Methods for Sampling and Testing Recycled High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Bales, Pellets or Regrind
Methods for Sampling and Testing Recycled High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Bales, Pellets or Regrind

CWC
2200 Alaskan Way, Suite 460
Seattle, Washington 98121

December 1996

This recycled paper is recyclable

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Report No. PL-97-5
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</thead>
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<td>452</td>
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<td>459</td>
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<td>64</td>
</tr>
<tr>
<td>473</td>
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<td>66</td>
</tr>
<tr>
<td></td>
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<td>A-1</td>
</tr>
</tbody>
</table>
400 Guidelines for Using the Sampling and Test Procedures for Recycled High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Bales, Regrind and Pellets

1.0 Scope

1.1 These guidelines describe test procedures for the attributes of recycled HDPE and PET bottles or containers, regrind and pellets.

1.2 These methods are intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The methods do not provide an Acceptance Quality Level (AQL) or acceptance criteria, and do not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.3 The sampling methods herein provide guidance in obtaining representative field samples. These methods are derived from common industry practices that seek to balance the value of the commodity with the cost of sampling and testing. Due to this sensitivity to economics, the field sample sizes are tailored to suit industry practices. The Clean Washington Center takes no position respecting the statistical validity of the sampling methods presented herein. Users of this method are expressly advised that determination of the statistical validity of sampling is entirely their own responsibility. Other methods for acquiring a field sample, particularly the techniques of statistical process control (SPC) and trend analysis, may allow the estimation of reliable attribute values using fewer samples over a longer period of time.

1.4 The guidelines do not address safety problems, if any, associated with their use. The user is responsible for following appropriate safety and health practices.

1.5 These methods do not address material contamination with any form of medical wastes, nor toxic and/or hazardous waste or materials. These are typically considered to be prohibited contaminants and any amount detected may be justification for load rejection based on discretion of buyer.

2.0 Definitions

2.1 Attribute - material or product characteristic or contamination type for which test methods are provided to aid in dispute resolution of product quality during trading.

2.2 Bale - mass of compressed material that is bound with wrap or wire for ease in transportation.

2.3 Certificate - a document from the supplier verifying the feedstock origin and material quality. The documentation may be a certification letter, or “certificate of analysis”, and/or “certificate of origin”, that certifies the material meets minimum specifications as established by trading parties and/or industry specifications.

2.4 Feedstock origin - description of the source (previous use) and/or type and/or grade of material. Feedstock origin includes, but is not limited to the following examples:

<table>
<thead>
<tr>
<th>Type</th>
<th>Post-consumer, post-industrial, mixed, or other.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Manufacturing company, residential curbside collection or other.</td>
</tr>
<tr>
<td>Grade</td>
<td>Injection molded, blow molded, rotational, extruded or other.</td>
</tr>
</tbody>
</table>
2.5 **Pellets** - material extruded from regrind to yield homogeneous, contoured particles ready for use in production.

2.6 **Regrind** - the particles (flakes) produced when plastic containers are mechanically shredded and granulated.

2.7 **Toxic, hazardous or medical contamination** - contaminants that pose potential risk to human health and/or the environment. Medical contamination includes but is not limited to: syringes, contaminated blood transfusion bottles, and other containers contaminated by drugs or bodily fluids. Hazardous materials includes but is not limited to pesticide residue in containers, pesticides, crude oil, petroleum products, strong oxidizers, fluorides, chlorides, strong alkaline and biological agents. Hazardous materials are defined as any materials or residues that exhibit the characteristics of ignitability, corrodability, reactivity, or toxicity as defined in the July 1, 1993 edition of 40 CFR 260, Subpart C, Chapter 1 - *Characteristics of Hazardous Waste.*

3.0 **Apparatus**

Not applicable.

4.0 **Procedure**

4.1 These test methods cover recycled HDPE and PET in the form of bottles or containers, post-industrial scrap from container manufacturing, unwashed regrind, washed regrind, and pellets. Depending on the form of the material, choose the appropriate sampling and test procedures as described below.

4.2 Sampling and inspecting baled bottles or containers.

4.2.1 Attributes applicable to HDPE bales are listed in Table 400-1. Attributes applicable to PET bales are listed in Table 400-2.

4.2.2 The sampling and inspection test methods for all attributes applicable to bales are discussed in Method 402 -Sampling and Determination of Attributes for HDPE and PET Bales. All applicable tests will be performed on the same sample(s). If baled material is processed into regrind or pellets, refer to Section 4.3 for applicable attribute tests.

4.3 Sampling regrind and pellets.

4.3.1 Attributes applicable to HDPE regrind and pellets are listed in the following tables:

- Table 400-3 - List of Attributes for HDPE Unwashed Regrind
- Table 400-4 - List of Attributes for HDPE Washed Regrind
- Table 400-5 - List of Attributes for HDPE Pellets.
4.3.2 Attributes applicable to PET regrind and pellets are listed in the following tables:

Table 400-6 - List of Attributes for PET Unwashed Regrind
Table 400-7 - List of Attributes for PET Washed Regrind
Table 400-8 - List of Attributes for PET Pellets.

4.3.3 Sample collection methods for regrind and pellets are discussed in Method 410 - Sampling of HDPE and PET Regrind and Pellets. All applicable tests will be performed on the same sample(s).

Table 400-1 - List of Attributes for HDPE Bales

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin:</td>
<td>*Certificate</td>
<td>1</td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bale Volume</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Bale Weight</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Bale Density</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Bale Integrity</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Caps and Closures Removed</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Bottles Rinsed</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Moisture Level</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Photodegradation</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Non-HDPE Plastic Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Non-Ferrous Metal Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Toxic, Hazardous or Medical Contamination</td>
<td>*Certificate</td>
<td>2</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty: 1 = Attribute easily verified.
2 = Additional processing of material required to verify attribute.
Table 400-2 - List of Attributes for PET Bales

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td>*Certificate</td>
<td>1</td>
</tr>
<tr>
<td>Bale Volume</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Bale Weight</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Bale Density</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Bale Integrity</td>
<td>402</td>
<td>1</td>
</tr>
<tr>
<td>Caps and Closures Removed</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Bottles Rinsed</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Moisture Level</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>PVC Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Other Non PET Plastic Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Non-Ferrous Metal Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>402</td>
<td>2</td>
</tr>
<tr>
<td>Toxic, Hazardous or Medical Contamination</td>
<td>*Certificate</td>
<td>2</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty:  
1 = Attribute easily verified.  
2 = Additional processing of material is required to verify attribute.
### Table 400-3 - List of Attributes for HDPE Unwashed Regrind

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>** DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>444</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin:</td>
<td>Certificate</td>
<td>1</td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk Density</td>
<td>448</td>
<td>1</td>
</tr>
<tr>
<td>Particle Size</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Fines</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Polymer Density and Specific Gravity</td>
<td>459</td>
<td>2</td>
</tr>
<tr>
<td>Melt Index</td>
<td>455</td>
<td>2</td>
</tr>
<tr>
<td>Odor</td>
<td>434</td>
<td>1</td>
</tr>
<tr>
<td>Caps and Closures Removed</td>
<td>*Certificate</td>
<td>1</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>440</td>
<td>1</td>
</tr>
<tr>
<td>Wood and Paper Product Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Volatile Organic Contamination</td>
<td>425</td>
<td>3</td>
</tr>
<tr>
<td>Floatable Plastic Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Non-floatable Plastic Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Non-ferrous Metal Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>424, 425</td>
<td>2, 3</td>
</tr>
<tr>
<td>Toxic, Hazardous or Medical Contamination</td>
<td>*Certificate</td>
<td>1</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty:  
1 = Attribute easily verified.  
2 = Additional processing of material required to verify attribute.  
3 = Test(s) should be performed by certified personnel or qualified laboratories, and only when specifically requested.
Table 400-4 - List of Attributes for HDPE Washed Regrind

<table>
<thead>
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<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>444</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin</td>
<td>*Certificate</td>
<td>1</td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk Density</td>
<td>448</td>
<td>1</td>
</tr>
<tr>
<td>Particle Size</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Fines</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Polymer Density and Specific Gravity</td>
<td>459</td>
<td>2</td>
</tr>
<tr>
<td>Melt Index</td>
<td>455</td>
<td>2</td>
</tr>
<tr>
<td>Odor</td>
<td>434</td>
<td>1</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>440</td>
<td>1</td>
</tr>
<tr>
<td>Wood and Paper Product Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Volatile Organic Contamination</td>
<td>425</td>
<td>3</td>
</tr>
<tr>
<td>Floatable Plastic Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Non-floatable Plastic Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Non-ferrous Metal Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>424, 425</td>
<td>2, 3</td>
</tr>
<tr>
<td>Toxic, Hazardous or Medical Contamination</td>
<td>*Certificate</td>
<td>1</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

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1 = Attribute easily verified.
2 = Additional processing of material required to verify attribute.
3 = Test(s) should be performed by certified personnel or qualified laboratories, and only when specifically requested.
Table 400-5 - List of Attributes for HDPE Pellets

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>444</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin</td>
<td>*Certificate</td>
<td>1</td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk Density</td>
<td>448</td>
<td>1</td>
</tr>
<tr>
<td>Pellet Weight</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Pellet Size</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Polymer Density and Specific Gravity</td>
<td>459</td>
<td>2</td>
</tr>
<tr>
<td>Melt Index</td>
<td>455</td>
<td>2</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>440</td>
<td>1</td>
</tr>
<tr>
<td>Floatable Plastic Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Non-floatable Plastic Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Non-ferrous Metal Contamination</td>
<td>424</td>
<td>1</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>424</td>
<td>2</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty:  
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2 = Additional processing of material required to verify attribute.  
3 = Test(s) should be performed by certified personnel or qualified laboratories, and only when specifically requested.
### Table 400-6 - List of Attributes for PET Unwashed Regrind

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>444</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin:</td>
<td>Certificate</td>
<td>1</td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle Size</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>440</td>
<td>1</td>
</tr>
<tr>
<td>PVC Contamination</td>
<td>473</td>
<td>2</td>
</tr>
<tr>
<td>Glycol-Modified Polyethylene Terephthalate (PETG)</td>
<td>473</td>
<td>2</td>
</tr>
<tr>
<td>Floatable Plastic Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Non-floatable Plastic Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Non-ferrous Metal Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>430</td>
<td>2</td>
</tr>
<tr>
<td>Toxic, Hazardous or Medical Contamination</td>
<td>Certificate</td>
<td>1</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty:**

1 = Attribute easily verified.

