BACKGROUND DOCUMENT FOR PROPOSED CPG IV AND DRAFT RMAN IV

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I. INTRODUCTION

A. History

Section 6002(e) of RCRA requires EPA to designate items that are or can be made with recovered materials and to recommend practices to assist procuring agencies in meeting their obligations with respect to designated items under RCRA section 6002. After EPA designates an item, RCRA requires that each procuring agency, when purchasing a designated item, must purchase that item composed of the highest percentage of recovered materials practicable.

Executive Order 13101 (Executive Order) establishes the procedure for EPA to follow in implementing RCRA section 6002(e). Section 502 of the Executive Order directs EPA to issue a Comprehensive Procurement Guideline (CPG) that designates items that are or can be made with recovered materials. Concurrent with the CPG, EPA must publish its recommended procurement practices for purchasing designated items, including recovered materials content levels, in a related Recovered Materials Advisory Notice (RMAN). The Executive Order also directs EPA to update the CPG every 2 years and to issue RMANs periodically to reflect changing market conditions. The first CPG (CPG I) was published on May 1, 1995 (60 FR 21370). It established 8 product categories, designated 19 new items, and consolidated 5 earlier item designations. The first CPG update (CPG II) was published on November 13, 1997 (62 FR 60962) and designated an additional 12 products. The second CPG update (CPG III) was published on January 19, 2000 (65 FR 3070) and designated an additional 18 products. Today, in CPG IV, EPA is proposing to designate the following 11 additional items:

Vehicular Products
Rebuilt vehicular parts
Tires

Construction Products
Cement and concrete containing cenospheres
Cement and concrete containing silica fume
Modular threshold ramps
Nonpressure pipe
Nylon carpet and nylon carpet backing
Roofing materials

Non-Paper Office Products
Office furniture

Miscellaneous
Bike racks
Blasting grit

B. Contents of These Supporting Analyses

This document, hereafter referred to as the proposed CPG IV/Draft RMAN IV background document, explains EPA's overall objectives, the process for designating procurement items, and the methodology used in recommending recovered materials content levels for items designated in the proposed CPG IV. In addition, the proposed CPG IV/Draft RMAN IV background document lists the recommended procurement practices for designated items.

Also for the reader's convenience, the table below lists acronyms referenced throughout this document.

Table 1
List of Acronyms

Acronym	Term
AASHTO	American Association of State Highway and Transportation Officials
ABA	Architectural Barriers Act
ABS	Acrylonitrile-Butadiene-Styrene
ACAA	American Coal Ash Association
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ADA	Americans With Diabilities Act
ANSI	American National Standards Institute
APP	Affirmative Procurement Program
APRA	Automotive Parts Rebuilders Association
APWA	American Public Works Association
ARMA	Asphalt Roofing Manufacturers Association
ASTM	American Society for Testing and Materials
BIFMA	Business and Institutional Manufacturers Association
BOF	Basic Oxygen Furnace
BPIA	Business Products Industry Association
C&D	Construction and Demolition Debris
CDA	Copper Development Association
CFR	Code of Federal Regulations
CIWMB	California Integrated Waste Management Board
CPG	Comprehensive Procurement Guideline
CRI	Carpet and Rug Institute
DIAR	DOI Acquisition Regulations
DLA	Defense Logistics Agency

Acronym	Term
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
DWV	Drain, Waste, Vent (Pipe)
EAF	Electric Arc Furnace
EPA	U.S. Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer
FR	Federal Register
FTC	Federal Trade Commission
GGBF	Ground Granulated Blast Furnace Slag
GSA	U.S. General Services Administration
HDPE	High Density Polyethylene
HPC	High Performance Concrete
HUD	U.S. Department of Housing and Urban Development
IDA	Illinois Department of Agriculture
LRFD	Lead and Resistance Factor Design
MCPS	Montgomery County Public Schools
MDF	Medium Density Fiberboard
MHD	Massachusetts Highway Department
MSW	Municipal Solid Waste
NASA	National Aeronautical and Space Administration
NAVFAC	Navy Facilities Programming and Construction Division
NCHRP	National Cooperative Highway Research Program
NEMA	National Electrical Manufacturers Association

Acronym	Term
NHS	National Highway System
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute for Testing and Materials
NPS	National Park Service
NRC	National Recycling Coalition
NRCA	National Roofing Contractors Association
NRCS	Natural Resource Conservation Service
OA	U.S. EPA Office of Administration
OCPS	Orange County Public Schools
OEM	Original Equipment Manufacturer
OFPP	Office of Federal Procurement Policy
OFRF	Office Furniture Recyclers Forum
OSHA	Occupational Safety and Health Administration
PBS	Public Broadcasting Service
PET	Polyethylene Terephthalate
PP	Polypropylene
PPI	Plastic Pipe Institute
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act of 1976
RIC	RCRA Information Center
RMAN	Recovered Materials Advisory Notice
SFC	Silica Fume Coalition
SSPC	Society for Protective Coatings
SRI	Steel Recycling Institute
SSL	Soil Screening Level

Acronym	Term
STMC	Scrap Tire Management Council
STP	Surface Transportation Program
TEA	Transportation Equity Act
TWA	Time Weighted Average
UFAS	Uniform Federal Accessibility Standards
UL	Underwriters Laboratories
UNICOR	Federal Prison Industries
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USPS	U.S. Postal Service
UV	Ultraviolet
VDOT	Virginia Department of Transportation
WSBCC	Washington State Building Code Council

II. BACKGROUND

A. Requirements

The Resource Conservation and Recovery Act (RCRA or the Act) section 6002 and Executive Order 13101 (Executive Order) specify requirements for the procurement of products containing recovered materials. The requirements of RCRA section 6002 apply to "procuring agencies," as defined in RCRA section 1004(17); the Executive Order applies only to federal "executive agencies," as defined in section 202 of the Executive Order.

Section 6002(e) of RCRA requires EPA to designate items that are or can be made with recovered materials and to recommend practices to assist procuring agencies in meeting their obligations with respect to the procurement of designated items under RCRA section 6002. After EPA designates an item, RCRA requires that each procuring agency, when purchasing a designated item, must purchase that item composed of the highest percentage of recovered materials practicable.

The Executive Order specifies the procedure for EPA to follow in implementing RCRA section 6002(e). Section 502 of the Executive Order directs EPA to designate items in the CPG and to recommend procurement practices for purchasing designated items, including recovered materials content levels, in a related RMAN. The Executive Order also directs EPA to update the CPG every 2 years and to issue RMANs periodically to reflect changing market conditions.

The following sections provide an overview of RCRA section 6002 and the Executive Order and explain the basis for designating specific products as procurement items subject to RCRA section 6002. Appendix I contains a summary of the generation and recovery of materials in the solid waste stream. Appendix II provides a more detailed explanation of the provisions and requirements of RCRA section 6002. Appendix III provides additional details on the Executive Order. Appendix IV briefly discusses additional federal procurement policies and requirements, and Appendix V explains RCRA Section 6002 requirements for agencies to use in developing affirmative procurement programs.

1. RCRA Section 6002

RCRA section 6002 requires EPA to designate items that are or can be made with recovered materials and to recommend practices to assist procuring agencies in purchasing the designated items. Once an item is designated by EPA, procuring agencies that use appropriated federal funds to purchase the item are required to purchase it containing the highest percentage of recovered materials practicable (and in the case of paper, the highest percentage of postconsumer recovered materials), taking into consideration the limitations set forth in section 6002(c)(1)(A) through (C) (i.e., competition, price, availability, and performance). The requirement applies when the purchase price of the item exceeds $10,000 or when the total cost of such items, or of functionally equivalent items, purchased during the preceding fiscal year was $10,000 or more.

RCRA section 6002(d)(2) requires that, within 1 year after EPA designates an item, federal agencies revise their specifications to require the use of recovered materials to the maximum extent possible without jeopardizing the intended end use of the item. Section 6002(d)(1) further requires federal agencies responsible for drafting or reviewing specifications to review all of their product specifications to eliminate provisions prohibiting the use of recovered materials and requirements specifying the exclusive use of virgin materials. To comply with section 6002(d)(2), the revision process for items designated in CPG IV should be completed within 1 year after the final CPG IV is published in the *Federal Register*.

Once EPA designates an item, responsibility for complying with RCRA section 6002 rests with the procuring agencies. For each item designated by EPA, RCRA section 6002(i) requires each procuring agency to develop an affirmative procurement program (APP), which sets forth the agency's policies and procedures for implementing the requirements of RCRA section 6002. The APP must ensure that the agency purchases items composed of recovered materials to the maximum extent practicable and that these purchases are made consistent with applicable provisions of federal procurement law. In accordance with RCRA section 6002(i), the APP must contain at least four elements:

1. A recovered materials preference program.
2. An agency promotion program.

3. A program for requiring vendors to estimate, certify, and reasonably verify the recovered materials content of their products.

4. A program to monitor and annually review the effectiveness of the APP.

Appendix V provides detailed information on APPs.

Finally, RCRA section 6002(g) requires the Office of Federal Procurement Policy (OFPP) to implement the requirements of RCRA section 6002 and to coordinate this policy with other federal procurement policies in order to maximize the use of recovered materials. RCRA further requires OFPP to report to Congress every two years on actions taken by federal agencies to implement such policy.

2. Executive Order 13101

Executive Order 13101, *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*, was signed by President Clinton on September 14, 1998. It replaces Executive Order 12873, *Federal Acquisition, Recycling, and Waste Prevention*. Section 502 of the Executive Order establishes a two-part process for EPA to use when developing and issuing the procurement guidelines for products containing recovered materials, as required by RCRA Section 6002(e). The first part of the process, issuing the CPG, involves designating items that are or can be made with recovered materials. The CPG is developed using formal notice-and-comment rulemaking procedures and is codified in the Code of Federal Regulations (CFR) at 40 CFR Part 247. The Executive Order requires EPA to update the CPG every 2 years.

The second part of the process is the publication of the RMAN, which provides recommendations to procuring agencies on purchasing the items designated in the CPG. The Executive Order directs EPA to publish the RMAN in the FR for public comment. The RMAN, however, is not codified in the CFR, because the recommendations are guidance. RMANs are issued periodically to reflect changes in market conditions and provide procurement recommendations for newly designated items.

Appendix III provides additional information on the provisions and requirements of Executive Order 13101, including requirements for procuring agencies to comply with EPA's guidelines.

B. Criteria for Selecting Items for Designation

While not limiting consideration to these criteria, RCRA section 6002(e) requires EPA to consider the following when determining which items it will designate:

1. Availability of the item,
2. Potential impact on the solid waste stream of item procurement,
3. Economic and technological feasibility of producing the item, and
4. Other uses for the recovered materials used to produce the item.

EPA consulted with federal procurement and requirement officials to identify other criteria to consider when selecting items for designation. Based on these discussions, the Agency concluded that the limitations set forth in RCRA section 6002(c) should also be factored into its selection decisions. This provision requires each procuring agency to procure a designated item composed of the highest percentage of recovered materials practicable, while maintaining a satisfactory level of competition. A procuring agency, however, may decide not to procure an EPA-designated item containing recovered materials if it determines: (1) the item is not reasonably available within a reasonable period of time; (2) the item fails to meet the performance standards set forth in the agency's specification; or (3) the item is available only at an unreasonable price. EPA recognized that these limitations could restrict procuring agencies from purchasing EPA-designated items with recovered materials content, and, thereby, could limit the potential impact of an individual item designation. (The limitations of section 6002(c) also effectively describe the circumstances in which a designated item is “available” for purposes of the statute.) For this reason, EPA also takes into account the limitations cited in RCRA section 6002(c) in its selection of items for designation.

The Agency developed the following criteria for use in selecting items for designation: use of materials found in solid waste; economic and technological feasibility and performance; impact of government procurement; availability and competition; and other uses for recovered materials. The items proposed for designation in CPG IV have all been evaluated with respect to EPA's criteria. Details of these evaluations are discussed in Sections V through VIII of this document.

1. Use of Materials Found in Solid Waste

All items designated in CPG IV are manufactured with materials recovered or diverted from the solid waste stream. These include both materials recovered or diverted from municipal solid waste (MSW) and materials recovered or diverted from other solid waste streams, such as construction and demolition (C&D) debris and other nonhazardous industrial waste streams. Once recovered or diverted, these materials are reclaimed and refined, disassembled and remanufactured, or separated and processed for use as feedstock to manufacture a new product. Appendix I provides an overview of the materials in MSW in the United States and provides a more detailed explanation of the materials used in the products proposed for designation in CPG IV.

The potential impact that procuring agencies may have on the solid waste stream by procuring EPA-designated items varies depending on the sophistication of the process used to recover or refine the materials and on the recovered materials content of the final product. Additionally, although designating a single item may not have a significant impact on the amount of solid waste recovered or diverted from the waste stream, EPA has concluded that designating several items made from the same recovered material can lead to the diversion of substantial quantities of that material from the waste stream.

Information on the recovered materials used to produce items proposed for designation by EPA is presented in subsection 2(a), "Impact on Solid Waste," within the individual item discussions in Sections V through VIII of this document.

2. Economic and Technological Feasibility and Performance

Before selecting an item for designation, EPA determines that, based on its market research, it is economically and technologically feasible to use recovered materials to produce the item. EPA uses several indicators in making this determination. The availability of the item in the marketplace and procurement of the item by federal and/or other procuring agencies are primary indicators that it is economically and technologically feasible to manufacture the product with recovered materials content. Other indicators include the ability of the item to meet performance specifications, the general acceptance of the item by consumers and purchasers, and the use of recovered feedstock by manufacturers.

RCRA directs EPA to "designate items that are or can be produced with recovered materials and whose procurement by procuring agencies will carry out the objectives of RCRA section 6002." This being the case, there may be instances where a particular item is not currently made with recovered materials content, but a similar item is. In those cases where the Agency has concluded that there are no technical reasons that prevent an item from being manufactured with recovered materials, and there is a demonstrated use of recovered materials in a similar item, EPA also may consider designation of the item that currently does not contain recovered materials.

Prior to selecting an item for designation, EPA also considers the ability of the item to meet the standards, specifications, or commercial item descriptions set forth by federal agencies or national standard-setting organizations.

Information on the economic and technological feasibility of producing items proposed for designation by EPA, including the availability of the item and the number of manufacturers that produce the item, the ability of the item to meet federal or national specifications, the recovered materials content levels used by manufacturers to produce the item, and other information relevant to the economic and technical feasibility of producing and using the item, is discussed in section 2(b), “Technological Feasibility and Performance,” and section 2(d), “Economic Feasibility,” in the individual item discussions in Sections V through VIII of this document.

3. Impact of Government Procurement

The impact of government procurement of products containing recovered materials is a combination of: (1) direct purchases by federal agencies, (2) purchases made by state and local agencies using federal monies, and (3) purchases made by contractors to these government agencies. When considering items for designation, EPA examines whether government agencies and their contractors purchase the items.

Government procurement also has an impact that extends far beyond the federal, state, and local levels. As noted in RCRA and the Executive Order, the federal government often serves as a model for private and other public institutions. Because of this secondary effect, EPA includes items that are not

unique to or primarily used by government agencies. Many of the items that EPA selects for designation are selected because they have broad application in both the government and private sectors.

Information on the impact of government procurement for each item proposed for designation in CPG III is presented in section 2(e), "Government Purchasing," in the individual item discussions in Sections V through VIII of this document.

4. Availability and Competition

The items EPA selects for designation are available from national, regional, or local sources. The relative availability of an item influences the ability of a procuring agency to secure an adequate level of competition when procuring it. In the event that a satisfactory level of competition is unattainable, a procuring agency may elect to waive the requirement to purchase an EPA-designated item based on the limitations listed in RCRA section 6002(c).

Information on the availability of each item proposed for designation in CPG IV including the number of manufacturers that produce the item, is presented in subsection 2(c), "Availability and Competition," in the individual item discussions in Sections V through VIII of this document.

5. Other Uses for Recovered Materials

In selecting items for designation, EPA also considers the following: (1) the possibility of one recovered material displacing another recovered material as feedstock, thereby resulting in no net reduction in materials requiring disposal; (2) the diversion of recovered materials from one product to another, possibly creating shortages in feedstocks for one or both products; and (3) the ability of manufacturers to obtain recovered materials in sufficient quantity to produce the item under consideration.

While other uses for recovered materials are a consideration, they are not a determining factor when selecting items for designation, because there is a need for additional markets for all recovered materials used to manufacture the designated items.

6. Other Considerations

EPA also considers price as a factor affecting the availability of an item. The price of products, whether made from virgin raw materials or recovered materials, is affected by many variables, including the availability and costs of material feedstocks, energy costs, labor costs, rate of return on capital, transportation charges, and the quantity of the item ordered. In addition, price may vary depending on whether the product is a common stock item or whether it requires a special order. Price also can be affected by the geographical location of the purchaser, because some products are not uniformly available throughout the United States. The best sources of current price information, therefore, are the manufacturers and vendors of the recycled products.

Relative prices of recycled products compared to prices of comparable virgin products also vary. In many cases, recycled products may be less expensive than their virgin counterparts. In other cases, virgin products may have lower prices than recycled products. Other factors also affect the price of virgin products. For example, temporary fluctuations in the overall economy can create oversupplies of virgin products, leading to a decrease in prices for these items. Therefore, while price is a consideration, it is not in most cases, a determining factor when selecting items for designation. It becomes a determining factor only when EPA obtains evidence that the relative price of an item with recovered materials content is significantly higher than the relative price of a comparable virgin product. For this reason, EPA did not address price in the individual item discussions in Sections V through VIII of this document.

EPA has also considered the feasibility of designating experimental or developmental products containing recovered materials. In the Agency's experience, such designations do not result in federal procurement of products containing recovered materials, because the items are not reasonably available, or only one source exists, leading to an unsatisfactory level of competition. For this reason, EPA does not intend to designate experimental or developmental products until it can be shown that they meet all of EPA's selection criteria, as described above.

C. Methodology for Selecting Items for Designation

EPA used the following process to determine which items to designate in the CPG. First, EPA reviewed and updated information on items previously considered for designation but for which more information was needed.

Next the Agency gathered information on new items from comments submitted in response to the initial CPG, which was proposed on April 20, 1994. On September 20, 1995, EPA published a FR notice requesting information from the public on potential items for inclusion in CPG. From December 1, 1995, through February 29, 1996, EPA accepted information from interested parties to consider when selecting items for designation, recommending recovered materials content levels for selected items, and revising recommendations for existing designated items.

In the September 20, 1995, notice, EPA requested information regarding the following seven areas:

6. Barriers to Purchasing Products Containing Recovered Materials:

    - What government specifications, standards, purchasing policies, or purchasing procedures preclude government agencies from purchasing the item containing recovered materials?

2. Use of Materials in Solid Waste:

    - Is the item made using a material that represents a significant portion of the solid waste stream or presents a solid waste disposal problem?

3. Economic and Technological Feasibility and Performance:

    - Does the item perform as well as necessary to meet a procuring agency's needs?
    - Are there government, American Society for Testing and Materials (ASTM), or other consensus standards or specifications that would enable a procuring agency to buy the item containing recovered materials?
    - Is the item available at a reasonable price considering normal market fluctuations?

4. Impact of Government Procurement:

   # Is the item purchased in appreciable quantities by the federal government or by state and local governments?

5. Availability and Competition:

   # Is the item available from an adequate number of sources to ensure competition?

   # Is the item generally available, rather than available in a limited market area?

6. Recovered Materials Content Levels:

   # What levels of recovered materials content are used in the product?

   # Is the recovered materials content postconsumer material? What percentage is postconsumer?

7. Sources of information:

   # What is the source of the information provided (e.g., industry studies, technical journals)?

Items proposed for CPG IV designation are described in detail in Sections V through VIII of this document. Those items that might be considered for designation at later date are presented in section IX.

D. Broad Categories Versus Specific Items

EPA has adopted two approaches in its designation of items that are made with recovered materials. For some items, such as paper products, the Agency designated *broad* categories of items and provided information in the RMAN as to their appropriate applications or uses. For other items, such as plastic envelopes, EPA designated *specific* items, and, in some instances, included in the designation the specific types of recovered materials or applications to which the designation applies. The Agency provided the following explanation for these approaches to designating items in the preamble to the first CPG (60 FR 21369, May 1, 1995):

> *EPA sometimes had information on the availability of a particular item made with a specific recovered material (e.g., plastic), but no information on the availability of the item made from a different recovered material or any indication that it is possible to make the item with a different recovered material. In these instances, EPA concluded that it was appropriate to include the specific material in the item designation in order*

to provide vital information to procuring agencies as they seek to fulfill their obligations to purchase designated items composed of the highest percentage of recovered materials practicable. This information enables the agencies to focus their efforts on products that are currently available for purchase, reducing their administrative burden. EPA also included information in the proposed CPG, as well as in the draft RMAN that accompanied the proposed CPG, that advised procuring agencies that EPA is not recommending the purchase of an item made from one particular material over a similar item made from another material. For example, EPA included the following statement in the preamble discussion for plastic desktop accessories (59 FR 18879, April 20, 1994): "This designation does not preclude a procuring agency from purchasing desktop accessories manufactured from another material, such as wood. It simply requires that a procuring agency, when purchasing plastic desktop accessories, purchase these accessories made with recovered materials..."

The Agency understands that some procuring agencies may believe the designation of a broad category of items in the CPG requires them to: (1) procure all items included in such category with recovered materials content and (2) to establish an affirmative procurement program for the entire category of items, even where specific items within the category may not meet current performance standards. This is clearly not required under RCRA as implemented through the CPG and the RMAN. RCRA section 6002 does not require a procuring agency to purchase items with recovered materials content that are not available or that do not meet a procuring agency's specifications or reasonable performance standards for the contemplated use. Further, RCRA section 6002 does not require a procuring agency to purchase such items if the item with recovered materials content is only available at an unreasonable price or the purchase of such item is inconsistent with maintaining a reasonable level of competition. However, EPA stresses that, when procuring any product for which a recovered materials alternative is available that meets the procuring agency's performance needs, if all other factors are equal, the procuring agency should seek to purchase the product made with highest percentage of recovered materials practicable.

III. ITEM DESIGNATION CATEGORIES

Items designated in the CPG are organized in the following product categories: paper and paper products, vehicular products, construction products, transportation products, park and recreation products, landscaping products, nonpaper office products, and miscellaneous products. The categories were developed to describe the application of each designated item.

- **Paper and Paper Products.** Includes printing and writing papers, newsprint, tissue products, paperboard products, and packaging. This category does not include paper and paper products used in construction applications. A final RMAN for paper and paper products containing recovered materials was issued on May 29, 1996, at 61 FR 26985, and an updated RMAN (Paper Products RMAN II) was issued on June 8, 1998, at 63 FR 31214. No paper products are included in CPG IV.

- **Vehicular Products.** Products used in repairing and maintaining automobiles, trucks, and other vehicles. Examples include re-refined lubricating oils, retread tires, and engine coolants. In CPG IV, EPA is proposing to designate rebuilt vehicular parts and tires containing recovered rubber in the vehicular products category.

- **Construction Products.** Products used in constructing roads and the interior and exterior components of commercial and residential buildings. Examples include building materials and paint. In CPG IV, EPA is proposing to designate cement and concrete containing cenospheres, cement and concrete containing silica fume, modular threshold ramps, nonpressure pipe, nylon carpet and nylon carpet backing, and roofing materials in the construction products category.

- **Transportation Products.** Products used for directing traffic, alerting drivers, and containing roadway noise and pollution. Examples include parking stops and traffic control devices. No transportation products are proposed for designation in CPG IV.

- **Park and Recreation Products.** Products used in operating and maintaining parks and recreational areas. Examples include playground equipment and running tracks. No park and recreation products are proposed for designation in CPG IV.

- **Landscaping Products.** Products used to contain, maintain, or enhance decorative and protective vegetation or areas surrounding buildings and roadways. Examples include compost and hydraulic mulch. No landscaping products are proposed for designation in CPG IV.

- **Nonpaper Office Products.** Equipment and accessories used by government agencies and businesses to perform daily operational and administrative functions of an office. Examples include toner cartridges, desktop accessories, and waste receptacles. In CPG IV, EPA is proposing to designate office furniture in the nonpaper office products category.

- **Miscellaneous Products.** Includes all other products not covered by the categories listed above. In CPG IV, EPA is proposing to designate bike racks and blasting grit in the miscellaneous products category.

IV. DEFINITIONS

The proposed item designations and the purchasing recommendations in draft RMAN III use the terms "postconsumer materials" and "recovered materials." The definitions for these terms are shown below for the convenience of the reader. These definitions were included as part of the original CPG and can also be found at 40 CFR§247.3.

> **Postconsumer materials** means a material or finished product that has served its intended end use and has been diverted or recovered from waste destined for disposal, having completed its life as a consumer item. Postconsumer material is part of the broader category of recovered materials.
>
> **Recovered materials** means waste materials and byproducts which have been recovered or diverted from solid waste, but such term does not include those materials and byproducts generated from, and commonly reused within an original manufacturing process.

VI. VEHICULAR PRODUCTS

A. Rebuilt Vehicular Parts

1. Item Description

In May 1994, the Automotive Parts Rebuilders Association (APRA) commented on the proposed Guidelines for Procurement of Products Containing Recovered Materials published in the *Federal Register* on April 20, 1994. The U.S. Environmental Protection Agency (EPA) previously studied rebuilt parts in 1988. APRA believes that since reinked printer ribbons and rebuilt ink jet cartridges have been designated, rebuilt vehicular parts should be designated as well. APRA believes the industry deserves some recognition in this area. Rebuilt vehicular parts can be used in passenger vehicles as well as medium- and heavy-duty equipment (e.g., trucks, cranes, off-road vehicles, military vehicles).

Rebuilt vehicular parts are vehicle parts that have been remanufactured, reusing parts in their original form. For an automotive product to be considered remanufactured or rebuilt under the Federal Trade Commission (FTC) guides, it must be dismantled; all internal and external parts must be cleaned and made free of rust and corrosion; all impaired, defective, or substantially worn parts must be restored to sound condition or replaced with new or rebuilt parts; and all necessary operations must be performed to put the remanufactured product in sound working condition. These FTC guides are applied the

remanufacturing industry in general. Although not a part of the FTC guides, once the reassembly process is complete, reliability tests are performed to ensure that the product performs as good as new. Motor vehicle parts rebuilders recover plastic and metal parts including copper, steel, and nickel. For automotive starters, for example, about 50 percent of the original part is recovered in the rebuilding process.

The following parts can be rebuilt: air brakes, air conditioners, alternators, armatures, ball bearings, batteries, brake calipers, brake cylinders, brake shoes, carburetors, clutches, constant velocity drive shafts, crankshafts, cruise controls, cylinder heads, differentials, distributors, drive shafts, electronic control modules, engines, engine parts, fan clutches, front wheel drive axles, fuel injectors, fuel pumps, generators, heavy duty vacuum brakes, master cylinders, oil pumps, power brake units, power steering gears, power steeling pumps, power window motors, rack and pinion steering units, rotors, smog pumps, solenoids, spark plugs, speedometers, starters, starter drives, stators, throttle body injectors, torque convertors, transmissions, transmission parts, turbochargers, voltage regulators, water pumps, and wiper motors.

Automotive parts rebuilding is a $14 billion per year industry. According to APRA, motor vehicle parts have been rebuilt almost since the invention of the automobile itself, because rebuilding makes economic sense and preserves materials, labor, and energy.

Consumers often can choose if they want a new or rebuilt replacement part. Rebuilt parts often are lower in cost. Some states require service stations to inform consumers that a part is rebuilt before they install it; other states do not. Some consumers might, therefore, buy parts based on price and unknowingly buy rebuilt parts.

2. Rationale for Designation

EPA has concluded that rebuilt vehicular parts meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

According to APRA, there are over 200 million vehicles in the United States. APRA is not aware of any other uses for recovered vehicle parts except melting them down to their base materials. APRA does not know how many vehicle parts are melted down or discarded. Smaller components usually are disposed.

b. Technological Feasibility and Performance

According to APRA, rebuilt parts have been routinely used by the general public for more than 50 years. In fact, when a vehicle manufacturer exhausts its supply of new parts for a vehicle, used parts are rebuilt by the original manufacturer itself.

Rebuilt parts are not just cleaned, visually inspected, and resold with little to no repair work done. These parts undergo an extensive remanufacturing and testing process. Rebuilt parts must meet the same industry specifications for performance as new parts. According to APRA, to be labeled "rebuilt" or "remanufactured," a part must be processed in accordance with the FTC's *Guides for the Rebuilt, Reconditioned and Other Used Automotive Parts Industry*, 16 CFR Part 20. As mentioned previously, these guidelines, which were established in 1962, require that the part be completely disassembled, cleaned and made free of rust or corrosion, inspected for wear and breakage, and reassembled (with new or rebuilt components replacing worn out or nonfunctioning ones). In addition, rebuilders must test each part for compliance with FTC specifications and correct defects as necessary. According to APRA, rebuilt parts are comparable in quality to new parts and can be of even better quality than new parts when items are upgraded during the rebuilding process. Many rebuilt parts carry better warranties than new ones.

The FTC is currently reviewing its guides for rebuilt, reconditioned, and other used automobile parts to see if they should be retained or eliminated. APRA strongly supports the retention of these guides as essential to maintaining integrity in the rebuilding industry. APRA has met with FTC staff on the issue and generated written support for the rebuilders' position from Congress, various state attorneys general, consumer groups, and other trade associations.

c. Availability and Competition

Most rebuilt parts are currently readily available throughout the United States at competitive prices. Rebuilders and manufacturers have access to an ample supply of original or core parts that consist of trade-in and scrap yard parts. (The "core" is a used unit that provides the raw base material for the rebuilt part.) When a vehicle manufacturer exhausts its supply of new parts for a vehicle, used parts are rebuilt by the original manufacturer itself. According to APRA, trade-in parts constitute 80 percent of core parts in the market and come from car owners who exchange old parts for discounted functioning parts at repair shops. Towing companies sell wrecked vehicles to scrap yards that salvage the other 20 percent of core parts in the market and sell them to core suppliers—professionals who work with automobile scrap yards and make parts available to remanufacturers. Rebuilt parts can be purchased directly from thousands of independent rebuilders or from independent parts retailers. In addition, all automobile manufacturers supply rebuilt parts at their dealerships.

Rebuilt motor vehicle parts constitute 50 to 95 percent of the parts sold for use on motor vehicles in the aftermarket, depending on the part. Ninety percent of alternators and starters sold on the aftermarket, for example, are rebuilt. Rebuilt parts are not specialty or low use items, according to APRA. In fact, the largest percentage of sales in the aftermarket often comes from rebuilt, rather than virgin, parts. The sale of rebuilt brake shoes, rotating electrical parts, starters, and alternators, for example, constitutes about 90 percent of the total market for these parts, and rebuilt clutch sales constitute about 70 percent of that market.

Rapid turnover of vehicles affects the availability of rebuilt parts. It takes approximately 3 years for a supply of new parts to create a sufficient number of cores for rebuilding. Thus, rebuilt parts are usually installed in vehicles that are retained for longer periods of time.

d. Economic Feasibility

For all makes and models of vehicles, rebuilt parts sell for about 20 to 50 percent below the cost of new parts. Purchasers can also receive discounts on rebuilt parts if they trade in their old parts. The U.S. Forest Service estimates that the rebuilt parts it purchases cost 30 to 40 percent less than new parts. The U.S. Air Force has found that rebuilt parts are as much as one-third the cost of new parts. Motor

vehicle parts have been rebuilt almost since the invention of the automobile, because rebuilding makes economic sense and preserves materials, labor, and energy. Depending on the product, between 50 and 95 percent of sales in the vehicular aftermarket (after a new vehicle has left the dealer's showroom) comes from rebuilt, rather than new, parts. In addition, once a car has been on the aftermarket 4 to 5 years, new parts are usually no longer being manufactured for that model and rebuilt parts must be used.

e. Government Purchasing

Vehicles are kept for about 3 to 6 years by most government agencies. Some agencies, however,say that vehicles are not usually kept long enough to need many replacement parts. According to APRA, heavy-duty equipment is generally kept longer and is usually almost totally rebuilt.

EPA contacted several federal government agencies to determine whether they request, use, or rebuild vehicular parts. EPA focused on identifying agencies with large fleets of vehicles. These included the U.S. Department of Interior, the U.S. Department of Agriculture, the U.S. Air Force, and GSA.

EPA found that the majority of replacement vehicular parts purchased by the Forest Service are rebuilt parts (for all types of vehicles). Engines for medium- and heavy-duty equipment are always rebuilt. The U.S. Air Force has a written policy stating its preference for rebuilt parts, and the majority of parts for all of their vehicle types are rebuilt.

