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**RECYCLING INTERIOR FINISH MATERIALS —
CARPET AND CEILING TILES**



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FACILITIES ENGINEERING
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RECYCLING INTERIOR FINISH MATERIALS –
CARPET AND CEILING TILES

1. Purpose. The purpose of this Public Works Technical Bulletin (PWTB) is to transmit information on the state of practice for recycling carpeting and other interior finish materials.

2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities.

3. References.

a. Unified Facilities Guide Specifications (UFGS) 0968A Carpet. U.S. Army Corps of Engineers (USACE), May 2001.

b. Architectural and Engineering Instructions (AEI), Army Family Housing, Headquarters USACE, Directorate of Military Programs, Engineering Division, Washington, DC 20314-1001, November 1996.

c. Army Regulation (AR) 200-1, *Environmental Protection and Enhancement*, 21 February 1997.

4. Discussion.

a. An enormous amount of carpeting is removed from Army buildings during remodeling projects and disposed of in landfills. The bulkiness of carpet and padding not only makes disposal very costly, but carpet also takes over 50 years to begin to decompose. Landfill space is diminishing and many

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landfills will no longer accept carpet. Disposal alternatives need to be found. This PWTB outlines recycling options and alternative procurement/maintenance programs necessary to reduce the amount of carpet waste generated and landfilled within the Army.

b. UFGS 0968A gives guidance on selection and installation of various carpet materials. It also discusses purchasing carpet with recycled content, per the U.S. Environmental Protection Agency's (EPA's) Comprehensive Procurement Guidelines (<http://www.epa.gov/cpg>).

c. AR 420-49, Chapter 3 discusses solid waste management in general terms. Construction projects on active troop installations are currently generating enormous quantities of waste materials – as much as 80 percent of the total solid waste generated. While most of these materials are structural, an appreciable fraction is interior finish materials, e.g., drywall, partitions, carpet, and ceiling tile.

d. Appendix A to this PWTB primarily addresses the recycling of carpet, including composition, recycling technology, alternative purchasing systems, and key vendors. Appendix B summarizes recycling activities in the carpet industry, and Appendix C lists suppliers of construction products containing recovered materials.

5. Points of Contact. HQUSACE is the proponent for this document. The POC at HQUSACE is Mr. Malcolm E. McLeod, CEMP-RI, 202-761-0206, or e-mail: Malcolm.E.Mcleod@HQ02.usace.army.mil. Questions and/or comments regarding this subject should be directed to the technical POC: U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory ATTN: CEERD-CN-E (Stephen D. Cosper), 2902 Newmark Drive Champaign, IL 61822-1072, Tel. (217) 398-5569, FAX: (217)373-3430, e-mail: Stephen.D.Cosper@erdc.usace.army.mil.

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Appendix A: Guide On Recycling Interior Finish Materials – Carpet and Ceiling Tiles

INTRODUCTION

Interior finish materials such as carpet and ceiling tiles are often removed from Army buildings either when replaced or during demolition. Ceiling tile waste is produced during remodeling projects and during construction and demolition. Recarpeting accounts for over half of all carpet sold and annually generates approximately 4 billion pounds of waste. Virtually all of it is placed in landfills, accounting for 1 percent by weight, or about 2 percent by volume, of municipal solid waste (MSW) (NAHB 1998). Considering that carpet is just one of millions of products placed in landfills every day, this amount of waste is considerable.

U.S. standard units of measure are used throughout this appendix. A table of conversion factors for Standard International (SI) units is provided below.

SI conversion factors	
1 ft	= 0.305 m
1 yd	= 0.9144 m
1 sq ft	= 0.093 m ²
1 sq yd	= 0.836 m ²
1 cu yd	= 0.764 m ³
1 lb	= 0.453 kg
°F	= (°C x 1.8) + 32

1. CARPET

The cost to use landfills is predicted to increase steadily over the next 10 years, as the number of landfills decreases. The bulkiness of carpet and padding not only makes disposal very costly, but carpet also takes over 50 years to begin to decompose; therefore, many landfills no longer accept carpet. Alternatives to disposal need to be found for these large amounts of carpet waste.

1.1 CHARACTERIZATION OF WASTE

Recarpeting produces a relatively homogenous waste stream consisting of carpet and carpet pad, miscellaneous packaging, fasteners, and adhesives. One-third of the carpet waste is

generated from competitively bid commercial carpet removal and installation contracts. This waste is usually put into a dumpster at the job site. The other two-thirds of post-consumer carpet is removed from homes or small businesses. The majority of this carpet waste is taken back to the carpet retailer's or installer's place of business where it also is put into a dumpster. Any carpet not taken back is usually placed on the curb for pick-up with MSW. Carpet disposed of this way is difficult to collect for recycling and usually ends up in a landfill.

1.2 TYPES OF CARPET

While the waste stream is fairly homogeneous, the composition of the carpet is not. Carpet is a composite product made from several different components including face fiber, primary and secondary backings, and an adhesive layer. Manufacturers make different brands of carpet from different face fibers, which makes carpet recycling programs more challenging because most carpet recyclers only accept carpet made from a particular type of face fiber. Carpet pad, on the other hand, is generally a homogenous product, such as polyurethane foam or rubber, and better lends itself to recycling.

1.2.1 BROADLOOM CARPET

Broadloom carpet is the most widely used carpet in both homes and businesses. Face fibers are woven into a backing material and held together with "glue" that stiffens the backing. Broadloom carpet is best for residential applications. It comes in rolls and is typically placed over padding.

1.2.2 VINYL-BACKED CARPET

Vinyl-backed carpet is far less common than broadloom carpet and is mainly used in commercial applications. Vinyl-backed carpet differs from broadloom in that the face fibers, typically nylon, are integrally molded into a vinyl backing. This type of carpet does not require padding and may come in tile squares or on a roll.

1.3 CARPET CUSHION

Carpet cushion is padding placed beneath carpet to improve its insulation properties, reduce the impact of foot traffic or furniture indentation, enhance comfort, and prolong appearance. It is available in a variety of thicknesses – the most common being ¼- and ½-inch – and used in both residential and

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commercial settings. Carpet cushions made from bonded urethane, jute, synthetic fiber, and rubber can be made from recovered materials (EPA 2001).

1.4 TYPES OF FACE FIBERS

The Carpet and Rug Institute (CRI) reports that approximately 95 percent of all carpet is manufactured from synthetic fibers. Face fibers include Nylon 6,6, Nylon 6, Olefin (polypropylene), polyester (PET), and other materials such as acrylic or wool. Figure A1 shows the most common face fibers and their respective percentage of the carpet in the market.

Only carpets made from fibers especially made for such applications should be selected. These fibers are typically given a brand name with popular names listed in Table A-1. Branded fibers have known performance in carpet applications and are backed by the respective manufacturers. Use of unbranded fibers could result in unacceptable performance.

