

		
E. I. du Pont de Nemours and Company	Mohawk Industries, Inc.	PTT Poly Canada

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Office of Secretary
Federal Trade Commission
600 W. Pennsylvania Ave., NW
Washington, DC 20580



Petition To Establish A New Generic Subclass

Mohawk Industries, Inc.¹ (Mohawk), E. I. du Pont de Nemours and Company² (DuPont), and PTT Poly Canada³ (PTT Canada) (collectively “Petitioners”) hereby submit this Petition to the Federal Trade Commission (the “Commission”) for the establishment of a new generic subclass within the existing polyester category for fibers made from poly(trimethylene terephthalate) (“PTT”). In the event the Commission determines that this petition deserves further consideration, Petitioners propose the designation PTT for temporary use in identifying PTT fiber. Petitioners propose in order of preference the following names for a new generic subclass of polyester that may be used with respect to PTT fibers: 1. triexta; 2. resisoft; and 3. durares.

¹ Mohawk was founded more than 120 years ago and today is the leading producer and distributor of flooring worldwide. Mohawk products serve all major flooring categories: carpet, rugs, hardwood, laminate, ceramic tile, and vinyl flooring. Mohawk has launched a line of carpets manufactured from PTT and sells such carpets under the trademark SmartStrand.

² Founded in 1802, DuPont is a science company operating in more than 70 countries. DuPont offers a wide range of innovative products and services for markets including agriculture, nutrition, electronics, communications, safety and protection, home and construction, transportation and apparel. DuPont markets PTT under the trademark Sorona®.

³ PTT Poly Canada is a 50 / 50 Limited Partnership between Shell Chemicals Canada LTD and SGF Chimie, a subsidiary of Societe Generale de Financement du Quebec (SGF). PTT Poly Canada markets PTT under the trademark Corterra® Polymers.



Summary of Petition

Petitioners seek to establish a generic subclass for fibers spun from PTT on the grounds that such fibers satisfy the three tests required by the Commission for the use of a generic subclass.⁴ These tests are satisfied by fibers spun from PTT because:

1. PTT fiber has the same general chemical composition as the Commission's established polyester generic fiber category.
2. PTT fiber, while having the general chemical composition of polyester, has distinctive properties of importance to the general public as a result of its unique chemistry, molecular design, and fiber structure. These properties are durability, resilience, softness, and stretch with recovery.

PTT fiber's distinctive features of durability, resilience, softness, and stretch with recovery make PTT fiber suitable for uses which conventional polyester (PET) is significantly less well suited. These features are as follows:

- a) Carpet applications: Durability and softness.
- b) Apparel applications: Softness and stretch with recovery.

Fiber Attributes Of Importance In Markets Where PTT Fiber Is Used

An important issue in an application for a generic subclass is the requirement that the distinctive features of any new polymer or fiber be important to the general public, and that such features make the fiber suitable for uses for which other fibers which fall under the established generic name are not suited, or would be significantly less well suited.

Since the distinctive features of a fiber may differ from application to application, it is useful to first discuss the two fiber markets where fibers made from PTT are used so that the properties of PTT can be compared to the properties of the other polyester that is used for fiber applications. These markets are apparel and residential carpet. In these markets, the form of polyester that is most widely used is poly(ethylene terephthalate) ("PET"). Accordingly, Petitioners will provide data comparing the chemistry and crystalline structure of PTT to PET and the performance of fibers made from these polymers in carpet and apparel applications.⁵

⁴ These factors were identified as follows by the Commission in its Notice of Proposed Rulemaking of February 15, 2002 appearing at 67 FR 7104:

"Thus, a new generic fiber subclass may be appropriate in cases where the proposed subclass fiber: (1) Has the same general chemical composition as an established generic fiber category; (2) has distinctive properties of importance to the general public as a result of a new method of manufacture or substantially differentiated physical characteristics, such as fiber structure; and (3) the distinctive feature(s) make the fiber suitable for uses for which other fibers under the established generic name would not be suited, or would be significantly less well suited."

⁵ In addition, Petitioners will provide data comparing the performance of PTT in carpet applications to the performance of nylon carpet because nylon currently has the largest market share in residential carpet. Accordingly, the properties of nylon fibers are a useful reference to define those features of PTT carpet fibers that are of importance to the general public.

