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Background Document for Proposed CPG III and Draft RMAN III

BACKGROUND DOCUMENT FOR PROPOSED CPG III AND DRAFT RMAN III

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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 12873 (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 annually 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. Today, in CPG III, EPA is proposing to designate the following 19 additional items:

Construction Products
Nylon carpet with backing containing recovered materials
Carpet cushion
Flowable fill
Railroad grade crossing surfaces

Park and Recreation Products
Park benches and picnic tables
Playground equipment

Landscaping Products
Food waste compost
Plastic lumber landscaping timbers and posts

Non-Paper Office Products
Solid plastic binders
Plastic clipboards
Plastic file folders
Plastic clip portfolios
Plastic presentation folders

Miscellaneous
Absorbents and adsorbents
Awards and plaques
Industrial drums
Mats
Non-road signs, including sign supports and posts
Manual-grade strapping

B. Contents of These Supporting Analyses

This document, hereafter referred to as the proposed CPG III/Draft RMAN III 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 III. In addition, the proposed CPG III/Draft RMAN III 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
ACAA	American Coal Ash Association
ACI	American Concrete Institute
ACR	Association of Container Reconditioners
AF&PA	American Forest and Paper Association
ANSI	American National Standards Institute
APC	American Plastics Council
APP	Affirmative Procurement Program
APWA	American Public Works Association
ARTBA	American Roads and Transportation Builders Association
ASTM	American Society for Testing and Materials
BOF	Basic Oxygen Furnace
C&D	Construction and Demolition Debris
CCC	Carpet Cushion Council
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CLSM	Controlled Low-Strength Material
COAP	Coalition for Absorbent Producers
CPG	Comprehensive Procurement Guideline
CPSC	U.S. Consumer Product Safety Commission
DLA	Defense Logistics Agency
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation

Acronym	Term
DRMO	Defense Reutilization Marketing Office
EAF	Electric Arc Furnace
EPA	U.S. Environmental Protection Agency
FDA	Food and Drug Administration
FHWA	Federal Highway Administration
FR	Federal Register
FRA	Federal Railroad Administration
GPO	U.S. Government Printing Office
GSA	U.S. General Services Administration
HDPE	High Density Polyethylene
HSWA	Hazardous and Solid Waste Amendments of 1984
HUD	U.S. Department of Housing and Urban Development
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
IV	Inherent Viscosity
LDPE	Low Density Polyethylene
LLDPE	Linear Low Density Polyethylene
MAC	Multiple Awards Contract
MSW	Municipal Solid Waste
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NPS	National Park Service
OFPP	Office of Federal Procurement Policy
OSHA	Occupational Safety and Health Administration
PDI	Plastic Drum Institute
PE	Polyethylene

Acronym	Term
PET	Polyethylene Terephthalate
PLTA	Plastic Lumber Trade Association
PP	Polypropylene
PS	Polystyrene
PSI	Pounds Per Square Inch
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act of 1976
RIC	RCRA Information Center
RMAN	Recovered Materials Advisory Notice
RPG	Recycled Products Guide
SCAA	Spill Control Association of America
SCBA	Self-Contained Breathing Apparatus
SMS	Spunbonded-Meltblown-Spunbonded
SRI	Steel Recycling Institute
SSCI	Steel Shipping Container Institute
TxDOT	Texas Department of Transportation
UN	United Nations
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USPS	U.S. Postal Service
UV	Ultraviolet
VOC	Volatile Organic Compound

II. BACKGROUND

A. Requirements

The Resource Conservation and Recovery Act (RCRA or the Act) section 6002 and Executive Order 12873 (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 annually 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, and Appendix IV briefly discusses additional Federal procurement policies and requirements.

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 III should be completed within 1 year after the final CPG III 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 12873

Executive Order 12873, *Federal Acquisition, Recycling, and Waste Prevention*, was signed by President Clinton on October 20, 1993. 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 at 40 CFR Part 247. The Executive Order requires EPA to update the CPG annually.

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 *Federal Register* 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.

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 III have all been evaluated with respect to EPA's criteria. Details of these evaluations are discussed in Sections V through IX of this document.

1. Use of Materials Found in Solid Waste

All items designated in CPG III 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 III.

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 believes 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 IX 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 believes 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 IX 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 IX 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 III, 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 IX 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 IX 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:

1. 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)?

CPG III proposes to designate some of the items recommended in the public comments on the September 1995 FR notice.

After EPA conducted additional product research, the information was presented to an interagency work group composed of individuals representing major Federal procuring agencies. The work group members identified additional items to be considered for designation, based on their experiences developing product specifications, their knowledge of the marketplace, and their respective agencies' procurement practices. The work group reviewed the available information and prioritized the products into several

categories: (1) products that EPA should propose for designation in CPG III, (2) products that might be designated in the near future pending receipt of additional information and further review, and (3) products that EPA cannot propose for designation because of limited availability, unreasonable price, negligible effects on the waste stream, or the current inability of manufacturers to produce the items with recovered materials content.

Items proposed for CPG III designation are described in detail in sections V through IX of this document. Those items that will be considered for designation at later date are presented in section X.A, and those items that cannot be proposed for designation at this time are discussed in section X.B, along with a brief explanation of the basis for this determination.

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, non-paper 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. No paper products are included in CPG III.

- **Vehicular Products.** Products used in repairing and maintaining automobiles, trucks, and other vehicles. Examples include re-refined lubricating oils, retread tires, and engine coolants. No vehicular products are proposed for designation in CPG III.

- **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 III, EPA is proposing to designate carpet backing, carpet cushion, flowable fill, and railroad grade crossing surfaces 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 III.

- **Park and Recreation Products.** Products used in operating and maintaining parks and recreational areas. Examples include playground equipment and running tracks. In CPG III, EPA is proposing to designate park and recreational furniture, specifically, park benches and picnic tables, and playground equipment in the park and recreation products category.

- **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. In CPG III, EPA is proposing to designate food waste compost and plastic lumber landscaping timbers and posts in the landscaping products category.

- **Non-Paper 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 III, EPA is proposing to designate plastic binders, clipboards, file folders, clip portfolios, and presentation folders in the non-paper office products category.

- **Miscellaneous Products.** Includes all other products not covered by the categories listed above. In CPG III, EPA is proposing to designate absorbents and adsorbents, awards and plaques, industrial drums, mats, signage, and strapping 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.

V. CONSTRUCTION PRODUCTS

A. Carpet Backing

1. Item Description

Carpet backing is a layer of woven or nonwoven material used to hold carpet fibers in place and provide structural support. Carpet backing differs depending on how the carpet is constructed. Approximately 90 to 95 percent of all carpet manufactured in the United States is called broadloom (or “roll carpet”) and is constructed in the following manner: carpet fibers (nylon, polyester, wool, etc.) 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 materials, the secondary backing, is then applied to the primary backing to provide stability. The secondary backing is also usually made of PP, although it can also be made of jute.

The remaining 5 to 10 percent of carpet manufactured in the United States is carpet squares or tiles. They 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 in office settings, and can offer more flexibility than broadloom carpet. Individual tiles can be replaced when they become worn. According to one manufacturer, the backing on this type of carpet is the single heaviest component of the carpet, typically constituting two to four times more weight than the face yarn.

Some manufacturers also adhere carpet cushion to the back of carpet (rather than installing carpet over a separate cushion). Manufacturers refer to this cushion as backing and use such terms as "cushion back" or "foam back." This research distinguishes carpet cushion from carpet backing; carpet cushion is discussed in Section V.B of this document.

2. Rationale for Designation

EPA believes that nylon carpet tiles and broadloom carpet made with backing containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Recovered content vinyl carpet backing is made of postconsumer carpets. As shown in Appendix I, plastic is a significant component of the solid waste stream.

According to one manufacturer, 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 materials. About 2 pounds of recovered materials, therefore, are used in each square yard of this manufacturer's carpet tiles. If a government agency purchased 1,000 square yards of the carpet tiles with recovered-content backing, approximately 2,000 pounds of materials would be diverted from the waste stream.

b. Technological Feasibility and Performance

According to the company, recovered-content vinyl carpet backing performs as well as virgin vinyl backing and meets the company's performance specifications. Carpet manufactured by this company with recovered-content backing comes with a 15-year warranty. As this product was only made commercially available in December 1996, EPA has not been able to identify any users of the recovered-content backing. The company is marketing its product in unspecified trade and government publications.

c. Availability and Competition

EPA did not identify any manufacturers or distributors of broadloom carpet with recovered-content backing. Carpet tiles with recovered-content vinyl backing are currently available from one company that distributes its products nationwide. It is anticipated that other manufacturers could enter the marketplace in 1997. The company bids larger government projects directly but relies on its distributor network for smaller projects.

d. Economic Feasibility

Carpet tiles with recovered-content vinyl backing are cost-competitive with carpet tiles manufactured with virgin vinyl backing. Carpet tiles, however, are generally more expensive than broadloom carpet, because they are sturdier and are designed to last longer.

e. Government Purchasing

EPA assumes that virtually all government agencies purchase carpet. Because carpet tiles are generally used in office settings, EPA also assumes that some government agencies buy carpet tiles. EPA is still attempting to determine to what extent government agencies buy carpet tiles as opposed to broadloom carpet, considering that carpet tiles are often more expensive than broadloom carpet.

EPA learned that one manufacturer has been working with the U.S. General Services Administration (GSA) to place its carpet tiles with recovered-content backing on GSA's carpet schedule (Schedule 72, Part 1, Section A). This company indicated that GSA's current specification for recovered-content carpet applies only to carpet made with recovered-content polyester fibers. A GSA representative stated that the product should be available on the carpet schedule by mid-June 1997. The company also stated that the state of Florida has purchased its carpet through the state's SNAPS program, a special purchase schedule that provides early introduction of recycled-content, energy-efficient, and other environmental products.

f. Barriers to Purchasing

The higher cost of carpet tiles compared to other types of carpet might be a purchasing barrier for carpet tiles with recovered-content vinyl backing. EPA did not identify any other barriers to purchasing carpet tiles with recovered-content vinyl backing.

g. Designation

EPA proposes to designate nylon carpet (broadloom and tiles) made with backing containing recovered materials. A final designation would not preclude a procuring agency from purchasing broadloom carpet or carpet tiles made from other materials, such as wool. It simply requires that a procuring agency, when purchasing nylon carpet tiles or nylon broadloom carpet, purchase these items with backing containing recovered materials when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

EPA contacted two manufacturers of woven PP primary and secondary backings. One of these manufacturers had submitted a comment to EPA, stating it is "technologically and economically infeasible to manufacture carpet backing with recycled PP at this time." The manufacturer went on to state, "Extrusion of recovered polymer for carpet backing purposes would result in such production problems as draw breaks, slow holes, higher waste generation, and lower yields. One consequence of such production difficulties is a higher unit cost for the end product." The company continues to attempt to use recovered materials in its backing, however.

Another manufacturer of woven PP backings is also not using recovered materials in carpet backing due to the difficulty of removing impurities from recovered materials.

EPA identified one carpet manufacturer that is manufacturing carpet tiles with recovered-content PVC backing for use in commercial settings. The company manufactures the PVC backing using postconsumer materials from old carpets. This manufacturer recovers 100 percent of the carpet it brings back and does not need to separate the carpet into its component parts in order to recover the materials. The company estimates that its recovered-content carpet backing contains 75 percent postconsumer materials. The recycled-content carpet backing has the same performance characteristics as virgin backing

and comes with a 15-year warranty. It is cost-comparable to virgin carpet backing as well. The company plans to make roll carpet with the recovered-content backing commercially available sometime in 1997. Also, the company hopes to offer roll carpet with recovered-content cushion backing in 1998.

Although EPA did not identify any other carpet tile manufacturers currently using a significant portion of recovered materials in their vinyl backing, some companies are experimenting with using recovered materials in vinyl backing. One company, for example, stated that it is currently testing a small amount (less than 10 percent) of in-house scrap and postconsumer materials in its hard vinyl backing. The company is using only a small amount of postconsumer backing due to the difficulties of separating used carpet backing from the face fibers. Another company stated that it had previously ground postconsumer carpet to use in a variety of products, including carpet backing. The equipment used to grind the carpet was destroyed in a recent fire, however. As a result, the company is currently using only in-house scrap materials in its vinyl carpet backing. The company plans to be back on line grinding postconsumer carpets in a year.

Table 2 presents information provided by manufacturers of carpet backing on recycled content availability.

Table 2

Recovered Materials Content of Carpet Backing

Material	**Postconsumer Content (%)**	**Total Recovered Materials Content (%)**
PVC	Company A: 75 Company B: <5	Unknown <10

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 3, procuring agencies establish minimum content standards for use in purchasing carpet backing.

Table 3

Draft Recovered Materials Content Recommendations for Backing for Nylon Broadloom and Carpet Tiles

Material	Postconsumer content (%)	Total recovered materials content (%)
Old carpets	35-70	100

c. Specifications

EPA is not aware of any performance specifications for carpet backing.

B. Carpet Cushion

1. Item Description

Carpet cushion, also known as carpet underlay, is padding placed beneath carpet. According to the Carpet Cushion Council (CCC), carpet cushion improves the acoustical and thermal insulation properties of carpet, reduces the impact caused by foot traffic or furniture indentation, enhances comfort, and prolongs appearance. It is available in a variety of thicknesses—the most common being ¼- and ½-inch—and is used in both residential and commercial settings, although it appears to be less common in commercial settings. Carpet cushion can be sold separately or preattached to the carpet. Carpet can also be installed without any cushioning. Carpets with preattached cushions are referred to as "cushion back" or "foam back" carpets. Approximately 20 percent of commercial carpet sold has a preattached cushion. The remainder of this report focuses on separate, nonattached cushion.

Carpet cushions can be made from three large categories of materials: polyurethane foam, fiber, and rubber. A variety of materials within each of these categories can be used to make carpet cushion, as shown in Table 4.

Table 4

Materials Used in Carpet Cushion

Category	Material Type
Polyurethane Foam	Prime
	Grafted prime
	Densified prime
	Bonded*
	Mechanically frothed
Fiber	Hair
	Jute*
	Synthetic fibers*
Rubber*	Flat rubber
	Rippled rubber

* Can be made with recovered materials.

Of these materials, cushions made from bonded urethane, synthetic fiber, and rubber can be made from recovered materials. In addition, some jute cushions can contain recovered materials. Preattached carpet cushion is generally made of polyurethane foam. EPA is not aware of any manufacturers currently using recovered materials in preattached carpet cushion. EPA identified one manufacturer that plans to offer carpet with preattached recovered-content cushion backing in 1998.

Bonded urethane is a multicolored conglomeration of scraps. According to the CCC, about 70 percent of all bonded urethane is made from recovered materials. The postconsumer content ranges from 15 to 50 percent, with 15 percent being the most common percentage. The postconsumer source is old carpet cushion. Although manufacturers must use different machinery to make bonded urethane cushions, some make both bonded and prime urethane cushions. Synthetic fiber cushions are made from 100 percent recovered scrap from the carpet fabrication process or purchased from processors. Manufacturers are unable to use postconsumer fibers because they contain latex, which manufacturers are unable to separate from the fibers to make the cushion. Synthetic fiber cushion manufacturers do not use virgin fiber because it is prohibitively expensive. Rubber carpet cushions are manufactured from postconsumer rubber from

old tires. They contain 60 to 90 percent postconsumer rubber. EPA also identified one manufacturer making jute carpet cushions from postconsumer burlap. They contain 40 percent postconsumer jute.

The CCC estimates that 700 million square yards of carpet cushion are sold each year by 32 manufacturers. EPA identified 12 manufacturers of recycled-content carpet cushion and contacted seven of them. EPA was unable to determine the percent of carpet cushion production that is virgin or recycled.

2. Rationale for Designation

EPA believes that carpet cushion containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Recovered content carpet cushions are made of postconsumer urethane, recovered synthetic fiber, and rubber from old tires. Two manufacturers indicated that their 100 percent recovered-content synthetic fiber cushions weigh from 18 to 40 ounces per square yard. The majority of this weight consists of the fibers. Therefore, if Federal agencies bought 10,000 square yards of carpet cushion, they would divert 1,125 to 2,500 pounds of material from the waste stream. In addition, a manufacturer of bonded urethane cushions stated that its cushions weigh from 3 to 8 pounds per cubic foot. Federal agencies purchasing 10,000 cubic feet of bonded urethane cushions would therefore divert 30,000 to 80,000 pounds of urethane scrap from the waste stream. A manufacturer of postconsumer rubber carpet cushions stated that 3 square yards of cushion can be made from one used tire. Agencies purchasing 10,000 square yards of rubber cushion would divert 3,333 tires from the waste stream. Appendix I details the generation and recovery of polyurethane, fiber, and rubber in MSW.

b. Technological Feasibility and Performance

Manufacturers indicated that their recycled-content carpet cushions perform as well as virgin cushions in terms of cushioning and durability and meet standards set by the Carpet and Rug Institute and the CCC. These standards include requirements for density, thickness, tensile strength, and elongation.

Resistance to flammability is not a requirement for carpet cushion in national building codes. Commercial carpet cushion standards differ depending on whether the cushion is Class 1, 2, or 3. Class 1 cushions are used for moderate traffic areas such as conference rooms and executive offices. Class 2 cushions are used for heavy traffic areas such as clerical areas and corridors. Class 3 cushions are used for extra heavy traffic areas such as lobbies and cafeterias. Recovered-content carpet cushions perform well regardless of whether the carpet is made of nylon, wool, or polyester fibers and are available in a variety of thicknesses. Two manufacturers also stated that their recycled-content cushions meet specifications set by the U.S. Department of Housing and Urban Development (HUD). EPA obtained copies of the CCC and HUD specifications; neither appears to prohibit the use of recovered materials in carpet cushions. Both specifications include the above requirements for bonded urethane, rubber, and synthetic fiber cushions.

c. Availability and Competition

EPA identified 12 companies that manufacture recycled-content carpet cushion. They are located throughout the country, and their products are available through distributors nationwide.

d. Economic Feasibility

One manufacturer indicated that its carpet cushions were 10 percent less expensive than cushions containing virgin materials. Another indicated that their cushions were priced competitively with virgin cushions.

e. Government Purchasing

GSA offers four different types of cushion on its carpet schedule: rubber, urethane, natural fiber (e.g., hair and jute), and synthetic fiber cushions. During the 5-year period between October 1992 and May 1997, government agencies spent approximately $1,072,091 on carpet cushion. The GSA representative stated that many government agencies do not use cushion or buy carpet with preattached cushion. GSA's current carpet cushion specifications do not include requirements for postconsumer content, although GSA's representative stated the schedule does include bonded urethane cushion, which is made from fabrication scrap. GSA expressed interest in learning of manufacturers of recovered-content rubber carpet cushion.

HUD has installed 100 percent recovered content carpet cushion in approximately 25 percent of its executive office suites, although the representative contacted was not aware of the total quantity of recovered content cushion purchased. The agency has been using recovered content cushion since 1986. The state of Florida also has installed 100 percent recovered content carpet cushion. The state specification for carpet cushion does not preclude the use of recovered materials; in fact, the state has approved one brand of recovered content cushion.

f. Barriers to Purchasing

EPA did not identify any barriers to purchasing carpet cushions containing recovered materials.

g. Designation

EPA proposes to designate carpet cushion made from bonded polyurethane, jute, synthetic fibers, or rubber containing recovered materials. A final designation would not preclude a procuring agency from purchasing carpet cushion made from other types of materials, such as prime polyurethane foam. It simply requires that a procuring agency, when purchasing bonded polyurethane, jute, synthetic fiber, or rubber carpet cushion, purchase this item containing recovered materials when it meets applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Recovered content carpet cushions made from postconsumer rubber contain 60 to 90 percent postconsumer rubber from old tires. Synthetic fiber cushions contain 85 to 100 percent recovered materials. Bonded polyurethane cushions contain 15 to 50 percent postconsumer polyurethane.

Table 5 presents information provided by manufacturers of carpet cushion on recycled content availability.

Table 5

Recovered Materials Content of Carpet Cushion

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Synthetic Fiber	Company A: Unknown	85
	Company B: 100	Unknown
	Company C: Unknown	100
	Company D: 10	90
Bonded Polyurethane	Company E: Unknown	Unknown
	Company F: Up to 20	Up to 70
Rubber	Company G: 65 - 80	Unknown
	Company H: 92	Unknown
	Company I: 80	Unknown
Jute	Company J: 40	Unknown
Unknown Plastic	Company K: Unknown	80

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 carpet cushion.

Table 6

Draft Recovered Materials Content Recommendations for Carpet Cushion

Product	Material	Postconsumer content (%)	Total recovered materials content (%)
Bonded polyurethane	Old carpet cushion	15-50	15-50
Jute	Burlap	40	40
Synthetic fibers	Carpet fabrication scrap	--	100

Product	Material	Postconsumer content (%)	Total recovered materials content (%)
Rubber	Tire rubber	60-90	60-90

c. Specifications

EPA is not aware of any performance specifications for carpet cushion.

C. Flowable Fill

1. Item Description

In response to the September 20, 1995, request for information, EPA received a number of comments about flowable fill. The American Coal Ash Association (ACAA) maintains that flowable fill made with coal fly ash should be designated in the CPG. The use of coal fly ash in flowable fill has proven to be technically feasible, environmentally sound, and cost-effective in areas of the country where coal fly ash is available. In addition, it has become so widely accepted in highway construction projects that the ASTM and more than 20 states have developed testing methods and specifications for its use. Flowable fill containing spent foundry sand has been used successfully in several state demonstration projects and efforts to develop specifications for its use.

Flowable fill is a low strength material that is mixed to a wet, flowable slurry and is used as an economical fill or backfill material. Flowable fill is also designed to support traffic without settling and yet have the ability to be readily excavated. It is usually a mixture of coal fly ash, water, a coarse aggregate (such as sand), and portland cement. Flowable fill flows like a liquid (similar to a watery milkshake), sets like a solid, is self-leveling, and requires no compaction or vibration to achieve maximum density. For some mixes, an optional filler material, such as spent foundry sand, coal bottom ash, or quarry fines, is added. Flowable fill can take the place of concrete, compacted soils, or sand commonly used to fill around pipes or void areas.

Other names for flowable fill include: flowable mortar, controlled low-strength material (CLSM), lean mix backfill, lean fill, controlled density fill, unshrinkable fill, flowable fly ash, hydraulic cement, low strength slurry backfill, flowable backfill, and flowable grout. Applications for flowable fill include:

- Backfill:
  - —Sewer trenches
  - —Utility trenches
  - —Building excavations
  - —Bridge abutments
  - —Conduit trenches

- Structural Fill:
  - —Foundation subbases
  - —Sub footing
  - —Floor slab bases
  - —Pipe bedding

- Other uses:
  - —Filling abandoned wells
  - —Filling abandoned sewers and manholes
  - —Abandoned underground storage tanks
  - —Voids under existing pavement
  - —Retaining wall backfill.

EPA considered the two primary recovered materials used in flowable fill, coal fly ash and spent foundry sand.

Coal Fly Ash

Coal fly ash is a byproduct of burning coal to generate electricity. Flowable fill can be made with two types of coal fly ash: Class F or Class C. Class F fly ash has a lime content of less than 10 percent. Large amounts of Class F fly ash serve primarily as an aggregate in cementitious construction mixes. Burning anthracite or bituminous coal, which is found primarily in the eastern United States, produces Class F fly ash. Ready mix concrete producers in the eastern United States have access to, and therefore primarily use, Class F fly ash. Some eastern utilities, however, have recently changed to burning subbituminous coal, found in the western United States, to avoid installing scrubbers, since subbituminous coal has a lower sulfur content than anthracite or bituminous coals. As a result, more Class C coal fly ash is now being produced east of the Mississippi River.

Class C ash has cementitious properties, and the amount that can be used in flowable fill is limited by the desired strength. When Class C fly ash is used, portland cement can be left out of the mix. Class C fly ash typically has a lime content of 20 percent or more.

Foundry Sand

Spent foundry sand is another recovered material that can be used as an aggregate in flowable fill. Foundry sand is clean, high quality silica sand or lake sand bonded to form molds for ferrous (iron and steel) and nonferrous (copper, aluminum, and brass) metal castings. After casting, the sand can often contain a number of contaminants, including residual metals and binder materials.

There are basically two types of spent foundry sand, “green” sand and chemically bonded sand. Green sand, used in ferrous metal castings, consists of high quality silica sand, approximately 10 percent bentonite clay (as the binder), 2 to 5 percent water, and about 5 percent sea mold (e.g., a carbonaceous mold additive that helps improve the casting finish). Chemically bonded sand is used in nonferrous metal castings and usually contains 97 percent foundry sand and a small amount of organic binders and catalysts. Nearly 95 percent of all spent foundry sand is green sand.

Technically, foundry sand from both ferrous and nonferrous metal castings can be used in flowable fill mixtures. While both ferrous and nonferrous foundry sand can be used in flowable fill mixtures, typically nonferrous foundry sand is hazardous because it can contain leachable phenols and heavy metals, such as cadmium, lead, copper, nickel, and zinc. High concentrations of these contaminants may preclude their use in flowable fill mixtures. In contrast, ferrous foundry sand is not known to be hazardous. For this reason, EPA is limiting the designation to flowable fill containing ferrous foundry sand.

Over the past five years, states began experimenting with spent foundry sand in flowable fill mixtures. To date, Pennsylvania, Indiana, Wisconsin, Ohio, and New York have all reported successes using spent foundry sand, as a replacement for natural sand, in flowable fill applications. Illinois, however, has attempted to use spent foundry sand in flowable fill mixtures and found that it is unsuitable due to poor performance and economics.

2. Rationale for Designation

EPA believes that flowable fill containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Coal Fly Ash

In 1995, approximately 54.2 million tons of coal fly ash were generated. As shown in Appendix I, approximately 13.6 million tons, or 25 percent of the coal fly ash generated, were recovered and used in concrete or other building materials and transportation applications. Coal fly ash is also used in cement and concrete production, roadbase and subbase construction, structural fills and embankments, filler in asphalt mixes, grouting, and waste stabilization applications. About 300,000 tons of recovered coal fly ash were diverted from landfills in 1995.

Foundry Sand

Annual generation of foundry sand has been estimated at between 6 and 15 million tons. Flowable fill mixtures generally contain between 50 and 85 percent foundry sand. The actual volume used, however, depends on the type of fly ash used and the performance requirements for the flowable fill. According to contacts from Wisconsin, the amount of foundry sand used in flowable fill applications is rather small. Generally, only 100 to 300 tons of sand are used per project. Foundry sand is also being used as a fine aggregate substitute in construction applications, as kiln feed in the manufacture of portland cement, as a bulking agent for compost, and as supplemental cover material at landfill sites. The Federal Highway Administration (FHWA) estimates that approximately 20 percent of the spent foundry sand generated is recycled. Appendix I of this document details the amount of coal fly ash and foundry sand in the solid waste stream.

b. Technological Feasibility and Performance

Coal Fly Ash

According to FHWA, substantial information has been accumulated regarding the use of coal fly ash over the past 10 years. Flowable fill has been used both on land and in water with excellent success. Flowable fill containing coal fly ash outperforms flowable fill made with only portland cement or sand, according to most of the manufacturers and engineers EPA contacted. Coal fly ash gives flowable fill qualities that are superior for many types of jobs. For example, flowable fill can be excavated, code-dyed for later excavation, and can act as an emulsifier, allowing the fill to flow as a distinct unit.

Flowable fill mixes are usually designed based on the percentage of coal fly ash by dry weight. High fly ash mixes generally contain 95 percent fly ash and 5 percent portland cement. Low fly ash mixes have a broader range of mix proportions because they usually contain fillers other than fly ash (e.g. sand). Tables 7 and 8 present what the FHWA considers typical proportions for high and low ash content mixes:

Table 7

Typical Proportions for High Fly Ash Content Mixes

Component	Range kg/m^3 (lb/yd^3)	Mix Design kg/m^3 (lb/yd^3)
Fly Ash (95%)	949 to 1542 (1600 to 2600)	1234 (2080)
Cement (5%)	47 to 74 (80 to 125)	62 (104)
Added Water	222 to 371 (375 to 625)	247 (416)*
	Total:	1543 (2600)

* Equal to 189 liters (50 gallons)
Source: FHWA, 1995

Table 8

Typical Proportions for Low Fly Ash Content Mixes

Component	Range kg/m^3 (lb/yd^3)	Mix Design kg/m^3 (lb/yd^3)
Fly Ash (6% to 14%)†	119 to 297 (200 to 500)	178 (300)
Cement	30 to 119 (50 to 200)	59 (100)
Sand	1483 to 1780	1542 (2600)
Added Water	198 to 494 (333 to 833)	297 (500)‡
	Total:	2076 (3500)

† High calcium fly ash is used in lower amounts than low calcium fly ash.
‡ Equal to 227 liters (60 gallons)
Source: FHWA, 1995

Strength development, flowability, time of set, and bleeding and shrinkage must all be taken into account when evaluating the physical characteristics of flowable fill mixtures. Strength development depends largely on the cement and water content of the mixture. In most high fly ash content mixes only 3 to 5 percent portland cement is required to achieve a compressive strength between 50 and 150 pounds per square inch (psi). Water content can also affect strength development. For example, at a given cement content, as water is added, the compressive strength development declines over time.

Flowability is a function of the water content. In general, it is desirable to design the mixture to be as flowable as possible to take advantage of the self-compacting qualities of flowable fill. Time of set relates directly to the mixture's cement content. Generally, high coal fly ash mixes containing 5 percent portland cement achieve sufficient set to support the average adult male in 3 to 4 hours, depending on the temperature and humidity. After 24 hours, construction equipment can move across the surface without damage. In some instances, low fly ash mixes containing high calcium fly ash have been set within 1 to 2 hours after placement. For both mixes, particularly high fly ash mixes, increased cement content or decreased water content, or both, should reduce the setting time.

Bleeding and shrinkage is possible in high fly ash mixtures with relatively high water contents. Evaporation of the bleed water can result in shrinkage up to 10.42 mm/m (1/8-in/ft) of depth of the fill. Shrinkage can occur laterally and vertically, but no shrinkage or long-term settlement of the flowable fill mixture occurs after the initial set.

Flowable fill is generally mixed to support 50 to 100 psi. In specific applications, contractors can limit the strength of the mix so that later excavation of the hardened flowable fill will be possible. The strength can be controlled by altering the amount and portland cement of Class C coal fly ash, which have cementitious properties.

Flowable fill hardens more quickly than concrete, shortening work time and traffic disruption where applicable. Depending on the amount of portland cement in the flowable fill mixture, it can gain strength in as quickly as 20 minutes; concrete, by contrast, takes at least 4 hours to gain strength.

Foundry Sand

Engineering properties that must be considered when using spent foundry sand in flowable fill mixtures include the following:

Particle Shape. The grain size distribution of spent foundry sand is more uniform and somewhat finer than conventional concrete sand. The fineness of foundry sand contributes to good suspension, thus limiting segregation of flowable fill. The spherical shape of spent foundry sand contributes to good flow characteristics. The fineness of the particles, however, results in lower strength or bearing capacity of hardened flowable fill. In addition, foundry sand usually contains a high concentration of heavy metals, which may limit its usability in flowable fill applications.

Strength Characteristics. Although some organic binder materials can interfere with cement hydration, low (rather than high) strength development is, in most cases, more desirable with flowable fill to permit excavation at a later date (for utility repairs and maintenance). It has been reported that the flowable fill incorporating spent foundry sand aggregates, fly ash, a small quantity of portland cement, and water readily satisfies specified limited strength criteria.

Soundness. The performance of spent foundry sands in soundness tests depends on the amount of clay binder materials present in the spent foundry sand, the amount of clustering of the fines, and the coating on the individual particles. The greater amount of clay binder or clustering, or the thicker the coatings, the higher the soundness loss. Regardless, spent foundry sands generally exhibit favorable performance in soundness testing, with soundness losses of less than 10 percent (indicative of durable aggregate).

Deleterious Substances. Poorly managed spent foundry sand could contain objectionable materials such as wood, garbage, metal, carbon, and dust as well as large chunks of sand. For use in flowable fill, spent foundry sand must be managed to ensure that the sand is clean and processed to the proper size. Foundry sand is often contaminated with up to 12 percent organic material.