Many federal agencies use local commercial facilities for maintenance and repair of government-owned or leased vehicles. Many of these agencies simply request the least expensive parts, which usually are rebuilt parts. A very small amount of maintenance work is still conducted in-house by government agencies. While these agencies might purchase rebuilt parts for the vehicles repaired in their shops, none of the government agencies contacted reported rebuilding their own parts.

None of the government agencies contacted by EPA track the number of rebuilt parts purchased. APRA believes that federal agencies should be encouraged to buy rebuilt parts, although it is currently impossible to tell to what extent government agencies already use rebuilt parts.

EPA learned the following information from the various agencies it contacted:

The U.S. Department of Interior owns 17,000 vehicles and leases 14,000 vehicles from GSA. Each location within the 10 bureaus of the department are autonomous in terms of buying parts. The five bureaus that use the most vehicles are: Bureau of Land Management, National Park Service, Bureau of Indian Affairs, Bureau of Reclamation, and U.S. Geologic Survey. EPA contacted the following three of these bureaus.

The Bureau of Indian Affairs, the U.S. Geologic Survey (USGS), and the Bureau of Reclamation repair and maintain vehicles at commercial facilities through GSA. USGS owns about 58 percent of its vehicles and leases 42 percent from GSA. It specifically does not want to use rebuilt parts. The Bureaus of Indian Affairs and Reclamation rent all their vehicles from GSA. At the Bureau of Reclamation, it is rare that vehicles ever need replacement parts, because the bureau only keeps vehicles 2 to 3 years. Most of the time, maintenance entails oil changes, oil filter replacement, and tire replacement. At the Bureau of Indian Affairs, no records are kept on repairs or parts.

The U.S. Department of Agriculture has an in-house fleet repair shop for the Forest Service. Although the Forest Service has five divisions, about 90 percent of all vehicles and 94 percent of all employees are in the National Forest System (commonly known as the Forest Service). Within this system there are nine regions, 156 national forests, and 682 districts. Each district operates independently in terms of vehicle repair. In total, the Forest System owns and manages about 10,000 to 12,000 small vehicles, such as motorcycles and snow mobiles, and about 22,000 vehicles ranging from compact sedans to 18-wheelers. The Forest Service owns 90 percent of its vehicles and leases the rest from GSA. About 10 to 20 percent of the maintenance performed on those vehicles is done in-house with the remainder done by commercial facilities. Of the vehicles leased from GSA, 6 to 7 percent are maintained by GSA, and the remainder are maintained by commercial shops. When tracking money spent on parts, no distinction is made between in-house maintenance or service stations.

  Forest Service contacts indicate that rebuilt parts constitute the majority of replacement parts purchased by the agency. Prices for rebuilt parts are typically 30 to 40 percent lower than new parts. Engines for medium- and heavy-duty equipment always contain rebuilt parts. The Forest Service only keeps vehicles for a short period of time (with the exception of heavy-duty equipment) and does not have experience keeping vehicles for long periods of time.

  Vehicular maintenance work is managed by each Forest Service facility. Contacts believe that about 80 percent of the water pumps, alternators, starter motors, distributors, and carburetors are probably rebuilt, based on the price information.

  Of the 20 Forest Service facilities in Region 6 (Washington and Oregon), 10 have in-house maintenance facilities, though not all repairs are completed in-house. The region spends about $1.3 million on parts and labor for the 4,500 vehicles maintained at commercial facilities and about $900,000 on parts and labor for vehicles maintained in-

house (1995 data). Since the agency buys the least expensive parts, many of them are rebuilt, such as alternators, carburetors, transmissions, and starters.

Region 5 (California) has approximately 20 in-house maintenance facilities, but most repair and maintenance work is done by commercial facilities. The region spends about $180,000 to $200,000 a year on replacement parts. Depending on location and parts availability, the region's vehicular maintenance facilities might use rebuilt parts such as starters, generators, and alternators, but only after the vehicle's warranty has run out. If the vehicle is still under warranty it is repaired at the dealership, which uses new parts.

The U.S. Air Force (USAF) has about 118 bases worldwide, each of which has its own vehicular fleet maintenance shop. These shops purchase their parts from commercial facilities either through a contract or a government credit card. USAF has a written policy stating its preference for rebuilt parts. The majority of the parts bought by USAF are rebuilt, including alternators, water pumps, and other charging system units. The parts are used in vehicles ranging from passenger vehicles to light, medium, and heavy trucks; forklifts; firefighting equipment; and refueling vehicles. USAF generally does not encounter any performance problems with rebuilt parts. They expect these parts to last as long as new parts and perform as well. They have found that rebuilt parts cost one-third less than new parts.

GSA leases about 150,000 vehicles to government agencies. Agencies keep passenger vehicles about 3 years (or 60,000 miles) and light trucks about 5 or 6 years. Individual agencies lease anywhere from three to 49,000 vehicles (Army). Most repair work for these vehicles is procured on the open market. GSA maintains a list of about 50,000 repair vendors nationwide. When employees need vehicular maintenance, they can call a toll-free GSA number and ask for recommended vendors, or they can take the vehicle to a local shop. GSA has no specification for rebuilt parts.

The GSA Automotive Center sells vehicles. About 60 percent of its business goes to GSA Fleet Management. The other 40 percent of its business is with Departments of Treasury, Justice, Defense (including Navy, Army, Marines, and Army Corps of Engineers), and the U.S. Forest Service.

During 1999, bills were introduced in California, New York, Connecticut, Missouri, and Texas that would make procurement of remanufactured products by those state governments easier and prevent procurement by them of products that have restrictions on being remanufactured. APRA provided support for several of these bills, and bills were ultimately passed and made law in California, Connecticut, and Texas.

f. Barriers to Purchasing

Section 2b of this document details FTC guides concerning the quality of recycled automotive parts. The National Recycling Coalition (NRC) had objected to the FTC's expanded definition of "recyclable" and "recycled-content" that includes reused, reconditioned, or remanufactured products, parts, or materials. The recyclable definition includes any package or product that can be collected, separated, or otherwise recovered from the solid waste stream for reuse, or for the manufacture of another package or product, so long as it can be collected through an established recycling program (FTC, 16 CFR Part 260). NRC believes that the guides could allow products of inferior quality to enter the market labeled as recycled products, thus negatively affecting public perception of the quality and performance of recycled products. However, it should be noted that rebuilt parts must meet the same industry specifications for performance as new parts.

EPA identified only one situation that precluded the purchase of rebuilt parts. USGS uses vehicles in remote locations, requiring a high degree of vehicle reliability. If an engine needed to be replaced, for example, the agency would trade in the vehicle rather than use a rebuilt engine (or even a new replacement engine) because it wouldn't feel comfortable taking the vehicle back into the field. USGS only keeps vehicles about 6 years.

EPA identified the following trends in government purchasing of vehicle parts:

- When appropriate, government agencies are already buying rebuilt parts. Some agencies say that vehicles are not usually kept long enough to need many replacement parts. At the Bureau of Reclamation, for example, it is rare that vehicles ever need replacement parts because it only keeps vehicles 2 to 3 years. This would not change even if rebuilt parts were designated.
- According to APRA, heavy-duty equipment is generally kept longer and parts are usually almost totally rebuilt.
- EPA found that the majority of replacement vehicular parts purchased by the Forest Service are rebuilt parts (for all types of vehicles). Engines for medium and heavy-duty equipment are always rebuilt.
- The Air Force already has a written policy stating its preference for rebuilt parts, and the majority of parts for all types of vehicles are rebuilt.

g. Designation

EPA proposes to designate rebuilt vehicular parts. A final designation would require that a procuring agency, when purchasing vehicular parts, purchase the parts as rebuilt when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

EPA contacted five remanufacturers of parts that use between 60 and 95 percent postconsumer materials (i.e., viable components from the used part). One company remanufactures clutches for farm tractors and passenger automobiles with 80 to 85 percent postconsumer materials. Another company rewinds stators and rotors for alternators, and armatures for starters and generators using 60 and 80 percent postconsumer material, respectively. Another company that rebuilds alternators, starters, and generators for cars and trucks uses 80 to 85 percent postconsumer materials. One company remanufactures power and air brakes for passenger, medium-duty, and heavy-duty tractor trailer trucks with 90 to 95 percent postconsumer materials. Still another company remanufactures rack and pinion steering and constant velocity axle units with 85 to 90 percent postconsumer materials.

Table 2 presents information provided by manufacturers of rebuilt vehicular parts on recovered content.

Table 2
Recovered Materials Content of Rebuilt Vehicular Parts

Product	Postconsumer Content (%)	Total Recovered Materials Content (%)
Rebuilt Vehicular Parts	Company A: 80 to 85 Company B: 60 to 80 Company C: 80 to 85 Company D: 90 to 95 Company E: 85 to 90	80 to 85 60 to 80 80 to 85 90 to 95 85 to 90

b. Preference Program

EPA recommends that procuring agencies whose vehicles (passenger vehicles as well as medium- and heavy-duty equipment, including trucks, cranes, off-road vehicles, and military vehicles) are serviced by a motor pool or vehicle maintenance facility establish a program for vehicular parts rebuilding and reuse consisting of either recovering a used vehicular part and rebuilding it, replacing it with a rebuilt part, or contracting to have the part replaced with a rebuilt part.

c. Specifications

Rebuilt parts must meet the same industry specifications for performance as new parts. According to APRA, rebuilt parts are comparable in quality to new parts and can be of even better quality than new parts when items are upgraded during the rebuilding process.

B. Tires

1. Item Description

Tires are used on almost all types of vehicles, are available in different sizes, and are designed for specific applications. An average passenger tire weighing about 20 pounds would consist of 10 pounds of elastomers, which are a combination of both synthetic and natural rubber; 5 pounds of carbon black; 3 pounds of fibers such as steel and nylon; and 2 pounds of 40 different kinds of chemicals, waxes, oils, pigments, and binding agents.

EPA previously designated retread tires and retreading services in CPG I, published May 1, 1995 (60 *FR* 21370). This report contains information on recovered materials being used in new tires.

2. Rationale for Designation

EPA has concluded that tires containing recovered rubber meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Ground or "crumb rubber" is the primary recovered material used in recovered material content tires. Crumb rubber is derived from scrap tires that have been shredded into fine pieces of rubber. After whole tires are fed into a shredder, they are reduced to 2-inch pieces. This feedstock of tire shred still includes steel beads, belts, cords, and other contaminants such as rocks and glass. "Cracker" mills then further reduce the rubber pieces into ½ inch particles and eliminate the remaining contaminants. A second cracker mill reduces the ½ inch particles down to a variety of sizes including 4-, 10-, 20- and 30- mesh and smaller. The pieces are screened to separate out the different mesh sizes and then prepared for packaging. The crumb rubber ultimately is combined with elastomers, new rubber, filler materials, and various other chemicals in all parts of the tire.

According to one crumb rubber manufacturer, U.S. tire manufacturers use approximately 110,000 tons of crumb rubber each year. The manufacturer speculated that if U.S. tire manufacturers were to use 10 percent recovered materials content in their tires, demand for crumb rubber would increase to 356,400 tons per year.

In 1998, 273 million scrap tires were generated in the United States. Of these, between 12 to 14 million were used to manufacture crumb rubber for use in tires and other products. One manufacturer speculates that if the current annual U.S. crumb rubber consumption rate of 110,000 tons remains consistent, there is no foreseeable shortage of raw materials to produce this product.

b. Technological Feasibility and Performance

A major concern of tire manufacturers that use recovered materials is the adverse impact it might have on tire mileage and durability. Furthermore, the Scrap Tire Management Council (STMC) mentioned that tire manufacturers do not use crumb rubber in the production of high-performance or premium tires due to the effect it might have on performance. High-performance tires are built to provide better vehicle control at higher speeds.

According to STMC and one tire and rubber company, there is typically a 1 percent rate of degradation in tire durability for every 1 percent of recovered material that is used. Tire manufacturers

that use crumb rubber generally limit the use of recovered materials to only .5 to 1 percent in most of their non-high-performance tires. A report by one tire company states that using ground rubber from scrap tires in quantities of 10 percent can cause degradation because the ground rubber from scrap tires is not the same as natural or synthetic rubber. The company believes that reclaimed or ground material used as a filler in tires causes lower tensile strength, heat buildup, and oxidative aging. In addition to reduced tread life, the company maintains that tires containing recovered material have increased roll resistance, which results in a lower fuel economy for the vehicle. In addition, there is increased lug cracking in large tires containing crumb rubber. The company does, however, make at least one tire that contains up to 3 to 5 percent crumb rubber.

Another tire company uses 1 to 4 percent recovered rubber in its tires, but believes that to maintain good performance, a tire should not have more than 4 percent recovered content. According to the company the worldwide average for use of crumb rubber in tires is 0.9 percent.

c. Availability and Competition

EPA was able to identify five manufacturers of recovered materials content tires. Only two manufacturers provided the names of the tire lines that contain specific levels of recovered materials. Other tire manufacturers that EPA contacted would not disclose whether or not they use recovered materials or would only disclose the range of recovered materials used in some tires. It is difficult, therefore, to determine which tires being sold in the market contain recovered materials.

d. Economic Feasibility

Two tire companies indicated no significant production cost differences between tires with recovered materials and their virgin counterparts. Tires that contain recovered materials, however, are usually only available in the more inexpensive tire models and original equipment manufacturer (OEM) tires. A contact from one tire company suggested that because there is no demand for tires with recovered materials content, there is currently no incentive for tire manufacturers to produce them on a larger scale. In fact, the company is only using one manufacturing plant to produce tires with recovered materials content.

e. Government Purchasing

GSA currently has 161,000 vehicles that it leases to different government agencies. A contact with GSA's Fleet Management Service was unable to provide information on GSA expenditures for replacement tires because such purchases are decentralized and are difficult to track. Most repair work for leased vehicles is procured on the open market or through a list of 50,000 repair vendors that GSA provides to its customers.

The National Resource Conservation Service (NRCS), an entity within the U.S. Department of Agriculture (USDA), informed EPA that it does not track at the national level how much is spent on replacement tires or how many are used annually.

The United States Postal Service (USPS) maintains a fleet of 202,741 vehicles and spent $21.8 million in tire purchases in FY97. USPS has no requirements for purchasing tires with recovered materials.

The Department of Defense (DOD) purchases its tactical fleets from the Defense Logistics Agency. Each branch of DOD is responsible for procuring its nontactical fleets and the vast majority of these vehicles are leased from GSA. By leasing, instead of purchasing, the branches can eliminate or downsize their vehicle service and purchasing infrastructure.

Annually, the U.S. Forest Service (USFS) replaces 8,000 to 10,000 tires. Of these replacement tires, 50 percent are retread tires. EPA's contact at USFS does not believe there is any information available to purchasing agents on the percentage of recovered materials in tires.

f. Barriers to Purchasing

Currently, there are only three tire models that are known to contain 5 percent recovered materials. Only two of the models, however, are available for public sale. It is possible that other tire manufacturers are using recovered materials in the production of their more inexpensive tires. This information, however, is considered confidential and manufacturers would not disclose it or would not provide specific information on the percentage of recovered materials used.

According to a contact from NRCS, USDA follows the guidelines of Executive Order 13101, *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*, and RCRA Section 6002. The only purchasing barrier to purchasing recovered materials content products is that they must meet NRCS performance standards and be competitive in price.

g. Designation

EPA proposes to revise the tires designation include tires containing recovered materials as an item whose procurement will carry out the objectives of section 6002 of RCRA. A final designation would require that a procuring agency, when purchasing tires, either procure retread tires and retreading services or purchase tires containing recovered rubber when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

In 1999, another tire company used 643,848 pounds of crumb rubber out of a total of 141,740,000 pounds of rubber (0.45 percent) to manufacture a limited number of motorcycle, light truck, and passenger car tires. The company did not provide percentages of recycled content used in individual tire lines. The company would use more recovered materials, but feels there are a limited number of quality crumb rubber producers in the United States.

At the request of one automobile manufacturer, three tire companies have succeeded in incorporating as much as 5 percent, 4 percent, and 3 percent crumb rubber into their tires without sacrificing performance and durability. The automobile manufacturer has used 800,000 tires containing recovered materials and expects that number to increase in the future.

One tire company first began testing ways to incorporate up to 10 percent crumb rubber into their tires without sacrificing tire durability or driving performance. The tire company estimated that this process could divert as much as 30 million scrap tires from landfills annually. According to a contact from an automobile manufacturer, however, the tires containing 10 percent recovered material did not perform

well in initial tests. Consequently, the manufacturer is currently not using tires that contain 10 percent recovered material on any of its vehicles. The manufacturer is optimistic, however, that as more fine grade crumb rubber becomes available, the company will be able to purchase tires with an increased percentage of recycled materials. The tire company's research to incorporate 10 percent recovered material into its tires is still ongoing.

As an OEM for one company's minivan, a tire company currently produces a product line of tires which contains 5 percent recovered materials. The automobile company has not reported any loss of performance for the tire on the minivan.

Another tire company makes two tires for one automobile manufacturer's line of pickup trucks. Currently, the tires contain up to 6 percent recovered material, while radial and truck tires contain as much as 4 percent. The company has set a goal to increase the percentage of recovered material in certain tire lines to 25 percent in the next 4 years. The company does not see any durability issues with using or increasing its use of recycled materials in its tires.

EPA identified at least five manufacturers that incorporate some percentage of crumb rubber into some of their tire lines. The percentages ranged from .5 to 6 percent. At least one manufacturer is looking into incorporating 10 percent recovered material into one of its tires.

Table 3 presents information provided by manufacturers and suppliers of tires on recovered content availability.

Table 3
Recovered Materials Content of Tires

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Rubber	Company A: 3 Company B: 5 Company C: unknown Company D: 3 to 5 Company E: 3 to 5 Company F: 5	3 5 unknown 3 to 5 3 to 5 5

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 4, procuring agencies establish minimum content standards for use in purchasing tires. Sec. 403(b) of EO 13149, "Greening the Government through Federal Fleet and Transportation Efficiency," encourages agencies to purchase tires containing 5 to 10 percent recovered rubber. EPA's recommendations are consistent with this Executive Order. EPA recognizes that tires containing recovered rubber at levels toward the high end of this range may not be available, but encourages procuring agencies to try to find and purchase tires with the highest level of recovered rubber possible.

Table 4
Draft Recovered Materials Content Recommendations for Tires

Material	Postconsumer content (%)	Total recovered materials content (%)
Rubber	5 - 10	5 - 10

Note: EPA previously designated retread tires and retreading services in CPG I, published May 1, 1995 (60 *FR* 21370).

c. Specifications

EPA did not identify any specifications that would preclude the production or procurement of tires with recovered content.

VI. CONSTRUCTION PRODUCTS

A. Cement and Concrete Containing Cenospheres

1. Item Description

In 1983, the U.S. Environmental Protection Agency (EPA) designated cement and concrete containing coal fly ash in the Comprehensive Procurement Guideline (CPG). EPA subsequently amended the designation in May 1995, to include cement and concrete containing ground granulated blast furnace (GGBF) slag. At the time of these designations, these materials were readily available in some areas for

use as ingredients in cement and concrete. During EPA's research on cement and concrete containing coal fly ash and GGBF slag, it came across information indicating that cenospheres, an additive similar to coal fly ash and GGBF, were being used in cement and concrete in a variety of construction projects. If designated, the existing cement and concrete designation would be amended to include cenospheres as one recovered material option.

Cenospheres are very small (10 - 350 microns), inert, lightweight, hollow, "glass" spheres composed of silica and alumina and filled with air or other gases. They are a naturally-occurring component of fly ash, the largest byproduct of coal-fired power plants. Cenospheres are recovered and marketed throughout the world as an aggregate (or "filler") material in a wide variety of products. Unlike some aggregates that compete with cenospheres for certain applications (described below), cenospheres are not manufactured; they are recovered only from fly ash.

Cenospheres are easily separated from fly ash because they float in water. (Cenospheres have a specific density ranging from 0.4 to 0.6, which is less than 1.0, the specific density of water.) When fly ash is recovered from a coal burning power plant and placed in a settling pond, the cenospheres float on the surface of the pond and can be easily collected. Another collection method separates cenospheres from fly ash using an air clarifier, which uses air currents rather than water.

After collection, the cenospheres are processed for reuse. This can involve drying and sorting them by size using a centrifuge with a variety of sieves or other mechanical filtering methods, and packaging them for sale. After removing the cenospheres, the remaining fly ash can be disposed of, reused in other applications such as concrete, or stored for future reuse.

Estimates vary widely on the quantity of cenospheres available in the United States. The percentage of cenospheres in fly ash ranges from 1 to 5 percent depending on a variety of factors related to the type of coal being used and the design of the coal plant. According to the American Coal Ash Association (ACAA), almost 63 million tons (126 billion pounds) of fly ash were produced in 1998. Based on the estimates above, there are between 1.26 billion and 6.3 billion pounds (630,000 to 3.15 million tons) of cenospheres produced annually.

One cenosphere supplier, however, estimates the annual U.S. availability to be only 50 to 90 million pounds or 25,000 to 45,000 tons. This lower estimate is based on the supplier's own calculations of the amount that can be recovered annually using its processing techniques. The supplier does not believe that current technologies allow all cenospheres to be recovered, but believes that future advances might make that a possibility.

Concrete containing cenospheres is a high performance concrete used in many construction applications including but not limited to specialty cements, mortars, grouts, and stucco. It can be used in construction of roads, bridges, buildings, docks, and dams.

Many other uses for cenospheres other than concrete additives have also been identified. Cenospheres are used as an aggregate in a variety of products because of their light weight and small size (10 to 350 microns). They are used in place of traditional aggregates like calcium carbonate, clay, mica, and sand. According to several suppliers, cenospheres are being used in products ranging from bowling balls to anti-radar coatings for stealth airplanes. Some of the products for which they are used or can be used include:

Any cementitious material
Bowling balls
Ceramic products
Coatings for stealth airplanes
Computer screen coverings
Countertops
Drainage pipe
Electrical boxes
Epoxies
Explosives
Grouts
Hard contact lenses
Insulation
Light weight concrete
Oil well cement
Paint
Plastics
Roof shingles
Roof tiles
Sheetrock
Sinks
Tires
Toilets
Underbody automobile coatings
Vanities
Wall board

The percentage of cenospheres used in these products is difficult to estimate since most manufacturers are not advertising the use of this material in products.

According to two cenosphere suppliers, many manufacturers do not advertise that their products contain cenospheres for two primary reasons. First, manufacturers using cenospheres are attempting to protect a competitive price or profit advantage because of the relatively low cost of cenospheres when compared to other available aggregates. Second, manufacturers might be concerned that revealing that their products contain a coal combustion byproduct will be perceived negatively by consumers.

2. Rationale for Designation

EPA has concluded that cement and concrete containing cenospheres meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

According to data provided by ACAA, between 630,000 and 3,150,000 tons of cenospheres were generated in 1998 by metal producers in the United States and 25,000 to 45,000 tons were reclaimed. The total amount of cenospheres reused will be higher because of the cenospheres content of fly ash, which is used as an additive in concrete as well. Cenospheres that are not reused are landfilled with the fly ash from which they are derived. Cenospheres are an inert material that does not leach hazardous pollutants in landfills or during storage. It is estimated that 70 to 80 percent of all cenospheres produced are landfilled.

Assuming a conservative cenosphere production rate of 1 million tons per year, the calculated volume of solid waste this represents is 83 million cubic feet of solid waste based on an average bulk density of 24 pounds per cubic foot. Based on the average U.S. reclamation volume of 35,000 tons annually, this represents a volume reduction of approximately 2.9 million cubic feet per year.

b. Technological Feasibility and Performance

Cenospheres can be added to traditional concrete mixtures to increase strength and decrease shrinkage and weight. Concrete containing cenospheres has increased thermal stability and better overall endurance as compared to traditional concrete. Cenospheres are used as fillers or extenders in place of traditional fillers such as manufactured glass spheres, calcium carbonate, clays, talc, and other various silicas. Cenospheres can be used in concrete in conjunction with other recovered materials such as fly ash

and silica fume, or by itself. Cenospheres are 75 percent lighter than other minerals currently used as fillers and 30 percent lighter than most resins.

c. Availability and Competition

According to one large cenosphere supplier, cenospheres are available throughout the United States from four primary suppliers. The two largest suppliers, however, refuse to "confirm or deny" that they sell cenospheres. The reason, according to one cenosphere supplier, is that the large supply companies also manufacture glass and ceramic "microspheres," in addition to recovering and packaging cenospheres. The manufactured microspheres, marketed under several different trade names, compete with cenospheres for use as aggregates in many of the same products. According to one large cenosphere supplier, the use of cenospheres reduces raw material costs.

Cenospheres are available worldwide and have been used in Europe in numerous applications for several decades. According to one supplier, some suppliers are importing cenospheres from Australia for sale in the United States because Australia has a more developed market for cenosphere recovery.

d. Economic Feasibility

According to one supplier, average U.S. sales price for standard grade cenospheres at truckload quantities is $0.38 per lb. Another cenosphere supplier claimed that cenospheres that have been thoroughly processed to meet a customer's very specific size and density requirements can be sold for as much as $5 a pound and are used in highly specialized applications.

Additional economic advantages of using cenospheres can be realized by the cement manufacturers that generate it. The volume of unused cenospheres generated each year results in an annual disposal cost of $7.5 million to $33.8 million based on the disposal costs of $10 to $45 per ton, 1 millions tons of cenospheres produced, and a 75 percent waste rate. If the equivalent volume of cenospheres were sold in the commercial marketplace at the bulk rate, this loss could be converted to approximately $760 million in sales based on a market value of $.38 per pound.

e. Government Purchasing

EPA contacted the Virginia Department of Transportation (VDOT) to find out whether it uses cement and concrete containing cenospheres. The contact with VDOT indicated that the agency does not, but for no reason other than it was not aware of the existence of this material. The contact added that he was interested in learning more about the benefits of cement and concrete containing cenospheres. One contact indicated that the Tennessee Department of Transportation has used cement containing cenospheres for vertical overhead patching. Attempts to reach the contact there, however, were unsuccessful. This same contact indicated that most procuring agencies would not be aware that cement with cenospheres was being utilized for a particular project because the product is not typically advertised as such.

f. Barriers to Purchasing

According to ACAA and two cenosphere suppliers, the primary barrier preventing the increased recovery and use of cenospheres is a lack of knowledge about the inherent cost advantages to using them. Another reason, according to one cenosphere supplier, is that the aggregate market is highly competitive and cenospheres are a relatively inexpensive aggregate that can decrease profit margins for other aggregate manufacturers and suppliers.

g. Designation

In CPG IV, EPA is proposing to revise its original cement and concrete designation to include cement and concrete containing cenospheres. A final designation would not preclude a procuring agency from purchasing cement and concrete containing another material. It simply requires that a procuring agency, when purchasing cement and concrete, purchase it containing cenospheres or some other recovered material when the item meets applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

The percentage of cenospheres used in concrete varies depending on the application and desired performance characteristics of the concrete, but according to sources in the industry, the typical content of cenospheres in concrete ranges from 10 percent to 15 percent by weight. Concrete containing cenospheres also often contains fly ash and vice versa, which further increases the recovered materials content percentage of the concrete. In products other than concrete, cenospheres content can reach 70 percent depending on the products and application.

b. Preference Program

EPA recommends that, based on the recovered materials content levels stated below, procuring agencies revise their preference program to establish minimum content standards for use in purchasing cement and concrete containing cenospheres.

- EPA recommends that procuring agencies revise their procurement programs for cement and concrete or for construction projects involving cement and concrete to allow use of cement and concrete containing 10-15% cenospheres (by weight), as appropriate. EPA recommends that procuring agencies specifically include provisions in all construction contracts to allow for the use, as optional or alternate materials, on cement or concrete that contains cenospheres, as appropriate.

c. Specifications

EPA identified the following national specifications and guidelines which enable procuring agencies to buy concrete containing cenospheres of a standard quality: ASTM C-618, which covers concrete additives.

B. Cement and Concrete Containing Silica Fume

1. Item Description

In 1983, EPA designated cement and concrete containing coal fly ash in the Comprehensive Procurement Guideline (CPG). EPA subsequently amended the designation in May 1995, to include cement and concrete containing ground granulated blast furnace (GGBF) slag. At the time of these designations, these materials were readily available in some areas for use as ingredients in cement and concrete. Since that time, EPA has obtained information on the use of silica fume in cement and concrete. Silica fume is an additive, similar to coal fly ash and GGBF, that has been used for a number of years in cement and concrete in highway construction projects. If designated, the existing cement and concrete designation would be amended to include silica fume as one of the recovered materials. This designation would be limited to silica fume from silicon and ferrosilicon metal production as discussed below and in section 2b of this research summary.

Silica fume is a waste material recovered from alloyed metal production—it is the solid waste collected on filters of electric arc furnace stacks. According to the Silica Fume Coalition (SFC), silica fume is a very fine, dust-like material composed primarily of silicon dioxide, the basic component of most rocks and sand. The glassy, spherical particles, approximately 1 micrometer in diameter, are a byproduct resulting from the reduction of high-purity quartz with coal or coke and wood chips in an electric arc furnace (EAF) during the production of silicon metal or ferrosilicon alloys. For comparison purposes, a grain of sand is about 1,000 times larger than a silica fume particle. Although silica content and particle size of fumes will vary according to the source of the fume, the use of silica fume in concrete has been standardized in specifications published by the American Society for Testing Materials (ASTM), the American Concrete Institute (ACI), the American Association of State Highway and Transportation Officials (AASHTO), and several state departments of transportation (DOTs). Hydrogen gas is released from concrete mixtures containing silica fume with a silicon metal production greater than 2 percent, which can result in the hazards discussed in section 4 of this research summary. ASTM standards require that silica fume used in concrete be derived from only silicon or ferrosilicon metal production, which yields silica fume having a silicon metal content less than 2 percent, thus eliminating these hazards. Based on this situation, EPA has determined that any designation should be limited to silica fume from silicon and ferrosilicon metal production.

Concrete containing silica fume is a high-performance concrete (HPC) used in construction and maintenance projects including, but not limited to, roads, bridges, buildings, docks, and dams. As defined by ACI, HPC is concrete that meets special requirements not achievable through the use of conventional materials and construction practices. Concrete containing silica fume is sold premixed in bags, similar to concrete with other additives.

Coal fly ash, GGBF slag, and silica fume are all recovered materials and have been used in concrete for the last 15 years in flood control projects by the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and in highway projects by state DOTs. The following state DOTs are known to have used concrete containing silica fume: New York, Ohio, Washington, South Carolina, Pennsylvania, Indiana, and Virginia. A contact with the New York DOT indicated that most states have used concrete containing silica fume at one point or another and that many probably use it routinely.

2. Rationale for Designation

EPA has concluded that cement and concrete containing silica fume meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

According to SFC, approximately 115,000 tons of silica fume were generated in 1999 by metal producers in the United States and approximately 67,200 tons were reused. SFC estimates, however, that due to increased generation of silica fume, reuse will need to increase 93 percent by the year 2000 to eliminate the need to dispose of silica fume. Other than its use in concrete, no other beneficial uses of silica fume are known. Silica fume that is not reused is either landfilled or stored for future reuse. Silica fume is an inert material and does not leach hazardous pollutants in landfills or during storage.

EPA was unable to locate any other estimates for generation, disposal, or reuse of silica fume. To verify the figures provided by SFC, the generation of silica fume can be extrapolated from the amount of EAF metal alloys produced. Silica fume is produced solely by facilities that manufacture silicon metal or other ferrosilicon alloys in EAFs. In such furnaces, EAF dust is generated at a rate of 0.4 to 3.2 percent per pound of metal alloy produced. One magazine reports that 16,925,900 tons of metal alloys were

produced in EAFs in 1996. Dividing SFC's estimate that 115,000 tons of silica fume were generated, by the magazine's estimate that 16,925,900 tons of metal alloys were produced, suggests that silica fume comprises approximately 0.7 percent of the volume of metal alloys produced. This figure falls between a 0.4 to 3.2 percent estimate for EAF dust generation, which suggests that SFC's estimate is reasonable.

According to SFC, the United States uses more than 500 million tons of concrete a year, which is more than 2 tons for every person in the United States. Using silica fume in only a small percentage of concrete production would eliminate the need to dispose of silica fume.

b. Technological Feasibility and Performance

Silica fume can be added to traditional concrete mixtures, which are composed of cement, aggregate, and water. It increases strength, microstructure density, and electrical resistivity; decreases fluid permeability; and improves the overall endurance of the concrete. As a concrete additive, it is used to replace some of the cement added to concrete. Silica fume is not a cementitious agent. It is categorized as an admixture, an aggregate, a filler, a pozzolanic additive, and other synonymous terms in specifications for its use in concrete. Silica fume can also be used in concrete in conjunction with other recovered materials, including fly ash and GGBF slag.