Residential Carpet

Prior to the launch of residential carpet made from PTT by Mohawk Industries, Inc. and Shaw Industries, Inc. (the two largest United States suppliers of carpet for the residential market), the four principal types of man-made fiber used to manufacture carpet were nylon, PET polyester, and polypropylene. Of these three materials, nylon carpet offered the broadest range of attributes most highly valued by consumers. As a result, for comparable carpet constructions, nylon carpet has commanded the highest price. Carpet made from PET has been less highly regarded because PET fiber lacks the durability and resilience of nylon and because, compared to many recent nylon carpet constructions, PET fibers were less flexible and not as soft as some nylon constructions.

With the launch of carpet based on PTT, consumers have a choice of a fiber that has stain resistance properties superior to nylon, together with durability, resilience and softness that matches the highest quality constructions of nylon residential carpet.

In a 2004 study of consumer purchasing preferences⁶, 1600 consumers between 25 and 64 years of age who shopped for carpet in the past were asked questions pertaining to carpet fiber performance and preferences. A list of those carpet attributes that relate to fiber performance and the percentages of consumers who rated the attribute as very important is in Table 1 below. The attributes where PTT fiber has a significant performance advantage in residential applications over PET fiber because of its physical and chemical properties are highlighted in bold italics.

Table 1: Consumer preferences in carpets

Attribute	Percentage Rating Attribute As Very Important
Common spills and pet accidents can be removed easily even after they have dried	69%
<i>The carpet will stand up to years of foot traffic without matting down</i>	67%
Dirt and soil can be removed easily from the carpet with regular vacuuming	66%
Areas where spills have been cleaned will not be visible	64%
Stain resistant properties will not diminish over the life of the carpet	63%
Soil resistance properties will not diminish over the life of the carpet	61%

⁶ Data taken from a August 23, 2004 study titled Carpet Fiber Performance and Preferences prepared for Mohawk Industries by the Brandware Group.

<i>The pile of the carpet stays tight and will stand up like new after normal vacuuming</i>	58%
The color of the carpet will stay the same year after year and never fade, even in direct sunlight	56%
Heavy soil and most stains can be removed from the carpet with just plain water	53%
The carpet pile will not shed or fuzz	53%
<i>The carpet is soft and comfortable to sit on or lie on</i>	49%
The carpet can be professionally cleaned as often as you want	36%
The carpet never shows tracks from footprints or vacuuming	27%
The carpet will never produce static shock, even if you walk on it in wool socks	24%

Apparel

There are many man-made fibers used in the apparel industry, and the supply chain is far more complex than in the carpet industry. However, it is still possible to obtain market requirements information thru a carefully designed “voice of customer” process by interviewing fabric buyers and brand managers in the apparel industry. These steps in the supply chain determine what fabrics are made into garments for the consumer public. Fabric buyers and brand managers understand the downstream requirements and must match that demand to the supply of fabrics and in turn what polymers and fibers are used in those fabrics.

In order to understand these preferences, DuPont conducted a survey⁷ of downstream participants in the supply chain to determine preferences in the apparel supply chain where differences in fabric fiber content were important and discernable. Table 2 lists the companies that were surveyed in the countries which are the major sources of fabrics made from man-made fibers. The purpose of the survey was to determine the attributes of fabrics that are of greatest importance to consumers.

⁷ This study was conducted by DuPont employees in the first and second quarter of 2004.