2 = Additional processing of material is required to verify attribute.
### Table 400-7 - List of Attributes for PET Washed Regrind

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>444</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin:</td>
<td>Certificate</td>
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</tr>
<tr>
<td>- Post-Consumer Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle Size</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Intrinsic Viscosity</td>
<td>467</td>
<td>3</td>
</tr>
<tr>
<td>Clarity, Color</td>
<td>452</td>
<td>2a</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>440</td>
<td>1</td>
</tr>
<tr>
<td>PVC Contamination</td>
<td>473</td>
<td>2</td>
</tr>
<tr>
<td>PETG Contamination</td>
<td>473</td>
<td>2</td>
</tr>
<tr>
<td>Floatable Plastic Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Non-floatable Plastic Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Non-ferrous Metal Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>430</td>
<td>3</td>
</tr>
<tr>
<td>Toxic, Hazardous or Medical Contamination</td>
<td>Certificate</td>
<td>1</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty:**

1 = Attribute easily verified.

2 = Additional processing of material required to verify attribute.

2a = Special laboratory equipment or independent lab required to verify attribute.

3 = Test(s) should be performed by certified personnel or qualified laboratories, and only when specifically requested.
Table 400-8 - List of Attributes for PET Pellets

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>TEST METHOD</th>
<th>**DIFFICULTY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>444</td>
<td>1</td>
</tr>
<tr>
<td>Feedstock Origin:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Post-Consumer Content</td>
<td>Certificate</td>
<td>1</td>
</tr>
<tr>
<td>- Previous Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pellet Weight</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Particle Size</td>
<td>419</td>
<td>1</td>
</tr>
<tr>
<td>Intrinsic Viscosity</td>
<td>467</td>
<td>3</td>
</tr>
<tr>
<td>Clarity, Color</td>
<td>452</td>
<td>2a</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>440</td>
<td>1</td>
</tr>
<tr>
<td>Floatable Plastics Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Non-floatable Plastics Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Ferrous Metal Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Non-ferrous Metal Contamination</td>
<td>430</td>
<td>1</td>
</tr>
<tr>
<td>Other Contamination</td>
<td>430</td>
<td>3</td>
</tr>
</tbody>
</table>

* Where “Certificate” is listed as the test method, the seller must submit documentation (i.e., certification letter, and/or certificate of analysis, and/or certificate of origin) to verify this attribute. No further testing is required.

**Level of Difficulty:  
1 = Attribute easily verified.  
2 = Additional processing of material required to verify attribute.  
2a = Special laboratory equipment or independent lab required to verify attribute.  
3 = Test(s) should be performed by certified personnel or qualified laboratories, and only when specifically requested.
4.4 Testing pellets and regrind.

4.4.1 It is not necessary to perform all test methods, only those for attributes in dispute.

4.4.2 The testing methods for the attributes in dispute for baled HDPE or PET are presented in Method 402 - Sampling and Determination of Attributes for HDPE and PET Bales.

4.4.3 The testing methods for the attributes in dispute are presented in the remainder of the methods, and are charted in Figure 400-1 for HDPE regrind or pellets, and Figure 400-2 for PET regrind or pellets.

5.0 Calculations

Not applicable.

6.0 Report

Not applicable.

7.0 Reference Documents

7.1 Method 402 - Sampling and Determination of Attributes for HDPE and PET Bales

7.2 Method 410 - Sampling of HDPE and PET Regrind and Pellets

7.3 American Society for Testing and Materials (ASTM) standards as noted within these methods. Several of the methods herein have been adapted, in part, from ASTM standards, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, the methods have neither been approved nor endorsed by ASTM. The complete and official text of any ASTM standards listed in these procedures may be obtained directly from the ASTM Customer Service department by writing to the above address or by phone at (215) 299-5585, fax: (215) 977-9679.

7.4 MIL-STD standards as noted within these methods. These methods have neither been approved nor endorsed by the MIL-STD standards.

7.5 PBI 28-1993 Technical Bulletin from The Plastic Bottle Institute - Recommended Practice for Documentation of Recycled HDPE Content In Baled Bottles and Reclaimed Resin.

7.6 American National Standards Institute (ANSI) standards as noted within these methods. These methods have neither been approved nor endorsed by ANSI.
Figure 400-1 - Test Methods for HDPE Regrind and Pellets

Method 410 Sampling

Method 434 Odor (Regrind Only)

Method 424 Contamination

Method 444 Color

Method 448 Bulk Density

Method 419 Particle Size

Method 440 Moisture

Method 455 Melt Index

Method 459 Polymer Density and Specific Gravity
Figure 400-2 - Test Methods for PET Regrind and Pellets

- Method 410 Sampling
  - Method 430 Contamination
  - Method 440 Moisture
  - Method 444 Color
  - Method 473 PVC and PETG Content (Regrind Only)
  - Method 419 Particle Size
    - Method 452 Clarity
    - Method 467 Intrinsic Viscosity
1.0 Scope

1.1 This method characterizes HDPE or PET bales received in a single lot. It includes selecting a representative sample of bales from the lot, inspection of the selected bales, and determination of specific physical attributes mentioned in Tables 400-1 and 400-2 of Method 400 - Guidelines for Using the Sampling and Test Procedures for Recycled HDPE and PET Bales, Regrind and Pellets.

1.2 Sampling methods were developed in part from military standards, ASTM methods and current accepted industry practices. The sampling methods herein provide guidance in obtaining representative field samples. These methods are derived from common industry practices that seek to balance the value of the commodity with the cost of sampling and testing. Due to this sensitivity to economics, the field sample sizes are tailored to suit industry practices. The Clean Washington Center takes no position respecting the statistical validity of the sampling methods presented herein. Users of this method are expressly advised that determination of the statistical validity of sampling is entirely their own responsibility. Other methods for acquiring a field sample, particularly the techniques of statistical process control (SPC) and trend analysis, may allow the estimation of reliable attribute values using fewer samples over a longer period of time.

1.3 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.4 This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

2.1 Attribute - material or product characteristic or contamination type for which test methods are provided to aid in dispute resolution of product quality during trading.

2.2 Bale - a mass of compacted material that is bound with wrap or wire for ease of transportation. Bales are formed by utilizing a standard industry baler. Different baling equipment will produce bales of various sizes, weights and densities.

2.3 Certificate of Conformance or Certificate of Analysis - a document from the supplier verifying feedstock origin, and that the material meets certain quality specifications as established by trading parties and/or industry specifications.

2.4 Lot - a collection of bales or unbaled material that is presented as one parcel. All the material in this parcel is either processed at the same time, with the same baler, or arrives from one supplier on one delivery.

2.5 Feedstock origin - description of the source (previous use) and/or type and/or grade of material. Feedstock origin includes, but is not limited to the following examples:
Material Descriptor | Example
---|---
Type | Post-industrial or post-consumer.
Source (previous use) | Manufacturing company, residential curbside collection or other.
Grade | Injection molded, blow molded, rotational, extruded or other.

2.6 Medical, toxic and/or hazardous materials or contaminants - medical contamination includes items such as syringes, contaminated blood transfusion bottles, and other containers contaminated by drugs or bodily fluids. Hazardous materials includes containers contaminated with pesticides, insecticides, crude oil, petroleum products, strong oxidizers, fluorides, chlorides, strong alkaline and biological agents. Hazardous materials are defined as any materials or residues that exhibit the characteristics of ignitability, corrodability, reactivity, or toxicity as defined in the July 1, 1993 edition of 40 CFR 260, Subpart C, Chapter 1, - Characteristics of Hazardous Waste.

3.0 Apparatus
3.1 Dry boxes, crates, or trash cans (for sorting bale contents) that are moisture resistant, and large enough to hold the weight and volume of all sorted contaminants.
3.2 Calibrated scale of 1000 kg (or 2000 pound) capacity, with precision to 1 kg (or 1 pound). Note the scale(s) capacity, accuracy and model on the logsheet.
3.3 Calibrated scale at 50 kg (or 100-pound) capacity, with precision of ± 1 g (or 0.005 pounds). Note the scale(s) capacity, accuracy and model on the logsheet.
3.4 Tape measure (metric and/or English).
3.5 Strap cutter.
3.6 Conveyor belt to aid in processing and sorting bale contents.
3.7 Logsheet 402 (See Appendix A).

4.0 Procedure
4.1 Determine total lot weight.
4.1.1 Weigh and record the weight of each bale to the nearest 1 kg (or 1 pound) and sum all the weights. Alternatively, weigh the entire lot of bales at one time. Record the total lot weight as \( W_{\text{LOT}} \).
4.2 Determine the number of bales to include in representative sample and randomly select bales.
4.2.1 Label each bale in the lot with the following information:
   a) Lot number designating the source of material, typically obtained from bill of lading.
   b) Date and time material was received.
   c) An assigned identification number for each bale, chosen in sequence (e.g., 1, 2, etc.).
4.2.2 Refer to Table 402-1 to determine the number of test bales \( n \) to pull for sampling.
4.2.3 Select test bales through a random drawing of bale numbers. Write each bale identification number on a separate tag or piece of paper and place in a box or bag.

4.2.4 One at a time, draw tags out of the bag until the desired bale count \( (n) \) is reached. Record the bale identification numbers drawn. Separate the selected test bales from the lot.

<table>
<thead>
<tr>
<th>Total Number of Bales in the Lot (N)</th>
<th>Number of Bales to Sample (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 8</td>
<td>2</td>
</tr>
<tr>
<td>9 - 15</td>
<td>3</td>
</tr>
<tr>
<td>16 - 25</td>
<td>5</td>
</tr>
<tr>
<td>26 - 50</td>
<td>8</td>
</tr>
<tr>
<td>51 - 90</td>
<td>13</td>
</tr>
<tr>
<td>91 - 150</td>
<td>20</td>
</tr>
<tr>
<td>151 - 280</td>
<td>32</td>
</tr>
<tr>
<td>281 - 500*</td>
<td>50</td>
</tr>
</tbody>
</table>

*For lots of over 500 bales, consult MIL-STD-105 Level II for the appropriate sample size.

4.3 Inspect for qualitative attributes of sample bales through visual inspection.

4.3.1 Bale integrity: Visually check each sample bale to confirm the integrity of the bale. Ensure the straps are non-corroding and hold all baled material intact. Bales must maintain shape in shipping, unloading and storage. Record the bale integrity as the number and type of straps, and whether the material is intact.

4.3.2 Photodegradation or ultraviolet (UV) degradation of HDPE bales: Visually check each HDPE sample bale for evidence of photodegradation. This may include HDPE milk bottles that have turned opaque white in color and have become brittle from sun exposure. Note findings on logsheet.

4.3.3 Moisture level (wetness): Examine sample bales for moisture or frozen material. Visually check for liquid in the bottles and/or leaking from the bale. Record the moisture level rating (dry, damp, or wet) for each bale as described below.

If no moisture is detected in or around a bales, grade as “Dry.”

If moisture is detected on or in the bales, or leaking from the bales, grade as:

“Damp’’ if liquid is adhering to the bale, but is not dripping from the bale.

