Mylar®
polyester film

Physical-Thermal Properties

Mylar® polyester film retains good physical properties over a wide temperature range (–70 to 150°C [–94 to 302°F]), and it is also used at temperatures from –250 to 200°C (–418 to 392°F) when the physical requirements are not as demanding.

Some physical and thermal properties of Mylar® are summarized in **Table 1**. Detailed information and other physical and thermal properties are described in the remaining pages of this bulletin.

Table 1
Typical Physical and Thermal Properties of Mylar® Polyester Film

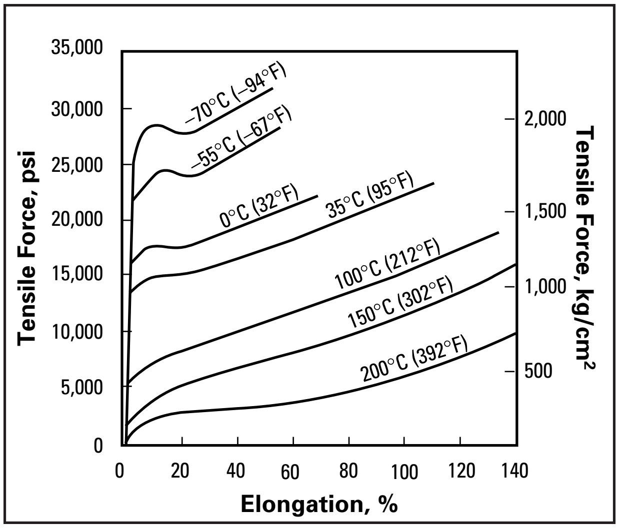
Property	Typical Value	Unit	Test Method
Gauge and Type **End Use**	**92A** **Industrial**		
Ultimate Tensile Strength, MD TD	 20 (29) 24 (34)	kg/mm² (kpsi)	ASTM D 882
Strength at 5% Elongation (F-5), MD TD	 10 (15) 10 (14)	kg/mm² (kpsi)	ASTM D 882
Modulus, MD TD	490 (710) 510 (740)	kg/mm² (kpsi)	ASTM D 882
Elongation, MD TD	116 91	%	ASTM D 882
Surface Roughness Ra	 38	nm	Optical profilometer
Density	1.390	g/cm³	ASTM D 1505
Viscosity	0.56		ASTM D 2857
Melt Point	254	°C	DSC*
Dimensional Stability at 105°C (221°F), MD TD at 150°C (302°F), MD TD	 0.6 0.9 1.8 1.1	%	DuPont test
Specific Heat	0.28	cal/g/°C	
Coefficients of Thermal Expansion Thermal Conductivity (Mylar® 1000A)	 1.7×10^{-5} 3.7×10^{-4}	 in/in/°C $\frac{cal \cdot cm}{cm^2 \cdot sec \cdot °C}$	 ASTM D 696 30–50°C (86–122°F) 25–75°C (77–167°F)
UL94 Flame Class	See UL file # E93687	VTM	

*Differential Scanning Calorimeter

Tensile Properties

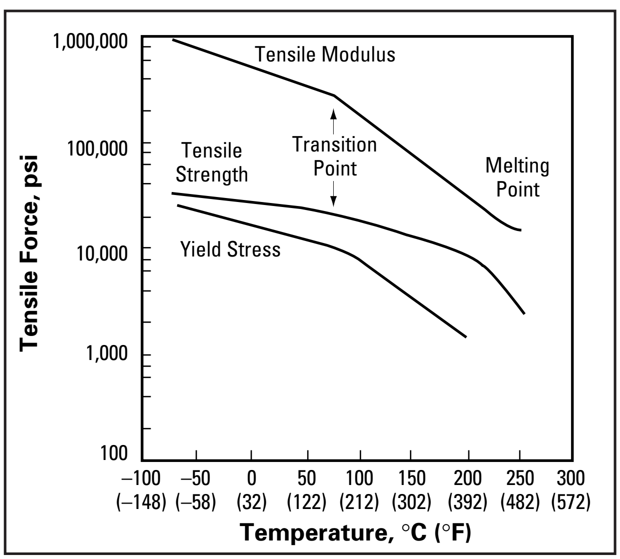
Figure 1 shows typical stress-strain curves for Mylar® polyester film at various temperatures. Poisson's ratio is typically 0.38 before yield and 0.58 after yield.

