built to LAST

TESTING FOR DURABILITY

By Maria C. Thiry, Features Editor

On the surface, durability is a simple concept—a measure of the reasonable wear life of an item. Or, as a consumer might say, "How long is that going to last?" However, in the arena of textiles, the concept of durability can be considerably more complex.

"Buying or selling cloth is, essentially, nothing more nor less than buying or selling the service that cloth performs," says Sandeep Khatua of Bureau Veritas Consumer Products Services. Sometimes the primary service performed by a particular cloth—as in garments such as women's dress goods—is fashion. According to Khatua, "It may be impossible to preserve a reasonable amount of durability while producing a fabric entirely desirable in appearance…[especially] where extreme sheerness, filminess, or laciness [is] considered essential to good looks."

"In some other cases, fashion swings to the other extreme, calling for…strength far beyond the actual needs of the garment; wherefore many clothes go out of fashion long before they wear out," notes Khatua. In fact, some retailers (such as L.L. Bean, Lands End, etc.) use durability as a synonym for quality, and have built their reputations on the durability of their goods. In this case, durability is used as a marketing tool to differentiate a retailer's product offerings.

The concept of durability can certainly apply to other textile applications beyond garments, and can also apply to the dyes, finishes, and construction applied to those textiles. "Durability can have many interpretations depending on what sector of the industry you're talking about," notes Eduardo Palomo of Intertek Labtest. "Durability is a performance attribute. It's a measure of the reasonable wear life of a product. The key to understanding durability lies in defining the 'reasonable wear life' of a product."

THE KEY TO DURABILITY

The key to defining the reasonable wear life of a product lies in determining what should last, how long it should last, where it should last, and under what conditions it should last. The basis of this determination rests on the expectations of the end user for the product. "Durability can mean different things in different products," notes Norma Keyes of Cotton Incorporated. "A consumer expects that performance attributes will last as long as they want to use the textile product."

Different Expectations

Since textile products encompass a broad spectrum of end uses, there is also a broad spectrum of durability expectations depending on the product's end use. "We expect a different lifespan for a sofa than for clothes," says Ken Greeson of Cotton Incorporated.

In fact, depending on the product's end use, some aspects of durability may be more important than others. "Consumer products need to look good," says Allen Zielnik of Atlas Material Testing Technology LLC. "Therefore, durability of appearance is important. For industrial fabrics, like parachute cord, durability of mechanical performance is paramount. Some fabrics need durability of both appearance and performance, like awnings that are exposed to the weather. Some fabrics must be durable to extreme conditions where performance is vital, such as protective garments."

Even in garments, there are different expectations for durability based on the type of garment. "We have lesser durability expectations for fashion items than work items," notes Michelle Pittiglio of Kmart. "We have different durability expectations for denim jeans than for swimwear, because they have entirely different functions." In some cases, durability is not a highly important part of a garment's function. But sometimes it is. "Durability is extremely important when it comes to children's clothing," says Pittiglio. "It is much more important than for adult garments because of the legal issues with choking hazards fo children. Buttons have to pass 100% of testing. Fastenings have to be attached extremely well."

VERIFYING DURABILITY

In end uses where durability is an important consideration, it becomes part o an item's performance specification. Thus, testing for durability becomes a way to prove a product's fitness for its intended use.

However, according to Zielnik, "There are different durability tests for different applications and different test methods for different materials. One te can't be predictive for all materials for





all circumstances. The tests have to be appropriate."

According to Greeson, there are three major categories where a textile product's durability is measured: durability to wear, care, and performance environment.

Durability to Wear

Measuring durability to wear involves simulating anticipated wear conditions for the product, and is a different proposition for fabrics than for garments. According to Louann Spirito of SGS, testing fabric involves various tests that measure the physical strength of the fabric. "For a garment, you also need to test the strength of seams, zippers, and snaps. The life of garment can be limited based on components and construction."

Typical durability to wear tests for fabric include abrasion, tensile and tear strength, burst strength, stretch and recovery, perspiration tests, crocking, and staining. "Basically, you test any physical attribute that a consumer could use to make a judgment of 'acceptable' or 'not acceptable'," notes Keyes. "For garments, you will also look at the seam strength, and the details of construction. Will the garment twist, skew, or shrink? Will the button, zippers, and loops stay attached?"

One complication with garment testing, according to Keyes, is that labs usually don't get enough garments of the same item to have adequate test sampling to get realistic results on some tests.

Durability to Care

According to Heather Dameworth of



Photo courtesy of Kmart/M. Pittiglio. Used with permission.

Button attachement strength test. "This is one of those critical children's tests that must have 100% passing rates," says Pittiglio.

