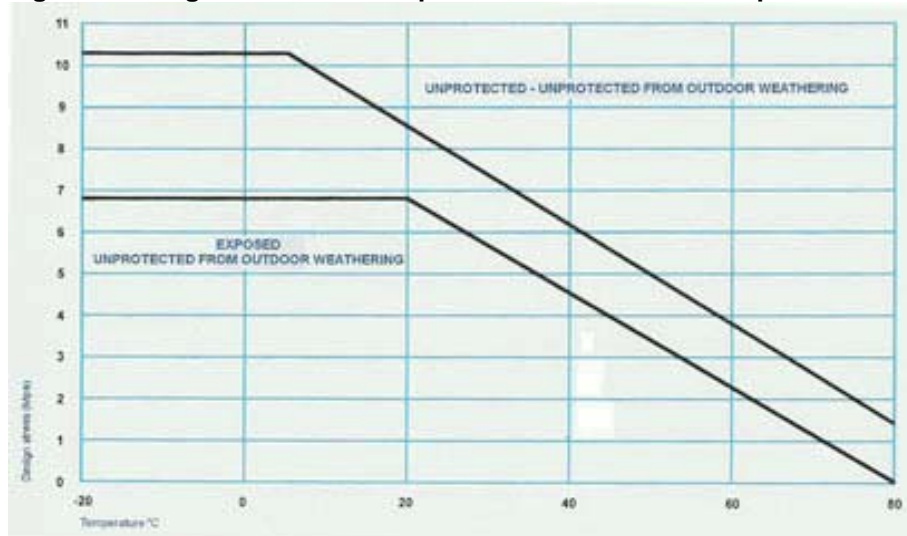


Figure 2: Design stress for 'Perspex'® as a function of Temperature Design Stress



Design Stress

The stress / strain curves for 'Perspex'® in its surface temperature range are almost linear for strains of up to 1%. Since the recommended design stresses are such that this strain is never exceeded even after creep, the problem of nonlinearity is immediately solved. However, considerations of design stress do not take into account the question of the large deflections which may occur in bend because of the low Young's modulus of 'Perspex'®. The problem of large deflections may be overcome in two ways.

The first and most obvious one is the use of large deflection theory. This is complicated and in many instances formulae are not readily available for plastics. In the second method the very much simpler small deflection theory is used. Instead of considering design merely from the point of view of stresses produced in the material by loading, the deflections produced are considered first and a restriction imposed on the deflection permissible. This treatment has the additional advantage of ensuring a good appearance of the article under load

For these reasons, it is strongly recommended that when designing signs made from 'Perspex'®, the use of small deflection theory is applied. In this case the restriction applied is that the ultimate deflection shall not exceed the thickness of the material. At this deflection the membrane stresses produced in the surface under tension are small compared with the bending stresses. Having designed the component on this basis the next step is to ensure that the design stress is not exceeded under these conditions. For components with a small area to thickness ratio it is quite possible that the design stress may be exceeded under the deflection conditions stipulated. It is, therefore, essential that both deflection and stress calculations be made and what is more important that they are made in the order specified, namely first the deflection calculation and then the stress calculation. The procedure for designing beams and panels in 'Perspex'® sheet may be summarized as follows:

a. Equate the term for the maximum deflection to thickness (1) for the system by using the appropriate deflection formula given in Table 2 following. Then knowing the design modulus and dimensions of the component, determine the minimum thickness for a given load or the maximum load for a given thickness whichever is required.

b. Substitute in the stress formula (2) the value found in (1) for the minimum thickness or maximum load in order to determine the maximum stress produced. If this exceeds the design stress, increase the thickness or reduce the load by a suitable amount.

Note – if the second step becomes necessary, the first design condition, i.e. that the ultimate deflection shall not exceed the thickness of the material will then be more than satisfied.