“Wet” if liquid is dripping from the bale or is present in bottles.

If bale(s) are frozen, grade as follows:

“Damp” if frost is present on the bale.

“Wet” if chunks of frozen liquid or material is observed in bottles.

Note: if the majority of a sample exhibits one attribute, report that attribute only. For example, if most of the bale is dry, but a little moisture is present, report as “dry”.

**Table 402-1 - Number of Bales to be Sampled from a Lot**
4.3.4 Rinsed: Inspect for dried or liquid residue (other than rinse water) indicating the bottles were not adequately rinsed prior to delivery. Record findings on the logsheet.

4.3.5 Feedstock origin as documented in the Certificate of Analysis or Certificate of Conformance provided by the supplier:

4.3.5.1 Verify post-consumer or post-industrial content. Record findings on the logsheet.

4.3.5.2 Verify the source of the material (i.e., manufacturer, residential curbside collection or other source). Record findings on the logsheet.

4.3.5.3 Verify the material is the proper grade for its intended use (i.e., injection molding, blow molding, extrusion grade, rotational grade, or other). Record findings on the logsheet.

4.3.6 Caps and closures: Visually inspect for caps and closures based on the allowable amount of caps and closures established between trading parties. Record findings on the logsheet.

4.3.7 Toxic, hazardous or medical contamination: Inspect for visible evidence of toxic or medical contamination. Record any findings on the logsheet. These methods do not address the situation of material contamination with any form of medical wastes, nor toxic and/or hazardous waste or materials. These are often considered to be prohibited contaminants and any amount detected may be justification for load rejection based on discretion of buyer and prior agreement between trading parties.

4.4 Determine quantitative attributes of sample bales.

4.4.1 Average bale volume: Visually inspect the sample bales for uniform length, width and height.

4.4.1.1 If all bales appear to be fairly uniform, measure the length (L), width (W), and height (H) of one bale. (If using English units, measure to the nearest inch. If using metric units, measure in meters to 1 cm). Calculate and record the average bale volume \( V_{AVE} \):

\[
V_{AVE} = L \times W \times H
\]

4.4.1.2 If bales appear non-uniform in length, width and height, classify them into similar-sized groups (e.g., large, medium, small, etc.). Measure the length (L), width (W), and height (H) of one bale from each size grouping. For each different size grouping, calculate the volume by multiplying LxWxH. Calculate and record the average bale volume \( V_{AVE} \) for the entire representative sample:

\[
V_{AVE} = (N_1V_1 + N_2V_2 + N_3V_3 + \ldots) / (N_1 + N_2 + N_3 + \ldots)
\]

where \( N_i \) = number of bales in each size grouping for group number \( i \)

\( V_i \) = volume of bale \( i \)

4.4.2 Average bale weight: Divide total lot weight (\( W_{LOT} \)) by the number of bales in the lot and record this average bale weight (\( W_{AVE} \)).

4.4.3 Average bale density: Divide the average bale weight (\( W_{AVE} \)) by the average bale volume (\( V_{AVE} \)). Report the bale density (in kilograms per cubic meter or pounds per cubic foot).
4.5 For the remainder of the attribute determinations, each sample bale is broken down and sorted on a conveyor belt to examine bale contents. In general, breaking down bale(s) for inspection is not recommended due to space limitations, general impracticality, and the possibility of spending more on inspection than the material may be worth. However, if further inspection is necessary for dispute resolution, the following procedure applies.

4.5.1 Prepare containers to sort and collect the bale material into the following colors and contamination types:

4.5.1.1 Color

<table>
<thead>
<tr>
<th>HDPE Color Codes</th>
<th>PET Color Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = natural</td>
<td>C = clear</td>
</tr>
<tr>
<td>P = pigmented</td>
<td>G = green</td>
</tr>
<tr>
<td>S = specified</td>
<td>O = other</td>
</tr>
</tbody>
</table>

4.5.1.2 Ferrous metal contamination
4.5.1.3 Non-ferrous metal contamination
4.5.1.4 Other plastic contamination (including caps and closures but excluding PVC)
4.5.1.5 PVC contamination (PET bales only)
4.5.1.6 Non-plastic contamination (dirt, mud, stones, etc.)

4.5.2 Place the sample bales at the conveyor input. Cut bale straps with EXTREME CAUTION as the bale material is compressed and may expand with ample force when straps are cut.

4.5.3 Feed the bale material onto the conveyor belt. Sort bale colors and contaminants into the different contaminant categories listed in Section 4.5.1, by placing each sorted constituent in a separate container.

4.6 Determine and quantify contaminants.

4.6.1 Weigh and record all the contaminant material in each category to ± 1 k (or ± 0.005 pounds). Sum this information for all sample bales to obtain the total weight of each contaminant in the sample.

\[ F_{\text{total}} = \text{Weight of ferrous material in all sample bales} \]
\[ N_{\text{total}} = \text{Weight of non-ferrous material in all sample bales} \]
\[ P_{\text{total}} = \text{Weight of other plastic material (excluding PVC) in all sample bales} \]
\[ P_{\text{VPC total}} = \text{Weight of PVC in all sample bales} * \text{(for PET bales only)} \]
\[ D_{\text{total}} = \text{Weight of dirt, mud, stones, and other material in all sample bales} \]

4.6.2 Determine the total contaminant weight \( C_{\text{total}} \) for all sample bales as follows:

\[ C_{\text{total}} = F_{\text{total}} + N_{\text{total}} + P_{\text{total}} + D_{\text{total}} + P_{\text{VPC total}} \]

4.7 Determine color composition.

4.7.1 Sort the bottles into the different basic colors:
For HDPE, sort the material into (N) natural, (P) pigmented, and (S) a specific color (if specified).

For PET, sort the material into (C) clear, (G) green, and (O) other.

4.7.2 Weigh each color-sort separately to ± 1 g (or ± 0.005 pounds). Record the total weight of each color as N, P, or S for HDPE, and C, G, or O for PET. (Refer to color codes above).

4.8 Inspect for visible evidence of toxic or medical contamination. These methods do not address the situation of material contamination with any form of medical wastes, nor toxic and/or hazardous waste or materials. These are often considered prohibited contaminants and any amount detected may be justification for load rejection based on discretion of buyer and prior agreement between trading parties. Record any findings on the logsheet.

5.0 Calculations

In addition to calculations in above steps, calculate the following:

5.1 Average weight (per bale) of total contamination for the lot ($C_{AVE}$):

$$C_{AVE} = \frac{C_{total}}{n}$$

where $n$ = total number of test bales.

5.2 Average weight (per bale) of each contaminant

$$F_{AVE} = \frac{F_{total}}{n}$$

$$N_{AVE} = \frac{N_{total}}{n}$$

$$P_{AVE} = \frac{P_{total}}{n}$$

$$D_{AVE} = \frac{D_{total}}{n}$$

$$^{*}PVC_{AVE} = \frac{V_{total}}{n}$$

* PET Bales Only

5.3 Weight percent of contamination:

$$\% \text{ of each contaminant} = \left( \frac{X_{AVE}}{W_{AVE}} \right) \times 100$$

where: $X_{AVE} =$ average weight (per bale) of each contaminant ($X = F, N, P, D,$ and PVC).

$W_{AVE} =$ average bale weight

5.4 Average weight (per bale) of desired HDPE or PET material ($Z_{AVE}$):

$$Z_{AVE} = W_{AVE} - C_{AVE}$$

5.5 Color composition:

5.5.1 Average bale weight of each color:

For HDPE:

$$N_{AVE} = \frac{\text{total sum weight of all natural colored HDPE}}{n}$$
\[ P_{\text{AVE}} = \frac{\text{total sum weight of all pigmented HDPE}}{n} \]
\[ S_{\text{AVE}} = \frac{\text{total sum weight of all “specified” color HDPE}}{n} \]

For PET:
\[ C_{\text{AVE}} = \frac{\text{total sum weight of all clear PET}}{n} \]
\[ G_{\text{AVE}} = \frac{\text{total sum weight of all green colored PET}}{n} \]
\[ O_{\text{AVE}} = \frac{\text{total sum weight of all “other” colored PET}}{n} \]

5.52 Weight percent of each color:

For HDPE:
\[ \% N = \left( \frac{N_{\text{AVE}}}{Z_{\text{AVE}}} \right) \times 100\% \]
\[ \% P = \left( \frac{P_{\text{AVE}}}{Z_{\text{AVE}}} \right) \times 100\% \]
\[ \% S = \left( \frac{S_{\text{AVE}}}{Z_{\text{AVE}}} \right) \times 100\% \]

For PET:
\[ \% C = \left( \frac{C_{\text{AVE}}}{Z_{\text{AVE}}} \right) \times 100\% \]
\[ \% G = \left( \frac{G_{\text{AVE}}}{Z_{\text{AVE}}} \right) \times 100\% \]
\[ \% O = \left( \frac{O_{\text{AVE}}}{Z_{\text{AVE}}} \right) \times 100\% \]

where \( Z_{\text{AVE}} \) = average bale weight less contamination.

6.0 Report

6.1 Report the presence or absence values and indicator for each attribute in Section 4.3.

6.2 Report the weight percent for each contamination type.

6.3 Report the calculated weight percent for each color category.

7.0 Reference Documents

7.1 MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes
410 Sampling Procedure for High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Regrind and Pellets

1.0 Scope

1.1 This sampling method is designed to capture a representative sample of the lot. The method covers sampling of pellets or regrind of recycled HDPE or PET that is received in gaylord boxes (or similar sized containers), or in a transportation unit (e.g., hopper truck or rail car). Included within are methods for both handling the collected gross field sample and reducing the gross field sample to a laboratory test sample.

1.2 Sampling methods were developed in part from military standards, ASTM methods and current accepted industry practices. The sampling methods herein provide guidance in obtaining representative field samples. These methods are derived from common industry practices that seek to balance the value of the commodity with the cost of sampling and testing. Due to this sensitivity to economics, the field sample sizes are tailored to suit industry practices. The Clean Washington Center takes no position respecting the statistical validity of the sampling methods presented herein. Users of this method are expressly advised that determination of the statistical validity of sampling is entirely their own responsibility. Other methods for acquiring a field sample, particularly the techniques of statistical process control (SPC) and trend analysis, may allow the estimation of reliable attribute values using fewer samples over a longer period of time.

1.3 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.4 This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

2.1 Gross field sample - a portion of material collected from the lot that is statistically representative of the entire lot.

2.2 Laboratory test sample - the reduced portion of the field sample used for testing.

2.3 Lot - a collection of bales or unbaled material that is presented as one parcel. All the material in this parcel is either processed at the same time, with the same baler, or arrives from one supplier on one delivery.

