



TECH NOTE

Allowing for Expansion/Contraction in Sign Manufacture

1. All materials expand or contract with temperature change.
2. The amount of expansion (or Contraction) depends on the material, the original length of the material and the temperature change
3. Each material has a Thermal Expansion Coefficient and that coefficient multiplied by the original length and multiplied by the change in temperature gives the increase or decrease in length because of the temperature change.
4. If the material is constrained by a frame or fixings when the temperature changes the expansion force will cause the material to buckle or bow - it is a very powerful force.
5. When we have a frame in one material surrounding another material e.g. an aluminum frame containing an acrylic face in a light box then there must be an allowance for the acrylic to move inside the frame with temperature change.
6. Say we specify an acrylic face as 3000mm x 500mm. What size should the aluminum frame be so that there is no expansion problem?
7. The answer is as follows:

Say the temperature in the factory when the face and frame are cut is 10°C

Say the temperature of the light box in service in summer is 70°C

i.e. Temperature change is $70^{\circ}-10^{\circ} = 60^{\circ}\text{C}$

Then change in length of acrylic due to expansion is

Coefficient of expansion (obtained from tables for materials) x length x temperature change

$=0.00006 \times 3000 \times 60\text{mm}=10.8\text{mm}$

Change in length of aluminum frame

$=0.000024 \times 3000 \times 60\text{mm}=4.32\text{mm}$

Hence the aluminum frame length should be

$10.8\text{mm} - 4.32\text{mm} = 6.48\text{mm}$ longer than the acrylic

Otherwise the acrylic will buckle in the frame.

Can you calculate what the depth of the frame should be?

8. Attached as Appendix A is a list of the coefficients of Thermal Expansion for some common signage materials. Going onto the web will give you access to the Expansion coefficients for other materials and also for different grades of common materials.

**APPENDIX A****COEFFICIENTS OF THERMAL EXPANSION**

Material	Mms per mm per C ° change in temperature	
Acrylic	'0.0000600	600 x 10 ⁻⁷
Poly carbonate	'0.0000700	700 x 10 ⁻⁷
Polypropylene	'0.0000750	750 x 10 ⁻⁷
Polyethylene L.D.	'0.0001600	1600 x 10 ⁻⁷
Stainless Steel	'0.0000160	160 x 10 ⁻⁷
Steel	'0.0000120	120 x 10 ⁻⁷
Cast Iron	'0.0000100	100 x 10 ⁻⁷
Wrought Iron	'0.0000120	120 x 10 ⁻⁷
Concrete	'0.0000100	100 x 10 ⁻⁷
Glass	'0.0000080	80 x 10 ⁻⁷
Wood	'0.0000045	45 x 10 ⁻⁷
Copper	'0.0000170	170 x 10 ⁻⁷
Brass	'0.0000210	210 x 10 ⁻⁷
Aluminium	'0.0000240	240 x 10 ⁻⁷

Notes:

- The higher the coefficient of Thermal Expansion the more the material will expand or contract as the temperature changes.
- The Coefficient of Thermal Expansion is the number of millimetres each millimetre of length will increase when the temperature changes 1 degree centigrade.