Corrosivity. Depending on the binder and type of metal cast, the pH of spent foundry sand can vary from approximately 4 to 8. It has been reported that some spent foundry sand can be corrosive to metals. Others have indicated that flowable fill mixes containing spent foundry sand, due to the absence of chlorides and high pH values are noncorrosive in nature, usually between 11.4 and 12.3.

c. Availability and Competition

Coal Fly Ash

Ninety percent of the roughly 3,000 ready mix producers in the United States make some type of flowable fill. An estimated 65 to 75 percent of ready mix producers utilize coal fly ash, and roughly 55 to 65 percent of ready mix producers use some type of coal fly ash in flowable fill. An engineer at

FHWA estimated that about 20 states currently use flowable fill and several others are currently studying the material. Flowable fill made with foundry sand (and coal fly ash) currently is available in parts of New York, Ohio, Indiana, Wisconsin, and Pennsylvania.

Coal fly ash is available in most parts of the country. There are approximately 460 coal-fired utility generation stations in the United States. Sparsely populated states, however, may not have a local source of coal fly ash to make flowable fill use practical. EPA identified 17 coal fly ash marketers.

Foundry Sand

Spent foundry sand is available from all foundries. Most foundries are located in the Midwest, particularly in Illinois, Wisconsin, Michigan, Ohio, and Pennsylvania.

d. Economic Feasibility

The two main factors in determining the economic feasibility of using recovered materials in flowable fill are transportation and labor costs. Transportation costs for flowable fill made with coal fly ash or foundry sand will vary depending on the distance from those materials to the project site. For example, a contact from Montana stated that it would not be economically feasible if the source of the material is more than 150 miles away. Another contact from Wisconsin claims that, because natural fill materials are abundant (particularly in the western part of the state), the source of the recovered material would have to be within 30 to 40 miles of the project site to make it economically feasible.

In general, it is not the cost of the recovered material used in flowable fill that is prohibitive but rather the cost of flowable fill compared with natural fill materials. Flowable fill mixtures can cost anywhere from $30 to $40 per cubic yard, whereas, natural fill materials usually cost between $2 and $10 per cubic yard. Thus, unless contractors have accounted for labor costs associated with placement of the material and future labor and maintenance costs, they are likely to use the less expensive natural fill material.

The use of flowable fill can, however, save on future labor and maintenance costs. Concrete is more labor-intensive than flowable fill, because flowable fill can be poured into any size trench with machinery and requires no manual labor or compaction. Concrete, on the other hand, requires manual labor to smooth its surface and to compact it in trenches, which must be made large enough to safeguard against cave-ins. Flowable fill does not require inspection or compaction, and it sets more quickly than concrete.

e. Government Purchasing

State and local transportation departments are one of the largest markets for flowable fill, and they use Federal funds for road repair and construction. EPA contacted several state and county transportation departments. Erie County, in Buffalo, New York, uses flowable fill with coal fly ash and foundry sand in specific applications. California anticipates that its coal fly ash usage will be 1,288 tons and flowable fill usage will be 2,644 tons for the years 1997 and 1998. Illinois reported wide usage of Class C fly ash in flowable fill mixes but was unable to provide estimated usage figures. Colorado, Delaware, Florida, Kentucky, Minnesota, and New Hampshire reported minimal use of flowable fill in the last few years, but also reported that coal fly ash is part of these states' mixes. Georgia recently wrote a flowable fill specification and has used it in specialized cases. Flowable fill with coal fly ash recently passed the specification committee in Indiana. Montana reported very minimal use of flowable fill and no use of coal fly ash in its current flowable fill mixes.

f. Barriers to Purchasing

The main barriers to purchasing flowable fill containing coal fly ash or foundry sand are the cost of transportation and the perceptions of highway construction contractors.

In some parts of the country, in areas far from sources of coal fly ash, it might be too expensive because of high transportation costs. Also, flowable fill, once mixed and on the truck, is not practically usable if it must be hauled over 30 miles to the construction site, since it hardens so quickly. Soil, lime, natural sand, or other materials are often less expensive and more accessible in some areas for use as a fill material. Volumetric mixer trucks, storage silos, or other specialized equipment may be necessary but unavailable in some areas, or too expensive for a department to purchase.

In addition, soil, sand, and concrete have been used as fill materials for decades, and the construction industry is generally resistant to the use of new materials. Although EPA found many states that allow flowable fill to be used, flowable fill is not yet widely used, according to a senior engineer at FHWA. One reason is that, currently, there is not a very high level of understanding of flowable fill. Designation could help facilitate knowledge and awareness of the benefits of using flowable fill made with coal fly ash and foundry sand.

g. Designation

In CPG III, EPA is proposing to designate flowable fill containing recovered coal fly ash and/or ferrous foundry sands. A final designation would not preclude a procuring agency from purchasing other types of fill materials, such as conventional concrete or compacted soil. It simply requires that a procuring agency, when purchasing or contracting for the use of flowable fill, purchase this item containing recovered materials when it meets applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Coal Fly Ash

The percentage of coal fly ash in flowable fill varies a great deal and depends on the strength needed for the job. A range of 22 percent to 88 percent coal fly ash in flowable mixes is used by one manufacturer. One ash marketer quoted a range of 5 to 95 percent coal fly ash in flowable fill. FHWA's *Fly Ash Facts for Highway Engineers* also quotes a range of 6 to 95 percent fly ash in different flowable fill mixtures. Most manufacturers, marketers, and engineers were very reluctant to provide even rough estimates, since coal fly ash content in flowable fill can vary widely depending on the properties needed in the finished product.

Foundry Sand

The amount of spent foundry sand in flowable fill mixtures can also vary. According to a study conducted by the University of Wisconsin's Center for Byproducts Utilization, flowable fill "can be manufactured using foundry sand as a replacement of fly ash up to 85 percent."

Table 9 presents information provided by manufacturers of flowable fill on recycled content availability.

Table 9

Recovered Materials Content of Flowable Fill

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Coal Fly Ash	Company A: 22-88 Company B: 5-95	Unknown Unknown
Foundry Sand	Company C: 50-85 Company D: Unknown	Unknown Unknown

b. Preference Program

EPA recommends that procuring agencies use flowable fill containing coal fly ash and/or ferrous foundry sands for backfill and other fill applications. EPA further recommends that procuring agencies include provisions in all construction contracts involving backfill or other fill applications, to allow for the use of flowable fill containing coal fly ash and/or ferrous foundry sands, where appropriate.

The specific percentage of coal fly ash or ferrous foundry sands used in flowable fill depend on the specifics of the job, including the type of coal fly ash used (Class C or Class F); the strength, set time, and flowability needed; and bleeding and shrinkage. Therefore, EPA is not recommending specific coal fly ash or ferrous foundry sands content levels for procuring agencies to use in establishing minimum content standards for flowable fill. EPA recommends that procuring agencies refer to the mix proportions in

Tables 7 and 8 for typical proportions for high and low coal fly ash content mixes. EPA further recommends that procuring agencies refer to American Concrete Institute (ACI) report ACI 229R-94 for guidance on the percentages of coal fly ash that can be used in flowable fill mixtures. Among other things, ACI229R-94 addresses materials, including coal fly ash and foundry sands, mix design, and mixing, transporting, and placing. It also provides examples of mixture designs containing coal fly used by the states of Iowa, Florida, Illinois, Indiana, Oklahoma, Michigan, Ohio, and South Carolina. "Fly Ash Facts for Highway Engineers" addresses materials, strength, flowability, time of set, bleeding and shrinkage.

A mix design for the use of foundry sand and coal fly ash in flowable fill was developed for Ford Motor Company. Procuring agencies can obtain a copy of this design by contacting the RCRA Hotline at 800 424-9346. Table 10 provides the recommended trial mixture from this specification.

Table 10

Materials Quantities for Flowable Fill Mixture Containing Foundry Sands and Coal Fly Ash

Component	Quantity per Cubic Yard
Cement	50 lbs.
Coal fly ash	250 lbs.
Foundry sand	2850 lbs.
Water	500 lbs.

c. Specifications

Coal Fly Ash

Several technical organizations have, or are developing, specifications for flowable fill containing coal fly ash, including The American Concrete Institute (ACI), The American Association of State Highway and Transportation Officials (AASHTO), and ASTM.

EPA recommends that procuring agencies use ACI229R-94 and the ASTM standards listed in Table 11 when purchasing flowable fill or contracting for construction that involves backfilling or other fill applications.

Table 11

Standard Specifications, Test Methods, and Practices for Flowable Fill

ASTM Specification Number	Title
D 4832-95e1	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
D 5239-92	Standard Practice for Characterizing Fly Ash for Use in Soil Stabilization
D 5971-96	Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material
D 6103-07	Standard Test Method for Flow Consistency of Controlled Low Strength Material
D 6023-96	Standard Test Method for Unit Weight, Yield, Cement Content and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
D 5971-96	Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material
D 6024-96	Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application

EPA has also identified more than 20 states with specifications for flowable fill containing coal fly ash. These specifications generally vary from state to state. For example, some states require the coal fly ash to be tested prior to its use, while others "maintain lists of approved sources and accept project suppliers' certifications of fly ash quality," according to FHWA's *Fly Ash Facts for Highway Engineers*. States with specifications for flowable fill containing coal fly ash include: California, Colorado, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Mexico, North Carolina, Ohio, Texas, Washington, West Virginia, and Wisconsin. According to *Fly Ash Facts for Highway Engineers* "virtually any coal fly ash can be used in flowable fill mixes."

There are two basic types of flowable fill containing coal fly ash, high ash content and low ash content. High fly ash content mixes generally contain coal fly ash, a small amount of portland cement, and enough water to make the mixture flowable. Low coal fly ash content mixes contain a higher percentage of filler material (e.g., sand), small amounts of coal fly ash and portland cement, and enough water to make it flowable. ACI's CLSM specifications, mentioned above, are for a low coal fly ash mixture.

Foundry Sand

Currently, no national test methods or specifications exist for the flowable fill mixtures containing foundry sand. Ohio is the only state EPA identified that has a specification for "Flowable Fill Made with Spent Foundry Sand." Pennsylvania, Wisconsin, and Indiana, however, are all working on developing specifications. The Pennsylvania Department of Transportation and Pennsylvania State University are just beginning a 4-year "materials durability testing and analysis" study to help them develop specifications. In addition, a group from the University of Wisconsin's Geotechnical Information Center is working with Wisconsin's Department of Transportation to collect data to develop standard mix proportions, specifications, and performance requirements for spent foundry sand used in flowable fill applications. This study is completed, and the report is currently in draft format.

The FHWA is also in the process of developing guidelines to promote the use of flowable fill containing foundry sand. The following information has been gleaned from FHWA's preliminary draft guidance document but should only be used as a general overview of some of the technical issues surrounding the use of spent foundry sand in flowable fill mixtures:

> Foundry sand must be processed prior to its use in flowable fill mixtures. Spent foundry sand should be free of foreign materials, burnt carbon, binders, and mold additives that may inhibit cement hydration. Foundry sand from ferrous operations needs to be screened and any oversized material removed. Before it can be used in flowable fill, spent foundry sand usually needs to be blended with natural or other fine aggregate to meet the gradation requirements specified by ASTM C33-93, *Standard Specification for Concrete Aggregates*.

D. Railroad Grade Crossing Surfaces

1. Item Description

Railroad grade crossings are surfacing materials placed between railroad tracks, and between the track and the road at highway and street railroad crossings, to enhance automobile and pedestrian safety. Railroad grade crossings are made, typically, of sectional treated timber, full wood plank, asphalt, concrete slab, concrete pavement, rubber, or metal (see definitions below). According to a September, 1996, Federal Railroad Administration (FRA) report, the majority of railroad grade crossings surfaces in the United States are asphalt. Wood is the second most prevalent material used, followed by rubber and concrete. According to an official with FHWA, the trend in railroad grade crossings is towards concrete, specifically concrete modular systems that can be disassembled. The number of concrete railroad crossings has increased in recent years due to changes in railroad preferences, advances in technology, and increasingly competitive pricing.

EPA contacted several organizations to ascertain their preference or policy position on railroad crossing materials. A contact at AASHTO indicated that they follow and endorse the positions held by FHWA. A representative with the American Public Works Association (APWA) reported the organization does not have an official position, and an official with the American Roads and Transportation Builders Association (ARTBA) reported the same.

Table 12 summarizes FRA's inventory of more than 168,000 public railroad crossings in the United States by material type.

Table 12

Public Crossings by Crossing Surface:
Calendar Year 1995

Crossing Surface	Number of Crossings
Asphalt	84,361
Sectional Treated Timber	27,100
Full Wood Plank	25,203
Rubber	6,535
Concrete Slab	2,208
Concrete Pavement	796
Metal	340
Unconsolidated (crushed stone)	16,540
Other	834
Total	**163,917**

Source: FRA, 1996

Definitions

FRA provides the following standard definitions for the different crossing surfaces:

- **Sectional Treated Timber.** Prefabricated units, approximately 8 feet in length, of treated timber individually installed and removable for maintenance and replacement purposes.

- **Full Wood Plank.** Wood surface, other than sectional treated timber, covering the entire crossing area above the crossties. Crossties are the wooden or concrete supports upon which the track rails rest.

- **Asphalt.** Asphalt surface over the entire crossing area, or in the area between the planks or other materials forming flangeway openings, with or without single planks on outside of running rails. Flangeways are formed parts of the rail that eliminate contact of the running rails with crossing surface materials.

- **Concrete Slab (also "Panel" or "Modular").** Precast concrete slabs that are removable, individually, for maintenance and replacement purposes.

- **Concrete Pavement (also "Tub" or "Platform").** Concrete surface that is continuous over the track area and removable only by destruction of the surface.

- **Rubber Slabs.** Preformed rubber sections that are removable, individually, for maintenance and replacement purposes.

- **Metal Sections.** Preformed sections of steel or other metal that are removable, individually, for maintenance or replacement purposes.

- **Unconsolidated.** Ballast or other unconsolidated material (commonly crushed stone) placed above the tops of crossties, with or without planks on one or both sides of the running rails.

- **Other.** Surfaces other than the above: structural foam, plastic, etc.

2. Rationale for Designation

EPA believes that railroad grade crossing surfaces containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Railroad grade crossings are manufactured with recovered rubber, coal fly ash, and steel. As discussed in Appendix I of this document, these items comprise a significant portion of the solid waste stream. The information obtained by EPA indicates that it is not feasible to use reclaimed asphalt in asphalt railroad grade surface crossings because asphalt recycling equipment is designed for operation on highways and roads, not on smaller projects such as railroad crossings. EPA does not believe that crumb rubber modified asphalt can be used in railroad grade crossings because of cost and performance constraints. EPA requests information on the use of either reclaimed asphalt or crumb rubber modified asphalt in railroad grade crossing surfaces.

The majority of coal fly ash is produced in electric generating plants, where powdered coal is burned to produce steam to drive the turbines. Coal fly ash typically represents about 75 percent of the ash generated by coal combustion, with coarser, heavier bottom ash accounting for the remaining 25 percent. ACAA estimates that 54.2 million tons of coal fly ash were generated in 1995. Approximately 25

percent of this material (13.6 million tons) was recovered and the remaining 40.6 million tons were stored or disposed of. No figures are available on the amount of coal fly ash recovered for use in railroad crossings. A 9 by 9-foot concrete panel, however, reportedly weighs approximately 7,000 pounds. A common railroad crossing configuration involves three panels of this size. Thus, if a company were to use cement with 15 percent coal fly ash content, each panel would contain 1,050 pounds of the recovered material, and a crossing consisting of three panels would divert 3,150 pounds of coal fly ash from the solid waste stream.

Rubber railroad grade crossing surfaces contain tire buffings from tire retreading operations, crumb rubber from scrap tires, and off-specification virgin rubber. As with coal fly ash, there are other uses for scrap tires and other applications for crumb tire rubber. However, additional markets for crumb rubber are needed.

All domestic steel contains recovered materials. Depending on the process used to manufacture the steel, the railroad grade crossing surface can contain up to 100 percent recovered steel.

b. Technological Feasibility and Performance

Traditionally, wood and asphalt crossings have dominated the marketplace due to their low initial cost. In the past few years, the railroad industry has changed its orientation from lowest initial cost towards obtaining the best performance from grade crossings, which includes reusability. Since fuel costs are a significant portion of a railroad's operating budget, the industry relies on routine track maintenance to create a smoother track surface, which, in turn, increases fuel efficiency. The marketplace has moved to greater use of concrete and rubber grade crossings due to their reusability after track maintenance, unlike asphalt and wood which normally are removed and disposed of.

Rubber

According to one manufacturer of rubber railroad grade crossings, the average lifespan of a rubber crossing is estimated to be 10 to 15 years. This life expectancy is based on the original quality of the material; the application; traffic patterns (notably the presence of trucks); vehicular speeds; condition (e.g., roughness) of the approach to the crossing; and the quality and condition of the sub-ballast,

the ballast, the ties, and the rails. Ballast is material placed on a track roadbed to hold the track in alignment and keep it elevated. Sub-ballast is the material upon which the ballast is laid, usually gravel, cinders, or sand. Proper drainage and well-supported ties will significantly increase the life of the crossing.

Although not specific to recovered content rubber railroad crossings, a FHWA report issued in 1979 stated, "...a crossing constructed with one of several types of manufactured crossing surfaces, although much higher in initial cost, will provide superior riding quality for even high speed and high density vehicular traffic and generally will require minimum maintenance if the original installation is made on a well-prepared track structure with good subgrade conditions." The same report also stated, "...the additional cost of a proprietary crossing (e.g., rubber crossings) may well be warranted by the longer life of the material, lower maintenance costs, superior riding quality, or a combination of these features." According to a manufacturer, in general, full depth rubber crossings, where the height of the rubber is even with the height of the rail, stay in place better than other crossings, provide a smoother crossing, are easier to remove and replace (compared to other surfaces), and will not deteriorate as rapidly. Full depth rubber crossings do not require shims, which are additional thin wooden panels that are located between the rubber and the crossties.

In general, contacts agreed that rubber crossings are preferable for roads with lighter traffic flow and lighter vehicles. Municipalities appear to favor full depth rubber crossings, as they provide a smoother, quieter ride for passenger vehicles. One contact representing a major railroad, reported that, although they do not typically use rubber railroad crossings on heavily traveled roads or those used by heavy vehicles, they find them applicable on roads with lower traffic levels. According to two different railroad company officials, however, rubber crossings are particularly suitable at crossings where there is a curve in the track or where two tracks cross each other, typically called a railroad diamond or interlock. In these cases, a flexible material is essential and rubber is usually the best choice, regardless of the level of traffic.

EPA's research uncovered mixed opinions about the performance of rubber railroad crossings. A railroad company official indicated that virgin rubber is somewhat more flexible than recovered content rubber and it wears a little better. He stated, however, that recovered content rubber crossings are slightly less expensive than virgin rubber crossings, and the performance differences were not pronounced. Only

one manufacturer of rubber railroad grade crossings, of the four contacted, explained that they no longer produce crossings made of tire buffings or crumb rubber, because they were finding it difficult to meet the performance standards of nonrecovered content rubber. In particular, he noted difficulty in obtaining comparable physical properties, such as tensile strength. The company now manufacturers rubber railroad crossings only from uncured stock (off-spec) rubber.

A few states contacted by EPA expressed reservations regarding rubber railroad crossings, regardless of the recovered content. An official with the Massachusetts Highway Department reported that a newly installed recovered content rubber crossing was torn up by a snow plow, and another that had been in place for 6 months did not hold up well. However, the source indicated that these problems were most likely due to improper installation, not the recovered content. A Georgia Department of Transportation official reported that rubber is sometimes used by shortline railroads and less traveled roads in the state. He indicated, however, that rubber crossings can be problematic if not installed correctly. They do not hold up well under heavy loads or if exposed to natural elements, such as salt from shoreline areas. The New York State Department of Transportation has found that virgin rubber can be more readily produced in uniform quality and density than recovered rubber. Furthermore, an employee with the railroad section of the Texas Department of Transportation reported that the state is no longer purchasing any type of rubber railroad crossings. In his opinion, using recovered content rubber for products that require strength properties is hindered by the use of steel belts in tires. He said he has witnessed situations where bits of steel have ended up in the final product, resulting in reduced strength properties. An official with the Florida Department of Transportation indicated that the state has been using full-depth rubber crossings for the past ten years on roads with high average daily traffic and they have held up fairly well with few problems. However, he pointed out that the rubber crossings they currently purchase are manufactured from virgin material. They had purchased the recycled content shim-type crossings prior to ten years ago, but found that the wood shims rotted and resulted in an unstable crossing, so they switched to full-depth rubber. Finally, an official with the Vermont Department of Transportation reported that the state is no longer purchasing the recycled content rubber crossings they had been procuring several years ago. He said that the state found them to be slippery and to wear out quickly in 5 to 6 years. As mentioned earlier, although many states have preferences for certain types of crossings in specific situations, ASTM specifications are not normally considered by states. The contact from New York, however, indicated that they do have requirements to meet the minimum ASTM and other specifications used by certain manufacturers.

Several of EPA's contacts have had positive experiences with rubber railroad grade crossings. The following summarizes the positive comments conveyed by those contacted by EPA.

City of Prineville, Oregon. The city has seven recovered content rubber railroad crossings in place along a shortline railroad that runs through Prineville and two neighboring counties. A city official reported that they are very pleased with the performance of the crossings, which have been in place for 5 to 7 years. He reports that they are durable and have shown no signs of wearing or cracking. The official said that he prefers rubber over asphalt or wood, because it has a higher life expectancy and is more durable. The city also uses concrete crossings, but these have not been in place long enough to evaluate their performance.

Delta Railroad Construction, Ashtabula, Ohio. This railroad contractor has installed many rubber crossings, especially in the Boston area. An official with the company reported that the recycled content rubber crossings they have installed have performed reasonably well and are suitable for most applications, except for crossings with heavy, industrial-type traffic.

Long Island Railroad, New York. The railroad maintains more than 300 recovered content rubber railroad crossings over 594 miles of mainline track. A railroad official stated that the newer full-depth rubber crossings have held up fairly well and are quite durable. The railroad began using recovered content rubber crossings comprising a shim and a rubber pad about 10 to 15 years ago. This product consisted of wooden shims on the railroad ties, a 2-1/2 inch rubber pad, and steel spikes driven into the rubber and ties. They witnessed problems with these crossings because the wood shims would deteriorate over time, making the crossings unstable. Several states experienced similar problems with this type of crossing. For the past 4 years, however, the railroad has purchased full-depth recovered content rubber crossings and has been satisfied. The only problem they have observed has been with rubber peeling away from the steel used as reinforcement inside rubber crossings. Although this problem had the potential to affect performance and safety, it was expeditiously corrected. The railroad official indicated, however, that the problem may have been due to improper installation.

Concrete

Concrete crossings can be found throughout North America in applications ranging from the most basic rural environments to premium crossing configurations in metropolitan areas. Most are "panel" designs, where the concrete is separated into modular panels that rest on top of the railroad ties. The other type of concrete crossing is known as a "tub-type" or "platform" crossing, which replaces the entire track structure through the crossing.

EPA contacted four manufacturers of concrete railroad crossings and spoke with 10 state department of transportation officials and railroad companies concerning their experiences with concrete crossings. A manufacturer that uses coal fly ash in the concrete mixture stated that coal fly ash helps produce a more workable and durable product that helps preclude the absorption of moisture into the concrete, which helps prevent cracking and prolongs the life of the crossing. The use of coal fly ash also contributes to the product's ability to resist temperature fluctuations and freeze and thaw cycles. While the contact found no technical barrier to the use of coal fly ash, he identified a practical barrier in that coal fly ash is not readily available in all areas of the country.

While state department of transportation officials were unsure whether the concrete used in the concrete crossings they purchased contained coal fly ash, generally they have had positive experiences with concrete crossings. The Louisiana Department of Transportation has installed modular concrete railroad crossings over the last 3 to 4 years and has experienced only one design-related problem, unrelated to the type of material: the approach put too much stress on the crossing. Concrete is their primary choice for high to moderate volume areas. The New York State Department of Transportation also has had success with modular unit concrete crossings. Slow speed shortlines in the state have found the product more resistant to damage by snowplows. They also have found the product to be chemically and mechanically resistant to freeze and thaw cycles on heavily salted roadways.

A Georgia Department of Transportation official added that, although they use mostly asphalt and timber for crossings, the trend among the southeastern states is towards concrete. Based on personal research on the use of concrete crossings, this official recommends concrete or rubber as the preferred choice for railroad crossing improvements. In addition, one railroad contractor stated that there are excellent concrete crossings available and that they are highly durable, lasting 20 to 30 years on average.

According to one manufacturer, concrete offers advantages in price, longevity, and ease of installation. Another manufacturer of concrete modular systems claims that the product is much more durable than asphalt.

A few of the individuals EPA contacted had negative remarks concerning concrete railroad crossings. One railroad official stated that concrete is more difficult to repair compared to rubber, because of the weight of the concrete. Although modular crossings may be removed and replaced, their weight is somewhat prohibitive. He added that heavy machinery is required to remove the cement slabs and that smaller rail lines are unlikely to have this equipment. One manufacturer stated that special attention must be given to the design and installation of precast concrete slab crossings to avoid the tendency of some slab units to rock after a period of use. With a modular system, the crossing sits on the ties and is dependent on the ties and fasteners for support. As the ties and fasteners deteriorate over time, the concrete may become unstable. Platform concrete systems, which replace the entire crossing, must be removed and disposed of during track maintenance. For this reason, this manufacturer only sells the product to port authorities and slow speed tracks that will not require maintenance as frequently.

Asphalt

At crossings with heavier traffic, asphalt requires more attention than concrete or rubber to maintain a smooth riding surface. Without frequent maintenance, rough surfaces result, posing safety concerns. Conversely, asphalt crossings work very well under light traffic conditions and where train use and weight is low enough not to require frequent resurfacing. As with other surfaces, the lifespan of asphalt crossings is dependent on the condition of the subgrade and on traffic conditions. It is difficult to gauge the lifespan of asphalt crossings because they may be removed for track maintenance before the life of the material has expired. If left in place for a period of time, asphalt tends to degrade faster than rubber or concrete under similar conditions.

Metal

Steel is the most commonly used material in metal railroad grade crossings. Steel sections can be removed and replaced to allow for better aeration, compared to rubber, of the ballast and roadbed section, but they can be subject to rapid corrosion and are sometimes difficult to hold in place. Steel is used relatively infrequently and accounts for less than 0.50 percent of all railroad crossings. One contact stated that steel is not commonly used because it offers poor resistance for vehicle tires during skids.

Wood

Wood plank crossing surfaces can be continually maintained by replacement of deteriorated or worn planks one at a time. The disadvantage is that the wood plank crossing cannot be removed in one section for track maintenance and then be replaced. Wood plank crossings may deteriorate rapidly under medium rail traffic or truck crossings.

Prefabricated sectional treated timber crossings permit the removal and replacement of individual panels for maintenance and replacement purposes and provide good service at locations with moderate to heavy highway and railroad traffic. The panels are generally thick enough not to require shims, thus providing a smooth, stable crossing surface. In some heavy traffic locations, excessive wear might occur in the normal vehicle track areas. Although no longer a concern in most states, wear might be severe in locations where studded tires are permitted.

c. Availability and Competition

EPA identified three manufacturers of rubber railroad crossings containing recovered materials, all of which offer their products nationwide. Two companies manufacture crossings from tire buffings and crumb rubber, utilizing 20 to 25 million pounds and 10 to 11 million pounds of feedstock annually, respectively. The third manufacturer uses approximately 3 to 4 million pounds of tire buffings in the manufacture of railroad crossings.

EPA identified numerous companies that manufacture or distribute concrete railroad crossings, with at least two that use coal fly ash. Many companies that distribute concrete railroad crossings contract with ready mix manufacturers and are less aware of the material content of the concrete. However, one manufacturer of concrete crossings reported that, of the four concrete suppliers it uses, three use coal fly ash. There are about 3,000 ready mix producers in the United States. According to ACAA, an estimated 65 to 75 percent of ready mix operators utilize coal fly ash in a variety of products.

Steel used to manufacture railroad grade crossings contains up to 20 percent recovered materials. Almost all steel produced in U.S. steel mills currently contains recovered material.

d. Economic Feasibility

Asphalt and prefabricated sectional treated timber crossings are the least expensive materials and have the lowest installation cost. Industry experts estimate material costs ranging from $35 to $60 per track foot for asphalt and $50 to $75 per track foot for timber. Asphalt and prefabricated sectional treated timber crossings must be completely torn out during work on the track, however. If track maintenance is required frequently, asphalt can become much more expensive in the long run. Wood is also a fairly inexpensive option, but is subject to splitting and splintering, requiring more frequent maintenance.

The initial cost of rubber and concrete crossings is high, especially compared to asphalt. The higher upfront costs, however, may be offset by the longer lifespan of rubber and concrete crossings. According to railroad contacts, material costs are often the least expensive portion of a crossing installation. The total cost of a crossing will likely be $1,200 to $1,500 per track foot. Material costs per track foot will range from $150 to $200 for concrete and from $160 to $210 for rubber crossings. Concrete containing coal fly ash is economically available in most areas of the country. Its use, however, may be limited by transportation issues and manufacturer material preferences. According to ACAA, more than half of the ready mix concrete producers use coal fly ash. One manufacturer stated that a major drawback to using coal fly ash in their area is that it is more expensive and prolongs the curing process, including how the concrete is handled when poured. The manufacturer added, however, that a low percentage of coal fly ash, such as 15 percent, used in concrete would not have an effect on the curing process, but would still change the structure of the mixture slightly. Recovered content rubber crossings tend to be slightly less expensive that those made of virgin rubber. Most rubber and concrete crossings are modular and can be removed and then reinstalled following track maintenance. Although heavy equipment is required to handle the modular sections, the consolidation of railroad companies has made that equipment more available.

e. Government Purchasing

EPA identified five state departments of transportation, two Class I railroads, two regional and shortline railroads, two passenger railroads, and two cities and counties that are currently using railroad crossings with recovered content rubber. A Class I railroad is defined as a freight railroad that has

revenues greater than or equal to $250 million, although this amount changes depending on fluctuations in the inflation rate. Although EPA also identified five state departments of transportation using concrete railroad crossings, none of the officials knew if the crossings contained coal fly ash. Based on EPA's research, it is likely that at least some of the crossings contain coal fly ash.

Funds for the purchase of railroad grade crossings are available under the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) Surface Transportation Program. Funds are apportioned to states by a legislatively prescribed formula based on state land area, population, rural road mileage, and total number of public railroad-highway grade crossings in the state. At least 10 percent of the Surface Transportation Program funds authorized by ISTEA must be set aside for carrying out Rail-Highway Crossings and Hazard Elimination programs. Of this amount, states must reserve for each of the two programs at least as much as was apportioned for each program in 1991. If a state's 10 percent set-aside amount exceeds the combined apportionments for these two programs in fiscal year 1991, the excess amount may be spent for either program but may not be used for other than safety purposes and may not be used for routine maintenance. The Crossing Safety Improvements Program is funded at approximately $140 to $150 million annually, about 25 percent of which is spent for new or improved crossing surfaces. The expressed goal of this program is to eliminate 25 percent of grade crossings by closing access to crossings and rerouting traffic. This, according to industry experts, will increase the demand for improvements as the burden on remaining crossings increases. At the same time, with fewer crossings, a higher percentage of the available funds for safety improvements will be available for each of the remaining crossings, allowing for installation of more durable crossing surfaces such as rubber and concrete.

At least half of the 10 percent set-aside funds for crossing improvements must be used for installing protective devices at railway crossings. The other half may be spent on any type of safety improvement. FHWA includes crossing surface improvements in their definition of protective devices. According to industry experts, all states will use some of the funds for improving crossing surfaces.