Figure 1. Stress-Strain Curves



Temperature affects the tensile properties of Mylar®; data on a typical sample are shown in **Figure 2**. When considering the use of Mylar® at high temperatures, reference should be made to the last five pages of this bulletin.

Figure 2. Tensile Properties vs. Temperature



Compressive Properties

Compression tests provide information about the compressive properties of plastics when employed under relatively low uniform rates of uniaxially applied loading. Data on the compressive properties of Mylar® polyester film were obtained in accordance with ASTM D 695, except that a cylindrical pile of pieces 1 in high, 1 in in diameter, was used. The data are summarized in **Table 2**.

When loaded in compression, Mylar® did not exhibit a yield point nor did it fail in compression by a shattering fracture. Therefore, it would be inappropriate to report any value as a compressive strength. However, the stress at 2% deformation and the stress at 1% offset have been calculated. Because the latter stress occurs at very nearly the point where the stress-strain curve begins to deviate markedly from the initial relatively linear portion, it is probably a meaningful upper limit for any application where Mylar® is loaded in compression.

Shear Strength

Mylar® has a shear strength that is significantly higher than published data for other polymeric materials such as acetals, nylons, and polyolefins. Shear strength was measured by a punch-type of test according to ASTM D 732 and is reported in the pounds of force to shear divided by the product of the circumference and the thickness. These tests showed that 5 and 10 mil Mylar® films have shear strengths of 15.0 (21.5) and 13.6 (19.5) kg/mm^2 (kpsi), respectively.

Dimensional Stability

The main factors affecting dimensional stability of film are strain relief, thermal expansion, hygroscopic expansion, and creep. Typical values for these factors are described on following pages.

Strain Relief

Strain relief (also called residual shrinkage) occurs when a film is heated to an elevated temperature. The resulting shrinkage of the film is merely a relaxation of strains induced during the manufacture of the film or during processing of the film. Once these strains are relieved at a specific temperature, there should be no further shrinkage due to strain relief as long as that temperature is not reached.

Table 2
Compressive Properties of Mylar® Polyester Film

Film Type	Compressive Modulus, kg/mm² (kpsi)	Stress, kg/mm² (kpsi) at 2% Deformation	1% Offset Stress, kg/mm² (kpsi)	Maximum Stress During Test, kg/mm² (kpsi)	Maximum Strain During Test, %
Mylar® 1000A	289 (413)	5.91 (8.45)	11.8 (16.8)	21 (30)	23
Mylar® 1400A	278 (397)	5.76 (8.23)	11.6 (16.6)	21 (30)	27

Some typical curves of shrinkage due to strain relief are shown in **Figures 3** and **4** for two types of Mylar® polyester film.

Figure 3. Shrinkage vs. Temperature—Mylar® 92A

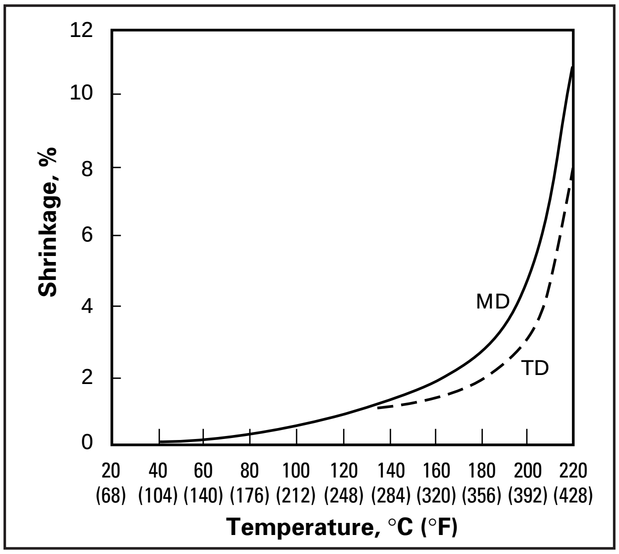
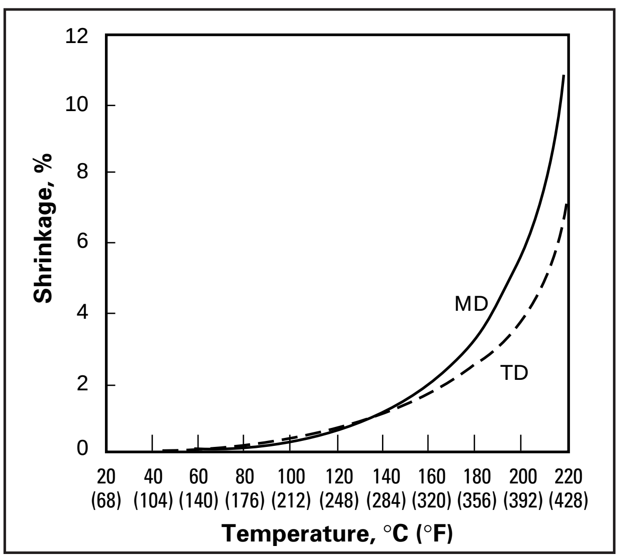