2.4 Regrind - material formed by grinding, shredding or chopping the material into flake form.

2.5 Retain - the portion of the field sample not tested but held for potential further testing.

2.6 Pellets - material formed by extruding and cutting regrind.

2.7 Sample thief or probe - a double-tube system with the inner tube holding small particle sample material. When the outer and inner tube openings are aligned, material may flow into or be extracted from the inner tube. Rotating the outer tube covers the openings in the inner tube, retaining the collected material within. (Other terms include: trier, coring tool, or grain probe).
3.0 Apparatus

3.1 Sample thief of approximately 35 mm (1-3/8") outside diameter. Aluminum sample thieves are not recommended. The required length of the thief is determined by the length from the top corner of the box to the opposite bottom corner. For sampling gaylord boxes, a thief of approximate length of 1.5 m (5’) thief is sufficient.

3.2 Sample sheet, clean, dry, and free of holes. The sheet must not trap fines, trap or absorb moisture, or contaminate the sample, and be large enough so all sample material will remain on the surface of the sheet. Recommended sheet materials include polypropylene, PVC, or polyethylene.

3.3 Clean, sealable, sample collection container(s) such as a five-gallon bucket(s) or ten-gallon plastic bag(s) capable of holding 25 kg (or about 50 pounds) each.

3.4 Broom or brush.

3.5 Calibrated scale with capacity up to 1000 g (or about 2.2 pounds), with readability to 1 g (or 0.005 pounds). Note the scale(s) capacity, accuracy and model on the logsheet.

3.6 If mechanical splitting method is used to reduce field sample: Riffle splitter, with 12-chutes and double-receptacles. The splitter has equal-width chutes that discharge material alternately to receptacles on either side of the splitter. Chute width should be approximately 50% wider than the largest particle.

3.7 Resealable plastic zipper locking bags.

3.8 Straight-edged scoop, shovel, or trowel.

3.9 Logsheet for Method 410 (See Appendix A).

4.0 Procedure

4.1 Collect gross field sample.

4.1.1 Label each shipment container in the lot with the following:

a) Lot number designating the source of the material, typically obtained from supplier or bill of lading.

b) Date and time material was received.

c) An assigned identification number for each container, chosen in sequence (e.g., 1, 2, 3, etc.).

4.1.2 Visually inspect the outside of each shipment container to ensure the container is in good condition and has not damaged in any way so that contamination (such as rain or dirt) could enter the container. Note and record any container damage.

4.1.3 Select the number of containers to include in the representative sample, based on the type of container. For hopper trucks or other transportation units where material is shipped in bulk, all containers will be sampled. For gaylords, select sample gaylords through a random drawing per the following procedure.
4.1.3.1. Write each assigned container identification number (Section 4.1.1.c) on a separate tag or piece of paper and place in a box or bag.

4.1.3.2. Using Table 410-1, determine the number of gaylords to sample (N) and record this number. Draw tags, one at a time, until the desired box count is reached. Record the identification numbers of the gaylords to be sampled.

**Table 410-1 - Number of Gaylord Boxes to Sample from a Given Lot**

<table>
<thead>
<tr>
<th>Total Number of Gaylords in Lot (N)</th>
<th>Number of Gaylords to Sample (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 8</td>
<td>2</td>
</tr>
<tr>
<td>9 - 15</td>
<td>3</td>
</tr>
<tr>
<td>16 - 25</td>
<td>5</td>
</tr>
<tr>
<td>26 - 50</td>
<td>8</td>
</tr>
<tr>
<td>51 - 90</td>
<td>13</td>
</tr>
<tr>
<td>91 - 150</td>
<td>20</td>
</tr>
<tr>
<td>151 - 280</td>
<td>32</td>
</tr>
<tr>
<td>281 - 500</td>
<td>50</td>
</tr>
</tbody>
</table>

For lots with more than 500 containers, refer to MIL-STD-105D Level II for the appropriate sample size.

4.1.4. Determine the number of samples to draw for gaylord boxes (or similar sized containers).

4.1.4.1. The field sample will consist of approximately 1 weight-unit of sample for every 1000 weight-unit of material (e.g., 1 kg of sample for every 1000 kg of material) in the lot, for total lot weight below 22,700 kg (50,000 pounds). If the weight (or approximate weight) of the entire load of material is known, determine the required weight of the field sample by dividing the weight of the entire load by 1,000. Record the required field sample weight as W.

4.1.4.2. Insert a closed sample thief (1.5 m or 5 feet length for typical gaylord) into the material at one corner of the box with the zone openings facing upward. Diagonally insert the thief to the opposite bottom corner, then turn the handle to open the sample zones. Move the thief up and down with two short strokes to fill the zones. (When sampling regrind material, rotate the thief twice in a small circle to fill the zones. While rotating, keep the thief openings facing up). Close the thief and remove it from the container.

4.1.4.3. Observe the contents of the zones for obvious contaminants. If contaminants or unusual contents are found, indicate which zone(s) and what was observed on the bag and on the logsheet.

4.1.4.5. Pour the thief contents (and any spillage) into the sample bag and seal.

4.1.4.6. Weigh the sample to 1 g (or ± 0.005 pound). Record the net weight of the sample (less the bag) as \( w_o \) and write the sample weight on the bag.

4.1.4.7. To determine the total number of samples to draw (S), divide the required field sample weight (W) by the weight of the initial sample (\( w_o \)). Round this result up to the nearest whole number and record on the logsheet.
4.1.4.8 To determine the number of samples to draw from each sample gaylords/containers \(S_n\), divide the total number of thief samples \(S\) by the number of sample gaylords/containers \(n\). Record \(S_n\).

4.1.4 From Figure 410-1, and the calculated number of samples to draw from each container, determine a sampling pattern for the container type.

4.1.5 Determine the number of samples to draw from trucks and/or rail cars.

4.1.5.1 Typical field sampling for a truckload or bulk load of material up to 25,000 kg (~55,000 pounds) consists of approximately 1 weight-unit of sample for every 1000 weight-unit of material (e.g., 1 kg of sample for every 1000 kg of material) in the lot. If the weight (or approximate weight) of the entire load of material is known, determine the required field sample weight \(W\) by dividing the weight of the entire load by 1,000.

For a lot of material greater than 25,000 kg (~55,000 pounds), (excluding a compartmented rail car shipment), determine a total field sample weight \(W\) that contains at least 25 kg (~55 pounds).

For compartmentalized rail car shipments, determine a total field sample weight \(W\) that contains at least 15 kg (~33 pounds) from each full rail compartment.

4.1.5.2 Select a thief that will reach at least to the bottom of the shipping container when inserted at about a 10 degree angle. Insert the closed sample thief into the material at a top opening, at as much of an angle as possible while still reaching the bottom of the container. Turn the handle to open the sample zones. Move the thief up and down with two short strokes to fill the zones. (When sampling regrind material, rotate the thief twice in semi-circles to fill the zones, keeping the thief openings facing up). Close the thief and remove from the container.

4.1.5.3 Observe the contents of the sample zone for obvious contaminants or problems. Record findings on the logsheet.

4.1.5.4 Pour the thief contents into a pre-weighed bag and seal. Weigh the sample to 1 g (0.005 pounds). Record the net weight of the sample (less the bag weight) as \(w_O\) and write the sample weight on the bag.
Figure 410-1 - Sampling Patterns for Gaylords/Containers

Top View of a Bulk Container

3-D View of a Bulk Container Showing the Pattern for Sample Draws (1), (2), and (5).

Draw samples from the top of the bulk container to the opposite bottom edge or corner.

Start with top corner to bottom opposite corner samples in this order:
(1) A - A*      (2) B - B*      (3) C - C*      (4) D - D*      (5) E - E*

If additional samples are required, add top middle to bottom middle patterns in this order:
(6) 1 - 1*      (7) 2 - 2*      (8) 3 - 3*      (9) 4 - 4*

4.1.5.5 To determine the total number of samples to draw with the thief (S), divide the required field sample weight (W) by the weight of the initial sample (w₀). Round this result up to the nearest whole number and record on the logsheet as S.

4.1.5.8 From Figure 410-2, and the calculated number of samples to draw (S), determine a sampling pattern.
Figure 410-2 - Sampling Pattern for Rail Cars

Top View of Two-Compartment Rail Car

Side View of Two-Compartment Rail Car

Draw samples in diagonal patterns from the top of the rail car as shown.

4.2 Collect individual samples to form composite field sample.

4.2.1 Label sample bags or containers with the date, corresponding container identification number, lot information, sampling zone and order of sampling.

4.2.2 Following the selected sampling pattern, draw the number of samples determined above. Draw each thief sample as described in step 4.1.5.2. Compile the individual samples in a composite sample either on a sample sheet or storage container. Segregate material by lot or shipping unit.

4.3 Reduce the field sample size to create the laboratory size sample.

4.3.1 One of two methods, coning and quartering, or mechanical splitting, reduces the field sample to a laboratory test sample weight. Mechanical splitting is the preferred method.

4.3.2 Determine the total laboratory sample weight needed for all specific test(s) that will be conducted, as determined in Tables 410-2 and 410-3.
### Table 410-2 - Weights for HDPE Laboratory Test Samples

<table>
<thead>
<tr>
<th>TEST METHOD</th>
<th>TEST</th>
<th>SAMPLE SIZE (VOLUME OR WEIGHT)</th>
<th>Pellet</th>
<th>Regrind</th>
</tr>
</thead>
<tbody>
<tr>
<td>419</td>
<td>Particle Size</td>
<td>500 ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>419</td>
<td>Pellet Count/Gram</td>
<td>10 g</td>
<td>100 ml</td>
<td></td>
</tr>
<tr>
<td>419</td>
<td>Fines</td>
<td>N/A</td>
<td>100 ml</td>
<td></td>
</tr>
<tr>
<td>424</td>
<td>Solid Contamination</td>
<td>200 g</td>
<td></td>
<td>200 g</td>
</tr>
<tr>
<td>425</td>
<td>Organic Contamination</td>
<td>N/A</td>
<td></td>
<td>30 g</td>
</tr>
<tr>
<td>434</td>
<td>Odor</td>
<td>Taken directly from shipping container.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>440</td>
<td>Moisture Content</td>
<td>500 g</td>
<td></td>
<td>500 g</td>
</tr>
<tr>
<td>444</td>
<td>Color</td>
<td>500 ml</td>
<td></td>
<td>500 g</td>
</tr>
<tr>
<td>448</td>
<td>Bulk Density</td>
<td>Taken directly from shipping container.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>455</td>
<td>Melt Index</td>
<td>250 ml</td>
<td></td>
<td>250 ml</td>
</tr>
<tr>
<td>459</td>
<td>Polymer Density and Specific Gravity</td>
<td>Uses extrudate from Melt Index (Method 455)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 410-3 - Weights for PET Laboratory Test Samples

<table>
<thead>
<tr>
<th>TEST METHOD</th>
<th>TEST</th>
<th>SAMPLE SIZE (VOLUME OR WEIGHT)</th>
<th>Pellet</th>
<th>Regrind</th>
</tr>
</thead>
<tbody>
<tr>
<td>419</td>
<td>Particle Size</td>
<td>500 ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>419</td>
<td>Pellet Count/Gram</td>
<td>10 g</td>
<td>100 ml</td>
<td></td>
</tr>
<tr>
<td>430</td>
<td>Solid Contamination</td>
<td>500 ml</td>
<td></td>
<td>500 ml</td>
</tr>
<tr>
<td>440</td>
<td>Moisture Content</td>
<td>500 g</td>
<td></td>
<td>500 g</td>
</tr>
<tr>
<td>444</td>
<td>Color</td>
<td>500 ml</td>
<td></td>
<td>500 ml</td>
</tr>
<tr>
<td>452</td>
<td>Clarity</td>
<td>3 x 125 ml each</td>
<td>3 x 125 ml each</td>
<td></td>
</tr>
<tr>
<td>467</td>
<td>Intrinsic Viscosity</td>
<td>10 g</td>
<td></td>
<td>10 g</td>
</tr>
<tr>
<td>473</td>
<td>PVC and PETG Content</td>
<td>N/A</td>
<td></td>
<td>1000 g</td>
</tr>
</tbody>
</table>
4.3.3 **Coning and Quartering:**

4.3.3.1 Pour the entire sample from the labeled bag onto the middle of the sample sheet. Mix the material thoroughly by turning the entire sample over at least three times with the scoop or shovel.