EPA identified the following national specifications and guidelines, which enable procuring agencies to buy HPC containing silica fume of a standard quality: ASTM C1240, AASHTO M840, and ACI 234R-96. ACI 234R-96 describes the properties of silica fume; how silica fume interacts with cement; the effects of silica fume on the properties of fresh and cured concrete; typical applications of silica fume concrete; recommendations on proportions, specifications, and handling of silica fume in the field. Silica fume has been used in HPC primarily to enhance strength and endurance properties, not because it is a recovered material.

Silica fume enhances HPC properties because its small particle size fills the microscopic holes in cement, which increases density and strength. The density of silica fume concrete makes it an appropriate material for bridges, parking decks, docks, and dams because of its strength and its impermeability. In these types of applications, building materials are subject to numerous freeze and thaw cycles during the winter months. With conventional concrete, water can permeate below the surface of the concrete and

the concrete can crack and weaken when the water freezes. Bridges, parking decks, docks, and dams freeze more easily than many surfaces because they are suspended in midair; for other types of structures, the ground provides insulation from the cold. Concrete containing silica fume significantly reduces the potential damage from freeze and thaw cycles because it is too dense for water to permeate below the surface of the concrete. According to a contact with the NYDOT, HPC with silica fume and coal fly ash is used on all NYDOT bridge and deck construction projects as well any other structures that are subjected to salts or chlorides (i.e., deicing salts or salt spray from seawater). The contact indicated that the low permeability of the concrete slows the ingress of salt to internal reinforcements, thus delaying corrosion.

Silica fume and fly ash can be used interchangeably as concrete additives in many applications. Silica fume particles, however, are much smaller than fly ash particles, which makes silica fume preferable for use in selected HPCs. Average silica fume particles are approximately 1 micrometer, while fly ash particles are approximately 20 micrometers. When used in concrete, silica fume's smaller particles settle between the cement grains better than fly ash particles and result in a stronger, denser, and less permeable concrete.

Researchers are continuing to examine the use of silica fume in concrete, including its long term performance and potential adverse effects on human health. Hydrogen gas is released from concrete mixtures containing silica fume with a silicon metal content greater than 2 percent. The release of hydrogen gas can cause the reinforcing steel within the concrete to become brittle and lose strength. It also presents the potential for explosion. ASTM standards require that silica fume used in concrete be derived from only silicon or ferrosilicon metal production. These production processes yield silica fume having a silicon metal content less than 2 percent, and eliminate dangers associated with hydrogen releases.

There also are potential health effects related to silica fume's small particle size. Massive inhalation of silica fume is linked to metal fume fever and silicosis. Metal fume fever results from massive inhalation of any metal fume. It is characterized by limb pains and constriction in the chest, but spontaneous recovery typically occurs within a few days following elimination of the source.

Silicosis is a potentially debilitating lung disorder that results from the inhalation of crystalline silica. While the Occupational Safety and Health Administration (OSHA) has not established specific exposure limits for silica fume, OSHA has established a permissible exposure limit for all inert or nuisance dusts, which includes silica fume, of 5 mg/m^3 based on an 8-hour time weighted average (TWA) (29 CFR 1910.1000, Table Z-3). The American Conference of Governmental Industrial Hygienists (ACGIH), however, has established a threshold limit value for silica fume of 2 mg/m^3 based on an 8-hour TWA. ACGIH's threshold limit values are established so that "nearly all workers may be repeatedly exposed day after day without adverse health effects." Unlike OSHA's permissible exposure limits, ACGIH's threshold limit values are not legal standards; however, they are used by some companies to establish their own permissible limits.

To reduce the potential risks associated with silica fume particles, suppliers typically slurry with water or compact silica fume to reduce workers' potential exposure to the dust.

c. Availability and Competition

Silica fume is available worldwide. It is packaged dry in bags and pressurized cubes, or as a slurry with chemical stabilizers to prevent freezing. There are seven major producers and ten major suppliers. Distributors are available in all 50 states.

d. Economic Feasibility

Concrete containing silica fume can be significantly more expensive than traditional concrete, including concrete containing fly ash. Silica fume is sold in relatively small quantities and is frequently packaged in 25- and 50-pound bags. It is available nationally for $0.30 to $0.35 a pound, which is equivalent to $672 to $784 a ton. Fly ash is typically sold by the ton and is available nationally for $15 to $45 a ton. While silica fume and fly ash can be used interchangeably for some non-HPC applications, silica fume is primarily used in HPC applications.

Without the addition of plasticizers to make silica fume concrete easier to pour, it can be more difficult to work with than concrete containing fly ash. The required plasticizers contribute to the additional cost of concrete containing silica fume.

Although concrete containing silica fume is generally more expensive, there are lifecycle savings that can result because it is stronger, more durable, and requires less maintenance and repair than conventional concretes. Typically, the determination to use silica fume in concrete is based primarily on performance requirements and long-term lifecycle costs, not acquisition cost.

Additional economic advantages of using silica fume can be realized by the metal factories that generate it. The volume of silica fume generated is expected to increase 10 to 15 percent annually, resulting in an annual disposal cost of $2 million for silica fume produced and disposed in 1999. If silica fume is sold in the commercial marketplace, the $2 million loss can be converted to $10.9 million in sales, based on the market value of silica fume.

e. Government Purchasing

Silica fume has been used in concrete by the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and state DOTs. Some major projects include the Los Angeles River Channel repair in 1985; the Cincinnati International Airport Terminal D Parking Garage; the Salt Lake City International Airport; the AT&T Kansas City, Missouri Headquarters Building; the Illinois DOT State Route #4 Bridge Deck Overlay; the Roosevelt Bridge in Stuart, Florida; and the Virginia DOT tie-back anchors on the King's Highway retaining wall project in Fairfax County, Virginia.

Of the 580,000 bridges in the U.S., approximately 1,900 bridges were built or repaired using concrete containing silica fume by 1999.

f. Barriers to Purchasing

According to the SFC, the only barrier that has been identified to purchasing concrete containing silica fume is a lack of knowledge among purchasing agents about the performance and long-term lifecycle cost savings associated with its use. Construction material cost analyses typically focus on initial procurement cost rather than lifecycle costs, which prevents concrete containing silica fume from being thoroughly considered.

Engineers and builders are already using silica fume for its endurance and strength-enhancing properties, regardless of the environmental benefit of recovering and using it.

g. Designation

In CPG IV, EPA is proposing to revise its original cement and concrete designation to include cement and concrete containing silica fume. A final designation would not preclude a procuring agency form purchasing cement and concrete containing another material. It simply requires that a procuring agency, when purchasing cement and concrete, purchase it containing silica fume or some other recovered material when the item meets applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

The percentage of silica fume used in HPC varies depending on the application and desired performance characteristics of the concrete, but according to numerous sources in the concrete industry, the typical content of silica fume in concrete ranges from 5 percent to 20 percent on a dry weight basis. HPC containing silica fume also often contains fly ash, which further increases the recovered materials content percentage of the concrete. The New York DOT, for example, regularly uses HPC composed of 74 percent cement, 6 percent silica fume, and 20 percent fly ash.

b. Preference Program

EPA recommends that, based on the recovered materials content levels stated below, procuring agencies revise their preference program to establish minimum content standards for use in purchasing cement and concrete containing silica fume from silicon or ferrosilicon metal production.

- EPA recommends that procuring agencies revise their procurement programs for cement and concrete or for construction projects involving cement and concrete to allow use of cement and concrete containing 5-20% silica fume (by weight), as appropriate. EPA recommends that procuring agencies specifically include provisions in all construction contracts to allow for the use, as optional or alternate materials, on cement or concrete that contains silica fume, as appropriate.

c. Specifications

As with many recovered materials, silica fume is not uniform in size, shape, or chemical content. ASTM C 1240 describes the required physical and chemical properties of silica fume, including minimum silicon dioxide content, maximum loss on ignition, maximum moisture content, and specific surface area. Other requirements limit the amount of contaminants in the product, the percentage of oversize particles, allowable variability for some parameters, and minimum performance requirements defined by a pozzolanic activity index. Some optional requirements are also provided for refining individual project specifications.

As mentioned earlier, ASTM standards require that silica fume used in concrete be derived from only silicon or ferrosilicon metal production. These production processes yield silica fume having a silicon metal content less than 2 percent, and eliminate dangers associated with hydrogen releases.

C. Modular Threshold Ramps

1. Item Description

EPA investigated the potential for designating modular threshold ramps in response to a comment from a manufacturer using 100 percent postconsumer recovered rubber in this product. Threshold ramps are used to modify door thresholds and other small rises to remove barriers that changes in level landing create, particularly with regards to access by people with disabilities. Modular threshold ramps are usually made of metal or rubber. They are typically used for retrofitting buildings to comply with the Architectural Barriers Act (ABA) of 1968, the Rehabilitation Act of 1973, the Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act (ADA) of 1990. The ADA Accessibility Guidelines cover the construction and alteration of facilities in the private sector (places of public accommodation and commercial facilities) and the public sector (state and local government facilities). The accessibility guidelines issued under ABA primarily address federal sector facilities and other designed, built, altered, or leased with federal funds. On November 16, 1999, the Architectural and Transportation Barriers Compliance Board (Access Board) issued a Notice of Proposed Rulemaking to revise and update its accessibility guidelines for buildings and facilities covered by the ADA and ABA. The proposed rule would require access for people with disabilities to additional areas of buildings, such as when an addition

is constructed or when a building is altered (64 FR 62247). In addition, the rule would make the requirements for both ADA and ABA facilities more consistent.

A change of level landing greater than ½ inch, such as at a door threshold, creates a barrier to access by disabled individuals. Whenever possible, therefore, level differentials in thresholds should be eliminated to comply with UFAS and the ADA guidelines, which apply to state and local governments and private facilities of public accommodation. As a result, products have been developed to retrofit door thresholds. These products are also used to improve access by people with disabilities to outdoor recreation areas.

When the change of level landing is greater than 6 inches and where a modular ramp is not suitable, concrete, asphalt, wood, or metal are typically used to create a transition that effectively removes the barrier. A modular rubber ramp for a transition greater than 6 inches becomes very heavy and prohibitively expensive to ship.

2. Rationale for Designation

EPA has concluded that modular threshold ramps containing recovered steel, aluminum, or rubber meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Rubber

EPA estimates that almost 3.7 million tons of rubber tires were generated in 1998. This represents close to 2 percent of the total municipal solid waste (MSW) generated. In 1998, an estimated 24 percent, or 900,000 tons, of tire rubber generated was recovered for recycling, leaving 2.8 million tons to be discarded. The amount of rubber tires discarded comprised 1.8 percent of the total MSW discarded in 1998 (EPA's recovery estimate does not include tires retreaded or energy recovery from tires).

EPA identified two producers of recovered content rubber threshold ramps. A contact with one of these companies indicated that these products require 1.7 tires per ramp (with dimensions 42 in. x

12.25 in. x 1.24 in.) and each ramp weighs 16 to 18 pounds. The ramp is made from 100 percent postconsumer automobile and truck tires. Therefore, for every 10,000 ramps purchased by the federal government, 17,000 tires, or roughly 200 tons of rubber, could be diverted from disposal. The potential consequences of purchases by state and local government agencies are much greater, considering the need to comply with ADA.

Aluminum

Aluminum cans and other packaging, and aluminum found in durable and nondurable goods constitute the aluminum fraction of MSW. Total generation of aluminum in 1998 was 3 million tons, representing 1.4 percent of the total MSW generated. In 1998, 27.9 percent of all aluminum and 44 percent of all aluminum in containers and packaging was recovered for recycling, leaving 2.2 million tons to be discarded, which was 1.4 percent of the total MSW discards.

According to a distributor of aluminum threshold ramps, each ramp weighs approximately 5 pounds. If the ramps were made from secondary aluminum billet containing 35 percent postconsumer recovered aluminum, then each ramp would contain approximately 1.75 pounds of recovered aluminum. For every 10,000 ramps purchased by the federal government, 9 tons of postconsumer recovered aluminum could be diverted from disposal.

Steel

EPA reports that ferrous metals (steel and iron) represented approximately 5.6 percent of MSW generated in 1998. According to the Steel Recycling Institute (SRI), steel was recycled at a rate of about 64 percent in 1999. The recovered steel includes more than 14 million tons of steel recovered from nearly 13.5 million automobiles; 18 billion steel cans and containers; and 39 million appliances. SRI estimates that every ton of recycled steel saves 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone.

Copper

Copper and brass are categorized as "other nonferrous" metals in EPA's waste characterization report, along with lead and zinc. This category excludes aluminum. Other nonferrous metals are found in appliances, consumer electronics, and other products. Lead in lead-acid batteries is the most prevalent nonferrous material in MSW, other than aluminum. Generation of other nonferrous metals totaled 1.4 million tons in 1998. Lead comprised 970,000 tons of this; copper, brass and zinc amounted to about .4 million tons. EPA's report does not provide data on copper and zinc recycling, but it does indicate that 95.9 percent of battery lead was recovered in 1997. Moreover, as previously stated, CDA estimates that copper has a 72 percent recycling rate.

b. Technological Feasibility and Performance

One producer has proven that the use of postconsumer recovered rubber in threshold ramps is technically feasible. The use of recovered aluminum, steel and copper in threshold ramps is also technically feasible.

The Access Board developed a *Retrofit Manual* that provides guidance on modifying entryways to meet UFAS access requirements. . The manual indicates that "raised thresholds of any dimension greatly increase the difficulty that individuals with disabilities have in using doors. Thresholds with abrupt level changes are a tripping hazard for pedestrian traffic and also impede passage for wheelchairs. Whenever possible, raised thresholds should be eliminated completely."

UFAS allows a maximum threshold height of 3/4 inch for exterior sliding doors and ½ inch for other types of doors. Raised thresholds also are required to be beveled with a slope no greater than 1:2. In retrofit situations, UFAS does provide an exemption for existing thresholds of 3/4 inch or less. If existing thresholds are beveled or modified to provide a beveled edge on each side, they may be retained. The *Retrofit Manual* also states that a smooth transition, or "flush" threshold, is preferred.

Although the federal government is not governed by ADA, the Access Board's ADA standards are more current than the UFAS and are therefore generally used by federal facilities. According to the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities* (28 CFR Part

36), published in the *Federal Register*, July 26, 1991, ground and floor surfaces along accessible routes and in accessible rooms and spaces including floors, walks, ramps, stairs, and curbramps, must be stable, firm, and slip-resistant. The guidelines do not define what is meant by "stable, firm, and slip-resistant," but the Access Board recommends static coefficient of friction values of 0.8 for ramps and 0.6 for accessible routes.

The ADA guidelines also address acceptable slopes for changes of level landing and other design criteria for threshold ramps. The Access Board is working on combining the UFAS with the ADA guidelines.

Rubber

Synthetic (virgin) rubber threshold ramps have been actively utilized by school districts, hospital buildings, and government facilities for several years. One company introduced synthetic rubber threshold ramps and access pads shortly after the ADA guidelines became effective in 1992. Synthetic rubber ramps are also manufactured by another company. Both ramps meet the ADA and UFAS performance standards.

Recycled rubber threshold ramps meeting the ADA and UFAS standards have been available since 1996 and are similar in performance and cost to the synthetic rubber ramps; however, the recycled rubber ramp provides a greater static coefficient of friction rating, and is therefore more slip-resistant. The rubber threshold ramps can be used anywhere where there is a change of level landing requiring a ramp of 1:12 slope. The ramps are not limited to door thresholds. Therefore, this product has applicability along any access route, indoors or outdoors.

A limitation to the recycled rubber ramp is that it is only suitable for heights up to 6 inches. At this height the ramp becomes very heavy and expensive to ship. (The standard ramp weighs 16 to 18 pounds). For changes in level landing greater than 6 inches, modifications generally require repouring concrete or using an alternative product.

Since the rubber threshold ramps are only available in black, color is also a limitation. Where a specific color is required, generally for aesthetics, rubber ramps are not appropriate. Aluminum, in contrast, is available in a variety of colors.

According to a contact at a school district in Florida, the recycled rubber threshold ramp is less expensive and easier and faster to install than metal or concrete alternatives. The rubber also is more slip-resistant.

The California Integrated Waste Management Board (CIWMB) and the California State Architect are promoting the use of recycled rubber threshold ramps. The state views the recycled rubber threshold ramp as an inexpensive alternative to aluminum that presents an excellent opportunity to create a market for scrap tires. CIWMB is purchasing ramps to give to state agencies as samples. A contact with California Department of General Services, Division of the State Architect, indicated that his office encouraged the use of recycled rubber threshold ramps in California school districts several years ago. Although he was not able to provide any numbers, it was his general sense that they are quite popular with many of the 1,100 school districts in California. The rubber ramps are far less costly than some of the metal products on the market.

Metal (aluminum, steel, and copper)

Scrap metal is routinely substituted for primary material in the production of extruded products. Secondary billet containing recovered aluminum, for instance, can be substituted for primary (virgin) billet in the production of aluminum extruded products. For many years, aluminum, steel, and copper ramps have been used to provide access for people with disabilities and to eliminate barriers at door thresholds and other changes of level landing. Aluminum threshold ramps generally involve assembling locking pieces and end flanges onsite with a minimum of nine cement anchors installed to fasten the product to the substrata. Aluminum ramps also have slippery cross-traffic surfaces requiring a nonslip treatment that can wear and deteriorate, and must be refurbished over time.

c. Availability and Competition

EPA contacted six manufacturers of threshold ramps. Four of these companies manufacture rubber threshold ramps, and two use postconsumer recovered rubber; the other two use virgin (synthetic) rubber. Most have a network of distributors, but one company only sells its rubber threshold ramp to one specific customer. EPA also contacted a manufacturer of recovered content rubber flooring and mats. The company does not currently have distributors.

Three of these suppliers also manufacture aluminum ramps that can contain recovered materials when secondary billet is less expensive than primary billet. For example, one company manufactures aluminum, steel, copper and brass ramps. The company has 6,000 distributors, many of which supply materials for federal jobs. According to a source, the company does not specify that its raw material be primary or secondary metal. According to a contact at an aluminum extrusion plant, primary and secondary billet are interchangeable; the price of the raw material is the determinant. Specifying that secondary aluminum billet be used in the production of aluminum threshold ramps would not change the performance standards of the product, as long as the billet contains no more than 35 to 40 percent scrap aluminum. The contact, however, indicated that she would have to know more about the recycled product's ability to meet performance standards before she would specify recovered material content in their products.

d. Economic Feasibility

Traditionally, aluminum and cement have been used for threshold modifications. Asphalt is sometimes used on large projects. Aluminum ramps are more expensive than rubber and less slip-resistant. Cement modifications are very labor intensive. Cement typically requires the cutting of the substratum prior to forming and pouring the cement ramp. Constant attention is required by the contractor to continuously shape and form the cement as it sets. Depending on the application and number of ramps installed, a worker can spend up to three hours on each ramp to guarantee a slope of 1:12. Asphalt, on the other hand, is seldom used in small amounts, because it requires a hotpack. This is generally very expensive unless large construction projects are underway. Furthermore, guaranteeing the proper grade is difficult with asphalt. According to the one manufacturer identified in this research, a recycled rubber threshold ramp is less expense to buy and install than alternative products.

e. Government Purchasing

Although exempt from ADA requirements, the federal government is using the 1992 ADA guidelines with regards to accessibility by people with disabilities because they are more current than the much older UFAS. Manufacturers of threshold ramps are selling some products, albeit of an unknown quantity, to the federal government. Three manufacturers indicated that their distributors have made sales to federal facilities. At Moffett Field in California, the National Aeronautics and Space Administration (NASA) purchased several recycled rubber threshold ramps to allow for the movement of heavy equipment into part of its facility. The U.S. Forest Service in Clarksville, Arkansas, ordered a recycled rubber threshold ramp to make it easier for anyone in a wheelchair to get through its entrance door.

In 1998, one company received a New Item Introductory Schedule (NIIS) from the U.S. General Services Administration (GSA) (GSA contract no. GS-27F-0521H). A contact with the company indicated that government agencies have been procuring its rubber threshold ramps through GSA's schedule, but he was not able to indicate the level of purchasing. Another contact at GSA indicated that it is unlikely that GSA is buying "retrofit" products since the federal government should be in compliance with ABA. If ramps are added to federal facilities, he thought they would be built into the structure using concrete. He did indicate, however, that access ramps are required for temporary staging areas, which might account for some federal government purchasing.

EPA also contacted the U.S. Housing and Urban Development's (HUD's) Office of Fair Housing and Equal Opportunity, Disability Rights Office. Sources there indicated that most federal buildings are in compliance with UFAS. Since housing authorities are required to comply with Section 5 of the Rehabilitation Act, however, there may be a fair amount of demand for retrofit products for federally funded activities, although they could not estimate demand for this product.

EPA's research suggests that a burgeoning market for ramps and accessibility products could be emerging for outdoor recreational areas. On July 9, 1999, the Access Board issued a Notice of Proposed Rulemaking in the *Federal Register* for *Proposed Accessibility Guidelines for Recreation Facilities* (64 *FR* 37325). The public comment period ended in December 1999, but a final rule has not been issued yet. If finalized, the guidelines would expand the ADA Accessibility Guidelines to include newly developed or altered outdoor recreation facilities. The current UFAS and ADA guidelines are written for

buildings and do not address outdoor recreation areas. These guidelines will ensure that beaches, golf courses, playgrounds, sports facilities, amusement parks, swimming pools, fishing piers, boat launch facilities, campgrounds, and trails will be designed for accessibility. This could create federal demand for retrofit products, including the threshold ramps and access pads which also have outdoor application. In fact, the recycled rubber threshold ramp is also suitable for outdoor applications. The U.S. Fish and Wildlife Service is using recycled rubber mats to provide access for people with disabilities to waterfowl hunting blinds at the Sacramento National Wildlife Refuge Complex in California. The mats extend 310 feet from a gravel roadside parking area to two blinds.

In 1973, the Rehabilitation Act required state and local governments to follow UFAS. While state and local governments should now be in compliance with these accessibility standards, many ignored the Rehabilitation Act requirements and are therefore scrambling to comply. For example, a school district in Florida, is installing over 20,000 transition ramps, including threshold ramps, throughout more than 350 facilities. The school district is using a combination of rubber, aluminum, and concrete ramps to meet the requirements of ADA and Section 504 of the Rehabilitation Act.

The Washington State Building Code Council (WSBCC), Olympia, Washington, is responsible for writing and maintaining building codes in Washington. Nothing in the Washington state code or the ADA guidelines precludes the use of recycled materials in threshold ramps. The state has not received federal funding for barrier removal, however. Furthermore, since Washington received ADA certification several years ago, WSBCC does not expect that there is a large demand for retrofit products at this point. California, on the other hand, is in the process of barrier removal and the State Architect expects a large increase in demand for retrofit products like the threshold ramp.

f. Barriers to Purchasing

For suitable applications, there appear to be no barriers to the purchase of postconsumer content rubber or recovered content aluminum, steel, or copper threshold ramps and access mats. There is an established network of thousands of local distributors for the manufacturers identified. One company's recycled rubber threshold ramps are marketed at more than 3,000 local distribution points. Moreover, recovered materials can readily be substituted in the manufacturing process for the alternative metal

products, as is currently the case when the price of primary raw materials exceeds that of the recovered material feedstock.

g. Designation

EPA proposes to designate modular threshold ramps containing recovered content steel, aluminum, or rubber. A final designation would not preclude a procuring agency from purchasing threshold ramps made from another material. It simply requires that a procuring agency, when purchasing steel, aluminum, or rubber threshold ramps, purchase these items made with recovered materials when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Rubber threshold ramps can be manufactured with up to 100 percent postconsumer recovered materials. Metal ramps are manufactured from aluminum, steel, copper, or copper alloy (brass) containing recovered materials. Aluminum ramps can be composed of up to 40 percent secondary aluminum billet. Secondary aluminum billet contains 35 to 40 percent scrap aluminum, with the balance consisting of primary aluminum (ingot) and alloying ingredients. Steel ramps are made from either or a combination of steel made from the Basic Oxygen Furnace (BOF) and Electric Arc Furnace (EAF). A contact at the Steel Recycling Institute, therefore, indicated that a steel threshold ramp could contain between 25 and 85 percent recovered content including 16 to 67 percent postconsumer material. Nearly three-fourths (72 percent) of the copper used by copper and brass mills, ingot makers, foundries, power plants, and other industries comes from recycled copper scrap.

Recycled Rubber

Rubber ramps are made from either recycled or synthetic rubber. One company manufactures a 100 percent recycled threshold ramp and approach mat from 100 percent postconsumer recovered rubber derived from scrap automobile and truck tires. Scrap tires are collected from dealers and the public and ground into crumb rubber at a processing plant.

A company manufacturers recycled rubber flooring material from 80 to 100 percent crumb rubber. The material is extruded and compressed into a resilient interior and exterior flooring material. The company sells the flooring material to manufacturers of metal threshold ramps who use it to cover the metal surface, thus improving accessibility by people with disabilities.

Aluminum

Aluminum products are manufactured from aluminum billet—small ingots of aluminum. (An ingot is a mass of metal shaped for convenience in storage and transportation). There are two types of aluminum billet: primary and secondary. Primary manufacturers make aluminum ingot from bauxite. Secondary plants produce aluminum billet from scrap. This is combined with aluminum ingot and alloys to create aluminum for extrusion products.

According to the *Aluminum Statistical Review for 1997*, published by the Aluminum Association, 36.5 percent of the aluminum supply in the United States in 1997 was secondary billet. Technically, both primary and secondary billet can be used to make threshold ramps. Aluminum extruders will buy both, depending on price. To obtain the necessary performance specifications, however, no more than 35 to 40 percent of recovered aluminum is used in secondary billet. According to one aluminum extruder, the company uses about 30 percent secondary billet on average through the course of a year. Since secondary billet contains only 35 to 40 percent recovered aluminum, the end product contains an average of 10 percent recovered materials. According to the Aluminum Extruders Council, the choice of which aluminum alloy to use is generally driven by the product's application. Everyday threshold ramps can probably be made from common 6xxx alloys (e.g., 6061, 6063, etc.), which can use scrap aluminum. There are a few alloys with low impurity limits (e.g., 7050) but these do not apply to threshold ramp applications.

Several of the manufacturers contacted by EPA make aluminum threshold ramps. One company makes aluminum folding ramps, curb ramps, handrail ramps, and entrance ramps, among other products. EPA did not confirm whether these particular ramps contained any recycled content, since the manufacturers generally do not specify secondary billet.

Steel

EPA received information from two manufacturers of stainless steel threshold ramps. The steel used in threshold ramps can be made from either BOF or EAF steel, or a combination of the two. It could potentially contain 25 to 85 percent total recovered content, including 16 to 67 percent postconsumer material.

Copper

According to the Copper Development Association (CDA), copper and copper alloys have been recycled for thousands of years. The entire economy of the copper industry is dependent on recycling. Although worldwide copper resources are estimated at nearly 5.8 trillion pounds, only about 0.7 trillion pounds (12 percent) have been mined. Nearly all of this is still in circulation, because copper's recycling rate is higher than that of any other engineered material. Each year, nearly as much copper is recovered from recycled material as is derived from newly mined ore in the United States.

Copper and brass threshold ramps are generally more expensive than rubber and steel. EPA contacted one manufacturer of brass threshold ramps. This company makes extruded aluminum and brass (bronze) thresholds and strips, including an interlocking ramp system that meets ADA accessibility guidelines. The company did not specify the percentage of recovered material in its ramps.

Concrete and Asphalt

Since concrete and asphalt threshold ramps require construction, they are not included with the modular threshold ramps under consideration for designation. However, since EPA has already designated cement and concrete containing certain recovered materials, procuring agencies should require cement and concrete used for constructing threshold ramps to contain these recovered materials.

Table 5 presents information provided by manufacturers of modular threshold ramps on recovered content availability.

Table 5
Recovered Materials Content of Modular Threshold Ramps

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Aluminum	Company A: unknown Company B: unknown Company C: unknown	10 10 10
Rubber	Company D: 100 Company E: 100 Company F: 80-100 (flooring material)	100 100 up to 100
Steel	Company G: 16 to 67 Company H: 16 to 67	25 to 100 25 to 100
Copper	Company I: unknown	unknown

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 6, procuring agencies establish minimum content standards for use in purchasing modular threshold ramps.

Table 6
Draft Recovered Materials Content Recommendations for Modular Threshold Ramps

Material	Postconsumer Content (%)	Total Recovered Material Content (%)
Steel	16 - 67	25 - 100
Aluminum	–	10
Rubber	100	100

Note: A final designation would not preclude a procuring agency from purchasing threshold ramps made from another material. It simply requires that a procuring agency, when purchasing steel, aluminum, or rubber threshold ramps, purchase these items made with recovered materials when they meet applicable specifications and performance requirements.

The recommended recovered materials content levels for steel in this table reflect the fact that the designated items can be made from steel manufactured in either a Basic Oxygen Furnace (BOF) or an Electric Arc Furnace (EAF). Steel from the BOF process contains 25% - 30% total recovered steel, of which, 16% is postconsumer steel. Steel from the EAF process contains a total of 100% recovered

steel, of which, 67% is postconsumer steel. In addition, threshold ramps can be made from a combination of BOF and EAF steel which, according to industry sources, would result in a steel with 25% - 85% total recovered steel content, of which 16% - 67% would be postconsumer steel.

b. Specifications

Although the federal government is not governed by ADA, the Access Board's ADA standards are more current than the UFAS and are therefore generally used by federal facilities. According to the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities* (28 CFR Part 36), published in the *Federal Register*, July 26, 1991, ground and floor surfaces along accessible routes and in accessible rooms and spaces including floors, walks, ramps, stairs, and curbramps, must be stable, firm, and slip-resistant. The guidelines do not define what is meant by "stable, firm, and slip-resistant," but the Access Board recommends static coefficient of friction values of 0.8 for ramps and 0.6 for accessible routes.

D. Nonpressure Pipe

1. Item Description

Nonpressure pipe is used throughout the United States as drainage pipe and conduit in construction, communications, municipal, industrial, agricultural, and mining applications. Drainage pipe is used in water distribution systems for surface and subsurface applications (e.g., building foundations, highway construction, and general land drainage) to collect and convey water by gravity flow. It also is used in drain, waste, and vent (DWV) applications where it functions similarly to drainage pipe. In DWV applications it is used primarily in residential construction and other building projects. It is used in sanitary and storm sewer applications and as conduit and ducts to house electrical and communications wires.

Pipes are used in two major types of applications, "critical" and "noncritical." While not strictly defined, these terms are used and understood by technical contacts to refer to two distinct scenarios influencing decisions about the type of pipe that should be used in a specific situation. If failure of the pipe could result in loss of human life or valuable property, the application is considered to be "critical." Other criteria used to determine critical applications include: when the cost of repairing the failure is much greater than the cost of installing the application; if the application cannot be monitored for failure, so

signs of failure go unnoticed or cannot be corrected before catastrophic failure occurs; if the application requires engineering design; or if the application has the potential for heavy water flow through the pipe. Critical uses of pipe include the following applications: sanitary sewers, placement under structures (i.e., roads or buildings), waste containment, specifications that require pipe larger than 12 inches, and highway drainage and storm sewers.

In contrast, "noncritical" uses of plastic pipe include agricultural drainage, home venting, drainage, small diameter land drainage and sewage septic field piping, communications and utility ducts for low voltage wires, and temporary uses.

Table 7
Noncritical, Nonpressure Pipe Applications Considered for Designation

Type of Pipe	Use
Agricultural drainage pipe	C Subsurface drain pipe and tile C Drainfield pipe C Terrace risers C Compost aeration pipe C Golf course drainage pipe
Gravity-fed sanitary drainage pipe	C Leachfield (leaching, absorption field) pipe C Absorption trench pipe C Individual or on-lot subsurface sewage disposal system pipe C Storm sewers C Manholes C Culverts and outlets C Stream enclosures

Type of Pipe	Use
Building and construction applications	C Building foundation (footer) drain pipe C Downspouts (roof drains) C Entrance culverts C Drain, Waste, Vent (DWV) C Utility (electrical & communications conduit/ducts C Landfill gas recovery pipe C Erosion prevention systems C Storm water detention C Material handling conveyors C Flumes
Road and highway applications	C Downspouts for bridges or other above ground applications. C Temporary slope drain pipe or culvert used in detours (run-around). C Temporary drain pipe or culvert used in detours (run-around). C Utility ducts for off the shoulder and for above ground structures.
Utility conduit and duct	C Telephone and computer wires and cables C Low-voltage insulated wires

According to industry spokespersons and trade associations, the applications for pipe and duct are not formally defined by industry. For the purposes of this report, the following descriptions explain the types of nonpressure pipe used in noncritical applications.