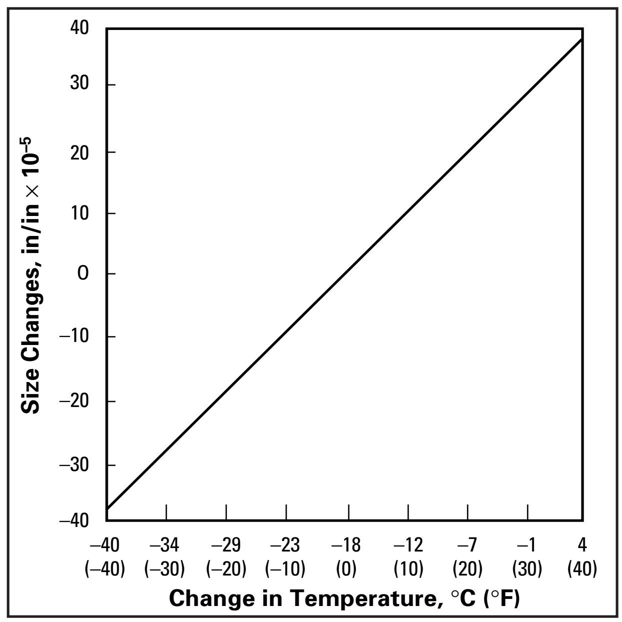
Figure 4. Shrinkage vs. Temperature—Mylar® 750A



Thermal Expansion

The thermal coefficient of linear expansion of Mylar® is 1.7×10^{-5} in/in/°C (9.5×10^{-6} in/in/°F). As a guide to estimating changes due to thermal expansion, **Figure 5** gives the dimensional changes (in/in) over a wide temperature range. Multiplying the indicated change by the sample length gives the thermal dimensional change in the sheet of Mylar®.

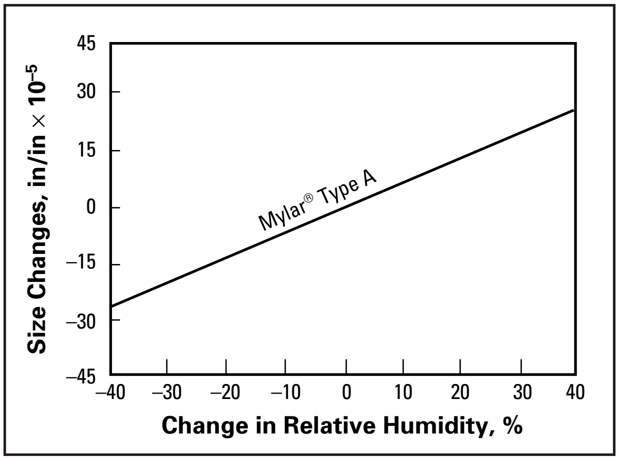
Figure 5. Dimensional Stability vs. Temperature Changes



Hygroscopic Expansion

The hygroscopic coefficient of linear expansion is 0.6×10^{-5} in/in/% RH for Mylar® polyester film. The dimensional change due to hygroscopic expansion over a wide range of humidities is shown in **Figure 6**. To calculate the total dimensional change in a sheet of Mylar® due to hygroscopic expansion, multiply the indicated change by the linear dimensions of the sheet. Under normal atmospheric conditions, changes in thermal expansion tend to compensate for changes in hygroscopic expansion because rising temperatures usually result in lowering in the relative humidity.