Table 2: Apparel fabric preferences survey participants

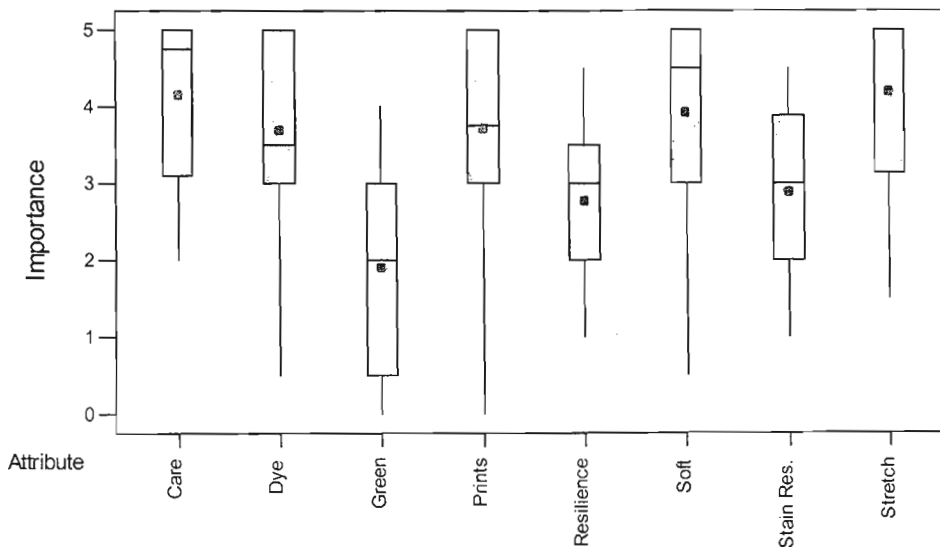
Country	Fabric Producer or Purchaser
Korea	Li & Fung, C&A/Mondial, Sears, SAE-A Trading Company, Mastex, Liz Claiborne, Mast Industries
Taiwan	Esquel, Levi, TAL, Adidas, Li & Fung, Nike, Puma, Eddie Bauer
China	Burrington, Liz Claiborne, Federated, May Co., Mast, Newtimes Jones (Jones New York)

Survey participants were asked to rate the following attributes on a scale of 0 to 5. The results are shown in Figure 1 with the mean denoted by the small square and the range denoted by the box. The average of the responses is the horizontal line.

1. Stretch
2. Softness (also referred to as “Drape”)
3. Easy Dye
4. Easy Care
5. Made from renewable resources
6. Stain resistance
7. Resilience
8. Printability

From this list of eight attributes, the three which had the greatest importance were easy care, softness (hand or drape), and stretch with recovery. PTT fiber is superior to PET fiber with respect to two of these three attributes: softness and stretch with recovery.

Figure 1: Fabric survey results



Discussion of Factors Needed For The Designation Of A New Generic Subclass For Fibers Spun From PTT Polymer

Section 1. PTT polymer and fibers spun from PTT have the same general chemical composition as the FTC's established polyester generic fiber category.

Rule 7(c) defines "polyester" as "[a] manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of an ester of a substituted aromatic carboxylic acid, including but not restricted to substituted terephthalate units, [formula omitted] and para substituted hydroxy-benzoate units, [formula omitted]." 16 CFR 303.7(c).

PTT polymer is made by reacting (a) dimethyl terephthalate (DMT) or terephthalic acid (TPA), both of which are substituted aromatic carboxylic compounds, and (b) 1,3-propanediol (PDO) to form a long chain synthetic polymer consisting of more than 85% of substituted terephthalate esters. Accordingly, fiber made from PTT polymer has the same chemical composition as is described by Rule 7(c).

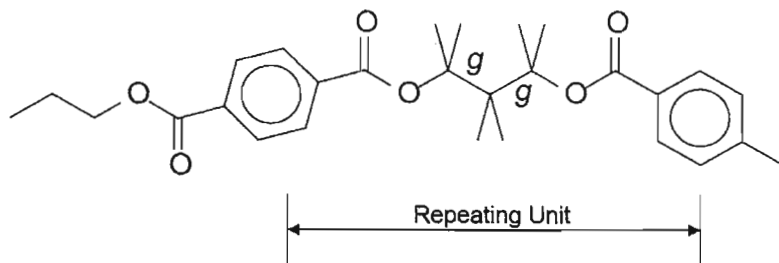
Section 2. PTT fiber, while having a chemical composition which causes it to fall within the definition provided for polyester set forth in 16 CFR 303.7(c), has distinctive properties of importance to the general public as a result of its unique chemistry, molecular design, and fiber structure.

The generic class of aromatic polyesters today consists of several different chemical formulations including poly(ethylene terephthalate) (PET) and PTT. The type of polyester that is familiar to consumers because of its use in carpet and apparel applications is PET. However, the molecular differences between PET and PTT are quite profound, and result in significantly different physical properties of fibers. These properties are (a) durability/resilience for carpet applications, (b) softness for both consumer carpet and apparel applications, and (c) stretch and recovery for apparel applications.