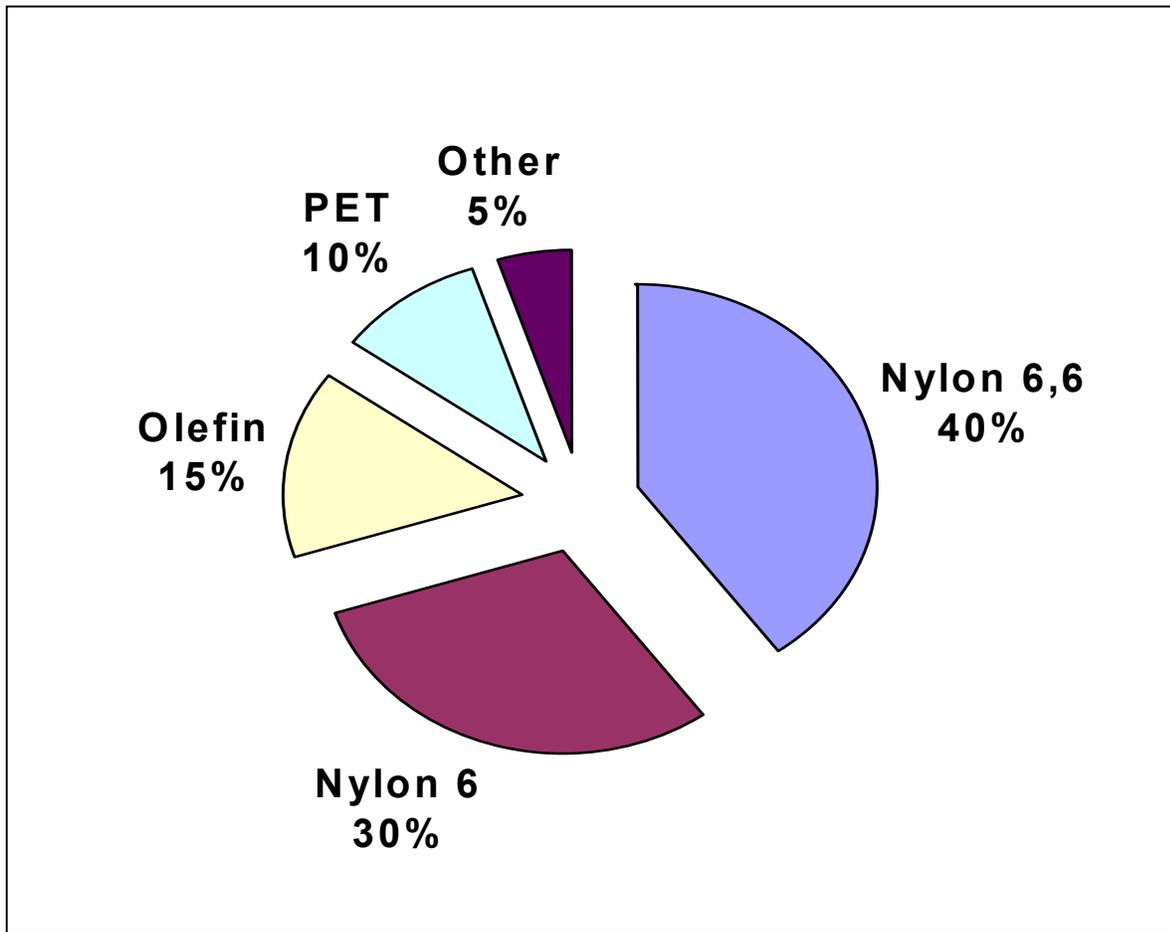


Figure A-1. Carpet face fiber types. (Source: Beck 2000)

**Table A-1. Popular Brand Names for Carpet
 (Source: Evergreen Recycling, Inc.)**

Brand Name	Fiber Type
Allied	Nylon 6
Allied Signal	Nylon 6
Anso	Nylon 6
BASF	Nylon 6
Crush Resister	Nylon 6
WorryFree	Nylon 6
Zeftron	Nylon 6
6ix Again	Nylon 6
Antron	Nylon 6,6
DuPont	Nylon 6,6
HomeSelect	Nylon 6,6
Legacy	Nylon 6,6
Lumena	Nylon 6,6
Luxura	Nylon 6,6
Monsanto	Nylon 6,6
ProSelect	Nylon 6,6
Stain Master	Nylon 6,6
Tactesse	Nylon 6,6
Timbrelle	Nylon 6,6
Ultron VIP	Nylon 6,6
WearDated	Nylon 6,6
Hoechst	Polyester
Trevira	Polyester
Resistron ISF	Recycled PET
Resistron	Recycled PET
Permalon	Recycled PET
Amoco	Polypropylene
Genesis	Polypropylene
Marquesa Lana	Polypropylene

1.4.1 NYLON

Nylon, used for 70 percent of commercial carpets, is the dominant fiber for commercial and institutional applications. Of the synthetic fibers, nylon offers the best performance characteristics. It has the greatest resistance to crushing and matting and is easy to maintain. Nylon carpets have different molecular constructions and are made of either Nylon 6 or Nylon 6,6. Type 6 is softer and easier to dye, and Type 6,6 is more resilient and more stain resistant.

The nylon produced in the United States is supplied to carpet manufacturers by one of the following companies: DuPont, BASF, Honeywell D.S.M, and Monsanto. Fibers produced by these companies are given brand names and are made available to any carpet manufacturer (Table A-2).

Table A-2. Fiber Producers

Company	Brand Name	Type
Solutia	Ultron VIP	Nylon 6,6
DuPont	Antron	Nylon 6,6
BASF	Zeftron	Nylon 6
Honeywell	Anso	Nylon 6

1.4.2. OLEFIN (Polypropylene)

Olefin fiber is also called polypropylene, and is very popular in Berbers. Olefin carpets are strong and highly resistant to static, stains, and moisture. Color is added during fiber production, making these carpets colorfast. Olefin, however, is very low in resilience and is not recommended for heavy traffic areas. It is less expensive than nylon and is often used for projects with tight budgets or for short-term installations.

1.4.3 POLYETHYLENE TEREPHTHALATE (PET)

PET (polyester) is more commonly used for residential carpet. It has superior color clarity, because the plastic fiber is an excellent conduit of light. Carpet made from PET is resistant to water-soluble stains and is permanently static resistant. It is not as resilient, however, as nylon carpets, and it crushes and mats easily. Carpets made with polyester typically are replaced after 2 to 5 years and end up occupying valuable space in a landfill.

PET is the only carpet fiber made today with significant recycled content. About half of the 273 million pounds of polyester fibers used in carpeting in the United States is recycled materials. Recycled PET is principally derived from post-consumer soft drink bottles. About 40 two-liter soda bottles are recycled per square yard of carpeting. Discarded PET containers are cleaned and then ground into tiny chips. The chips are next heated to the melting point and extruded into high-quality carpet fiber. Finally, the fiber is spun into yarn and tufted into carpet. The use of virgin fossil fuel raw materials is not required. This alone eliminates the need for several million barrels of crude oil per year as raw material for fiber production.

1.4.4 OTHER

Wool and acrylic are the two other common carpet types. Acrylic offers the appearance and feel of wool without the cost. This fiber has a low static level and is resistant to moisture and mildew, but mats and soils easily. It is not recommended for commercial applications. Wool is a natural fiber known for its

luxury and performance. Its major disadvantage is the high initial cost. Blends such as wool/nylon are less expensive and are also used to provide desired performance characteristics.

Table A-3. Fiber Performance Characteristics
 (Source: Air Force Carpet Selection Handbook)

Characteristic	Nylon	Olefin	Polyester (PET)	Wool
Color	Excellent	Limited	Good	Limited
Abrasion Resistance	Excellent	Excellent	Good	Fair
Resilience	Excellent	Poor	Poor	Excellent
Soiling	Very Good	Good	Fair	Good
Cleaning	Very Good/Good	Excellent	Fair/Good	Good
Spot Removal	Fair/Good	Excellent	Good	Fair/Good
Pilling	Excellent	Excellent	Poor	Good
Static Electricity	Poor/Very Good	Good	Good	Bad/Good
Allergy Problems	Good	Good	Good	Fair
Chemical Resistance	Good	Good	Good	Fair

1.5 ALTERNATIVES TO LANDFILL DISPOSAL

Carpet manufacturers are concerned about the environmental impacts of their products and keeping used carpet out of landfills. Some manufacturers "lease" carpeting as part of a service arrangement, and remove and recycle the carpet at the conclusion of its service life. Other companies are refurbishing used carpet tiles. Several companies have collection sites in place and are developing the means to separate carpet components and recover polymers. The industry is working toward recycling these materials into new carpet fiber.

1.5.1 LEASE

One recent trend in building product selection is to lease a product from the manufacturer instead of purchasing it, similar to the way furniture and office equipment are leased. Carpet leasing is becoming a more popular method of paying for carpet, as it takes into consideration all aspects of total ownership and spreads the expense over a longer time. With a lease, users pay a monthly fee and eliminate their role in maintenance, which saves on capital costs and allows them to concentrate on business. An environmental lease is one in which the supplier provides and installs the product, arranges for maintenance as required, and removes and recycles the product at the end of its service life.

Interface, Inc. has a lease program where customers lease carpet tiles instead of purchasing the carpet. By using carpet tiles,

only the area that is worn or damaged is removed and replaced instead of the entire floor. By leasing the carpet squares, Interface is able to ensure that the carpet is returned to one of their facilities where it can be either reconditioned or recycled into new carpet. Several manufacturers offer leases for carpet use and are responsible for repairing and recycling the product. Some used carpet can be recovered, cleaned, and re-sold depending on the condition. A credit may also be given towards the lease or purchase of new carpet.

1.5.2 REUSE

Carpet replacement sometimes yields usable waste carpet. Reuse is preferable to recycling or other processing, although there are practical limitations. Carpet reuse is limited by the age of the carpet, its condition, and the contamination of the carpet by animal fur, dander, or waste. Rips and stains are undesirable and cleaning cannot remove animal residues. Also, reused carpet must be suitable for the new application. It must have the appropriate style and aesthetics to be considered acceptable.

Floor covering can sometimes be removed and repurposed within the same building or establishment to be used in break rooms or storage areas. The carpet can also be given away or donated to local nonprofit organizations. Various operations across the country recover carpet and clean, trim, and resell it. Carpet typically undergoes a reconditioning process prior to its reuse, including cleaning, deodorizing, and possibly dyeing and retexturing.

Big Bob's Used Carpet Shops, a retail chain with franchises in 25 states, for example, sells both used and new residential carpet. The Re:Source reclamation program has to date donated more than 158,000 square yards of repurposed flooring to a variety of community and nonprofit organizations, such as Goodwill Industries, Boys and Girls Clubs of America, Habitat for Humanity, churches, and other charitable organizations. Milliken Company practices carpet reuse on a national level. They will remove commercial vinyl-backed carpet tiles and ship them to their mill for refurbishment.