Kmart, the most important durability test is washing. As well as giving insight into a product's durability to care, it provides quite a bit of data on a product: colorfastness, strength, pilling, shrinkage, seam issues, and abrasion issues. "It would be really bad if something fell apart in the wash," says Dameworth. According to Greeson, washing and tumble drying may reveal abrasion problems not evident from abrasion testing alone. "Washing is where most consumers notice problems," agrees Pittiglio.

Ron Pacheco of STR notes that different markets have different laundering conditions that will require different washfastness testing. "For example, washing machines sold in Europe are different than those sold in North America. European machines (typically front loaders) bring cold water into the machine, and then heat the water. Machines in the United States (typically top loaders) put hot, cold, or warm water directly into the machine." The machines also use different agitation levels and require different kinds of detergents. "Because there are different laundering systems in different countries," says Pacheco, "you can't use the same tests to predict durability in all markets."

Greeson agrees that differing laundry conditions complicate washfastness testing. "The amount of chlorine or hardness in the consumers' water supply may be variable. This also complicates trying to predict multiple laundering durability. However, fabrics, finishes, and dyes need to perform under all kinds of conditions."

Wash testing is also where the durability of performance finishes are measured. Pacheco gives an interesting insight into how some of today's washfastness standards were developed. "When children's sleepwear flammability regulations came out in the 1970s, the Consumer Product Safety Commission (CPSC) had to decide what would be a reasonable amount of durability for flame retardant finishes, because that

Adequate testing has to have a way to measure the CHANGE in the material.

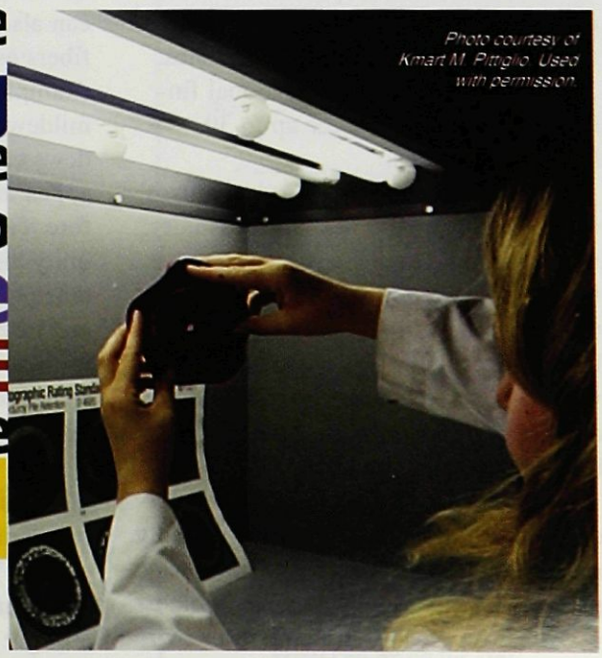
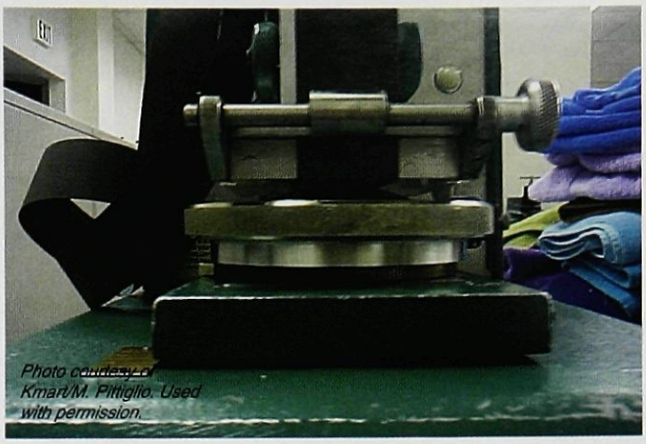


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Rating abrasion samples. The pile has worn off the velour on this failing sample.



Abrasion test. "Most fabrics must go 50 cycles without any thread breakage," says Pittiglio.

would become part of the regulations. They basically assumed that each garment would be laundered an average of once per week, and that a reasonable lifespan for children's sleepwear would be one year. So they decided that flame retardant finishes should last at least 50 launderings in order to pass their tests. It eventually became a standard in the industry to consider a finish that would last at least 50 launderings a durable finish," says Pacheco.

Nevertheless, washfastness testing is more complex than just washing an item a specified number of times. According to Greeson, there are different expectations for different applications. "Stain release fluorochemical finishes for general wearing apparel can be expected to be durable to 25-30 home launderings. However, for technical or industrial fabrics and garments, the expectations for a similar finish may be for over 50 launderings in a commercial laundry, where conditions are much harsher than in home laundering," said Greeson. "Additionally, different finishes have different durability expectations. We can expect 25-30 launderings for apparel treated with wrinkle resistant finishes. Some of the new multi-functional finishes claim durability for up to 30 home launderings."