a) Durability/Resilience

Fiber durability, which in carpet applications is measured by the resiliency of the fiber and its ability to recover from compression, is together with stain resistance the most important property that consumers look to when selecting a residential carpet as shown in the consumer survey results set forth above. This property is inherently better in fibers made from PTT vs. PET because of PTT's chemistry and molecular design. PET and PTT crystallize into triclinic unit cells during fiber formation. However, the glycol portion of their chemical chains crystallizes into different conformations. The two methylene units in the glycol portion of PET are arranged *trans* to each other, whereas the three methylene units in PTT are arranged in a *gauche-gauche* conformation as shown in Figure 2 below:

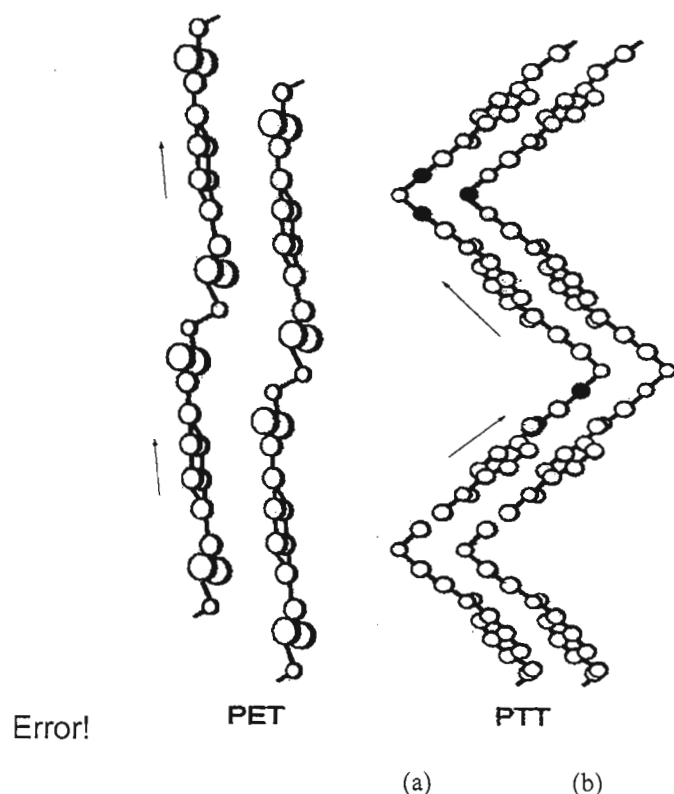
Figure 2. PTT molecule showing *gauche-gauche* Conformation (ref. 1)



Because of the methylene diol's conformations, PTT chains are contracted by 24.7% while the PET chain is fully extended. Also the benzene ring of the terephthalic ester groups of PET are oriented parallel to each other in every chemical repeating unit. However, the orientation of PTT's benzene ring in the successive terephthalic ester units is at an angle to each other, thus PTT molecular chain forms a 2/1 helix, which is made up of two repeating units per turn which introduces a zigzag shape to the polymer chain. This difference is illustrated in Figure 3 which compares the molecular structures of PET and PTT. As a result of this structure, compressive forces translate at the molecular level to bending and twisting of bonds, rather than just stretching. The molecular structure of PTT is more like a coil spring compared to a straight wire structure in the case of PET polyester.⁸ Therefore, PTT fiber can take an additional level of applied strain and recover completely.

⁸ This property of PTT polymer has also been confirmed through study of x-ray diffraction patterns which occur when fibers of PTT are subjected to stress. See Crystal Deformation in Aromatic Polyester, Journal of Polymer Science, Vol. 13, 799-813 (1975) ref 2.

Figure 3: Structural differences between PET and PTT (ref 3)