1.5.3. CARPET PADDING RECYCLING

Carpet cushion recycling is a relatively common practice. The success of pad recycling can be attributed to the homogeneity and market dominance of polyurethane pad and the well-established market and collection infrastructure for used carpet

pad. Used padding has a commodity value in the recyclables market that provides an economic incentive for generators to bring waste padding to collection points.

Carpet padding is composed of a single material that can be visually identified. The most common type of padding, polyurethane, accounts for 90 percent of the market. Over 100 million pounds of prime polyurethane carpet padding is recycled each year and made into bonded carpet padding. Polyurethane padding is easily recycled by shredding and gluing it back together to make new "rebound" carpet pad, a widely accepted product that is competitive with new foam padding.

Most carpet padding is environmentally friendly because it is made from either recycled materials or materials that are recyclable. Natural felt carpet cushion is almost always made from recycled burlap bags. Synthetic felt carpet cushion is manufactured almost entirely from recycled carpet waste. Carpet cushion can be made from recycled clothing and other post-consumer textile fibers. Post-consumer scrap from automotive recycling and carpet installations is also recycled to make bonded carpet padding.

1.5.4 CARPET RECYCLING

The carpet recycling industry is in its infancy in the United States. It is driven primarily by resin producers who seek a low cost feedstock material and by certain large carpet manufacturers that use carpet recycling as a promotional tool to increase carpet sales (Beck 2000). Virgin nylon is relatively inexpensive; however, the carpet manufacturing process uses a large amount of energy. This consumption of natural resources, coupled with the growing sensitivity to the vast amount of carpet waste being landfilled, is the reason for the increased popularity of carpet recycling.

1.6 OBSTACLES

Only about one percent of used carpeting is recycled currently. Carpet recycling is more difficult than padding recycling because of the material complexity of carpet, the logistics of identification, collection, transportation, and the limitations of sorting and reclaiming technologies. Markets for reclaimed materials not made into new carpet need to be developed.

1.6.1 COMPOSITION

Padding is manufactured from a single material; however, a variety of materials are used in manufacturing carpet. Only a small amount of these materials is recyclable, presenting greater difficulty to a recycler. Once identified as recyclable, the face fiber must be separated from the backing. The remaining carpet components have little value and must be disposed of or recycled. Trying to recycle products not designed for recycling is difficult. Making carpet out of a single material and using an easily removed adhesive would enhance the recycling process.

1.6.2 COLLECTION

High collection costs can dominate the economics of recycling due to the complex handling practices for carpet waste. While collecting more carpet will make recycling more economically feasible, shipping the used carpet becomes costly. A 40-foot semi-trailer carries only 10 tons of carpet and may have to travel across the country to reach a processing facility.

1.6.3 RECLAMATION TECHNOLOGY

Another barrier to carpet recycling is the limitations of technologies to sort and reclaim. As much as 70 percent of the carpet collected for recycling may not contain marketable fibers. Identifying valuable facing fibers for recycling is difficult. Many carpets look alike, but most have one-of-a-kind formulations. Carpet fiber type cannot be classified through visual inspection, but must be identified through testing.

A tool to analyze carpet fiber using infrared has been developed to distinguish between several carpet types. The CarPID tool allows identification of carpet types in the field. This portable instrument is simply placed on the face side of a carpet and a light illuminates the carpet. The reflected light is measured and analyzed. Since materials absorb light differently in various areas of the spectrum, it is possible to identify the face fiber. CarPID is available for lease through Evergreen Recycling LLC and must be used to reclaim Nylon 6 carpet for Evergreen's recycling program.

The Carpet and Rug Institute (CRI) developed an identification system for carpet materials, to make the sorting of fiber and backing compounds much easier and more efficient. This 7-character code, called the Carpet Component Identification Code (CCIC), is printed either directly on the back of the carpet or on an attached bar code label. Using a key for the CCIC allows for simple visual identification and enables

recyclers to target only the desired carpet types for collection. The carpet industry only started using this code in 1996, however, so with carpet lasting between 8 and 12 years, the only waste carpet likely to have the code on it today are remnants and installation scraps.

1.6.4. END USES OR MARKETS

Recycling carpet into new carpet has been a technical challenge. Recycling processes should produce an existing material if at all possible, because new materials face marketing problems. As stated elsewhere in this appendix, end uses must exist for the recycled carpet.

1.6.5 CLOSED-LOOP PROGRAMS

At present, not all types of carpet can be recycled into new carpet in what is called a closed-loop system. Several companies have developed technology to process recycled nylon carpet into other useful products such as automotive parts and carpet backing.

With the goal of turning used carpet into new carpets, DuPont has developed "ammonolysis," which can depolymerize mixtures of both Nylon 6 and Nylon 6,6. DuPont uses this technology to manufacture a Type 6,6 fiber containing post-consumer recycled content. The fibers from this process can be used to make new carpet and also enables nylon to be recycled over and over again.

In a closed-loop system, reclaimed floor covering from Collins & Aikman is recycled into ER3 (Environmentally Redesigned, Restructured, Reused) backing material. This ER3 backing material is bonded to nylon face materials to produce endlessly recyclable products. The recycled-content backing gives the carpet a total of 28 to 52 percent recycled content by weight. Collins & Aikman offers a sustainable warranty along with any carpet purchase, guaranteeing that no part of any carpet reclaimed for recycling will be sent to a landfill or incinerated by them.

1.7 RECYCLING PROCESS

Once carpet is collected, it is sorted by face fiber type prior to processing. There are two basic recycling methods – chemical and mechanical.

1.7.1 CHEMICAL PROCESSING

Depolymerization is the chemical method of breaking down plastics to their basic building blocks called monomers. These monomers are reacted with other virgin chemical molecules and purified so that virgin-equivalent recycled plastic resin is produced. This technology has been around for 35 years; however, it has taken significant technological advancements to achieve a depolymerization process that can accept post-consumer carpet containing highly contaminated nylon. New carpet can be made from these pure fiber resins for closed-loop recycling (recycling old carpet into new carpet).

1.7.2. MECHANICAL PROCESSING

Materials from carpet can also be recycled through mechanical means. The mechanical method to remove carpet fibers begins with pounding and beating the carpet to separate the face fiber from the backing system. Once separated from the other materials, face fibers can be pelletized for use as a recycled resin. The resin produced in this process is not as pure as the resin produced in the depolymerization process. By using a series of shredders, grinders, screens, and, in some cases, wash systems, recyclers are able to produce a resin that is 95 percent pure. This resin can then be used in plastic applications such as making automobile parts that do not require 100 percent virgin equivalent material.

1.7.3. WHOLE CARPET PROCESSING

Whole carpet is treated as one basic material and downcycled into new products. The carpet is ground up, blended, and melted to manufacture plastic products. Recycled carpet has been used in products that include carpet installation tack strips, plastic lumber, and parking stops.

1.7.4. SHREDDED CARPET

Carpet is shredded and then processed by a machine that rips and tears carpet to produce individualized fibers. This process would be for non-nylon carpet primarily since carpet made from nylon fibers already has other recycling outlets. One of the most promising uses of recovered carpet fiber is as reinforcement in concrete products and pavements. However, several other uses have been found for shredded carpet.

Shaw Industries in conjunction with the Georgia Institute of Technology has developed an innovative program for geofiber

roadbeds. Shredded post-consumer carpet is combined with a variety of soil types. The result is a more durable roadbed, with substantially less moisture retention and greater resistance to compression and freeze-thaw conditions. At the rate of 70,000 pounds per linear mile, this application alone could potentially divert every square yard of post-consumer carpet from the nation's landfills. (Shaw)

Shredded carpet has also been used as reinforcement in natural grass playing surfaces. In a pilot project at Hershey Park, PA, the top 2-1/2 inches of the field will be reinforced with shredded carpet that is expected to demonstrate exceptional structural support and reduce soil compaction.

In 1993 Tom Deem, an expert in carpet recycling, came up with the idea of turning old carpeting into loose-fill insulation for attic applications and now has a patent pending on his recycled carpet insulation. In a thermal test, the insulation achieved a respectable R-3.3 per inch. It will be packaged into 40-lb bags, each of which will cover roughly 19 square feet at a rating of R-38. The retail price for this would be considerably less than cellulose and loose-fill fiberglass for comparable insulation value and area coverage.

Carpet shredded to finger-sized lengths, less than 1-inch thick, has end uses as absorbents in animal bedding, for sound deadening applications, and for road stabilizer. Larger strips (less than 6-inch square) are easier to make using a shear shredder and can be used with soil as an alternative daily cover (ADC) at landfills, or blended with other combustibles as a refuse derived fuel (RDF) for waste-to-energy (WTE) recovery. With the right equipment, carpet shredding is relatively simple compared to other technologies that require removal of contaminants prior to processing.