"To some degree, we need to mirror what the consumer does with wash/dry/wear patterns," says Keyes. "When we test soil release properties of finishes, they are washed in a load that does not have soiled clothes, as a consumer would. Most soils aren't visible. You don't see them, but they can complicate the removal of a visual stain."

Additionally, Keyes notes that accelerated washfastness testing, as generally accepted in the industry, may not always provide the actual results comparable to what consumers would see in their own laundering results. "Repeated launderings may show different colorfastness results than what you would get from the accelerated tests," says Keyes. "Some companies are depending less on accelerated colorfastness tests and more on full-scale launderings when trying to determine durability to color loss. We currently don't have adequate predictive tests that will measure the interaction of abrasion and color loss over multiple launderings."

Durability to Environment

The question of color loss is an important aspect of durability testing. "Colorfastness is part of durability," says Dameworth. "If the shirt and pants in an outfit fade at different rates—the outfit is not durable because not it is not useful for its intended purpose any more."

Testing for durability to the environment often involves testing for colorfastness to environmental exposures such as light, ozone, and ultraviolet radiation. In addition, the outdoors is not the only environment that a textile product will be exposed to. "The product's colorfastness should last in the store and in storage as well," notes Pittiglio.

But color loss is not the only hazard offered to textiles by the environment. "Environmental factors can also break down finishes and fibers as well as destroy color. For example, geotextiles' resistance to mildew is important, because mildews can destroy strength as well as appearance," says Greeson. Therefore testing for environmental durability also involves testing for resistance to molds, mildews, bacteria, and insects. It can also involve rain testing, since water resistance or waterproof properties may define the useful life of some textile products.

MEASURING RESULTS

It all comes down to defining a product's useful life again. Because of the broad variety of standard tests, it might sometimes be difficult to determine the best tests to measure a textile product's useful life. For one product, colorfastness may not determine its useful life as much as water resistance. For another product, abrasion resistance may be the determinant of lifespan.

Pushing the Envelope

"Adequate testing has to have a way to measure the change in the material," says Zielnik. "Normal durability tests try to replicate the worst case service conditions that a material will see in its service environment without overstressing the material. Accelerated stressing artificially subjects material to stresses way beyond what they will be expected to undergo."

This kind of testing is as important as more traditional durability testing, argues Zielnik. "It is important to know how to measure the change in the material," says Zielnik. "In general, we don't always test until the product actually fails. If a material doesn't change, do you know if the product was good or if the test was bad? The testing procedure could have been bad. The testing equipment could be malfunctioning. When testing for durability, you should first run a test until product failure, to make sure you can detect the change in the material. That way you can really validate that the type of failure you see in the test is the same type of failure that the product





would experience in the field."

Zielnik makes an argument for the use of "forced degradation tests" to see what stresses the material is sensitive to. The material being tested can be the fiber, colorant system, or finishes. "Forced degradation tests help design appropriate durability tests; help to improve stability efforts; help us understand appropriate service environments, markets, and applications for the product; and help prevent product failure," says Zielnik.

Touching All Bases

Within each battery of tests, there are weighted factors. Some tests will be more important than others, depending on the application. According to Pacheco, in the United States, there are three tests that *must* be performed, by law—tests to fulfill the requirements of the flammable fabrics act (16 CFR Part 1610 Standard For The Flammability of Clothing Textiles), care labeling act (16 CFR Part 423 Care Labeling of Textile Wearing Apparel and Certain Piece Goods), and fiber identification act (The Textile Fiber Products Identification Act). If the fabric fails any of these mandated tests, then it fails completely.

There is a general set of tests for all garments, according to Pacheco. Besides the three tests required by law (in the United States), there are the tests measuring general performance specifications, such as seam strength, colorfastness to crocking, colorfastness to perspiration, and an abrasion test if the item needs high durability. "These are the benchmark tests to help produce general apparel fabric," says Pacheco. "If a garment had a specialized application, like a bathing suit, it would also be tested for durability to water, salt water, chlorinated water, sunlight, and UV."

Knowing the Ropes

"What kind of testing can define durability? There is no one size fits all," says Palomo. That is why retailers rely on good testing laboratories not only to perform the durability testing, but to help choose the appropriate battery of tests and to help interpret the results of the tests. "We run into a lot of people who don't know what the test is simulating," says Palomo. "It is important to know how to put the test data into the right context in relation to the materials you're working with."

For retailers and product designers, it is important to realize how the tests they specify can help predict the durability of the end product. Knowledge gained through organizations like AATCC can help a product designer keep from specifying and paying for inappropriate and unnecessary testing. "They need to find out why a particular test is being done and what you're looking for," says Palomo. "The more you know about the process the better prepared you are."

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