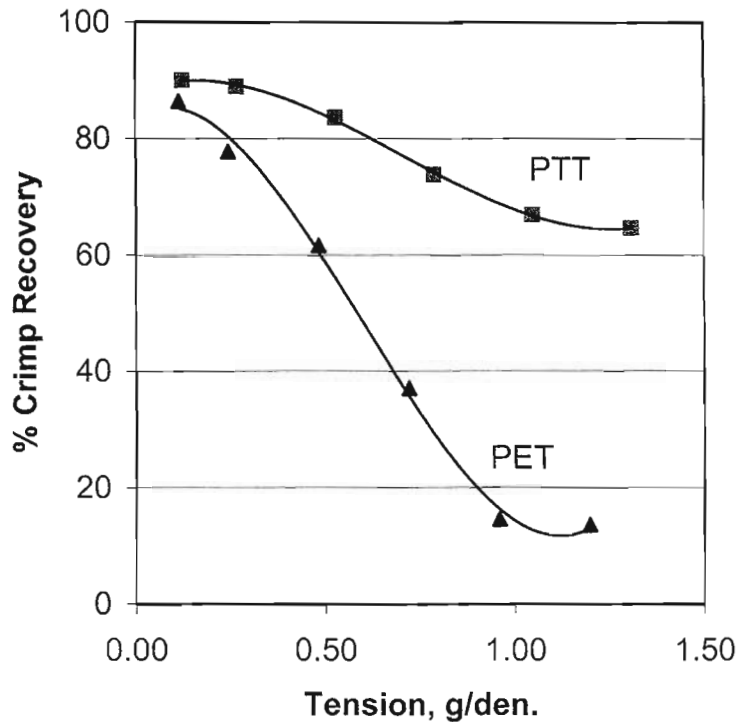


Arrangement of PET (a) and PTT (b) crystalline molecular chains. Arrow indicates the alignment direction of the benzene ring.

Accordingly, when a PET fiber is subjected to compression forces in carpet applications (e.g., when carpet is walked on or subjected to carpet industry tests that simulate foot traffic), the molecular chain structure of PET changes and develops a larger permanent set or crystal deformation which is not completely recoverable. This causes consumer carpet made from PET polyester to develop a crushed appearance where the carpet fibers do not continue to stand up as they did when the PET carpet was new.

In the case of PTT, compression forces in carpet applications cause the molecular chain structure to deform. However, the crystalline structure is able to recover without developing a permanent set. The carpet fibers continue to stand up and appear new for a significantly longer period of time. The basis for this performance difference is the molecular structure of the two polymers, extended to larger physical properties differences such as crimp retention as shown in Figure 4 below:

Figure 4: Crimp recovery of PET and PTT BCF yarns (Shell internal study)



b) Softness

Softness is important to the consumer for both carpet and apparel applications. Consumers judge the softness of a residential carpet by touching or walking on the upright twisted fibers or yarns. The ease with which the yarns bend over is a measure of softness. Consumers judge the softness of a fabric by assessing its hand or drape (the ease with which conforms to the shape of the body). The degree of softness in both cases is proportional to the amount of force required to bend the fiber. The laboratory measurement of the amount of force required to bend a fiber is known as fiber modulus, which can also ascertain the relative softness of the resulting fabric or article.

The lower modulus of PTT fibers over PET fibers is explained on a molecular level by the lower crystalline modulus of PTT. The odd number of carbon atoms in the tri-methylene constituent of PTT results in different chain conformations for PTT as compared to PET. PTT conformation is more helical or spring like, whereas PET is straighter like a wire. Naturally, more force is needed to deform a straight wire while very little force is required to deform a coil spring to the same extent, therefore, PTT with coil spring structure has a very low crystal modulus, 2.5 GPa vs. 107 GPa (ref 5) for PTT and PET crystals, respectively. As a result, the crystals of PTT are relatively weaker and easier to bend compared to PET, and the fiber made from this polymer has lower modulus.

Evidence of this different crystalline modulus caused by molecular structure differences is apparent also in the higher glass transition temperatures (T_g) and crystalline melting temperatures (T_m) of PET vs. PTT. These higher temperatures generally correspond to stiffer molecular structures. See Table 3 below:

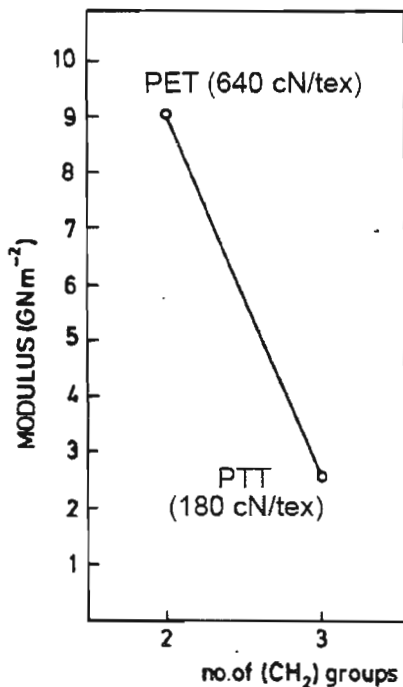
Table 3: Differences in physical properties of PTT and PET (ref. 4)