1.7.5. WASTE-TO-ENERGY

Carpet can also be recycled into energy at WTE facilities. Although WTE is not the preferred method of disposal, it is acknowledged as a renewable energy source under the Federal Powers Act. By combusting solid waste like carpet into inert, nonhazardous ash, WTE typically generates enough electricity to power its own facilities and sell the balance to local utilities. Waste-to-energy cuts waste volume by 90 percent, preserving dwindling landfill space.

Covanta Energy Corporation, the world's leading operator of large-scale WTE facilities that use municipal solid waste as

fuel to generate renewable energy, has 15 facilities in the United States where old carpet is processed from waste to energy. Carpet is heated in a forced-air furnace at temperatures greater than 1,800 °F (982 °C) to create steam. A generator turns the steam into electricity for the community, reducing the need for fossil fuels.

1.7.6. NYLON RECLAMATION AND PROCESSING

Nylon is the largest single component of the carpet stream. Virgin nylon fiber, the most valuable resin used to make new carpet, commands premium pricing compared to other plastics. Recycled resin production is costly; however, because virgin nylon is made from petrochemicals and consumes natural resources, reclaiming the nylon is a primary driver in carpet recycling.

1.7.6.1. NYLON 6

Currently, Nylon 6 is the only carpet fiber in demand for recycling. Through the chemical process of depolymerization, Nylon 6 carpet can be broken down into caprolactum, the building block for new Nylon 6. In a closed-loop recycling process, these pure fiber resins are then used to make new carpet.

1.7.6.2. NYLON 6,6

Nylon 6,6 requires higher temperatures, pressures, and expensive catalysts to depolymerize. Therefore, Nylon 6,6 carpets are mechanically ground up and contaminants are removed. The material is partially melted into pellets and then sold to automotive parts manufacturers that re-engineer the resin. Closed-loop recycling programs are difficult because Nylon 6,6 is not easily and cost effectively broken down. Many companies are in the process of taking steps to set up this type of program, however, to reduce the use of depletable forms of raw materials.

1.7.7. PET (POLYESTER) AND POLYPROPYLENE RECLAMATION AND PROCESSING

PET carpets may be made of recycled material, but they are not yet recyclable into new products. PET is renewable and, as a fiber, requires no additional petrochemicals to be made into carpet. PET is not valuable enough, however, to justify the cost of separating it from other fibers once it is in a carpet. Therefore, used polyester carpets are typically landfilled.

Polypropylene, by nature of the way it is made, cannot be depolymerized. However, several manufacturers are experimenting with end uses for the polypropylene from carpet backing.

1.8. RECYCLING PROGRAMS

Numerous companies within the carpet industry support reuse and recycling, which has resulted in the independent development of a variety of programs. Four sectors are developing recycling and reuse programs: industry-wide, carpet mills, fiber manufacturers, and private recyclers.

1.8.1 INDUSTRY-WIDE

The carpet industry has been fairly proactive in developing solutions to the environmental concerns inherent with their industry products (Midwestern Workgroup 2000). In January 2002, a voluntary agreement aiming to eliminate landfill disposal and incineration of used carpet was signed by carpet and fiber manufacturers, the Carpet and Rug Institute, state governments, nongovernmental organizations and the U.S. EPA. The National Agreement on Carpet Recycling encourages product stewardship by asking manufacturers to meet goals for reuse and recycling of waste carpet. This approach is expected to reduce the environmental impacts of carpet throughout its life cycle - from design to disposal.

To help manufacturers, material suppliers, and local governments efficiently and cost-effectively recycle and reuse carpet, the carpet industry has established a third-party organization known as the Carpet America Recovery Effort (CARE). The carpet industry will work with government entities through CARE to achieve the goals set forth in the National Agreement on Carpet Recycling.

The industry's primary trade association, the CRI, has also been addressing the challenges of post-consumer recycling. The Carpet Component Identification Code (CCIC) carpet labeling system, first discussed in section 1.6.3, makes the sorting of fiber and backing compounds for the purposes of recycling much easier and more efficient. A large number of manufacturers are now participating.

1.8.2 CARPET MILLS

Today, there are approximately 240 manufacturing plants with 80 percent of the U.S. carpet market supplied by mills located within a 65-mile radius of Dalton, GA (CRI 2001). Recycling

programs offered by carpet manufacturers are typically available only to large commercial and institutional establishments that use a competitive contracting approach for replacing their carpet. The larger carpet manufacturers offer in-house recycling programs when their product replaces other carpet, but these programs are not open to retail (residential and small business) carpet recycling jobs. Collins and Aikman, Milliken, and Interface are the three largest manufacturers of carpet tiles for higher-end, more expensive lines of the carpet market. The following three sections highlight these companies and their initiatives in waste reduction through production of recycled-content carpeting.

1.8.2.1. COLLINS & AIKMAN

Collins & Aikman (C&A) has a program to recycle its own vinyl-backed carpet into vinyl backing for its new carpet. C&A's customers pay the cost of shipping, but do not pay a tipping fee for the materials. Carpet is shredded with the backing materials and sent through an extrusion process. The resulting extruded material is made into backing for new carpet, and reportedly the nylon fibers from the recycled carpet make the new backing stronger than the virgin vinyl backing.

1.8.2.2. MILLIKEN

Milliken restores used carpet tiles to new condition through its Earthwise Ennovations (E²) program. In this three-step program, vinyl-backed carpet tile is removed, redyed, and resold. The carpet tile reused in this program was usually installed by Milliken originally. This program is exclusively for carpet tile; therefore, conventional broadloom carpet with a woven polypropylene backing cannot be reused in this program.

1.8.2.3. INTERFACE

Interface produces 40 percent of the world's commercial carpet tile. Through their innovative Evergreen Lease program, carpet is leased for a monthly fee, and tiles are replaced as they wear out, especially in high traffic areas. This program helps ensure that the tiles are returned to Interface for recycling. Interface also collects other used carpet materials during the installation of its own carpet, regardless of fiber composition. Only the backing material is recycled into new backing and other products, while the Nylon 6,6 is stockpiled for future use.

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1.8.3. FIBER MANUFACTURERS

There are four major nylon fiber manufacturers in the United States: Honeywell, BASF, DuPont, and Solutia. These nylon manufacturers conduct most of the carpet recycling.

1.8.3.1. EVERGREEN NYLON RECYCLING LLC

Evergreen Nylon Recycling LLC (ENR) in Augusta, GA, is the largest market for used carpet. ENR is a joint venture of Honeywell International, Inc. and DSM Chemicals North America, Inc. Honeywell International, Inc. was formed in December 1999 when Honeywell merged with Allied Signal, Inc. ENR recycles 200 million pounds of Nylon 6 carpet per year, which is approximately 20 percent of all used Nylon 6 carpet generated in the United States. A chemical process converts Nylon 6 carpet into caprolactam, the raw material that is used in new carpets. The recycled caprolactam, marketed under the brand name "Infinity," is described as an "infinitely renewable nylon resin."

1.8.3.2. BASF

BASF operates a processing plant in Canada for nylon 6 carpets. The program, called 6ix Again, is based on the recycling of qualifying Nylon 6 carpet fiber into new carpet nylon. This closed-loop process enables nylon fiber to be recycled over and over again. The 6ix Again program is open to all commercial carpet end users throughout the United States and Canada. Other than shipping costs, participation in the program is free. Only carpet made with BASF Nylon 6 face fiber is accepted, and they reserve the right to incinerate what they do not process. New carpets made from this recycling process have been available for some years.

1.8.3.3. DUPONT

DuPont's Partnership for Carpet Reclamation is a collection program for Nylon 6,6 post-consumer carpets that has been in operation since 1991. The plant in Chattanooga, TN, can process both Nylon 6 and Nylon 6,6 carpets, but specializes mainly in processing Nylon 6,6. The recovered Nylon 6,6 is chemically broken down and compounded into a black resin with 25 percent post-consumer recycled nylon. This resin is used for the production of automobile parts, sod reinforcement, and carpet backing.

DuPont collects most of the carpet it needs through commercial carpet installations where the carpet is being replaced by DuPont Antron carpet. DuPont also formed a network of commercial dealers who sell only DuPont products and set up an agreement for them to ship all of the carpet that they remove back to Chattanooga for recycling.

1.8.3.4. SOLUTIA, INC.

Solutia developed a patented technology through their Partner's for Renewal Program that recycles every component of nylon carpet – the face fiber, latex, and backing – into thermoplastic pellets for a variety of automotive and industrial applications. To participate, replacement carpet made with Ultron VIP nylon fiber by Solutia must be specified. All kinds of carpet are accepted, but some types limit the recycling options. Solutia has teamed with one of the world's leading operators of large-scale WTE facilities to recycle carpet into energy.