Table 2: Design formulae for ‘Perspex’®

APPLICATION	TYPE LOAD	FIXING	(1) DEFLECTION	(2) STRESS
REGULAR PANEL	UNIFORM	SUPPORTED AT ALL EDGES	$t^4 = \frac{0.14pb^4}{E_D(1+2.2\alpha^3)}$	$\frac{0.75pb^2}{t^2(1+1.6\alpha^3)} < SD$
		CLAMPED AT ALL EDGES	$t^4 = \frac{0.028pb^4}{E_D(1+1.06\alpha^5)}$	$\frac{0.5pb^2}{t^2(1+0.6\alpha^6)} < SD$

Table 3: Notation to Table 2

a	Length of panel	SD Design Stress
b	Breadth of panel or beam	t Thickness
α	b/a	Pressure p can also be derived from wind velocity:
E _D	Design modulus	P = 0,0026V ²
p	Load per unit area	Where V = Wind Velocity in mph
		P = Pressures in lb/in ²

Table 4: Properties of 'Perspex'® important in mechanical design

PROPERTY	UNITS	VALUE	TEST METHOD
Design modulus		See Fig 1	
Design stress		See Fig 2	
Poisson's ratio at 20°C		0.38	
Density	g/cm ³	1.19	ISO R 1183/A
Coefficient of linear thermal expansion	per °C	7.7x10 ⁻⁵	DIN 53752 (0-50°C)
Dimensional allowance due to water absorption	% length	0.3	

* These are typical values obtained from representative samples of "Perspex"®, and do not constitute a specification.

For all other signs, e.g. for shops, filling stations, etc, experience has shown over 30 years that some simple rules can apply concerning ratio of sheet thickness to area, in order to meet maximum anticipated wind loads.

Provision for sheet deflection

Deflection may occur as a result of wind loading or from the weight of the material, when large size sheets are resting on their lower edges. It is important therefore that suitable precautions should be taken to avoid this effect becoming too extreme, and the following recommendations should be followed during design and fabrication.

Table 5 provides an indication of the minimum recommended thickness of 'Perspex'® in relation to the narrow access of a panel, for example a fascia panel. These recommendations will ensure a reasonable limit to the bending of a well supported sign panel in a wind of 50 metres per second.

Table 5: Thickness of 'Perspex'® required for supported flat sign panels to withstand 50 metres/second wind velocity.

SHORTEST PANEL DIMENSION (USUALLY HEIGHT) (mm)	THICKNESS OF PERSPEX (mm)
UP TO 400	3
400-600	4
600-750	5
750-900	6
900-1200	8
1200-1500	12
1500-2000	15

Water absorption

'Perspex'® may absorb up to 2% of water over long periods and this absorption results in a change in the dimensions of the sheet. The level of absorption and dimensional change depends on the relative humidity of the atmosphere and the initial water content of 'Perspex'®. As a general guide it has been shown that:

Table 6:

Relative humidities	100%	80%	60%
Give dimensional changes of for sheet that is fairly dry.	0.3%	0.2%	0.1%

It has also been shown that as a general rule, Extruded Sheet can give slightly higher dimensional changes in view of the fact that it has lower initial moisture than Cast Sheet. These higher dimensional changes cause distortions to occur in large fascia panels.

Thermal expansion

The coefficient of linear thermal expansion of all plastics materials is greater than that of most conventional materials, and therefore, where significant variations in temperature are expected, an allowance must be made for movement of the material.

It follows, therefore, that when 'Perspex'® is to be used outside for signs, adequate allowances must be made during the design and construction for thermal expansion and contraction. In many parts of South Africa a maximum temperature variation of up to 50oC (-10oC to + 40oC), and a relative humidity of 60 to about 90% are experienced. It is therefore recommended that an expansion allowance of 0.5% or 5mm per metre be made on each dimension. If you have any doubts about conditions in your region and the allowances to be made please contact the Perspex SA Technical Service team for advice.