Drainage Pipe

Drainage pipe collects and conveys excess water. Also called “drainage tile,” it is used for land drainage and in construction applications. Materials used for this type of pipe include plastics, concrete, aluminum, and steel. More than 70 percent of drainage pipe is made with PVC and HDPE, which is often perforated. (Perforated straightwall pipe also is used to collect gas in landfill gas recovery systems). HDPE corrugated pipe has a single wall with fluted inner and outer surfaces to give the pipe structural strength. HDPE smoothwall pipe has a second, smooth layer inside the corrugated exterior wall. PVC single-layer straightwall pipe has smooth walls extruded in one layer. PVC coextruded pipe sandwiches an inner core between two smooth layers.

Drain Pipe

Drain pipe, which is sometimes called culvert, conveys excess water from subsurface soil around residential and commercial structures into storm sewers. While mostly made from plastic, other materials used for drain pipe include steel, concrete, clay and cast iron. The same types of HDPE and PVC pipe are used for drain pipe applications as for drainage, although drain pipe is never perforated.

DWV Pipe

DWV pipe forms an interlocking network for waste removal within a structure. One part of the system drains sewage and waste water to sewer systems; the other part allows the system to vent, thereby
preventing backflow and internal vacuums. Piping used in this application generally range in diameter from 1.25 inches to 12 inches. Over 90 percent of DWV pipe footage is plastic, primarily PVC. Acrylonitrile-Butadiene-Styrene (ABS), cast iron, copper, and steel are used as well.

Utility and Communication Duct

Utility and communication duct fall within the overall conduit category. Also called “raceway,” this type of pipe is an enclosed channel expressly for placing cables and wires underground or within walls. Utility duct carries low-voltage insulated wires such as telecommunications wire. Materials used for this type of pipe application include plastics and metal.

Communication duct is small diameter pipe, ½ inch to 6 inches, used to manage low-voltage communication wire and optic fiber. Straightwall HDPE pipe, corrugated HDPE pipe, and PVC pipe are used. Typical installations are 18 inches to 24 inches underground. This industry sector is expanding rapidly due to increased demand for telephone wire and horizontal directional drilling installation equipment. The same type of pipe sold to other markets is used for communication duct. Manufacturers of HDPE straightwall pipe use ASTM specifications for pipe pressure-rated for water. One contact indicated that the only potential technical performance reason to use pressure-rated HDPE resin for

communication duct is environmental stress crack resistance. “Environmental Stress Crack Resistance” refers to the parameter used to predict stress crack resistance of HDPE resin used in pipe manufacture. A stress crack is an external or internal rupture caused by tensile stress less than its short-term mechanical strength. The development of such cracks is frequently accelerated by the environment to which plastic is exposed. The stresses which cause cracking may be present internally or externally or may be a combination of these stresses.

b. Rationale for Designation

EPA has concluded that nonpressure pipe containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Approximately 22.4 million tons of plastics were generated in municipal solid waste (MSW) in 1998, comprising 10.3 percent of total MSW generated. Of this, HDPE comprised 5 million tons, or 22.3 percent of all plastic. Approximately 940,000 tons of PVC were generated in 1998. That year, 12.4 million tons of steel entered the waste stream (5.7 percent of MSW generated). In 1998, almost 63 million tons of fly ash were generated, of which approximately one third was recovered.

A 1996 report by the Reason Foundation indicated that because the pipe industry uses minimal amounts of recycled resin in its manufacturing, the industry could potentially absorb additional quantities. Reason estimated that as much as 130,000 additional tons of recovered PVC and 120,000 additional tons of recovered HDPE can be used in the manufacture of pipe. The study did not address the recycling industry's ability to meet that demand, however, nor the specific grades of recycled PVC and HDPE resins appropriate for use in the production of pipe.

b. Technological Feasibility and Performance

Pipe containing recovered material has been used throughout the country for many years. Manufacturers of postconsumer-content plastic pipe report their products are used primarily for agricultural drainage and other applications where specifications do not preclude recovered materials.

Definitions of recycled content vary from one specification to the next. A wide-range of research has been conducted on the use of recycled pipe, as discussed below.

State agencies in Connecticut, Maine, Michigan, New Jersey, New York, and Pennsylvania have approved nonpressure thermoplastic pipe with recovered material content for smoothwall sanitary leachfield and drainage pipe applications. Kentucky approved the use of recycled-content PVC pipe for DWV applications. The approved pipe is not marked for pressure applications and must meet ASTM standard D2665 (*Standard Specification for Polyvinyl Chloride Plastic Drain, Waste, Vent Pipe*), even though this standard requires the use of virgin material. The Massachusetts Highway Department (MHD) specifies corrugated plastic drain pipe made out of corrugated polyethelene, using MHD specification M5.03.10, which is silent on the matter of recovered material content. The state's recycling coordinator does not know if the state has actually procured recycled content plastic pipe.

A number of state and local agencies are involved in testing recycled pipe products. The status and results of their studies are described below.

North Carolina Department of Transportation (NCDOT)

In North Carolina, legislation (Senate bills 111 and 58 ratified in 1989 and 1993, respectively) mandates research and incorporation of recycled and or recyclable materials into highway construction products with specific attention to ground waste rubber tires and recycled mixed plastic materials. NCDOT interprets the mandate broadly and has a budget to offer price preferences.

Ten separate installations of recycled-content HDPE pipe and fittings are in place or underway. The types of pipe involved include 4-inch outlet pipe, 6-inch perforated pipe, 12-inch temporary slope drain, 6-perforated subdrain, and perforated subdrain fittings. So far, no performance problems have been reported.

The Georgia Department of Transportation

The Georgia Department of Transportation (GADOT) tested recycled HDPE highway edge drain in the 1970s and 1980s. When the 1970s oil embargo squeezed the supply of virgin HDPE, GADOT

allowed recycled HDPE pipe to qualify in its highway specifications. At that time, Section 839 - *Polyethylene (PE) Plastic Corrugated Underdrain Pipe* stated in part:

> 839.03 C. Reprocessed polyethylene [as distinguished from re-work] purchased as such by the manufacturer may be blended with virgin material to manufacture tubing provided the material as received meets the physical requirements specified in 839.03A [stated cell classification values from ASTM 1248] except for Class, and provided the resultant tubing meets all requirements of the specification. Reprocessed material shall be adjusted as necessary to meet the requirements of Class C material.

The allowance for reprocessed PE remained in the GADOT Highway Specifications from the mid- 1970s to the mid-1980s. The reference was removed to simplify the specifications, not because of any known product failure. GADOT now references AASHTO specifications. The physical properties of plastic pipe (not necessarily recycled plastic pipe), were tested when the switch from other materials began. Since the specifications allowed recycled content, some pipe certainly contained it although there are no records to prove it. Approved pipe was used throughout the state with no need for followup testing or inspection. Pipe placed by the state was surrounded by crushed stone aggregate, which supported the flexible pipe adequately.

Illinois Department of Agriculture (IDA)

In 1994, the Illinois Bureau of Environmental Programs ran a study of corrugated plastic drainage tubing made from postconsumer HDPE agricultural chemical containers. All containers were triple washed or pressure washed before processing. The Agricultural Container Research Council estimated that, at the time, U.S. agriculture used 35 million agrichemical containers per year.

According to an interim report published by IDA, a 4-inch corrugated pipe was extruded in batches with 25 percent, 50 percent and 100 percent recycled content. A contractor installed the pipe in a typical, shallow burial, parallel lateral drainage system configuration. Effluent from the pipe, as well as controls from virgin plastic pipe and surrounding soils, were sampled and analyzed. Although analysis detected some pesticides, the report concluded that there was no statistical difference between effluent from the recycled-content pipe and virgin plastic pipe. Additional research and tests of recycled-content pipe retrieved from the field were planned. Leaching of residual agricultural chemicals from the pipe rather than pipe performance, was the issue under study.

No follow-up report has been published to date, and the study continues. At the time of the study, the dry weather in Illinois meant too few samples could be taken. Those samples collected showed no more than background levels of pesticides. The trace amounts of pesticides in the published data were typical of background soil and water in the test site region. The IDA staff person responsible for taking samples reported no problems with pipe performance. The Agricultural Container Research Council is considering approving drainage pipe as a suitable product to be made with postconsumer agrichemical containers.

City of Santa Barbara

The city of Santa Barbara Public Works Department installed three 500-foot sections (1,500 linear feet) of 8-inch recovered-content PVC coextruded pipe as sanitary sewer pipe under a roadway. The company that installed it used standard installation procedures, following SDR 35 ASTM D3034, and encountered no problems. The pipe was buried approximately 36 inches under residential roads and carries live loads. The city expects a minimum of 50 years of service but expects such projects will last 100 years. For the past 20 years, the city has been replacing 100-year old clay pipe with plastic. All of the recycled-content pipe was inspected in March 1997 and again in April 2000, and appeared to be in excellent condition. Although used in a "critical" application, the Public Works Department considers the recycled-content pipe to be a superior product for use as sewer pipe under roads.

San Diego County

In San Diego County, thousands of feet of coextruded PVC pipe with recycled content in the interior layer were used in a methane recovery project at the San Marcos Landfill. Vertical collectors reached depths of 85 feet. Horizontal collectors were buried about 5 to 6 feet. A portion of each vertical pipe served as an outlet above ground. The gas recovery contractor, who monitors the pipe frequently, stated that the ASTM Schedule 40 pipe holds up substantially better than comparative virgin pipe. He attributed this to thicker walls and residual UV inhibitors in the recycled product. In his experience, standard ASTM Schedule 40 pipe loses strength within 1 year and must be replaced. The pipe was installed in early 1994. After more than 2 years in use, the contractor detected no deterioration. Pilot tests for other applications in San Diego were placed on hold until a permanent ASTM standard became available.

Research that pertains to recycled thermoplastic pipe has been conducted by or is underway at several organizations. These studies are described below.

National Cooperative Highway Research Program (NCHRP)

The National Cooperative Highway Research Program (NCHRP) is a division of the Transportation Research Board, which, in turn, is part of the National Research Council under the National Academy of Sciences. NCHRP works closely with AASHTO. NCHRP completed several pipe studies as described below.

NCHRP 20-7-68 Polyethylene Pipe Specifications

This study was completed in January 1996 and published by AASHTO. The report, among other things, concluded that recycled resins need further study**.** Specifically, it states that quality assurance and quality control procedures are needed for both pre- and post-pipe production; combining postconsumer and virgin resin might result in a blend with properties inferior to each component; variations in resin density can have a strong influence on flexural stiffness, tensile strength, and stress crack resistance; postconsumer materials that pass preproduction cell classification might still be the source of great variation in mechanical properties of the end product; and that the highest quality resins, virgin or blended with postconsumer materials, should not be expected to compensate for poor geometric design.

NCHRP 20-7-89 Load and Resistance Factor Design (LRFD) Specifications for Plastic Pipe

This study began in August 1997. When completed, the project will develop design specifications that reduce the need to over-specify pipe material characteristics. The specification would no longer use the structural design of corrugated metal pipe as the starting point. Consequently, it would not depend on values derived from plastic pipe failures. In addition, some lifecycle issues will be addressed.

NCHRP 4-26 Thermoplastic Drainage Pipe Design and Testing

This study began in 1998 and is expected to be completed in August 2001. The AASHTO "Soil-Thermoplastic Pipe Interaction System" design procedure (Section 18 and LRFD Section 12) was written in the early 1980s based on corrugated metal pipe design procedure. The study will address inherent problems in this approach. The objectives include a recommended LRFD specification for thermoplastic pipe used as culverts and drainage systems for consideration by AASHTO. The recommended specification will include a simplified design procedure based on a comprehensive model and experimental data. The procedure should account for both failure and performance criteria based on soils structure interaction and time-dependent pipe properties. In addition, the project is to develop quality assurance and quality control procedures to test manufactured thermoplastic pipe.

NCHRP 4-24 HDPE Pipe Material Specifications and Design Requirements

This study began in January 1997 and was completed in August 1998. The research objective was to validate the SP-NCTL test as a measure of slow crack growth resistance under sustained loading of HDPE resins, including compositions containing postconsumer resins, that are intended for nonpressure drainage pipes. The study calibrated minimum slow crack growth resistance requirements using the results of actual experience. Compounded resin samples were tested as well as exhumed pipe that failed in the field because of stress cracking. The final report is published as NCHRP Report 429, *HDPE Pipe: Recommended Materials Specifications and Design Requirements*. The findings of this study have generated debate within the pipe industry. In an article in an industry trade journal, Dr. Hsuan acknowledges that, while "... overall performance of corrugated PE pipe has been good and users are generally enthusiastic about continued use, as we are; however, we do have some concerns with expected long-term performance."

Research studies identified in this report suggest that the long-term performance and endurance of pipe containing both recovered and virgin plastic will likely remain the subject of debate and study for many years.

The Plastic Pipe Institute (PPI) is an industry trade association serving HDPE pipe manufacturers. PPI's Resin Committee contracted a study published in 1997 entitled, *A Stress Crack*

Resistance Method for Evaluation of PE Materials Intended for Pipe Applications (PPI #AW188). The study results confirmed that the NCTL and the SP-NCTL tests are more accurate and efficient than hydrostatic design basis and environmental stress crack resistance tests for slow crack resistance. The study also systematically evaluated the effects of postconsumer resin on the properties of virgin resin. This study did not define postconsumer resin, however, nor were details about the postconsumer or postindustrial source or characteristics of the postconsumer resin available to the investigator. A PPI representative was not certain how postconsumer resin was defined.

In the PPI study test plaques were prepared for each sample resin and for compounds of virgin and postconsumer resins. Intentionally, the plaque preparation accentuated crystallinity and, therefore, stress crack potential. The correlation between slow crack resistance and material properties, melt index, crystallinity (heat of fusion) and amount of antioxidant were analyzed. Results showed that slow crack resistance must be evaluated in, and of, itself and not be assessed by other material properties. Further research will identify the "go-no go" value for the SP-NCTL test.

Test results showed that some samples of postconsumer resin improved the slow crack resistance of the virgin resin samples while others reduced it. The effect could be measured according to the percentages of each material in the blend. Slow crack resistance, therefore, is governed by the type of HDPE virgin resin and the type of postconsumer resin incorporated in the mix as well as the proportions of each.

In addition, the study explained that creep is not a major concern when evaluating pipe resins for long-term service. Failure due to creep would appear in the short term when the pipe deforms according to the surroundings and soil load. When the pipe and soil reach equilibrium, slow crack growth is the critical concern.

Florida Department of Transportation Corrosion Research Laboratory

The Florida Department of Transportation (FDOT) Corrosion Research Laboratory evaluated the fire risk of HDPE pipe in a report dated July 15, 1994 (*High Density Polyethylene Pipe Fire Risk Evaluation, FDOT Report No. 94-7A*). Florida used HDPE pipe on a limited basis for 5 years and was

evaluating a new mitered end section proposed by the pipe industry. The study concluded that HDPE pipe was not a significant risk when exposed to fire like that encountered in roadside grass fires.

c. Availability and Competition

Pipe and duct products with recovered material content are available nationwide. Large companies with many manufacturing plants and broad distribution networks compete with smaller companies that serve regional markets. In both the PVC and HDPE markets, numerous companies use percentages of recovered material in their standard lines when specifications allow. Other companies introduce postconsumer content according to customer demand. EPA identified 4 manufacturers using some percentage of postconsumer recovered material in their thermoplastic pipe. EPA also identified 2 manufacturers of thermoplastic pipe made from postindustrial recovered material.

One pipe manufacturer produces corrugated and smoothwall HDPE pipe. It has used recovered and postconsumer recovered material for many years. Incoming resin is tested using ASTM D1248 and ASTM D3350. Finished pipe is tested using ASTM F405 and F667 and AASHTO M252. The percentage of postconsumer content is determined by the quality of the resin available from suppliers. The percentage can be as high as 100 percent for good quality material but no more than 15 percent for the lowest quality. Recovered material from postindustrial sources can be as high as 100 percent and still meet quality assurance and quality control procedures.

Another company manufactures two nonpressure recycled-content corrugated pipe products with postindustrial and postconsumer HDPE. Postconsumer HDPE is derived from milk jugs and laundry detergent bottles and comprises 80 percent of the product weight. The balance of the product weight consists of 20 percent postindustrial HDPE from plastic 55-gallon drums that have been rejected by the manufacturer. The company claims that its pipe with recycled content is just as strong as virgin pipe and meets appropriate ASTM and AASHTO standards. Virgin materials are only used if requested by customers or required by standard specifications. The pipes are used as septic tank lines, culverts, and drainage for driveways and golf courses in 17 states in the southeast.

One company produces corrugated HDPE pipes with up to 50 percent postconsumer or postindustrial recovered materials. They are produced only when an order specifies recycled content.

Recovered HDPE is purchased from a processor. The contact believes the material comes from motor oil bottles, shampoo containers, and laundry detergent containers. In-house manufacturing scrap also is consumed. The company only makes pipe with recovered material content for nonpressure applications such as septic system and agricultural land drainage applications. The product is sold throughout the United States.

One company manufactures an ASTM Schedule 40 PVC conduit pipe containing 50 percent postindustrial PVC recovered from the fabrication of siding, window frames, and other PVC products. The remaining feedstock is virgin PVC. This manufacturer does not use postconsumer PVC because its variable molecular weight makes it difficult to use. The company's pipe with recovered material content is used in building applications such as wiring and cable conduit. Distribution is wide throughout North and Central America.

Another company manufactures a pipe containing 10 percent postconsumer PVC from house siding and window installation as well as from PVC bottles. The other 90 percent is postindustrial PVC from fabricators of PVC house siding, windows, and bottles. The recovered-content pipe is formed with layers of virgin material on the interior and exterior of the pipe, sandwiching recovered material between them. An 8-inch sewer pipe with a thickness of .240 inches, for example, has inside and outside layers of virgin material that are .030 inches thick and an internal layer of recovered material, which makes up 75 percent of the product weight. The pipe is used in sewers, gas extraction systems on landfill sites, and DWV applications.

One company manufactures PVC plastic pipe using recovered waste from plastic bottle and vinyl siding factories. The company's standard pipe contains 25 percent postindustrial PVC. It produces a 100 percent postindustrial PVC pipe on demand. The company indicated that its system can incorporate small amounts of contamination without sacrificing the strength of the final product. The company considers its 100 percent recovered-content pipe to be stronger than a comparable pipe made of virgin material because the recovered PVC is purer than the standard virgin formulation that contains 40 to 50 percent calcium carbonate. The pipe meets the appropriate ASTM specifications for use in nonpressure applications such as sewage and drainage. The company has tested the pipe and also considers it appropriate for pressure applications. The products are sold in the eastern United States.

d. Economic Feasibility

According to the companies contacted, the pipe industry is very competitive and manufacturers use the least expensive raw materials that meet their quality standards. For plastic pipe, wide-specification virgin, recovered, and postconsumer resins have been used for many years in noncritical applications for pipe and duct. All manufacturers contacted for this report agreed that producing pipe and duct with recovered material is economically feasible.

e. Government Purchasing

Thermoplastic pipe is purchased by all federal, state, and local government agencies that engage in new construction or renovation projects. Quantities for individual products cannot be obtained. In most cases, architects, engineers, and contractors are engaged for "turn-key" projects that include all design specifications and construction details. With the advent of performance-based contracting, agencies are leaving all details of the design and material specifications to the contractor.

Construction subdivisions within agencies are aware of "green" building practices. Those most actively engaged stressed the need to coordinate recycled-content objectives with other environmental issues such as energy efficiency and indoor air quality. These people view construction projects as systems that should be designed to achieve the widest range of environmental goals..

The National Institute of Building Sciences began operation in late 1996. Its objective is to standardize construction specifications for all federal agencies. As one of the first steps toward standardization, it has placed specifications on its Construction Criteria Base. This criteria base is available on CD-ROM and is updated quarterly as federal agencies adjust their specifications. Committees comprised of federal agency personnel set priorities for the product areas to be addressed. One subcommittee addresses environmentally preferable criteria.

Details of construction and renovation contracts are handled by federal personnel in the field offices. Field offices follow the agency acquisition regulations as well as local building codes. It is generally best to consult construction contracts for details about construction products. Information for specific agencies follows.

U.S. Department of Agriculture

USDA has numerous agencies with individual procurement responsibility. The agencies with the broadest construction spending are the Agricultural Research Service, NRCS, and the Forest Service.

The Forest Service is the primary user of subsurface drainage pipe. In its *National Strategy for Waste Prevention and Planning* published in March 1995, the Forest Service included explicit sections about purchasing products made with recovered materials or that are environmentally preferable. The strategy includes revisions to product descriptions, work statements, standards and specifications. The strategy can be found on the Forest Service Web page <www.fs.fed.us> under Forest and People/Waste Prevention and Recycling.

U.S. Department of Commerce

Two agencies within the U.S. Department of Commerce have the largest construction responsibility: the National Institute for Standards and Technology (NIST) and the National Oceanic Atmospheric Administration. NIST uses a special DWV pipe made with fire retardant polypropylene. The DWV system must be impervious because the laboratories use troublesome materials.

U.S. Department of Defense (DOD)

The Army Corps of Engineers and the Navy Facilities Programming and Construction Division (NAVFAC) are responsible for DOD construction.

An official in the Construction Branch of the Army Corps of Engineers mentioned that the existing policy is to require “all new” products for new construction. This does not preclude products with recycled content but might preclude reused materials such as reclaimed wood. Guide specifications are available on the Web at <www.hnd.usace.army.mil/techinfo/gspec.htm>.

The Navy Facilities branch has two initiatives underway. One actively seeks EPA designated products through changes in specifications and the other pursues sustainable design with a focus on environmental performance and indoor air quality. Implementation instructions are being completed.

According to specifications received, NAVFAC uses metal and clay pipe. The Defense Supply Center - Columbus, Defense Logistical Agency manages pipe contracts and stock under the 4701 code.

U.S. Department of Energy

The U.S. Department of Energy (DOE) is engaged in demolition and deconstruction of facilities rather than new construction. It also renovates existing facilities. Construction details are handled by the agency's 12 field offices. Many of the buildings being renovated are cast concrete or cinder block construction. Renovation projects might involve converting existing office space to updated office space or factory facilities to office space. Changes in production equipment also results in building renovation projects.

The Rocky Flats field office in Golden, Colorado, will be closing in about 10 years; therefore, there is no new construction. There are approximately 50 renovation projects per year at the field office ranging from a few rooms to complete buildings. Some production facilities are being modified for storage sites. Contracts reference the Uniform Building Code. Pipe requirements include subsurface drainage, foundation drains, DWV pipe, and utility duct. ASTM specifications are used.

U.S. Department of Health and Human Services

The U.S. Department of Health and Human Services, through the National Institutes of Health (NIH) Division of Engineering Services, constructs laboratories, offices, and hospital additions. Administrative space is a very small part of the construction budget. The Intramural program, with 11 percent of the NIH budget is focused on the Bethesda, Maryland, campus. The current $400 million construction budget is unusually high. The 400-acre campus has about 80 buildings, most of which are research laboratories. The Extramural program, with 89 percent of the NIH budget, issues grants to other research organizations. A portion of the grants are construction related, primarily for research laboratories.

The NIH Design Construction and Alteration Branch reviews and tests products for use in hospitals and laboratories. There are very strict protocols to maintain a healthy interior environment in hospital and laboratory spaces. Some of the considerations include pest management, moisture absorbency, particulate release, off-gassing, toxicity, and chemical effects of one product on another.

Energy efficiency and noise control matter as well. Test results are shared with other agencies. This branch also reviews construction plans for grantees in the NIH Extramural program. There is a strong interest in products with recovered material and other environmental attributes, but products must meet the existing performance specifications.

U.S. Department of the Interior

Several years ago, the U.S. Department of Interior (DOI) amended its supplement to the Federal Acquisition Regulations (FAR), the DOI Acquisition Regulations (DIAR), to include provisions of Executive Order 13101. Details are posted on the DOI's Web site at <www.doi.gov> under Policy Management and Budget/Policies and Procedures/DIAR Policy Release # 97-2, Environmental Contracting. There is no centralized oversight for construction throughout the agency. Construction and renovation is undertaken by the National Park Service, Fish and Wildlife, Land Management, and the Geological Survey.

The Denver Service Center coordinates the majority of construction in individual parks for the National Parks Service. The Environmental Policy and Compliance Office implements environmentally preferable purchasing practices. It is currently updating its document on affirmative procurement. Staff send bulletins to the field offices to distribute and gather information about products. In this way it gets hands-on experience from its field office personnel. Queries about experience with recycled products for EPA research are handled this way if there is sufficient time for field staff to respond.

U.S. Department of Justice

The Real Property and Management Services of the Department of Justice manages new construction. Types of new facilities for the Immigration and Naturalization Service, for example, include border patrol stations, low-level detention centers, and headquarters offices. Fire ratings follow the national fire code regulations and local building codes apply. Thermoplastic pipe will be used as allowed by local building codes. DWV pipe may be cast iron. No details about specifications were available.

The Bureau of Prisons is responsible for the construction and renovation of prisons. Some prisons are campus-like structures and others are high-rise buildings. Technical specifications are left to the engineers for each project. Subsurface drainage pipe, foundation drains and driveway culverts are used when necessary on campus installations. Sanitary drains, DWV, and utility or communication duct are used too, but no details about specifications were available.

U.S. Department of Transportation

The U.S. Department of Transportation (USDOT) administers the Transportation Equity Act for the 21st Century (TEA-21), which appropriates funding for highway construction programs for 1998 through 2003. TEA-21 distributes funding to states for various construction projects through various programs. Under the National Highway System (NHS) Program, $28.6 billion will be distributed to states. The Surface Transportation Program (STP) provides flexible funding that can be used by states and localities for projects on any federal-aid highway, including the NHS, bridge projects on any public road, transit capital projects, and public bus terminals and facilities. TEA-21 expands STP eligibilities, including environmental provisions such as natural habitat mitigation, storm water retrofit, and anti-icing and de-icing. Funding for STP for the 6 years of the Act is $33.3 billion. Several other programs under TEA-21 allocate funds to states and localities for activities such as bridge replacement and reparation of damaged roads due to natural disasters. EPA assumes that many of the activities undertaken by states using TEA-21 allocated funds involve the purchase of various types of pipe, although no data is available to estimate the allocation of funds for noncritical versus critical applications of pipe.

f. Barriers to Purchasing

Purchasing barriers identified in this research primarily related to recycled content plastic pipe. While restrictive specifications constitute a significant barrier to purchasing pipe and duct with recovered material or postconsumer content, new ASTM specifications could reduce this barrier for the noncritical applications described in this report. A second barrier is inconsistent definitions of recycled plastic in specifications and test programs. ASTM committees are addressing definitions and might standardize language used in plastic resin and plastic product specifications.

Another barrier could be postconsumer resin availability. Although large volumes of suitable postconsumer bottles remain in the waste stream, strong, consistent demand is necessary to increase recovery operations. Numerous comments to the EPA docket in 1994 expressed concern that sufficient quantities of postconsumer recovered materials were not available to support the EPA designation of plastic pipe. Volatile virgin resin prices in the past few years put serious pressures on postconsumer plastic processors and discouraged communities from expanding their plastic collection programs. On the other hand, improving sorting and cleaning technologies are helping processors provide cleaner feedstocks.

Yet another barrier is the lack of general consensus among highway engineers about using recovered materials in road construction. As an example, key subcommittees within AASHTO disagree on these issues. The subcommittee dealing with galvanized steel and concrete disagree with the subcommittee on structural materials on issues relating to use of recovered materials.

The cost of recovered-content pipe could be another purchasing barrier. The pipe industry is particularly sensitive to feedstock costs. Traditionally, producers of low-value pipe with less severe performance requirements have used the feedstock least expensive to them at any given time.

g. Designation

EPA proposes to designate nonpressure pipe containing recovered steel, plastic, or concrete. A final designation would not preclude a procuring agency from purchasing nonpressure pipe made from other materials. It simply requires that a procuring agency, when purchasing steel, plastic, or concrete nonpressure pipe, purchase the item containing recovered materials when it meets applicable specifications and performance requirements.

3. Procurement Requirements

a. Recovered Materials Content

The principal recovered materials investigated by EPA in its research on pipe were plastics (HDPE and PVC), steel, aluminum, and coal fly ash used in cement and concrete.

HDPE

Two types of HDPE bottle resins are used in pipe: homopolymer and copolymer. Homopolymer is generally natural in color and used to contain products with a short shelf life such as milk and water. Copolymer is stronger, usually colored, and is used to contain detergent or household chemical products. Although manufacturers use homopolymer material, they prefer copolymer HDPE due to its lower cost and environmental stress crack resistance properties. Resin characteristics vary according to the type of pipe being manufactured.

A chemical company manufacturers a 100 percent postconsumer homopolymer derived from plastic bottles collected in recycling programs (i.e., milk and water jugs). Incoming material is cleaned and extruded into pellets. According to the specification, small amounts of other plastics, paper, metals, and other materials typically found in postconsumer plastic waste streams can be expected. Nothing is added to the material. In August 1997, the company was the only major virgin resin manufacturer producing postconsumer resin in pellet form for resale.

Polyvinyl Chloride (PVC)

Recovered PVC is being used for a variety of applications including conduit, sewers, gas extraction systems on landfill sites, and DWV. The PVC industry primarily uses “preconsumer” (also called “postindustrial”) PVC recovered from the siding and window industries. A small amount of construction site scrap is included. This material includes ultraviolet (UV) stabilizers as well as fillers. Singlewall pipe manufacturers avoid “bottle” material, because it melts at a different rate. Co-extruded pipe manufacturers can accept 5 to 15 percent bottle grade PVC when it is blended with other materials in the interior layer.

One company manufacturers a conduit pipe containing 50 percent postindustrial PVC recovered from the fabrication of siding, window frames, and other PVC products. The remaining feedstock is virgin PVC. This manufacturer does not use postconsumer PVC because of its variable molecular weight. Another company, however, uses 10 percent postconsumer PVC from house siding and window installations, and from bottles in the manufacture of its pipe. The other 90 percent is postindustrial PVC from fabricators of PVC house siding, windows, and bottles. The pipe is formed with layers of virgin

material on the interior and exterior of the pipe, sandwiching recovered material between them. The pipe is used in sewers, gas extraction systems on landfill sites, and DWV applications. Another company manufacturers a PVC pipe from 25 percent postindustrial PVC. It also manufacturers a 100 percent postindustrial PVC pipe on demand. The company considers this pipe to be stronger than a comparable pipe made of virgin materials because the recovered PVC is purer than the standard virgin formulation that contains 40 to 50 percent calcium carbonate. The pipe also meets the appropriate ASTM specifications for nonpressure applications such as sewage and drainage.

Steel

Steel pipe is manufactured in three basic types: corrugated, welded, and cast. All types contain recovered steel. If manufactured in the Basic Oxygen Furnace (BOF) process, the pipe contains 25 to 30 percent recovered steel including at least 15 percent postconsumer steel. Pipe made by the Electric Arc Furnace (EAF) process can contain 100 percent recovered steel including 67 percent postconsumer steel.

Aluminum

Aluminum products are manufactured from aluminum billet—small ingots of aluminum. (An ingot is a mass of metal shaped for convenience in storage and transportation). Aluminum billet is manufactured in two types: primary and secondary. Primary manufacturers make aluminum ingot from bauxite, a naturally-occurring mineral. Secondary plants produce aluminum billet from recovered materials. Although EPA has concluded that the aluminum used for pipe can and does contain some percentage of recovered materials, we could not obtain any information on the recycled content levels in aluminum pipe from industry sources.

Cement and Concrete

Coal fly ash, a recovered material, can be used in the cement used to make pipe. ASTM Committee C13 on Concrete Pipe is responsible for the formulation and review of specifications, methods of test and definitions for concrete pipe.

Table 8 presents information provided by manufacturers of nonpressure pipe on recovered content availability.

Table 8
Recovered Materials Content of Nonpressure Pipe

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 15-100 Company D: 80 Company E: up to 50	up to 100 100 up to 50
PVC	Company B: 0 Company C: 10 Company F: unknown	50 10 25-100
Steel	Companies G through II: 16 to 67	25 to 100

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 9, procuring agencies establish minimum content standards for use in purchasing nonpressure pipe.