The 10 percent set-aside funds for grade crossing safety improvements are available at a 90 percent Federal share, with the remaining 10 percent paid by state and/or local authorities and/or the railroad. In general, however, railroad companies (e.g., Union Pacific, Santa Fe, etc.) are not required to pay a share of the cost of the new or improved grade crossing surfaces since, per chapter 23 of the Code of Federal Regulations, Section 646.310(a)(1), these are deemed "of no ascertainable net benefit to the railroads."

f. Barriers to Purchasing

EPA did not identify any technical barriers to the use of recovered materials in concrete, metal, or rubber railroad crossings. States or railroads, however, may adopt guidelines for the purchase of a certain type of crossing. Despite an industry trend to utilize more expensive, durable rubber and concrete crossings, inexpensive wood and asphalt crossings, as noted above, are preferred in some less traveled areas.

Recently, the use of rubber crossing surfaces has become more widespread, but these surfaces still account for only a small percentage of total crossings. Moreover, while rubber grade crossing surfaces are becoming more accepted and are often preferred, there is a long, institutionalized history of using cheaper materials such as unconsolidated materials, wood, and asphalt for crossing surfaces. Rubber railroad grade crossings also are not appropriate for all situations, such as lightly traveled rural areas. According to one manufacturer, a Federal procurement program would likely increase their use in situations for which they are suitable.

Recycled content rubber, concrete, and steel crossing surfaces have the environmental advantage of containing recovered materials, some up to 100 percent. However, in deciding whether to implement a Federal procurement program, certain other advantages should be considered. Specifically, the extended life of rubber and concrete grade crossings vastly decreases costs associated with multiple removal, replacement, and disposal of asphalt and wood crossing surfaces and may help reduce repairs of asphalt street surfaces.

g. Designation

In CPG III, EPA is proposing to designate railroad grade crossings containing recovered rubber, concrete, or steel. A final designation would not preclude a procuring agency from purchasing railroad grade crossings manufactured from another material. It simply requires that a procuring agency, when purchasing railroad grade crossings made from rubber, concrete or steel, purchase the item made with recovered materials when the item meets applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Several types of railroad grade crossings are available with recovered materials content, including rubber, coal fly ash, and steel. They are described below.

Rubber

According to one manufacturer of rubber railroad grade crossings, all rubber grade crossings are made of some form of recovered content rubber. Recovered content rubber falls into three categories: tire buffings, crumb rubber, and off-specification (off-spec) virgin rubber. Tire buffings are the waste byproduct of tire retreading operations. Crumb rubber is composed primarily of ground-up scrap tires. Off-spec virgin rubber is rubber that is defective in some way and, therefore, not usable for its original intended end use. Off-spec rubber is sold to processors for other applications. Tire manufacturers and other rubber product manufacturers cannot use the off-spec rubber in their normal applications because of safety requirements and unacceptable physical and chemical properties. Off-spec rubber must be used relatively quickly because of the short shelf life of uncured rubber. While off-spec rubber is not postconsumer material, because of the chemical changes that occur in the rubber while it is stored, if it is not reprocessed and recycled, it would otherwise be discarded or used as fuel through incineration.

Coal Fly Ash

Concrete used to manufacture railroad grade crossings may contain coal fly ash, a recovered material. EPA contacted two manufacturers of concrete railroad crossings that incorporate coal fly ash into the concrete mix. One manufacturer utilizes a 15 percent coal fly ash mix to create a high strength, 8,000 pounds-per-square-inch concrete railroad crossing. The other manufacturer produces a controlled density fill product, or "flowable fill," that is a mixture of cement, fly ash, sand, and water for use as a base for its concrete platforms. The company also manufacturers a concrete platform utilizing microsilica, a fly ash derivative, which adds compressive strength to the concrete and helps prevent the intrusion of salt water. Another major manufacture contacted by EPA is currently not using coal fly ash, but stated it would be technically feasible to do so.

Steel

Steel used to manufacture railroad grade crossings contains at least 20 percent recovered materials. Most steel produced in U.S. steel mills currently contains recovered material. The steel used to manufacture railroad crossings may be produced by either basic oxygen furnace (BOF) process or electric arc furnace (EAF) process, with EAF-produced steel likely used in most cases. The BOF process uses 25 to 30 percent recovered steel, while the EAF process uses virtually 100 percent recovered steel.

Asphalt

Although there are many cases of reground asphalt being used in highway construction, recovered materials are not used in asphalt railroad crossings. An industry contact explained that the equipment used in highway construction is large and designed for continuous operation on highways. This equipment would not be practical or economical for use on small projects, such as railroad crossings.

Theoretically, crumb rubber and plastic could be mixed with asphalt used for railroad crossings. However, these materials have a tendency to stiffen the asphalt mixture to a point that might preclude its use for railroad crossing applications. In addition, according to an official with the National Asphalt Paving Association, using asphalt with these recovered materials for railroad crossings would be extremely expensive.

Wood

Typically, wood used in crossings must be removed for periodic track maintenance. Since crossings sustain more vehicular traffic than any other portion of the rail line, the wood is not reused because it is typically damaged or splintered. According to one industry expert, this wood is not commonly reused in railroad crossings, but rather is reused within the track as crossties or for other purposes, such as in landscaping. Wood used for crossings is reused when tracks are repaired or replaced on shortline railroads that operate with limited budgets. Shortline railroads, also referred to as Class III railroads, are railroads that earn revenues of less than $24 million annually. They usually consist of less than 100 miles of track.

Table 13 presents information provided by manufacturers of railroad crossings on recovered content availability.

Table 13

Recovered Materials Content of Railroad Grade Crossings

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Concrete containing coal fly ash	Company A: Unknown	Unknown
	Company B: Unknown	Unknown
	Company C: 15	15
Rubber	Company D: Unknown	Unknown
	Company E: Unknown	85
	Company F: Unknown	95
	Company G: Unknown	85 - 90

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 14, procuring agencies establish minimum content standards for use in purchasing railroad grade crossing surfaces containing recovered materials.

Table 14

Draft Recovered Materials Content Recommendations for Railroad Grade Crossings

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

c. Specifications

EPA identified no national specifications or standards that either require or preclude the use of recovered materials in railroad crossings. Many states, however, have developed guidelines or criteria for use in selecting a crossing surface. Different crossing grade surfaces may be appropriate for different settings, based on highway traffic and functional classification, types of vehicles using the crossing, railroad traffic and truck classification, condition of approach surface, engineering judgment, costs, and the expected life of the surface. When state or Federal dollars are used to build or improve crossings, states are required by law to offer competitive bidding and may specify a particular type of crossing (e.g., rubber). Several states specify rubber crossings as the surface of choice for high traffic-volume crossings. In practice, state departments of transportation and railroad companies have preferences for certain materials, and states work jointly with railroad companies in deciding what materials to use in grade crossings.

The state of Alabama has a policy to use full-depth rubber or concrete crossings when the railroad is paying for the crossing or when the state department of transportation is paying for it through an agency project. Table 15 shows the traffic guidelines the state observes.

Table 15

State of Alabama Railroad Crossing Surface Guidelines

Vehicles Per Day	Speed Limit	Trucks Per Day	Crossing Type
0 to 5,000	< 40 miles per hour (mph)	> 250	Asphalt/Timber
0 to 5,000	< 40 mph	< 250	Solid Timber
5,000 to 10,000	< 40 mph	----	Prefab Rubber
5,000 to 10,000	> 40 mph	----	Rubber/Concrete

Source: ADT, 1997

The following ASTM standards for rubber products may be specified by customers of rubber railroad crossings. Although ASTM standards are not widely used in bid documents, many manufacturers provide them in their product literature.

- **D2000-96 Rubber Products in Automotive Applications**. This classification system tabulates the properties of vulcanized rubber materials that are intended for, but not limited to, use in rubber products for automotive applications.

- **D2240-97 Rubber Property—Durometer Hardness**. This test method describes the procedure for determining indentation hardness of substances classified as rubber, cellular materials, elastomeric materials, thermoplastic elastomers, and some hard plastics.

- **D412-97 Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension**. These test methods describe procedures used to evaluate the tensile (tension) properties of vulcanized rubbers, thermoplastic rubbers, and thermoplastic elastomers.

- **D297-93 Rubber Products—Chemical Analysis.** These test methods cover the qualitative and quantitative analysis of the composition of rubber products.

E303-93 Measuring Surface Frictional Properties Using the British Pendulum Tester. This test method covers the procedure for measuring surface frictional properties using the British Pendulum Skid Resistance Tester.

D1171-94 Rubber Deterioration—Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens). This test method permits the estimation of the relative ability of rubber compounds used for applications requiring resistance to outdoor weathering or ozone chamber testing.

D573-88 Rubber—Deterioration in an Air Oven. This test method describes a procedure to determine the influence of elevated temperature on the physical properties of vulcanized rubber.

D395-89 Rubber Property—Compression Set. These test methods cover the testing of rubber intended for use in applications in which the rubber will be subjected to compressive stresses in air or liquid media.

D257-93 DC Resistance or Conductance of Insulating Materials. These test methods cover direct-current procedures for the determination of direct current insulation resistance, volume resistance, volume resistivity, surface resistance, and surface resistivity of electrical insulating materials, or the corresponding conductances and conductivities.

D2137-94 Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics. These test methods cover the determination of the lowest temperature at which rubber vulcanizes and rubber-coated fabrics will not exhibit fractures or coating cracks when subjected to specified impact conditions.

E. Building Insulation Products

1. Additional Procurement Recommendations

EPA recommended purchasing practices, including recovered materials content levels, for thermal building insulation products in RMAN I. EPA is revising those recommendations by adding a recovered materials content level for plastic batt building insulation. When EPA issues final recommendations for purchasing plastic batt building insulation products, procuring agencies should substitute the revised Table 16 for the recommendations found in Section C-1 of the 1995 RMAN I.

a. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 16 (Revised), procuring agencies establish minimum content standards for use in purchasing building insulation products.

Table 16

Recommended Recovered Materials Content Levels for Building Insulation

Insulation Material	Recovered Material	Total Recovered Materials (%)
Cellulose loose-fill and spray-on	Postconsumer paper	75
Fiberglass	Glass cullet	20-25
Perlite composite board	Postconsumer paper	23
Phenolic rigid foam	Recovered materials	5
Plastic, non-woven batt	Recovered and/or postconsumer plastics	100
Plastic foam-in-place, polyisocyanurate/ polyurethane	Recovered materials	5
Plastic rigid foam, polyisocyanurate/ polyurethane	Recovered materials	9

Insulation Material	Recovered Material	Total Recovered Materials (%)
Plastic foam, glass fiber reinforced polyisocyanurate/ polyurethane	Recovered materials	6
Rock wool	Slag	75

Note: The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. Specifications

EPA recommends that procuring agencies reference ASTM standard specification D 5359, "Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber," in Invitations for Bid and Requests for Proposal.

VI. PARK AND RECREATION PRODUCTS

A. Park and Recreational Furniture

1. Item Description

Park and recreational furniture is found in parks, outdoor recreational facilities, and the grounds of office buildings and other facilities. This furniture consists primarily of park benches and picnic tables.

Park Benches

Park benches provide opportunities for people to rest and comfortably enjoy outdoor settings. Park benches are typically made from concrete, brick, aluminum, steel, wood, or plastic lumber. Benches are available in a number of different styles and designs, including pedestal benches with a single supporting leg and standard benches with two supporting legs. They are also available with or without seat backs and with or without arms. Benches commonly range in length from 4 to 8 feet. Some park benches are movable; others are set in concrete. Benches made from wood or plastic lumber typically have a frame made from either steel or aluminum with the slats that make up the seat and/or back of the bench being commonly attached with bolts.

Picnic Tables

Picnic tables provide opportunities for people to gather and eat in an outdoor environment. Picnic tables are typically made from wood, concrete, aluminum, or plastic lumber. They are available in a number of different styles, including standard 6 by 6-foot rectangular tables, hexagonal tables, and handicapped accessible tables with 8-foot tops. Picnic tables can be movable or set into concrete.

EPA has already designated cement and concrete made with recovered coal fly ash. According to the Steel Recycling Institute (SRI), all steel contains between 25 and 100 percent recycled material. Aluminum also usually contains recovered material. There are some indications that reclaimed wood is beginning to be used in indoor furniture, but EPA was unable to obtain any substantial information on its

use for outdoor furniture. For these reasons, this section will focus on outdoor furniture made from plastic lumber, but also presents information on the use of other recovered materials, such as steel, aluminum, and concrete.

Plastic Lumber

The ASTM draft 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. The Plastic Lumber Trade Association (PLTA) identifies four main technologies used to produce recycled plastic lumber.

- **Single-polymer systems made from recycled high density polyethylene (HDPE).** EPA's research noted that most of the manufacturers of 100 percent HDPE plastic lumber use 100 percent postconsumer HDPE for their products. This HDPE often comes from sources such as postconsumer milk jugs, water jugs, detergent bottles, and soda bottles.

- **Mixes of recycled polyethylene and/or other recycled plastics (commingled plastics).** EPA's research identified several different mixtures of resins that fall into this category including a mixture of HDPE and low-density polyethylene (LDPE); a mixture of polyethylene (PE) and PP; and a mixture of HDPE, LDPE, linear low-density polyethylene (LLDPE), and PP. LDPE often comes from sources such as plastic bags and stretch wrap. The PE/PP mix comes from sources such as detergent bottles (in which the bottle body and spout/cap are made of PE and PP, respectively). In addition, a few manufacturers were identified who make lumber from unspecified resins.

- **Fiberglass reinforced plastic lumber.** EPA's research revealed that a few manufacturers reinforce plastic lumber with fiberglass rods, while others disperse glass fibers into the plastic lumber to increase its stiffness.

- **Wood/thermoplastic composites**. Some manufacturers blend plastic resin with wood chips and/or sawdust. A typical blend is 50 percent recovered plastic (usually HDPE) and 50 percent recovered wood.

When recycled plastic is mixed with wood, fiberglass, or some other material to make lumber, the end product is generally referred to as "composite lumber." EPA also found references to composite lumber made by mixing plastic and rubber scrap, and by mixing recycled plastic and recycled paper.

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).

2. Rationale for Designation

EPA believes park benches and picnic tables containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

According to one manufacturer, extruding HDPE into a mold requires approximately 6.3 milk jugs to make one pound of 100 percent HDPE plastic lumber. Another manufacturer said that in their continuous extrusion process it takes seven milk jugs to make a pound of plastic lumber. A third manufacturer states that their continuous extrusion process requires approximately nine milk jugs to make a pound of plastic lumber. Assuming between 6.3 and 9 milk jugs per pound, an average 300-pound picnic table would use between 1,890 and 2,700 milk jugs. Therefore, if Federal agencies were to buy 10,000 such picnic tables, between 18.9 and 27 million milk jugs would be diverted from the solid waste stream. Similarly, if Federal agencies were to buy 10,000 park benches of an average weight of 125 pounds, it would divert between 7.9 million and 11.3 million milk jugs from the waste stream. According to one aluminum manufacturer, it takes 31 aluminum cans to make 1 pound of recycled aluminum, compared to 4 pounds of mined bauxite per pound to produce virgin material. According to one manufacturer of aluminum benches and tables, their 6 foot long table weighs 83 pounds and would, therefore, use approximately 2,573 aluminum cans. Accordingly, if the Federal agencies were to buy 10,000 such picnic tables, almost 26 million aluminum cans would be diverted from the solid waste stream. The same

manufacturer sells park benches weighing 35 pounds. Consequently, if Federal agencies were to buy 10,000 such park benches, almost 11 million aluminum cans would be diverted from the solid waste stream. According to the SRI, when 1 ton of steel is recycled, 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone are conserved. SRI also indicated that it takes eight household steel soup cans to make a pound of steel, and a steel park bench could weigh anywhere from 150 to 300 pounds. Therefore, if Federal agencies were to purchase 10,000 such park benches, between 12,000,000 and 24,000,000 steel cans would be diverted from the waste stream. Appendix I of this document discusses the generation and recovery of aluminum, steel, wood, and plastic in MSW.

b. Technological Feasibility and Performance

A number of technical and performance issues exist with respect to the different materials used to make park and recreational furniture. In particular, wood and plastic lumber park and recreational furniture differ in terms of longevity and durability, the effects of temperature, maintenance, strength, weight, and other issues. Different kinds of plastic lumber also differ with respect to these issues.

Longevity and Durability

Many manufacturers of plastic furniture indicated that plastic lumber park and recreational furniture will last two to three times longer than its wooden counterparts. They also noted that plastic lumber is resistant to rot, termites, and general deterioration. The state of Georgia stated that, although the 100 percent HDPE plastic lumber picnic tables and park benches it purchases cost 25 to 30 percent more initially, the state believes that the increased durability and longevity is worth this initial cost. Georgia chose to purchase only 100 percent HDPE plastic lumber products in part because it was concerned that wood/plastic composite lumber might deteriorate more quickly than 100 percent plastic. A study conducted at Rutgers University revealed that plastic lumber exposed to UV radiation disintegrates at a rate of only 2 to 3 thousandths of an inch per year. A purchaser in the state of Wisconsin, however, stated that a life-cycle analysis comparing wood and plastic lumber revealed, surprisingly, that standard wooden tables had lasted longer than anticipated; some of the state's wooden picnic tables have been in service since World War II. As a result, the contact felt the increased cost of other materials may not be justified. The contact did not provide specific information on the condition of these tables that had been in service for over 50 years.

One manufacturer stated that one of its customers, a national park in the U.S. Virgin Islands, ordered four of their plastic lumber picnic tables a few years ago. After a rough hurricane season, the park's wooden tables were washed away or sustained heavy damage, whereas the plastic lumber tables were intact. This national park recently placed an order for 50 new picnic tables. Similarly, two national parks in Washington, DC, area have used plastic lumber park and recreational furniture for more than 2 years and expressed satisfaction with their performance and durability.

A manufacturer of concrete tables and benches said that concrete is more durable than almost any other material. At least one other park and recreational furniture manufacturer, however, stated that this statement is highly dependent on environmental factors, such as temperature, rain, and exposure to other elements. EPA was unable to confirm this statement or obtain specific figures on durability of concrete. Steel and aluminum are generally considered more durable than wood.

Heat and Cold

Some plastic lumber has a tendency to expand and contract with changes in temperature. One manufacturer noted that a 6-foot recycled plastic lumber board may expand or contract a quarter of an inch with a 50° Fahrenheit temperature fluctuation. At least one manufacturer said that extremes of heat and cold can cause warping or cracking, but two government purchasers indicated that they had not witnessed problems with plastic lumber due to temperature changes. One manufacturer's product literature states that single-resin plastic lumber is better than commingled plastic because different resins expand and contract at different rates, causing internal stresses that may cause warping. According to an independent consultant, wood/plastic composite lumber expands and contracts much less than does 100 percent plastic, regardless of resin composition. According to this consultant, incidents of warping in plastic lumber have declined as manufacturers have improved quality control. The chair of ASTM Subcommittee D20.20.01 *Plastic Lumber and Shapes* commented that plastic inherently has a larger thermal expansion than wood. This tendency to expand and contract based on temperature changes can be controlled by putting in glass or other reinforcements, and can also be accounted for in the design of park and recreational furniture.

A purchaser for the state of Wisconsin mentioned that small table top grills can damage the appearance of plastic lumber picnic tables. Hot coals from these grills can melt the plastic and leave ugly scars. According to one government purchaser, in areas prone to vandalism, plastic lumber picnic tables are better than wooden tables because plastic lumber catches fire less easily. ASTM Subcommittee D20.20.01, has a task group currently studying combustion and combustibility issues.

In general, plastic takes a relatively long time to heat up, but also takes a fairly long time to cool down. Heat is a performance issue with regard to steel or aluminum park and recreational furniture. Metal components absorb heat more quickly than either wood or plastic lumber and retain heat longer. This can cause some discomfort to users during the summer or where metal furniture has prolonged exposure to direct sunlight. Wood is generally considered to be a cooler material than 100 percent plastic lumber, but wood/plastic composite lumber is comparable to wood.

Maintenance Issues

Many manufacturers of plastic lumber park and recreational furniture say that one advantage of this material is that it is virtually maintenance free. Wood equipment needs to be inspected regularly for splinters and rotting. It also may need to be painted, stained, or treated on a regular basis. PLTA's 1996 report mentioned that the commercial parks and recreation industry constitutes 50 to 70 percent of the plastic lumber market in part because of maintenance issues. According to an industry consultant, aluminum is virtually maintenance-free. Steel, on the other hand, requires frequent painting, as oxidization can be an issue.

One other difference between plastic lumber park and recreational furniture and wood is its resistance to graffiti. A purchaser with the state of Wisconsin mentioned that parks and other outdoor areas particularly vulnerable to graffiti tend to favor plastic lumber benches and tables because they are difficult to carve into and write on and easier to clean up. If written or painted on, plastic lumber can either be cleaned with a solvent or sanded. A number of plastic lumber manufacturers state that the advantage of plastic lumber is that it is the same color all the way through, so that if it is sanded down, it will not require painting.

A contact in King County, Washington, mentioned that plastic lumber picnic tables may need to be washed more frequently than wooden tables, which could add maintenance costs. According to a purchaser with the state of Wisconsin, the maintenance required for wooden picnic tables does not add significant costs to park budgets. In a period of declining budgets, however, many states have fewer employees available for routine maintenance, and these employees could be doing other projects in the parks if they were not maintaining outdoor furniture.

Strength and Creep Properties

According to an industry consultant, composite lumber has greater tensile strength than 100 percent plastic lumber. Plastic lumber may bend or sag under weight. According to this consultant, composite lumber resists bending and warping better than 100 percent plastic does.

Creep is a measure of how much a material deforms under load weight. To test for creep, a length of lumber is suspended between two supports and a weight is placed in the middle. According to one materials engineer, plastic lumber has more tendency to creep than wood. In the above described situation, wood may creep less, but it will fracture under a strain of approximately 0.7 percent. By contrast, plastic lumber made of 100 percent polyethylene requires a strain of 600 to 800 percent before fracturing. In other words, plastic lumber may bend or sag under weight more than wood, but under strain, it will bend much more than wood before it breaks.

Weight

Plastic lumber park and recreational furniture can weigh two to three times more than wooden furniture. In areas where picnic tables are set in concrete, the additional weight of plastic lumber can make these fixtures more permanent and durable. When picnic tables are free standing, however, weight can be an issue, making it difficult for people to move picnic tables together to create a group setting. In some areas, picnic tables need to be moved aside in order for the grass underneath and around them to be mowed. A plastic lumber picnic table weighs approximately 200 to 300 pounds, which can make it difficult for maintenance workers to move it. The weight of plastic lumber picnic tables can be a particular issue in areas with vandalism. If a group of vandals move a table to a new location such as a lake, it can

be difficult for park staff to move it back. Steel is obviously a heavier material than wood or plastic lumber, and aluminum is about half the weight of steel. One independent consultant indicated, however, that manufacturers can circumvent the weight issue with steel through design modifications.

Safety

The safety manager of Rock Creek Park, Washington, DC, stated that the park had recently purchased a number of plastic lumber picnic tables and benches. He has some reservations about the tables since the additional weight could cause back injuries when the furniture is moved to accommodate large gatherings. He noted, however, that one very important benefit of plastic lumber picnic tables in terms of safety is that the tables do not require painting with paints that release hazardous volatile organic compounds and require disposal as hazardous wastes.

Steel normally is only used for park and recreational furniture frames and small parts. Because of its hardness properties, it is generally uncomfortable to sit on and could be unsafe if fallen upon. Aluminum is a softer metal that may not present the same safety concerns.

Other

One restaurant chain indicted that it no longer purchases plastic lumber park and recreational furniture because of negative experiences with warping, discoloration, and displacement and because of the lack of industrywide standards. An independent consultant noted the importance of UV stabilizers and inhibitors to prevent discoloration. In its product literature, a manufacturer of park and recreational furniture from single resin plastic lumber claims that single resin lumber is better than mixed plastic lumber because chemical additives, such as pigments and UV stabilizers, are dispersed unevenly through the various resins. One manufacturer mentioned that one of the benefits of the wood/plastic composite lumber is that, unlike 100 percent plastic, it can be painted if desired. Wood is more sensitive to moisture, and tends to warp or swell when it gets wet.

c. Availability and Competition

EPA identified and communicated with 19 manufacturers of park and recreational furniture, 15 of which manufacture products using recovered materials. EPA also identified, but did not communicate with, 36 additional manufacturers or distributors. The majority of these manufacturers and distributors sell their products nationally.

d. Economic Feasibility

Plastic lumber outdoor furniture can be up to 50 percent more expensive than its wooden counterpart. A number of manufacturers state that, over the long term, plastic lumber is more economical because of reduced maintenance costs and increased longevity and durability. The state of Georgia's experience indicates that plastic lumber costs 25 to 35 percent more up front, but is economical over the long term. One independent consultant stated that the cost of plastic lumber has dropped recently and is now only about 20 percent more than wood. The price of steel is comparable to that of plastic lumber. Aluminum can be expensive, costing up to 40 percent more than plastic lumber and 60 percent more than wood.

e. Government Purchasing

The GSA contracting representative for Schedule 781-C *Park and Outdoor Recreational Equipment* said that in 1996, GSA-tracked purchases of picnic tables and park benches by government agencies totaled $3,148,996. This figure includes picnic tables and park benches made from all types of materials; information is not kept on a material-specific basis. The actual figure for Federal spending is approximately 20 percent larger, since the U.S. Postal Service (USPS) and the U.S. Department of Defense (DOD) often buy "off schedule."

The National Park Service (NPS) said many national parks do buy picnic tables and park benches, but that no aggregate figures are available since purchasing is now decentralized. NPS encourages purchasers to buy items with recycled content. Rock Creek Park recently purchased plastic lumber park and recreational furniture. The Edwin W. Forestrief National Wildlife Refuge in New Jersey, a U.S. Fish and Wildlife Service reserve, purchased plastic lumber picnic tables and park benches and is satisfied with

their performance. The Prince William Forest National Park in Triangle, Virginia, has repeatedly purchased plastic lumber picnic tables and is so satisfied that it would like to replace all of its old wooden tables with recycled plastic lumber tables. The Navy stated that naval bases purchase park and recreational furniture and some of them purchase plastic lumber park and recreational furniture. A manufacturer mentioned that its main government buyers are military agencies; one of its main clients is the Department of Defense in the state of Texas.

f. Barriers to Purchasing

The higher cost of plastic lumber picnic tables and benches might represent a barrier if initial cost is the only factor considered. One state purchaser mentioned that the higher cost might be a barrier to purchasing as state budgets are predicated on low bid and rarely account for life-cycle costs. NPS mentioned that some historical parks are reluctant to buy plastic lumber for aesthetic reasons; the parks prefer to use virgin wood products as they look more historically authentic and match the appearance of the park. The state of Wisconsin noted that one of the biggest barriers to purchasing plastic lumber products is the current lack of industrywide standards.

g. Designation

In CPG III, EPA is proposing to designate park benches and picnic tables containing recovered steel, aluminum, plastic, concrete, or wood. If designated, a procuring agency would not be precluded from purchasing park benches and picnic tables manufactured from other materials. It would simply require that a procuring agency, when purchasing steel, aluminum, plastic, concrete, or wood park benches and picnic tables, purchase these items containing recovered materials when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Plastic lumber used in park and recreational furniture contains varying percentages of postconsumer and total recovered materials content. All of the manufacturers of 100 percent HDPE plastic lumber that EPA contacted use 100 postconsumer material from milk jugs, detergent bottles, pop bottles, and other HDPE products. Total recovered-content percentages for HDPE plastic lumber range from 20 to 100 percent, including 20 to 100 percent postconsumer HDPE and 10 to 90 percent recovered material. Wood/plastic composite lumber can be made with 50 percent recovered wood waste and 50 percent postconsumer HDPE. One manufacturer of fiberglass/plastic composite lumber uses 75 percent postconsumer plastic and 25 percent recovered fiberglass.

Aside from the plastic lumber components, park benches and picnic tables often use steel for structural elements, and all steel is made with 25 to 100 percent recovered materials. Although steel is commonly used in structural elements of such furniture, it is not often used for the entire bench or table. EPA was able to identify only one manufacturer of steel park benches produced from 70 percent postconsumer steel. One manufacturer makes tables and benches out of 100 percent recovered aluminum, and another makes park and recreational furniture from 25 percent recovered aluminum. The only manufacturer found to use concrete to make tables and benches reported that it does not use any recycled materials. EPA obtained information from 15 manufacturers of park and recreational furniture using recovered materials. This information is displayed in Table 17.

Table 17

Recovered Materials Content of Park and Recreational Furniture

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 100 Company B: 100 Company C: 100 Company D: 100 Company E: 100 Company F: 100 Company G: 100 Company H: 100 Company I: 90 Company J: 25 Company K: 100 Company L: 96 Company M: 100 Company N: 0-100 Company O: 90 Company P: 25 Company Q: 90	100 100 100 100 100 100 100 100 90 25 100 96 100 0-100 90 100 100
Plastic (Unspecified)	Company R: 95 Company S: 60 Company T: Unspecified Company U: 70 Company V: 100 Company W: 100	100 100 100 70 100 100

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastic (Unspecified) (cont.)	Company X: 70 Company Y: 50-100 Company Z: 100 Company AA: 100 Company BB: 100 Company CC: 50-100 (comp. plastic/wood/sawdust) Company DD: 51-75 (comp. plastic/wood/sawdust) Company EE: Unknown Company FF: 40-60 Company GG: 30-70 Company HH: 85-90	70 50-100 100 100 100 50-100 25-49 100 100 30-70 100
Mixed Resins (HDPE, PET, PE, LDPE)	Company II: 97	97
HDPE, Commingled Plastic (Unspecified Resins)	Company JJ: 75 (HDPE) Company KK: 50-100 (HDPE)	100 100 (0-50 Recovered Plastic)
Mixed Resins (HDPE, LDPE, PET, PP)	Company LL: 0-97	0-97
Mixed Resins (PET, HDPE, LDPE, LLDPE, PVC, PS, and other)	Company MM: 100	100
Mixed Resins (PE, PS, PP)	Company NN: 10-60	40-90
Mixed Resins (HDPE, LDPE, LLDPE, PP)	Company OO: 90-95	100
PE, Fiberglass	Company PP: Unknown	100
LDPE, Wood, Sawdust	Company QQ: 50 (LDPE)/ 50 (Wood/Sawdust)	100
LDPE, PP	Company RR: Unknown	100
Steel/Plastic	Company SS: 25 (Steel)/ 75 (Plastic)	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 park benches and picnic tables containing recovered materials.

Table 18

Draft Recovered Materials Content Recommendations for Park and Recreational Furniture (Park Benches and Picnic Tables)

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastics	90-100	100
Plastic composites	50-100	100
Aluminum	25	25
Concrete	--	15 - 40
Steel	16 - 25	100

Notes: "Plastics" includes both single and mixed plastic resins. Picnic tables and park benches made with recovered plastics may also contain other recovered materials such as sawdust, wood, or fiberglass. The percentage of these materials contained in the product would also count toward the recovered materials content level of the item.

c. Specifications

EPA was unable to locate any ASTM specifications specifically addressing the use of steel or aluminum (either recycled or virgin) in park benches or picnic tables. One manufacturer of steel benches and tables verified this finding, citing as a reason the established history usage and well known performance of the materials in such applications.

PLTA has been working with ASTM's Subcommittee D-20.20.01 to develop several test methods for plastic lumber. One hundred percent recycled plastic lumber cannot be tested using the same tests already developed for virgin plastic. Tests on virgin plastic are performed on small cross-sections of the material. This is an accurate indicator of how the plastic will perform, as it is a homogeneous material.

Plastic lumber, however, is not always homogeneous in its construction, so tests on a cross section of this material do not accurately predict how a length of lumber will perform in certain circumstances. For this reason, new test methods have been developed for lengths of lumber. These test methods apply to all types of plastic lumber or equivalent materials that are not homogeneous at the cross-section. These test methods were recently finalized and are scheduled to be available as of early 1998. These test methods are as follows:

- D 6108-97 Standard Test Method for Compressive Properties of Plastic Lumber.
- D 6109-97 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastic Lumber.
- D 6111-97 Standard Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement.
- D 6112-97 Standard Test Method for Compressive and Flexural Creep and Creep Rupture of Plastic Lumber and Shapes.
- D 6117-97 Standard Test Method for Mechanical Fasteners in Plastic Lumber and Shapes.