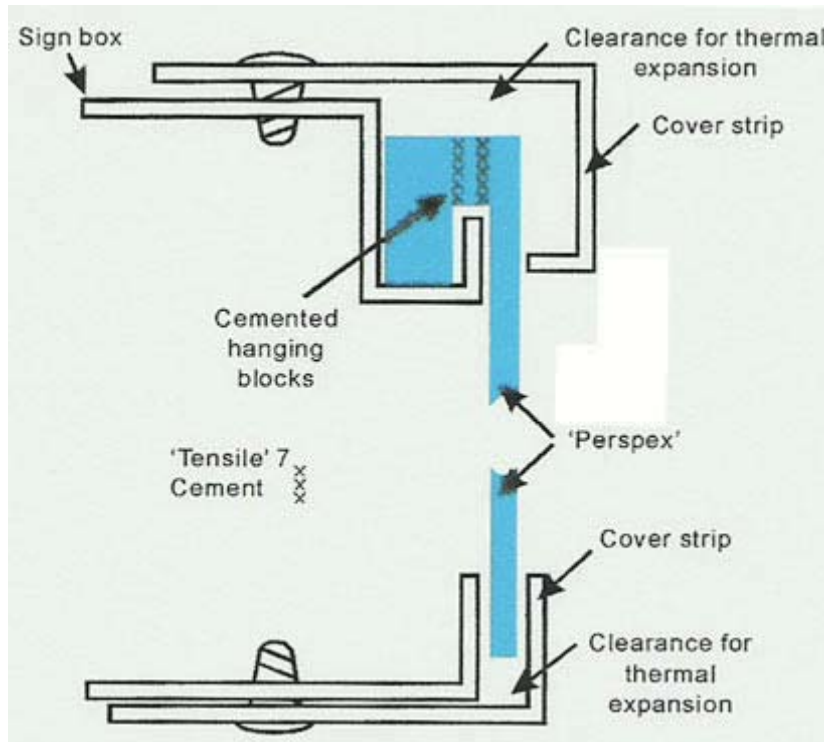
It is also essential to bear in mind, when fixing 'Perspex'® into frames or channel sections, that the rebate depths of the frames must be sufficient to absorb not only the expansion but the corresponding contraction in severe cold weather conditions. Failure to observe this important consideration could result in panels being blown out in gale force winds, or the occurrence of light loss through gaps in vertical sections appearing between the sheet and the frame.

5.5 FASCIA DESIGN

Flat panels

It is recommended that all sign fascias made from 'Perspex'® greater than 600 mm in height should be top hung (see Figure 3) in suitably designed aluminium sign box sections to avoid undue deflection due to self loading. In order to top hang sheets of 'Perspex'®, strips of 'Perspex'® must be cemented to the top edge to build up a suitable top hanging bar. For long term reliability and safety, TENSOL® No. 7 must be used. In all instances, care must be taken, particularly with the larger signs, to ensure the cement preparation is carried out thoroughly.

Figure 3: Typical for top hanging bar



For very long sign fascias it will be necessary to join several panels of 'Perspex' together and to avoid light loss through gaps between the sheets, it is recommended that panels of 'Perspex'® are overlapped by the use of machined half-lapped joints. Various techniques exist to prevent gaps appearing between the panels.

Where it is necessary to remove panels of 'Perspex'® for maintenance, each panel should be located by a central pin, preferably on the top edge to prevent excessive movement of the panel. Expansion clearances must be calculated and allowance made for clearance at each lap joint.

For sign fascias up to a maximum height of 600 mm, conventional framing techniques can be applied and 3 or 5 mm 'Perspex'® used. Where complete freedom from optical distortion arising from self loading deflection is required, 5 mm 'Perspex'® is recommended.

Moulded panels

The design criteria here are mainly to consider the overall size of the fascia and how many panels will be required. A moulded pan is more rigid than a flat panel due to the side walls. However this is only true if the dimensions of the panel are rectangular and not more than 1 metre high.

6. FABRICATION TECHNIQUES

6.1 SAFETY

Before commencing any work using 'Perspex'® Acrylic Sheet or TENSOL® Cements you are advised to read carefully the appropriate Material Safety Data Sheets (MSDS) and the Health and Safety sections in this note.

6.2 PREPARATION

The protective masking which is used to prevent damage to the surface during normal handling and transit can vary according to product and grade (see below). For flat sheet work the masking can be used conveniently for marking out and usually left in position until fabrication is complete.

6.3 MASKING

The most common masking is pressure sensitive polyethylene film (PsPe). In all cases the masking printed with the 'Perspex'® logo or any other marking protects the show surface. The back face is normally clad with plain white film. PsPe offers the end-user several advantages:

It adheres to the sheet extremely well, but can be easily removed.

The 'Perspex'® can be cut and certain machine operations carried out whilst the masking is in place

NB: Care must be taken when drilling or routing that the masking does not become trapped around the bit and so cause the sheet to spin dangerously.