Figure 6. **Dimensional Stability vs. Relative Humidity Changes**



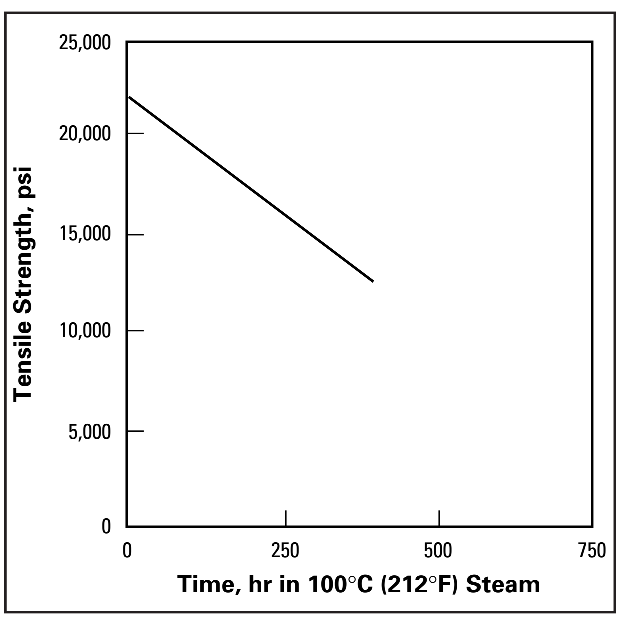
Creep

Mylar® is unusually resistant to creep. Two values measured at room temperature are 0.1% after 260 hr at 2.09 kg/mm^2 (2.98 kpsi) and 0.2% after 1000 hr at 2.10 kg/mm^2 (3.00 kpsi). After 4000 hr at 0.35 kg/mm^2 (0.50 kpsi) in 100°C (212°F) oven, a creep of 0.9% was measured.

Hydrolytic Stability

Mylar® polyester film will hydrolyze and become brittle under conditions of high temperature and humidity, as shown by the effect of steam on the tensile properties of Mylar® (**Figures 7**, **8**, and **9**). Therefore, care should be taken to ensure that there is a minimum of water in any hermetically sealed unit. Adequate removal of water from Mylar® is usually obtained by heating for 4 hr at 160°C

Figure 7. **Tensile Strength of Mylar® after Exposure to Steam**



(320°F). (Drying at these conditions should reduce the water content of the film to less than 0.1%; more than this amount of water must be present in a system before the film can become embrittled due to hydrolysis.) Drying at lower temperatures is not as effective in removing water as shown in **Figure 10**. Data for this figure were obtained with samples of Mylar® 1000A conditioned for one month at 22°C (72°F) and 80% RH and then dried under vacuum for 4 hr at the indicated temperatures.