1.8.4. PRIVATE RECYCLERS

Private recyclers collect carpet from retailers, installers, and municipal collections. ReCycle Solutions in Greenville, SC, is one such company. They collect all types of carpet, padding, cardboard, and tubes throughout the state from counties and large retailers. Clients are supplied with storage trailers that, upon request, ReCycle empties when full. Some private recyclers process and recycle the carpet themselves. Others ship or sell it to processors like Evergreen Nylon Recycling, currently the only company that purchases recovered retail carpet on the open market. For a truckload of Nylon 6 carpet – approximately 45,000 lb – ENR will pay \$2,700.

1.8.5. OTHER

Underfoot Recycling serves manufacturers, dealers, and end users nation-wide with all their carpet-recycling needs by offering a 30 percent reduction in cost per square yard versus current landfill costs. CarpetCycle is an example of a local recycling company that serves both commercial and residential customers in the Dover, NJ area. Ripped up carpet and padding is collected, sorted, and shipped back to either the manufacturer or the recycler.

Appendix B summarizes recycling activities in the carpet industry. The programs mentioned above are included in the appendix table along with the efforts of several other companies involved with carpet recovery.

1.9. CARPET REPLACEMENT

Carpet is replaced because it "uglies out" well before it is actually worn out. Most carpet is engineered to last many years, yet once it is soiled, matted, or out of style, it is often thrown away within 2 to 5 years. Choosing products and services with extended life cycles prevents early disposal, unnecessary waste, and reduces the solid waste burdens on landfills.

1.9.1. MAINTENANCE

Maintenance plays a vital role in efforts to divert material from landfills. Regular maintenance keeps carpet clean and makes it last longer. One of the best ways to benefit the environment is to use products longer before disposal. The longer a product lasts, like carpet, the less it costs. Extending the life of the floor covering increases the value of the investment and delays the environmental impact of any reclamation option.

Facilities spend millions of dollars on buildings' interior design concepts, including carpet, as part of their overall image. Poorly maintained carpet can adversely affect a facility's image, waste thousands of dollars in misdirected cleaning costs, reduce product performance, and accelerate the need for replacement. Regular maintenance makes restorative cleaning unnecessary. Restorative cleaning occurs when carpet has been neglected and its appearance has degenerated to a point where cleaning is an absolute necessity. However, restorative cleaning may not achieve the desired original beauty and appearance of the carpet if the stains and soils are excessive.

Figure A-2 shows two different approaches to carpet maintenance. The Plan A program of consistent, regularly scheduled maintenance shows that the carpet retains most of its original appearance over time. Plan B illustrates that restorative maintenance, performed only after the appearance of the carpet is totally unacceptable, cannot bring carpet appearance back to the levels maintained in Plan A. With Plan B, carpet life is shortened and life-cycle costs are increased.

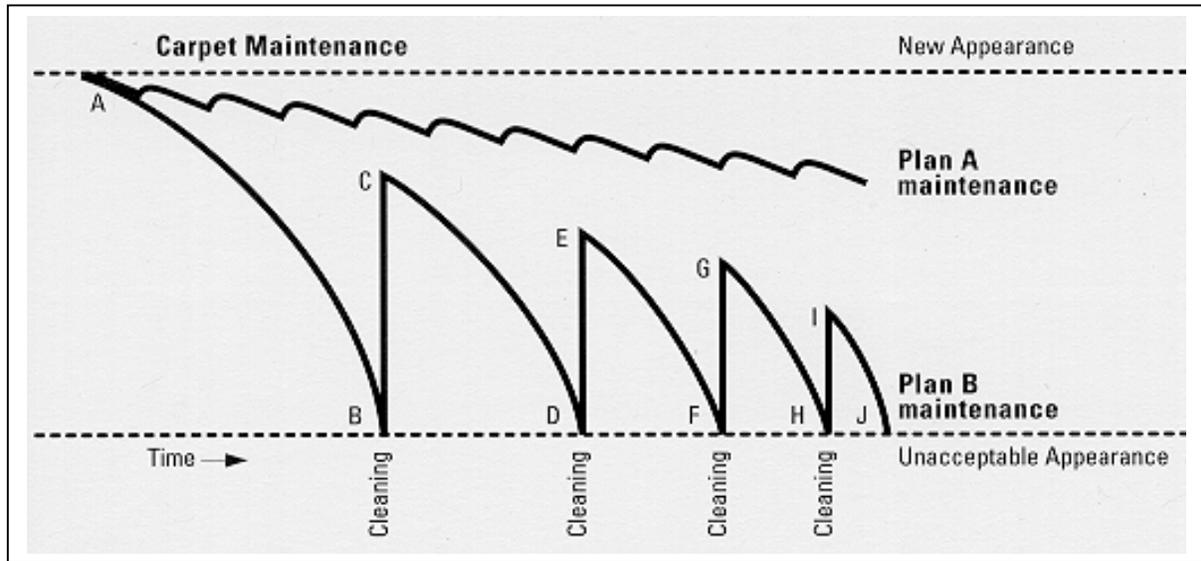


Figure A-2. Carpet Maintenance Plans (Source: DuPont 1996).

A consistent, well-planned maintenance program can extend the life of the carpet by removing dirt before it can build up. For a high-quality carpet, a program of consistent maintenance that extends the life as long as possible is usually the most economical and pays carpet dividends as well. Figure A-3 shows two alternatives illustrating this point.

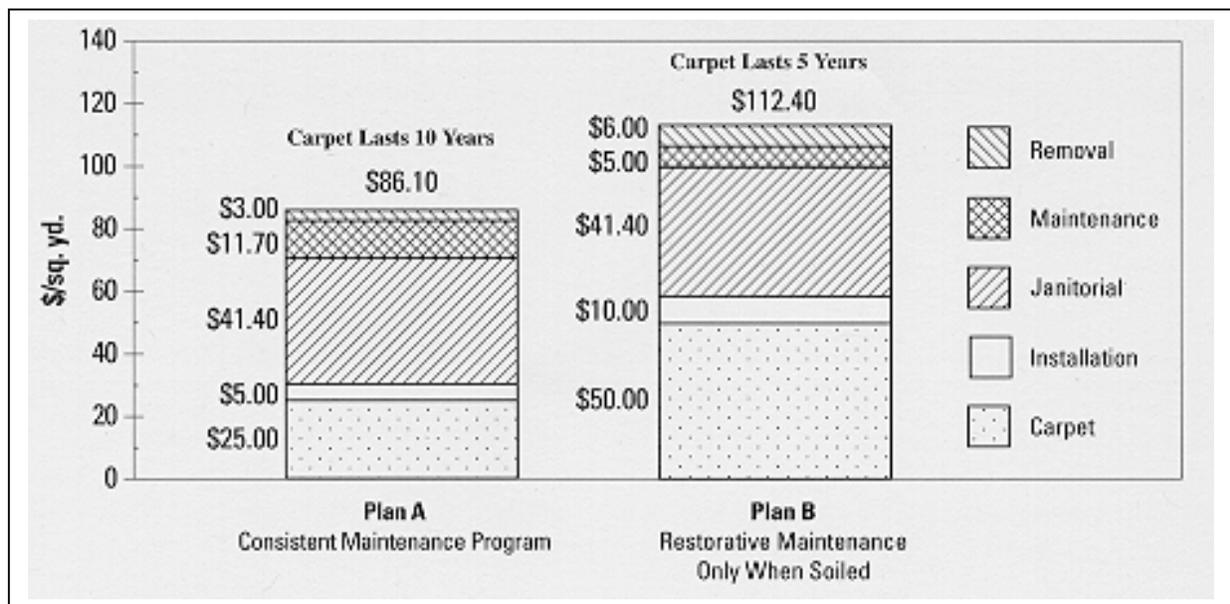


Figure A-3. Total Life Cycle Cost. Consistent Maintenance vs. Restorative Maintenance Over 10-Year Time Horizon (Source: DuPont 1996).

This example assumes quality carpet with an initial purchase price of \$25 per square yard and installation costs of \$5 per square yard. Janitorial vacuuming is conservatively estimated to cost \$0.46 per square foot (\$4.14 per square yard) annually. Removal, disposal, and floor prep costs are estimated at \$3 per square yard. Furniture moving and business disruption costs, which can be quite sizable, are not included here.

Plan A is a consistent program of carpet maintenance with quarterly cleaning of the 10 percent high traffic areas and an annual cleaning for the other 90 percent of the facility. Assuming cleaning cost of \$0.10 per square foot per cleaning, annual costs are \$1.17 per square yard. With Plan A, the carpet is expected to last 10 years before replacement is needed.

Plan B is for restorative cleaning only when the carpet is soiled. For purposes of illustration, 10 percent of the facility would have a restorative cleaning once per year and the remaining 90 percent would be cleaned every 2 years. Cleaning costs would be the same, again \$0.10 per square foot per cleaning or \$0.50 per square yard per year. With Plan B, the carpet will need to be replaced in 5 years.