Pspe masking can be kept in place for local bending operations PROVIDING the heaters or any heated surfaces are not in direct contact with the film. PsPe masking is not otherwise designed to be thermoformed.

There is no need to wash sheet masked with PsPe, however for all surface decoration requirements, especially vacuum metallising, it is recommended that the sheet is rinsed with clean water after removing the masking and then dried gently with a soft cloth. This will remove particles of dust and neutralise (for a short time) any static charge.

6.4 CLEANING

To preserve the surface finish of 'Perspex'®, harsh fabrics and abrasive cleaners should not be used. Under no circumstances should non recommended proprietary cleaning sprays or polishes be used to clean the surface of 'Perspex', as these may contain materials harmful to the 'Perspex'® acrylic sheet.

Before spraying or screen printing, all 'Perspex'® must be washed using clean fresh water. The use of anti-static cleaner at this stage is not recommended as these materials may interfere with the adhesion of the paint or the ink film. It is an advantage to wipe 'Perspex'® surfaces with a clean slightly damp chamois leather just prior to spraying or screening to reduce any static charge and remove dust. The use of static eliminator air guns can be effective but great care must be taken to ensure that the air jet is not contaminated with compressor oil residue.

6.5 ELECTROSTATIC CHARGE

All grades of 'Perspex'® have good electrical insulating properties. Therefore, due to its high surface resistivity, 'Perspex'® is readily charged electro statically when it is rubbed with a dry cloth and especially after removal of the masking. This may cause it to become covered with dust in a fairly short time and cleaning with a dry cloth will tend to aggravate the problem. Treating the surface with an Anti-Static Cleaner suitable for 'Perspex'® will delay the development of static charge and thus reduce the collection of dust. Washing with water destroys the anti-static effects completely and Anti-Static cleaner must be reapplied afterwards. It is important to ensure that all surfaces of the article are treated.

If it is intended to cement, paint or silk-screen the sheet subsequently then no anti-static cleaner should be applied. In these instances static charge can be removed in clean fresh water and allowing the sheet to dry naturally. The use of air ionising static eliminating guns can also be considered, provided the air supply is totally free of any oil contamination if cementing or decorating is to take place later. This system is particularly useful when removing polythene masking providing the gun is in use during de-masking.

6.6 FABRICATING 'PERSPEX'®

Full details on machining 'Perspex'® are contained in the Acrylic Sheet Information Manual. However there are some safety aspects of machining 'Perspex'® that are worth mentioning here.

6.7 SAFETY ASPECTS OF FABRICATING 'PERSPEX'®

'Perspex'® is a hard material. Sharp edges could cause cuts, and flying chips could damage eyes. You are advised to read the appropriate Product safety Data Sheet prior to commencing work. The manufacturer's recommendations should be followed when coolants are used during machining of 'Perspex'®.

The area should be well ventilated with extraction of both fumes and swarf.

7. CUTTING

NB: Read the literature on Handling and Machining before any work is carried out with 'Perspex'®.

'Perspex'® can be cut with conventional woodworking tools and 'Perspex'® letters can be cut with fret saws. Full details of how to cut 'Perspex'® sheets and letters can be obtained from the Acrylic Sheet Information Manual.

7.1 CNC ROUTERS

In recent years designers have been more creative in their use of self coloured 'Perspex'® thanks to the introduction of CAD/CAM systems, for cutting 'Perspex'® by either computer controlled lasers or routers. This has had a dramatic impact on the Signs Industry, enabling greater efficiencies to be achieved with much greater cutting accuracy and reproductivity. When using router cutters to perforate panels of 'Perspex'® acrylic sheet care must be taken to ensure that no heat or stress is induced into the cut edge which may subsequently craze on cementing.

Router tools must be kept sharp and the speed of cutting must be slow enough to allow the 'Perspex'® to be cut cleanly without inducing any heat. This is particularly important in the case of Extruded acrylic. Care must be taken to ensure that all swarf is removed from the work and collected.