Figure 8. **Tensile Elongation of Mylar® after Exposure to Steam**

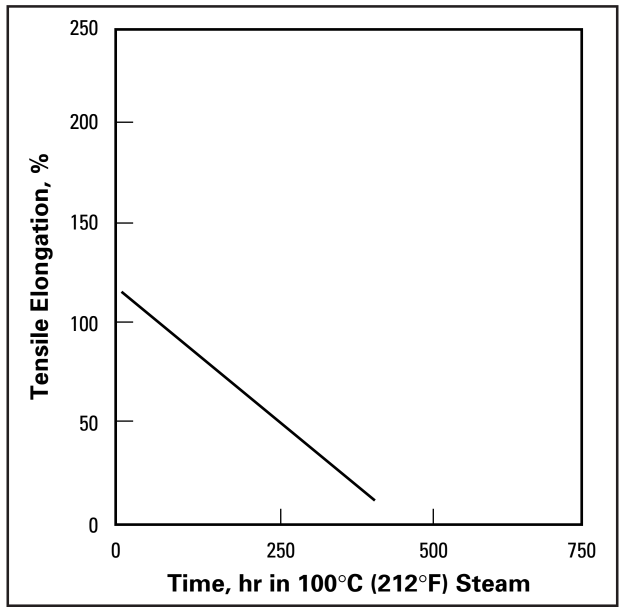


Figure 9. **Tensile Modulus of Mylar® after Exposure to Steam**

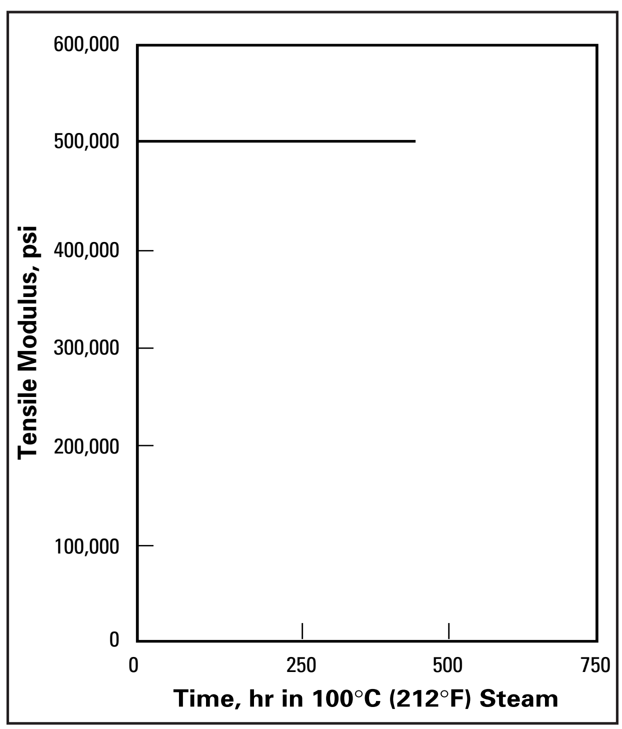
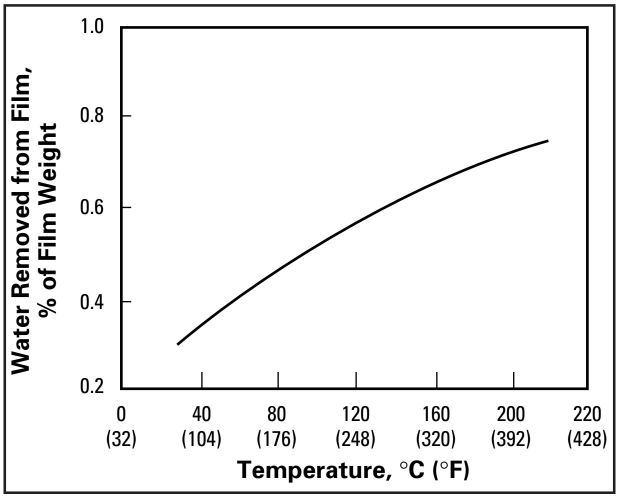


Figure 10. Effect of Temperature on the Removal of Water from Mylar®



Heat Aging

The maximum service temperature usually recommended for Mylar® polyester film is 150°C (302°F). Where extensive exposure, severe environmental conditions, or unusual physical requirements are involved, it may be necessary to reduce service temperatures. However, coatings are available to increase the resistance of Mylar® to the effects of heat aging. The effects of heat aging on uncoated Mylar® in 150°C (302°F) air are shown in **Figures 11** and **12**.

Processing conditions for Mylar® should be kept below 200°C (392°F) to prevent damaging the film. For instance, if heated at 220°C (428°F) for 30 min, the film loses about 10% of its tensile strength; moreover, the film becomes brittle and shatters after heating at 235°C (455°F) for less than 1 min.