A draft test method is also under review for shear properties. In addition, a task group of the ASTM Subcommittee is developing performance specifications for plastic lumber and shapes. These specifications will be divided based on the modulus of the material; modulus is a measure of the products' stiffness.

An industry consultant recommends that purchasers only buy from manufacturers who willingly provide the results of physical and mechanical product testing done by an outside testing lab. This contact believes that independent testing is essential because the quality of plastic lumber products currently varies tremendously.

B. Playground Equipment

1. Item Description

Playground equipment is found in parks, schools, child care facilities, institutions, multiple family dwellings, restaurants, resort and recreational developments, and other public use areas. Major types of playground equipment include slides, swings, climbing equipment, merry-go-rounds, seesaws, and spring rocking equipment. Other playground components include stairways and ladders, rungs and other handgripping components, handrails, protective barriers, and platforms. Playground equipment is usually designed to be age appropriate and is often divided into equipment for 2- to 5-year-olds and 5- to 12-year-olds.

Playground equipment can be made with a number of different materials. Many playgrounds have railings and structural support pieces made out of one material, fittings made out of another, and decks and platforms made of a third material. Galvanized steel is often used for railings and structural support, but these items can also be made with aluminum. Fittings, such as the bolts that hold chains to swings, are usually made from stainless steel or aluminum. Decks, platforms, and slides can be made from steel, aluminum, plastic, wood, and plastic lumber. Much information is already available about the performance of steel, aluminum, and wood, so this product description will focus on playground equipment made with plastic lumber.

Plastic Lumber

The ASTM draft 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.” (Note: 50 weight percent resin means that 50 percent of the product by weight consists of a plastic resin.) 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 shades. PLTA identifies four main technologies used to produce recycled plastic lumber.

- **Single-polymer systems made from recycled HDPE.** EPA's research noted that most of the manufacturers of 100 percent HDPE plastic lumber use 100 percent postconsumer HDPE for their products. This HDPE often comes from sources such as used milk jugs, water jugs, detergent bottles, and soda bottles.

- **Mixes of recycled PE and/or other recycled plastics (commingled plastics).** EPA's research identified several different mixtures of resins that fall into this category, including HDPE and LDPE; PE and PP; and HDPE, LDPE, LLDPE, and PP. In addition, a few manufacturers were identified who make lumber from unspecified resins.
- **Fiberglass reinforced polyethylene.** EPA's research revealed that a few manufacturers reinforce plastic lumber with fiberglass rods, while others disperse fiberglass into the plastic lumber to increase its stiffness.

- **Wood/thermoplastic composites.** Some manufacturers blend plastic resin with wood chips and/or sawdust. A typical blend is 50 percent recovered plastic (usually HDPE) and 50 percent recovered wood.

When recycled plastic is mixed with wood, fiberglass, or some other material to make lumber, the end product is generally referred to as "composite lumber."

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, the HDPE is ground up, melted, and mixed with additives. These additives frequently include 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).

2. Rationale for Designation

EPA believes that playground equipment containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Playground equipment can be made with recovered wood, steel, aluminum, HDPE, LDPE, LLDPE, PP, and other resins.

According to one manufacturer, extruding HDPE into a mold requires approximately 6.3 milk and water jugs to make one pound of 100 percent HDPE plastic lumber. Another manufacturer said that in their continuous extrusion process, it takes seven milk jugs to make a pound of plastic lumber. A third manufacturer stated that their continuous extrusion process requires approximately nine milk jugs to make a pound of plastic lumber. This manufacturer said that the most common lumber profiles used in playground equipment are 4 by 6-foot and 6 by 6-foot lengths. A 4 by 6-foot lumber profile weighs approximately 5 pounds per foot, and a 6 by 6-foot lumber profile weighs approximately 7 pounds. Assuming 6.3 to 9 milk jugs per pound, 1 foot of a 4 by 6-foot lumber profile would use approximately 31.5 to 45 milk and water jugs (HDPE). Therefore, if a Federal agency were to buy 1,000 linear feet of 4 by 6-foot dimensional lumber used in playground equipment, it would divert between 31,500 and 45,000 milk jugs from the MSW stream. Similarly, if a Federal agency were to buy 1,000 linear board feet of 6 by 6-foot dimensional lumber, it would divert between 44,100 to 63,000 milk and water jugs from the MSW stream. EPA measured a standard set of playground equipment and found it to contain between 300 and 500 square feet of lumber. Therefore, a standard playground can contain between 31,500 and 63,000 milk and water jugs.

There are many different configurations for playground equipment using varying amounts of plastic lumber. One private purchaser of 100 percent HDPE plastic lumber playground equipment notes that the playground set they purchased, which includes three slides, used 86,000 milk jugs.
A standard set of playground equipment sold by one manufacturer, including four slides, climbing equipment, and a number of platforms, uses 10,000 pounds of recycled plastic, 1,500 pounds of aluminum, and 2,000 pounds of recycled steel. Appendix I of this document discusses the generation and recovery of aluminum, steel, wood, and plastic in MSW.

b. Technical Feasibility and Performance

A number of technical and performance issues exist with respect to the different materials used to make playground equipment. In particular, wood and plastic lumber playground equipment differ in terms of their longevity and durability, the effects of temperature, maintenance, strength, weight, and other issues. Different kinds of plastic lumber also differ with respect to these technical considerations.

Longevity and Durability

Several manufacturers say plastic lumber playground equipment will last two to three times longer than its wooden counterpart. They also note that plastic lumber is resistant to rot, termites, and deterioration.

Heat and Cold

Some plastic lumber has a tendency to expand and contract with changes in temperature. One manufacturer noted that a 6-foot recycled plastic lumber board may expand or contract one-quarter inch with a 50°F temperature fluctuation. Extremes of heat and cold can cause warping or cracking. One manufacturer's product literature states that single-resin plastic lumber is better than commingled plastic, because different resins expand and contract at different rates, causing internal stresses that may cause warping. According to an independent consultant, wood/plastic composite lumber expands and contracts much less than does 100 percent plastic. The chair of ASTM Subcommittee D20.20.01, *Plastic Lumber and Shapes*, commented that plastic inherently has a larger thermal expansion than wood. This tendency to expand and contract based on temperature changes can be controlled by putting in glass or other reinforcements. This tendency can also be accounted for in the design of playground equipment.

One manufacturer of 100 percent plastic lumber commented that their plastic lumber can heat up more quickly than wood, and that, for customers in hot climates, they recommend light-colored material. Heat is also a performance issue with regard to steel or aluminum playground equipment, such as slides. These metal components can heat up more quickly than either wood or plastic and retain heat longer.

Maintenance Issues

Manufacturers of plastic lumber playground equipment say one advantage of this material is that it is virtually maintenance-free. Wood equipment needs to be inspected for splinters and rotting. It also needs to be painted, stained, or treated on a regular basis. Plastic lumber playground equipment, by contrast, is usually the same color all the way through and does not need to be painted. One private purchaser noted that wooden playground equipment requires a lot of maintenance, including treating to prevent rotting and damage from UV rays. By contrast, with plastic lumber playground equipment, the only maintenance required is tightening the bolts.

One other advantage of plastic lumber playground equipment over wood is its resistance to graffiti. Plastic lumber is more difficult to carve into. If written or painted on, it can either be cleaned with a solvent or sanded down. Plastic lumber manufacturers say the advantage of plastic lumber is that it is the same color all the way through, so that if it is sanded down, it will not require painting. One private purchaser confirmed that this solid coloring is an advantage, since wooden playground equipment requires touch-up painting for nicks and scratches.

Strength and Creep Properties

According to an industry consultant, composite plastic lumber has greater tensile strength than 100 percent plastic lumber. Plastic lumber may bend or sag under weight. According to this consultant, composite lumber resists bending and warping better than 100 percent plastic does. Plastic lumber of both types has greater tensile strength than virgin wood. In other words, plastic lumber is much less likely to break under strain.

Creep is a measure of how much a material deforms under load weight. To test for creep, a length of lumber is suspended between two supports and a weight is placed in the middle. Plastic lumber has more tendency to creep than wood. According to an industry consultant, 100 percent plastic lumber can be used in playground equipment but has demonstrated a problem when bolted or nailed and used in spans of more than 4 feet (for instance, above a swing). According to a manufacturer, this tendency to creep can be compensated for by increasing the centers of support (e.g., from 18 inches apart to 12 inches under decks). Composites do not experience similar problems due to the presence of wood fiber. In the above described

situation, wood may creep less, but it will fracture under a strain of approximately 0.7 percent. By contrast, plastic lumber made of 100 percent polyethylene requires a strain of 600 to 800 percent before fracturing. In other words, plastic lumber may bend or sag under weight more than wood, but under strain, it will bend much more before it breaks than wood. This tendency to bend rather than break under weight makes plastic lumber potentially safer than wood in playground applications.

Safety

Safety is a key issue with playground equipment. In 1990, the U.S. Consumer Products Safety Commission (CPSC) estimated that about 150,000 victims were treated in U.S. hospital emergency rooms for injuries associated with public playground equipment.

One private purchaser of plastic lumber playground equipment noted a few reasons why plastic lumber is better from a safety perspective. It does not rot or splinter, and it does not require treatment with potentially hazardous chemicals. Wood used in playground equipment is commonly treated with "inorganic arsenicals," and special care must be taken to ensure that the level of dislodgeable arsenic is minimal. In fact, CPSC urges purchasers to "obtain documentation from the manufacturer that the preservatives or other treatments applied to the equipment would not present a hazard to the consumer." CPSC also notes that wood playground equipment should be inspected regularly for rot and splinters.

In addition, CPSC recommends that "to avoid the risk of contact burn injury in geographical regions where intense sunlight can be expected, bare or painted metal surfaces on platforms and slide beds should be avoided unless they can be located out of the direct rays of the sun."

In short, plastic lumber playground equipment has potential safety benefits when compared to playground equipment made with other materials. It conducts less heat than metal equipment. It is more resistant to rot, splintering, and breaking than wooden equipment. And unlike wood, it does not need to be treated with potentially hazardous chemicals.

Other

In its product literature, a manufacturer of single-resin plastic lumber claims that single-resin lumber is better than mixed plastics, because chemical additives such as pigments and UV stabilizers are dispersed unevenly through resins with different properties.

c. Availability and Competition

EPA identified and communicated with nine manufacturers of playground equipment, eight of which use recovered materials in their products. The majority of these manufacturers sell at the national level. EPA also identified, but did not communicate with, nine additional manufacturers.

d. Economic Feasibility

Playground equipment made with plastic lumber can cost up to 50 percent more than its wooden counterpart. Manufacturers state that over the long term, plastic lumber saves money due primarily to longevity and lower maintenance costs. One private purchaser said the plastic lumber playground equipment he bought was cost competitive with wooden equipment. This purchaser noted that when the lack of maintenance costs were figured in, this playground equipment was less expensive over the long term.

e. Government Purchasing

The GSA contracting representative for Schedule 781-C, *Park and Outdoor Recreation Equipment*, said that, in 1996, GSA-tracked purchasing of playground equipment totaled $4,118,035. This figure included playground equipment made from all types of materials; the contact was unable to provide specific information on the materials used. The contact estimates that the actual figure for Federal spending is approximately 20 percent higher since USPS and DOD often buy “off schedule.”

EPA contacted HUD, NPS, the U.S. Department of the Interior, and FHWA. HUD said that purchasing of playground equipment is done by individual housing projects. NPS said that, in general, national parks do not purchase playground equipment because of liability issues. Purchasers of

playground equipment include the U.S. Army and other branches of the Armed Services and the GSA child care facilities. The U.S. Navy said that no aggregate figures for purchasing of playground equipment are available as purchasing is decentralized. The states of Georgia, Wisconsin, and Washington said they did not have statewide policies for procurement of playground equipment. One distributor mentioned recent sales to Langley Air Force Base and Fort Smith Naval Base, among other U.S. military purchases.

f. Barriers to Purchasing

Playground equipment made with plastic lumber can cost up to 50 percent more than wooden playground equipment. Greater longevity and reduced maintenance costs may make plastic lumber cost competitive over the long term. Two purchasers mentioned the lack of industry-wide standards as a barrier to buying plastic lumber products, partly because of the liability issues related to playground equipment. One company said they buy playground equipment made from plastic as opposed to plastic lumber. The contact noted that the company prefers plastic, because it has been tested more extensively and has more established standards than plastic lumber.

g. Designation

In CPG III, EPA is proposing to designate playground equipment containing recovered plastic, steel, wood, or aluminum. If designated, a procuring agency would not be precluded from purchasing playground equipment manufactured from other materials. It would simply require that a procuring agency, when purchasing playground equipment made from plastic, steel, wood, or aluminum, purchase these items with recovered materials when these items meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Playground equipment often uses steel for structural pieces, and all steel has recycled content of 25 to 100 percent. One manufacturer makes posts and other structural pieces out of 100 percent recovered aluminum.

Plastic lumber used in playground equipment contains varying percentages of postconsumer and total recovered materials. Total recovered materials content for HDPE plastic lumber ranges from 5 to 100 percent, consisting of 5 to 100 percent postconsumer HDPE. Wood/plastic composite lumber can be made with 50 percent recovered wood waste and 50 percent postconsumer HDPE. One manufacturer of fiberglass/plastic composite lumber uses 75 percent postconsumer plastic and 20 percent recovered fiberglass. Information obtained from manufacturers on recovered materials content is displayed in Table 19.

Table 19

Recovered Materials Content of Playground Equipment (Non-Structural Pieces)

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 100 Company B: 50 Company C: 0-100 Company D: 60 Company E: 100 Company F: 20 Company G: 100 Company H: 100 Company I: 96 Company J: 98.9	100 100 0-100 85-90 100 30-90 100 100 96 98.9

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE, LDPE, LLDPE, and PP	Company K: 90-95 Company L: 90-95	100 100
Plastic (Unspecified Resins)	Company M: 95 Company N: Unspecified	100 Unspecified
Composite Plastic/Fiberglass	Company O: 75 (Plastic)	20 (Fiberglass)/95 (Total)
Steel	Company P: 25-100	25-100

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 20, procuring agencies establish minimum content standards for use in purchasing playground equipment.

Table 20

Draft Recovered Materials Content Recommendations for Playground Equipment

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastic	90-100	100
Plastic composites	50 - 75	95 - 100
Steel	25 - 100	25 - 100
Aluminum	25	25

Notes: "Plastics" includes both single and mixed plastic resins. Playground equipment made with recovered plastics may also contain other recovered materials such as wood or fiberglass. The percentage of these materials contained in the product would also count toward the recovered materials content level of the item.

c. Specifications

Playground equipment is subject to CPSC guidelines and ASTM standard F-1487-95, *Safety Performance Specification for Playground Equipment for Public Use*. Both of these standards note that playground equipment should be "manufactured and constructed only of materials which have a demonstrated record of durability in the playground or similar outdoor setting." The CPSC guidelines do not preclude the use of recovered materials. The ASTM standards note that "any new materials shall be documented or tested accordingly for durability by the playground equipment manufacturer."

Both CPSC and ASTM note issues with regard to the metal fittings and structural pieces used in playground equipment. ASTM states that "metals subject to structural degradation such as rust and corrosion shall be painted, galvanized, or otherwise treated." Similarly, CPSC notes that "ferrous metals should be painted, galvanized, or otherwise treated to prevent rust."

One private purchaser mentioned that, in addition to ASTM and CPSC standards, playground equipment must also meet state and local codes and standards as well as Federal child safety laws.

PLTA has been working with ASTM's Subcommittee D-20.20.01 to develop several test methods for plastic lumber. One hundred percent recycled plastic lumber cannot be tested using the same tests already developed for virgin plastic. Tests on virgin plastic are performed on small cross-sections of the material. While this is an accurate indicator of how the virgin plastic will perform, as it is a homogeneous material, some plastic lumber is not homogeneous in its construction, so tests on a cross-section of this material do not accurately predict how a length of lumber will perform in certain circumstances. For this reason, new test methods have been developed for lengths of lumber. These test methods apply to all types of plastic lumber or equivalent materials that are not homogeneous at the cross-section. These test methods were recently finalized and are scheduled to be available as of early 1998. These test methods are as follows:

- D 6108-97 Standard Test Method for Compressive Properties of Plastic Lumber.
- D 6109-97 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastic Lumber.

- D 6111-97 Standard Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement.
- D 6112-97 Standard Test Method for Compressive and Flexural Creep and Creep Rupture of Plastic Lumber and Shapes.
- D 6117-97 Standard Test Method for Mechanical Fasteners in Plastic Lumber and Shapes.

A draft test method is also under review for shear properties. In addition, a task group of the ASTM subcommittee, working with Batelle Laboratory, is developing performance specifications for plastic lumber and shapes. These specifications will be divided based on the modulus of the material, a measure of the product's stiffness.

An industry consultant recommends that purchasers only buy from manufacturers who willingly provide the results of physical and mechanical product testing done by an outside testing lab. This contact believes that independent testing is essential, because the quality of plastic lumber products currently varies tremendously.

VII. LANDSCAPING PRODUCTS

A. Plastic Lumber Landscaping Timbers and Posts

1. Item Description

Landscaping timbers and posts are used to enhance the appearance of and control erosion in parks, highways, housing developments, urban plazas, zoos, and the exteriors of office buildings, military facilities, schools, and other public use areas. Timbers and posts are used in a number of landscaping applications, such as raised beds, retaining walls, and terracing. Timbers are generally used in horizontal applications, whereas posts are generally used in vertical applications.

Permanent raised beds are generally built with a frame of rocks, bricks, concrete blocks, railroad ties, or landscaping timbers. This frame also serves to keep lawn grass and weeds from invading the bed.

Retaining walls are used to retain soil and control erosion. Terraces can turn a steep slope into flat, usable garden space. Terraces are often made up of a series of retaining walls and resemble a series of elongated steps. One option for terracing is to hold landscape ties in place behind posts driven into the ground. Stone, pressure treated wood, used railroad ties, and plastic lumber can all be used to make these walls.

Landscaping timbers can also be used to frame walkways. Landscaping posts can form the upright portions of trellises used for climbing flowers.

Landscaping timbers and posts can be used in similar applications to lawn and garden edging (designated and described in CPG II). They can provide a border between lawns and flower beds. Timbers and posts differ from lawn and garden edging, however, because they are composed of stiff pieces of lumber as opposed to thin strips or rolls of material.

For many landscaping projects, dimensional lumber, such as 4 by 4-foot lengths, is purchased directly from manufacturers or distributors and is fit together to make the landscaping structures. Some companies sell kits for landscaping applications, such as retaining walls and raised beds.

Railroad ties are often reused as landscaping timbers and posts. Construction remnants can also be reused for landscaping applications, but this is not common. The two other materials commonly used in these landscaping applications are pressure treated virgin lumber or plastic lumber. This product description focuses on plastic lumber landscaping timbers and posts.

Plastic Lumber

ASTM's draft 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 shades. PLTA identifies four main technologies used to produce recycled plastic lumber.

- **Single-polymer systems made from recycled HDPE.** EPA's research noted that most of the manufacturers of 100 percent HDPE plastic lumber use 100 percent postconsumer HDPE for their products. This HDPE often comes from sources such as used milk jugs, water jugs, detergent bottles, and soda bottles.

- **Mixes of recycled polyethylene and/or other recycled plastics (commingled plastics).** EPA's research identified several different mixtures of resins that fall into this category including a mixture of HDPE and LDPE; PE and PP; and HDPE, LDPE, LLDPE, and PP. In addition, a few manufacturers were identified who make lumber from unspecified resins.

- **Fiberglass reinforced polyethylene.** EPA's research revealed that a few manufacturers reinforce plastic lumber with fiberglass rods, while others disperse fiberglass into the plastic lumber to increase its stiffness.

- **Wood/thermoplastic composites.** Some manufacturers blend plastic resin with wood chips and/or sawdust. A typical blend is 50 percent recovered plastic (usually HDPE) and 50 percent recovered wood.

When recycled plastic is mixed with wood, fiberglass, or some other material to make lumber, the end product is generally referred to as "composite lumber." Composite lumber also can be made by mixing plastic and rubber scrap.

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, the HDPE is ground up, melted, and mixed with additives. These additives frequently include UV inhibitors and coloring agents. A blowing agent can also be added to decrease the density of the material. The plastic is then either flowed into a mold (extrusion into a mold) or pulled out of a machine, shaped using a series of sizing plates, cooled, and cut to the desired length (continuous extrusion).

The Plastic Lumber Industry

The PLTA report, *The State of the Recycled Plastic Lumber Industry: 1996*, estimates that the 1996 sales volume for plastic lumber products was between $40 and $60 million. The report also estimates that the industry has been growing at an annual growth rate of 30 to 40 percent. PLTA has identified 27 manufacturers of recycled plastic lumber, including both 100 percent plastic and composite types. The report lists figures for percentages of plastic lumber sales for the park and recreation industry (50 to 70 percent), residential decking (5 percent), marine and waterfront use (5 to 15 percent), material handling (less than 5 percent), and miscellaneous (20 to 30 percent), but does not specifically mention lumber used for landscaping applications.

Three lumber trade associations and a landscaping trade association were unable to provide figures on the volume of virgin wood used for landscaping applications. The landscaping association commented, "in general, there is a lack of sound marketplace data for landscaping."

2. Rationale for Designation

EPA believes that plastic lumber landscaping timbers and posts containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Landscaping timbers and posts can be made with recovered wood (sawdust and wood chips used in composite lumber), HDPE, LDPE, PE, PET, PP, PS, PVC, and other plastic resins. Appendix I of this document discusses the generation and recovery of wood and plastic in MSW.

According to one manufacturer, extruding HDPE into a mold requires approximately 6.3 milk and water jugs to make 1 pound of 100 percent HDPE plastic lumber. Another manufacturer said their continuous extrusion process requires seven milk jugs to make 1 pound of plastic lumber. A third manufacturer stated that their continuous extrusion process requires approximately nine milk jugs to make a pound of plastic lumber. This manufacturer said the most common lumber profiles used in landscaping applications are 4 by 6-foot and 6 by 6-foot lengths. A 4 by 6-foot lumber profile weighs approximately 5 pounds per foot and a 6 by 6-foot lumber profile weighs approximately 7 pounds. Assuming 6.3 to 9 milk jugs per pound, 1 foot of a 4 by 6-foot lumber profile would use approximately 31.5 to 45 milk jugs. Therefore, if a Federal agency were to buy 1,000 linear feet of 4 by 6-foot dimensional lumber, between 31,500 and 45,000 milk jugs would be diverted from the municipal solid waste stream. Similarly, if a Federal agency were to buy 1,000 linear feet of 6 by 6 dimensional lumber, between 44,100 to 63,000 milk jugs would be diverted from the municipal solid waste stream.

One manufacturer of wood/plastic composite lumber made from recovered sawdust and postconsumer LDPE estimates that between 25 and 100 plastic grocery bags are used to make one foot of lumber, depending on the dimensions of this lumber (i.e. 2 by 6-feet, 4 by 4-feet, 6 by 6-feet). If the government were to buy 1,000 linear feet of this lumber, it would divert 25,000 to 100,000 plastic (LDPE) grocery bags from the municipal solid waste stream. This manufacturer also estimates that, in 1996, the company used 50 million pounds of HDPE, LDPE, and LLDPE and 70 million pounds of sawdust to produce their products. They were unable to provide figures regarding the percentage of their products used for landscaping applications.

A manufacturer of mixed resin plastic lumber said it would be too difficult to estimate the amount of recovered materials used in their products, since they use varying amounts of so many different kinds of materials. Their plastic lumber consists of 100 percent postconsumer plastic including PET, HDPE, LDPE, LLDPE, PVC, and PS.

The amount of lumber used in landscaping varies greatly depending on the specific application. One manufacturer estimates that a typical commercial landscaping job might use 50 4 by 4 foot boards.

b. Technological Feasibility and Performance

A number of technical and performance issues exist with respect to the different materials used to make landscaping timbers and posts. In particular, wood and plastic lumber landscaping timbers and posts differ in terms of longevity and durability, the effects of temperature, maintenance, strength, weight, and other issues. Different kinds of plastic lumber also differ with respect to these performance issues.

Longevity and Durability

Manufacturers say plastic lumber timbers and posts will last two to three times longer than their wooden counterparts. They note that plastic lumber is resistant to rot, termites, and deterioration. One manufacturer of wood/plastic composite lumber said that they have performed a special test simulating the extreme conditions of the Florida Everglades (e.g. high amounts of rain and UV exposure). Although the manufacturer declined to provide the results of this test, they guarantee their products for 10 years. Two manufacturers of 100 percent HDPE plastic lumber offer 20 and 25 year warrantees respectively. One government purchaser mentioned that after using plastic lumber for 7 years in a number of applications, including landscape retaining walls, he is convinced that claims about the product's longevity, serviceability, and durability are accurate.

Maintenance Issues

Manufacturers of plastic lumber posts and timbers say one advantage of this material is that it is virtually maintenance-free. Wood timbers need to be painted, stained, or treated on a regular basis. One government purchaser of 6 by 6 foot plastic lumber profiles used in retaining walls confirmed that the plastic lumber is virtually maintenance-free.

Strength and Creep Properties

Terraces and retaining walls built with landscaping timbers must be able to withstand considerable pressure from wet soil. According to an industry consultant, wood/plastic composite lumber has greater tensile strength than 100 percent plastic lumber. Plastic lumber may bend or sag under weight. According to this consultant, composite lumber resists bending and warping better than 100 percent plastic. Plastic lumber of both types has greater tensile strength than virgin wood. In other words, plastic lumber is much less likely to break under strain.

Creep is a measure of how much a material deforms under load weight. To test for creep, a length of lumber is suspended between two supports, and a weight is placed in the middle.
Plastic lumber has a tendency to creep more than wood. In the above described situation, wood may creep less, but it will fracture under a strain of approximately 0.7 percent. By contrast, plastic lumber made of 100 percent PE requires a strain of 600 to 800 percent before fracturing. In other words, plastic lumber may bend or sag under weight more than wood, but under strain, it will bend much more than wood before it breaks.

Heat and Cold

Some plastic lumber has a tendency to expand and contract with changes in temperature. One manufacturer noted that an 8-foot recycled plastic lumber board may expand or contract one quarter inch with a 50° temperature fluctuation. Extremes of heat and cold can cause warping or cracking. One manufacturer's product literature states that single-resin plastic lumber is better than commingled plastic, because different resins expand and contract at different rates, causing internal stresses that may cause warping. According to an independent consultant, wood/plastic composite lumber expands and contracts much less than 100 percent plastic. The chair of ASTM Subcommittee D-20.20.01, *Plastic Lumber and Shapes*, commented that plastic inherently has a larger thermal expansion than wood. This tendency to expand and contract based on temperature changes can be controlled by adding glass or other reinforcements. One government purchaser of plastic lumber used for seven consecutive years in boat docks noted that the lumber has been exposed to temperatures ranging from -38° to 112° with no problems. Another government purchaser of plastic lumber used in landscape retaining walls for 6 years said the product has been exposed to temperatures ranging from 27° to 110° without problems.

Weight

Plastic lumber timbers can weigh two to three times more than wood. Some manufacturers make hollow profile dimensional lumber as well as solid dimensional lumber to compensate for this weight difference. The weight of the plastic lumber may provide an advantage for landscaping timbers and posts used in structural applications by contributing added strength and stability.

Leaching

One environmental organization, reporting on the chemicals used to preserve pressure-treated or creosote-treated lumber, noted, "Studies on the movement of wood preservatives from poles have found that they move from poles into soil and from the soil into aquatic ecosystems." Some states, such as California, have banned the use of creosote. Plastic lumber does not need to be treated with chemicals and so does not have the same potential for leaching.

Other

A plastics consultant noted the importance of UV stabilizers and inhibitors to prevent discoloration. One manufacturer's product literature states that single resin plastic lumber is better than mixed plastics lumber because chemical additives, such as pigments and UV stabilizers, are dispersed unevenly through resins with different properties. One manufacturer mentioned that one of the benefits of wood/plastic composite lumber is that, unlike 100 percent plastic, it can be painted if desired.

c. Availability and Competition

EPA contacted 11 companies who manufacture either specialized landscaping timbers and posts made out of plastic lumber or plastic lumber profiles that can be used for landscaping. EPA also identified 50 manufacturers and/or distributors of plastic lumber. The majority of these companies sell on a national level.

d. Economic Feasibility

Plastic lumber can cost up to 50 percent more than its wooden counterpart. Manufacturers say its longevity, durability, and low maintenance costs make it cost competitive to wood in the long term.

e. Government Purchasing

Materials for landscaping are purchased by all levels of government but the quantity or dollar value is not known. EPA contacted the U.S. Department of Interior, HUD, NPS, FHWA, and the Chief of Naval Operations office. Some U.S. Navy bases purchase landscaping timbers, but the Navy did not have figures on the recovered materials used in these products. Within NPS, a number of parks purchase landscaping timbers and posts, and there are currently 14 proposed landscaping projects that plan to use plastic lumber. The specifications and standards used in these proposed projects were unavailable. The states of Georgia, Washington, and Wisconsin are purchasing landscaping timbers, but could not provide any aggregate figures, because purchasing is decentralized. The Recreation and Park District of the City of Carmichael, California, has purchased dimensional plastic lumber for landscaping applications.

f. Barriers to Purchasing

Plastic lumber can cost up to 50 percent more than wood, which can be a barrier if initial cost is the only criterion considered. One state purchaser noted that one of the biggest barriers to purchasing plastic lumber products is the current lack of industry-wide standards that would ensure consistent product quality.

g. Designation

In CPG III, EPA is proposing to designate plastic lumber landscaping timbers and posts containing recovered materials. A final designation would not preclude a procuring agency from purchasing landscaping timbers and posts manufactured from another material, such as wood. It simply

requires that a procuring agency, when purchasing landscaping timbers and posts made from plastic lumber, purchase them with recovered materials when they meet applicable specifications and performance standards.

3. Procurement Recommendations

a. Recovered Materials Content

Plastic lumber used for landscaping contains varying percentages of postconsumer and total recovered materials content. For 100-percent HDPE plastic lumber, postconsumer content ranges from 20 to 100 percent and total recovered materials content ranges from 20 to 100 percent. Wood/plastic composite lumber can be made with 50 percent recovered wood waste and 50 percent postconsumer HDPE. One manufacturer of wood/plastic composite lumber uses 50 percent "post-industrial" sawdust recovered from furniture, flooring, and other plants, and 50 percent postconsumer mixed polyethylene (LDPE, HDPE and LLDPE), primarily consisting of LDPE grocery bags and plastic wrap. A manufacturer of mixed-resin plastic lumber uses a 100 percent postconsumer blend of resins including LDPE, LLDPE, HDPE, polystyrene (PS), polyethylene tetraphthalate (PET) and PVC, from materials such as plastic wrap, yogurt cups, and bottle caps. One manufacturer of fiberglass/plastic composite lumber uses 75 percent postconsumer plastic and 20 percent recovered fiberglass. Table 21 details the postconsumer and recovered materials content of the lumber produced by manufacturers contacted by EPA, listed in the Recycled Products Guide, or listed on the Internet.