7.2 LASER CUTTING

Laser cutting heads have certain advantages when cutting panels of 'Perspex'® and letters, but because of the intense heat that can be generated in the immediate localised area of the cut edge, great care must be taken to ensure that no serious crazing will occur around the cut edge when inlaying letters with cement. It is strongly recommended that all laser cut pieces and panels of 'Perspex'® are given a short annealing cycle to relieve heat induced stresses. Full details of the annealing cycle are given in the Acrylic Sheet Information Manual.

7.3 CEMENTING AND JOINING

NB. It is important to read and follow the Health and safety guidelines on the use of cements prior to commencing work.

For adhering letters cut from coloured 'Perspex'® onto sign fascias made from 'Perspex'®, it is strongly recommended that TENSOL® No. 7, a two part initiated cement, is used for all sign work.

For indoor signs TENSOL® No. 12 may be used, but not for exterior signs, It is particularly important to use TENSOL® No. 7 for outdoor work because of its superior outdoor weathering performance and higher bond strength, particularly when cutting and inlaying large letters and motifs from selfcoloured 'Perspex'®.

TENSOL® No. 12 which contains dichloromethane and methyl methacrylate monomer is non flammable and has no flash point as supplied.

Good quality cementing is essential not only for good illumination but also for the structural integrity of large signs which may be subjected to gale force winds.

It is essential when carrying out any cementing techniques that the two surfaces to be joined together are properly prepared and cleaned.

The TENSOL® range of cements has been especially formulated for use on 'Perspex'® to give maximum adhesion, light transmission, long service life and the minimum risk of crazing. Proprietary adhesives supplied by specialist manufacturers, e.g. hot melt adhesives, silicone, rubber resin and polyurethane adhesives can sometimes be used for some applications. However great care must be taken to ensure that the solvents present in such products do not cause damage to the 'Perspex'®, such as crazing, as this can reduce the safety of the sign in service. Always observe the manufacturer's advice. Such products are sometimes useful when bonding 'Perspex'® to other materials.

7.4 HEALTH AND SAFETY ASPECTS OF TENSOL CEMENTS

You are strongly advised to read the Material safety Data Sheets (MSDS) prior to commencing work with TENSOL® cements and to carry out an assessment of working practices to ensure that you are meeting local/national legislation. If you are using materials not supplied by Lucite you are advised to obtain from your supplier(s) MSDS's applicable to the material or chemical that you are using.

Effective eye protection is recommended when using 'Perspex'® or TENSOL® Cements i.e. to BS 2092 C or similar local standards.

7.5 MECHANICAL FIXTURES

It is sometimes necessary to fix signs made from 'Perspex'® to other materials by the use of mechanical means only. The use of screws and bolts is not recommended but if such fixing methods must be used, care must be taken to ensure that adequate allowance is made for thermal expansion and contraction. Oversized holes must be drilled in the 'Perspex'® to allow for movement and screws must not be over tightened. The use of cup washers is often of assistance in spreading the load and disguising oversized holes.

Proprietary brands of double-sided adhesive tape (such as 3M's VHB tape) can be used to bond 'Perspex'® to itself and to other materials particularly for non-illuminated signs but care must be taken at the design stage to ensure that all signs so constructed are safe for continuous outdoor exposure for the specified design life time of the sign. NB. The 'Perspex'® must be washed carefully to remove any grease from handling.

7.6 THERMOFORMING

When 'Perspex'® is heated, it softens and can be shaped readily. It may be thermoformed safely at temperatures of 140 to 165°C. At temperatures of 200°C and above the polymer will decompose giving rise to highly flammable and harmful vapours. You are advised to read the Product Safety Datasheets applicable to the grade you are using prior to commencing work.

7.7 THERMOFORMING SIGN PANS AND LETTERS

'Perspex'® Cast Sheet can be easily thermoformed to produce sign pans for projecting signs, large area pole-top signs and individual letters by heating the sheet and press-forming on suitable moulds.

Extruded acrylic sheet is particularly suitable for vacuum forming sign pans and letters using fast-cycling automatic vacuum-forming machines. Extruded acrylic sheet requires less force during thermoforming and is capable of much greater extension and sharper definition. Extruded acrylic is therefore ideal for vacuum-forming sign pans with integral designs, shapes or letters to be subsequently decorated on the reverse surface. Alternatively, on easy shaping grade of 'Perspex'® may be used to obtain high definition moulding.