Physical properties of PTT vs. PET

	<u>PTT</u>	<u>PET</u>
T_m ($^{\circ}\text{C}$)	228	255
T_g ($^{\circ}\text{C}$)	50	75

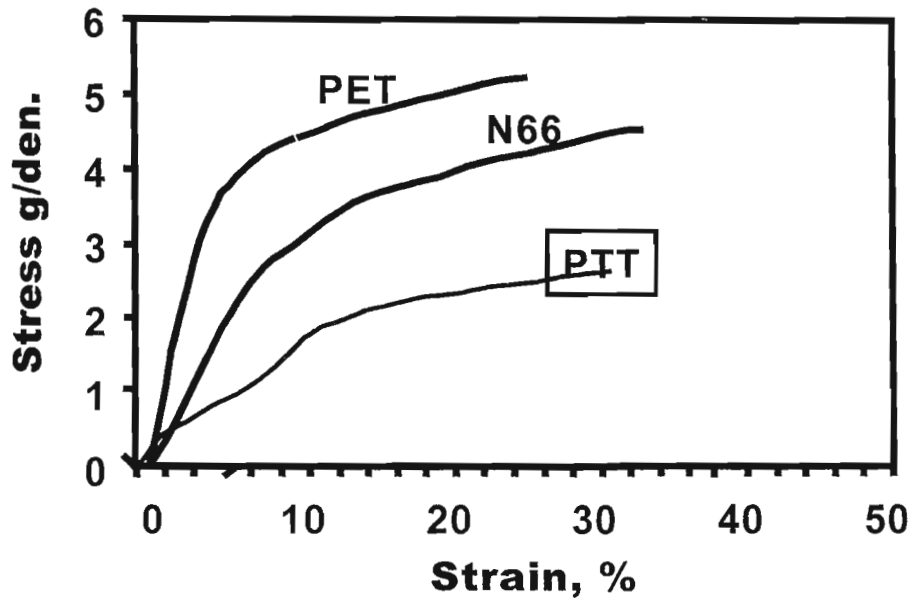
Young's modulus is yet another measure of the relative hardness of a material, and from the data in Figure 5 it is readily apparent that PTT has far lower modulus than PET.

Figure 5. Young's modulus of PET and PTT fibers (ref 5)



Finally, Figure 6 shows a stress (force) vs. strain (fiber deformation) comparison of fibers made from PET, nylon 66, and PTT. This graph shows that the properties of PTT polymer result in fibers of PTT which have lower modulus than fibers made from either PET or nylon 66.

Figure 6. Modulus of PET and PTT Fibers vs. Nylon 6,6 (ref 5)



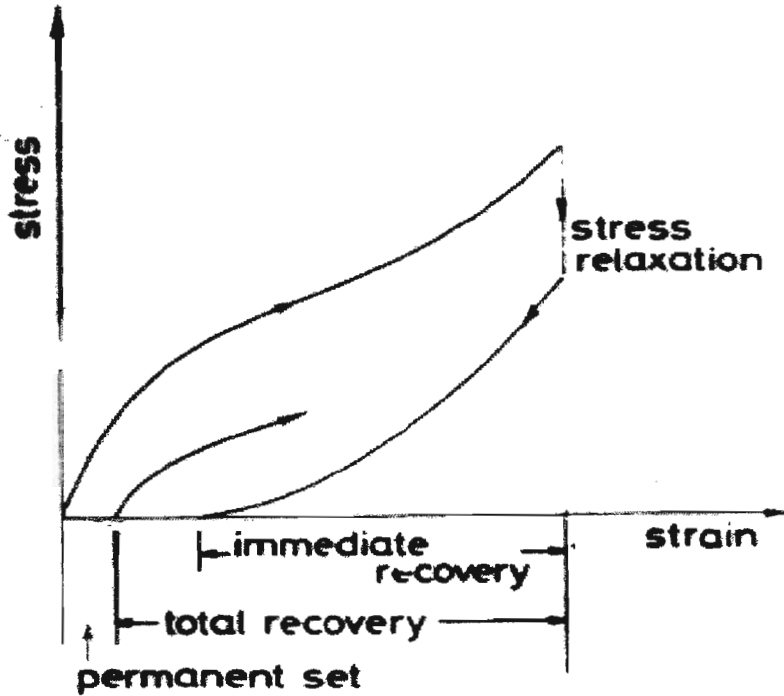
As a result of the lower modulus of the PTT fibers, carpets made from PTT fibers are perceived to be softer, and apparel fabrics made from PTT fibers have greater softness and superior “hand”.