Table 21

Recovered Materials Content of Landscaping Timbers and Posts

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 25-90 Company B: 0-100 Company C: 75-100 Company D: 100 Company E: 50 Company F: 0-100 Company G: 100 Company H: 100 Company I: 100 Company J: 100 Company K: 100 Company L: 80 Company M: 25 Company N: 95 Company O: 100 Company P: 0-100 Company Q: 96 Company R: 80-100 Company S: 30-50 Company T: 95 Company U: 85-95 Company V: 100	25-90 0-100 75-100 100 100 0-100 100 100 100 100 100 80 100 100 100 0-100 96 80-100 100 100 85-95 100
LDPE, HDPE, LLDPE/Sawdust	Company W: 50	100
HDPE, Fiberglass	Company X: 75 HDPE	95 (20 recovered fiberglass)
HDPE, LDPE	Company Y: 90	100
HDPE, Commingled Plastic (unspecified resins)	Company Z: 50-100	100 (0-50 recovered plastic)

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
LDPE, PP	Company AA: 100	100
Mixed Resins (PET, HDPE, LDPE, LLDPE, PVC, PS, Other)	Company BB: 100	100
Mixed Resins (HDPE, LDPE, LLDPE, PP)	Company CC: 90-95	95-100
Mixed Resins (HDPE, LDPE, PET, PP)	Company DD: 80	100
Mixed Resins (HDPE, PP, PET)	Company EE: 100	100
Mixed Resins (HDPE, PET, PE, LDPE)	Company FF: 97	97
Plastic (unspecified)/Wood/Sawdust	Company GG: 100	100
Plastic (unspecified)	Company HH: 100	100
	Company II: 50-100	50-100
	Company JJ: 95	100
	Company KK: 100	100
	Company LL: 0-100	0-100
	Company MM: 100	100
	Company NN: 80	100
	Company OO: 95	100
	Company PP: 50	100
	Company QQ: 40-60	100
	Company RR: 80-100	80-100
	Company SS: varies	96
	Company TT: varies	100
	Company UU: 90	100
	Company VV: 30-50	100
	Company WW: 50	100
	Company XX: 100	100

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastic (unspecified)/Rubber tires	Company AAA: 100	100
PE	Company BBB: 60	100
	Company CCC: 97	97

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 22, procuring agencies establish minimum content standards for use in purchasing landscaping timbers and posts.

Table 22

Draft Recovered Materials Content Recommendations for Landscaping Timbers and Posts

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	25 - 100	75 - 100
Mixed plastics/sawdust	50	100
HDPE/Fiberglass	75	95
Other mixed resins	50 - 100	95 - 100

Note: EPA's recommendations do not preclude a procuring agency from purchasing wooden landscaping timbers and posts. They simply require that procuring agencies, when purchasing plastic landscaping timbers and posts purchase these items made with recovered materials when the items meet applicable specifications and performance requirements.

c. Specifications

PLTA has been working with ASTM's Subcommittee D-20.20.01 to develop several test methods for plastic lumber. One hundred percent recycled plastic lumber cannot be tested using the same tests already developed for virgin plastic. Tests on virgin plastic are performed on small cross-sections of the material. This is an accurate indicator of how the virgin plastic will perform as it is a homogeneous material. Plastic lumber, however, is not homogeneous in its construction, so tests on a cross-section of this material do not accurately predict how a length of lumber will perform in certain circumstances. For this reason, new test methods have been developed for lengths of lumber. These test methods apply to all types of plastic lumber or equivalent materials that are not homogeneous at the cross-section. These test methods were recently finalized and are scheduled to be available as of early 1998. These test methods are as follows:

- D 6108-97 Standard Test Method for Compressive Properties of Plastic Lumber.
- D 6109-97 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastic Lumber.
- D 6111-97 Standard Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement.
- D 6112-97 Standard Test Method for Compressive and Flexural Creep and Creep Rupture of Plastic Lumber and Shapes.
- D 6117-97 Standard Test Method for Mechanical Fasteners in Plastic Lumber and Shapes.

A draft test method is also under review for shear properties. In addition, a task group of the ASTM subcommittee, working with Batelle Laboratory, is developing performance specifications for plastic lumber and shapes. These specifications will be divided based on the modulus of the material, a measure of the product’s stiffness.

An industry consultant recommends that purchasers only buy from manufacturers who willingly provide the results of physical and mechanical product testing done by an outside testing lab. This contact believes that independent testing is essential, because the quality of plastic lumber products currently varies tremendously.

B. Food Waste Compost

1. Item Description

In May 1995, EPA designated yard trimmings compost in the CPG. At that time, most food waste composting programs were still pilot projects and few large-scale programs existed. The number of composters incorporating food waste grew from 58 to 214 between 1995 and 1997, however, and the market continues to expand. In light of this growth, this product description focuses on food waste composting as a specific sector of the composting industry.

The Composting Council and most compost facility operators contacted support the designation of compost that meets state standards, with no specifications about the specific organic wastes comprising its content. Although EPA has no separate standards for compost, many states use Chapter 40 of CFR Part 503 criteria for "sewage sludge used in land applications" for compost usage. The 40 CFR Part 503 criteria outline maximum pollutant levels, such as heavy metal and chemical levels, and provide standards for other chemicals, such as nitrogen.

EPA's research suggests that it is difficult to talk about "food waste compost" as a completely separate item, since most food waste composting programs add other available organic materials such as wood chips, sawdust, manure, or yard trimmings to their mixes. Different types of compost are better suited to different applications, making information about the composition of the compost feedstocks important to purchasers. Thus, there is no consensus among compost experts about how compost made with a significant amount of food waste should be classified. There is agreement, however, that all types of mature compost have great value due to humus and micro-organism content as soil amendments and fertilizer.

Composting is the controlled biological process of decomposition of organic matter in the presence of air to form a humus-rich material which provides organic matter and nutrients to the soil. Mature compost (in which the composting process is completed) is composed of small brown particles, resembles soil, and is free of pathogens and weed seeds. The Composting Council defines mature compost as follows:

Compost is the stabilized and sanitized product of composting; compost is largely decomposed material and is in the process of humification (curing). Compost has little resemblance in physical form to the original material from which it was made. Compost is a soil amendment, to improve soils. Compost is not a complete fertilizer unless amended, although composts contain fertilizer properties, e.g., nitrogen, phosphorus, and potassium, that must be included in calculations for fertilizer application.

Compost added to soil improves the ability of the soil to support plant growth. The organic matter in compost is particularly beneficial to soil with poor infrastructure. Adding compost to clay soil, for example, reduces soil density and compaction, increases aeration, and increases soil porosity and drainage. These soil changes make plants less susceptible to root rot disease. Compost added to sandy soil increases its ability to retain water and nutrients and increases its resistance to drought and erosion.

Compost can be used in a wide range of applications. It can be used as a substitute for peat moss, potting soil, topsoil, or other organic materials in agriculture, horticulture, silviculture (growing of trees), and in landscaping. In landscaping, compost is used as a soil conditioner, soil amendment, lawn top dressing, potting soil mixture, rooting medium, and mulch for shrubs and trees, and for restoration and maintenance of golf course turf and other sports turf. Compost also can be used for bioremediation of contaminated soils, treatment of contaminated stormwater runoff, volatile organic compound (VOC) emission reduction, and reclamation of mining sites.

2. Rationale for Designation

EPA believes that food waste compost containing recovered organic materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Composting serves as a method of managing organics that would otherwise be landfilled or disposed of in some other manner. Up to 60 percent of municipal solid waste is potentially compostable (including food, paper, and yard trimmings). Appendix I of this document discusses the generation and recovery of food waste in MSW. Although food wastes represent nearly 7 percent of MSW, at present, a small percentage (4.1 percent) of food waste is recovered. Food waste is often composted with yard

wastes which comprise more than 14 percent of MSW. Composting provides a unique opportunity to manage large quantities of food wastes and other organic components of MSW and produce a product that has many beneficial uses.

b. Technological Feasibility and Performance

Currently, food waste composting is primarily being done by large corporations, because economic and permitting issues discourage widespread curbside food waste collection programs. Due to health code regulations regarding food waste's potential to contain pathogenic bacteria, compost facilities must obtain permits to accept food waste for composting. Currently, waste haulers are reluctant to haul food waste, because of the permits needed, its weight and odor problems, its potential to soil trucks, and its potential to contain pathogens. During the composting process, however, these pathogens are terminated so that the compost product does not pose a threat to public health or the environment.

Many composters have had difficulty obtaining the necessary equipment to manage the actual composting of food waste, since food scraps generate leachate and odors and are difficult to handle due to their high moisture content.

Benefits

The nutrient and organic carbon content of compost serves as a food source for micro-organisms in soil, thus increasing the availability of the soil's organic and nutrient content to plants and aiding faster recycling of nutrients within the system. In addition to returning organic materials and nutrients to the soil, other advantages of amending soil with compost include:

- **#** Moderates soil temperature, so that plant roots are warmed in winter and, through water retention, cooled in dry, hot conditions.
- **#** Suppresses some plant diseases, such as wilt and root rot, reducing the need for chemical pesticides and fungicides. Compost has been shown to be important in controlling wilt disease in certain flowers commonly grown for indoor use. Specifically, compost prevents fusarium wilt disease on cyclamens, a disease that is not otherwise treatable.

- Replaces part or, in some cases, all of the fumigants and fungicides used on food crops or landscape projects, according to research conducted at Ohio State University and verified by researchers in Florida, Pennsylvania, and Alabama.

- Releases nutrients in organic form, such as nitrogen, into the soil slowly over time. This property of compost allows for a significant reduction in fertilizer use and is compatible with the rate of plant root uptake.

- Reduces nonpoint source runoff by preventing siltation and by degrading pollutants in the runoff.

- Restores contaminated, eroded, or compacted soil.

Compost's fine organic composition increases the soil's water-holding capacity. Compost also increases water infiltration into the soil. Compost helps to reduce soil compaction and increase soil friability, thus decreasing the erodability of soil. Finally, compost prevents the crusting of soil surfaces, which can otherwise inhibit seedling growth.

c. Availability and Competition

The first nationwide survey of composting projects to include food waste was conducted in 1995. At that time, there were 58 projects in operation or in a demonstration phase. By 1997, that number had risen to 214 operational composting projects in 36 states. The number of food composting projects is expected to rise, as more food processors begin composting the byproducts of food production and with the increased availability of technologies and equipment to make onsite composting viable.

According to some sources, food waste composting is only available on a regional basis. In Maine, for example, food waste programs have grown steadily, but are still operating on a small scale. The state has a 50 percent recycling goal by 2000, and, according to one contact, the seafood, blueberry, and potato industries have begun to look at composting to help meet that goal. At this time, Maine food waste composters could not supply enough product for a large highway project, but could provide compost for smaller landscaping projects such as flower gardens and borders in public parks. The largest growth in food waste composting appears to be in areas of the country with high tipping fees and a high demand for the end product. In particular, continued growth is expected in New Jersey, Florida, and on the west coast.

Nationwide, the number of food waste composting programs is increasing, but it is still a developing industry that faces logistical problems such as transportation. In general, continued growth is expected as more programs are incorporated into existing yard trimmings composting programs.

d. Economic Feasibility

Compost industry experts have demonstrated that mature compost exceeds the performance of peat moss, potting soil, or topsoil in function, since mature compost provides nutrients and acts as a fertilizer, mulch, and potting soil. In an economic comparison, however, experts indicate that peat moss, potting soil, and topsoil are compost's closest competitors. Compost prices are usually comparable to or less than those for peat moss, potting soil, and topsoil. Some specially designed composts are more expensive, however, than traditional potting soil mixes alone. In these cases, the compost is able to substitute not only for potting soil, but also for fertilizers and pesticides, since compost naturally provides extra nutrients and retards diseases and pests.

According to several contacts, curbside food waste collection projects are not currently cost-effective, though there are about 15 to 20 such programs in operation in the country. It is still cheaper to landfill household food waste, due to transportation issues and permit requirements.

Companies that operate large food production facilities have found food waste composting to be economically attractive. While initially only avoiding disposal costs, one such company expects to profit from its operation within the next 2 years through increased revenues from the sale of compost, tipping fee revenues from yard trimmings brought to the site, and improved efficiency of the overall operation.

The same company transports materials, including spent coffee grounds, tea leaves, pasta, and bread dough, from four of its food production plants (one in New Jersey, one in New York, and two in Connecticut) to its compost facility in New Milford, Connecticut. The company sells the finished product to a distributor which then sells the compost in bulk. It uses an aerated windrow system in a closed building for more than 85 percent of the material. The remaining material is processed in one of three open bay compost agitators utilizing specialized equipment. Due to recurring maintenance problems with the equipment, the company plans to eventually process all of its compost using the windrow system. In

fact, the majority of operating composting facilities utilize the windrow composting method. The company sells the finished product to a distributor, which sells the compost in bulk for $2 to $16 per yard, depending upon market fluctuations.

Another large company would not discuss the economics of its operation in detail, but revealed that it sends liquor from cleaning operations, liquid drained out of grains, cattle feed, and bottle cleaning wastes to the city of Merrimack, New Hampshire. Merrimack mixes this waste with municipal sewage waste, composts the mix, and sells the compost locally and to a company that markets the product to more distant markets, including New York City's Central Park.

Institutions with large cafeterias, such as universities, hospitals, and prisons, constitute one of the fastest growing sectors in the food composting arena. Grocery stores and restaurants are also sources of food waste compost. One grocery store's food waste composting program was one of the first in the country. The Seattle-based chain conducted a pilot project with a yard waste composter in 1991 and 1992 that showed its food waste could be efficiently collected, transported, and composted. The store's composting program and recycling program saved them $40,000 in 1993.

Of the 70 correctional facilities in New York State, 48 compost food waste. In fiscal year 1996, these institutions diverted approximately 8,300 tons of food waste for a savings of more than $1 million. These savings included avoided disposal costs, hauling fees, and equipment maintenance and storage costs.

e. Government Purchasing

Military installations alone contain about 20 million acres of land that need to be maintained. The potential compost usage (at 40 cubic yards per acre) for even a portion of this acreage would be significant. A Marine Corps base in Camp Lejeune, North Carolina, for example, has been composting food waste for more than 2 years. The operation mixes food waste from mess halls on the base with shredded paper, cardboard and yard and wood waste. The facility accepts an average of 10 tons of food waste per week, generating more than 2,400 tons of yard trimmings and food waste compost per year for use on the base's more than 150,000 acres. Compost is used on landscaping projects and made available to contractors for use in construction projects.

As part of a 1-year demonstration project, the DOD District Depot in New Cumberland, Pennsylvania, partnered with a nearby state correctional facility to compost its food waste. The depot mixed the food waste with scrap wood from its pallet reclamation operation in two aerated static piles. The finished product was used onsite for landscaping projects and made available to project partners, including the local townships. In addition, Whiteman Air Force Base in Missouri generated 42 tons of food waste compost through a pilot program in the fall of 1995. Using an invessel system, the base mixed yard trimmings with the food waste generated at a recycling conference in Kansas City. They have used the compost on the base and given at least 40 cubic yards to the local solid waste district for a local land improvement program. By the fall of 1998, the base plans to establish a permanent invessel food waste composting operation.

Other Federal markets for compost made with food waste could be substantial. As of 1997, the U.S. Forest Service and Park Service maintain 500,000 miles of roadsides and embankments and millions of acres of land. The U.S. Forest Service manages more than 190 million acres of land at 156 national forests, while the U.S. Park Service manages more than 83 million acres and 369 national parks. At John Muir National Historic Site, for example, fruit residuals from the 8 acres of orchards and vineyards are composted with wood chips, yard trimmings and paper waste. The site composts approximately 6 tons per year in three 20-cubic yard containers. In addition, universities, hospitals, and prisons may be using appropriated Federal funds for their composting operations and purchases.

To assist in the development of Federal markets for compost, President Clinton issued a memorandum entitled, “Environmentally and Economically Beneficial Practices on Federal Landscaped Ground” on April 26, 1994. Agencies are encouraged to develop practical and cost-effective landscaping methods that preserve and enhance the local environment. This memorandum requires the use of mulches and compost by Federal agencies and in Federally funded projects.

f. Barriers to Purchasing

Potting soil, top soil, and peat moss have long-established markets that make it difficult for compost to compete for increased market share. One other barrier identified is that the infrastructure— especially transportation—needed to allow food waste composting programs to flourish is not well established. Waste haulers are currently reluctant to agree to haul food waste, because of its weight, odor, potential to soil

trucks, and potential to contain pathogens. Most food waste operations must contract out for hauling, but finding economical transport is difficult at this stage in market development.

Permitting issues present similar barriers to the implementation of food waste composting programs. Obtaining a solid waste permit can be an expensive and time consuming process. In general, however, state regulations are much less stringent for sites taking only preconsumer vegetative materials such as produce trimmings and spoiled fruits and vegetables from grocery stores, produce terminals, restaurants, and salad processors, as opposed to leftover food from restaurants, institutions, and homes. Also, some states have recognized the potential of composting to increase recycling rates and have tried to streamline regulations to accommodate increased composting of food waste. As a result, according to an industry observer, these states have helped foster much more composting of commercial, institutional, and industrial wastes.

g. Designation

EPA is proposing to revise the yard trimmings compost designation to include compost made from food waste or commingled food waste and yard trimmings.

3. Procurement Recommendations

a. Recovered Materials Content

Food waste compost contains 100 percent recovered materials. Institutions such as prisons, universities, and hospitals are excellent sources of food waste for large-scale or regional composting projects. Commercial establishments, such as grocery stores, restaurants, and cafeterias, also provide materials for use in commercial composting. In addition, a few curbside programs provide food waste to community-based composting programs. Fruit and vegetable trimmings are the most common feedstock composted, followed by kitchen preparation residuals, which can include overcooked pasta, stale rolls, and soups. Most food waste compost programs mix other organic materials, such as sawdust, wood chips, yard trimmings, or manure, with food wastes to produce compost. These other added materials vary

depending upon what is available to the program, and what nutrients or bulking agents are needed to make a high quality compost. Yard trimmings are the most popular amendment to food waste compost, followed by wood chips and sawdust.

Because compost is often tailor-made or designed for specific uses, the recovered materials used can vary. Whether the ingredients are food wastes, manure, biosolids, yard waste, wood chips, or mixed municipal waste, compost may be formulated to fit a particular end use, such as landscaping or land reclamation. A company in Maine that composts ground mussel waste and sawdust, for example, needed additional nitrogen to facilitate the composting process and to decrease odors. Chicken manure, a readily available source of nitrogen in the area, was added to the mix. The additional nitrogen accelerated the composting process, decreased odors, and provided the company with a higher quality end product.

b. Preference Program

EPA recommends that procuring agencies purchase or use compost made from yard trimmings, leaves, grass clippings and/or food wastes in such applications as landscaping, seeding of grass or other plants on roadsides and embankments, as nutritious mulch under trees and shrubs, and in erosion control and soil reclamation.

EPA further recommends that those procuring agencies that have an adequate volume of yard trimmings, leaves, grass clippings, and/or food wastes, as well as sufficient space for composting, should implement a composting system to produce compost from these materials to meet their landscaping and other needs.

c. Specifications

The Composting Council is helping to define and develop industrywide standards for composts made from various combinations of materials, including food wastes. The Composting Council publishes these standards in an operating guide for composting facilities. The guide also provides standards for the suitability of different types of composts made for different applications, depending on the compost mix (59 FR 18878). As stated previously, many states have adopted EPA's 40 CFR Part 503 criteria for "sewage sludge used in land applications" for compost usage. Also, in DOT's *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects 1996*, the agency specifies mature compost for use in road construction and does not specifically preclude the use of food waste in its required composition of compost.

VIII. NON-PAPER OFFICE PRODUCTS

A. Plastic Binders, Clipboards, File Folders, Clip Portfolios, and Presentation Folders

1. Item Description

Plastic binders, clipboards, file folders, clip portfolios, and presentation folders are commonly used office products made from a variety of materials, such as paper, plastics, paperboard, and wood fiber. The EPA has previously designated paper file folders, pressboard binders, and plastic-covered chipboard or paperboard binders. The Agency recently learned, however, that these office products also can be made of solid plastic containing recovered materials. As shown in Table 23, the types of recovered plastic used in these products include HDPE, PE, PET, PS, and an unspecified plastic from recovered circuit boards, telephones, and vacuum cleaners.

Table 23

Materials Used in Solid Plastic Binders, Clipboards, File Folders, Clip Portfolios, and Presentation Folders

Product	Type of Recovered Plastic Used
Binders	HDPE, PE, PET, and recovered circuit boards
Clipboards	HDPE, PS, and unspecific plastic from recovered circuit boards, telephones, and vacuum cleaners
File folders	HDPE
Clip portfolios	HDPE
Presentation folders	HDPE

2. Rationale for Designation

EPA believes that solid plastic binders, plasic clipboards, plastic file folders, plastic clip portfolios, and plastic presentation folders meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Recovered-content plastic binders, clipboards, file folders, clip portfolios, and presentation folders are made of postconsumer HDPE, PE, PET, PS, and an unspecified plastic from recovered circuit boards, telephones, and vacuum cleaners. Appendix I of this document discusses the generation and recovery of plastics in MSW.

According to a distributor of recovered-content HDPE binders, each binder is made from approximately eight plastic bottles collected from residential curbside collection programs. For every 500 binders ordered, therefore, 4,000 HDPE bottles would be diverted from the waste stream.

b. Technological Feasibility and Performance

According to a product distributor, recovered-content HDPE binders, clipboards, file folders, clip portfolios, and presentation folders perform as well as their virgin counterparts. In addition, two government users of these products indicated that the products performed well.

A user of recovered-content PE binders stated that the binders performed well and were less expensive than binders made of virgin materials because of the quantity purchased. In addition, a user of recovered-content PS clipboards stated that the clipboards performed well.

c. Availability and Competition

Recovered-content solid plastic binders, clipboards, file folders, clip portfolios, and presentation folders are available from a number of sources nationwide.

EPA identified one processor of the recovered-content HDPE (minimum 90 percent postconsumer content) used in binders, file folders, clipboards, clip portfolios, and presentation folders. EPA identified at least five distributors that use this recovered material in the products they distribute. The HDPE binders, clipboards, and presentation folders are also available through an additional distributor as a New

Item Introductory Schedule on GSA's Federal Supply Schedule. (The specification numbers are 7510 for binders, 7520 for clipboards, and 7530 for presentation folders.) That distributor's contract with GSA is effective as of November 1, 1996, and runs through October 31, 1999.

EPA also identified five manufacturers and distributors of recovered-content plastic binders, clipboards, and file folders made from other kinds of plastic, including PE, PS, PET, and unspecified plastics.

d. Economic Feasibility

Distributors indicated that the recovered-content HDPE binders, clipboards, file folders, clip portfolios, and presentation folders are priced competitively with their virgin counterparts. Two contacts EPA spoke with stated that the recovered-content HDPE binders were slightly higher in cost than their virgin counterparts. One user stated that he was able to purchase the recovered-content binders despite their higher cost due to a price preference for recovered-content items. This user reported a price differential of 30 cents (Canadian) per binder, making the recycled-content binder 8 percent more expensive than the binder made of virgin materials. A user of recovered-content PE binders stated that they were less expensive than binders made of virgin materials, because of the quantity purchased. A manufacturer of recycled-content PS clipboards and PE binders indicated that its products are cost-competitive to their virgin counterparts. A user of recovered-content PS clipboards did not know whether the clipboards were priced competitively to virgin clipboards.

e. Government Purchasing

The vendor on GSA's Federal Supply Schedule for the recovered-content HDPE binders, clipboards, and presentation folders has received numerous requests for quotes from government purchasers. The company is in the process of responding to these inquires. EPA was unable to identify any Federal government agencies that have already purchased the HDPE products. EPA learned that the Ontario Ministry of Transportation in Ontario, Canada, has purchased recovered-content HDPE binders and is pleased with their performance. The contact stated that the HDPE binders were slightly more expensive than virgin material-content solid plastic binders. According to another source, this price differential results from the slightly higher costs of recycled

resin used in manufacturing binders. This same source stated that higher prices for HDPE binders can also result from consumers' willingness to pay higher costs for items with recycled materials. However, this assessment is not shared by the industry as a whole. Another manufacturer stated that there was no difference in price between their recovered and virgin content HDPE binders. EPA also learned that the school board of Broward County, Florida, has purchased recovered-content HDPE binders; the Missouri Department of Conservation has purchased recovered-content PE binders; and the Recycling and Litter Prevention Division of Fairfield County, Ohio, has purchased recovered-content PS clipboards.

f. Barriers to Purchasing

The slightly higher price of recovered-content solid plastic binders, clipboards, file folders, clip portfolios, and presentation folders may be a purchasing barrier. Although manufacturers indicated that their products were priced competitively to binders made of virgin materials, two users indicated that they were more expensive. One of these users reported a price differential of 30 cents (Canadian) per binder, making the recycled-content binder 8 percent more expensive than the binder made of virgin materials. EPA was unable to determine if the higher price is due to regional differences, but one source indicated that volume purchasing can make recycled-content binders less expensive than those made of virgin materials.

g. Designation

EPA proposes to amend the existing designation of binders to include solid plastic binders containing recovered plastic. EPA proposes to designate plastic clipboards, plastic file folders, plastic clip portfolios, and plastic presentation folders containing recovered plastic. A final designation would not preclude a procuring agency from purchasing these items manufactured from another material. It simply requires that a procuring agency, when purchasing plastic binders, clipboards, file folders, clip portfolios, and presentation folders, purchase these items made with recovered plastic when these items meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Solid plastic binders, clipboards, file folders, clip portfolios, and presentation folders made from HDPE contain a minimum of 90 percent recovered HDPE, all of which is postconsumer. PE binders contain 30 to 50 percent postconsumer PE, and PET binders contain 100 percent postconsumer PET. PS clipboards contain 50 percent postconsumer PS. Clipboards made from an unspecified plastic from recovered telephones and vacuum cleaners contain 15 percent postconsumer plastic. Binders and clipboards made from recovered circuit boards consist of 80 percent of the unspecified recovered plastic.

Table 24 presents information provided by manufacturers of plastic binders, clipboards, file folders, clip portfolios, and presentation folders on recovered content availability.

Table 24

Recovered Materials Content of
Plastic Binders, Clipboards, File Folders, Clip Portfolios, and Presentation Folders

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 100	100
	Company B: 100	100
	Company C: 90	Unknown
	Company D: 100	100
PE	Company E: 50	Unknown
	Company F: 30	Unknown
Plastic (unspecified)	Company G: Unknown	80
	Company H: 15	Unknown
PS	Company F: 50	Unknown
PET	Company D: 100	100

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 25, procuring agencies establish minimum content standards for use in purchasing plastic binders, clipboards, file folders, clip portfolios, and presentation folders.

Table 25

Draft Recovered Materials Content Recommendations for Plastic Binders, Clipboards, File Folders, Clip Portfolios, and Presentation Folders

Product	Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Solid plastic binders	HDPE PE PET Misc. Plastics	90 30 - 50 100 80	90 30 - 50 100 80
Plastic clipboards	HDPE PS Misc. Plastics	90 50 15	90 50 15 - 80
Plastic file folders	HDPE	90	90
Plastic clip portfolios	HDPE	90	90
Plastic presentation folders	HDPE	90	90

Note: EPA's recommendations do not preclude a procuring agency from purchasing binders, clipboards, file folders, clip portfolios, or presentation folders made from another material, such as paper. They simply require that procuring agencies, when purchasing these items made from solid plastic, purchase them made with recovered plastics when these items meet applicable specifications and performance requirements. For EPA's recommendations for purchasing pressboard binders and paper file folders containing recovered materials, see table A-1c in the Paper Products RMAN (61 FR 26986, May 29, 1996). See Table G-3 in RMAN I for EPA's recommendations for purchasing plastic-covered binders containing recovered materials.

c. Specifications

EPA did not identify any specific specifications or standards regarding plastic binders, clipboards, file folders, clip portfolios, and presentation folders.

IX. MISCELLANEOUS PRODUCTS

A. Absorbents and Adsorbents

1. Item Description

Absorbents and adsorbents are used in a diverse number of environmental, industrial, agricultural, medical, and scientific applications to retain liquids and gases. While absorbents and adsorbents are often used in the same applications, they perform fundamentally different functions. *Absorption* is "the incorporation of a substance throughout the body of the absorbing material," whereas *adsorption* is the "gathering of substances over the surface of the adsorbing material." Since absorbent and adsorbent products are used interchangeably in many applications, and are to almost universally called "absorbents," EPA has chosen to use the term *sorbent(s)* to describe all materials and products discussed in this section.

Sorbents are most often used to clean up industrial and environmental oil and solvent spills. They are also used in wastewater treatment, odor control, food processing, septic system maintenance, resource recovery, dust and erosion control, photography, hazardous waste remediation, precious metal recovery, chemical processing, and leachate control of phosphates and nitrates from fertilizers. In addition, sorbents are used in packaging materials, animal bedding, cat litter, protective clothing, gas masks, and personal hygiene products. After reviewing the government procurement of sorbent products, EPA determined that oil and solvent spill cleanup and animal bedding are some of the most common applications for sorbents. These products are purchased with appropriated Federal funds and are commercially available with recovered materials content. This summary, therefore, focuses on these types of sorbents.

Types of Sorbents

As shown in Table 26, sorbent products are manufactured from a variety of organic, inorganic, and synthetic materials, or combinations thereof :

- ***Organic sorbents*** can be manufactured from virgin materials, but most commercially available sorbents are made from organic materials recovered from municipal and industrial solid waste streams.

Inorganic sorbents are generally mined virgin materials, such as perlite or vermiculite. Most inorganic materials can also be recovered and used again through a laundering process (see Section 2b, Technological Feasibility and Performance).

Synthetic sorbents are made from either virgin synthetic materials or synthetics recovered from the municipal and industrial solid waste streams.

Table 26

Sorbent Materials

Organics	**Inorganics**	**Synthetics**
Cork	Clay	Activated carbon
Corn cobs and stalks	Diatomaceous earth	Polymers
Cotton	Perlite	Resins
Ground pecan shells	Pumice	Styrenes
Paper and paperboard	Salt	Silica gel
Peat	Sand	
Rice hulls	Sodium bicarbonate	
Straw	Soil	
Wool		
Wood		
Yard trimmings		

Industry Overview—Sorbents Used for Oil and Solvent Spills

According to industry estimates, the size of the sorbent products market for the types used to clean up oil and solvent spills is $400 to $500 million per year, with an annual growth rate of 30 percent. EPA was unable to determine the market share for each category of sorbent materials. Government agencies and trade organizations all indicated, however, that products made from clays and polymers are the most popular. According to EPA's research, of the three largest sorbent manufacturers, only one sells products made from recovered materials.

The sorbent spill cleanup industry can be divided into the following two categories:

- ***Environmental spills*** that generally occur as a result of liquid hydrocarbons, such as gas or oil, being accidentally released into the natural environment. These spills can occur on both land and water.

- ***Industrial spills*** that occur as a result of industrial or maintenance operations, involving the use of hydrocarbons, chemicals, and other liquids.

One major producer estimates that the market share of sorbents for environmental spills and industrial spills is 20 percent and 80 percent respectively. The industrial spill market can be subdivided into two categories: routine spills, and leaks and emergency spill response, with the former representing about 90 percent of sales.

Industry Overview—Sorbents Used for Animal Bedding

EPA was unable to determine the size of the animal bedding industry. For animal bedding used for both large (e.g., cattle and horses) and small animals (e.g., pets and laboratory animals), however, one manufacturer estimates that the industry is extremely large—possibly a $10 to $11 billion per year industry in the New England states alone. According to this same representative, animal bedding products are always manufactured from organic materials. Sorbents used for animal bedding generally come in particulate (e.g., sawdust) or pelletized form.

Animal bedding consists of primarily byproducts from lumber production. Lumber production byproducts provide the material used in many absorbents. Saw mills that contribute their byproducts range from large central producers to small operators. More than half of the saw mills in the industry are large operations, however, due to the fact that most companies need to operate in greater volume to stay in business.

Forms of Sorbent Products

Sorbents used in spill applications come in many different forms, which determine how they are used and collected after use. Sorbent materials may be either continuous, particulate, or loose fill or bulk form. Continuous materials are those that can be handled as a unit, such as pads, rolls, mops and booms.

Particulates are fine materials that must be spread over a spill area. These materials are often spread over spills on land and then removed by scraping, raking, or using vacuum units. The loose fill or bulk form is typified by wood puff balls rather than granular particulate. These materials are also spread over the spill and then recovered by some mechanical means. A discussion of which form of sorbent is best for a particular application is presented in more detail in Section 2b, "Technological Feasibility and Performance," under the subheading, Criteria for Choosing Sorbent Materials.