Over a 10-year period with Plan A, carpet purchase, installation and removal costs would occur only once. With Plan B, these same costs would be incurred twice. Although maintenance costs for Plan B are less than half those of Plan A, total costs are \$26.30 per square yard less for Plan A than for Plan B (\$86.10 vs \$112.40) over a 10-year period. By purchasing and investing in a high quality carpet and installation, maintaining and prolonging the useful life of that investment pays off.

When carpet underperforms because it was poorly maintained, it becomes a needless replacement expense. Realistic maintenance budgets should be developed and included in the specifications if possible. By outlining a carpet maintenance program, an accurate life-cycle cost projection is possible.

1.9.2. LIFE-CYCLE COSTS

Life-cycle costing calculates the true cost of carpet over time to determine the best value for the money. Life-cycle costs should take into consideration the initial cost of installed carpet, its useful life, installation costs, maintenance expenses (labor, cleaning supplies and equipment), removal/disposal costs, plus lost revenues during rehabilitation and maintenance costs over the life of the carpet. The "useful life" of carpet should reflect the years the carpet is expected

to be on the floor, rather than the length of time it will take for the carpet to wear out. Renovation and scheduled refurbishing of the facility generally occur even if the carpet is not worn out.

Long carpet life begins with proper selection of carpet for the specific application, giving consideration to both aesthetics and maintainability. An inexpensive carpet cannot match the durability, performance, and appearance retention of a better grade carpet. **Looking at life-cycle costing to determine the relative value of a better grade of carpet is the best idea.**

1.9.3. CARPET SPECIFICATIONS

When carpet is chosen for floor covering, whether in a remodeling project or new construction, any negative environmental impact that might result because of its use can be mitigated through appropriate requirements in the procurement specifications. Specifying the appropriate carpet materials and installation methods with the intent to recycle can facilitate recycling. The latest Unified Facilities Guide Specification (UFGS) 09680A, Carpet, October 2000, has several provisions included that cover the recycling and reuse of carpet materials as addressed in this Technical Bulletin. However, the Architectural and Engineering Instructions (AEI), Army Family Housing, dated 1 November 1996, does not. The AEI specifically requires 100 percent branded continuous filament nylon carpet material. If using the AEI guidance to develop the procurement specifications for carpet, require, where practical, the use of nylon fiber carpet with a recycled material content per the guidance in UFGS 09680 and this Technical Bulletin. In addition, also require the use of carpet cushion containing recovered materials.

The UFGS 09680 has provisions for the use of recycled PET polyester fiber faced carpet. A note of caution must be given here. Generally, it is known that polyester carpet does **not** wear as well as other carpet types, especially nylon. Recent statements have been made that a premium polyester carpet will wear just as well as a nylon carpet. These statements are not substantiated and in an environment of low-bid procurement, the likelihood of getting a "premium" polyester carpet, if polyester carpet is allowed as an option, is considered remote. Even if a premium polyester carpet is used in a residential application, its use in high-traffic hallways and stairs is not advisable. Some environmental regulators are pushing the use of carpet made from recycled PET (such as the EPA's Comprehensive Procurement Guidelines to be addressed later). However, if a recycled PET

carpet is selected just to satisfy this guideline but fails prematurely due to inappropriate application for the expected exposure, the end result is a negative environmental effect. This is especially true since this prematurely failed carpet cannot be easily recycled into another high-value product, and certainly not into another carpet.

The UFGS encourages using programs for carpet reclamation. Dupont's carpet reclamation program and a specification regarding this program can be found on their web site at <http://antron.dupont.com>. The following provisions should also be considered for inclusion in any carpet procurement specification:

- Require old carpets be cleaned prior to removal to allow offering to charitable organizations.
- Require a recycling guarantee.

1.9.4. CHOOSING CARPET

Several environmentally responsible carpet choices each have their own merits and considerations, and choices will depend on specific need, location, and use. Purchasing a carpet with recycled content backing that is recyclable is worth considering. Sixty percent of the carpet material is backing, which is made of plastics from petroleum, a nonrenewable resource associated with high-energy consumption and pollution.

The use of recycled content in carpets reduces solid waste. Environmentally responsible carpet should include a face fiber with some post-industrial or post-consumer recycled content. Recycled content carpet fiber is said to be more resilient and colorfast than virgin fiber carpet. Recycled content carpet has the same look, feel, and price as virgin fiber carpet, but takes advantage of post-consumer recycled material.

How and where the carpet will be used is very important to selection. Carpet with recycled PET from soda bottles is durable and naturally stain resistant, and is a better choice for residential needs. When deciding on new carpet, consider not only recycled content but recyclability. Most carpets produced today can be recycled or down-cycled to some degree.

Require a recycling guarantee by adding a section on carpet reclamation and recycling to your project specifications. DuPont has a sample specification with language for recycling carpet included. By including a reclamation specification in

project documentation, you can be confident that the contractor removing the old carpet will not send it to a landfill. Specifications would include utilizing a dealer or installer in your area that routinely recycles. Mandate in the specification that the contract winner is responsible for providing proof in writing that the removed carpet was not landfilled. Companies that are certified according to ISO 14000ff must demand such a recycling guarantee.

Look for the CRI's Green Label when selecting carpet. This labeling program has been developed to assist consumers in the selection of low-emitting carpet, cushion, and adhesives. The CRI Indoor Air Quality Carpet Testing Program green and white logo displayed on carpet samples in showrooms informs the consumer that the product type has been tested by an independent laboratory and has met the criteria for very low emissions.

Perhaps the best environmental choice is to use carpet only where necessary and maintain and clean it properly so that its maximum life is realized. Frequent and good maintenance is the key to long lasting and good-looking carpet. Using carpet tiles rather than rolls aids in spot replacement and longer life. Leasing carpet is a relatively new idea in floor covering, putting the responsibility for carpet maintenance and replacement on the manufacturer. Leased carpet is typically recycled at the end of its lease period, making this an environmentally preferable option.

1.10. EPA PROCUREMENT GUIDELINES

The Comprehensive Procurement Guideline (CPG) program is part of EPA's continuing effort to promote the use of materials recovered from solid waste. Buying recycled-content products ensures that the materials collected in recycling programs will be used again in the manufacture of new products. EPA is required to designate products that are or can be made with recovered materials, and to recommend practices for buying these products. Once a product is designated, procuring agencies are required to purchase it with the highest recovered material content level practicable. For information on or copies of the CPG, contact EPA's RCRA Hotline at 800-424-9346 or access EPA's CPG Web site at <http://www.epa.gov/cpg>.

1.10.1. CARPET

The definition of recycled carpet may be different among manufacturers. Some call their carpet recycled if the backing is recycled, while others focus on the face fiber. The EPA has

designated carpet as an affirmative procurement item, and defines recycled carpet as having at least 25 percent of the face fiber manufactured from PET.

Table A-3. CPG Recycled Content for Carpet. (Source: EPA 2001)

Product	Material	Post-consumer Content	Total Recovered Materials Content (%)
Polyester Carpet Face Fiber	PET	25-100	25-100

EPA recommends that procuring agencies establish minimum content standards for use in purchasing polyester carpet **for light- and moderate-wear applications**. This recommendation does not include polyester carpet for use in **heavy-wear or severe-wear applications**. However, procuring agencies are encouraged to evaluate the suitability of polyester carpet in these applications (EPA 2001).

EPA recommends that procuring agencies use the U.S. General Services Administration's (GSA's) contract GS-27F-5069-C, Federal Supply Schedule 72, Part I, Section A, to purchase polyester carpet containing recovered materials and that agencies currently limiting carpet materials to nylon, wool, or other materials consider adding polyester, where appropriate, to enable them to procure carpet containing recovered materials (EPA 2001).

1.10.2. CARPET PADDING

EPA's recommendations do not preclude a procuring agency from purchasing another type of carpet padding. However, when purchasing bonded polyurethane, jute, synthetic fiber, or rubber carpet cushions, agencies should consider these items made with recovered materials when these items meet applicable specifications and performance requirements (EPA 2001).

Table A-4. CPG Recycled Content for Carpet Padding. (Source: EPA 2001)

Product	Material	Post-consumer Content (%)	Total Recovered Materials Content (%)
Bonded polyurethane	Old carpet cushion	15-50	15-50
Jute	Burlap	40	40
Synthetic fibers	Carpet fabrication scrap	--	100
Rubber	Tire rubber	60-90	60-90

The GSA Federal Supply Schedule lists contracts for floor coverings including listings for recycled carpet and recycled

carpet programs. These listings can be found in Federal Supply Schedule 72, Part I, Section A.