Table 9
Draft Recovered Materials Content Recommendations for Nonpressure Pipe

Material	Postconsumer content (%)	Total recovered materials content (%)
Steel	16 67	25 - 30 100
HDPE	100	100
PVC	5 - 15	25 - 100
Cement	Refer to cement and concrete recommendations in C-3 of the RMAN	

Notes: A final designation would not preclude a procuring agency from purchasing nonpressure pipe made from other materials. It simply requires that a procuring agency, when purchasing steel, plastic, or concrete nonpressure pipe, purchase the item containing recovered materials when they meet applicable specifications and performance requirements.

The recommended recovered materials content levels for steel in this table reflect the fact that the designated item can be made from steel manufactured in either a Basic Oxygen Furnace (BOF) or an Electric Arc Furnace (EAF). Steel from the BOF process contains 25% - 30% total recovered steel, of which, 16% is postconsumer steel. Steel from the EAF process contains a total of 100% recovered steel, of which, 67% is postconsumer steel.

c. Specifications

American Society of Testing and Materials (ASTM)

The American Society of Testing and Materials (ASTM) has standards covering plastic, concrete, steel, and aluminum pipe. ASTM's plastic pipe standards are developed by ASTM's F-17 Plastic Piping Systems Committee and ASTM's D-20 Plastics Committee. Among its responsibilities, D-20 also maintains basic resin standards used by product manufacturers to select (call out) the optimum type and grade of resin for a particular use. In 1998 the D-20 committee finalized D5033-90, *Standards Guide for the Development of Standards Relating to the Proper use of Recycled Plastics*.

In the absence of recycled pipe standards, manufacturers seek approvals based on recycled content-neutral standards. One manufacturer of recycled HDPE pipe uses the ASTM D3350 standard to call out resin for its "Environmental Solutions" coextruded smoothwall sewer and drain pipe in 3-, 4-, and 6-inch diameters. The postconsumer resin being used meets the requirements of the specification. Table 10 shows a sampling of ASTM specification on plastic pipe.

Table 10
ASTM Plastic Pipe Specifications

F1960, *Standard Specification for Co-extruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed Recycled Content*
F1732, *Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer and Drain Pipe Containing Recycled PVC Material*
D1248, *Standard Specification for Polyethylene Plastics Molding and Extrusion Materials*
F810, *Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Absorption Fields*
F405, *Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings*
F512, *Standard Specification for Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation*

F667, *Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings*
F949, *Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings*
D2665, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*
D3034, *Standard Specification for Type PSM (Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings*
D2239, *Standard Specifications for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter*
D2447, *Standard Specification for Polyethylene (PE) Plastic Pipe Schedules 40 and 80, Based on Controlled Outside Diameters*
D2729-96a *Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings*
D3035, *Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter*
D4976, *Standard Specification for Polyethylene Plastic Molding and Extrusion Materials*
D3350, *Standard Specification for Polyethylene Plastic Pipe and Fitting Materials*
D4396, *Standard Specification for Rigid Poly(Vinyl) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Nonpressure Applications*
F810 - *Standard Specification for Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Disposal Absorption Fields*
F405 - *Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings*
F1970 *Standard Specification for Special Engineered Fittings or Appurtenances for Use in Poly Vinyl (Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems*

ASTM Committee C13 on Concrete Pipe formulates and reviews test methods and definitions for concrete pipe, concrete box sections, and concrete manhole sections used for constructing sewers and culverts. It develops and reviews practices and guides covering design, installation, testing, economic evaluation, and performance of concrete pipe systems. All C-13 pipe standards allow the unrestricted use of coal fly ash in concrete mixes for concrete pipe manufactured under the standards. ASTM standards for concrete pipe are listed in Table 11 below.

Table 11
ASTM Concrete Pipe Specifications

C14-99 *Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe*
C118-99 *Standard Specification for Concrete Pipe for Irrigation or Drainage*

C412-99 *Standard Specification for Concrete Drain Tile*
C444-95 *Standard Specification for Perforated Concrete Pipe*
C505-99a *Standard Specification for Nonreinforced Concrete Irrigation Pipe With Rubber Gasket Joints*
C654-99 *Standard Specification for Porous Concrete Pipe*
C76-99 *Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe*
C506-99 *Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe*
C507-99 *Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe*
C478-97 *Standard Specification for Precast Reinforced Concrete Manhole Sections*

Both AASHTO and ASTM publish specifications for steel pipe, as shown in Table 12 below:

Table 12
ASTM & AASHTO Specifications for
Steel Pipe

Material	**Description**	**AASHTO Specifications**	**ASTM Specifications**
Zinc Coated Sheets and Coils	Steel base metal* with 610 g/m2 (2 oz/ft2) zinc coating	M-218	A929M
Polymer Coated Sheets and Coils	Polymer coatings applied to sheets* and coils* 9.25 mm (0.010 in.) thickness each side	M-246	A742M
Fiber Bonded Coated Coils	Steel base metal with zinc coating and fibers pressed into the zinc while molten to form fiber bonded coating	--	A885
Aluminum Coated	Steel base metal* coated with 305 g/m2 (1 oz/ft2) of pure aluminum	M-274	A929M
Sewer and Drainage Pipe	Corrugated pipe fabricated from any of the above sheets or coils. Pipe is fabricated by corrugating continuous coils into helical "from with lockseam or welded seam, or by" rolling annular corrugated mill sheets and riveting seams:		

Material	Description	AASHTO Specifications	ASTM Specifications
	Galvanized corrugated steel pipe	M-36	A760M
	Polymeric pre-coated sewer and drainage pipe	M-245	A762M
	Fiber bonded impregnated corrugated steel pipe	--	A760M
	Aluminized corrugated steel pipe	M-36	A760M
	Structural plate pipe	M-167	A761M
Asphalt Coated Steel Sewer Pipe	Corrugated steel pipe of any of the types shown above with a 1.3 mm (0.0050 in.) high purity asphalt cover	M-190	A849 A862
Invert Paved Steel Sewer Pipe	Corrugated steel pipe of any one for the types shown above with an asphalt pavement poured in the invert to cover the corrugation by 3.2 mm (l/8 in.)	M-190	A849 A862
Fully Lined Steel	With an internal asphalt lining centrifugally spun in place	M-190	A849 A862
	Corrugated steel pipe with a single thickness of smooth sheet fabricated with helical ribs projected outward	M-36	A760M
	With an internal concrete lining in place	M-36	A760M
	Corrugated steel pipe with a smooth steel linter integrally formed with the corrugated shell.	M-36	A760M
Cold Applied Bituminous Coatings	Fibrated mastic or coat tar base coatings of various viscosities for field or shop coating of corrugated pipe or structural plate	M-243	A849
Gaskets and Sealants	Standard O-ring gaskets	--	D1056
	Gasket strips, butyl or neoprene	--	C361

Notes: * Yield point 0230MPa (33ksi) min,; tensile strength -310MPa (45 ksi) min.; Elongation (50 mm/2 in.) - 20% min.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO pipe specifications restrict the use of recycled plastic through the reference to "rework" material. Specifications referenced by those who commented in 1994 are listed in Table 13. AASHTO's specifications are updated annually.

Table 13
American Association of State Highway and Transportation Officials
Pipe Specifications (1994)

M 252-93 Corrugated Polyethylene Drainage Tubing
M 294-93 Corrugated Polyethylene Pipe
M278 Class PS 46 Polyvinyl Chloride (PVC) Pipe
Section 18 Standard Specifications for Highway Bridges

Natural Resource Conservation Services

Previously called the Soil Conservation Service, the Natural Resource Conservation Services (NRCS) is part of the U.S. Department of Agriculture (USDA). It maintains the Code 606 conservation practice standard for subsurface drain pipe. Per Code 606, the purpose of subsurface drainage is to improve the soil environment for vegetative growth, reduce erosion, and improve water quality; collect ground water for beneficial uses; remove water from heavy use area, such as around buildings, roads, and play areas and accomplish other physical improvements related to water removal; and regulate water to control health hazards caused by pests such as liver fluke, flies or mosquitoes.

The 606 federal standard serves as a minimum model for the states; each state can modify the specification for local conditions. Federal agencies adhere to the local version when using this specification. Conservation practice standards are reviewed periodically and updated if needed.

Underwriters Laboratories, Inc.

The conduit industry uses specifications from Underwriters Laboratories, Inc. (UL Labs) rather than ASTM standards. The exception is ASTM F512 for PVC utility duct. UL Labs evaluated

nonmetallic (plastic) electrical conduit with recycled content and found the products met all requirements according to UL-651, Rigid PVC Conduit.

UL Labs changed its definition of recycled content and revised its standard to allow recycled content in April 1995. As of 1995, UL Labs had tested recycled plastic for two conduit manufacturers and found it acceptable. UL Labs tests the plastic at the maximum recycled-plastic content the manufacturer will use in its resin blend.

National Electrical Manufacturers Association

The National Electrical Manufacturers Association (NEMA) serves small and large electrical companies. Manufacturers of conduit and utility duct belong to the Polymer Raceways Products Section and represent over 95 percent of U.S. productive capacity for PVC and HDPE conduit. NEMA standards that apply to thermoplastic pipe include:

- TC6-1990 *PVC and ABS Plastic Utility Duct for Underground Installation.*
- TC8-1990 *Extra Strength PVC Plastic Utility Duct* .

These standards are silent regarding recycled content. They neither require virgin resin nor reference rework material.

E. Nylon Carpet, Nylon Carpet Backing, and Revised Polyester Carpet Recommendations

1. Item Description

Carpet backing is a layer of woven or nonwoven material used to hold carpet fibers in place and provide structural support. The majority of office floors in the United States are covered with nylon-based broadloom carpet, and nylon-based carpet represents 90 to 95 percent of all carpet, the remaining being polypropylene, acrylic, or polyester-based. Typically, with broadloom, or “roll” carpet, carpet fibers are inserted into a layer of woven material and glued into place. This layer of woven material, the primary backing, is most often made of polypropylene (PP). Another layer of woven material, the secondary

backing, is then applied to the primary backing to provide stability. The secondary backing is also usually made from PP but can also be made of jute.

Broadloom carpet is purchased and installed as one large piece that is cut and fitted for a particular office environment. In the past, when the carpet was removed, it was largely discarded in landfills. However, many nylon fiber and carpet companies have initiated collection programs to divert used carpet from landfills for re-use in their products. Still, it is estimated that 5 billion pounds of carpet are deposited in landfills annually.

Carpet tile was introduced to the marketplace about 40 years ago as an alternative to broadloom. In the past 10 years, the popularity of carpet tile has increased and now represents approximately 10 percent of total U.S. commercial carpet dollars in sales, estimated to be $2.8 billion. In the government, carpet tile represents approximately 30 percent of total carpet purchased, estimated to be 3.2 million yards per year at a cost of approximately $57 million.

Carpet tiles are manufactured first as broadloom carpet, but a third layer of polyvinyl chloride (PVC), polyurethane, or other hardback material is applied to the secondary backing for enhanced durability. The carpet is then usually cut into 18 by 18-inch squares. Carpet tiles are used in modular flooring systems, such as office settings, and can offer more flexibility than broadloom carpet. Individual carpet tiles can be replaced when they become worn.

EPA learned that the technology to use postconsumer and recovered materials in nylon carpet fiber is established and practiced. Several methods can produce the monomer caprolactam, the main product of recovery. Methods of producing caprolactam include depolymerization, an energy and resource intensive process that uses heat and pressure to separate the nylon 6 into its constituent parts, and elutriation, a process that involves air separation.

2. Rationale for Designation

EPA has concluded that nylon carpet and nylon carpet backing made with recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Today's global carpet industry produces more than 4 billion pounds (2 million tons) of replacement carpet yearly. It is estimated that 5 billion pounds (2.5 million tons) of carpet are disposed of in landfills each year. Of this amount, approximately 1 billion pounds (500,000 tons) is type 6 nylon face yarn, that which is most commonly recovered.

One corporation uses more than 20 million pounds (10,000 tons) of postindustrial waste per year in its manufacturing processes.

The recycling facility will reportedly recover 100 million pounds (50,000 tons) of caprolactam annually from 200 million pounds (100,000 tons) of postconsumer nylon 6 carpets. The facility currently produces caprolactam from postconsumer nylon 6 face fiber. It is estimated that in 1996 more than 1.3 billion pounds (650,000 tons) of nylon 6 face fiber carpet was landfilled or incinerated. Approximately 20 percent of this waste stream must be recovered annually for use in this facility.

Another company diverting waste from landfills manufactures five styles of carpeting that recover between one and one and a half pounds of recovered nylon per square yard.

According to one contact, carpet tiles with recovered content backing weigh approximately 8.4 pounds per square yard. Approximately 22.4 percent of a carpet tile by weight contains recovered material. About 2 pounds of recovered material, therefore, are used in each square yard of carpet tiles. If a government agency purchased 1,000 square yards of the carpet tiles with recovered content backing, approximately 2,000 pounds (1 ton) of material would be diverted from the waste stream.

Installation of carpet tile reportedly results in 3.5 to 5 percent less discard than broadloom.

b. Technological Feasibility and Performance

Overall, EPA's research indicates that nylon carpet and nylon carpet backing made with recovered materials are of similar quality to nylon carpet and backing made from virgin materials. One company's carpet tiles are comparable in quality and performance to, and carry the same warranty as their carpeting manufactured with virgin nylon fiber. According to a representative at one corporation,

their process produces the purest reconstituted nylon available and is indistinguishable from virgin fiber. Similarly, another company's recycled content nylon carpet offers the same quality and performance as carpet made from virgin nylon. One company's nylon fiber made from recovered material retains the wear, stain resistance, and dyability features of its nylon fiber made from virgin material.

Most of the companies contacted have collection programs for recovering used carpet and other materials. One company collects postconsumer nylon 6 carpet and also obtains postindustrial materials through negotiations for nonvalue, formerly landfilled nylon waste from carpet mills, plastics extruders, and other industrial manufacturers. The contact, however, indicated that his company would like to use more postconsumer material, but that many factors make collection cost-prohibitive, especially on the residential end. Another company has a carpet reclamation program through which it reclaims commercial carpet, regardless of manufacturer, fiber type, or construction. The reclaimed carpets are processed into sod reinforcement, tile utility flooring, automobile parts, and engineering plastics, depending on the type of fiber and whether the carpet is broadloom or tile. One company is recovering nylon from any used carpet, as long as the replacement carpet is a qualified carpet under its program. The carpets that would have otherwise been landfilled or incinerated are manufactured into useful products, including carpet fiber. Currently, 35 manufacturers producing more than 200 carpet styles have been certified through one company's program. To be certified, a carpet must be manufactured after February 1, 1994, be made of the company's nylon fiber, and meet the company's requirements for construction and material composition. The company has established collection centers across the country to accept postconsumer carpet.

The contact from one company indicated that nylon fibers are very sensitive to contamination due to their small size. The company uses clean postindustrial material as opposed to dirtier postconsumer material. The contact indicated that the nylon fibers that it produces are as recyclable as nylon 6 carpet fibers, but the depolymerization process is just more complicated. The contact added that in theory, nylon 6 looks easier to recycle than their nylon fibers, but that their fiber has been recycled into automotive resin since 1995, while the recycling of postconsumer nylon 6 is a much more recent event.

Another contact indicated that the reason the company uses only postindustrial material in its carpet tiles is because the material needs to be exceptionally pure and clean. In the case of carpet tiles, the backing tends to contaminate the nylon, making it difficult to use as feedstock. The company has been working, however, to develop a process that allows it to clean the carpet facing from the tiles and use it to make new fibers.

According to one contact, recovered content PVC carpet backing performs as well as virgin PVC backing.

One contact indicated that it is not possible to use postconsumer polypropylene backings to make new backings because the layer of latex between the facing and the backing makes it impossible to separate the individual carpet components. Another contact added that polypropylene is very sensitive to heat and impurities and degrades easily; however, the company invested in the development of new filtration and extrusion technologies that allows for the incorporation of a small amount without a compromise in quality.

c. Availability and Competition

Carpet with recovered content is widely available on the marketplace. For example, more than 35 carpet distributors sell carpeting manufactured by one company, many of which offer nylon carpeting with recovered material content.

d. Economic Feasibility

According to a contact there is no cost difference between nylon carpeting with recovered material content and virgin nylon carpeting.

Carpet mills are entirely independent from the recycling facility, so they have no control over the carpet manufacturing process, carpet distribution methods, or retail prices of carpet. However, the nylon they sell to carpet mills is competitively priced with virgin fiber.

Carpet tiles with recovered content PVC backing are cost-competitive with carpet tiles manufactured with virgin PVC backing.

According to one contact, the cost of installing carpet tile is approximately one-third to one-half that of broadloom.

e. Government Purchasing

As mentioned previously, the popularity of carpet tile has increased and now represents approximately 10 percent of total U.S. commercial carpet dollars in sales, estimated to be $2.8 billion. In the government, carpet tile represents approximately 30 percent of total carpet purchased, estimated to be 3.2 million yards per year at a cost of approximately $57 million.

According to contacts at two companies several carpets manufactured from recovered material content yarn systems are available through GSA's schedule. The recycling facility's nylon is the major component in numerous carpet styles offered by carpet mills, dealers, and retailer that are listed in the Floor Coverings section of the Federal Supply Schedule (72 I-A). In addition to other government facilities, the government currently purchases one company's nylon carpeting with recovered material content for military housing.

City, county, state, and federal government agencies currently purchase recovered content carpets manufactured by one company.

f. Barriers to Purchasing

According to a contact, while numerous commercial carpet specifications exist, the members of the carpet industry do not utilize any universal standards. Specifications vary and are determined based on the particular factors of the installation. The project's designer, architect, general contractor, and/or facility manager typically decide the specifications. Nylon, however, is widely accepted as the highest performing carpet fiber and accounts for 60 to 70 percent of all carpet in the U.S. Nylon face fiber is widely purchased and used throughout government facilities.

One company's carpet is cut pile (i.e., shag) carpeting designed for moderate to heavy traffic and is purchased predominately for residential purposes. Manufactured for commercial purposes, loop carpeting—similar to Berber—can withstand heavy traffic. The company is not sure if the government uses cut pile carpeting.

g. Designation

EPA proposes to revise the designation for carpet to include nylon carpet and nylon carpet backing made with recovered materials. A final designation would not preclude a procuring agency from purchasing carpet or carpet backing made from other materials such as wool or acrylic. It simply requires that a procuring agency, when purchasing nylon carpet and nylon carpet backing, purchase them containing recovered materials when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

In November 1999, the first large-scale commercial nylon recycling facility was opened. The facility uses a jointly developed, patented technology that converts recovered material into caprolactam. Currently, the feedstock is 100 percent postconsumer material from old carpets. The long-term feedstock target, however, is 70 percent postconsumer and 30 percent postindustrial material. The resulting caprolactam will contain 50 percent postconsumer material and 50 percent postindustrial material due to the fact that the postconsumer carpet is only 43 percent nylon fiber. The remaining 57 percent of the carpet is used for other purposes. Depending on what percent recycled content a particular mill specifies, the facility mixes the 100 percent recovered content caprolactam with virgin caprolactam to achieve the desired ratio. Typically, the facility will use a ratio of 25 percent recovered content caprolactam to 75 percent virgin caprolactam, but anything up to 100 percent is possible. The carpet fiber is sold to various carpet mills where the nylon is combined with other materials to make carpet. The facility has a collection system for gathering postconsumer nylon carpet and obtains postindustrial materials through negotiations, for formerly landfilled nylon waste, with carpet mills, plastics extruders, and other industrial manufacturers.

One carpet manufacturer currently manufactures a yarn system that contains 25 percent recovered content. They use the recovered content caprolactam produced at the recycling facility to produce nylon chips which are subsequently used to feed its yarn extrusion plant. The yarn is used at the manufacturer’s production facility to make carpet tiles and 6-foot broadloom carpet.

The contact from the carpet manufacturing company indicated that recovered material can also be used in their thermoplastic polyolefin backing, but because of the long lifespan of the carpet, it will be 10 to 15 years before a significant amount of the product is returned to the company for recycling. The company is in the process of developing a method for substituting the virgin limestone filler, common to all carpet backings, with coal fly ash, a postconsumer material. In addition, the company hopes to incorporate its recovered content backing technology into broadloom carpet production as well.

Another company manufactures post-dyeable nylon 6 carpet fiber with 25 percent recovered material. The material is a combination of postconsumer and postindustrial material. The contact at the company indicated that the ratio of postconsumer to postindustrial material depends on the supply of old carpets available through its collection program. The company also manufacturers a solution-dyed nylon fiber. This fiber contains 10 percent recovered material, also a combination of postconsumer and postindustrial sources. The company indicated that it would like to use more postconsumer material in its carpet fiber, but that currently, many factors make collection cost-prohibitive, especially on the residential end. The company also makes 10 percent recovered content nylon chips that it both sells to other carpet manufacturers and uses in its own manufacturing process. The recovered material is a varying combination of postconsumer and postindustrial.

One carpet manufacturer makes recovered content nylon broadloom carpet using 10 percent recovered content nylon chips produced by a different manufacturer. The company adds additional recovered content caprolactam, made primarily with postindustrial material, thus increasing the recovered materials content of their fibers to 10 to 15 percent. The company also uses a polypropylene backing on its carpet, but the contact indicated that he was not aware of any suppliers of recovered content PP carpet backing.

Another manufacturer produces a solution-dyed nylon carpet fiber with up to 10 percent recovered materials. The percent recovered content depends on the fiber color—darker colors have 10 percent, while lighter colors might have none or very little recovered content. They hope to have all colors available with recovered content by summer 2000. All of the recovered material in their carpet fibers is postindustrial material from manufacturing processes. The contact indicated, however, that as depolymerized, first quality postconsumer material becomes available later this year, they will begin adding it to the total recovered material.

In addition, the company is currently depolymerizing postconsumer nylon 6 and nylon 6.6 carpet in one of its facilities. The facility mixes the postconsumer material with postindustrial material and creates recovered content carpet fibers. The contact indicated, however, that this is a pilot facility and there has not yet been any commercially available production from it. Furthermore, the type of recovered material used will depend on economics, availability, and market demand.

The company currently is working with several mills to recycle vinyl carpet tiles and produce new vinyl carpet tile backing with the recovered material, but they have not made progress with recovered content PP broadloom carpet backing.

Another manufacturer produces nylon carpet tiles from 100 percent recovered content carpet fibers and 100 percent recovered content PVC carpet backing. The recovered material used for the fibers is entirely postindustrial material from mill waste. The material in the carpet backing is a combination of postindustrial scraps from the manufacturing process and postconsumer carpet backings. The ratio of postconsumer to postindustrial material depends on the availability of old carpet tiles. The laminate used to attach the backing to the facing is virgin material, thereby bringing the total recovered content of its carpet down to 70 percent.

In addition to its carpet tiles, the manufacturer also produces a broadloom nylon carpet that contains a small percentage of postindustrial recovered material in the fiber. The contact indicated that the company has a used carpet collection system in place and plans to begin incorporating this postconsumer material as early as summer 2000. It intends for this product to contain 100 recovered content fibers.

Another company is manufacturing both nylon carpet tiles and broadloom carpet with recovered content fibers and backing. Its carpet fibers are purchased from two carpet fiber manufacturers and contain 0 to 10 percent recovered material, all of which is postindustrial and 82 to 96 percent recovered material, all of which is postindustrial.

The company makes a recovered content nylon carpet backing and has phased out its virgin backing on its carpet tiles. The PVC backing is made from 100 percent recovered material, including more than 35 percent postconsumer carpets and less than 65 percent postindustrial material from the carpet-making and automobile manufacturing industries. As a result, the company claims that all of its carpet tiles contain a minimum of 30 percent total recovered content. The company will collect and

recycle vinyl products from competitors as well as from its own processes. The recovered content of the company's roll goods is comparable to that of the carpet tiles. The company still offers a virgin content roll carpet that has more cushioning than its recovered content counterpart.

One company is the sole provider of the only renewable carpet program on the market. Its process super cleans, retextures, restyles, and recolors modular carpet tiles to look like new. The process, therefore, creates a product that essentially contains 100 percent postconsumer material. Furthermore, Carpet tiles can be renewed 3 to 5 times, giving them a lifespan of 30 to 50 years.

One fabric and fiber company makes a polypropylene carpet backing with a small amount (1 to 2 percent) of postindustrial in-house manufacturing scrap in its backings. The contact stated that the products are essentially virgin.

Another company also has recently started using a small amount (1 percent) of postindustrial manufacturing scrap in its polypropylene backings. The company intends to increase the recovered material content to 5 to 10 percent in the future, possibly including some postconsumer carpet backing material.

Table 14 presents information provided by carpet manufacturers on recovered content availability.

Table 14
Recovered Materials Content of Nylon Carpet and Carpet Backing

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Nylon	Company A: varies	10-25
	Company B: 0	6-10 or 82-96
	Company C: 0	up to 10
	Company D: 12.5-37.5	25-75
	Company E: 0	100
	Company F: varies	10-15
	Company G: 100	100
	Company H: varies	25
Vinyl Backing	Company B: 35+	100
	Company E: varies	100
Polypropylene Backing	Company I: 0	1 to 2
	Company J: 0	1

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 15, procuring agencies establish minimum content standards for use in purchasing nylon carpet and nylon carpet backing and polyester carpet.

Table 15
Draft Recovered Materials Content Recommendations for Nylon Carpet and Carpet Backing and Polyester Carpet

Product	Material	Postconsumer content (%)	Total recovered materials content (%)
Polyester carpet face fiber	PET	25 - 100	25 - 100
Nylon carpet face fiber	Old carpets	1 - 100	25 - 100
Nylon carpet backing	Vinyl	35 - 70	100

Notes: EPA's recommendations do not preclude a procuring agency from purchasing carpet made from other materials such as acrylic or wool. They simply require that procuring agencies, when purchasing nylon carpet, purchase it with recovered materials in either the fiber facing or the backing, or

both, when it meets applicable specifications and performance requirements and when purchasing polyester carpet, purchase it with recovered materials in the fiber facing when it meets applicable specifications and performance requirements.

The nylon carpet recommendations would also include "renewed" nylon carpet, which is cleaned, retextured, recolored, or otherwise reused to produce a new nylon carpet product.

c. Specifications

According to a contact, while numerous commercial carpet specifications exist, the members of the carpet industry do not utilize any universal standards. Specifications vary and are determined based on the particular factors of the installation. The project's designer, architect, general contractor, and/or facility manager typically decide the specifications.

F. Revisions to Polyester Carpet Designation

a. Background

In CPG I (60 FR 21386), issued May 1, 1995, EPA designated recovered-content polyester carpet for use in light- to moderate-wear applications. At that time, EPA indicated that its recommendation did not include polyester carpet for use in heavy- or severe-wear applications, but the Agency encouraged procuring agencies to evaluate the suitability of polyester carpet in these applications. Recently, the Carpet and Rug Institute (CRI) developed Carpet Specification Guidelines to assist specifiers in preparing the appropriate carpet specifications, including both the physical performance requirements and the product characteristics, for selected end-use applications. CRI's Specification Guidelines identify three use classifications: moderate, heavy, and severe. The new CRI classifications of moderate and heavy wear applications are similar to applications recommended by EPA for light and moderate wear applications, respectively. In light of CRI's new classification scheme, EPA is recommending revising its previous designation and RMAN recommendations to include recovered-content polyester carpet for use in moderate- and heavy-wear applications such as those found in single-family housing units, private offices, and similar applications as identified in the CRI specifications. Procuring agencies should refer to the attached table entitled **"**Use Classification by End-Use Application" for a complete listing of CRI's recommended carpet applications. These classifications are currently under review by the CRI and may revised in the near future. Any revisions made by the CRI will be included in EPA's recommendations.

Table 16
Use Classification by End-Use Application

END-USE APPLICATION	MINIMUM USE CLASSIFICATION		
	Moderate	Heavy	Severe
BANKS/CREDIT UNIONS			
Entrance and customer banking space			X
Open office space		X	
Private offices	X*	X	
BOWLING ALLEYS			
Concourse (excluding food service, working, and storage areas)			X
CHAPELS AND OTHER RELIGIOUS FACILITIES			
Educational wing	X*	X	
Worship areas		X	
CHILD CARE CENTERS		X*	X
CLUBS		X*	X
GOLF COURSE CLUBHOUSE			
Administrative (no golf shoe traffic)		X	
Dining area (no golf shoe traffic)		X*	X
Grill area (golf shoe traffic)			
Pro shop (golf shoe traffic)			
LIBRARIES		X*	X
Conference rooms			X
Corridors			X
LODGING FACILITIES/DORMITORY, ETC.			
Conference rooms			X
Combination living/sleeping rooms		X*	X
Dining facilities			X
Offices	X*	X	
Public areas (lobbies, lounges, TV rooms, day rooms, etc.)		X*	X
Sleeping rooms		X	

END-USE APPLICATION	MINIMUM USE CLASSIFICATION		
	Moderate	Heavy	Severe
MEDICAL FACILITIES (excluding patient treatment areas)			
Assisted living areas		X	
Chapels	X		
Classrooms		X	
Clinical waiting areas (outpatient/pharmacy/ancillary zone only)			X
Consultation rooms	X		
Corridors			X
Dining areas		X*	X
Elevators			X
Entrance areas (entry mats should be utilized)			X
Libraries	X		
Lobbies			X
Lounges		X	
Offices-private/semi-private		X*	X
Patient rooms		X	
Playrooms-OB/GYN-Pediatric clinic			X
Staff sleeping and watch areas	X		
HOUSING			
SINGLE FAMILY			
Family rooms		X	
Living rooms	X*	X	
Dining rooms	X	X	
Sleeping rooms	X		
Combination living/sleeping rooms	X*	X	
MULTI-FAMILY			
Common areas (lobbies, lounges, etc.)		X*	X
Corridors		X*	X
Family rooms		X	
Living rooms	X*	X	
Dining rooms	X*	X	

END-USE APPLICATION	MINIMUM USE CLASSIFICATION		
	Moderate	**Heavy**	**Severe**
Multi-purpose areas		X*	X
Sleeping rooms	X		
Combination living/sleeping rooms	X*	X	
MILITARY HOUSING			
FAMILY HOUSING			
Flag	X		
Single unit		X	
Multi-unit			
Corridors		X	
Public areas (lobbies, lounges, etc.)		X*	X
Sleeping/living rooms	X*	X	
BACHELOR OFFICER QUARTERS			
Sleeping/living rooms	X		
Public areas (lobbies, lounges, etc.)		X*	X
Dining facilities			X
Offices	X		
BACHELOR ENLISTED QUARTERS			
Sleeping/living rooms		X*	X
Public areas (lobbies, lounges, etc.)		X*	X
Dining facilities			X
Offices	X*	X	
MUSIC and/or DRAMA CENTERS		X*	X
OFFICES (including Administrative Areas)			
Closed private offices	X*	X	
Corridors			X
Conference rooms	X*	X	
Open Plan Office			
Circulation areas			X
Work areas		X	
LABORATORY/RESEARCH FACILITIES			

END-USE APPLICATION	MINIMUM USE CLASSIFICATION		
	Moderate	**Heavy**	**Severe**
Computer work areas where applicable			X
Closed private office		X	
Open work areas			X
Dry labs			X
RESTAURANTS (excluding work spaces)			
Dining areas		X*	X
Cafeteria-type dining areas, enlisted canteens, etc.			X
Office areas		X	
RETAIL STORES			
Offices		X	
Restaurant & cafeteria dining areas			X
Sales areas			X
THEATERS			X
TRAINING BUILDING/EDUCATIONAL FACILITIES (including dependents' schools)			
Classrooms		X*	X
Corridors			X
Staff/administration offices		X	
YOUTH CENTERS			X

***Use lower Use Classifications only where applicable based on expected lower traffic exposure.**

b. Revised Designation

Based on the classification guidelines issued by the Carpet and Rug Institute, EPA proposes to revise its previous designation for polyester carpet made with recovered materials to read "carpet made from polyester fiber made from recovered materials for use in moderate- and heavy-wear applications such as single-family housing, private offices, and similar wear applications."

G. Roofing Materials

1. Item Description

A building's roof system and its finished roofing materials are the primary means of shielding a structure's interior from the natural elements. According to the Roofing Industry Educational Institute, approximately 30 variables determine the type of roof to use on a building. Variables include the roof structure and decking, its slope, appearance, the weight the structure must support, local building and fire codes, the roofing materials already on the building, and the area's climate and wind zone. For example, while a sloping shingle roof easily sheds water, a flat roof must depend on a continuous waterproof membrane to contain the water while it drains and/or evaporates.