2. Rationale for Designation

EPA believes that sorbents used for oil/solvent cleanups and animal bedding containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

MSW

Sorbents are currently being made from mixed office paper, newspaper, paperboard, plastic, rubber, textiles, wood, and yard trimmings recovered from the MSW stream. EPA was unable to determine the total amount of recovered materials being diverted from the MSW stream into the production of sorbent products. One company estimates that it diverts about 2,400 pounds of postconsumer newspapers from the MSW stream each year. Appendix I of this document discusses the generation and recovery of materials in MSW currently used to manufacture sorbent products.

Industrial Waste

Sorbent products also are being manufactured from waste recovered from industrial processes, including the manufacture of lumber, paper, and textiles. Although EPA was unable to determine the total amount of waste generated and recovered from these industries, the following are examples of how much of these wastes are being diverted for the manufacture of other products, including sorbents:

- # ***Lumber Mill Waste—***According to one lumber producer, and as previously noted, recovered sawdust is commonly used for sorbent products, particularly for animal bedding. If the recovered sawdust were not used in sorbent products, however, it would generally be burned or disposed of in landfills. The contact admitted, however, that it is rare for wood waste to be disposed of in landfills. Another company estimates it diverts between 600 and 1,000 tons of wood waste from the lumber industry each year.

- # ***Paper Mill Waste***—One company stated that it diverts approximately 8,000 tons of fines recovered from paper mill sludge each year. Another company indicated it also diverts an estimated 8,000 pounds of sludge fines from the pulp and paper industry each year.

- # ***Textile Waste***—A representative of the Textile Fibers and By-Products Association said the textile industry has been diverting textile fines from sludges into the production of sorbent products for years. In fact, only some textile waste is being disposed of in landfills.

C&D Waste

Some C&D wastes are used for sorbents. Gypsum (calcium sulfate) from construction wallboard trimmings is a component of C&D wastes, although the sorbent manufactured from this waste currently is available only from one regional company in Michigan.

A comprehensive list of C&D debris recovery programs is not available but published reports indicate that programs exist in all parts of the United States and that it is technologically and economically feasible to recover wood for use in products and as industrial boiler fuel, landscaping and hydraulic mulch, sludge bulking media, and animal bedding. According to one article, C&D wood waste generation was about 33.2 million tons in 1996, of which 14.1 million tons were potentially available for recovery; and 19.1 million tons were already recovered, combusted, or were not usable (McKeever, "Wood Residual Quantities in the United States," *BioCycle*, January 1998).

b. Technological Feasibility and Performance

Criteria for Choosing Sorbent Products Used for Spills

The type of sorbents used for spill applications generally depends on the type of substance being sorbed, where the spill occurs, and worker health and safety issues. The type of material(s) used to manufacture sorbents is very important to consider when choosing a sorbent product. Sorbents made from materials that are

incompatible with the substance being sorbed can potentially disintegrate, create a fire hazard, or pose problems for worker safety. Organic sorbents, for example, are incompatible with and should **not be** used to clean up substances such as inorganic acids, caustics, or hydrazines and hydrazides. Sorbents made from organic materials can, however, be used to clean up most oils and fuels (e.g. mineral oil, gasoline, and hydraulic fluid), coolants (e.g., antifreeze), transformer oils (including polychlorinated biphenyls), paints (e.g., latex based, lacquers, and thinner), alcohols, solvents, toxins (e.g., cyanides, sulfamides, and battery acid), and insecticides and herbicides.

According to one manufacturer, using products made with recovered materials can pose some potential problems. Postconsumer wastes are often contaminated with residuals that are incompatible with aggressive materials (e.g., highly flammable jet fuels). The contact also indicated that products used to absorb some types of jet fuel need to have specific nonstatic characteristics.

Where the spill occurs will also affect the type of sorbent that is used. To clean up spills on water, for example, the sorbent used should be hydrophobic, or water resistant, so it will float on water. Sorbents that are not hydrophobic (i.e., hydrophillic) are generally not used for spills on water, as they will sink, causing problems when removing the product from the waterbody. Thus, for spills on water, polypropylene—and a small number of organic sorbent products that are treated to make them hydrophobic—are the most commonly used. According to the *World Catalog of Oil Spill Response Products*, particulate and loose sorbents are also **not** recommended for use on open water because they too "may absorb water and sink or be lost to recovery because of winds, waves, and currents."

End users also must consider how a sorbent product may affect the environment, particularly when cleaning up spills in environmentally sensitive areas (e.g., salt marshes and wildlife refuges). According to an EPA contractor, a spill response team must choose a product that will not negatively impact wildlife or the environment. In costal areas where sea turtles are present, for example, contractors will generally not use sorbents made from plastics. Sorbents made from plastics can resemble jellyfish, a sea turtle's main food source. If ingested by sea turtles, plastics can cause severe digestive problems or even death. Entanglement is also an issue when choosing a sorbent product for areas where sea turtles, manatees, or otters may be present. In these areas, sorbent snares (i.e., sorbents made from thin strands of polypropylene

fibers) should not be used. In such cases, the contractor suggests that organic particulate sorbents (i.e., sweeps) could be used to prevent entanglement. The contact suggested that in cases where wildlife and habitat protection are an issue, organic sorbents would work best.

Worker health and safety issues also can play a role in the selection of sorbent products. A contact from the U.S. Army Corps of Engineers, for example, suggested that sorbent mats, pads, and rolls (made from virgin PP) are the products best suited for the routine spills that occur during machine maintenance operations. These products are easier to handle because they lie flat and keep walking surfaces safe for workers. Particulate sorbent materials, on the other hand, are difficult to clean up and may cause workers to slip. While sorbent mats also are available with recovered material content, the contact suggests that, because they are thicker than mats made from virgin materials, they may compromise the comfort and safety of workers' walking surfaces.

According to a representative of the Coalition for Organic Absorbent Producers (COAP), using clay and diatomaceous earth products can be detrimental to worker health. These products produce airborne crystalline silica, which has been linked to silicosis, a progressive and sometimes fatal lung disease, and cancer. In fact, in some states, such as California, manufacturers of clay sorbent products are now required by law to put warning labels on their products. According to the COAP representative, the Occupational Safety and Health Administration (OSHA) regulates worker exposure levels to silica dust and these regulations are currently being revisited. OSHA has a Permissible Exposure Limit, which is the maximum amount of airborne crystalline silica that an employee may be exposed to during a work shift. OSHA is still revising the ruling on the regulation of these products.

Pollution Prevention Considerations

Under certain conditions, some sorbent materials can be reused or recycled. Some manufacturers of synthetic sorbents, for example, market products that can be reused up to 100 times. Under pressure, synthetic sorbents will release the sorbed substance, allowing it to be recovered and the sorbent to be reused. Manufacturers of organic sorbents, on the other hand, claim their sorbents can be incinerated for energy recovery and that this process leaves very little ash residue. In addition, clay sorbents can be put through a "laundering" process through which the sorbed substance and clay can both be reclaimed for reuse.

Sorbent Products Made from Recovered Materials

According to industry representatives, it is technically difficult and costly to manufacture melt-blown sorbent mats, pads, and rolls from recovered postconsumer PP because the material must be first processed into pellets and then "fiberized." In addition, some industry representatives believe that recovered PP does not produce a fine enough fiber to meet the same performance standards as those for a sorbent made from virgin PP. Contamination of recovered materials may also limit their use for cleaning up acidic or caustic materials, because trace elements of certain contaminates could potentially pose a fire hazards. Contaminates can also damage machinery designed to manufacturer products from virgin materials.

Sorbents also can be manufactured from other types of recovered polymers. For example, one company distributes two types of sorbent mats made from recovered textile waste, including wool, cotton, and PP fibers. These fibers can be woven, needle punched, or layered and subjected to heat to produce sorbent mats. These products can be used effectively for most spill applications, except when the spilled substance is of an unknown origin or known to be caustic or acidic. In such cases, using sorbents made from recovered textile waste could pose a problem because of their organic content (e.g., wood and cotton). In addition, mixtures of various textile fibers do not always provide for consistent performance and generally do not have the same affinity for oil as virgin PP. According to a representative of the company, mats made from recovered materials are recommended for use where small amounts of oil need to be cleaned up, whereas PP works best on heavy drips and splashes.

c. Availability and Competition

Manufacturers and distributors of recovered content sorbents are located throughout the United States, supplying both domestic and international markets. GSA currently has supply contracts with several companies that manufacture or distribute recovered content sorbents. One manufacturer suggested, however, that there are fewer suppliers of sorbents made from organic (i.e., recovered) materials.

d. Economic Feasibility

Manufacturers of recovered content sorbent products claim that their products are cost-competitive with virgin counterparts. While this seems to be true in most cases, NPS prefers clay sorbents because they are the least expensive sorbents available. In addition, a U.S. Army Corps of Engineers representative claims that the recovered content product it uses for emergency spills is very expensive. The cost of transporting sorbent products should also be figured into the cost of sorbent products. Sorbents made from clay tend to cost more to ship than those made from synthetics or organics because clay weighs more. The cost of disposal can also have an impact on the type of sorbent an end user chooses when dealing with hazardous or potentially hazardous waste spills. The cost of recycling, reusing, incinerating, or disposing of sorbents considered to be hazardous can vary from state to state. An EPA contractor, for example, explained that it cost $400 per ton to dispose of clay sorbents in a hazardous waste landfill, whereas it only costs $65 per drum to treat (launder) the clay, which can then be reused.

e. Government Purchasing

Government agencies procure sorbent products through GSA's stock contracts and the Multiple Award Federal Supply Schedule. GSA stock contractors must meet GSA's Commercial Item Description specification for *Absorbent Materials, Oil and Water (For Floors and Decks).* Thus, when purchasing sorbent products from GSA, government agencies are limited to purchasing sorbents made from silicate minerals. When ordering sorbent products directly from a multiple award contractor, however, there are no procurement specifications. Instead, government agencies rely on the manufacturers specifications, and a full range of sorbent products (e.g., organic, inorganic, and synthetic) are available for purchase.

A number of Federal and state agencies purchase a variety of sorbent products, as listed below.

Sorbents Used for Spills

- **The U.S. Coast Guard's Marine Safety and Environmental Protection Division** typically uses PP sorbents to clean up spills on water, and paper or cellulosic sorbents to clean up spills on land (i.e., spills that occur during maintenance of vehicles and boats). The contact did not know, however, if the absorbents made from paper are made from recovered materials.

NPS purchases a variety of sorbent products used to clean up routine and emergency spills on water, and for spills that occur during fleet (i.e., vehicles and boats) maintenance. Although they do not track the purchase of absorbent products, a contact for the NPS claims they spend well over $10,000 on sorbent products each year. **EPA** does not purchase sorbent product. Emergency spill response tasks are handled by EPA contractors, who purchase sorbents for their cleanup activities. One such contractor claims that they mainly use products made from virgin PP . These products come in several different forms, including pads, blankets, sweeps, and 5- and 8-inch booms. These products are used for "light" oils only. For heavy or viscose oils (e.g., #6, bunker-c, and crude oils), the contractor uses a product called *OilSnare* which is made from a recovered PP ribbon material. According to the manufacturer, this product is made from materials recovered from a company that manufactures carpet backing. After the backing has been cut to size, the seconds are sold to companies that manufacture products such as *OilSnare*. The seconds are either first run scraps or reground material. This recovered PP ribbon material can also come from manufacturing seconds from plastic packaging companies.

The U.S. Army Corps of Engineers at Dworshak Dam in Idaho are using *Sea Sweep*, a product made from 100 percent recovered wood waste from the lumber industry, for emergency spill response activities. The supplier of wood waste for *Sea Sweep* however, said that fiber would not necessarily be disposed of in landfills because the company would simply sell the wood waste as animal bedding.

Sorbents Used for Animal Bedding

The **National Institutes of Health (NIH)** purchases more than $10,000 of animal bedding a year, including products made from recovered paper.

The U.S. Department of Energy and one of its contractors purchase a sorbent product made from recovered paper pulp waste. The contractor recently spent more than $100,000 on supplies of the sorbent.

f. Barriers to Purchasing

EPA identified some barriers for procurement of recovered content sorbent products, including government specifications that in some way preclude the use of recovered materials and misconceptions regarding the effectiveness of sorbents made from recovered materials.

A significant barrier appears to be the fact that GSA's stock item specification for sorbents precludes procurement of sorbent products that are not made from silicate minerals. In a November 8, 1995, letter the commissioner of GSA stated:

> At this time, a stock contract for organic sorbents is not practicable. Such procurement would require a technical description covering the varying needs of the Government. Because the industry is still evolving and there are numerous products lacking standardization, it is not feasible to draft and adequate technical document. The Multiple Award Schedule method of procurement is generally used in these circumstances.

According to recent conversations with GSA representatives, it is apparent that the specification will not be changed in the near future. One representative claims that because there are so many different types of sorbent products now available, it would be impossible to stock the warehouses with hundreds of different types of products. Another GSA representative stated that sorbent products are simply "too bulky" to consider stocking different kinds of sorbent products and that it did not make "good economic sense" to do so. This contact also suggested that the customers (i.e., government agencies) have grown to expect mineral sorbents to be available through GSA and that there is no indication from these customers that they want other products made available. If clay sorbents are discontinued as a stock item, as another contact stated, a variety of sorbent products would be available through a multiple award schedule.

Also noted above, NIH's specification for *Laboratory Animal Bedding, Softwood*, could be a possible barrier for procurement of recovered content animal bedding, although NIH does not believe that this specification prevents purchase of animal bedding from recovered materials.

Barriers also stem from attitudes reflecting preconceived judgements regarding the performance of recovered content products. Users prefer to use products they are familiar with and most are used to using sorbents made from PP.

g. Designation

In CPG III, EPA is proposing to designate sorbents containing recovered materials for use in oil and solvent clean-ups and as animal bedding. A final designation would not preclude a procuring agency from purchasing sorbents made from other materials.

3. Procurement Recommendations

a. Recovered Materials Content

EPA contacted 14 companies and identified more than 40 others that manufacture sorbent products from recovered materials. Information obtained from these manufacturers is displayed in Table 27.

Table 27

Recovered Materials Content of Sorbents

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Paper	Company A: Unknown	Unknown
	Company B: 10	100
	Company C: 100	100
	Company D: 95-100	95-100
	Company E: 30	100
	Company F: 10	100
	Company G: 100	100
	Company H: 90-98	90-98
	Company I: 100	100
	Company J: 95	95
	Company K: 100	100
	Company L: 95	100
	Company M: 100	100
	Company N: 100	100
	Company O: 100	100
	Company P: 98	98
	Company Q: 100	100
	Company R: 100	100
	Company S: 100	100
	Company T: 95-100	95-100
	Company U: 100	100
Textiles	Company V: —	95
	Company W: 95-100	95-100
	Company X: —	65-100
	Company Y: 100	100
	Company Z: 100	100

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
PP	Company AA: Unknown Company BB: Unknown Company CC: Unknown	100 25 100
Gypsum	Company DD: 100	100
Wood	Company EE: — Company FF: — Companies GG through TT: Company UU: —	100 Unknown 100 Unspecified
Other Organics	Company VV: — Company WW: —	100 (peanut hulls) 100 (corn stover)
Multi-material	Company XX: —	100 (polymer and cellulose fiber)
PVC	Company YY: 50	50

Sorbents Used in Spill Applications

Representatives from the Spill Control Association of America (SCAA) and a particular supplier of sorbent products estimate that between 50 to 80 percent of the sorbent products currently available are made from some type of recovered material. However, based on the fact that the two largest manufacturers of sorbents do not manufacture their products from recovered materials, this range appears high.

Sorbents used in spill applications are manufactured from a variety of recovered materials, including 100 percent postconsumer newspapers, tires, yard trimmings, and C&D debris, such as wood waste and gypsum. Sorbent products also are made with 100 percent recovered material from the plastics, textile, lumber, and pulp and paper industries. Waste from these processes (usually the unusable short fibers or fines) are sold to companies producing sorbents. These materials are processed and made into various types and forms of sorbent products. The following are just a few of the examples of sorbent products EPA identified that contain 100 percent recovered materials:

- A sorbent manufacturer in Norwalk, Ohio, produces sorbent socks from 100 percent recovered materials from the textile industry. The company purchases textile trimmings (approximately 95 percent polyester and 5 percent cotton fiber dust) from textile manufacturers.

- A company in Everett, Washington, manufactures a product made from 100 percent recovered materials—70 percent from fines recovered from paper manufacturing and 30 percent newspapers recovered from the municipal solid waste stream. The product is sold in particulate form.

- A manufacturer in Denver, Colorado, makes a 100 percent recovered content sorbent from sawdust or "pin-chips" recovered from the lumber industry. The sawdust is subject to a heating processes that removes residual water and natural oils, making the wood fiber particularly sorbent. The product is sold in particulate form.

- A manufacturer and distributor in Tipton, Pennsylvania, sells a sorbent sock product made from 100 percent recovered materials from textile manufacturing waste. While the percentage of the types of fibers in this product may vary, the material is generally a mixture of wool, cotton, and polypropylene fiber.

Due to the wide range of recovered materials used to manufacture sorbents for oil and solvent spills, EPA was unable to identify which type of recovered content sorbent product is most common.

Sorbents Used for Animal Bedding

According to one manufacturer, nearly all animal bedding is made from recovered wood or other cellulosic fiber. For large animals, the contact estimates that straw and other organic wastes recovered from agricultural production comprises between 40 to 50 percent of the market, with the other 50 to 60 percent being manufactured from cellulose fiber sources, such as recovered wood waste, paper and other paper products. The contact also estimates that 99 percent of the animal bedding used for pets and laboratory animals is made from wood residue recovered from the lumber industry. The other 1 percent is made from a variety of recovered organic materials, including rice hulls, ground pecan shells, corn stalks, and straw. Animal bedding for pets and laboratory animals is also made from materials recovered from the MSW stream, such as paper, newspaper, kraft paper, and corrugated boxes.

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 absorbents and adsorbents.

Table 28

Draft Recovered Materials Content Recommendations for Sorbents

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Paper	90 - 100	100
Textiles	95 - 100	95 - 100
Plastics	--	25 - 100
Wood	--	100
Other Organics/Multi-Materials	--	100

Notes: "Wood" includes materials such as sawdust and lumber mill trimmings. Examples of other organics include, but are not limited to, peanut hulls and corn stover. An example of multi-material sorbents would include, but not be limited to, a polymer and cellulose fiber combination.

c. Specifications

EPA identified two Federal specifications containing language that precludes the use of organic sorbents in applications where the type of sorbent material is not an issue. GSA's specification for *Absorbent Material, Oil and Water (For Floors and Decks),* for example, states that "the absorbent material shall consist of a uniform mixture of **minerals of the silicate type**."

According to a commodity management specialist with GSA's Chemicals and Paint Division, GSA's financial analysts rejected a recommendation that clay sorbents be discontinued from stock and consolidated with those sorbents on the multiple awards schedule. The analysts cited the more than $1 million a year in sales as a sign that GSA should still make the item available as a stock item. The contact believes, however, that the demand for this stock item is diminishing due to increased purchases from the

multiple awards schedule and directly from manufacturers. When sorbents are purchased through the multiple awards schedule or directly from manufacturers, agencies are not required to use the GSA purchasing specification for *Absorbent Material, Oil and Water (For Floors and Decks)*.

The NIH specification for *Laboratory Animal Bedding, Softwood*, precludes the use of recovered material. The specification states that sorbents used for "contact bedding for animals ... shall be from **unused** white pine (or related species of low resin soft pine) lumber."

ASTM has test methods for both absorbents and adsorbents used to remove oils and other compatible fluids from water. These are *Standard Methods of Testing Sorbent Performance of Absorbents (F716-82)* and *Standard Method of Testing Sorbent Performance of Adsorbents (F716-81)*. Neither of them mention any exceptions or differences for testing of sorbents made from recovered materials, however.

The Federal government does not regulate the use of sorbent materials in spill cleanup activities. According to Title 40 of CFR Part 300, *National Oil and Hazardous Substances Pollution Contingency Plan, Proposed Rule*:

> EPA believes the use of sorbents does not create deleterious effects to the environment because these materials are essentially inert and insoluble in water and because the basic components of sorbents are nontoxic.

EPA provides some oversight for the use of inorganic particulate sorbents and sorbents mixed with chemicals to improve sorption. In such cases, EPA reviews company product tests to determine that the product is not deleterious to the environment. If EPA finds that the product may not perform appropriately for a specific application (e.g., on open water), it will send a letter the company expressing these concerns.

While EPA does not regulate sorbent use, the Agency does regulate the disposal of sorbents when they are determined to be hazardous waste after they are used. According to a contact at EPA, regulations regarding the disposal of used sorbent products are listed in the 40 CFR Part 300, Subpart J. Sorbents that are determined to be hazardous waste must be reused, recycled, incinerated for waste-to-energy, or disposed of in a hazardous waste landfill.

B. Industrial Drums

1. Item Description

An industrial drum is a cylindrical container used for shipping and storing liquid or solid materials. They are typically manufactured in 5-, 15-, 30-, and 55-gallon sizes, although other sizes are available. Containers under 7 gallons are known throughout the industry as pails.

Industrial drums are manufactured from a variety of materials, including steel, plastic, and pressed fiberboard. The Steel Shipping Container Institute estimates that 35 million new steel drums were manufactured in 1995 and, according to the Plastic Drum Institute (PDI), between 12 and 15 million plastic drums are manufactured annually. The International Fiber Drum Institute was unable to provide an estimate for the number of fiber drums manufactured.

Drums are manufactured from different materials, each of which provides slightly different performance or cost benefits. Fiber drums, for example, are the lightest and least expensive, but are not as durable as steel or plastic drums. Plastic drums are more durable than fiber drums and lighter and less expensive than steel drums, but are not traditionally used for certain materials, such as petroleum products, because of the costs involved with treating the plastic to prevent adverse reactions. Steel drums are used more widely than plastic or fiber drums but are heavier and dent and rust with use.

While drums can be used to ship a very large variety of materials, most drums are used to ship chemical and petroleum products. A 1996 Steel Shipping Container Institute (SSCI) study determined that 39 percent of drums are used for chemicals, 15 percent for petroleum products, 11 percent for paints and coatings, 6 percent for food products, and 29 percent for other unspecified uses. The study also estimated that over 40 percent of drums (in the 30- to 55-gallon range) are used for transporting and storing hazardous materials. SSCI estimates that up to 70 percent of the drums purchased for use by the Federal government may be used for hazardous materials, based on the nature of the products typically stored and transported by the Federal government.

Drums can be divided into two categories: closed head and open head. Closed head drums have a permanently affixed lid with two sealable openings on top, a 2-inch and a 3/4-inch opening. They are usually used to hold oils, solvents, and flowable resins, which can be pumped in or out through the openings in the top of the drum. Open head drums have a completely removable lid and are typically used to hold more viscous materials than closed head drums, such as petrochemicals and adhesives, or to contain dry goods.

Drums used to transport or store hazardous materials are rated by one of three markings (X, Y, or Z), which correspond with DOT hazardous material packing group classifications. DOT classifies regulated materials into three packing groups Type I, II, and III. The Type I packing group includes the most hazardous materials, and Type III includes the least hazardous.

2. Rationale for Designation

EPA believes that industrial drums containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Industrial drums are made with recovered and postconsumer steel, HDPE, and paperboard. Appendix I of this document discusses the generation and recovery of these materials in MSW.

b. Technological Feasibility and Performance

DOT classifies regulated materials into three packing groups: Type I, II, and III. The Type I packing group includes the most hazardous materials, and Type III includes the least hazardous. DOT specifies drum performance criteria for Type I, II, and III materials based on drop, stacking, hydrostatic, leak, and vibration tests. Drums that meet DOT hazardous materials packing group specifications are identified by an X, Y, or Z. Drums with an X rating are capable of passing the most stringent DOT standards and can be used to transport and store materials from all three packing groups (Type I, II, and

III). Drums with a Y rating can be used for Type II and Type III packing groups, while drums with a Z rating can be used only for Type III packing group materials. Drums rated X, Y, or Z can also be used for nonhazardous materials. Table 29 provides a listing of drum packaging groups.

Table 29

DOT Drum Packaging Groups

DOT Drum Rating	Approved for:
X	DOT packing groups Type I, II, and III and all nonhazardous materials
Y	DOT packing groups Type II and III and all nonhazardous materials
Z	DOT packing group Type III and all nonhazardous materials
Unrated	All nonhazardous materials

According to one manufacturer of both virgin and recovered materials content drums, drums manufactured from recovered materials perform as well as drums manufactured from virgin materials for some, but not all, applications. There are no performance concerns with drums manufactured with recovered content steel because all steel drums contain at least 25 percent postconsumer recovered materials. Recovered content fiber and plastic drums, however, have more limited applications than their virgin counterparts. One manufacturer of virgin and recovered content fiber drums explained that recovered content fiber drums perform differently than virgin fiber drums. They are stronger in compression tests but weaker in impact tests. As a result, the manufacturer does not recommend using recovered content fiber drums for liquids or for loads over 60 kg (132.6 lbs.). He also explained that virgin and recovered content open-head fiber drums do not meet DOT performance criteria for Type I, II, or III liquid hazardous materials and can not be used to store or transport them.

PDI claims that there are no performance issues associated with recovered content plastic drums. DOT, however, currently requires virgin plastic for drums that will be used to transport or store hazardous materials because plastic absorbs small quantities of some materials. DOT is concerned that if a drum made from recovered plastic is used for transporting hazardous materials, the hazardous materials may react with materials previously absorbed by the plastic.

At least one manufacturer produces a multilayer plastic drum with a recovered content middle layer that is surrounded by two virgin plastic layers. The recovered plastic is obtained from postconsumer industrial drums. DOT granted the company an exemption under 49 CFR 107.107 that allows the manufacturer's drums to be used for transporting Type II or III packing group materials. The exemption does not allow the drums to be used to transport the more hazardous Type I materials.

c. Availability and Competition

According to SSCI, there are 26 new steel drum manufacturers producing 34.6 million drums and 86.5 million pails annually. PDI reports that there are at least 10 manufacturers of plastic drums manufacturing 12 to 15 million new drums annually. According to the Fiber Drum Institute, there are approximately eight fiber drum manufacturers producing an unknown quantity of drums. In addition, according to the Association of Container Reconditioners (ACR), there are over 100 drum reconditioners.

EPA identified two plastic drum manufacturers and one fiber drum manufacturer producing recovered content drums. The manufacturers declined to identify the number of drums produced, citing reasons of confidentiality. The recovered content fiber drum manufacturer stated that approximately half of the drums they manufacture contain recovered materials. One of the recovered content plastic drum manufacturers stated that they have the capacity to make as many as 400,000 recovered content drums a year.

Every steel drum manufacturer produces recovered content steel drums.

d. Economic Feasibility

According to several plastic and fiber drum manufacturers, plastic and fiber drums made from recovered materials are generally less expensive than their virgin counterparts.

The ACR explained that reconditioned drums are approximately one-third less expensive than new drums.

e. Government Purchasing

A 1994 survey of 28 Department of Energy (DOE) facilities revealed that the facilities procured 77,731 drums for waste management, 85 percent of which were steel. The drums were generally procured by contractors and not directly by DOE.

Although EPA believes that DOD procures significant quantities of industrial drums, the Agency was unable to confirm quantities because there is not a central office that tracks drum purchases. In fact, EPA's research found that most drums are purchased in quantities small enough for individual facilities to purchase them with government credit cards.

Steel drums are reused routinely within DOD, but EPA was unable to determine to what extent they are refurbished. Any DOD drum that has not contained hazardous materials can be triple rinsed and reused. In addition, the Defense Reutilization Marketing Office (DRMO), part of the Defense Logistics Agency (DLA) tasked with redistributing excess materials among government facilities for reuse, frequently provides triple-rinsed steel drums free of charge to defense facilities that need them. DRMO stockpiles excess drums when consolidating nonhazardous materials from drums shipped to DRMO for redistribution. The drums are triple rinsed and made available to any facility that requests them.

A Steel Shipping Container representative suggested that the Government Printing Office (GPO) and the Bureau of Printing and Engraving both purchase large quantities of ink in 55-gallon drums. EPA was unable to contact representatives from these government agencies to determine if their specifications include the means by which the inks are delivered.

f. Barriers to Purchasing

According to PDI, one of the biggest barriers to increasing Federal procurement of drums containing recovered materials is DOT's prohibition against the use of recovered content plastic drums when transporting or storing hazardous materials. Although at least one plastic drum manufacturer has successfully obtained a DOT exemption allowing it to use recovered plastic, many manufacturers are reluctant to pursue exemptions because of the time and expense involved and concerns about negative customer reactions.

Plastic drum manufacturers are also concerned that if EPA designates recovered content drums and DOT does not change its requirements, government purchasing agents could decide to purchase steel drums to avoid having to order different drums for different applications.

g. Designation

In CPG III, EPA is proposing to designate industrial drums containing recovered steel, plastic, or paper. A final designation would not preclude a procuring agency from purchasing industrial drums manufactured from another material. It simply requires that a procuring agency, when purchasing industrial drums made from steel, plastic, or pressed fiberboard, purchase these items made with recovered materials when these items meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Steel, plastic, and fiber drums are manufactured with recovered material content. All steel drums contain at least 25 percent recovered materials due to the nature of the steel manufacturing process. Almost all of the sheet steel used to manufacture drums is produced in blast oxygen furnaces, which produce steel with 25 to 28 percent postconsumer content. Steel produced in electric arc furnaces contains close to 100 percent postconsumer recovered materials, but is not used to produce drums.

DOE is using recovered radioactive steel from decommissioned DOE facilities to manufacture steel drums for containing low-level radioactive and hazardous wastes. Recovering radioactive steel to manufacture industrial drums reduces the volume of radioactive steel that DOE must dispose of by reducing the need to procure additional drums or other containers to encase the radioactive steel. According to the Trade Association of Radioactive Metals, it is not economically feasible to decontaminate the steel recovered from DOE facilities for unrestricted use, but it does make economic sense to use the steel available onsite or from other DOE facilities.

Plastic drums are manufactured with up to 100 percent postconsumer HDPE. At least one manufacturer is also producing a multilayer drum that includes a 100 percent postconsumer recovered HDPE layer sandwiched between two virgin layers with a total recovered material content of 30 to 35 percent. Due to differences in molecular weight, the recovered HDPE used in plastic drums is obtained from postconsumer plastic drums collected by the manufacturer and not from curbside recycling programs. The HDPE available from curbside collection programs mainly consists of discarded milk jugs, which use a relatively porous, lower molecular weight plastic than is used in industrial drums.

Fiber drums are manufactured from postconsumer recovered corrugated boxes and other sources of paperboard, and contain up to 100 percent postconsumer recovered materials. Many fiber drums have steel rims around the top and bottom to help maintain drum integrity. Some fiber drums also contain an interior plastic lining to make the drum waterproof. According to one manufacturer, the plastic liners do not contain recovered materials, and many manufacturers have stopped making plastic lined drums due to competition from the plastic drum industry.

Drum Reconditioning and Reuse

In addition to recycled content, steel, plastic, and fiber drums can also be reused within a controlled distribution chain, or they can be reconditioned and reused. If an undamaged drum remains in a shipper's control, it can be reused to ship or store the same material. Most shippers do not clean the drums before refilling them because the same material is being transported and there is little risk of contamination.

Damaged or discarded drums can be reconditioned and reused. There are over 100 drum reconditioners in the United States. According to ACR, between 35 and 40 million steel drums and approximately 3 million plastic drums are reconditioned each year. A small number of fiber drums are reconditioned, but because fiber drums are less likely to be reconditioned, ACR does not track them.

Plastic and steel drums are reconditioned in three basic stages: the drum is thoroughly cleaned, worn gaskets and seals are replaced, and the drum is tested for leaks. Plastic drums are generally triple rinsed with high pressure neutralizing detergents. Steel drums are typically cleaned by exposing them to an intense flame that burns away any residue from the previous shipment. Steel drums undergo two additional steps to remove the dents and dings from normal use and to repaint the drum to help protect it from the elements.

An ACR report, *The Energy Requirements of Steel Drum Manufacturing and Reconditioning*, concludes that it takes approximately 10 times as much energy to manufacture a steel drum as it does to recondition it. ACR also estimates that it takes six times more energy to recycle than to recondition a steel drum.