1.10.3. WHAT'S NEW

New developments include carpets made from Corterra fibers, the trade name for polytrimethylene terephthalate (PTT). This thermoplastic can be spun into fibers and yarns that are hard wearing and inherently stain resistant and easy to clean. Corterra fibers feel like wool and perform as well as or better than Nylon 6,6. These carpets will wear better and last longer than Nylon 6,6 carpets, thus requiring replacement less often. When the time comes, these carpet fibers have the potential to be easily recycled with an established industry program in place.

A variety of actions would change the attractiveness of recycling nylon carpet. The industry is changing manufacturing processes to make carpet more recyclable, as well as improving technology for carpet recycling. Government actions to ban discarded carpets from landfills would force manufacturers to take back and recycle their carpets. Refusing to collect discarded carpet with municipal solid waste (MSW) would force individuals or stores selling replacement carpet to deliver the discarded carpet to a recycler.

2. CEILING TILE

Since their invention in the 1920s, acoustical ceiling tiles have become more and more prevalent in construction. Next to carpet, ceiling tile is one of the most expensive investments in building materials requiring maintenance. Ceiling tiles often become discolored and need to be replaced for aesthetic reasons. A program exists for recycling ceiling tiles as does a process for re-facing tiles to avoid disposal in a landfill.

2.1. RECYCLING

Armstrong World Industries, Inc. operates a ceiling tile reclamation program through which they recycle old ceiling tiles into new. Armstrong recycles acoustical ceiling tiles from commercial building renovations, adding the old tiles to the slurry used for manufacturing new ones. The program involves three steps. First, Armstrong must verify that the old ceiling tiles can be recycled. Neither the old tiles nor the new replacement tiles need to be Armstrong products to qualify for the program. Then, old tiles must be stacked on pallets and wrapped for pick-up. Once a trailer of old ceiling tiles is

full (30,000 square feet or more), Armstrong is contacted and arrangements are made for a truck to pick up the material anywhere in the continental United States. Armstrong pays the freight for shipment to the plant. The costs incurred for removing and handling the tiles for recycling are competitive with landfill disposal costs. A recent time analysis proved that the process for recycling old ceilings was nearly as fast as dumping them, so the program should have little, if any, adverse impact on renovation or demolition schedules.

2.2. RECYCLED CONTENT CEILING TILES

Ceiling tiles have been around for a long time and, from the beginning, these products have used recycled materials because they have been inexpensive and widely available (King County 1998). All Armstrong ceiling tiles contain recycled materials. While a portion of the content is old scrap ceiling tiles, the company also uses waste products from other industries, specifically newsprint and mineral wool, a byproduct of steel production. Other companies are making ceiling panels out of natural fibers that can be easily recycled. Affordable Building Systems LLC has a plant in Texas where several different types of compressed straw panels are being produced from an agricultural waste material. Tectum acoustical ceiling tiles have been manufactured in Ohio since 1949 with natural wood fiber produced by shredding thin wood strands of aspen trees. Panel waste from renovation or demolition is nontoxic. As an alternative to landfilling this waste, the panels can be ground up and composted to produce a soil amendment.

2.3. RE-FACING

Acoustic Enterprises, Inc. has a patented process to re-skin ceiling tile and make them look new. This process reduces replacement costs, improves utility usage and preserves valuable landfill space by extending the life of current ceiling tiles by 15 years.

3. CONCLUSION/RECOMMENDATIONS

In today's world, where the demand for what is new prevails, it is difficult to persuade the public to make recycling and reusing part of their everyday lives. Carpet and other building products (e.g., acoustical ceiling tiles) are being discarded and replaced with new. The motivation behind recycling programs is based on economics. Currently only about one percent of used carpet is being recycled while over 3 billion pounds of discarded carpet waste goes into landfills each year.

Therefore, improving the economic feasibility of diverting millions of pounds of carpet from landfills annually is a major issue that needs to be addressed.

Today, government legislation, the costs for landfill space, and increased public awareness have moved companies towards green engineering and recycling. Arguments can be made for having the consumer, manufacturer, or both be responsible for making sure building product is recycled at the end of its useful life. Unfortunately, while this issue is being discussed, landfills are accepting material that does not have to be there. Lack of space will mean the types of material accepted into landfills will begin to decrease, and it is very possible that landfilling will be restricted to materials that cannot be disposed of in any other manner.

The growing concern for the environment has prompted recycling efforts in many directions. Consumer demand for products that contain recycled components has carpet and fiber producers pursuing programs that reduce, reuse, and recycle raw materials. Research is ongoing into the life cycle of carpet and better ways to manufacture durable carpet as well as new technologies that will eliminate the energy costs associated with production, use, and reuse of carpet products.

In summary, options to consider include:

- (1) Use carpet made with recycled materials.
- (2) Use carpet cushion made from recycled materials.
- (3) Select the fiber type and construction appropriate for the application. Polyester carpets should not be used in any high traffic wear areas.
- (4) Use a program that reconditions and restores old carpet or ceiling tiles for reuse.
- (5) Use a program that sends old carpet or ceiling tiles back to the manufacturer for recycling, rather than to landfills.
- (6) Use regular cleaning and other maintenance to maximize the useful life of carpets and ceiling tiles.

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APPENDIX B: Recycling Activities in the Carpet Industry

The information here is accurate to the best of our knowledge. Inclusion in this listing does not represent an endorsement by the U.S. Army Corps of Engineers.

A&M Carpet

160 E. Bullard Ave.
Fresno, CA
(559) 448-1000
4230 W. Shaw Ave.
Fresno, CA
(559) 276-4222
www.amcarpet.com/recycled.html

A&M recycles foam padding by sending old materials back to the manufacturers where it is reprocessed.

Atlas Carpet Mills

2200 Saybrook Avenue
City of Commerce, CA 90040
(213) 622-2314
(800) 372-6274
www.atlascarpetmills.com

Carpets using DuPont's Antron recyclable nylon fiber

Barnet USA

William Barnet & Son, LLC

1300 Hayne Street
P.O. Box 131
Arcadia, SC 29320
(864) 576-7154
www.barnet.com

Buys, supplies, processes and recycles fibers, polymers and yarns worldwide. Uses carpeting and rugs for

concrete/asphalt/paper reinforcement and polymer compounds.

BASF Corporation

(800) 477-8147
www.basf.com

6ix Again nation wide program to take back carpet at the end of its useful life for recycling. Accepts only residential and commercial carpet made with Zeftron.

Beaulieu of America

(800) 227-7211
(800) 627-4536
www.beaulieu-usa.com/INDEX.HTM

The Caladium Division converts PET (plastic) bottles to carpet fiber and markets residential carpet made with 100 percent recycled PET recovered from the bottles.

Big Bob's New and Used Carpet

(913) 782-1991
www.bigbobscarpet.com

Has franchises in 18 states that clean old carpet and resell it to the public.

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**Burlington Industries, Lees
Carpets**

(540) 258-2811 x436
www.lees-carpets.com

Partnership for Carpet
Reclamation Program, offering
recycling or reuse applica-
tions for any carpet removed
from the job site. Lees
performance product line is
warranted for life thus
reducing the frequency of
carpeting being landfilled.

CarpetCycle

447 Schiller Street
Elizabeth, NJ 07206
(908) 353-5900
www.carpetcycle.com
(973) 659-9595

Provides rip-up and haul-away
service, or collection after
carpet has been ripped up for
a \$50 flat fee. Carpet and
padding materials are baled
and shipped to plants where
they are recycled.

Carpet Cushions Associates

1248 Palmetto ST.
Los Angeles, CA 90013
(800) 244-6977

All cushions contain 100%
recycled materials and can be
recycled again. Ultimate
Pinnacle made from 100%
polyester derived from
recycled plastic bottles;
Dura, containing 92% recycled
rubber tire tread; Ultimate,
made from natural fiber coated
in corn-based polymer.

Carpet Solutions, Inc.

1406 SE 10th Street
P.O. Box 150219
Cape Coral, FL 33915-0219
(941) 574-5394
www.millijack.com

Underfoot Recycling gives new
life to old carpet by offering
carpet tile restoration to be
resold as used to various
commercial markets or donated
to charities. Underfoot
offers a 30% reduction in cost
per square yard vs current
landfill costs.

C'Board

Thomson, GA

A company contracted to handle
the initial receiving,
sorting, and separating of
used carpet.

Collins & Aikman

311 Smith Industrial Boulevard
P.O. Box 1447
Dalton, GA 30722-1447
(800) 248-2878
www.powerbond.com

They will take vinyl-backed
carpet at the end of its
useful life (regardless of
original manufacturer) and
guarantee that all of it will
be recycled into floor
coverings. Infinity
Initiative Program is a 10-
step closed-loop recycling
program. All C&A products can
be recycled again and again
after their 15-20 year life.