4.3.3.2 Shovel the entire sample into a conical pile.

4.3.3.3 Flatten the conical pile to a uniform thickness and diameter by pressing down on the apex of the pile with the shovel. The diameter of the flattened pile should measure about four to eight times the thickness of the pile. Refer to Figure 410-3.

4.3.3.4 Divide the flattened mass into four equal quarters with the shovel or trowel.

4.3.3.5 Remove two diagonally opposite quarters and brush the area clean around the selected quarter. Ensure the entire sample in the two quarters remains. If polymer fines are trapped on the sample sheet, brush the surface and/or lightly tap the sheet from underneath to loosen and collect the fines.

4.3.3.6 Successively mix, cone and quarter the remaining material, until the sample is reduced to the desired test quantity. Return the portion of material that will not be tested to its original sample bag and seal. Label this bag with "RETAIN SAMPLE". Save the retain sample for resolving future quality issues.

---

**Figure 410-3 Coning and Quartering**

- **Top Views**
  - Conical Pile
  - Flattened Pile
  - Quartered Pile
  - Separated Quarters

- **Side Views**
  - (Pile diameter 4 to 8 times pile height)
  - (Sweep 2 diagonal quarters away)
4.3.4 **Mechanical Splitting:**

4.3.4.1 Place the field sample in the hopper or pan that will feed the material into the riffle splitter without spillage.

4.3.4.2 Distribute the sample uniformly from edge to edge, so that when it is introduced into the chutes, equal amounts will flow through each chute. It is important that the presenting channel of funnel be adequately full to ensure even distribution.

4.3.4.3 Introduce the sample at a rate that allows free flow through the chutes into the receptacles below.

4.3.4.4 Reintroduce the portion of the sample in one of the receptacles into the splitter as many times as necessary to reduce the sample to the quantity specified for the intended characterization test.

4.3.4.5 Reserve the portion of material collected in the second receptacle future tests (if necessary).

4.3.5 Seal the final laboratory sample in a small bag and label the bag as "TEST SAMPLE". Also label the test sample bag with the date, corresponding container identification number, lot number and sampling order number.

5.0 **Calculations**

Not applicable.

6.0 **Report**

Not applicable.

7.0 **Reference Documents**

7.1 MIL-STD-105D *Sampling Procedures and Tables for Inspection by Attributes*
Determination of Particle Size for High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Regrind and Pellets

1.0 Scope

1.1 These test methods describe the measurement of particle size for HDPE and PET regrind and pellets. Three test methods are described, of which one, two, or all three may be used at discretion of buyer.

   a) Particle Size - Regrind or pellet particle size is determined by sieving.

   b) Pellet Count per Gram (applies to pellets only, no regrind) - The number of pellets per gram is determined by counting pellets in a specific sample weight. A typical range for pellet count is 30 - 80 pellets per gram.

   c) Percent Fines (applies to HDPE regrind only) - Percent fines is measured by sieving a dry mass of plastic, resulting in two fractions, percent passing and percent retained.

1.2 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.3 This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

Not applicable

3.0 Apparatus

3.1 Calibrated scale of minimum capacity 500 g, accurate to 0.1 g. Note the scale(s) capacity, accuracy and model on the logsheet.

3.2 Three (3) wire sieves in the following mesh sizes:

   a) No. 80 mesh (180 micron).
   b) 9.5 mm (or 3/8") mesh.
   c) 12.5 mm (or 1/2") mesh.

Sieves must be frame-mounted, with top and bottom covers to prevent spillage and to collect fines. Inspect sieves for wavy or torn wires and discard defective sieves. Wavy wires indicate improperly-stretched wire cloth, which will affect test results.

3.3 Standard mechanical shaker for sieves.

3.4 Graduated 500 ml measuring cup or cylinder.
3.5 Accessories for cleaning sieves such as brush, vacuum cleaner, air hose.

3.6 (Optional if static will hinder flow of material and fines through the sieves): Antistat agent in spray form.

3.7 Logsheet for Method 419 (See Appendix A).

4.0 Procedures

4.1 Prepare sample.

4.1.1 Plastic materials may segregate by particle size during handling. If possible, homogenize the reduced test sample (generated per Method 410 - Sampling of HDPE and PET Regrind and Pellets) before drawing material for the test sample.

Draw the volume and/or weight of test sample(s) according to the tests that will be conducted:

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size</td>
<td>500 ml</td>
</tr>
<tr>
<td>Pellet Count per Gram</td>
<td>10 gram + 0.1 g</td>
</tr>
<tr>
<td>Percent Fines</td>
<td>100 ml</td>
</tr>
</tbody>
</table>

4.1.2 Condition the sample(s) to laboratory temperature and humidity. Evaluate the sample material for good particle separation and free-flow.

4.2 Determine particle size.

4.2.1 Weigh the 500 ml sample to 0.1 g and record this weight as W1.

4.2.2 Clean and dry sieves before use. Assemble the 12.5 mm (or 1/2") mesh sieve above the 9.5 mm (or 3/8") sieve, with both top and bottom covers.

4.2.3 Place the sample material on the top sieve. If an antistat agent is needed, spray the agent on the sample. On the logsheet, record the type of antistat agent used. Shake the sieves briskly with a side to side motion until no material falls through.

4.2.4 Open the sieve assembly avoiding spillage. Weigh each portion to 0.1 g and record as follows:

a) weight of plus 12.5 mm (1/2") particles, (portion above 12.5 mm (1/2") sieve), as A.

b) weight of minus 12.5 mm (1/2") but plus 9.5 mm (3/8") particles, (portion between the two sieves), as B.

b) weight of minus 9.5 mm (3/8") particles, (portion below the 9.5 mm (3/8") sieve), as C.
4.3 Determine pellet count per gram weight.

4.3.1 Weigh out a 10.0 ± 0.1 g sample. Record weight.

4.3.2 Count and record the number of pellets in this 10 gram sample. Divide the count by 10 to obtain the number of pellets per gram. Record result.

4.4 Determine percent fines (HDPE regrind only).

4.4.1 Draw 100 ml from the test sample. Weigh to 0.1 g precision and record weight as W2.

4.4.2 Clean and dry the sieve before adding sample. Assemble the No. 80 sieve (180 micron mesh) with top and bottom covers. If an antistat or slip agent material is needed, add 1% of antistat to the sample and mix in with a spatula. Record the type and quantity of antistat agent used.

4.4.3 Place the sample material on the sieve. Shake the sieve for 15 minutes in a mechanical shaker. Open the sieve assembly avoiding spillage.

4.4.4 Remove all material remaining in the top portion of the sieve, (180 micron plus), and weight to the nearest 0.1 g. Record this weight as T.

5.0 Calculations

5.1 Particle or pellet size:

Size (A) = A/W1 x 100 = Percent material plus 12.5 mm (or 1/2")

Size (B) = B/W1 x 100 = Percent material plus 9.5 mm (or 3/8") but minus 12.5 mm (or 1/2")

Size (C) = C/W1 x 100 = Percent material minus 9.5 mm (or 3/8")

5.2 Percent fines in the HDPE regrind:

\[
\% \text{ Fines} = \left( \frac{W2 - T}{W2} \right) \times 100
\]

6.0 Report

6.1 Report the particle or pellet size as the largest percentage.

6.2 Report the average number of pellets per gram.

6.3 Report the percent fines.

7.0 Reference Documents

7.1 Method 410 Sampling of HDPE and PET Regrind and Pellets

7.2 ASTM D 1921 Standard Test Method for Particle Size (Sieve Analysis) of Plastic Materials

Note: This method has been adapted, in part, from ASTM D 1921, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, this method has neither been approved nor endorsed by ASTM.
424 Determination of Solid Contaminants in High Density Polyethylene (HDPE) Regrind and Pellets

1.0 Scope

1.1 This method describes how to measure the percent by weight of contaminants in HDPE regrind and pellets. Solid contaminants will be sorted into the following categories:

(1) floatable plastics
(2) non-floatable plastics
(3) ferrous metals
(4) non-ferrous metals
(5) wood and paper products (applies to regrind only)
(6) other

1.2 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.3 This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definition of Contaminants

2.1 Ferrous Metals - iron and other magnetic metals.

2.2 Floatable Plastic - plastics that float in a water-based wash system, including, but not limited to: caps and closures, expanded or foamed resins, and low-, medium-, or ultra-high density polyethylene.

2.3 Non-Ferrous Metals - aluminum, lead and other non-magnetic metals.

2.4 Non-Floatable Plastic - plastics that sink in a water-based wash system, including, but not limited to polystyrene and polypropylene.

2.5 Other Contamination - miscellaneous contaminants such as glass, that are not categorizable as wood, paper, floatable plastic, non-floatable plastic, ferrous metals, or non-ferrous metals.

2.6 Wood and Paper - fibrous material, including but not limited to paper labels and woody debris.

3.0 Apparatus

3.1 Calibrated metric scale of minimum capacity of 500 g and precision to 0.1 g. Note the scale(s) capacity, accuracy and model on the logsheet.