Figure 11. Tensile Strength of Mylar® after Heating in 150°C (302°F) Air

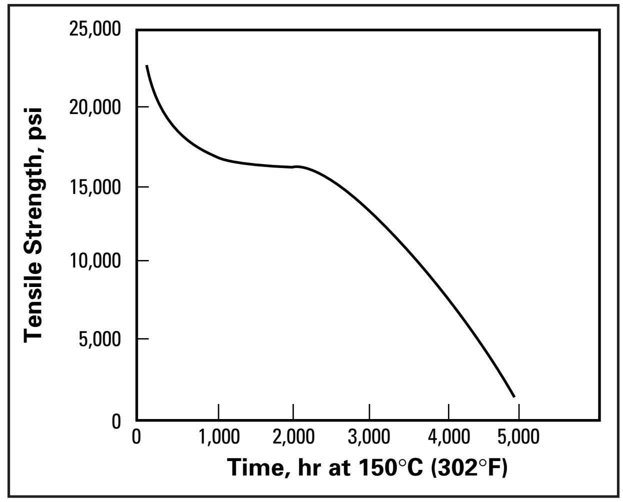
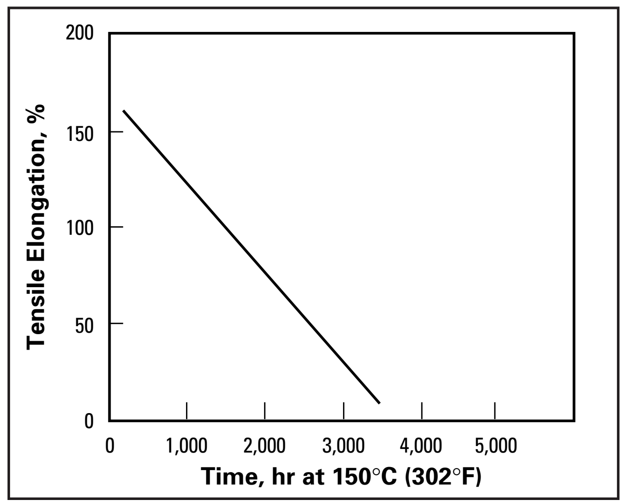


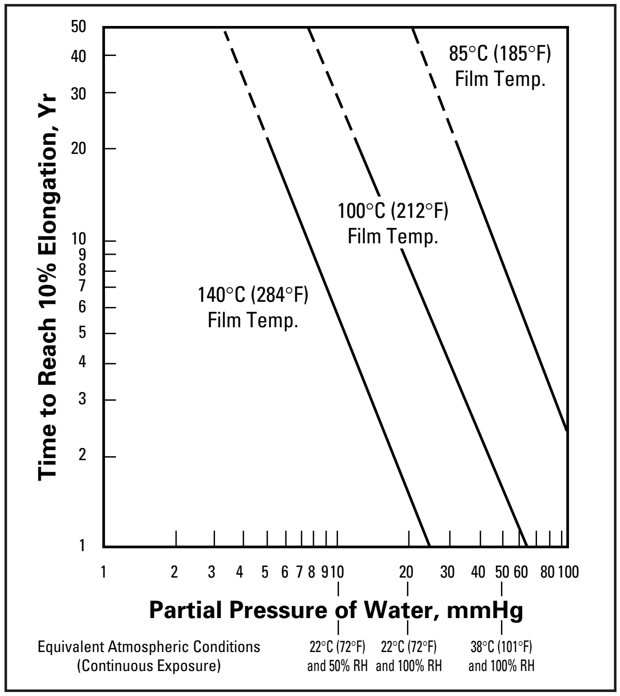
Figure 12. Tensile Elongation of Mylar® after Heating in 150°C (302°F) Air



Service Life

The service life of Mylar®, when subject to severe flexing, is considered to be the time required to reach 10% elongation under various conditions of humidity and operating temperature. The curves shown in **Figure 13** are based upon tests of Mylar® 92 and 1000A at various partial pressures of water. The estimated service life will be greater when the film is suitably encapsulated or coated. Longer life can also be expected when the Mylar® is not subject to flexing.

Figure 13. Effect of the Partial Pressure of Water on Service Life



Note: These values are typical performance data for Mylar® polyester film; they are not intended to be used as design data. We believe this information is the best currently available on the subject. It is offered as a possible helpful suggestion in experimentation you may care to undertake along these lines. It is subject to revision as additional knowledge and experience is gained. DuPont Teijin Films makes no guarantee of results and assumes no obligation or liability whatsoever in connection with this information. This publication is not a license to operate under, or intended to suggest infringement of, any existing patents.

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