According to a fiber drum manufacturer, fiber drums can be reconditioned by cutting a damaged drum to remove the damaged area. For example, if a fiber drum is damaged, the steel rim can be removed; the drum can then be cut in half, below the damage, parallel with the bottom of the drum; the steel rim can be replaced; and the newly refurbished, smaller-volume drum can be reused.

Table 30 displays recovered content information on industrial drums made by manufacturers contacted by EPA.

Table 30

Recovered Materials Content of Industrial Drums

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastic	Company A: 100 Company B: Unknown	100 30-35
Steel	Company C: Unknown	25-100
Fiber	Company D: 100	100

b. Preference Program

EPA recommends that, based on the recovered content levels shown in Table 31, procuring agencies establish minimum content standards for use in purchasing steel, plastic, or fiber industrial drums containing recovered materials. EPA further recommends that procuring agencies reuse drums, purchase or use reconditioned drums, or procure drum reconditioning services, whenever feasible.

Table 31

Draft Recovered Materials Content Recommendations for Industrial Drums

Product	Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Steel drums	Steel	16	20-30
Plastic drums	HDPE	30-100	30-100
Fiber drums	Paper	100	100

c. Specifications

The International Confederation of Drum Reconditioners, PDI, and several other plastic trade associations are working with DOT and the United Nations (UN) to demonstrate that there are no adverse performance issues associated with the use of recovered plastics in hazardous materials packaging. In July 1996, the UN Subcommittee of Experts on the Transport of Dangerous Goods passed a proposal to allow the use of recovered plastics in plastic drums that will be used to transport or store hazardous materials. The proposal was also passed at the full UN Committee of Experts meeting in December 1996 and will be published in the 10th revised edition of the UN's *Recommendations on the Transport of Dangerous Goods*.

The UN recommendations state:

> *Recycled plastics material* means material recovered from used industrial packagings that has been cleaned and prepared for processing into new packagings. The specific properties of the recycled material used for production of new packagings should be assured and documented regularly as part of a quality assurance programme recognized by the competent authority. The quality assurance programme should include a record of proper pre-sorting and verification that each batch or recycled plastics materials has the proper melt flow rate, density, and tensile yield strength, consistent with that of the design type manufactured from such recycled material. This necessarily includes knowledge about the packaging material from which the recycled plastics have been derived, as well as awareness of the prior contents of those packagings if those prior contents might reduce the capability of new packagings produced using that material. . .Packagings manufactured with such recycled plastics material should be marked "REC."

DOT will await formal publication of the UN recommendations before beginning an official evaluation. Based on past precedent, it is likely that DOT will approve the UN recommendations for the United States.[1] DOT tentatively anticipates a proposed rulemaking regarding the use of recovered plastics in industrial drums in 1998. After reviewing public comments, DOT anticipates the modified regulations

[1] On December 19, 1990, DOT adopted UN standards for the packaging and shipping of hazardous materials. DOT modified its regulations again on December 29, 1994, to reflect additional changes in UN specifications. It can take DOT 6 months to 5 years to adopt UN recommendations.

going into effect in January 1999. Until that time, DOT will continue to make exemptions (as described in 49 CFR 107.107) for manufacturers who demonstrate that their use of recovered plastics does not present a cross contamination concern. As of March 30, 1998, the UN recommendations were still under consideration by DOT, but not yet adopted.

The National Motor Freight Traffic Association also develops performance specifications for containers that will be used to transport goods via truck. Their specifications do not specify materials and do not prohibit the use of recovered materials.

C. Awards and Plaques

1. Item Description

EPA conducted preliminary research to ascertain the supply of, and government demand for awards and plaques made from recovered materials. To this end, EPA contacted the Promotional Products Association (PPA), four manufacturers of recovered content products, and four Federal agencies. For the purpose of this report the term "awards" refers to free-standing statues, while "plaques" refers to boardlike products generally used as wall-hangings.

2. Rationale for Designation

EPA believes that awards and plaques containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

According to one manufacturer, a standard 8 by 10-inch plaque diverts approximately 1 pound of material from the waste stream. Thus, if the Federal government were to purchase exclusively recovered content plaques, about 160 tons of waste material (e.g., sawdust and newspaper) would be diverted from the solid waste stream (based on the current Federal purchasing level of $12 million over 3 years at an average cost of $33.60 per plaque). Appendix I of this document discusses the generation and recovery of glass, wood, and paper in MSW.

b. Technological Feasibility and Performance

Awards and plaques are sold by manufacturers and distributors of promotional products. According to a 1995 survey, there are approximately 13,000 such distributors and manufacturers in the United States. EPA identified six companies that manufacture or distribute awards and plaques made from recovered materials. According to four of the companies contacted, recovered content awards are generally made from blown glass, while plaques are made from various materials, including compressed newsprint and sawdust.

c. Availability and Competition

As mentioned above, there are approximately 13,000 distributors and manufacturers of promotional products in the United States. EPA identified six companies that manufacture or distribute awards and plaques made from recovered materials. According to the four companies EPA contacted, recovered content awards are generally made from blown glass, while plaques are made from various materials, including compressed newsprint and sawdust. Awards and plaques made from recovered materials are generally identified as “recycled” only on the back or bottom of the product.

d. Economic Feasibility

The promotional products industry has grown from $5 billion a year in 1990 to more than $8 billion in 1995. A PPA survey estimates that awards and plaques account for almost 8 percent, or approximately $62 million, of promotional product sales. No discrete data are available on the percentage of awards and plaques manufactured with recovered materials. Distributors of awards made from recovered glass indicate these products are manufactured only on an as-needed basis. Three manufacturers of plaques made from recovered materials, on the other hand, state that their products are produced on a regular basis, but not in large volumes.

e. Government Purchasing

Government agencies purchase awards and plaques through GSA's Federal Supply Service Multiple Awards Contract (MAC) for *Trophies, Awards, Plaques, Plaques with Clocks, Pins, Ribbons, Medals, Pen Sets, and Plates/Bowls Suitable for Engraving*. GSA does not track the number of awards or plaques purchased under this contract, but does know that government agencies purchased approximately $10 million worth of products under the subcategory "awards, plaques, trophies, plaques with clocks, pins, ribbon, and medals" between 1990 and 1993. Between 1993 and 1996 $12 million worth of products were purchased. While unable to provide specific information on purchasing volume, the GSA contracting officer for this MAC claims that awards and plaques are the most popular items within the category.

Government agencies purchase awards and plaques directly from the 55 manufacturers and distributors listed in the MAC. Of the four manufacturers of recovered content awards and plaques contacted, only one is currently on contract to GSA. According to a representative of this company, Federal agencies are not currently purchasing large quantities of its products, however. Indeed, EPA research indicated that individual government agency annual purchases are generally less than the $10,000 minimum threshold set by RCRA for CPG applicability. The largest single purchase of awards identified by EPA was the Energy Star Program, which spent $7,000 on awards in 1996.

According to a U.S. Air Force (USAF) contact, however, it is likely that DOD purchases awards and plaques in amounts well over $10,000. The decentralized nature of these purchases, however, makes it difficult, if not impossible, to determine the total dollar amount of awards and plaques purchased by DOD each year.

f. Barriers to Purchasing

The decentralized nature of award and plaque purchases, and the fact that GSA does not track these purchases, makes it difficult to identify individuals within government agencies who are responsible for purchasing these items. In addition, it appears that these purchases now often are made through the use of a Federally issued credit card.

g. Designation

In CPG III, EPA is proposing to designate awards and plaques containing recovered glass, wood, paper, or plastic. A final designation would not preclude a procuring agency from purchasing awards and plaques manufactured from other materials. It simply requires that a procuring agency, when purchasing glass, wood, paper, or plastic awards and plaques, purchase these items containing recovered materials when the item meets applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Material Content

Table 32 displays the recovered and postconsumer content levels of awards and plaques produced by various manufacturers.

Table 32

Recovered Materials Content of Awards and Plaques

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Glass	Company A: 75-100 Company B: Unknown	Unknown 100
Wood	Company A: Unknown Company C: Unknown	100 100
Paper	Company C: 0-100	40-100
Plastic	Company D: 50-95	Unknown
Plastic/Wood	Company D: 50 (plastic)	50 (Wood/Sawdust)/100 (Total)

b. Preference Program

EPA recommends that, based on the recovered materials content level shown in Table 33, procuring agencies establish minimum content standards for use in purchasing awards and plaques containing recovered materials.

Table 33

Draft Recovered Materials Content Recommendations for Awards and Plaques

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Glass	75 - 100	100
Wood	--	100
Paper	40 - 100	40 - 100
Plastic and Plastic/Wood Composite	50 - 100	95 - 100

c. Specifications

EPA did not identify any specifications or standards regarding awards and plaques.

D. Mats

1. Item Description

Mats are temporary or semipermanent protective floor coverings used for numerous applications. They are used to protect carpeting by reducing wear and tear in heavy traffic areas and by removing moisture, dirt, and grime from people's shoes. They are used to protect car and truck floor boards from dirt or accidental spills, and office carpeting from wheel damage caused by swivel chairs. Mats are used to provide traction on stairs, ship decks, docks, around pools, or on marble or tile floors; to reduce worker fatigue in occupational work areas that require excessive standing; and to reduce the risk of injury during athletic events. Mats are also used for many specialty applications, such as protecting truck beds and the teeing areas of golf driving ranges.

Mats are manufactured in a wide variety of designs and from numerous materials. Some of the most common materials used include aluminum, cocoa fiber, HDPE, LDPE, nylon, PET, polycarbonate, PP, PVC, rubber, steel, tempered hardboard, and wood. Multiple materials may be used in a single mat. Vinyl or rubber "links," for example, are often joined together with steel rods.

Manufacturers may use the same material in mats designed for various applications. The only difference, for example, between a rubber entrance mat and a rubber truck bed mat may be the dimensions of the mat. Mats can also be easily customized by modifying the production process for an existing product to adjust the thickness, size, texture, or color. Other mats are designed as interlocking tiles that allow the end user to create mats as large or as small as needed.

2. Rationale for Designation

EPA believes that mats containing recovered materials meet the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Mats are made with recovered and postconsumer rubber, PVC, HDPE, LDPE, PET, and PP. In addition, many mats contain steel or aluminum links or frames, which contain recovered metal. Appendix I of this document discusses the generation and recovery of these materials in MSW.

EPA did not identify any trade organizations specifically representing mat manufacturers, which makes it difficult to quantify the volume of materials diverted from the waste stream due to the use of recovered content materials in mats. One manufacturer, however, uses approximately 1 million pounds of recovered PVC to produce 50,000 to 60,000 PVC mat tiles a year. Another manufacturer uses over 45,000 nonradial truck tires to produce an unspecified quantity of rubber mats.

b. Technological Feasibility and Performance

Manufacturers estimate that between 75 and 95 percent of all mats manufactured in the United States are made with some percentage of postconsumer material content. According to all of the manufacturers contacted by EPA, recovered content mats perform as effectively as their virgin counterparts, although virgin materials are sometimes added to provide color or product consistency.

According to one manufacturer using postconsumer material, PVC, in particular, has inherent limits as to how, and in what form, it may be recycled. PVC contains plasticizer, which gives it softness and flexibility. Each time the material is heated to be reformed, less plasticizer remains. PVC pipe, for instance, starts out with much less plasticizer, and being less malleable, it is more difficult to make into a new recycled product. New products are made from the more rigid PVC recovered products, but additional plasticizer is typically added during reprocessing.

c. Availability and Competition

EPA identified 44 manufacturers, distributors, or suppliers of recovered content mats. They are located throughout the United States and supply both domestic and international markets. EPA contacted five mat manufacturers who estimated that between 75 and 95 percent of all mats manufactured in the United States are manufactured with postconsumer recovered material content.

d. Economic Feasibility

According to several manufacturers throughout the mat industry, recovered content mats are generally less expensive than their virgin counterparts.

e. Government Purchasing

EPA has been unable to determine how many mats are procured by Federal agencies. A contact with USPS explained that, although each of the 40,000 USPS facilities probably uses antifatigue mats, USPS does not track their use or procurement because post offices are not required to obtain headquarters' permission for expenditures under $10,000 a year.

The GSA Supply Catalog lists 36 products in 9 mat categories, including chair, door, deck, dental floor, porch floor, antifatigue, insulating, ribbed floor, and stair tread mats. The GSA catalog only identifies two of the 36 products as containing recovered materials, both of which are door mats containing 100 percent postconsumer recovered rubber. The number of categories and products suggests that there is a sizable government market for mats. Most Federal buildings, for example, contain numerous entrance, floor, and chair mats. DOD procures a variety of mats, including antislip mats for boat and ship decks and docks, helicopter landing mats, and truck bed mats. Despite repeated attempts, EPA was unable to obtain information quantifying Federal procurement of mats.

f. Barriers to Purchasing

Mats containing postconsumer recovered materials are commercially available throughout the United States, but only two of the 36 mats listed in the GSA catalog are identified as containing recovered materials. All seven of the chair mats and all five door mats included in the GSA catalog are also listed as UNICOR/NIB/NISH mandatory source items.[2] The Federal government has established a preferential procurement program for UNICOR, NIB, and NISH products, which states that if a UNICOR/NIB/NISH

[2] The UNICOR, NIB, and NISH programs are designed to provide employment for Federal prisoners, people with severe visual impairments, and other physically challenged individuals.

product meets ordering requirements, it cannot be procured from an alternative source. None of the mandatory source chair mats and only two of the five door mats (both made from 100 percent postconsumer rubber) are identified as containing recovered materials. UNICOR could not identify the sources for recycled rubber, however.

A NISH manufacturer producing 400,000 to 500,000 vinyl chair mats a year explained that it did not know if their products contain any recovered materials. It purchases the vinyl used in its manufacturing process based on the price and quality of the vinyl. This NISH manufacturer explained that its vinyl supplier buys back scrap vinyl from its production process that would normally be discarded. The scrap vinyl is reground and reprocessed. The supplier is paid enough for the vinyl scraps to cover the cost of shipping them back to the vinyl manufacturer.

EPA contacted the vinyl supplier for the NISH manufacturer and learned that it occasionally buys back scrap vinyl, but does so primarily to maintain good customer relations rather than to recover the vinyl for reprocessing. This contact could not provide an estimate on the percentage of postindustrial scrap that is reground, but believes it is very small.

g. Designation

In CPG III, EPA is proposing to designate mats containing recovered rubber and/or plastic. A final designation would not preclude a procuring agency from purchasing mats manufactured from other materials. It simply requires that a procuring agency, when purchasing mats made from rubber and/or plastic, purchase these items with recovered materials when they meet applicable specifications and performance requirements.

3. Procurement Recommendations

a. Recovered Materials Content

Mats are available containing up to 100 percent postconsumer recovered materials. According to manufacturers contacted by EPA, most mats contain at least some postconsumer materials. EPA identified over 25 manufacturers that produce rubber mats from at least 90 percent postconsumer tires. Several

manufacturers also produce mats that contain 100 percent postconsumer PVC, 100 percent postconsumer mixtures of HDPE and PP, 100 percent postconsumer mixtures of rubber and PVC, and up to 97 percent postconsumer HDPE, LDPE, PET, and PP. Many mats also have steel or aluminum links or frames, which contain recovered metal.

Manufacturers are using postconsumer materials from a variety of sources in addition to curbside collection programs. One manufacturer, for example, is using postconsumer PVC recovered from used swimming pool liners, empty hospital intravenous bags, and water park rafts. For example, Typhoon Lagoon, located in Walt Disney World, Florida, disposed of 5,000 rafts a year until the manufacturer started collecting them to manufacture mats. The manufacturer explained that over 200 smaller scale water parks in the United States are still disposing of their rafts. Other manufacturers are producing mats from recovered tires, X-ray film, and industrial scraps from the roofing and automotive industries.

Table 34 displays recovered content information obtained by EPA from manufacturers of recovered content mats.

Table 34

Recovered Materials Content of Mats

Material	**Postconsumer Content (%)**	**Total Recovered Materials Content (%)**
Rubber	Company A: 92 Company B: — Company C: 100 Company D: 30 Company E: 92-98 Company F: 90 Company G: 40-92 Company H: 100 Company I: 75-95 Company J: 75-95 Company K: 100 Company L: 100 Company M: 90	92 60 100 30 92-98 90 40-92 100 75-95 75-95 100 100 90

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Rubber (cont.)	Company N: 98 Company O: 98 Company P: 85-100 Company Q: 95 Company R: 98 Company S: 90-100 Company T: 95 Company U: 100 Company V: 60 Company W: 90 Company X: 100 Company Y: 95 Company Z: 75 Company AA: 100 Company BB: 90 Company CC: 100 Company DD: 66 Company EE: 80 Company FF: 96 Company GG: 90 Company HH: 98 Company II: 100 Company JJ: 85 Company KK: 55-85	98 98 85-100 95 98 90-100 95 100 60 90 100 95 75 100 100 100 66 80 96 90 98 100 85 55-85
Plastic	Company M: — Company N: — Company V: — Company KK: 15 Company LL: — Company MM: 10 Company NN: 50 Company OO: 100 Company PP: 50	100 100 100 100 100 100 50 100 50
Mixed (Plastic/Rubber)	Company QQ: 50 (Plastic)/ 50 (Rubber) Company RR: 60 (Plastic)/ 40 (Rubber)	100 100

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 35, procuring agencies establish minimum content standards for use in purchasing mats containing recovered materials.

Table 35

Draft Recovered Materials Content Recommendations for Mats

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Rubber	75 - 100	85 - 100
Plastic	10 - 100	100
Rubber/Plastic Composite	100	100

c. Specifications

With the exception of competition wrestling mats, there are no industry, government, or independent specifications for mats. ASTM developed a wrestling mat specification for mats used in high schools and colleges. The specification addresses the construction of closed-cell foam cores with PVC, PVC coatings, or both; foam cores, either open- or closed-cell enclosed in sewn, loose covers; and molded open-cell PVC foam with a dense skin on one surface that is an integral part of the mat. The ASTM specification does not preclude the use of recovered content materials.

E. Signage

1. Item Description

Signs made from recovered materials are used for public roads and highways, and inside and outside office buildings, museums, parks, and other public places. The Federal government procures four types of signs: (1) conventional road signs, (2) expressway signs, (3) freeway signs, and (4) miscellaneous nonroad signs (DOT, 1988). This summary includes information on sign posts and supports, as well as sign blanks (the area of the sign that contains the actual information).

Highway and other road signs are purchased by state and local governments primarily with funds from the Federal government earmarked for transportation. Nonroad signs are procured at the Federal and state levels on an as needed basis.

Road Signs

There are three types of road signs: conventional road signs, expressway signs, and freeway signs.

Conventional Road Signs

Conventional road signs are guide signs used to direct vehicle operators along streets and highways; inform them of interesting routes; direct them to cities, towns, villages, or other important destinations; identify nearby rivers and streams, parks, forests, and historical sites; and provide information to help them along their way in the most simple, direct manner possible. These signs are generally relatively small.

Expressway Signs

Expressways are divided arterial, urban highways for through traffic. Most expressways have partial control of access and grade separation at major intersections. Because of increased driving speeds, expressways require large, high-impact signs. Expressway signs provide drivers with directions, furnish advance notice of the approach to intersections or interchanges, direct drivers into appropriate lanes for

exits or merges, and provide other useful information. Expressway signs are designed to be legible to drivers moving at moderate speeds (30 to 50 miles per hour). This usually means high visibility, large lettering and symbols, and short legends for quick comprehension.

Freeway Signs

Freeway signs provide information to drivers on high-volume, high-speed motor vehicle corridors. These signs are primarily for the benefit and direction of drivers who are not familiar with the route or area. The signs must quickly furnish drivers with clear instructions for orderly progress to their destinations.

While almost any rigid material can be used for any type of road sign, most states use aluminum because it has a high strength-to-weight ratio, costs less than other materials, and withstands extreme temperatures. Aluminum's strength-to-weight ratio is an important consideration. Road signs are usually more than 3 feet wide, so they must be strong but lightweight. States occasionally use smaller road signs, which could be made of a weaker material, but they prefer to use the same material for all signs to achieve economies of scale. States also prefer aluminum because it resists environmental damage. Plywood is also occasionally used for road signs, but one contact believed its use has declined in recent years.

Road signs are normally constructed of several extruded aluminum planks, formed into flat-bottomed U-shapes and placed side by side. Tape is used to smooth the joints, and braces are extended across the back to stabilize the sign. A reflective polymer is applied to the front to create lettering and symbols. Sign blanks are typically comprised of either aluminum sheeting or an exterior grade plywood.

Several grades of aluminum are used in road signs. Although most aluminum products contain recovered materials, products made from lower grade aluminum usually contain higher percentages of recovered materials. A contact at the Connecticut Department of Transportation said that most states use a mid-level grade of aluminum (Grade 5051) for road signs. The Ohio Department of Transportation uses a higher grade (Grade 6061) but has recently approved the use of two lower grades (Grade 5051 and 3038) as well. According to the National Aluminum Association, common alloy sheet aluminum, from which sign blanks are made, consistently contains fairly high levels of recovered content regardless of grade, although the association could not provide an average percentage.

Miscellaneous Nonroad Signs

These signs are used in Federally owned or managed areas other than roadways, such as national parks, historic sites, monuments, and other places of public interest. Nonroad signs are often smaller than standard roadway signs. As a result, they can be made of materials with lower strength-to-weight ratios, such as wood and plastics such as HDPE and PP, although they are also often made with aluminum. There are two types of plastic signs: a simple, paintable sheet and a triple-ply, two-color sheet that is meant to be routed (or etched) to expose the interior color. Plastic is better suited to smaller signs, as large plastic signs can be extremely heavy.

Sign Supports and Posts

Sign post and supports can be made from a variety of materials, including steel, fiberglass reinforced plastic, thin-wall steel tubing, steel U-post or flanged channel, and standard schedule 40 steel pipe. Other materials being used in small sign supports include wood and other types of plastic. The number and type of supports selected for use at a given site depends on sign blank area and buyer preference. A period of 15 to 20 years is the maximum life expectancy for most sign posts and supports, regardless of the type of material.

2. Rationale for Designation

EPA believes that signage containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Sign blanks, posts, and supports are manufactured using recovered aluminum; postconsumer or recovered wood; and recovered plastic, including HDPE, LDPE, PET, PP, and polycarbonate. The following information is based on information obtained from a number of sources and is based on commonly used sign measurements.

- **HDPE:** If the Federal government purchased 1,000 64-pound HDPE National Park trailhead signs (4 by 4 inches at 4 pounds per square foot), up to 64,000 pounds of HDPE could be diverted from the waste stream.

- **PET:** If the Federal government purchased 1,000 128-pound "Welcome" signs (4 by 8 feet at 4 pounds per square foot), up to 128,000 pounds of PET could be diverted from the waste stream.

- **Polycarbonate**: If the Federal government purchased 1,000 127.5-pound map signs (5 by 5 feet at 5.1 pounds per square foot), up to 127,500 pounds could be diverted from the waste stream.

- **PP**: If the Federal government purchased 1,000 24-pound men's room signs (2 by 4 feet at 3 pounds per square foot), up to 24,000 pounds could be diverted from the waste stream.

- **Aluminum** (common alloy sheeting, grade 3015): If the Federal government purchased 1,000 160-pound expressway signs (8 by 10 inches at 2 pounds per square foot), up to 64,000 pounds of aluminum could be diverted from the waste stream.

- **Particleboard/plywood**: If the Federal government purchased 1,000 36.8-pound informational signs (4 by 4 inches at 2.3 pounds per square foot), up to 36,800 pounds of wood materials could be diverted from the waste stream.

Appendix I of this document discusses the generation and recovery of these materials in MSW.

b. Technological Feasibility and Performance

Plastic Road Signs

Conventional road signs can be manufactured from 3/8- to 3/4-inch thick HDPE or PET recycled-content sheeting, which can be heavy when used in large sheets. Because conventional road signs rarely reach more than 36 inches wide or long, however, the thickness of the sheeting does not usually pose a weight problem.

Conventional road signs are normally used in applications where people have easy access to them. As a result, they are frequently vandalized, according to a plastic sign manufacturer. According to this manufacturer, plastic signs withstand such vandalism better than traditional wood or metal signage. A contact at the Grand Teton National Park confirmed that spray paint, for example, can be easily removed from HDPE (a wax-based polymer). This same contact said that bullet holes are nearly unnoticeable on

plastic signs, whereas on wood or aluminum they may practically destroy the sign. The plastic sign manufacturer said that while plastic signs with recycled content may cost up to double the price of a comparably sized aluminum sign, they have double the life expectancy because of durability. The Grand Teton National Park contact said that plastic signs have been in use in his park for more than 7 years without significant signs of wear. Wood signs typically last about 3 years before maintenance such as repainting is needed, while aluminum signs last a bit longer—from 5 to 7 years before they are reused or recycled, although in hot climates the vinyl letters used on aluminum signs tends to degrade more quickly. Some manufacturers estimate that plastic signs can last at least twice as long as aluminum—20 years or more.

According to a contact at the state of Connecticut, plastic is not commonly used in road signs because it can soften in heat and shatter in cold. The contact pointed out that aluminum, on the other hand, withstands extreme temperature fluctuations. In addition, a manufacturer of plastic signs in Colorado said that reflective coatings do not adhere well to recycled content plastic signs because trace amounts of waxes and polymers begin to emerge from the plastic after a year or two. This source suggested that aluminum signs hold reflective surfaces much better. The state of Ohio experienced similar minor performance problems in testing polycarbonate plastic road signs. In this case, the tester surmised that the dark plastic material absorbed heat from the sun, causing the heat-applied coating to bubble. UV inhibitors, however, can be added to the plastic to minimize bubbling, brittleness, and fading caused by long-term exposure to the sun. Polycarbonate is a thermoplastic used in car headlights and eyeglass lenses, known for its resistance to deformation and breakage. The plastic is relatively lightweight and can be used in large signs, whereas less-engineered plastics (such as HDPE and PET) cannot be used in large sign applications because they would have to be excessively thick and heavy to be strong enough. EPA identified one manufacturer that currently manufactures signs from recovered polycarbonate (International Plastics Company).

The Florida and Oklahoma Departments of Transportation also tested plastic road signs containing recovered materials and experienced performance problems such as warping, tearing, and bubbling. A few companies, however, manufacture fiberglass and plastic-reinforced postconsumer plastic signs to prevent warping, but these companies do not have any government customers at this time. One manufacturer offers a cast acrylic, shatterproof sign blank that is three times as rigid as polycarbonate, but this durable material does not currently contain recovered materials. To the best of EPA's knowledge, no states have tested these

reinforced signs. In 1980, the Texas Department of Transportation (TxDOT) tested several types of fiberglass roadsigns and found that pure fiberglass was too brittle and did not stand up to moderate wind gusts. Currently, TxDOT is experimenting with incorporating rubber recovered from automobile tires into plastic signs.

TxDOT, in cooperation with Texas A&M University, is studying the use of recovered material content in road signs but has not yet reached any conclusions. (A report on this research will be available to the public.)

Aluminum Road Signs

After an aluminum road sign has served its purpose, or when it becomes illegible or obsolete, it can be reused by replacing the old reflective polymer with new reflective polymers. The departments of transportation in Ohio, Connecticut, Oregon, Texas, and other states, for example, reuse their aluminum signs by grinding off the old surfacing and replacing it. This is a common practice nationwide, although aluminum signs can only be reused an average of two times using this technique because each sanding removes a layer of the aluminum with the reflective coating. When the sign blank becomes too thin to reuse, it is normally sent to a metal recycler for reprocessing.

Nonroad Signs

EPA contacted an official at Grand Teton National Park about plastic nonroad signs (maps, welcome signs, trail signs, etc.) containing recovered materials. The signs are HDPE, and have 50 to 80 percent postconsumer recovered materials content. The colors on the signs have held up well over time (some of the signs have been in place for nearly 8 years), and the contact believed that the extra initial expense of purchasing plastic as opposed to aluminum or wood has been recouped over the years in avoided maintenance costs, although he could not directly quantify that assumption. After just a few years, for example, most wood signs exposed to the elements require repainting, while a plastic sign can withstand the elements almost indefinitely. The contact said that the National Park Service sign manual is being rewritten to include information on signs containing, or made with recovered and other alternative materials, such as acrylic and foam board. The new manual, which will be available in 1998, will encourage the use of

recovered materials in signs by providing pertinent information (without specifying the types of materials to be used). This could spur other agencies to explore the use of signs containing recovered materials.

On the other hand, nonroad plastic signs containing recovered materials do have some minor shortcomings. In extreme climates, the plastic can contract and expand, causing some very minor distortion of sign design and wording. In addition, the plastic signs cannot be painted and cannot hold reflective material. One contact also had to create special sign supports for the plastic, which did not hold well with bolts because the plastic strips easily and the bolts become loose. Instead of using bolts, the crew designed a slotted channel frame, which has worked well.

Sign Posts and Supports

Recovered materials are commonly used in the manufacture of sign posts and supports. Sometimes signposts are made by wrapping a shell of recovered HDPE or LDPE around a steel core. Plastics used include postconsumer HDPE, LDPE, PP, and commingled resins. Other recovered materials used include fiberglass, old (postconsumer) tires, and wood fibers. According to a plastic lumber manufacturer, plastic posts are more durable than wood, and are safer than steel in the case of accidental impact. The steel supports contain at least 25 percent recovered materials. EPA was not able to obtain information on recovered content in wood sign posts and supports.

c. Availability and Competition

EPA identified two distributors that market aluminum sign blanks containing postconsumer recovered materials, although, as noted earlier, most aluminum products already contain recovered materials. Plastic road and nonroad signs with recovered content are manufactured or distributed by at least 15 companies that sell their products nationally. Recovered content plastic posts are manufactured by several companies.

d. Economic Feasibility

Road Signs

For recovered plastic materials to be used in large road sign applications, the plastic must be an engineered material, such as a polycarbonate, in order to meet strength requirements. Polycarbonate blanks are significantly more expensive than aluminum blanks, but can last twice as long or longer.

Smaller roadway and nonroad signs can be made of a nonengineered plastic, including some recovered resins. The use of nonengineered plastics in signs, however, would require manufacturing capabilities that most state road sign shops or contractors do not currently posses (because they manufacture mostly aluminum signs). According to a contact at the National Aluminum Association, providing plastic signs would require significant expenditures for retooling and manufacturing equipment on behalf of those shops and contractors that currently supply only aluminum sign blanks. The association contact said that retooling costs may vary from between $2,500 to $50,000 per shop. Depending on the size of the shop, retooling may be cost-prohibitive. Consequently, using plastics for roadway sign applications may not be economically feasible for some sign manufacturers at this time.

Also, states that refurbish their aluminum signs save one-third of the cost of new blanks. Refurbishing costs $1 less per square foot than a new aluminum sign, even after taking into account the extra labor needed for refurbishment.

A new high-intensity reflective sheeting (now required in some states for safety purposes) is difficult to remove, and can make reuse impractical and cost-prohibitive. The old reflective sheeting used to be sanded cleanly off the sign substrates in order to reuse the base sign blank. The new reflective material, however, gums up the sanding belts. To help ensure its durability, the new reflective sheeting bonds almost permanently with the sign substrate. In Texas, for example, the percentage of aluminum signs able to be reused has dropped from 25 percent to less than 5 percent as a result of using the new reflective sheeting.

Nonroad Signs

Signs used for informational purposes can be made with aluminum or other metals, wood, or plastic. As previously noted, contacts at NPS have observed that plastic signs are more resistant to vandalism and environmental damage and, therefore, incur much lower maintenance and replacement costs. Heavy-weight HDPE or PET can be used in this application instead of the more expensive engineered plastics; thus, using recovered plastic in informational signs appears to be economically feasible. Plastic signs are, in most cases, cost competitive with routed redwood, but can be more expensive than the aluminum and plywood signs most often used in nonroad applications. Both contacts at NPS, however, have found that in their parks, the initial extra expenditure for plastic signs is recovered over the long run through reduced maintenance costs.