3.2 Three (3) beakers at 4-liter capacity

3.3 Granular dishwashing detergent for standard dishwasher.
3.4 Large funnel and appropriately sized filter paper.

3.5 Bar magnet with 9 kg (20 pound) pull strength.

3.6 Teaspoon (or standard size eating spoon)

3.7 Three or four clean trays, preferable aluminum or glass.

3.8 Tweezers.

3.9 Weigh paper.

3.10 Hot tap water at ~130 degrees F (55 degrees C).

3.11 Isopropyl alcohol, laboratory grade, with minimum 91% alcohol and minimum specific gravity of 0.91.

3.12 Logsheet for Method 424 (See Appendix A).

4.0 Procedure

4.1 Obtain a laboratory test sample of about 500 ml of regrind or pellets from the reduced sample generated in Method 410 - Sampling of HDPE and PET Regrind and Pellets.

4.2 Weigh the 500 ml of this material to the nearest 0.1 g. Record this weight as T. Spread the material out on a tray so the layer of material is less than 6 mm (~1/4 inch).

4.3 Separate and weigh metals.

4.3.1 Zero the scale with a piece of weigh paper.

4.3.2 Hold a piece of paper under the bar magnet so that the paper covers the magnet. Pass the magnet just tray of material to pick up any ferrous metal. Shake the tray gently to free any trapped metal and pass the magnet over again.

4.3.3 Place the magnet with its collected ferrous material over a piece of weigh paper. Remove the magnet from behind the covering piece of paper to allow the ferrous material from the magnet to fall onto the weigh paper.

4.3.4 Weigh to the nearest 0.1 g. Record the net weight of the ferrous metals as F.

4.3.5 Zero the scale with a new piece of weigh paper.

4.3.6 From the remaining material on all three trays, remove any non-ferrous metal that is evident and place on the weigh paper.

4.3.7 Weigh to the nearest 0.1 g. Record the net weight of the non-ferrous metals as NF.

4.4 Put the remainder of the material into a 4 liter beaker. Add 2 liters of hot tap water at ~130 degrees F (55 degrees C) and add about one-half of a teaspoon of granular dishwasher detergent.
4.5 Vigorously stir the contents of the beaker with a stirring rod for 1 minute. Wait 3 minutes to allow floatables to rise. Gently stir the floatables to allow any trapped material to sink. If the floatable material is not adequately separated, repeat.

4.6 Skim the floatables from the surface and place the on tray #1. Allow to dry thoroughly.

4.7 Place the filter paper (or a stainless steel fine mesh sieve) into the funnel and set on top of an empty 4-liter beaker. Pour the water from the full 4-liter beaker into the filter assembly to collect the non-floatables (sunk material). Place the non-floatables material on tray #2 and allow to dry thoroughly.

4.8 Separate out the HDPE from the plastics that float in isopropyl alcohol. (HDPE will sink in a solution of while other plastics will float.)

4.8.1 Separate all the plastic material on tray #1 (floatables) and place into a 4-liter beaker containing 2 liters of isopropyl alcohol.

4.8.2 Scrape any non-plastic material back onto tray #1.

4.8.3 Vigorously stir the contents of the beaker with a stirring rod for 30 seconds to 1 minute. Wait 3 minutes to allow material to rise. Gently stir the material floating on top of the alcohol to allow any trapped material to sink.

4.8.4 If the material is not adequately separated, repeat steps 4.8.3.

4.8.5 Skim the material floating on top of the alcohol from the surface and place the material on tray #3. Allow material to dry thoroughly.

4.9 Weigh the floatable plastics material from tray #3 to the nearest 0.1 g. Record the net weight of the floatable plastics from tray #3 as P1.

4.10 Pick out all the plastic material from tray #2 (non-floatables) and scrape any non-plastic material back onto the tray.

4.11 Weigh the separated plastics material (non-floatables) from tray #2 to the nearest 0.1 g. Record the net weight of the non-floatable plastics from tray #2 as P2.

4.12 Separate and weigh wood and paper products (applies to regrind only).

4.12.1 Zero the scale with a piece of weigh paper.

4.12.2 Remove any wood or paper products or fibers from tray #1 and place on weigh paper.

4.12.3 Weigh this material to the nearest 0.1 g. Record the net weight of wood and paper as W.

4.13 Collect and weigh other contaminants.

4.13.1 Zero the scale with a piece of weigh paper.

4.13.2 Collect any material left on the trays following previous sorting, and place on weigh paper.

4.13.3 Weigh this material to the nearest 0.1 g. Record the net weight as Z.
5.0 Calculations

5.1 Weight percent of floatable plastics:
\[ \% P1 = (P1/T) \times 100 \]

5.2 Weight percent of non-floatable plastics:
\[ \% P2 = (P2/T) \times 100 \]

5.3 Weight percent of ferrous metals:
\[ \% F = (F/T) \times 100 \]

5.4 Weight percent of non-ferrous metals:
\[ \% NF = (NF/T) \times 100 \]

5.5 Weight percent of wood and paper products:
\[ \% W = (W/T) \times 100 \]

5.6 Weight percent of other contaminants:
\[ \% Z = (Z/T) \times 100 \]

5.7 Weight percent of all combined contaminants:
\[ \% \text{Total Contamination} = \% P1 + \% P2 + \% F + \% NF + \% W + \% Z \]

6.0 Report

6.1 Report contamination as the weight percent of each contaminant type.

6.2 Report total contamination as the weight percent of all contaminants combined.

7.0 Reference Documents

7.1 Method 410 Sampling of HDPE and PET Regrind and Pellets

7.2 This method was developed from: National Association for Plastic Container Recovery (NAPCOR) protocols. As such, it has neither been approved nor endorsed by NAPCOR.
425 Determination of Volatile Organic Contaminants in High Density Polyethylene (HDPE) Regrind

1.0 Scope

1.1 This method describes the measurement of organic contamination in HDPE regrind. Some of the analytical procedures may need to be performed by qualified analytical laboratories. Two laboratories known to perform this type of analysis are:

Rinehart Laboratories  Advanced Materials Center, Inc.
5810 Lamar Street  125 Swanson St.
Arzada, CO 80002  Ottawa, IL 61350-5114
Phone: (303) 422-4020  Phone: (815) 433-1495

1.2 Organic contamination, if present, is either surface or absorbed contamination. In this method, surface contamination is ascertained through quantitative extraction. Absorbed contamination is determined by ultrasonic extraction.

1.3 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.4 This method does not address the safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices, especially for the proper handling of chemicals.

2.0 Definitions

2.1 Organic contamination of HDPE regrind - organic compounds such as motor oil, pesticides, herbicides and other carbon-containing chemicals in HDPE regrind.

3.0 Apparatus

3.1 Ultrasonic washer and accessories, with timer and heater controls.

3.2 Infrared mass spectrophotometer, preferably with Fourier Transform Infrared (FTIR) capabilities and accessories.

3.3 Calibrated metric scale with minimum capacity of 50 g, and readability to 0.0001 g. Note the scale(s) capacity, accuracy and model on the logsheet.

3.4 Laboratory glassware including beakers (250 to 400 ml) and Erlynmeyer flasks.

3.5 Solvents of reagent or chromatography-grade: methylene chloride, cyclohexane, ethyl acetate (or isopropanol), and isopropyl alcohol.

3.6 Two aluminum weighing dishes.

3.7 Heated water bath or standard laboratory hot plate.
3.8 Drying oven.

3.9 Logsheet for Method 425 (See Appendix A).

4.0 Procedure

4.1 Obtain a test sample of 25 to 30 g from the reduced test sample generated in Method 410 - Sampling of HDPE and PET Regrind and Pellets.

4.2 Remove any non-plastic material from the sample. Weigh to 0.0001 g and record the weight as W.

4.3 Place sample in a 250 ml or 400 ml beaker (beaker size depends on the sample volume).

4.4 Wash and extract sample for testing of surface contamination.

4.4.1 Add 25 to 50 ml ethyl acetate (or isopropanol) to the beaker containing the sample until all material is completely covered.

4.4.2 Swirl with a glass rod for 2 to 3 minutes to wash the material. Pour the wash solvent into a clean beaker keeping all the sample material in the original beaker. Repeat the solvent wash and add the second batch of wash solvent to the first. Retain the washed HDPE sample and allow to dry in a hood.

4.4.3 Concentrate the wash solvent in a hood on a heated water bath (or hot plate). Do not bring to dryness. Note: ethyl acetate is flammable and caution is required. If particulate contaminants are present in the concentrate, filter or centrifuge before proceeding.

4.4.4 Weigh an empty aluminum weighing dish to 0.0001 g and record the weight as \( W_{\text{DISH1}} \). Pour the concentrate into the preweighed dish and bring to dryness at 66 degrees C (150 degrees F) in a drying oven. Weigh the dried dish to 0.0001 g and record this weight as \( W_1 \).

4.4.5 Reconstitute the dried material into a concentrate solution with several drops of ethyl acetate. Place a drop of the concentrate on a sodium-chloride infrared crystal and obtain a thin film on the crystal by allowing the ethyl acetate to evaporate. Analyze the residue with FTIR spectrophotometry per Section 4.6.1.

4.5 Extract sample for testing of absorbed contamination.

4.5.1 Obtain approximately 5 g of the washed and dried HDPE sample from step 4.4. Weigh to 0.0001 g and record the weight as \( W_A \).

4.5.2 Transfer the weighed portion to a 250 ml Erlynmeyer flask and add a 50/50 mixture of cyclohexane and methylene chloride to cover all material (about 50 ml total). Sonicate the sample for 40 minutes. This solvent mixture will remove pesticides, oil, compounding additives such as anti-block agents, anti-oxidants, UV stabilizers, anti-static agents, some dyes, and other contaminants. The cyclohexane swells the HDPE for easier extraction of absorbed materials. The methylene chloride extracts the organic contaminants and additives.
4.5.2 Weigh an aluminum weighing dish to 0.0001 g and record the weight as $W_{DISH1}$. After sonicating, pour off the solvent into a preweighed aluminum weighing dish and evaporate to dryness at 66 degrees C (150 degrees F) in a drying oven. Weigh the dried dish to 0.0001 g and record this weight as $W_2$.

4.5.3 Reconstitute this material into a concentrate solution with a few drops of 50/50 cyclohexane and methylene chloride. Place a drop of the concentrate on a sodium-chloride infrared crystal and obtain a thin film on the crystal by allowing the solvent to evaporate. Analyze the residue with FTIR spectrophotometry per Section 4.6.1.

4.6 Identify surface and absorbed organic contaminants.

4.6.1 Using FTIR, resolve the spectra of the surface and absorbed organic contaminants present in the extracts from step 4.4.5 (surface contaminants) and step 4.5.3 (absorbed contaminants). If the concentrate is too complex for FTIR, the analytes should be resolved with high-performance liquid chromatography (HPLC) or gel permeation chromatography (GPC).