Consequently, roofing systems fall into two general categories: 1) high-sloped or "pitched" roofs and 2) low-sloped or flat roofs. Residential structures normally have pitched roofs, although parts (such as garages or some additions) can be low-sloped. Commercial roofs are generally low-sloped. Roofs are generally referred to as "residential" or "commercial," but these terms can refer either to the slope of the roof or the use of the building (also see section 1e below).

In its research, EPA identified dozens of roofing systems and materials, but focused on those systems and materials that are most prevalent in the industry, as follows.

Commercial—New Construction	Built-up roofing
Commercial—Re-roofing	Single-ply systems (re-covering) Modified bitumen (tear-off/replacement) Built-up roofing (tear-off/replacement)
Residential—New Construction	Organic and Fiberglass Shingles
Residential—Re-roofing	Roll roofing (re-covering) Shingles (tear-off/replacement)

According to the National Roofing Contractors Association (NRCA), new construction represents only 26 percent of low-slope roofing; most low-slope roofing jobs (74 percent) are re-roofing and repair and maintenance. New construction makes up 29.5 percent of steep-slope roofing; most steep-slope roofing jobs (70.5 percent) are re-roofing and repair and maintenance. The roofing systems most commonly used in new construction are built-up roofing (commercial) and shingles (residential). The roofing systems most commonly used in re-roofing are single-ply systems (commercial) and roll-roofing and shingles (residential). In addition, the Asphalt Roofing Manufacturers Association (ARMA) stated that the major component of any roofing system [by volume] is thermal insulation. EPA did not research this aspect of roofing materials, however, because EPA has already designated building insulation in the CPG.

Most residential and some commercial roofing systems comprise three distinct "layers" or components: 1) the substructure, 2) the underlayment, and 3) the surface layer. Each one of these layers can contain a variety of components and materials (including recovered materials), as follows.

The Substructure

The substructure is the primary layer and serves as the structural support for the roof. The components of this layer include **rafters** (also known as decking), which act as the "ribs" of the roof; and **sheathing**, which is a rigid, flat material (often 1 inch x 6 inch or 1 inch x 12 inch plywood boards) that is nailed to the rafters, and to which the underlayment and/or surface layer is attached. These components are commonly made of wood, plywood, poured or precast concrete, gypsum planks, lightweight aggregate, or steel, with steel being the substructure material of choice for about 70 percent of new commercial buildings. In residential structures, the substructure is more commonly made of wood and plywood.

The Underlayment

The secondary layer of a roof is known as the underlayment. It provides a comprehensive substrate to help seal the roof and prevent leaking. It is designed to adhere tightly to roof sheathing and around the shanks of nails driven through it. The components of this layer include different types of **sheeting, matting, and membranes.** Often this component is referred to as "roll roofing," because these products often are applied in rolls. (Note: some roll roofing products are also used as primary or

"surface" layer materials.) "Tar paper" is another commonly used industry term because some products consist of a fiberglass or fiber substrate impregnated and coated with asphalt or tar.

Sheeting, matting, and membranes are made from a variety of materials, including fiberglass, paper, and felt; and more impervious materials (in sheet form, sometimes also used in "single-ply" systems as the "surface" layer) such as PVC, rubber composites such as Ethylene Propylene Diene Monomer (EPDM), and other elastomeric/polymeric materials such as butyl rubber or chlorinated polyethylene. EPDM, an elastomer which is generally used in conjunction with other elastomers and modifiers, is a synthetic rubber used in many rubber products except tires. It is thermoset rubber, meaning that it cannot be remelted or reformed without destroying its original characteristics. EPDM rubber most likely cannot contain recovered materials. In addition, as mentioned above, more porous substrate materials (such as paper and felt) are often impregnated or coated with additional water-resistant materials, such as tar or asphalt.

The Surface Layer

The surface or finish layer is the most important layer of a roof because it is the area directly exposed to the elements. This layer is constructed in a way that diverts precipitation toward gutters or other drainage systems. The surface layer can be constructed of many different types of products, depending on the type of building, climate, aesthetics, and desired durability. These products can include: **shingles, shakes, tiles**, **and panels; flashing, gutters, and downspouts; and coatings.**

Shingles, shakes, tiles, and panels are made from a wide variety of materials, including wood, plywood, steel, tin, iron, plastic, fiber-cement, clay (ceramic), concrete, asphalt (which may have either a fiberglass or natural fiber base), slate, rubber, and fiberglass. Metal panels often have a galvanized coating, or are factory-coated with a highly durable finish such as polyvinylidene fluoride or an aluminum zinc alloy (i.e., Galvalume).

Flashing is small pieces of surface material that are applied around vent pipes, chimneys, skylights, eaves, and in valleys that connect two sections of a roof, to prevent leaks. Flashing is usually made of galvanized sheet aluminum or copper, but can also be made of polymer modified bituminous

material. Some roll roofing products are occasionally used as flashing. Gutters catch and channel excess precipitation off the roof into downspouts, and onto the ground. Gutters are commonly made of aluminum and tin.

Roll roofing is commonly used in residential surface applications. These products consist primarily of coated and saturated (impregnated) felt.

Coatings are used for both residential and commercial roofing systems to patch, repair, retrofit, or extend the life of a roof, most commonly roofs without shingles. Coatings are most often asphalt and a fiber mixed with solvent and emulsion. Other kinds of coatings include aluminized asphalt, elastomeric systems (made from latex resin), and specialty coatings, such as urethane, modified acrylic, and soybean-based coatings.

Built-up (Slag), Single-ply, Foam, and Modified Bitumen Roofs

Several types of roofing systems do not consistently meet the 3-layer structure outlined above. These systems are used most commonly on commercial, low-slope buildings, and have design elements and material components that are, in some cases, unique unto themselves (i.e., not used in any other roofing product or system.) These independent systems often combine the underlayment and surface layers into one effective system. The systems and the materials used in them are outlined below:

- **Built-up roofing** (also referred to as "slag" roofing) is the oldest type of roofing system in use today. This simple yet effective system consists of several alternating layers of hot asphalt and roofing felt (also called tar paper). The final (surface) layer is commonly covered with pea gravel or slag. Sheathing is often used with this system as underlayment. A built-up roof can generally be expected to last 10 to 20 years.

- **Single-ply roofing** is made up of one layer of an impervious flexible membrane. Plies are either welded, attached with adhesive, or otherwise affixed to sheathing. They can be made in sheet form from rubber (EPDM), PVC, and elastomeric and polymeric materials such as butyl rubber or chlorinated polyethylene. They can also be liquid- applied using synthetic elastomeric rubber such as Hypalon (a proprietary DuPont product). (Note: This system differs from roll roofing in terms of the type of materials used—"roll roofing" refers to a group of products made with a fiber substrate and impregnated and/or coated with asphalt and/or tar.) Because single-ply is a relatively new roofing technology, there is little evidence as to life-span, but industry estimates range from 25 to 40 years.

- **Modified Bitumen Roofing** is a cross between built-up roofing and single-ply roofing. There are two forms of this asphalt-based system: plasticized (also called atactic polypropylene or APP), and rubberized (also called styrene-butadiene-styrene or SBS). These roofing systems are often used in re-roofing projects, and can be expected to last from 25 to 40 years.

- **Foam roofing** is used primarily in re-roofing jobs to remedy roof leaks, roof failures, and inadequate insulation. The foam is commonly made of urethane, and a silicone rubber or urethane elastomer protective coating is often applied over the foam. Foam roofing applications can be expected to last from 15 to 25 years.

Residential vs. Commercial Roofing

As previously mentioned, roofing systems generally fall into two categories: residential (high-sloped or pitched) and commercial (low-sloped). These two types of systems generally are constructed differently and use different materials, although some materials are used for both residential and commercial systems. A market survey found that 71 percent of the overall roofing market is commercial roofing and 29 percent of the market is residential roofing.

To re-roof commercial and residential roofs, the old roof is torn off and replaced or is covered over. Nationwide, tearoff/replacement represents 67 percent of the residential and commercial markets combined, and re-covering represents 33 percent of the market. For the most part, commercial and residential roofing systems can be used interchangeably for both new construction and re-roofing.

Residential Roofing

According to NRCA, new construction made up 18 percent of the 1996 - 1997 residential roofing market, while re-roofing made up 82 percent. Of residential re-roofing, tearoff/replacement comprised 77 percent of the market and re-covering comprised 23 percent. The most common types of residential roofing materials used in new construction and re-roofing in North America are fiber/asphalt shingles, which make up 63 percent of the residential roofing market nationwide.

Up to three layers of shingles can be placed on a roof for re-roofing. Although asphalt shingles (with either fiberglass or organic fiber mats) are still the most common choice for residential roofing applications, several other surface layer roof coverings are also commonly used on residential roofs, as

described below. (Several types are or can be made from recovered materials, as discussed later in section 2):

- **Fiberglass asphalt shingles.** These shingles are made with a fiberglass base layer impregnated and coated with asphalt and covered with slag or other granular material (often a byproduct of coal-burning furnaces). This type of shingle makes up approximately 80 percent of the asphalt shingle industry. An asphalt shingle roof can last anywhere from 15 to 35 years, depending on the climate.

- **Organic asphalt shingles (also known as "composite" shingles).** These shingles are made with a fiber base layer (usually corrugated containers, newspaper, kraft, or mixed paper) impregnated and coated with asphalt and covered with slag or other granular material (often a byproduct of coal-burning furnaces). This type of shingle makes up approximately 20 percent of the asphalt shingle industry.

- **Wood shingles or shakes**. Most commonly made of red cedar, wood shingles are thin, machine-cut, and smooth on both sides, while shakes are thicker and rough on at least one side. In addition, hardboard shingle panels are sometimes used, which are larger than traditional shingles or shakes. Wood shingles can last anywhere from 10 to 50 years, depending on the climate and type of wood.

- **Clay/Ceramic tiles**. Often used in the western United States, these tiles are very heavy but effective and long-lasting.

- **Slate tiles/panels**. One of the oldest and most expensive roofing materials, slate is made from unprocessed stone that is mined and cut to size. Synthetic slate, an alternative, has been created from cement-impregnated fiber. Slate roofing is typically used on buildings for historical accuracy. A slate roof can last indefinitely.

- **Cement shingles/concrete tiles.** Fiber-reinforced concrete tiles have many of the same attributes of ceramic tile and slate but are lighter weight.

- **Plastic shingles or shakes.** Plastic shingles and shakes often resemble other types of shingles and shakes, such as wood, clay, or slate, but can be less expensive, lighter weight, and can require less maintenance. This appears to be a small but growing new market.

- **Rubber shingles or shakes.** These types of roof coverings, often made from old tires, also appear to be a new type of roofing material that can be used in place of asphalt shingles or wood or plastic shakes.

- **Metal shingles/panels**. Metal roofing is commonly made of aluminum or a combination of steel with an alloy of aluminum and zinc. Some metal roofing is corrugated and used like fiberglass panels, and some metal shingles are designed to look like other types of materials. Normally these types of roof coverings have a galvanized coating, or are factory-coated with a highly durable finish such as polyvinylidene fluoride or an aluminum

zinc alloy. A coated metal roof can last indefinitely, depending on materials and coatings used.

- **Fiberglass panels.** Corrugated fiberglass panels are often used to construct roofs in decks, carports, and greenhouses.

- **Roll roofing.** Roll roofing is made with the same materials as composite shingles: usually fiber (such as felt) impregnated and/or coated with asphalt. It comes in a roll and is often used on low-slope parts of a building.

- **Built-up roofing** (see definition above).

- **Single-ply roofing** (see definition above).

- **Modified bitumen** (see definition above).

Commercial Roofing

About 900 distinct commercial roofing systems are on the market. In 1998, new construction made up 23 percent of the commercial market, while re-roofing made up 77 percent. For re-roofing, tearoff and replacement made up 65 percent of the market and re-covering made up 35 percent. The most common types of new commercial construction materials used in 1998 were single-ply and built up roofing. The most common types of systems used for commercial re-roofing were single-ply, modified bitumen, and built-up roofing. Commercial roofs can also be made from:

- **Roll roofing**

- **Metal panels**

- **Tile (ceramic or slate)**

- **Fiberglass and organic asphalt shingles**

- **Matting**

Commercial roof decking can be made from wood, concrete, lightweight aggregate, or steel, but about 70 percent of new buildings are made with steel decking.

2. Rationale for Designation

EPA has concluded that roofing materials containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Roofing materials can contain a wide variety of recovered materials and materials recovered from industrial manufacturing processes and municipal solid waste, including aluminum, steel, paper and paperboard, glass, plastics, wood, and rubber (including old tires).

b. Technological Feasibility and Performance

Durability is critical in roofing because a failure can mean serious damage, not just to the roofing itself, but to the building and its contents as well. EPA has found no performance issues relating to the use of recovered materials in roofing products.

In 1992, ARMA embarked on a research effort to conduct factory-scale tests to confirm the technical and economic feasibility of incorporating fresh factory waste (shingle tab cutouts from fiberglass shingles and mineral surfaced roll roofing) into the coating asphalt used to produce commercially available new fiberglass shingles. The new recovered-content shingles contained between 5 and 20 percent recovered materials and were field tested in different regions of the United States. The results of the study indicated that incorporating factory waste into new asphalt shingles is *technically feasible* and had no effect on the shingles' performance or physical properties.

c. Availability and Competition

EPA found 14 manufacturers representing a cross-section of roofing system types and recovered materials, as follows: cement roofing (1), steel panels (2), aluminum shingles (3), organic asphalt shingles (4), rubber/asphalt composite built-up roofing (1), plastic shingles (1), modified bitumen-APP (1), rubber shingles (1), steel decking (1), and wood shakes and shingles (1). EPA has determined that manufacturers

of recovered content fiberglass asphalt shingles exist, but was unable to contact any. EPA contacted an additional 14 roofing manufacturers who did not have any recovered content roofing products.

d. Economic Feasibility

At least one manufacturer indicated that using recovered materials in the manufacturing process saves money and that savings are usually passed on to the consumer. One company manufacturers roofing materials made out of old tires. Old tires costs this manufacturer less than virgin material due to the nature of the product. Additionally, some old tire collection centers pay the company to take away their old tires. The cost savings are passed on to their customers.

Overall, price does not appear to be an issue for products containing recovered materials compared to those made with virgin materials. Products EPA has identified as containing recovered materials are most often priced comparably to similar products that do not contain recovered materials.

The ARMA study discussed above, however, indicated that the process of incorporating factory waste into asphalt roofing products is not economically feasible because it would require an initial capital investment of more than $2 million per manufacturing facility for re-tooling. In addition, most (if not all) asphalt roofing manufacturers already sell their factory waste to asphalt road pavers, who can incorporate this waste into their product more easily than roofing manufacturers. Asphalt roofing manufacturers must separate and remove the small stones used on the surface of many asphalt roofing products from the factory waste before incorporating it into new roofing products. Asphalt pavers, on the other hand, can incorporate asphalt roofing factory waste into their product with little or no processing.

e. Government Purchasing

EPA contacted 10 government agencies and trade associations for government purchasing information and leads. Most of the government agencies provided tentative or uncertain answers while the trade associations have only been able to suggest other possible sources of information, such as additional trade associations, publications, and green building resource guides.

The federal government procures a vast amount of roofing materials annually, although statistics are not kept on this information. The Department of Commerce's *Commerce Business Daily* has on online, searchable database, however, and EPA was able to find numerous active and archived notices for roofing projects by federal agencies. While most of the information available is for re-roofing projects, it goes without saying that all new construction/building projects would include roofing.

Roofing materials are either purchased directly by GSA's Public Building Service (PBS), or by federal agencies through contracts for building maintenance. The source of federal funding for all roofing materials (re-roofing and new construction) is a single line item allocation that is included in the Presidential Budget on an annual basis. This single line item covers all construction repair and alteration projects (including roofing), the money for which is divided among GSA headquarters and regions on an as-needed basis. In addition, this line item accounts for all new construction projects and major alterations, but the funds for new projects and major alterations must be approved individually by Congress. For the most part, states do not use federal funds for building construction or repair projects.

Decisions regarding the type of roofing materials used for a given project can be made by various people. According to NRCA, in new construction, local building codes and other standards and specifications determine the type of roofing system used. Where there is flexibility on these codes and standards, the managing architect will select the materials. In re-roofing, the roofing contractor typically decides what type of roofing system and materials to use.

Several manufacturers indicated that they sell to federal, state, or local government entities, but did not provide names of specific agencies or units, contact names, or the amount sold.

For this research, EPA contacted agencies that seemed likely to build residential or commercial facilities, such as GSA's Public Building Service, the Department of Defense (DOD), the Army Corps of Engineers, the U.S. Environmental Protection Agency (EPA), the Department of the Interior (DOI), the Department of Housing and Urban Development (HUD), and several state and local government agencies.

- A manufacturer of organic and fiberglass asphalt shingles indicated that a "significant" amount of its sales is to the government. The manufacturer has sold to the DOD, the Army Corps of Engineers, and many state and city governments.

- One steel decking company "does a lot of government work" (25 percent of sales) and claims that most federal government buildings are made with steel frames. The company is a contractor for DOD and has worked on projects at Fairchild Air Force Base and GSA. It has supplied decking for air craft hangers and school buildings in Alaska.

- One manufacturer of organic asphalt shingles claims that about 1 or 2 percent of sales is to various Air Force bases.

- A manufacturer of plastic shingles and shakes has sold to the Federal Park Commission for use at a park in Berlin, Maryland, to the Nebraska State Parks and Recreation Division, and to the City of Omaha.

- One manufacturer sold aluminum shingles to the Ohio Department of Natural Resources for a pilot project in two state parks. Ohio has a preference for recycled materials in all purchasing. The federal government (national parks and forests) has expressed interest in these products but has not made any purchases yet.

Most roofs under GSA's jurisdiction are constructed of membrane roofing or built-up roofing. GSA uses pitched roofs mostly for historical buildings that use shingles or metal panels. GSA follows master building code specifications from the American Institute of Architects (see section 4a). GSA does not know whether any roofing materials it purchases contain recovered materials; GSA only tracks its use of recycled products that are already designated in the CPG. GSA's Facility Standards Guide indicates that "EPA guidelines require the use of recovered materials in federally funded construction. Architects and engineers should use recycled materials to the maximum extent practical within the project requirements."

The Army Corps of Engineers has revised several of its specifications for roofing to encourage the use of recycled materials. The majority of its buildings have low-sloped roofs. At present, the Corps does not know whether contractors are using recovered materials, although current specifications do not preclude their use.

EPA has managed the construction of several new laboratories in recent years, but EPA's contact was not aware of the use of recovered roofing materials in them. He stated that it is difficult to trace the source of specific materials in use because contracts cover an entire construction job, not individual components.

The DOI contact does not know whether the agency uses recycled roofing materials at any of its 600 facilities. It only tracks purchases of the products currently designated in the CPG.

King County, Washington, currently does not purchase any roofing products containing recovered materials. The King County contact expressed interest in purchasing recovered content roofing material and would like additional information when the roofing research is completed.

Most U.S. Navy buildings are currently constructed with slate roofs, as designated by the Historical Architectural Committee. The Navy, however, is exploring the use of recovered rubber or plastic roofing products that resemble slate for some of their buildings on a case-by-case basis. The Navy is not certain if this is feasible, but is open to suggestions.

GSA was unable to provide information on its roofing construction projects.

f. Barriers to Purchasing

Based on EPA's research, roofing products containing recovered materials are comparable in quality and performance to those that do not contain recovered materials. Some government purchasers actually prefer some of the characteristics of the newer, "alternative" roofing products such as rubber shingles (instead of asphalt), or plastic shingles (instead of wood), which happen to be made with recovered content materials.

EPA has not identified any performance issues that may prevent the procurement of roofing products made from recovered materials. The GSA/PBS contact confirmed this by saying he hasn't heard of anything that would indicate a degraded level of performance in roofing products that contain recovered materials. In addition, EPA is not aware of any codes or standards that prohibit the use of recovered materials in roofing systems and products (see section 3c).

g. Designation

EPA proposes to designate roofing materials made from recovered content steel, aluminum, fiber, asphalt, rubber, plastic, wood, and cement. A final designation would not preclude a procuring agency from purchasing roofing materials manufactured from another material. It simply requires that a procuring agency, when purchasing steel, aluminum, fiber, fiberglass, asphalt, rubber, plastic, wood, or cement

roofing materials, purchase these items made with recovered materials when these items meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

EPA ascertained the following information on the use of recovered materials in roofing:

- **Steel** used in roof decking, shingles, and panels always contains some recovered and postconsumer content. According to the Steel Recycling Institute, depending on whether the steel is produced by the basic oxygen furnace or electric arc furnace method, the steel used in roofing materials could contain 25 to 100 percent recovered steel, including 16 to 67 percent postconsumer steel. EPA contacted one manufacturer of steel decking that uses 30 to 35 percent recovered or postconsumer materials. The contact believes his product's postconsumer content is consistent with the industry standard for recycled steel. Most manufacturers do not know that their steel products contain recycled materials and do not advertise as such. There are at least 10 to 15 other steel decking manufacturers in the East and Midwest that use levels of recovered steel that are comparable with industry standards.

  EPA spoke with two manufacturers of steel shingles and panels. Both claimed levels of recovered materials in their products consistent with the steel industry standard. One of these manufacturers indicated that their steel panels are used primarily for commercial applications and are stone-coated.

- **Fiber** used in matting (tar paper, underlayment, felt), roll roofing, and organic asphalt shingles normally has some recovered and postconsumer materials content. A fiber base can also be used in concrete shingles. EPA contacted four manufacturers of organic shingles that each use between 66 and 100 percent postconsumer corrugated containers, kraft paper, mixed paper, and other recovered paper. One manufacturer that makes mostly organic asphalt shingles uses felt that is made from almost 100 percent postconsumer corrugated containers or kraft paper with negligible amounts of mill scraps from the company (less than 1 percent). The company's postconsumer materials are purchased from recyclers. In addition, one company manufactures a "corrugated asphalt" roofing product which contains 50 percent asphalt and 50 percent postconsumer recycled cellulose fibers from newspapers, magazines, corrugated paperboards, and office waste paper.

  Another manufacturer makes organic felt shingles from recovered paper. About 66 percent of the felt paper is made with postconsumer mixed paper and corrugated containers collected from recyclers who deliver it baled. The other 33 percent is made of wood chips, both from pallet scraps and virgin wood. The company also uses granules made from coal-fired-boiler slag (an industrial waste) as a surface coating.

Still another company EPA contacted makes five weights of roofing felt from 100 percent postconsumer paper. About 70 percent of the material is old corrugated containers and 30 percent is mixed paper. The company buys the material through a broker, and also directly from businesses where it has a baler. The products are used both in the residential and commercial sector. The contact indicated that the company uses recycled materials because the price for recovered paper can be less than virgin paper and because it feels "regulatory pressure" from the federal government to do so. One other company EPA contacted makes 100 percent recovered content dry felt for use in shingles and tar paper. About 70 percent is postconsumer paper from collection programs and 30 percent is sawdust. The sawdust and paper are used together, saturated with asphalt, and coated with a durable finish.

Fiberglass used in matting (tar paper, underlayment, felt), roll roofing, and asphalt shingles may contain recovered and postconsumer content. EPA has been unable to confirm this, however. In addition, EPA has not been able to confirm the use of recovered materials in the fiberglass substrate in fiberglass shingles. To date, large fiberglass shingle manufacturers that have been contacted, do not manufacture the shingles with recovered content material. Several smaller fiberglass shingle manufacturers contacted have been unable to confirm the use of recovered content materials in the shingles.

Asphalt used in matting, roll roofing, shingles, coatings, modified bitumen, and built-up roofing usually does not contain recovered or postconsumer materials. The Asphalt Roofing Manufacturers Association (ARMA), however, claims that asphalt itself is a recovered material, because it is a necessary by-product of the oil refining process. According to the Asphalt Institute, asphalt would have to be disposed of as a solid waste if it wasn't sold for use in other products. Most, if not all refineries sell their asphalt because a market exists. While shingles can be recycled into other asphalt products (see section 4c), other asphalt products are not currently recycled into roofing materials in the United States because the cost of doing so is not reasonable and demand is minimal. It is, however, being done in Germany. EPA contacted one manufacturer of an asphalt and rubber composite for built-up roofing with a fiber matting, penetrated with an asphalt emulsion containing latex. This composite is made with 12 to 20 percent postconsumer (old) tires. One company manufactures a “corrugated asphalt” roofing product called Ondura which contains 50 percent asphalt and 50 percent postconsumer recycled cellulose fibers from newspapers, magazines, corrugated paperboards and office waste paper.

Aluminum shingles and panels can and are being made with recovered and postconsumer materials. EPA contacted two manufacturers of aluminum shingles. One manufacturer uses up to 20 percent postconsumer material from curbside collection programs. This company indicated that its aluminum shingles are used primarily for residential applications. The other manufacturer makes 95 percent postconsumer aluminum shingles. The 1-foot by 2-foot residential shingles are made of postconsumer aluminum from used

beverage containers. The company buys the aluminum from a broker who purchases the postconsumer aluminum, has it smelted, and delivers it as a raw material in coils.

Rubber single-plies, shingles, and modified bitumen (SBS) can contain some recovered and postconsumer materials, including old tires. EPA spoke with one manufacturer of rubber shingles that uses 100 percent postconsumer (old) tires. The company takes old tires, removes the highly flammable sidewalls, and cuts and flattens the tires into shingles. It does not grind or re-melt the tires. EPA is aware of one other manufacturer that claims to use at least 50 percent postconsumer rubber in its shingles. One manufacturer of rubber roofing shingles uses postindustrial EPDM from automotive parts such as automotive door and trunk seals. Another company uses postindustrial tire scrap to manufacture rubber shingles. Both companies are looking into using postconsumer tires in their rubber shingles in the future. They currently do not use postconsumer tires because the rubber is contaminated with resin and glue. Additionally, tire rubber is composed of five different types of rubber. Rubber for the tread, lining, and interior are all different. Not all of this rubber is reusable. In order to use car tire rubber, the nonuseable rubber must be separated from the reusable rubber. It is uncertain whether this separation process will be cost-effective or not. EPA contacted one manufacturer who is planning to introduce rubber/plastic shingles into the roofing industry soon. These rubber/plastic shingles will be composed of approximately 50 percent rubber from old car tires and 50 percent plastic from postconsumer milk jugs. The manufacturer could not provide additional information due to its proprietary content.

Plastic single-plies, shingles, and modified bitumen (APP) can contain various types of recovered and postconsumer plastics. EPA spoke with one manufacturer of modified bitumen (APP). The plastic is made with polypropylene scrap materials from the carpet industry and plastic rope manufacturers, and polyester film scraps. The contact, however, was unable to provide a percentage of recovered material content. Another manufacturer EPA contacted makes plastic shingles and shakes from 100 percent postconsumer plastic.

Wood shakes can contain recovered materials from old pallets, pallet scraps, sawmill waste, and manufacturing waste. EPA contacted one manufacturer that incorporates the company's manufacturing waste into wood shakes and shingles. In addition, this company uses salvaged material, including trees killed by beetles, which come from the eastern part of the state of Oregon, where a beetle infestation has left millions of trees dead. These dead trees can not be used by pulp and saw mills for a variety of reasons. The company grinds the trees into "semi-fiber bundles" using a dry process, much like the process used to grind wood for manufacturing newsprint. The company is currently exploring the possibility of incorporating waste wood from building demolition into its shakes and shingles. Another manufacturer makes roofing shingles from 100 percent recovered wood and PVC plastic. This product has the look of a wood shake or shingle, without common wood related problems like degradation from water, wind damage, and fire danger. The source of recovered material is manufacturing waste from medical products and garden hoses for PVC, and wood pallets and sawmills for wood.

Cement-based shingles can include recovered materials. One manufacturer EPA contacted uses 4 percent postconsumer newsprint fibers and 14 percent recovered silica fume in their fiber base concrete shingles, which are made with portland cement.

Table 17 presents information provided by manufacturers of roofing materials on recovered content availability.

Table 17
Recovered Materials Content of Roofing Materials

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Cement/ Fiber/Silica Fume	Company A: 4 (fiber)	18
Steel	Company B: 16	25 to 30
	Company C: 67	100
	Company D: 16	25 to 30
Aluminum	Company B: 20	unknown
	Company E: 95	unknown
Aluminum/Steel	Company B: unknown	60-90
Fiber/Felt	Company F: 100	100
	Company G: 66	unknown
	Company H: 100	100
	Company I: 70	100
Rubber	Company J: unknown	unknown
	Company K: 12-20	unknown
	Company L: unknown	unknown
	Company M: 100	100
Rubber/Plastic	Company N: 100	100
Asphalt/Plastic	Company O: unknown	unknown
Wood	Company P: unknown	unknown
Wood/Plastic	Company Q: unknown	100

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 18, procuring agencies establish minimum content standards for use in purchasing roofing materials.

Table 18
Draft Recovered Materials Content Recommendations for Roofing Materials

Material	Postconsumer content (%)	Total recovered materials content (%)
Steel	16 67	25 - 30 100
Aluminum	20 - 95	20 - 95
Fiber (felt)	66 - 100	100
Rubber	12 - 100	100
Plastic or Plastic/Rubber Composite	100	100
Wood/Plastic Composite	–	100
Cement	Refer to cement and concrete recommendations in C-3 of the RMAN	

Notes: A final designation would not preclude a procuring agency from purchasing roofing materials manufactured from another material. It simply requires that a procuring agency, when purchasing steel, aluminum, fiber, rubber, plastic, wood, or cement roofing materials, purchase these items made with recovered materials when these items meet applicable specifications and performance requirements.

The recommended recovered materials content levels for steel in this table reflect the fact that the designated item can be made from steel manufactured in either a Basic Oxygen Furnace (BOF) or an Electric Arc Furnace (EAF). Steel from the BOF process contains 25% - 30% total recovered steel, of which, 16% is postconsumer steel. Steel from the EAF process contains a total of 100% recovered steel, of which, 67% is postconsumer steel.

c. Specifications

Roofing systems and their components are subject to an array of standards, tests, and codes pertaining to performance and other characteristics. EPA has found no building codes or standards that prohibit the use of recovered materials in roofing products.

Building Codes and Test Standards

National building codes specify that all products and materials used in constructing buildings and houses must be tested for fire-resistance, and that all roofing products and materials be tested for impact-resistance and wind lift. Master codes are set by the American Institute of Architects in cooperation with a nonprofit organization that does the actual product testing. Before a roofing system or product containing recovered materials can be sold on the market, it must be tested and classified according to national building standards, tests, and codes.

Different areas of the country favor different construction methods; the techniques used to build houses in a cold climate, for example, are different than those used in a warm climate. Severe weather patterns also play a role. Hence, most construction in the United States is regulated at the local level, and a few municipalities (mostly major cities) write and revise their own codes. Some states have mandatory statewide building codes. If EPA designates roofing systems, products, or materials, it should recommend that products or materials procured with recovered materials meet all applicable local, regional, and national building codes.

ASTM Standards

ASTM's Committee D08 on Roofing, Waterproofing, and Bituminous Materials maintains 186 standards for roofing products. The specifications do not discuss use of recovered materials, nor do they preclude the use of recovered materials.

H. Railroad Grade Crossing Surfaces (Revision)

1. Additional Procurement Recommendations

EPA recommended purchasing practices, including recovered materials content levels, for railroad grade crossing surfaces in RMAN III. EPA is revising those recommendations by adding recovered materials content levels for wood and plastic railroad grade crossing surfaces. When EPA issues final recommendations for purchasing railroad grade crossing surfaces, procuring agencies

should substitute the revised Table 19 for the recommendations found in Section C-10 of RMAN III. EPA recently received information from two companies, one that manufactures railroad grade crossings made from recovered wood, and another that manufactures railroad grade crossings from a composite plastic material. The information from these companies has been included in the RCRA docket for this proposed rule. One company recovers wood from old railroad ties and uses this material to make new railroad ties and railroad grade crossing surfaces. The wood used to make these products is made from old railroad ties combined with a proprietary plastic binder made from postconsumer plastic. The company claims that the end products contain 90-97 percent postconsumer materials content. The proposed inclusion of wood railroad grade crossing surfaces in EPA's designation would also include composite wood materials. The other company makes a composite crossing from 100 percent recovered materials, including auto shredder residue and postconsumer plastic. The company claims that the end product contains 85-95 percent postconsumer material. EPA requests comments on the inclusion of recovered wood and plastic as materials to be added to the previous designation of railroad grade crossing surfaces containing recovered content cement, rubber, or steel.

a. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 19 (Revised), procuring agencies establish minimum content standards for use in purchasing railroad grade crossing surfaces.