Sign Posts and Supports

Nonreinforced plastic sign posts cost approximately two and a half times that of wood, while steel-reinforced sign posts cost approximately three times that of wood. Plastic posts last at least two times longer than wood, however.

e. Government Purchasing

Road Signs

Most states purchase aluminum sign blanks made from common alloy sheet aluminum, which usually contains recovered materials. The number of states purchasing recovered plastic road signs is currently small, but that number is expected to grow as plastic sign technology matures. EPA was able to identify only two agencies (the NPS and the Forest Service) currently purchasing nonroad plastic signs containing recovered materials.

Nonroad Signs

EPA contacted purchasers of routed plastic informational signs at NPS who stated that plastic containing recovered materials is a viable alternative for nonroad signs in all national parks and national forests. Overall, they were pleased with the performance of the signs in their parks. Some of the signs have been in place for up to 8 years. A vendor that sells primarily recovered-content HDPE signs indicated an increase in demand for these signs over the past three years.

The following is a list of 24 Federal and state agencies that have purchased nonroad signs containing recovered materials:

ARIZONA
Glen Canyon National Recreation Area
Grand Canyon National Park

CALIFORNIA
U.S. Forest Service, San Demis Technical Development and Research Center

COLORADO
Gunnison National Forest
National Park Service, CurreCanti Recreation Area

FLORIDA
Naval Air Station, Pensacola
Naval Air Station, Whiting Field, Milton

GEORGIA
Chattahoochee-Oconee National Forest, Gainesville

KENTUCKY
Daniel Boone National Forest, Winchester

MICHIGAN
Isle Royale National Park, Houghton
Michigan Department of Transportation, Southfield

MONTANA
U.S. Forest Service, Northern Region, Missoula

NEVADA
Lake Tahoe Nevada State Park, Incline Village

OHIO
Cleveland Lake Front State Park
Ohio Department of Natural Resources, Columbus

OREGON
Wallowa-Whitman National Forest, Roseburg

SOUTH CAROLINA
Francis Marion National Forest, Columbia

TENNESSEE
Sycamore Shoals State Historic Area, Elizabathton

TEXAS
Unicor Federal Prison Industries, Fort Worth

UTAH
Intermountain U.S. Forest Service Region, Ogden

VERMONT
Green Mountain National Forest, Rutland

VIRGINIA
U.S. Coast Guard, Alexandria

WASHINGTON
U.S. Navy, Whidbey Island

DISTRICT OF COLUMBIA
U.S. Naval District

Sign Posts and Supports

Sign posts and supports are usually procured along with signs. As a result, EPA was unable to find purchasing information geared specifically toward these sign components. Government agencies do purchase them, however, in significant quantities.

f. Barriers to Purchasing

Aluminum

While the *Manual on Uniform Traffic Control Devices* published by FHWA does not specify the types of materials to be used in manufacturing signs, most states do specify grades and types of materials for signs. In the case of aluminum signs, most states specify that only grades 5052 (pure alloy) or 6061, which do not contain recovered materials, can be used for the manufacture of signs. A lower, less-expensive grade, 3015, does contain recovered content but, in most states, can only be used in the manufacture of temporary signs. Yet, according to one manufacturer, grades 5052 and 3015 are so similar that it is difficult to tell them apart by sight alone. In terms of performance, the manufacturer said that they are "virtually the same" and that some manufacturers knowingly (illegally) use 3105 when 5052 is specified because it is difficult to tell them apart without extensive testing. Grade 5052 is significantly more expensive, however, costing $.06 to $.08 more per pound than grade 3015. On the other hand, an official at AASHTO said that performance of the lower grade alloy (3015) is more dependent on thickness specifications. In other words, the thinner the aluminum, the more likely 3015 is to fail flatness specifications after manufacturing or to bend and contort in the wind once the sign is posted. This same official said that only the higher grades of aluminum consistently meet these flatness and strength specifications, and that is why the states specify the higher grades. Grade 3015 can meet these specifications, however, if properly manufactured. EPA is not aware of any testing that has been done to determine if lower grade aluminum can meet flatness and strength specifications.

Plastic

EPA also identified a possible barrier to purchasing plastic signs, which can cost two to three times (on average) more than a comparably-sized aluminum sign. Plastic signs, however, have an estimated life expectancy that is at least double that of aluminum signs. Because government agencies do not factor life-cycle aspects into many purchasing decisions, the cost of recovered content plastic signs may be viewed by some as cost-prohibitive. One manufacturer, however, claimed that his nonroad, postconsumer content HDPE signs are 10 percent less expensive than comparable aluminum signs. It is likely that the cost of postconsumer content plastic signs, while partially dependent on the recyclables market, will drop as technologies for processing recovered plastics mature.

g. Designation

In CPG III, EPA is proposing to designate non-road signs containing recovered plastic or aluminum and roadway signs containing recovered aluminum. In addition, this proposed designation includes sign supports and posts made from recovered plastic or steel. A final designation would not preclude a procuring agency from purchasing signage or supports/posts manufactured from other materials. It simply requires that a procuring agency, when purchasing plastic or aluminum signs for specific applications, purchase these items made with recovered materials when they meet applicable specifications and performance requirements. This designation pertains to plastic signs (and any associated plastic or steel supports/posts) used for non-road applications and aluminum roadway signs (and any associated steel supports/posts).

3. Procurement Recommendations

a. Recovered Materials Content

Recovered materials content signs are made with the following materials:

- **HDPE**: up to 100 percent total recovered materials, of which up to 100 percent is postconsumer materials.
- **PET**: 80 to 100 percent postconsumer materials.
- **Polycarbonate**: up to 100 percent total recovered materials, of which up to 90 percent is postconsumer content.
- **PP**: up to 100 percent total recovered materials, of which 0 to 40 percent is postconsumer content.
- **Aluminum** (common alloy sheeting, grade 3015): Up to 40 percent recovered materials, of which 0 to 25 percent is postconsumer materials, but highly variable depending on the grade specified.
- **Particleboard/plywood**: up to 100 percent recovered materials.

Table 36 displays recovered content information obtained by EPA from manufacturers on signage.

Table 36

Recovered Materials Content of Signage

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
HDPE	Company A: 99 Company B: Unknown Company C: Up to 80 Company D: 100	99 40-50 Up to 80 100
PET	Company E: Up to 100	Up to 100
Polycarbonate	Company F: 85-90	100
Polyethylene, polycarbonate, polypropylene	Company G: 25-100	25-100
Aluminum	Company H: Unspecified Company I: Unspecified	Unspecified Unspecified

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 37, procuring agencies establish minimum content standards for use in purchasing plastic signs for non-road applications (e.g., welcome signs, trail signs) and aluminum signs for roadway or non-roadway applications containing recovered materials.

Table 37

Draft Recovered Materials Content Recommendations for Signage

Item/Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Plastic signs	80 - 100	80 - 100
Aluminum signs	25	25
Plastic sign posts	80 - 100	80 - 100
Steel sign posts	25 - 100	25 - 100

Notes: Plastic signs and sign posts are recommended for nonroad applications only such as, but not limited to, trailway signs in parks and directional/informational signs in buildings.

c. Specifications

EPA did not identify any material specifications for signs. For the most part, states simply test new materials and decide whether they are appropriate for sign use. Standard specifications for road sign size, lettering, color, strength, and other design and performance requirements can be found in the *Manual on Uniform Traffic Control Devices* published by FHWA. The *Manual*, which is used by all states as the main source of roadway device specifications, states the following about materials for road signs:

> A variety of materials can be used effectively. However, it is recognized that technological progress may develop new and satisfactory or superior materials for highway signs, particularly in the fields of illumination and reflectorization. Nothing in this Manual should be interpreted to exclude any new material that meets the standard requirements for color and legibility, both by day and by night.

It should be noted that this passage refers primarily to reflective coatings, but also pertains to the "substrate" (sign blank material).

F. Strapping and Stretch Wrap

1. Item Description

The term "strapping" refers to actual straps of material used with transport packaging to hold products in place on pallets or in other methods of commercial, bulk shipment. Strapping can also prevent tampering and pilferage during shipping. EPA has included information on "stretch wrap," which serves a similar transport packaging function. Stretch wrap is a thin, semiadhesive plastic film that is sometimes used in conjunction with strapping to hold products or materials on a pallet.

In response to its September 20, 1995, request for information, EPA received one comment on the inclusion of strapping materials in the CPG from a company in Massachusetts. The company stated that strapping with recovered material content is available in commercial quantities at competitive prices from at least one company.

Five basic types of strapping are available in the marketplace—steel, PP, polyester, nylon, and polyester cord. Nylon is currently a small, declining percentage of the strapping market. PP strapping is the most commonly used and least expensive of all strapping materials. Polyester strapping is one of the most rigid strapping materials. It is frequently used to ship heavy duty loads, such as lumber, and can contain postconsumer recovered PET from recovered soda bottles. (Strapping containing PET is often referred to as "polyester strapping" in the industry.) Cord (nonflat) strapping, available in both polyester and rayon, is used only in manual applications. Because it offers excellent resistance to moisture, cord is often used in outdoor applications, such as agriculture (e.g., the bracing of fruit trees) and the boating industry. Steel is the strongest of all strapping materials. Like nylon, the market for steel strapping is also declining, but there are numerous applications in which steel will continue to be the preferred material, such as heavy construction material shipping. Based on comments from several manufacturers, polyester and PP constitute the majority of sales in the strapping industry, with steel and rayon placing a distant third and fourth respectively in terms of sales volume.

As mentioned above, stretch wrap is often used in conjunction with strapping, especially for palletizing applications. It is used by product manufacturers and distributors to bind shipping cartons to pallets going to warehouses and distribution centers, or from distributors to outlets and customers.

2. Rationale for Designation

EPA believes that manual-grade strapping containing recovered materials meets the statutory criteria for selecting items for designation.

a. Impact on Solid Waste

Strapping products can be manufactured from recovered and postconsumer PP, PET, and steel. Stretch wrap can incorporate postconsumer PET from recovered green soda bottles and postconsumer polyethylene from recovered stretch wrap. Because carpet manufacturers (the largest user of recovered PET) shy away from green PET soda bottles because of color issues, green PET soda bottles are an ideal feedstock for PET strapping and stretch wrap.

Although EPA was not able to find official statistics on the manufacturing and recycling of strapping and stretch wrap in the United States, several contacts indicated that the volume of recovered materials incorporated into strapping products varies greatly depending on the type of strapping, the materials being used (PET can be incorporated at higher volumes than PP, for example), and the company's ability to incorporate recovered materials, which, especially in the case of PET, depends in part on specialized equipment.

A 3,600 foot coil of 0.5 inch hand-grade PP strapping weighs, on average, 15 pounds. Since PP strapping can contain up to 100 percent recovered materials and 50 percent postconsumer materials, the weight of recovered materials in an average coil of recovered-content PP strapping is between 1 to 15 pounds, with postconsumer materials accounting for as much as 7.5 pounds per coil.

A 3,600 foot coil of 0.5 inch hand-grade PET strapping weighs, on average, 22 pounds. Since PET strapping can contain up to 100 percent recovered materials and 75 percent postconsumer materials, the weight of recovered materials in an average coil of recovered-content PET strapping is between 1 and 22 pounds, with postconsumer materials accounting for as much as 16.5 pounds per coil.

A 500 foot coil of flat, 0.5 inch hand-grade steel strapping, weighs, on average, 90 pounds. Since steel strapping can contain 25 to 100 percent recovered materials and 10 to 15 percent postconsumer materials, the weight of recovered materials in an average coil of steel strapping is between 23 and 90 pounds, with postconsumer materials accounting for as much as 13.5 pounds per coil. Appendix I of this document discusses the generation and recovery of plastic and steel in MSW.

b. Technological Feasibility and Performance

In terms of manufacturing strapping from recovered materials, one contact stated that additional equipment is needed, especially when it comes to incorporating PET into strapping products. The contact said that it is not a simple matter of substituting recovered materials for virgin ones. Recovered PET is usually received in the form of chopped or shredded bottles, and this material needs to be thoroughly dried before beginning the manufacturing process because of condensation and leftover product on the bottles. Consequently, this company invested nearly $1 million in additional drying equipment. The contact said that this figure was high because of the high volume of strapping they produce (20 million pounds in 1996), and that the costs for additional drying capacity could be lower for a smaller operation. With PP, drying is not normally necessary when incorporating recovered materials into the manufacturing process, but some minor adjustments in equipment may be necessary. With steel, no additional equipment is required to incorporate recovered materials. In any case, the equipment necessary for incorporating recovered materials into PET and PP strapping products is readily available through several companies in the United States.

Strapping is normally delivered in rolls of several hundred to several thousand feet, which can then be applied by hand or placed on a machine for automated application. All plastic strapping, including machine grade, can be applied manually and sealed with buckles or seals. Manual application is ideal for low and moderate volume users and requires little or no investment in tooling. In addition, manually applied strapping usually contains a higher percentage of recovered materials because performance requirements are less stringent.

By contrast, when applying strapping with automatic or semiautomatic machines, machine grade strapping must be used. It is manufactured under stricter tolerances and must have minimal camber (arch or curve) as specified by ASTM standards D3950, *Standard Specification for Strapping, Nonmetallic* and D3953, *Standard Specification for Strapping, Flat Steel and Seals*.

Despite these technical issues, machine grade strapping with recovered material content does exist and is in use, although it has only become available in the past few years. Manufacturers contacted expressed different opinions about the feasibility of manufacturing strapping with recovered content. One manufacturer claimed that the use of recovered materials can result in variations, making it difficult to consistently achieve precise strength and camber requirements necessary for machine grade products. Another manufacturer said that some performance characteristics are best achieved with virgin materials. For example, machine-applied strapping is usually heat-sealed, and thus consistent melt-flow indices (the temperature at which a material melts) and inherent viscosity (IV) are extremely important when manufacturing machine grade strapping. According to this manufacturer, recovered materials can alter these indexes. Because of this variability, many strapping manufacturers view recovered materials as less reliable, and are unwilling to incorporate them into their machine grade strapping products. As a result, machine grade strapping is more often manufactured without recovered material content.

Another manufacturer said that except for the most high-end, critical applications (such as transporting heavy equipment), polyester strapping can incorporate recovered PET and meet most specifications. In other words, according to this contact, most strapping products can, with the right equipment and technical knowledge, incorporate recovered materials and still meet all ASTM specifications and other important characteristics, such as consistent heat flow indices and IV. PET is a flexible polymer whose molecular structure can be recoupled under special conditions (high temperatures) without losing strength. Based on discussions with several manufacturers with extensive knowledge of the industry, 10 to 15 percent of PET machine grade PET strapping manufactured nationwide is made with recovered materials. For hand-grade PET strapping, 15 to 25 percent is made with recovered materials.

While steel is the strongest strapping material available, polyester (which often incorporates postconsumer PET) can be used in place of steel in many instances because its tensile strength is only slightly different than steel's. This is an important factor in some industries, such as the cotton and lumber

industries, in which steel strapping can rust and discolor the product during shipping. In fact, polyester is preferred over steel by these industries. One contact claimed that strapping used in food applications (such as that used to close cartons of fish or meat) must be approved by the FDA, but EPA was unable to confirm this assertion.

One problem with incorporating recovered PET bottles into the polyester strapping manufacturing process is that PVC bottles (which, to the average consumer, may resemble PET bottles) can accidentally get mixed into the recovered PET feedstock. This can destroy an entire manufacturing run and cause equipment problems.

PP is a less common recovered feedstock than PET. Some manufacturers claim that postconsumer PP strapping is not clean enough for remanufacturing and the cost of reprocessing it is higher than using virgin PP, but several manufacturers do incorporate postconsumer PP into their hand-grade strapping products. One manufacturer pointed out that the molecular structure of PP is easy to break down, but, unlike PET, it is extremely difficult to recouple. This means that the more recovered materials incorporated into PP strapping, the weaker it will be, which is not necessarily the case with PET.

Stretch wrap can be manufactured with recovered and postconsumer material content. A clean feedstock is desirable and contaminants such as food, paper, labels, staples, and dirt in recovered stretch wrap can be a problem. One company that manufactures stretch wrap from recovered materials has virtually eliminated the problem of contamination, however, by instituting a program whereby the company buys back its own stretch wrap after use. The sources of postconsumer stretch wrap used to manufacture stretch wrap with recovered content include warehouses and grocery stores.

The government agencies contacted by EPA did not know if the strapping products they bought were made with recovered materials; thus, it was difficult to get much performance information from the consumer's point of view.

c. Availability and Competition

Strapping products made from recovered materials are available nationwide from numerous sources. EPA identified eight strapping manufacturers that in some way incorporate recovered materials into their products. Seven of these manufacturers make both manual and machine grade strapping, although recovered materials are most often incorporated into manual grade strapping. EPA estimates that 25 to 30 companies are currently manufacturing strapping products.

EPA was able to identify only one manufacturer that incorporates recovered (postconsumer) materials into its stretch wrap. Other companies may be incorporating recovered materials into their stretch wrap products, but they do not market them as such.

d. Economic Feasibility

The economic feasibility of manufacturing strapping from recovered materials depends on several factors: type of materials being used, type of strapping being manufactured, and current market prices for virgin and recovered materials. Costs for strapping products vary by thickness of the strapping. On average, PET strapping, regardless of whether or not it incorporates recovered materials, is twice as expensive as PP strapping.

Strapping is sometimes made from recovered PP strapping. One company has instituted a program whereby it buys back its own used PP strapping for remanufacturing. Other companies buy recovered PP and polyester strapping as long as the used strapping meets their specifications. Although there are some technical challenges that must be overcome, such as difficulty of recoupling, PP strapping can be manufactured with recovered materials cost-effectively, as long as transportation costs for obtaining recovered feedstocks can be kept to a minimum.

Manufacturing from recovered PET is only economically feasible if the price of recovered PET is comparable to virgin PET. Most strapping distributors don't advertise their products as containing recovered materials, even when they do contain them (despite the fact that customers occasionally

request strapping that contains recovered materials). This situation allows the manufacturers to choose whatever material (recovered or virgin) most inexpensively meets their specifications at the time of manufacturing.

According to SRI, the average recovered content of all steel products is between 25 and 100 percent. Given the stable market for steel, manufacturing steel strapping with recovered materials content should remain economically feasible.

Like strapping, the economic feasibility of manufacturing stretch wrap from recovered materials depends on several factors, such as cleanliness of the recovered feedstock and market price of recovered materials. As previously mentioned, stretch wrap can incorporate postconsumer PET from recovered soda bottles and postconsumer polyethylene from recovered stretch wrap. Because the supply of both postconsumer PET and postconsumer polyethylene stretch wrap is strong, feedstock supply is not a problem. These materials are readily collected from grocery stores, warehouses, shipping yards, and convention centers. The market price for these materials, however, can vary widely over time.

e. Government Purchasing

EPA contacted representatives from DLA, DOD, GSA, and USPS. All indicated that they purchase manual grade strapping products, but none could provide evidence of machine grade strapping procurement. A kit that includes hand-applied steel and nylon strapping products is offered in the GSA Supply Catalog under Mailing and Packing Supplies. A contact at GSA estimated that the more versatile manual grade products account for a far greater percentage of government purchases than machine grade, but couldn't provide specific figures. One agency (DLA) indicated that it is in the process of making strapping products a regularly stocked item. Several contacts indicated that the military and GSA do procure strapping directly with appropriated Federal funds for use in palletizing operations.

Federal agencies also acquire these items indirectly by requiring the use of strapping and/or stretch wrap on palletized goods and materials that it receives. The U.S. Government Printing Office (GPO), for example, specifies the use of strapping and stretch wrap in its shipping guidance for paper suppliers: "The packaged and packed items shall be placed on new pallets with strapping and/or wrap that provides a

commercially acceptable shipping load." A contact at GSA indicated that, while the Federal government requests that either shrink wrap or strapping be used, strength, camber, and other performance characteristics are left up to the vendor and distributor.

Unfortunately, since strapping is a minor item in the overall shipping picture (compared to pallets, boxes, packing materials, etc.), it is not closely tracked and is often purchased on an as-needed basis. The former Commercial Item Description numbers for strapping products, AA880 and AA52211 for steel and nonmetallic strapping respectively, have been canceled. The new numbers, D3953 and D3950, correspond to the ASTM standards, as discussed below in section 3c, “Specifications.”

f. Barriers to Purchasing

EPA identified no barriers to Federal procurement of strapping made from recovered PP, PET, and steel.

g. Designation

In CPG III, EPA is proposing to designate manual-grade strapping containing recovered steel or plastic. A final designation would not preclude a procuring agency from purchasing strapping manufactured from another material such as rayon or nylon. It simply requires that a procuring agency, when purchasing steel, PP, or polyester strapping, purchase these items made with recovered materials when they meet applicable specifications and performance requirements

3. Procurement Recommendations

a. Recovered Materials Content

Levels of recovered materials used to manufacture strapping products depend mostly on the method of application (e.g., manual or machine). Machine-grade strapping, for example, is less frequently manufactured with recovered materials because machine application demands strict camber and strength specifications that are more easily satisfied by using virgin materials. Strapping that does not meet these

specifications can snap during application, causing equipment problems and safety concerns. Manually applied (or manual grade) strapping products, on the other hand, are often manufactured with recovered material content because of less stringent performance requirements.

Recovered material content strapping is currently being made with the following materials:

- **PP:** up to 100 percent recovered materials, of which 0 to 50 percent is postconsumer material.
- **PET (used to manufacture polyester strapping):** up to 100 percent recovered material, of which 0 to 75 percent is postconsumer material.
- **Steel:** 25 to 100 percent recovered material, of which 10 to 15 percent is postconsumer.

Stretch wrap is most commonly made of virgin LLDPE, but can also be made of regular LDPE and PVC, the latter being incompatible with polyethylene recycling operations. Postconsumer PET from used soda bottles and recovered stretch wrap can both be used to manufacture new polyethylene stretch wrap. Currently, one manufacturer incorporates 20 percent postconsumer LDPE into its stretch wrap. Table 38 lists the recovered materials used in the products of companies that manufacture strapping.

Table 38

Recovered Materials Content of Strapping

Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
PET	Company A: 40-50	40-50
	Company B: ≥75	≥75
	Company C: 15-35	15-35
	Company D: 60	100
	Company E: 50	50
	Company F: 85	85
	Company G: Unknown	Unknown
PP	Company A: —	5-10 (PP)
	Company B: —	20 (PP)
	Company C: —	15-20 (PP)
	Company E: —	10 (PP)
	Company F: —	20 (PP)
	Company G: —	Unknown
PP, Polyester, Hybrid Blend	Company H: —	40
LDPE	Company I: 20	20

b. Preference Program

EPA recommends that, based on the recovered materials content levels shown in Table 39, procuring agencies establish minimum content standards for use in purchasing manual-grade strapping containing recovered materials.

Table 39

Draft Recovered Materials Content Recommendations for Strapping

Product	Material	Postconsumer Content (%)	Total Recovered Materials Content (%)
Polyester strapping	PET	50-85	50-85
Polypropylene strapping	PP	--	10-40
Steel strapping	Steel	10-15	25-100

c. Specifications

Specifications and guidance for breaking strength, elongation, and other characteristics of various types of strapping and stretch wrap can be found in the ASTM standards listed in Table 40. These specifications neither recommend nor preclude the use of recovered materials.

Table 40

ASTM Specifications and Guidance for Types of Strapping

Material	ASTM Specification or Guidance Number	Title
Strapping, Flat Steel and Seals	ASTM D3953	Standard Specification for Strapping, Flat Steel and Seals
Strapping, Nonmetallic (and Joining Methods)	ASTM D3950	Standard Specification for Strapping, Nonmetallic (and Joining Methods)
Strapping, Flat Materials	ASTM D4675	Standard Guide for Selection and Use of Flat Strapping Materials
Stretch Wrap	ASTM D4649	Standard Guide for Selection of Stretch Wrap Films

Source: ASTM, 1990; ASTM, 1991; ASTM, 1994; ASTM, 1995

X. OTHER ITEMS CONSIDERED FOR CPG III DESIGNATION

EPA categorized the items that are not being proposed for designation in CPG III into two additional groups: 1) those items that will be considered for designation in future CPG revisions and 2) those items that are no longer under consideration. EPA based these determinations on information provided through public comments and its own research. (See section II.C of this document for a discussion of the methodology used for selecting items for proposed designation in the CPG.)

A. Items Still Under Consideration

A number of items containing recovered materials are still under consideration by EPA for future CPG designation. The Agency either has not completed its review of these items or has determined that additional research is necessary.

As part of its effort to designate items in the CPG, EPA conducted its own research on a number of items. Some items are being proposed for designation in CPG III, while EPA has insufficient information to designate other items at this time. For many of these items, EPA has information pertinent to only one or two of the item selection criteria. EPA has incomplete information on the following items, which are arranged alphabetically by product category. These items are still being researched and are being considered for possible future CPG designation.

Construction Products

Carpet runners
Flooring materials
Hardboard
Medium density fiberboard
Nylon carpet
Particleboard
Interior trim and window frames
Roofing materials
Rubberized asphalt
Building blocks
Decking material
Marine docks
Geotextiles
Plastic pipe

Cenospheres
Aggregates
Concrete containing silica fume

Transportation Products

Embankments
Threshold ramps

Non-Paper Office Products

Office dividers
Lightweight furniture

Vehicular Products

Rebuilt motor parts

Miscellaneous Products

Food service trays
Rolling carts
Industrial abrasives
Limited use protective apparel
Bicycle racks
Mattresses**,** mattress pads, and pillows

B. Items Dropped From Further Consideration

EPA considered several items for proposed designation but determined, based on the available information, that it was inappropriate to designate them. The items discussed below are no longer being considered for designation. A brief explanation of the basis for this determination is also provided. EPA requests additional information demonstrating that the items should be reconsidered for possible future designation.

1. Miscellaneous Products Dropped From Consideration

a. Recycled Ink

EPA contacted numerous printers, ink manufacturers, and printing trade associations and was able to identify only one potential recycled ink manufacturer. Several people commented that some parties have tried remanufacturing and filtering waste printing press ink, but that they produced inferior quality inks that were not cost effective. EPA learned, however, that many of the larger commercial printers recycle ink internally as ink remaining from a press run can be reused or reblended with virgin ink. As there is little, if any, activity to manufacture recycled content ink as a stand-alone product, EPA cannot designate this item.

b. Shotgun Shells

Two technical issues exist with regard to designating shotgun shells. First, the shotgun shell is manufactured with an impact extrusion process that is highly sensitive to any contaminants in the plastic resins, which precludes the use of recovered plastics. Second, shotgun shells are subject to more than 15,000 pounds per square inch of pressure when a shotgun is fired and manufacturers are hesitant to introduce any impurities that may impair the integrity of the shotgun shell and result in a potentially fatal injury.

XI. 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 Internet web page. 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.

XII. ECONOMIC IMPACT ANALYSIS

Details of the economic impact of CPG III are described in the document entitled *Economic Impact Analysis for the Proposed Comprehensive Procurement Guideline III,* EPA530-R-98-002, which is included in the RCRA Docket for CPG III.

XIII. SUPPORTING INFORMATION

A. Carpet Cushion

"The Supporting Facts About Carpet Cushion," Carpet Cushion Council, 1994.

B. Coal Fly Ash/Foundry Sand/Flowable Fill

"Management and Use of Coal Combustion Byproducts," American Coal Ash Association, 1996.

"1995 Coal Combustion Byproduct—Production and Use (Short Tons)," American Coal Ash Association, 1996.

"State Solid Waste Regulations Governing the Use of Coal Combustion Byproducts," American Coal Ash Association, 1996.

"Coal Fly Ash," Buy Recycled Business Alliance, 1996.

"Beneficial Reuse of Spent Foundry Sand," Clean Washington Center, 1995.

"Barriers to the Increased Utilization of Coal Combustion/Desulfurization By-Products by Government and Commercial Section (draft)," Energy & Environmental Research Center, 1993.

"Federal Highway User Guidelines for Coal Fly Ash," Federal Highway Administration, 1996.

"Federal Highway User Guidelines for Foundry Sand in Flowable Fill," Federal Highway Administration, 1996.

"Fly Ash Facts for Highway Engineers," Federal Highway Administration, 1995.

"Fine Foundry Aggregate in Your Backyard," Pennsylvania Foundryman's Association, 1995.

"Processing and Potential Applications of Fly Ash—Aluminum (Ash Alloy) Composite," University of Wisconsin, 1995.

"Development and Characterization of a Closed Pore Insulation Material," Grumman Aerospace Corporation, 1976.

"What, Why & How? Flowable Fill Materials," National Ready Mix Concrete Association, 1989.

"Ready Mixed Flowable Fill: A Controlled Density Material," National Ready Mix Concrete Association, 1993.

"Flowable Fill Made with Spent Foundry Sand," Ohio Department of Transportation, 1995.

"Practical Considerations for the Formulation and Usage of Flowable Fill Materials," L. Zimmerman, 1990.

C. Plastic Lumber

"Balloting of Draft Test Methods for Density, Compressive Properties, Flexural Properties, and Mechanical Fasteners for Plastic Lumber and Shapes," American Society for Testing and Materials, 1996.

"The State of the Plastic Lumber Industry: 1996," Plastic Lumber Trade Association, 1996.

"The Recycled Plastic Lumber Industry: Moving Toward Adulthood," Resource Recycling Magazine, 1996.

D. Playground Equipment

"Standard Consumer Safety Performance Specification for Playground Equipment for Public Use," American Society for Testing and Materials, 1995.

"Handbook for Playground Safety," U.S. Consumer Product Safety Commission, 1993.

E. Compost

"Biocycle Journal of Composting and Recycling," various issues.

F. Sorbents

"National Wood Recycling Directory," American Forest & Paper Association, 1996.

"Substances Absorbed by Absorbent Products," Absorption Corporation, 1994.

"Market Overview," Coalition of Organic Absorbent Producers, 1996.

"World Catalog of Oil Spill Response Products," Marine Spill Response Corporation, 1995.

G. Signage

"Manual of Uniform Traffic Control Devices," U.S. Department of Transportation, 1988.

"Use of Recycled Materials and Recycled Products in Highway Construction," University of Massachusetts Transportation Center, 1995.

H. Strapping

"Standard Specification for Strapping, Nonmetallic (and Joining Methods)," American Society for Testings and Materials, 1990.

"Standard Specification for Strapping, Flat Steel and Seals," American Society for Testing and Materials, 1991.

"Standard Guide for Selection and Use of Flat Strapping Materials," American Society for Testing and Materials, 1994.

"Standard Guide for Selection of Stretch Wrap Films," American Society for Testing and Materials, 1995.

I. Multi-Material

"Buy Recycled Guidebook," Buy Recycled Business Alliance, National Recycling Coalition, 1996.

"McRecycle USA Database Listing," McDonald's Corporation, 1995.

"NRC 1997 Program Book," 16th Annual Congress & Exposition, National Recycling Coalition, Sept. 22-24, 1997.

"Characterization of Municipal Solid Waste in the United States: 1996 Update," U.S. EPA, EPA530-R-97-015, April 1997.

"Buy Recycled Training Manual: A Guidebook for Government Buyers and Using Agencies," Northeast Maryland Waste Disposal Authority, 1995.

"The Official Recycled Products Guide," Recycling Data Management Corporation, 1996.

Opportunities for Government Procurement of New and Innovative Recycled Content Products," Final Report, prepared for EPA Region 1, by Yale University, School of Forestry and Environmental Studies, 1995.

"Recycled Products Research for the Comprehensive Procurement Guideline," Draft Final Report, prepared for EPA Office of Solid Waste, by Science Applications International Corporation, undated.

"Potential Items for Future Designation: Comprehensive Guideline for Procurement of Products Containing Recovered Content," Final Report, prepared for EPA Office of Solid Waste, by Science Applications International Corporation, 1995.

"Research on Potential Items for Designation in the Comprehensive Procurement Guideline," Report prepared for EPA Office of Solid Waste, by Eastern Research Group, Inc., 1995.

"Manufacturing from Recyclables: 24 Case Studies of Successful Recycling Enterprises," U.S. EPA, EPA530-R-95-001, 1995.

"Environmental Products Guide," U.S. General Services Administration, Office of Acquisition, Acquisition Management Center, Environmental and Engineering Policy Division, 1995.

"CPGNet," Internal website (**http://www.erg.com/hotlinks/cpgnet.htm**), created by Eastern Research Group, 1997.