Note: Standard FTIR laboratory procedures should yield spectra adequate for identification of contaminants. Motor oil and common pesticides are well known spectra. If the appropriate spectra are not available, prepare new spectra from samples of typical products, or obtain spectra from qualified equipment suppliers or laboratories.

5.0 Calculations

5.1 Weight of organic surface contaminants in sample ($W_S$)

$$W_S = W_1 - W_{DISH1}$$

5.2 Weight of absorbed organic contaminants ($W_A$)

$$W_A = W_2 - W_{DISH2}$$

5.3 Surface organic contamination present:

As a weight percent = $W_S \times 100\% / W$,
As a concentration = $(W_S / W) \times (1,000,000)$ parts per million (ppm)

5.4 Absorbed organic contamination present:

As a weight percent = $W_A \times 100\% / W_e$,
As a concentration = $(W_A / W_e) \times (1,000,000)$ parts per million (ppm)
6.0 Report

6.1 Report surface and absorbed organic contaminants present as weight percent or concentration.

6.2 Report the types of contaminants identified in the chemical analyses.

7.0 Reference Documents

7.1 Method 410 Sampling of HDPE and PET Regrind and Pellets
430  Determination of Solid Contaminants in Polyethylene Terephthalate (PET) Regrind and Pellets

1.0  Scope

1.1  This method describes how to measure the percent by weight of contaminants in PET regrind and pellets. Solid contaminants will be sorted into the following categories:

   (1) floatable plastics
   (2) non-floatable plastics
   (3) ferrous metals
   (4) non-ferrous metals
   (6) other

1.2  This method does individually measure polyvinyl chloride (PVC) or glycol-modified polyethylene terephthalate (PETG) contamination in regrind. Use Method 473 - Determination of PVC and PETG Content for PET Regrind to determine the weight percent of PVC and PETG contamination.

1.3  This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.4  This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0  Definition of Contaminants

2.1  Ferrous Metals - iron and other magnetic metals.

2.2  Floatable Plastic - plastics that float in a water-based wash system, including, but not limited to: caps and closures, expanded or foamed resins, and low-, medium-, or ultra-high density polyethylene.

2.3  Glycol-Modified Polyethylene Terephthalate (PETG) - PET which contains glycol. PETG is undesirable in the normal processing of recycled PET.

2.4  Non-Ferrous Metals - aluminum, lead and other non-magnetic metals.

2.5  Non-Floatable Plastic - plastics that sink in a water-based wash system, including, but not limited to polystyrene and polypropylene.

2.6  Other Contamination - miscellaneous contaminants, such as glass, wood or paper, that are not categorizable as floatable plastic, non-floatable plastic, ferrous metals, or non-ferrous metals.

2.7  Polyvinyl Chloride (PVC) - a vinyl-based resin containing chloride, which is incompatible with processing of recycled PET. Clear PVC containers are often indistinguishable from clear PET containers by visual examination.

3.0  Apparatus
3.1 Calibrated metric scale of minimum capacity 500 g and readability to 0.1 g. Note the scale(s) capacity, accuracy and model on the logsheet.

3.2 Three (3) beakers at 4-liter capacity

3.3 Granular dishwashing detergent for standard dishwasher.

3.4 Large funnel and appropriately sized filter paper.

3.5 Bar magnet with 9 kg (20 pound) pull strength.

3.6 Teaspoon measure

3.7 Three or four clean trays, preferrable aluminum or glass.

3.8 Tweezers.

3.9 Weigh paper.

3.10 Hot tap water at ~130 degrees F (55 degrees C).

3.11 Salt water solution with specific gravity of 1.2 (26 mg sodium chloride (NaCl) per 100 ml distilled water)

3.12 Logsheet for Method 430 (See Appendix A).

4.0 Procedure

4.1 Obtain a laboratory test sample of about 500 ml of regrind or pellets from the reduced sample generated in Method 410 - *Sampling of HDPE and PET Regrind and Pellets.*

4.2 Weigh the 500 ml of this material to the nearest 0.1 g. Record this weight as T. Spread the material out on a tray so the layer of material is less than 6 mm (~1/4 inch).

4.3 Separate and weigh metals.

4.3.1 Zero the scale with a piece of weigh paper.

4.3.2 Hold a piece of paper under the bar magnet so that the paper covers the magnet. Pass the magnet just tray of material to pick up any ferrous metal. Shake the tray gently to free any trapped metal and pass the magnet over again.

4.3.3 Place the magnet with its collected ferrous material over a piece of weigh paper. Remove the magnet from behind the covering piece of paper to allow the ferrous material from the magnet to fall onto the weigh paper.

4.3.4 Weigh to the nearest 0.1 g. Record the net weight of the ferrous metals as F.

4.3.5 Zero the scale with a new piece of weigh paper.

4.3.6 From the remaining material on all three trays, remove any non-ferrous metal that is evident and place on the weigh paper.
4.3.7 Weigh to the nearest 0.1 g. Record the net weight of the non-ferrous metals as NF.

4.4 Separate the floatables and non-floatables.

4.4.1 Put the remainder of the material into a 4 liter beaker. Add 2 liters of hot tap water at ~130 degrees F (55 degrees C) and add about one-half of a teaspoon of granular dishwasher detergent.

4.4.2 Vigorously stir the contents of the beaker with a stirring rod for 1 minute. Wait 3 minutes to allow floatables to rise. Gently stir the floatables to allow any trapped material to sink. If the floatable material is not adequately separated, repeat.

4.4.3 Skim the floatables from the surface and place the removed floatables on tray #1. Allow to dry thoroughly.

4.4.4 Place the filter paper (or stainless steel fine mesh sieve) into the funnel and set on top of an empty 4-liter beaker. Pour the water from the full 4-liter beaker into the filter assembly to collect the non-floatables (sunken material). Place the non-floatables material on tray #2 and allow to dry thoroughly.

4.5 Weigh the floatable plastics:

4.5.1 Place the material from tray #1 on the weigh paper and weigh it to the nearest 0.1 g.

4.5.2 Record the net weight of the floatable plastics as P1.

4.6 Separate the PETG and PVC from other non-floatable plastics.

4.6.1 Remove any non-plastic material from tray #2.

4.6.2 Place all the plastic material from tray #2 (non-floatables) into an empty 4-liter beaker containing 2 liters of a salt water solution with specific gravity of 1.2 (26 mg sodium chloride (NaCl) per 100 ml distilled water). Note: All PETG and PVC (which sink in the specified salt water solution) must be removed before non-floatable contaminants are quantified.

4.6.3 Replace the non-plastic material (from step 4.4.1) onto tray #2.

4.6.4 Vigorously stir the contents of the beaker with a stirring rod for 30 seconds to 1 minute. Wait 3 minutes to allow floatables to rise. Gently stir the floatables to allow any trapped material to sink. If the material is not adequately separated, repeat.

4.6.5 Skim the material floating in the salt water solution and place the material on tray #3. Allow material to dry thoroughly.

4.6.6 Place a piece of filter paper into the funnel and set on top of an empty 4-liter beaker. Pour the salt water from the 4-liter beaker into the filter assembly to collect the PVC and PETG (sunken) material. Place the non-floatables material on tray #2 and allow to dry thoroughly.

4.7 Weigh the PVC and PETG.

4.7.1 Zero the scale with a piece of weigh paper.

4.7.2 Place the PVC and PETG material on weigh paper and weigh to the nearest 0.1 g. Record the net weight of the PVC and PETG as C1.
4.8 Weigh the non-floatable plastics.
4.8.1 Zero the scale with a piece of weigh paper.
4.8.2 Place the material from tray #3 (non-floatables) on the weigh paper. Remove any non-plastic material from the sample and place back on tray #3. Weigh to the nearest 0.1 g and record the net weight of the non-floatable plastics as P2.

4.9 Weigh other contaminants.
4.9.1 Zero the scale with a piece of weigh paper.
4.9.2 Collect any material left on the trays following previous sorting, and place on weigh paper.
4.9.3 Weigh to the nearest 0.1 g. Record the net weight of the other contaminants as Z.

5.0 Calculations
5.1 Weight percent of floatable plastics:
\[
% P_1 = \left( \frac{P_1}{T} \right) \times 100
\]

5.2 Weight percent of PVC and PETG contamination:
\[
% C_1 = \left( \frac{C_1}{T} \right) \times 100
\]

5.3 Weight percent of non-floatable plastics:
\[
% P_2 = \left( \frac{P_2}{T} \right) \times 100
\]

5.4 Weight percent of ferrous metals:
\[
% F = \left( \frac{F}{T} \right) \times 100
\]

5.5 Weight percent of non-ferrous metals:
\[
% NF = \left( \frac{NF}{T} \right) \times 100
\]

5.6 Weight percent of other contaminants:
\[
% Z = \left( \frac{Z}{T} \right) \times 100
\]

5.7 Weight percent of all combined contaminants:
\[
% \text{Total Contamination} = % P_1 + % C_1 + % P_2 + % F + % NF + % Z
\]

6.0 Report
6.1 Report contamination as the percent-by-weight of each contaminant type.
6.2 Report total contamination as the percent-by-weight of for all contaminants combined.

7.0 Reference Documents

7.1 Method 410  *Sampling of HDPE and PET Regrind and Pellets.*

7.2 This method was developed from National Association for Plastic Container Recovery (NAPCOR) protocols. As such, it has neither been approved nor endorsed by NAPCOR.
434 Determination of Odor for High Density Polyethylene (HDPE) Regrind

1.0 Scope

1.1 This method describes how to detect and subjectively measure odor from post-consumer HDPE unwashed regrind. This procedure may also be used for washed HDPE regrind, and/or polyethylene terephthalate (PET) regrind if desired. Odor measurement is recognized to be subjective and prone to measurement error, however, this method may assist in determining whether more quantitative contaminant testing is required.

1.2 Test results are dependent on fatigue in the olfactory glands over time. Personnel conducting this test must be able to distinguish standard odor differences and strengths, and not have any chronic or temporary physical condition that may affect test results.

1.3 Odor measurement ratings are stated as a degree of olfactory strength: none, slight, or strong. Additionally, the odor is characterized by the source or type, such as the smell of oil or petroleum products, detergent, or sour milk.

1.4 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.5 This standard does not address the safety problems associated with its use. The user is responsible for following appropriate safety and health practices. Olfactory analysis methods may cause allergic reaction to dust or chemical contaminants.

2.0 Definitions

2.1 Olfactory Analysis - Analysis with sense of smell for detection of characteristic odors.

3.0 Attributes

3.1 Sample thief.

3.2 Sealable plastic bags.

3.3 Logsheet for Method 434 (See Appendix A).

4.0 Procedure

4.1 This method should be performed immediately after collecting samples directly from the shipping container to ensure that odors do not dissipate over time, and that the monitored odors will adequately represent the entire lot of material.