Table 19
Draft Recovered Materials Content Recommendations for Railroad Grade Crossing Surfaces (Revised)

Surface Material	Recovered Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Concrete	Coal fly ash	--	15 - 20
Rubber	Tire rubber	--	85 - 95
Steel	Steel	16 - 75	20 - 100
Wood	Wood or wood composite	90 - 97	90 - 97

Surface Material	Recovered Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastic	Plastic or plastic composite	85 - 95	100

b. Specifications

EPA did not identify any industry specifications for wood railroad grade crossing surfaces. EPA requests information on industry specifications or standards that might exist.

II. Revision to Consolidated and Reprocessed Latex Paint Specification

In RMAN II, EPA recommended that procuring agencies refer to federal specification TT-P-2846 when purchasing recycled paint. (See Section C-7-Latex Paint.) EPA has recently learned that the General Services Administration (GSA) has cancelled this specification and will replace it with commercial item description (CID) A-A-3185. A copy of this CID will be placed in the RCRA public docket for today's notice when it becomes available. In the final RMAN IV, EPA intends to revise Section C-7 of the RMAN to delete reference to federal specification TT-P-2846 and replace it with reference to CID A-A-3185.

VII. NON-PAPER OFFICE PRODUCTS

A. Office Furniture

1. Item Description

Office furniture includes seating, desks, storage units, file cabinets, tables, and systems furniture (or "cubicles") used in virtually all federal offices. Definitions of specific types of office furniture, according to the Office Furniture Recyclers Forum (OFRF), are listed below.

Conference Desk - A desk having a large overhang so visitors can draw their chairs under the desk top.

Chairs:
- — ***Fixed Back Chair*** - Chair with a nonmobile back that does not tilt.
- — ***Ganging Chairs*** - Usually stack or side chairs that are attached to each other by a clip or bolt so they stay in a straight line.
- — ***Posture Chair*** - Desk chair with a back that reclines independently from the seat-tilt mechanism.
- — ***Side Arm Chair*** - Guest chair with arms and usually without casters.
- — ***Stacking Chair*** - A chair designed to meet or stack together for ease of storage with minimum space.
- — ***Swivel Tilt Chair*** - Seat revolves on a hub for easy access to desk and files, but also tilts back for comfort.

Credenza - A large office storage unit. Usually of the same style and finish as a desk and placed behind the desk.

Systems Furniture - Classification applied to a coordinated line of work surface, storage, and panels or partitions that are designed to work together to form work spaces. Systems often include integral electrical distribution and lighting capabilities.

Vertical File - Conventional file cabinet where each drawer is deeper than it is wide.

Most office furniture is made of wood or steel. Other materials used in office furniture manufacturing include polyethylene terephthalate (PET) in fabrics; plastic, which is integrated in components such as laminated work surfaces and arm rests; aluminum; particle board; and medium-density fiberboard (MDF), which is thicker than particle board. According to the Business and

Institutional Furniture Manufacturer's Association (BIFMA), approximately 25 percent of furniture products are manufactured with wood and 75 percent are manufactured with nonwood materials.

Most companies in the furniture industry do not manufacture and assemble furniture from raw materials. Rather, companies specialize in one aspect of manufacturing and work together. Suppliers, or "base manufacturers," for example, take raw materials, usually, plastic, aluminum, wood, or steel, and convert them into components (e.g., table tops, rubber edging, metal frames). Furniture manufacturers then purchase the components from suppliers and piece them together to make furniture products. In some instances, however, manufacturers fabricate their own wood and metal components.

In researching office furniture, EPA found that products fall into one of the following categories:

- New office furniture
- Reused furniture
- Refurbished furniture
- Remanufactured furniture

New Office Furniture

New office furniture is purchased from an original equipment manufacturer (OEM) and is composed of entirely OEM parts. The parts are made mostly of virgin materials, but some have recovered materials content.

Reused Furniture

Reused or "as-is" office furniture has been returned to the market for sale without repair or improvement to its appearance.

Refurbished Furniture

Refurbished office furniture is used furniture that has been "touched-up" or cosmetically improved and then returned to the market for sale. Refurbished furniture remains the same product throughout its life. Refurbishers improve the condition of old furniture through a number of processes including adding material, cutting, or painting the product. All major systems furniture manufacturers refurbish only their own systems furniture. The federal prison industries (UNICOR) provide a refurbishing and remanufacturing service for desks and credenzas in addition to systems furniture. UNICOR also works with the U.S. Department of Agriculture (USDA) to refurbish and remanufacture surplus furniture, which is then sold in a USDA store.

Remanufactured Furniture

Remanufactured office furniture goes through a reconstruction process in which products are completely disassembled; parts are inspected, cleaned, repaired or replaced; and the products are reassembled and refinished to improved "like new" condition before being returned to the market for sale. With systems furniture, for example, the remanufacturer buys used furniture or gives the owner credit for the furniture, which the seller can use to acquire remanufactured furniture. The old furniture is then stripped; the original steel or aluminum frame, the center partition, and batten (i.e., foam) from the product are cleaned, inspected, and then covered with new fabric to produce the remanufactured product. In addition, any old surfaces in salvageable condition are kept and relaminated. Most remanufacturers of systems furniture and seating are small businesses.

According to the Business Products Industry Association (BPIA), today's furniture remanufacturers and refurbishers contribute more than $1.2 billion to the $13.6 billion commercial furniture industry, representing almost 9 percent of the market.

Table 20 shows the percentage of each furniture product's share of the furniture market in 1997. According to BIFMA, this is the most recent data available.

Table 20
1997 Furniture Industry Product Representation

Product	Percent of Market
Systems	36
Seating	25
Files	14
Desks	10
Tables	7
Storage	5
Other	3

Source: BIFMA, 1999

According to BIFMA, trends from 1988 to 1997 show a consistent increase in systems furniture manufacturing and a decrease in the manufacture of file cabinets and other products. Furthermore, many buyers are looking at refurbished and remanufactured furniture as a way to minimize costs. Still, most refurbishing is done by dealers rather than manufacturers, so it is difficult to quantify the impact it has on the new furniture market. Some estimates put refurbished furniture volume at about 8 to 10 percent of the new furniture volume.

According to BIFMA, retail channels, such as office superstores and warehouse clubs, are selling increased amounts of office furniture. Table 21 shows the percent of total sales of office furniture through various distribution channels. This is the most recent data available.

Table 21
1996 Percent of Total Sales Through Various Distribution Channels

Distribution Channel	Percent of Total Sales
"Aligned" contract office furniture dealers	53
Non-aligned office furniture dealers	16
Office products "mega" dealers	8

Superstores, warehouse clubs, other mass merchandisers	6
Wholesalers	6
Federal government	4
Mail order, direct, all other	7

Source: BPIA, 1998

2. Rationale for Designation

EPA has concluded that office furniture containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Office furniture can contain a wide variety of recovered materials including aluminum, steel, paper and paperboard, plastics, and wood.

Commercial and residential furniture and furnishings comprised 3.5 percent of MSW in 1998, representing more than 7.6 million tons. The recovery rate for furniture and furnishings in 1998 was less than 5,000 tons or 0.05 percent of the total MSW.

According to OFRF, approximately 3 million tons of office furniture is discarded in landfills each year. Remanufacturing and refurbishing can divert some of this furniture away from landfills by returning it to offices. In fact, remanufacturing just 40 typical work stations diverts one tractor-trailer load of furniture from a landfill. Also, reusing 1 pound of material through remanufacturing saves 5 to 9 pounds of original materials.

Using recovered materials in manufacturing and remanufacturing also diverts waste from landfills. When a company manufacturers or remanufacturers one typical work station with fabric made from recovered materials, for example, it uses 240 PET recycled soda bottles. So, if an agency were to purchase 1,000 remanufactured work stations, it would divert 240,000 soda bottles from landfills.

One company estimates the company has diverted approximately 48.4 million pounds of workstation materials from landfills since its founding in 1989.

b. Technological Feasibility and Performance

According to one vendor, furniture made with recovered materials content, remanufactured furniture, and refurbished furniture all perform as well as furniture manufactured with virgin materials. Remanufacturing and refurbishing restores worn office furniture to like new condition, which is comparable to new furniture in quality and reliability. In general, upholstery made with recovered PET looks, cuts, and upholsters the same as fabric made with virgin resins.

Office partitions covered with postconsumer content fabric are stainproof and fabric rated, which means they comply with Boston, New York, and California fire codes (the most stringent state fire codes in the country). Office partitions made from postconsumer content fabric are similar in durability to those made from fabrics with virgin materials.

In many cases, there are advantages to remanufactured or refurbished furniture. For example, furniture is usually available for delivery on much quicker timeframe. In the case of one company, the refinishing can be done on the premises due to the absence of toxic chemicals. As a result, there is very little moving of furniture required and minimal downtime for the client.

c. Availability and Competition

Less than 1 percent of furniture manufacturers make furniture with recovered materials. Office furniture refurbishers and remanufacturers are mostly small business owners operating on local and regional levels across the United States. Within the OFRF membership, an average company has 30 employees with sales between $2 and $5 million per year.

Availability of new furniture made with recovered materials could be an immediate problem because components made with recovered materials are not in great supply for furniture manufacturing. According to Government Sales Associates, this could be mitigated if furniture

component manufacturers were to purchase one machine to convert the recovered feedstock into components for furniture manufacturing.

Refurbished and remanufactured office furniture is often more readily available than new office furniture because the product is already partially manufactured. As a result, the refurbisher or remanufacturer is able to provide short lead times, usually delivering a product in less than 4 weeks. When working with bulk orders, most furniture manufacturers work with a standard lead time of 6 to 8 weeks, however, many companies offer quick-ship programs that are more expensive but can deliver in as little as 48 hours.

One company has established a national network of 16 large dealers and major independent remanufacturers. Through local dealers, the network supplies refurbished products, repaired with virgin materials, to customers seeking used office furniture. Local dealers also offer onsite furniture refurbishing through the a refurbishment program. Another program offers credit toward purchases of new furniture when customers trade-in old office furniture.

Another company offers remanufactured furniture. Upon receipt of a purchase order, the company remanufactures the used product to the customer's exact specifications. About 60 percent of the material from the products it remanufactures is retained and used in the remanufacturing process. About 10 percent is sold to other furniture brokers and another 10 percent is sold to scrap recyclers.

d. Economic Feasibility

New furniture made with recovered materials is comparable in price to new furniture made with virgin materials.

Prices for remanufactured furniture are typically 30 to 50 percent less than new furniture, and the quality has increased with the maturation of the industry. Also, customers that supply their own used furniture can increase savings by avoiding storage or waste disposal fees. A contact with one company indicated that an organization can save up to 80 percent of its furniture budget by refinishing.

An important factor in the cost of remanufactured furniture is the credit system that many remanufacturers use. Offices can trade in old furniture to remanufacturing companies who offer various amounts of credit on new furniture, depending on the condition and quantity of the old furniture. According to one contact, many government agencies have warehouses full of old systems furniture for which they can, and sometimes do, receive credit for remanufactured furniture.

UNICOR customers provide old furniture and pay approximately half of the original cost of the unit for UNICOR to remanufacture or refurbish it. UNICOR is a mandatory source provider to the federal government for office furniture and many other items (see Section 7).

Office partitions made from postconsumer content fabrics are similar in cost to those made from fabrics with virgin materials. Office furniture manufactured by one company with recovered materials is competitive in cost to that manufactured with virgin materials.

e. Government Purchasing

OFRF estimates that the federal government purchased $396.3 million in office furniture in 1996. According to another contact, however, the federal government spent approximately $562 million on office furniture in 1996. Over the past 5 years, federal government agencies purchased over $1.9 billion of office furniture including metal filing cabinets, seating, systems furniture and pedestals, office tables (excluding executive type), and executive offices. According to the contact with Government Sales Associates, most federal purchases are made through GSA schedules and some are made via open market contractors. In addition, the contact indicated that many state and federal prison systems purchase the recovered content furniture components that Government Sales Associates makes. The furniture parts are then used to build furniture under UNICOR. The contact also knows of at least 10 prison systems that are interested in switching their raw materials to the recovered content MDF components.

The following table shows a breakdown of federal government purchasing of the different types of office furniture. OFRF does not have this data available broken down by recycled versus new office furniture sales.

Table 22
Approximate Sales of Total Office Furniture to the Federal Government in Millions of Dollars

Fiscal Year	Office Tables (Excluding	Metal Filing Cabinets	Executive Offices	Seating	Systems Furniture and Pedestals	Totals
1994	5.4	10.2	13.3	23.0	307.8	359.6
1995	4.2	11.7	22.5	35.1	300.4	373.8
1996	9.4	11.2	17.5	77.4	280.7	396.3
1997	11.8	8.3	43.9	84.6	186.0	334.6
1998	17.8	10.4	50.9	11.7	251.7	442.5
Totals	48.6	51.8	148.1	331.7	1326.6	1,906.8

Source: OFRF, 1999a

The federal government purchases more systems furniture than any other type of office furniture. Systems furniture is made with wood, steel, particleboard, paint, cloth, and fiberglass.

EPA's Office of Administration (OA) is promoting a furniture management program that encourages facilities, when practical, to reuse and recycle furniture and consider environmental factors in furniture procurement. It has compiled a pamphlet that discusses pollution prevention activities (e.g., purchasing refurbished, remanufactured, and recovered materials content furniture) that have already been implemented at several EPA facilities. OA produced the pamphlet to supply facilities with the information they need to implement their own pollution prevention furniture programs.

Already, most EPA facilities have access to a small reserve of furniture and have established requirements for identifying whether this furniture will meet customer needs prior to procuring new furniture. A computerized inventory system facilitates this process by keeping information current. In addition, some EPA facilities have developed refurbishing capabilities onsite to repair furniture for reuse rather than disposing of it. If a facility does not have direct access to a furniture reserve, it can contact its local GSA representative to determine whether other federal agencies have excess furniture that will meet its needs.

GSA operates programs to reuse, refurbish, and donate used furniture. Additionally, GSA's National Furniture Center works with agencies interested in incorporating environmental considerations into its selection process. The 1999 GSA consolidated schedule includes furniture items in the new Solicitation No. 3FNO-M1-990001-B, Schedule 71, Part 1. This new schedule includes remanufactured furniture as Special Item Number (SIN) 711-92.

One office furniture manufacturer EPA contacted generates only about 10 percent of its annual revenue through federal government contracts; its primary purchasers are commercial designers and architects. Another manufacturer indicated that it sells approximately $1.5 million via GSA's schedule annually. OFRF member companies generate less than 3 percent of their annual revenue through federal government contracts.

UNICOR's Federal Prison Industries, Inc., is a mandatory source provider to the government for office furniture and many other items. That is, all federal agencies must seek to buy all products from UNICOR, provided it manufactures the product and it meets agency needs. If UNICOR can not satisfy agency needs then the agency can obtain a waiver that allows it to purchase products elsewhere. Despite the mandatory source requirement, UNICOR's refurbishing and remanufacturing service generates less than $1 million a year in revenue from the federal government. UNICOR's services include manufacturing new office furniture and remanufacturing and refurbishing old furniture. According to UNICOR, the government purchases over 15 percent of its furniture from them, which equates to 40 percent of UNICOR's furniture sales. In 1997, UNICOR's office furniture sales to the federal government totaled $80 million. Because of its dependence on office furniture sales to the government, UNICOR expressed concern about mandatory source and CPG requirements that might conflict if office furniture becomes a CPG designated item.

Office furniture manufactured by UNICOR includes seating, filing cabinets, systems furniture, and wood products such as cabinets, desks, credenzas, conference tables, and book cases. UNICOR manufactures new furniture that contains approximately 25 percent recovered materials content by volume. None of the recovered materials UNICOR uses, however, are postconsumer. All UNICOR particle board used in office furniture, for example, is made with recovered material from factories and sawmills. Plastic laminates manufactured by UNICOR also contain some recovered materials content,

as does seat padding, which contains some recovered textile content. UNICOR also refurbishes old furniture for less than purchasing new furniture would cost. In the refurbishing process, UNICOR strips, finishes, sands, and refinishes wood and metal items, repairs upholstered furniture, and replaces springs.

Additionally, UNICOR collects chairs, couches, and mattresses for disassembly and recycling. Salvaged wood is cut, shredded, and sold for fuel, or ground into mulch for sale to landscapers. Cotton batting, steel springs, sisal, foam, scrap metal, and scrap fabric are sold to a variety of processors for recycling.

f. Barriers to Purchasing

EPA did not identify any standards or specifications that would preclude government agencies from purchasing office furniture with recovered materials content or remanufactured or refurbished office furniture.

GSA requires that remanufactured furniture meet the same UL, ASTM, and BIFMA standards and fire codes (Boston and California) as new furniture.

Due to mandatory source statutes, government agencies are currently required to purchase office furniture from UNICOR. If EPA designates office furniture as a CPG item and UNICOR cannot meet CPG specifications, government agencies could use a waiver to purchase furniture from manufacturers other than UNICOR. While UNICOR does remanufacture and refurbish furniture, they are concerned that they might not be able to meet recovered materials content specifications and will lose valuable government business as a result. Also, UNICOR expressed concern about meeting demands for high volumes of refurbished or remanufactured furniture as they have only one refurbishing and remanufacturing plant.

According to a contact at Studio eg, the federal government might not purchase the company's office furniture because it has not been tested by industry standards. The company could not think of any other barriers that might prevent the federal government from purchasing its furniture manufactured with recovered materials content.

g. Designation

EPA proposes to designate office furniture containing recovered steel, aluminum, wood, and plastic. A final designation would not preclude a procuring agency from purchasing office furniture manufactured from another material. It simply requires that a procuring agency, when purchasing steel, wood, or plastic office furniture, purchase these items made with recovered materials when these items meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Reused office furniture tends to have the highest postconsumer content because the product is not significantly altered. Refurbished office furniture contains almost as much postconsumer content as reused office furniture, although it usually has virgin materials added due to necessary touch-ups. Remanufactured office furniture tends to contain less postconsumer content than reused or refurbished furniture but conserves the greatest value in the product.

EPA found that new furniture contains varying amounts (from 0 to 98 percent) of recovered materials. Refurbished and remanufactured office furniture typically contains 25 to 75 percent postconsumer materials depending on the condition of the core being refurbished or remanufactured. According to a government consultant with 20 years experience as a federal government sales representative, remanufactured office furniture can contain as much as 60 to 80 percent postconsumer content.

One company remanufactures office workstations. The company purchases used, name-brand workstations from end users, brokers, and dealers and then disassembles all components. All components are cleaned, painted, and oven-cured before being reassembled. In addition, it applies new fabric to the panels, flipper doors, and tackboards using fabric made from recovered materials (see below). The company is the only systems furniture manufacturer on GSA's schedule.

Another company specializes in restoring furniture from the hospitality industry (e.g., hotels) and university housing. The company has developed waterborne wood furniture refinishing technologies that do not use any toxic chemicals or emit VOCs or esters. The company also reupholsters seating units with new fabrics that contain 20 to 100 percent recovered (postindustrial) fibers. Although some small pieces might need to be replaced at the time of refinishing, the resulting furniture is essentially 100 percent postconsumer recovered material.

EPA identified seven manufacturers that use recovered materials in their new, remanufactured, refurbished, or reused office furniture. Manufacturers of office furniture often substitute virgin materials with recovered materials such as polyethylene terephthalate (PET), newspaper, cardboard, corrugated paper, wood, fiberglass, cellulose, nylon, acrylonitrile butadiene styrene (ABS), acetyl, polypropylene, polystyrene, foam, and rubber.

A contact with a manufacturer, marketer, and distributor of furniture and other items to government agencies, indicated that the company currently markets several types of office furniture and furniture components with recovered materials content. The company manufactures office partitions (i.e., systems furniture) with 75 percent total recovered materials content, all of which is postconsumer material. The core material, which is made of cellulose, contains 20 percent recovered newspaper, cardboard, and corrugated paper. The framing of the partitions is made from aluminum with 75 percent recovered materials content, and the fabric covering the batten is made from 100 percent recovered content PET from plastic bottles. The contact indicated that the partitions are due to be submitted to GSA's Federal Supply Schedule by summer 2000.

Steel

Steel used in office furniture inherently has recovered content; it also can be painted with recycled-content or virgin paint. According to the Steel Recycling Institute, the recovered steel used in office furniture would most likely be made from the basic oxygen furnace (BOF) process, and would, therefore, contain 25 to 30 percent recovered materials, including 16 percent postconsumer content.

A manufacturer of office furniture, including systems furniture, seating, storage units, surface materials, case goods, and tables, indicated that its steel components contain 30 percent recovered content, including 16 percent postconsumer steel.

Newspaper, Wood, Cardboard, and Corrugated Paper

According to Government Sales Associates, virgin wood usually is the first choice for manufacturing wood furniture and also is used in manufacturing particleboard and MDF. Substitutes for these materials are postconsumer newspapers and wood (e.g., shipping pallets and packing crates). Recovered-content fiberglass or cellulose also are made with postconsumer newspaper and can substitute for virgin fiberglass in office partitions.

According to a contact with the Composite Panel Association, a trade association representing the particleboard and MDF industries, most manufacturers of particleboard and MDF incorporate some level of recovered materials (typically mill scraps and trimmings) into their products, although very few use postconsumer, and any amount that is used is very small. The contact indicated that the reason for this is due to the limited availability of postconsumer wood. Some manufacturers are also combining recovered wood with other cellulosic materials such as wheat straw and bagasse (a material derived from sugarcane). The contact estimates the industry average for recovered materials content to be about 80 to 90 percent.

Government Sales Associates also distributes a recovered content wood component used in MDF-type furniture. The components are used by other companies to manufacture case goods such as desks, bookcases, and credenzas. The material is made from 100 percent urban wood waste such as pallets and wood crating. The wood is ground into flour and mixed with nontoxic binders to make a slurry. When hardened, the material can replace MDF in many types of office furniture. Biobased sealers, stains, and finishes are used to treat the furniture.

Three years ago one manufacturer made a product from 100 percent recovered newspaper or cardboard that substituted for plywood. The curved fiberboard was used as interior frames for seats and chair backs. Although this company is no longer in business, a contact from the company believes

other companies could use the process to manufacture recovered-content furniture. The contact indicated that the substitute materials cost about half of what plywood components would cost and meet all of the BIFMA industry standards.

Another company manufactures recovered content furniture, mostly dormitory style—desks, bookcases, lofts, study carrels. The desks that the company assembles are laminate tops made from either recovered content particleboard or a material which contains recovered newsprint and a soy resin.

Another company's recovered content sound insulating material is used in certain panel products. The company uses corrugated paper with between 15 and 35 percent recovered materials content. The company was unable to specify postconsumer vs. recovered materials and content percentages. The particle board that the company uses is made from approximately 50 percent postconsumer waste (e.g., from home deconstruction) and approximately 50 percent recovered waste (e.g., mill wastes, scraps, and trimmings). In addition, the company manufactures tackable surfaces with 12 percent recovered paper fibers.

One company used to make a honeycomb core material that could potentially replace the MDF or particle board used in conference table tops, desk tops, door cabinets, and shelves. The material was made with 98 percent postconsumer cardboard and corrugated paper. The factory was shut down in early 1999 due to financial difficulties. The company is still solvent and has been working with several parties who are interested in pursuing the rights to revive the technology.

Plastics

Recovered PET can substitute for virgin plastics used in chair structures, furniture backings, and batten material.

One company has developed a 100 percent postconsumer content PET panel/partition fabric. The company currently has 12 designs of the fabric. The contact estimates that the company covers 60 to 80 percent of the market for panel fabric for systems furniture. The company also recently introduced a postconsumer content PET seating fabric for upholstering chairs, couches, and benches.

ANS Custom manufactures a line of office partitions using the postconsumer content PET fabric. As the first panel fabric manufactured in the U.S., it was used to manufacture most office partitions. It was originally made without recovered PET, however. When replacing that fabric, remanufacturers and refurbishers purchase the new 100 percent recovered content fabric because they are most familiar with it.

In addition to panel fabric, the company also manufactures a seating fabric with recovered materials content.

A contact with one company indicated that the company's products contain at least 95 percent total recovered material content, including 70 to 75 percent postconsumer material. Most of the company's furniture is made from plastic containing high density polyethylene resins from milk bottles. Some small steel components contain 25 to 30 percent recovered material, including 16 percent postconsumer material.

Depending on the particular piece and its color and property needs the company sometimes uses plastic that contains 10 percent recovered material. The company also uses fabrics that contain a range of recovered materials. One collection from is made from 100 percent postconsumer recovered PET from plastic bottles.

Agricultural Fiber

One company is investigating wheat as a substitute material for flakeboard, which currently is made from bark, wood chips, sawdust, and other wood resins. Toxic additives that are used to manufacture flakeboard, such as urea formaldehyde, produce off gases. Possible raw material substitutes in making flakeboard include products made from wheat, rather than lumber, that do not require the use of formaldehydes in their manufacturing process. The contact indicated that the wheat used to replace wood is left over from the harvesting process and otherwise would be discarded. EPA is aware that five companies manufacture particleboard and/or fiberboard made from agricultural fiber, including wheat, grass, rice, kenaf, jute, and soybean hulls. Many of these products contain up to 100 percent recovered agricultural material.

Miscellaneous Recovered Materials

A manufacturer and distributor of office products, offers four lines of chairs with 58 to 70 percent recycled content. The chairs are manufactured with recovered aluminum, PET, ABS, steel, nylon, acetal, polypropylene, polystyrene, foam, and fabric. Like most furniture companies it does not distinguish between recovered and postconsumer. It uses the term "recycled content" to refer to both types of materials. The company uses 26 different recycled-content materials that it purchases from suppliers who do not identify their product materials uniformly.

Another company is a design firm that incorporates sustainability practices into their office management as well as their products. The company manufactures tables, shelving, desks, computer supports, and free standing systems—partitions that offer visual and acoustical privacy and accommodate free standing furniture. It procures components that contain recovered materials, such as wheat board made from 98 percent postindustrial wheat shafts, which it uses instead of wood in manufacturing work surfaces. The company also purchases and uses furniture legs made of 98 percent postconsumer cardboard and partition edges and other rubber accessories made of 98 percent postconsumer tires. Additionally, the company manufactures partitions with 98 percent postconsumer newsprint and reception desks with 98 percent recovered aluminum.

One of the largest furniture manufacturers in the U.S. currently does not have complete information on the use of materials with recovered content. The company does, however, currently offer one recovered content fabric which is made with 100 percent recovered polyester. Customer demand for the fabric is low, but if it increases, the company plans to explore additional lines of fabrics made with recovered materials. The plastics the company uses contain between 1 and 10 percent recovered materials. It also uses metals, mostly steel, that contain 25 to 30 percent recovered materials, and aluminum that contains between 10 and 100 percent recovered materials. The company uses mineral board made with less than 2 percent recovered material content, but can not obtain recovered content lumber (e.g., salvage timber an urban wood waste) in large or consistent volumes.

One company uses laminates that can contain an unspecified amount of recovered materials. Its laminate manufacturer regrinds defective top or finish sheets and uses them to make the backer sheets.

Table 23 presents information provided by manufacturers of office furniture on recovered content availability. In addition, EPA has limited information that particleboard and fiberboard are being made with 100 percent recovered agricultural fiber.

Table 23
Recovered Materials Content of Office Furniture

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Fabric	Company A: 100 Company C: 100 Company D: unknown Company G: 100	100 100 100 100
HDPE	Company B: 70 to 75	95
Steel	Company D: 16 Company I: 16	25 to 30 25 to 30
Aluminum	Company D: unknown	10 to 100
Miscellaneous	Company E: unknown Company I: unknown Company J: up to 98	58 to 70 unknown up to 98
Refurbished Furniture	Company D: 25 to 75	25 to 75
Remanufactured Furniture	Company F: unknown Company G: unknown Company H: unknown Company I: unknown	25 to 75 25 to75 25 to 75 unknown

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 24, procuring agencies establish minimum content standards for use in purchasing office furniture with recovered materials, including remanufactured or refurbished office furniture.

Table 24
Draft Recovered Materials Content Recommendations for Office Furniture

Product	Material	Postconsumer content (%)	Total recovered materials content (%)
Furniture structure	Steel	16	25 - 30
Furniture structure	Aluminum	–	75 - 100
Particleboard/ Fiberboard component	Wood composite	1 - 50	80 - 100
	Agricultural fiber	–	100
Fabric	PET	100	100
Plastic furniture component	HDPE	70 - 75	95
Remanufactured or Refurbished Furniture	Various	25 - 75	25 - 75

Notes: A final designation would not preclude a procuring agency from purchasing office furniture manufactured from another material. It simply requires that a procuring agency, when purchasing office furniture made from steel, aluminum, wood, agricultural fiber, or plastic, purchase these items made with recovered materials when these items meet applicable specifications and performance requirements, or procure office furniture that has been remanufactured or refurbished.

The recommended recovered materials content levels for steel in this table reflect the fact that the designated item is generally made from steel manufactured in a Basic Oxygen Furnace (BOF). Steel from the BOF process contains 25% - 30% total recovered steel, of which, 16% is postconsumer steel.

Particleboard and fiberboard used in the wood components of office furniture may also contain other recovered cellulosic materials, including, but not limited to, paper, wheat straw, and bagasse. The percentages of these materials contained in the product would also count toward the recovered materials content level of the item.

c. Specifications

Customers that purchase remanufactured and refurbished office furniture are guaranteed a quality product through warranties and performance standards. All materials used in new furniture manufacturing are tested by the American Society for Testing and Materials (ASTM). Once approved, components can be used and reused without further testing. As a result, only added components must be tested for remanufactured furniture. Also, materials used in furniture and manufacturing must pass

state and local standards such as the Boston and California fire codes. Retesting for flammability is required for remanufactured furniture because new fabric is used in its manufacturing.

Standards from the American National Standards Institute (ANSI) and BIFMA comprise the majority of furniture safety and performance standards. According to BIFMA, the ANSI/BIFMA standards were developed by the BIFMA Engineering Committee and are reviewed every 5 years according to ANSI guidelines. ANSI/BIFMA standards exist for flammability and for the following office furniture products :

- General purpose office chairs
- Lateral files
- Vertical files
- Lounge seating
- Desk products
- Panels systems

Additionally, OFRF has developed voluntary performance standards for refurbished and remanufactured furniture aimed at providing criteria for evaluating condition and performance. According to OFRF, many remanufacturers and refurbishers have incorporated these standards into their quality control practices.

Some refurbishers and remanufactures submit their products to an independent, not-for-profit product safety testing organization. It performs safety tests on refurbished and remanufactured office furniture and stamps approved products with their trademark.

According to one company representative, office furniture manufactured by one company and made from recovered materials has not been tested by industry standards. The company is relatively new and has not generated the revenue to pay for such testing.

VIII. MISCELLANEOUS PRODUCTS

A. Bike Racks

1. Item Description

Bike racks provide a method for cyclists to secure their bicycles safely. Commonly found in public areas, bike racks can be designed to hold 1 to 50 bicycles and can range from $100 to $1,000 each, depending on type. They can be free standing units, anchored by bolts or cement, or embedded into the ground.

Steel

Steel is the primary material used to manufacture bike racks. Stainless steel racks are made from American Society for Testing and Materials (ASTM) A312 Schedule 40 TP 304 stainless steel pipe. A majority of steel bike racks use a hydraulic pipe-bending machine and mandrel specifically tooled for this purpose. For aesthetics and protection, steel bike racks can be coated with a polyester powder coat or a polyvinyl thermoplastic coat. Bike racks made with galvanized steel are also available.

Plastic Lumber

Bike racks can also be made of plastic lumber or a combination of plastic lumber and steel. Bike racks that use a combination of both materials use plastic lumber for end posts and steel for the railings. Plastic lumber is generally made in one of two ways: by extrusion into a mold, or by continuous extrusion. For 100 percent HDPE plastic lumber, HDPE is ground up, melted, and mixed with additives. These additives frequently include ultraviolet (UV) inhibitors and color. A blowing agent can also be added to decrease the density of the material. The material is then either flowed into a mold (extrusion into a mold) or pulled out of a machine and shaped using a series of sizing plates, then cooled and cut to the desired length (continuous extrusion).

An ASTM definition states that plastic lumber is "a manufactured product composed of more than 50 weight percent resin, and in which the product generally is rectangular in cross-section and typically supplied in board dimensional lumber sizes, may be filled or unfilled, and may be composed of single or multiple resin blends." As noted in this definition, plastic lumber is normally produced in standard dimensional lumber profiles, such as 2 by 4 foot lengths, but it can also be produced in sheets. Some plastic lumber is available in a variety of colors, while other types come in only one or two different colors.