(c) Stretch with Recovery

Stretch and recovery of fiber is important in apparel applications in order to improve the comfort of garments and increase their ability to retain their shape and appearance.

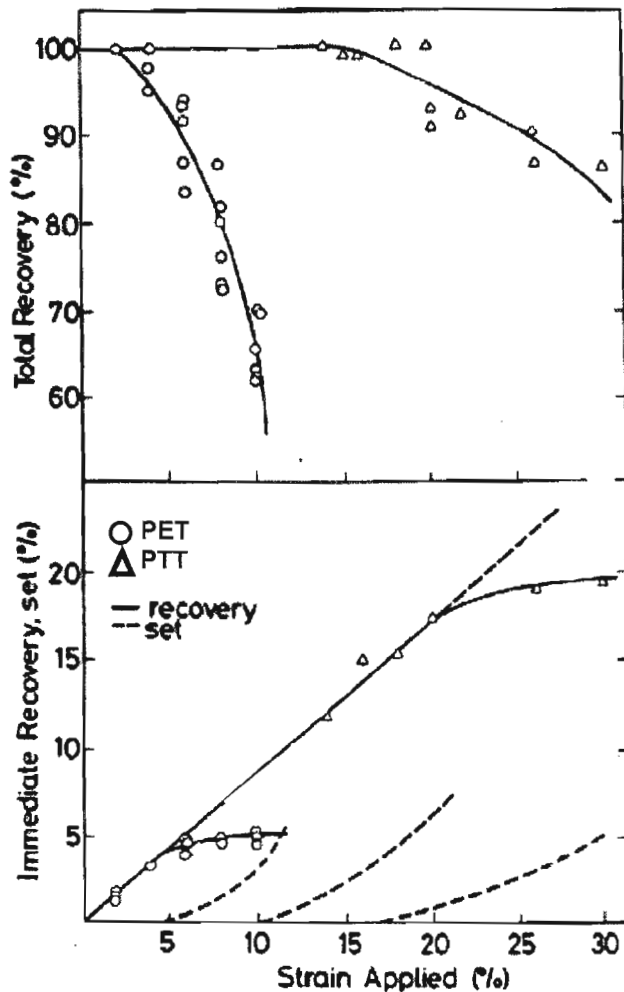
Elastic recovery is measured by first extending the fiber in a tensile tester to a given strain (percent of extension) and then holding the fiber at that position for a given time, after which time the strain is completely released. After a fixed period of relaxation time, the fiber is re-extended and released to measure its recovery again. The difference between these two extensions and recoveries represents the immediate recoverability of the fiber and the permanent set. More elastic fibers recover immediately with lower permanent set. The terms are further defined in Figure 7.

Figure 7. Elastic extension and recovery terminology (*ref 5*)



As shown in Section 2(a) above, the crystalline region of the PET polymer will absorb only a limited amount of strain. Strain beyond that point will cause the fiber to deform irreversibly. In the case of PTT, the strain is absorbed by the crystal structure uncoiling like a spring. When the strain is released, the crystalline structure recovers. This difference is shown in Figure 8 which compares the stretch and recovery performance of PET and PTT fibers. The data indicates that PTT fiber can be stretched with total recovery more than five times the stretch after which PET fails to recover.

Figure 8. Stretch with recovery of PET and PTT fibers (ref 5)



Section 3. The properties of fibers made from PTT described in Section 2 above cause PTT fibers to be suitable for carpet and apparel applications for which other fibers marketed under the established generic name polyester would be significantly less well suited.

As discussed above, the attributes of durability/resilience and softness are of greater importance to consumers when purchasing residential carpet. For apparel applications, softness and stretch with recovery are among the most important attributes of any fabric. The test results set forth below illustrate the improved performance of PTT fibers over PET fibers with respect to these attributes. Each test is preceded by a description of the protocol, and the identity of the company performing the test.

a) Durability/Resilience

Carpet durability and resilience can be measured by a number of standard tests. For example, there are simple floor walking tests, where a sample of carpet is placed in a high traffic location and the number of walkers is simply counted using an electric eye trigger. Another