Recommended thickness of 'Perspex'® cast or extruded for thermoformed signs with integral letters will depend on the design adopted and the number of letters used. Further advice can be obtained from Perspex SA Technical Service Department.

Blisters or bubbles which may develop in extruded acrylic sheet during infrared heating prior to thermoforming are usually caused by absorbed moisture or sometimes by over-heating. If extruded acrylic is kept in stock for several months, especially if it has been kept in a humid store, it can absorb moisture from the atmosphere and this moisture can cause bubbles to appear in the sheet during vacuum forming. If bubbles do appear, the sheet will need to be pre-dried before thermoforming. This can be achieved by drying vertically in air-flow oven with air gaps between individual sheets. The oven should be maintained at 85°C for at least 24 hours (for 3 mm sheet) with the masking removed from both sides. For thicker sheets it may be necessary to prolong the drying cycle time. There is no need to dry cast acrylic sheet. (See section on water absorption page 15).

7.8 TYPICAL METHODS OF SECRET SIGN CONSTRUCTION

Bisigns are generally small self contained units. Tungsten lamps can be used to achieve an instant response; they are cheap and provide an intense light source. However, Tungsten lamps can produce considerable heat inside the box and if these lamps are used adequate ventilation must be provided to keep the inside temperature below 70°C. Fluorescent lamps are more likely to be the choice of the sign maker but because BiSign 'Perspex'® has low light transmission values compared to many other colours of 'Perspex'®, it will be necessary to double the number of lamps per unit area in a BiSign box compared to conventional signs in 'Perspex'®. In certain locations, i.e. direct sun, it will be necessary to fit a cowl over the BiSign box in order to increase the visibility of the message.

Stencils

Stencils are best produced by applying opaque self-adhesive vinyl film to the reverse surface of the Bisign in 'Perspex'® and then cutting out letters or logos either by hand or by computer controlled cutting machines. Stencils must of course be cut in a reverse image. For large numbers of simple messages, screen printing may be a more economic alternative.

Outdoor Performance

Bisign 'Perspex'® is supplied in 3 mm thickness in order to achieve good letter definition from the reverse surface of the anti-reflective Silk. If signs larger than 500 x 500 mm are intended to be constructed, the 'Perspex'® sheet may need to be reinforced on the back surface for those exterior signs likely to be installed in exposed locations, or thicker Bisign 'Perspex'® used. Weathering tests have indicated that at least 7 years outdoor use can be expected from Bisign 'Perspex'®.

7.9 SURFACE DECORATION

Screen Printing or Spray Painting

In addition to the conventional method of using self-coloured 'Perspex'® sheet, internally illuminated signs and displays can be produced by applying surface decoration by printing or spraying. These techniques of sign manufacture have some advantages:

- A greater variety of colours easily available Fret cutting and cementing of letters are eliminated
- The resultant smooth internal and external surfaces reduce dirt collection
- The design may be applied to the reverse surface of clear material for greater protection from abrasive dirt

However, it is difficult to obtain uniformity of colour when viewed by transmitted light when large areas of dark blues or greens for example are applied in this way. Also from experience, it has been found that surface decoration signs made from 'Perspex'® rarely offer the same depth of colour on illumination and are more subject to handling damage and weathering effects over a 10 year exposure period than signs made from self-coloured 'Perspex'®.

For satisfactory weathering and service life specially formulated ink and paint systems are necessary. In order to withstand prolonged exterior use successfully, even in temperate climates, they must incorporate the most stable pigments or dyes available and must be based on resins which are fully compatible with the acrylics substrate. It is essential, therefore, to use paints and screen inks specially formulated for use on 'Perspex'. Experience and testing over many years have shown that only the acrylic based screen printing inks and spray paints have the necessary properties suitable for long term exposure outdoors. Cellulose based paints or inks are NOT recommended for use with acrylics. See also sections on Stress Cracking and Annealing.

7.10 SELF ADHESIVE FILMS

Letters and designs can be applied to 'Perspex'® for sign pans and fascias using self adhesive, coloured vinyl films. Users must ensure that the films chosen have adequate outdoor service life and that the adhesive is suitable for use on acrylic sheet.