Plastic lumber can also be manufactured from HDPE, polyethylene, commingled plastics, plastic and fiberglass, and wood/thermoplastic composites. All the manufacturers of plastic lumber bike racks that EPA contacted use plastic lumber made from 100 percent postconsumer HDPE.

2. Rationale for Designation

EPA has concluded that bike racks made from recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Bike racks are made with recovered steel and HDPE plastic. According to EPA, almost 12.4 million tons of steel and 5.0 million tons of HDPE plastic were generated in the United States in 1998.

b. Technological Feasibility and Performance

EPA contacted several organizations to determine the performance of both steel and plastic lumber bike racks. A search of the ASTM standards database on the ASTM Web site did not yield any specifications for bike racks.

Most contacts reported that steel bike racks are very durable and virtually maintenance-free. The Seashore State Park and York River State Park in Virginia maintain 25 miles of trails between both of them that are primarily used for biking. According to park officials, the steel bike racks

currently being used in both parks have lasted for as long as 6 years. There have been no maintenance problems to prompt them to replace the bike racks during that time.

According to a facilities employee at a University, however, although most steel bike racks are marketed as "maintenance-free," some of them tend to rust. Furthermore, for painted steel bike racks, contact with bikes and bike locks makes them vulnerable to scratches. Applications of paint are sometimes required to maintain their appearance.

EPA identified four manufacturers that use 100 percent postconsumer plastic lumber to manufacture their bike racks. Some of the manufacturers also offer a plastic lumber/steel combination on some models. The plastic lumber and steel combination bike racks are usually more expensive and heavier than the regular steel or plastic lumber bike racks. Steel bike racks generally cost less and are lighter in weight than their plastic lumber counterparts. According to one of the manufacturers, plastic lumber bike racks are just as secure as steel bike racks. Furthermore, plastic lumber bike racks do not tend to rust or scratch as easily as steel bike racks.

c. Availability and Competition

EPA identified five manufacturers of steel bike racks and knows of 16 possible others. Manufacturers of park and recreational equipment might also produce and sell steel or plastic lumber bike racks.

EPA has been able to identify four manufacturers of plastic lumber bike racks. According to one of the manufacturers, government procurement officials might not necessarily be aware of plastic lumber bike racks, which limits the product's selling potential. Two of the manufacturers identified recall selling plastic lumber bike racks to local parks and state agencies but not to the federal government. Only one of the four manufacturers identified was on the General Services Administration (GSA) schedule, but was unable to provide EPA with any information on the agency's purchasing activities. According to the manufacturers of both steel and plastic lumber bike racks, steel bike racks remain more popular primarily because of availability and price.

d. Economic Feasibility

According to the manufacturers EPA contacted, steel bike racks are still more popular than plastic lumber bike racks, primarily because of their lower cost. Manufacturers of both types of bike racks did not identify any problems in acquiring the raw materials to produce their products.

Although EPA did not identify any agency using plastic lumber bike racks, previous CPG research on plastic lumber items has indicated that the lifecycle costs of plastic lumber are comparable to those of steel.

e. Government Purchasing

According to the four county governments EPA contacted, purchases for equipment such as bike racks are usually not tracked. In Fairfax County, Virginia, and King County, Washington, for example, bike racks are usually purchased along with other park equipment when a park is being developed and replacement purchases are extremely rare.

Both these counties, as well as Montgomery County, Maryland, and the City of Newport News, Virginia, purchase steel bike racks. The contact from King County was not aware of the availability of plastic lumber bike racks.

Montgomery County Public Schools (MCPS), in Maryland, and the Orange County Public Schools (OCPS), in Florida, both use steel bike racks at their facilities. According to both contacts from MCPS and OCPS, bike racks are purchased during the construction stage of a new school and replacement bike racks are purchased by the individual schools through a contractor designated by county purchasing office.

The National Park Service (NPS) purchases bike racks for many of its 400 facilities, but according to the NPS contact, the number purchased per year in unknown. NPS does not keep any statistics on the bike racks purchased so in addition to not know the number, NPS does not know how many are steel and how many are plastic lumber, if any.

f. Barriers to Purchasing

The lack of awareness of plastic lumber bike racks might be a purchasing barrier for this type. In addition, the higher initial cost of plastic lumber bike racks might preclude their purchase by some agencies.

g. Designation

EPA proposes to designate bike racks containing recovered steel and plastic. A final designation would not preclude a procuring agency from purchasing bike racks manufactured from another material. It simply requires that a procuring agency, when purchasing steel or plastic bike racks, purchase them containing recovered material when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Steel

The manufacturers EPA contacted were not able to provide information on the recovered materials content of steel bike racks. According to the Steel Recycling Institute, however, the steel used in bike racks is most likely made using the basic oxygen furnace (BOF) process and would, therefore, contain 25 to 30 percent recovered material including 16 percent postconsumer material.

Plastic Lumber

EPA identified four manufacturers that use 100 percent HDPE plastic lumber to manufacture their bike racks. EPA's research noted that most of these plastic lumber manufacturers use 100 percent postconsumer HDPE for their products.

Table 25 presents information provided by manufacturers on availability of recovered content bike racks.

Table 25
Recovered Materials Content of Bike Racks

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 100	100
	Company C: 100	100
	Company E: 100	100
	Company G: 100	100
	Company I: 100	100
Steel	Company B: 16	25-30
	Company C: 16	25-30
	Company D: 16	25-30
	Company F: 16	25-30
	Company H: 16	25-30
	Company I: 16	25-30

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 26, procuring agencies establish minimum content standards for use in procuring bike racks.

Table 26
Draft Recovered Materials Content Recommendations for Bike Racks

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	100	100
Steel	16	25 to 30

Notes: A final designation would not preclude a procuring agency from purchasing bike racks manufactured from another material. It simply requires that a procuring agency, when purchasing steel

or plastic bike racks, purchase them containing recovered materials when they meet applicable specifications and performance requirements.

The recommended recovered materials content levels for steel in this table reflect the fact that the designated item is generally made from steel manufactured in a Basic Oxygen Furnace (BOF). Steel from the BOF process contains 25-30 percent total recovered steel, of which, 16 percent is postconsumer steel.

c. Specifications

According to the government agencies EPA contacted that use steel bike racks, there are no specifications or requirements to purchase this product with recovered materials.

B. Blasting Grit

1. Item Description

Industrial abrasives are used to shape, cut, sharpen, or finish a variety of other surfaces and materials. They come in countless varieties of grade (particle size), which is dictated by the materials being ground and the finish that is required. Abrasives can be fashioned for use on metals, ceramics, carbides, composites, glass, and plastics. They can be made from a variety of materials, both virgin (including metal, minerals, silicon, and natural materials such as walnut shells) and recovered, (including aluminum oxide, coal and metal slag, and glass). Abrasives are used in many industries, including construction, automotive, and landscaping.

There are several specific types of industrial abrasives:

- *Bonded* abrasives are abrasive materials that have been mixed and hardened with polymer or phenol formaldehyde resins or other types of fixing agents. They are also sometimes affixed to a substrate (most commonly aluminum oxide). They most often take the form of grinding wheels or sanding discs, but can also have flexible substrates and be customized to fit almost any application. These are commonly used in the automotive industry (among others) for sanding and refinishing purposes. Types of bonded abrasives include vitrified (aluminum oxide or silica carbide), resinoid (plastic), rubber, and shellac (a non-toxic resin secreted by insects).

- *Coated* abrasives are commonly known as sandpaper, sandpaper discs, and sanding belts, although the term is used somewhat loosely and is occasionally used to include some types of bonded abrasives as well.

- Abrasives are also commonly sold in raw or *unbonded* form for such purposes as blasting grit. These materials are sometimes used with water to help remove contaminants from the substrate, to wet the abrasive, and to reduce dispersion of fine particles (dust). These products can be made from coal and mineral slag, glass, plastic and steel.

- *Superabrasives* are abrasives made from only the strongest materials or minerals such as garnet or even diamond. These are highly specialized and expensive products and are used for heavy duty jobs such as compacted rust removal.

The following is a list of broad applications for industrial abrasives used for shaping or finishing surfaces:

Airports
Blasting grit (engine cleaning, surface priming and cleaning, corrosion control, etc.)
Bridges
Buildings
Dams
Grit for snow and ice removal
Highways/roads
Landscaping
Paint and rust removal
Tunnels

2. Rationale for Designation

EPA has concluded that blasting grit made with recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

EPA's preliminary research suggests that the use of recovered materials in industrial abrasive products is already diverting millions of tons of solid waste from the waste stream. For example, according to the American Coal Ash Association, electric utilities produced 2.9 million tons of boiler slag in 1998. Of this amount, 2.1 million tons were re-used as blasting grit and roofing granules. As

noted in the section below, however, there are some issues associated with the use of slag materials as blasting abrasives.

In addition, the use of postconsumer recovered glass in the manufacture of blasting abrasives has the potential to significantly boost demand for recovered glass. One company that manufactures blasting abrasives from recovered glass, for example, has developed a glass processing system capable of handling 5,000 to 10,000 tons of recovered glass per year.

b. Technological Feasibility and Performance

EPA has identified potential issues associated with the use of some recovered materials in industrial abrasives. In particular, there is an emerging body of evidence that documents dangerously high levels of heavy metals in abrasives containing coal and mineral slag materials that may present risks to workers. A study by NIOSH entitled *Evaluation of Substitute Materials for Silica Sand in Abrasive Blasting* reveals high concentrations of heavy metals present in airborne dust from blasting with copper, nickel, and coal slags, as well as several other mineral abrasives. For example, in one test of copper slag abrasives, concentrations of arsenic exceeded 24,000 mg/m3, while the OSHA PEL is 10 mg/m3. In another test of abrasives containing nickel slag, concentrations of chromium were 62 percent higher than the OSHA PEL for chromium. The report goes on to make the following two recommendations (among others):

1.) In order to reduce the airborne concentrations of the eleven hazardous health-related agents, consider the use of crushed glass.

2.) Given the potential exposures to multiple contaminants from both the abrasive as well as the painted surface, worker protection programs should be expanded to address all potential metals (e.g. as opposed to the current focus on worker lead protection programs).

Worker health may not be the only issue at stake regarding the use of slag materials in industrial abrasive products. Another study by the Institute for Environmental Toxicology and Chemistry correlates total metals results from the NIOSH study to U.S. EPA Soil Screening Levels (SSLs) for Migration to Groundwater and points to environmental risks inherent in copper, nickel, and

coal slag abrasives. As the NIOSH report states, however, SSLs are not national cleanup standards and alone do not define unacceptable levels of contaminants in soils. One manufacturer responded to this issue by saying, “SSLs should not be of concern for extremely glassy, inert materials such as coal slag. Instead, what should be looked at is metal leaching data, none of which is presented for coal slag in this report.”

In EPA’s final rule on the Regulatory Determination on Wastes from the Combustion of Fossil Fuels (40 CFR Part 261), which was issued May 22, 2000, the Agency maintained its exemption for fossil fuel combustion wastes under RCRA section 3001(b)(3)(C). In addition, EPA states in the final rule that it did not wish to place any unnecessary barriers on the beneficial use of fossil fuel combustion wastes for applications that conserve natural resources and reduce disposal costs. Therefore, EPA recommends that procuring agencies consider abrasives containing slag materials if appropriate, but that workers using these types of abrasives exercise OSHA or other required standard practices.

The practice of incorporating recovered materials into abrasives is common with some abrasive products, especially blasting grit. For example, to make blasting grit and roofing granules from boiler slag (a recovered material), the material is cooled, crushed, and screened in order to separate out the different grades (particles of different sizes). It is a fairly simple sorting and screening process. In terms of coated and bonded abrasives, however, the practice of incorporating recovered materials into the manufacture of these products has proven to be cost-prohibitive, although one company does incorporate old rags into the manufacture of a few of its coated abrasive products. As previously stated, EPA’s research indicates that many bonded and coated abrasive products are manufactured overseas and do not contain recovered materials.

In terms of performance, two sources indicate there is a commercial preference for abrasives made from nonrecovered materials in the marketplace. In addition, one contact noted that his company doesn't use recovered aluminum oxide to make aluminum oxide grinding wheels because it can be detrimental to product performance.

Regarding the technical feasibility and performance of one of the more promising products, abrasive blasting grit made from recovered, postconsumer glass can be used in most conventional

blasting equipment. To produce glass blasting abrasive products, manufacturers use glass processing equipment such as a feed hopper, crushing mechanism, discharge conveyors, dust control devices, vibratory screens, and trommel screens for control of particle size and debris removal. Complete processing systems cost at least $100,000. Other equipment may be required with more sophisticated systems, depending upon the final product being manufactured.

As a blasting abrasive, glass is lighter and sharper than other materials, so the person operating the blaster must turn the metering valve down and carefully adjust air pressure levels because glass provides more cutting action than most other blasting grit abrasives (therefore less air pressure is needed). Most people using glass set the metering valve as low as possible. If metered down properly, glass blasting grit is an effective product on most materials. It contains no heavy metals and no chloride. Furthermore, glass won't embed, has a very low conductivity and doesn't “beat up” steel; rather, it creates a smooth finish. Other abrasives sometimes require the use of sanding products after blasting because if the finish is rough, paint or coatings do not adhere well and the surface will rust more quickly. In addition, glass blasted surfaces don't “flash rust” as quickly (also known as “blueing”).

According to one contact, the use of glass blasting abrasives can result in the use of 1/3 less product (because of glass’efficient cutting action). In addition, because glass is lighter than competing abrasive blasting grit materials (glass is 80 lbs. per cubic foot; copper slag is 110 lbs. per cubic foot; coal and nickel are 100-105 lbs. per cubic foot), shipping is cheaper with glass. One company that does blasting work in remote areas (such as Alaska) confirmed that this product allows it to blast more surface area with less product and, therefore, reduce shipping costs.

In addition, glass carries no electrical charge. According to one contact, the U.S. Navy found that blasting grit made from copper slag generated too much conductivity, which can disrupt post-blasting paint and other coatings (the conductive charge can draw moisture through and cause "pinholes" and subsequent rust).

Another area of success for glass is its use on aluminum, which, because it is a softer metal, is a challenge for blasting because it shreds easily. Because glass is lighter and more precise, it works well on aluminum and does not damage the surface.

On the other hand, glass blasting grit is not good for extremely thick rust (1/4 inch or greater) or mill scale. In addition, one contact noted that glass blasting grit can generate more dust than other blasting grit materials. While not considered hazardous, glass dust is an abrasive nuisance dust and every consideration should be given to minimizing dust generation during blasting activities. In addition, appropriate personal protective equipment should be worn. A contact at one company used the glass blasting grit product on a limited basis (for stripping and cleaning of superstructure, masts, and aluminum) on the U.S. Coast Guard Cutter *Munro*. While its experience with this product was primarily positive, especially in terms of its blasting capacity, the contact said that the product produced extreme levels of dust. The contact said the product was far dustier than garnet or glass beads (both of these products are manufactured from virgin materials). Work areas had to be staged and shrink-wrapped in plastic to contain the dust clouds. While the manufacturer of this product has acknowledged the potential for increased dust generation, the excess dust in this case may have been due in part to the customer's inexperience with this product (i.e., failure to turn the metering valve down and carefully adjust air pressure levels). Another company said that standard personal protective equipment and dust collection systems are needed with this product when working in a confined space.

One additional possible challenge for glass blasting abrasive manufacturing is that blasting abrasives of any type must be absolutely dust-free, contaminant-free and graded to a certified, consistently statistically verifiable size. For example, minute particles of paper from postconsumer recovered glass bottles can collect during the manufacturing process of glass blasting abrasives and render the final product useless. One manufacturer had to make significant system modifications to overcome this problem.

In certification testing conducted by the California Air Resources Board on glass blasting abrasive products manufactured by one company, the product passed all aspects of the test, including breakdown rate, dust generation, embedment, and rust back. Additional tests were conducted to compare side-by-side performance with two other competing slag abrasive products. Blasting tests were conducted under varied pressures, substrates, coatings, and nozzle sizes. It was determined that the glass blasting abrasive products performed as well as or better than competing slag abrasive products.

Another material, plastic, is being used by at least one manufacturer as blasting grit, although the product in question is manufactured with glass. Blasting abrasives containing plastic work well on metal panels for such tasks as paint, rust, corrosion and dirt removal. The oil industry often uses plastic-based abrasives from cleaning purposes on offshore oil rigs; the autorefinishing industry uses them for paint stripping of automobiles; and the aircraft industry uses them for landing gear/wheel cleaning. Because plastic is a softer abrasive, it doesn't damage softer metals (such as aluminum) or create pit marks. The manufacturer made a point of mentioning that their consistent source of high-quality post-industrial plastic scrap makes manufacturing this product possible. Without this consistent feedstock source, the product would be more difficult and costly to manufacture.

c. Availability and Competition

EPA contacted several manufacturers of specific types of industrial abrasives who either incorporate recovered materials into their products or know of other companies who do. One manufacturer of industrial abrasive products claims that it offers 28 individual abrasive products that incorporate recovered materials into their manufacturing process.

One area of this industry, blasting grit made from recovered postconsumer glass, holds particular promise, as EPA is aware of several companies who undertake this practice.

d. Economic Feasibility

EPA identified some information that would indicate that incorporating recovered materials into some specific types of industrial abrasive products may be cost-prohibitive. One contact in particular noted that his company used to incorporate postconsumer vitrified grinding wheels into its manufacturing process but no longer does so. The used grinding wheels had to be acquired, crushed, and washed before being incorporated into the aluminum oxide manufacturing process. With virgin bauxite, these steps are eliminated. The contact said his company now processes virgin bauxite into aluminum oxide because it has proven to be far more efficient in terms of cost and labor. Another contact said that his company, which manufactures primarily bonded abrasives, said that it is too expensive to incorporate recovered materials into the manufacture of their products.

As noted above, blasting grit commonly contains recovered materials such as slag, but there may be other issues to consider with abrasive products manufactured from coal and mineral slag, such as potential health risks to workers.

One product in particular, blasting grit made from recovered glass, appears to be very cost competitive, both in terms of manufacturing (although the process is not always trouble-free; see above) and use. In terms of use, for example, a company could realize a 200 to 400 percent savings by using glass to blast an aluminum surface (as opposed to soda, aluminum oxide, or garnet, which are the only other materials that don't damage aluminum surfaces). The cost of manufacturing blasting grit from recovered glass is, of course, somewhat higher than the cost of "manufacturing" sand. These costs are reflected in the price of glass blasting grit; while sand commonly sells for between 2 to 5 cents per pound (depending on quality), blasting grit manufactured from recovered glass can range from 4 cents per pound for container glass to 6 to 9 cents per pound for plate glass (note: these are distributor prices; retail prices would be 2 to 3 cents higher plus freight).

One company manufactures a product which contains 80 percent plastic and 20 percent glass. The plastic is 100 percent urea- or melamine-based manufacturing scrap (primarily postindustrial scrap from the manufacture of plastic dinnerware and toilet seats); the glass is 100 percent postconsumer container glass. As previously mentioned, the manufacturer made a point of mentioning that its consistent source of high-quality postindustrial plastic scrap makes manufacturing this product possible. Without this consistent feedstock source, the product would be more difficult and costly to manufacture. The contact also noted that it would cost significantly more to manufacture this product using virgin plastic materials.

e. Government Purchasing

Federal, state, and local governments purchase large amounts of industrial abrasive products, but EPA was unable to obtain figures on actual amounts purchased. A recent search of the *Commerce Business Daily's* online database turned up six active awards for contracts for the purchase of industrial abrasives (all military agencies), including two contracts for black beauty (copper slag), two for unspecified types of industrial abrasives, one for garnet, and one for walnut shells. In addition, a

search of the Defense Logistics Agency's Federal Logistics Information System's database (http://www.dlis.dla.mil/online.htm) identified 62 types of abrasive products currently being purchased by the armed services alone. Judging by this information, it is apparent that the federal government in particular procures a vast amount of industrial abrasives containing various types of recovered materials, primarily for blasting purposes. In addition, abrasives are also often purchased by contractors for work done on government property. In these cases, the contractor determines what types of materials are appropriate for the given application.

During interviews with several manufacturers, EPA determined that specific types of industrial abrasives with recovered materials are currently being purchased and used by the following government agencies: all branches of the U.S. military, the Army Corps of Engineers, the Tennessee Valley Authority, the National Aeronautics and Space Administration, and several state departments of transportation.

f. Barriers to Purchasing

To date, EPA is not aware of any barriers that might preclude the purchase of industrial abrasives containing recovered materials. The predominant military specification for abrasive blasting material used in military ship cleaning, however, sets strict limits on the amount of certain toxic materials that can be present in any blasting abrasive. The specification states, "Inorganic abrasives have set limits for toxic metal content and radioactivity and meet Environmental Protection Agency hazardous waste requirements." This language would pertain primarily to abrasive products that are manufactured from coal or mineral slag (see section 2b).

g. Designation

EPA proposes to designate industrial abrasives containing recovered aluminum, coal and metal slag, and glass. A final designation would not preclude a procuring agency from purchasing industrial abrasives manufactured from another material. It simply requires that a procuring agency, when purchasing aluminum, coal and metal slag, or glass industrial abrasives, purchase these items made with recovered materials when these items meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

EPA found only limited information about the levels of recovered materials content in abrasive products. Based on this research, the application often determines whether or not recovered materials can be used. One contact indicated a commercial preference for abrasive products that do not incorporate recovered materials, as does comment #CPGN-L0003 (submitted by the Utility Solid Waste Activities Group, the Edison Electric Institute, the American Public Power Association, and the National Rural Cooperative Association on September 20, 1995, pertaining to the viability of incorporating coal combustion byproducts into commercial applications). Furthermore, the commentor pointed out that abrasive products made from some recovered materials, such as coal-combustion byproducts, can present a health risk if not applied with the appropriate personal protective equipment because they contain heavy metals.

In terms of the binding materials used in bonded abrasives (such as grinding wheels), EPA's research indicates that the use of recovered materials in fixing agents and substrates for these products is technically possible, but has proven cost-prohibitive for companies that have tried to incorporate recovered materials into the manufacture of these products. Based on the results of this research, bonded abrasives may not be readily available with recovered materials and therefore, this item is not being considered for designation at this time.

In terms of coated abrasives (i.e., sandpaper and sand discs), EPA is aware of one company that incorporates recovered fibers in the manufacture of coated abrasives. Additional research conducted by EPA indicates that many coated abrasive products are manufactured overseas, and do not contain recovered materials. Based on the results of this research, coated abrasives may not be readily available with recovered materials and therefore, this item is not being considered for designation at this time.

In terms of blasting grit, EPA is aware of several companies that manufacture blasting grit from recovered glass. In addition, several companies also manufacture blasting grit from other

recovered materials, including copper and nickel slag, but the safety of blasting grit products containing slag is uncertain (see Technical Feasibility and Performance section below).

Minerals and Gems

As mentioned above, certain abrasives are made from minerals and gems (e.g., garnet and diamond) for specific, heavy-duty applications. Because of the need for the hardest of materials in superabrasives, these specialized, virgin resource-based products do not incorporate recovered materials.

Metals

Many abrasives are derived from metal products such as steel grit, and steel and iron shot. According to one contact, recovered aluminum oxide is used as filler material by some companies to make #27 aluminum oxide grinding wheels (widely used in the auto-refinishing industry). However, EPA was not able to confirm this information as the contact could not reference a company currently incorporating this practice. Companies contacted to date denied using recovered aluminum oxide or even straight recovered aluminum for this product, except for one. The contact there said that until a year ago, they incorporated used (i.e., recovered) vitrified grinding wheels obtained from other companies into their manufacturing process, but no longer do so. The contact said his company now processes virgin bauxite into aluminum oxide because it has proven to be cheaper and more efficient.

The same contact said that while his company does not manufacture any products that contain recovered materials, it does send its waste material (such as used grinding wheels, which are crushed and sold to asphalt companies for use as aggregate or to aluminum oxide furnace plants to make a number of products) to be recycled. This contact also said that resin grinding wheels, which are made with a non-abrasive “center” or substrate, can incorporate recovered (preconsumer) dust collector fines (aluminum oxide), which are small metal particles or shavings created at the end of the grinding wheel manufacturing process, when the wheel is shaped and sized.

Furthermore, another contact who has worked in the industry for 45 years said he has never heard of anyone using recovered material to manufacture grinding wheels. He said that technically,

using recovered aluminum oxide to manufacture grinding wheels is possible, but it would add several steps to the manufacturing process which would make it cost-prohibitive. He said currently that there is no equipment available to recover postconsumer aluminum oxide abrasive products, although straight recovered aluminum could conceivably be incorporated into the aluminum oxide manufacturing process. Another contact said that his company investigated the possibility of using recovered aluminum oxide wheels in the manufacture of new wheels several years ago, but abandoned their efforts when the process proved to be too costly.

EPA's research indicates that the use of recovered materials in the grinding wheel manufacturing process is not a widespread practice because of cost concerns.

Another contact noted that copper and nickel slag (both recovered materials) are used by many companies to make blasting grit abrasives. The contact, however, could not name any companies. To date, EPA has identified one overseas company based in the United Arab Emirates, that manufactures blasting grit from copper slag. The source of the copper slag is a company in Japan, one of the largest producers of copper in the world. EPA has not been able, however, to identify any U.S. companies that manufacture abrasives from copper or nickel slag, possibly because of the potential health risks presented by abrasive products containing slag materials (see Technical Feasibility and Performance section below).

In addition, EPA is aware of a few companies who sell blasting grit made from steel shot. Depending on whether the steel shot is produced by the basic oxygen furnace or electric arc furnace method, the steel used in blasting grit could contain 25 to 100 percent recovered steel, including 16 to 67 percent postconsumer steel.

Glass

Glass is emerging as a promising blasting grit material that can effectively and efficiently incorporate postconsumer materials. Although glass is gaining acceptance as a blasting and surface preparation media, its market share is still relatively small. Glass blasting grit is a "low-end" blasting abrasive; its applications include rust and debris removal on bridge, dam, and marine projects. Glass is

particularly effective on aluminum, which, because it is a softer metal, is a challenge for blasting (it shreds easily). But because glass is lighter and more precise, it works well on aluminum and does not damage the surface.

One company in particular makes a blasting grit product from 100 percent postconsumer container and plate glass, which are collected through curbside recycling programs. Plate glass tends to be more dusty, harder, and brittle than container glass and thus, is used less frequently. According to the manufacturer, its blasting grit can be used for up to 75 percent of all blasting applications.

Several other companies are currently using postconsumer or recovered glass to make blasting grit material. One company manufactures and is beginning to market a product that combines both 100 percent postconsumer recovered container glass and recovered plastic.

Coal Combustion By-Products (Boiler Slag and Bottom Ash)

Boiler slag abrasives consist of fused ferro-alumino-silicates that are formed when molten coal slag is quenched in cold water. As an industrial abrasive, boiler slag can be used in a variety of applications such as surface cleaning and paint and rust removal. It is a relatively heavy material and can also be used for more difficult, heavy-duty blasting projects and surface preparation. According to comment #CPGN-L003, industrial abrasives made from boiler slag commonly contain 100 percent recovered materials, but no postconsumer materials. According to the American Coal Ash Association (ACAA), more than 2.1 million metric tons of boiler slag were used to make blasting grit and roofing granules in 1998, making it the number one or number two (silica sand may be higher; statistics for sand were unavailable) blasting abrasive used in the U.S. by weight. Coal slag is widely accepted as a cost-effective abrasive.

According to comment # CPGN-L0003, bottom ash can also be used as a light-to-medium-duty blasting grit. According to the American Coal Ash Association (ACAA), 220,914 metric tons of fly ash were used to make blasting grit and roofing granules in 1998. While several companies manufacture blasting grit from coal combustion by-products, the safety of blasting grit products containing these materials is currently uncertain (see Technical Feasibility and Performance section below).

Copper and Nickel Slag

Another popular product on the market, known as "black beauty," is manufactured from copper slag. This product is versatile, performs well, and is relatively inexpensive. While several companies manufacture blasting grit from copper and nickel slag, the safety of blasting grit products containing slag is currently uncertain (see Technical Feasibility and Performance section below).

Cotton Fiber

According to one manufacturer, coated abrasive products (primarily discs) can include fiber that is recovered from old rags.

Plastic

According to one manufacturer, certain recovered plastics can be used to manufacture blasting grit, either by itself or combined with glass. Plastic abrasives are a specialized, small niche market. As previously mentioned, one company manufactures and is beginning to market a product that combines both 100 percent postconsumer recovered container glass and postindustrial recovered plastic (urea- and melamine-based).

Table 27 presents information provided by manufacturers of blasting grit on recovered content availability.

Table 27
Recovered Material Content of Blasting Grit

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Glass	Company C: 100 Company D: 100 Company E: unknown	100 100 unknown
Plastic/Glass	Company F: 20	100 (80/20)
Coal Slag	Company B: 0	100
Miscellaneous	Company A: unknown	unknown

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 28, procuring agencies establish minimum content standards for use in purchasing blasting grit.

Table 28
Draft Recovered Materials Content Recommendations for Blasting Grit

Material	Postconsumer content (%)	Total recovered materials content (%)
Steel	16 - 67	25 - 100
Coal Slag	–	100
Copper and Nickel Slag	–	100
Glass	100	100
Glass/Plastic	20	100
Walnut Shells	–	100

Notes: A final designation would not preclude a procuring agency from purchasing blasting grit manufactured from another material. It simply requires that a procuring agency, when purchasing blasting grit made from steel, coal and metal slag, glass, plastic, or walnut shells, purchase this item made with recovered materials when it meets applicable specifications and performance requirements.

The recommended recovered materials content levels for steel in this table reflect the fact that the designated item can contain steel manufactured in either a Basic Oxygen Furnace (BOF) or an Electric Arc Furnace (EAF). Steel from the BOF process contains 25% - 30% total recovered steel, of which, 16% is postconsumer steel. Steel from the EAF process contains a total of 100% recovered steel, of which, 67% is postconsumer steel. In addition, blasting grit can be made from a combination of BOF and EAF steel which, according to industry sources, would result in a steel with 25% - 85% total recovered steel content, of which 16% - 67% would be postconsumer steel.

c. Specifications

There are a variety of industry standards pertaining to industrial abrasives. Two organizations in particular, the Society for Protective Coatings (SSPC) and ASTM have issued industry standards that may warrant consideration, as follows:

Applicable SSPC Standards (Note: the SSPC standards are more broad-based and are thus, more pertinent than the ASTM standards.)

Industrial Blast Cleaning Standard (SSPC-SP 14/NACE No. 8, 7/99)
Wet Abrasive Blast Cleaning (SSPC-TR 2/NACE 6G198, 10/99)
Newly Manufactured or Re-Manufactured Steel Abrasives (SSPC-AB 3, 10/99)

Applicable ASTM Standards

Standard Guide for Metallic Abrasive Blasting to Descale the Interior of Pipe (F1330-91, 1996)
Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives (D4940-98)

IX. ITEMS BEING CONSIDERED FOR FUTURE DESIGNATION

EPA has begun researching and gathering information on the following items. EPA requests information on these items, especially information on recovered content levels and any specifications or standards that might exist for each item.

Asphalt
Building blocks
Computers/Electronics
Door frames, window frames, and trim
Off-set guardrail blocks
Railroad cross-ties
Recycled ink

X. DESIGNATED ITEM AVAILABILITY

EPA has identified a number of manufacturers and vendors of the items proposed for designation. Once the item designations become final, these lists will be placed in the RCRA docket for this action and will be posted on EPA's Web site at <www.epa.gov/cpg>. They will be updated periodically as new sources are identified and product information changes. Procuring agencies should contact the manufacturers and vendors directly to discuss their specific needs and to obtain detailed information on the availability and price of recycled products meeting those needs.

Other information is available from the GSA, DLA, State and local recycling offices, private corporations, and trade associations. Refer to Appendix II of this document, for more detailed information on these sources of information.

XI. ECONOMIC IMPACT ANALYSIS

Details of the economic impact of CPG IV are described in the document entitled *Economic Impact Analysis for the Proposed Comprehensive Procurement Guideline IV,* EPA530-R-01-008, which is included in the RCRA Docket for CPG IV.

XII. SUPPORTING INFORMATION

"Environmental Fact Sheet: Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 1998," U.S. EPA, April 2000.

"Introduction to the Office Products Industry," The Business Products Industry Association, 1998.

"The Official Recycled Products Guide," Recycling Data Management Corporation, 1998.