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Dixie Manufacturing

110 Colley Avenue
Norfolk, Virginia 23510
(800) 868-3494
(757) 625-8251
www.carpet-cushion.com

Natural fiber & Summit high performance carpet cushion made with jute reclaimed from various forms of burlap.

DuPont Flooring Systems

(770) 420-7791
(800) 4-DUPONT
www.antron.dupont.com

The DuPont Carpet Reclamation Program for post-consumer recycling of carpet into building materials, automotive parts and other applications. None of the collected materials go to landfills.

Evergreen Nylon Recycling LLC

804-520-3165
877-N6-CYCLE
www.n6recycling.com

Recovery of post-consumer Nylon 6 carpet purchased through third-party collectors. Large-scale closed-loop nylon recycling facility located in Augusta, GA.

Feltex

www.feltex.com

Natural Wool Carpet using TacFast. ISO 9001 accredited manufacturer of carpets that

comply with the 'Environmental Choice' production requirements.

Foamex Carpet Cushion

1000 Columbia Avenue
Linwood, PA 19061
Tel: 610 859-3000
800 497-3626
www.foamex.com

Natural felt carpet cushion

Synthetic felt carpet cushion

Textile fiber carpet cushion

Bonded carpet cushion

Prime polyurethane and rubber carpet cushion

Honeywell International, Inc.

15801 Woods Edge Road
Colonial Heights, VA 23834
Phone: (804) 520-3584
800-707-4555
www.honeywell.com

See Evergreen Nylon Recycling. Overall program to recycle post-industrial waste, post-consumer waste, and provide recycled content carpet fiber. (Formerly Allied Signal)

Image Industries

800-722-2504
www.mohawkcarpets.com

Carpets with 100% recycled PET as carpet face fibers and also a combination of PET fibers and nylon.

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Interface, Inc.

800-336-0225
www.interfaceinc.com
www.resource-americas.com

ReSource (for post-consumer products) to eliminate waste and move toward environmental sustainability through repurposing, recycling, and waste to energy.

J&J Industries, Inc.

706-278-4454
www.jj-invision.com
63.73.204.71/home/home.asp

EnAct is an extensive program for minimization, reuse, and recycling of manufacturing waste. Encore SD Ultima nylon with 15% recycled content.

MilliCare Environmental Services

1-888-88M CARE
www.millicare.com

Perpetual floor plan called Earth Square that rejuvenates and restyles modular carpet. A division of Sylvan Chemical Co.

Milliken & Company

201 Lukken Industrial Drive
LaGrange, GA 30240
706-880-3221
www.earthsquare.com
(877) E2-RENEW

Carpet tiles are returned for reconditioning, including

cleaning, retexturizing and imprinting of a new pattern.

Mohawk Industries, Inc.

500 TownPark Lane #400
Kennesaw, GA 30144
770/792-6300
(800) 622-6228
(800) 553-6045 x 2247
(800) 554-6637
www.mowhawkcarpet.com

Stated commitment to ongoing recycling of manufacturing waste as well as active energy conservation. Commercial divisions participate with BASF in the 6ix Again programs.

Monsanto

320 Interstate North Parkway
Atlanta, GA 30339
800-543-5377

Partners for Renewal program has technology that recycles every component of nylon carpet - the face fiber, latex and backing - into thermoplastic pellets for a variety of automotive and industrial applications. Also substitution of carpet for fossil fuels to generate energy.

Musgrave Carpet Recycling

848 Eagle Drive
Bensenville, IL 60106
(800) 839-7900
(630)860 0301

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Collects used carpeting and associated materials for resale.

RD Weis Companies

1-800-215-8605

Serves the Northeast (NY, NJ, CT, MA)

Old carpet cleaned and reinstalled or recycled through private arrangement with BASF.

SelectTech

Tauton, MA
(877) 738-4537
888-738-4537

Heavy duty flooring product made from used carpet recycled through the DuPont Carpet Reclamation Program. RepTile is an industrial strength floor tile, containing 50% post-consumer recycled carpet

Shaw Industries, Inc.

706-278-3812
www.shawinc.com
706-275-4971
888-738-4537
(800) 441-7429

The largest producer of polypropylene yarn in the world. Recycles old carpet and supplies recycled content carpet. Developing a national infrastructure capable of collecting and recycling 250 million pounds of used carpet yearly.

Solutia, Inc.

320 Interstate North Parkway
Suite 500
Atlanta, GA 30339
(770) 951-7600
800-543-5377
www.ultronvip.com
www.solutia.com

"Partner's for Renewal" carpet recycling program for reuse and recycling of nylon and other waste at all manufacturing sites. Post-consumer efforts include WTE program with Ogden Martin Company.

Talisman Mills, Inc.

6000 W Executive
Mequon, WI 53092
Phone: (262) 242-6183
Fax: (262) 242-6751
Toll-free: (800) 482-5466
envirelon@aol.com

100% of the yarn used to produce Envirelon Commercial Carpet is extruded and spun from recycled PET from soft drink bottles.

Terra Technologies

LaGrange, GA

Old backing material from carpet tile is processed and turned into new backing material.

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wTe Corp.

Corporate Headquarters
7 Alfred Circle
Bedford, MA 01730
Tel: (617) 275-6400
E-Mail: dbswte@aol.com
www.wte.com

Investigated the viability of
using old carpet as fuel
supplement to coal in large
industrial and utility
boilers.

**APPENDIX C: Suppliers of Construction Products Containing
Recovered Materials**

This list helps buyers identify carpet, carpet cushion, and acoustical ceiling tile products made with recycled materials. The information here is accurate to the best of our knowledge. No effort has been made to investigate the performance of the products listed. Inclusion in this listing does not represent an endorsement by the U.S. Army Corps of Engineers.

CARPET

Belting Associates, Inc.

148 Lauman Lane
Hicksville, NY 11801
(516) 433-2828
(800) 433-2828

Central Vermont Carpet

R.R. 3, Airport Road
Barre, VT 05641
Contact: Stevan Parks
(802) 223-6252

**Collins & Aikman
Floorcoverings**

311 Smith Industrial Boulevard
P.O. Box 1447
Dalton, GA 30722-1447
(706) 259-2039
(800) 248-2878

**Environmental Building
Supplies**

1331 Northwest Kearney
Portland, OR 97209
(503) 222-3881

Forum Contract Carpet

3358 Carpet Capital Drive
Dalton, GA 30720
(706) 277-3066

Image Industries

P.O. Box 5555
Armuchee, GA 30105
(706) 235-8444 (800) 722-2504

Marglen Industries, Inc.

735 Broad Street, Suite 210
Chattanooga, TN 37402
(423) 265-5050

Martin Color-Fi

P.O. Box 469
Edgefield, SC 29824
(803) 637-7000
(800) 843-6382

Talisman Mills, Inc.

6000 West Executive Drive
Mequon, WI 53092
(414) 242-6183
(800) 482-5466

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CARPET CUSHION

Carpenter Company

P.O. Box 27205
Richmond, VA 23261
(804) 359-0800

Casa Reclaimed Rubber Products, Inc.

52 High Street
Bedford, Nova Scotia B4A 1M5
Canada
(902) 835-0143

Chris Craft International Products, Inc.

P.O. Box 70
Waterford, NY 12188
(518) 237-5850

Collins & Aikman Floorcoverings

311 Smith Industrial Boulevard
P.O. Box 1447
Dalton, GA 30722-1447
(706) 259-9711
(800) 248-2878

Dixie Manufacturing Corporation

100 Colley Avenue
Norfolk, VA 23510
(757) 625-8251

DURA Undercushions, Ltd.

8525 Chemin Delmeade Road
Montreal, Quebec H4T 1M1
Canada
(514) 737-6561

The Fairmont Company

2245 West Pershing Road
Chicago, IL 60609
(312) 376-1300
(800) 621-6907

Gaia Technologies

4710 Bellare Boulevard, #310
Bellare, TX 77401
(713) 661-5774

Leggett & Platt

100 Leggett Drive
Villa Rica, GA 30180
(770) 459-1800

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CEILING TILES

Armstrong World Industries

P.O. Box 3001
Lancaster, PA 17604
717-397-0611

Bio Fab

P.O. Box 990556
Redding, CA 96099
(916) 243-4032

Celotex Corporaton

P.O. Box 31602
Tampa, FL 33631
(800) 622-6061
(800) 227-1216

Fiber Rock Canada

5149 Durham Road 30
Uxbridge, ON L4A 7X4
Canada
(905) 640-8051

Martin Fireproofing Georgia, Inc.

P.O. Box 768
Elberton, GA 30635
(706) 283-6942
(800) 766-3969

Tectum, Inc.

P.O. Box 3002
Newark, OH 43058-3002
(614) 345-9691

USG Interiors Inc.

125 S. Franklin St.
Chicago, IL 60606-4605
(312) 606-4000

USG Interiors Inc.

35 Arch St.
Cloquet, MN 55720
(218) 879-2800

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