8. STRESS CRAZING

Extruded acrylic sheet has a lower resistance to solvents than 'Perspex'® cast acrylic sheet and it is advisable to anneal before bringing into contact with any solvent. It is also strongly recommended that inks and particularly the thinners used must be carefully selected if crazing is to be avoided in stressed areas such as sawn, routed, flame polished and laser cut edges as well as thermoformed radii. The solvents used to thin the paint or ink should be of a low activity to minimise the tendency to craze acrylic sheet and yet have sufficient attack to produce strong adhesion to the 'Perspex'®. The ink or paint suppliers' recommendations must be carefully followed to avoid any risk of crazing or subsequent loss of adhesion of the paint or ink film in service.

9. ANNEALING

Stress in plastic materials can be a problem but with 'Perspex'® can be removed or considerably reduced by annealing. This process is particularly recommended for use with extruded acrylic mouldings and sheet.

10. MAINTENANCE OF SIGNS

Although 'Perspex'® acrylic sheet is virtually self cleaning, certain finishes and some designs may require periodic cleaning to assist in retaining the quality appearance. The signs can be cleaned easily with soapy water, a soft brush or cloth or chamois leather. (Brushes with stiff bristles, or harsh fabrics should never be used). Before using proprietary cleaning agents it is advisable to check that they do not attack or stain the 'Perspex'®.

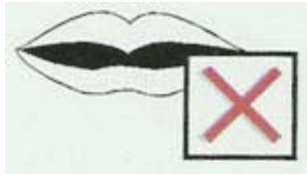
11. WASTE DISPOSAL

If it is necessary to dispose of any 'Perspex'® or any residues of TENSOL® cements, while still liquid, or remains of unused common solvents, then the local waste disposal authority and that in whose area the waste will be landfilled, should be advised. It may be possible to reclaim large quantities of 'Perspex'® or TENSOL®, please ask Perspex SA.

12. FIRST AID PROCEDURES

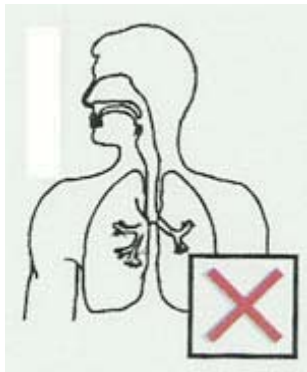
12.1 INGESTION

Do not induce vomiting. Give plenty of water to drink and obtain medical attention.



12.2 INHALATION

Move patient to fresh air, keep quite, warm and lying down. Give oxygen if necessary and obtain medical attention if recovery is not rapid.



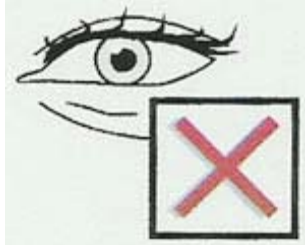
12.3 SKIN CONTACT

It is advisable not to allow TENSOL® cements to contact the skin. All spillages on the hands or other parts of the body should be washed immediately with soap and water. Obtain medical attention if any symptoms of dermatitis occur.



12.4 EYE CONTACT

Wash immediately with copious amounts of clean water or eye wash for at least ten minutes, whilst holding eyelids apart. Obtain medical attention if necessary.



13. IMPACT PERFORMANCE

The table below shows the impact performance of 'Perspex'® CI in comparison to standard cast 'Perspex'®, plate glass and toughened glass for sizes of approximately 600 x 450 mm.

SHEET MATERIAL	THICKNESS (mm)	DROP HEIGHT (mm)
'Perspex'® 000	3	300
'Perspex'® 000	5	800
'Perspex'® 'CI'	3	3200
Plate glass	6.35	250
Toughened glass	6.35	1520

For further information on the use of 'Perspex'® for signs please contact Perspex SA Technical Service Department.

Values quoted for properties of 'Perspex'® are results of tests on representative samples and do not constitute a specification.

Users of TENSOL® cements are recommended to consult the appropriate Perspex SA Health and Safety literature which is obtainable from your supplier.

Information contained in this publication (and otherwise supplied to users) is based on our general experience and is given in good faith, but we are unable to accept responsibility in respect of factors which are outside our knowledge or control.

'Perspex'® and TENSOL®, are trade marks of Perspex SA (Pty) Ltd.