4.2 Obtain five test samples of about 500 ml each directly from the shipping container, with a sample thief per Method 410-Sampling of HDPE and PET Regrind and Pellets.
Note: If sample separation of material from different zones is desired for this test, during sampling, lay the thief horizontally on the sample sheet and empty the thief keeping the material from each zone of the thief separated. Bag these individual piles of material separately, labeling the bag with the approximate sampling location in the container.

4.3 Directly place each sample from the thief into a separate plastic bag and seal. Mark the bag with date, source information, and sequential sampling order number.

4.4 Raise each plastic bag, one at a time, close to the nose and wave or fan hands to gently blow the odors toward nose. Record any characteristic smells, such as sour milk or dairy product, detergent, motor oil, pesticide, or other applicable descriptions. Also note the intensity of each odor per the following definitions:

- **none** - no detectable odor.
- **slight** - detectable odor, but not pervasive or over-powering.
- **strong** - pervasive or over-powering odor.

4.5 If a non-standard odor is detected, seal the sample and employ other methods such as Headspace Gas Chromatography to identify the odor.

4.6 Seal the plastic bags and retain for potential further laboratory testing.

5.0 Calculations

Not applicable.

6.0 Report

6.1 For each sample, report the odor type as a description of the source of odor, e.g., sour milk, detergent, motor oil, or other applicable source description. Concurrently report the intensity of the odor (none, slight or strong).

7.0 Reference Documents

7.1 Method 410 *Sampling of HDPE and PET Regrind and Pellets*
440 Determination of Moisture Content for High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Regrind and Pellets

1.0 Scope

1.1 This method describes how to measure moisture content of HDPE and PET regrind and pellets.

1.2 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.3 This method does not address the safety problems, if any, associated with its use. The user is responsible for establishing appropriate safety and health practices.

2.0 Definitions

2.1 Constant weight - the sample weight, after adequate drying, when less than 0.1 gram additional weight loss would occur from additional heating.

2.2 Moisture content - percent of water by weight in or on the plastic, expressed as the ratio of moisture weight to the weight of moisture-free material.

3.0 Apparatus

3.1 Calibrated scale with capacity of at least 500 g and readability to 0.1 g. Note the scale(s) capacity, accuracy and model on the logsheet.

3.2 Forced-convection oven, ventilated; and capable of maintaining temperature surrounding the sample at 230 ± 9 degrees F (110 ± 5 degrees C). A forced convection oven is preferred. Home appliance stores offer modestly priced forced-convection ovens that will perform adequately. A gravity oven will suffice but can extend the drying time.

3.3 Heating or baking tray(s) that are of such shape that the depth of sample will not exceed one fifth of the least lateral dimension. If the oven capacity is small, multiple trays may be used for one sample. Thin layers of resin dry most efficiently, thus metal cafeteria trays work well.

3.4 Logsheet for Method 440 (See Appendix A).

4.0 Procedure

4.1 This method should be performed immediately after collecting samples to avoid evaporation of moisture over time.

4.2 Preheat convection oven to 110 ± 5 degrees C (230 ± 9 degrees F).
4.3 Obtain a 500 g (approximate) test sample per Method 410 - Sampling of HDPE and PET Regrind and Pellets.

4.4 Weigh the test sample to 0.1 g and record the net weight as $W_{\text{WET}}$. Place the material in the baking tray and into the oven. Dry all sample material from a given lot at the same time, even if multiple trays are required.

4.5 Dry the test sample for 2 hours at 110 ± 5 degrees C (230 ± 9 degrees F), or to constant weight. Periodically stir to aid uniform drying. Periodically check for overheating, as short term overheating or melting will render the test results invalid.

4.6 Allow sample to cool for a short period in a dry atmosphere. Weigh the dried sample to the nearest 0.1 g and record the net weight as $W_{\text{DRY}}$. Note: Do not store dried sample for extended periods prior to weighing unless the material is storing in a dry, sealed container.

5.0 Calculations

5.1 Calculate the total moisture content (MC) as a percentage of dry weight:

$$MC(\%) = \frac{(W_{\text{WET}} - W_{\text{DRY}})}{W_{\text{DRY}}} \times 100$$

6.0 Report

6.1 Report percent moisture content, MC (%).

7.0 Reference Documents

7.1 Method 410 Sampling of HDPE and PET Regrind and Pellets

7.2 Method 473 Determination of PVC and PETG Content for PET Regrind

7.3 ASTM C 566 Standard Test Method for Total Moisture Content of Aggregate by Drying

Note: This method has been adapted, in part, from ASTM C 566, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, this method has neither been approved nor endorsed by ASTM.
Determination of Color for High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET) Regrind and Pellets

1.0 Scope

1.1 This method describes how to determine the predominant color of HDPE and PET regrind and pellets and determine if any discoloration of HDPE regrind has occurred.

1.2 Colors of HDPE and PET, and discoloration are stated as follows:

- HDPE colors: natural, pigmented, and a specified or mixed color.
- PET colors: clear, green, and other.
- Discoloration: dirty or stained.

1.3 Visual color and discoloration tests should be performed by trained personnel who have a rated color vision per the National Paint and Coatings Association (NPCA) visual color test standard.

1.4 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.5 This standard does not address the safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

2.1 Discoloration - the change in original color that occurred due to outside influences, such as sun exposure, staining, degradation, etc.

3.0 Apparatus

3.1 Graduated 500 ml measuring cup or cylinder.

3.2 Contamination-free work surface.

3.3 Adequate lighting, unobstructed. Natural light from a north facing window is preferred. Alternatively, fluorescent light with a minimum intensity of 2.1 Lamberts (.67 candles per square centimeter) is recommended.

3.4 Weighing paper.

3.5 Calibrated scale with minimum capacity of 500 g and readability to 0.1 g. Note the scale(s) capacity, accuracy and model on the logsheet.

3.6 Tweezers.

3.7 Clean tray, preferably a standard white food service tray, about 0.3 m x 0.5 m (1’ x 1.5’).
3.8 Logsheet for Method 444 (See Appendix A).

4.0 Procedure

4.1 Prepare test sample.

4.1.1 Obtain a 500 ml test sample from the reduced sample generated in Method 410 - Sampling of HDPE and PET Regrind and Pellets.

4.1.2 Weigh the 500 ml sample to 0.1 g. Record the net weight as W.

4.1.3 Spread the material on the white tray for individual particle inspection.

4.2 Zero the scale with a piece of weigh paper. Sort all of one color (or discolored) material and place on weigh paper. Weigh to 0.1 g and record net weight as:

- N = HDPE natural.
- P = HDPE pigmented.
- S = HDPE specified or mixed color.
- D = HDPE discolored.
- C = PET clear.
- G = PET green.
- O = PET other.

4.3 Repeat previous step for all sorted colors and any discolored material.

5.0 Calculations

5.1 Weight percent of each color found:

This example shows the calculation for the percent by weight of natural HDPE (%N):

\[
\% N = \frac{N}{W} \times 100
\]

5.2 Weight percent of any discoloration found:

\[
\% D = \frac{D}{W} \times 100
\]

6.0 Report

6.1 Report the percent by weight of each color portion and discoloration.

7.0 Reference Documents

7.1 Method 410 - Sampling of HDPE and PET Regrind and Pellets
**448 Determination of Bulk Density for High Density Polyethylene (HDPE) Regrind and Pellets**

1.0 Scope

1.1 This method is used to determine bulk density of HDPE regrind or pellets. Industry typically applies this method to pellets only, however, it is also acceptable for regrind.

1.2 Bulk density is reported as grams per cubic centimeter (g/cc), kilograms per cubic meter (kg/m³), or pounds per cubic foot (lb/ft³).

1.3 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.4 This procedure does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

2.1 Bulk density - the mass per unit volume of material, which include voids and porous characteristics inherent in the material.

3.0 Apparatus

3.1 Measuring cup, cylinder, or container that holds at least 100 cubic centimeters (cc) capacity (or if using English units, 0.5 cup minimum capacity). Alternatively, a container of known volume, such as a standard coatings weight-per-gallon cup may be used. If the exact volume of the container is unknown, use a perfectly cylindrical cup with the constant diameter throughout the height of the cup.

3.2 Calibrated scale with minimum capacity of 500 g and readability to ± 0.01 g. (If English units, minimum capacity of 1 pound and readability to 0.0005 pounds. Note that if a larger volume is tested, higher range scales may be required. Note the scale(s) capacity, accuracy and model on the logsheet.

3.3 Ruler, metric or English depending on the system of units of the scale.

3.4 Logsheet for Method 448 (See Appendix A).

4.0 Procedure

4.1 Obtain a test sample (of quantity to fill the volume-test container) directly from the shipping container, using Method 410 - Sampling of HDPE and PET Regrind and Pellets. To reflect the bulk density of the product as is, handle the sample carefully to avoid material settling.

4.2 If the exact volume of the measuring cup is unknown, measure and record the inside diameter (D) of the cup and the height (H) of the cup from inside.
4.3 Pour the sample into the measuring cup. Allow the material to flow freely and overflow the top of the cup to ensure an accurate volume measurement. Avoid compacting the material by shaking or pounding the cup on the work surface.

4.4 When the cup is full to overflowing, scrape off the excess on the top of the cup with a straight edge.

4.5 Weigh the full cup to the nearest 0.01 g (or 0.0005 oz) and record weight. Empty the cup and weigh the empty cup to the nearest 0.01 g (or 0.0005 oz). Subtract the weight of the empty cup from the full cup weight to obtain the material weight and record as \( W \).

5.0 Calculations

5.1 Volume of cup (\( V \)) if unknown:

\[
V = \left( \frac{H}{2} \right) x \left( \frac{D}{2} \right)^2 x (3.14) \quad \text{Units are cc, m}^3 \text{ or ft}^3.
\]

5.2 Bulk density (\( BD \))

\[
BD = \frac{W}{V} \quad \text{Units are g/cc, kg/m}^3 \text{ or lb/ft}^3.
\]

6.0 Report

6.1 Report the bulk density in g/cc, kg/m\(^3\) or lb/ft\(^3\).

7.0 Reference Documents

7.1 Method 410 Sampling of HDPE and PET Regrind and Pellets


Note: This method has been adapted, in part, from ASTM D 1895, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, this method has neither been approved nor endorsed by ASTM.
452 Determination of Clarity for Polyethylene Terephthalate (PET) Regrind and Pellets

1.0 Scope

1.1 This method is used to determine the clarity and color value of PET washed regrind and pellets.

1.2 Clarity values are stated in L*, a*, and b* coordinates or delta L*, delta a*, and delta b* coordinates.

1.3 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.4 This procedure does not address the safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

Not applicable.

3.0 Apparatus

3.1 Measuring cup or beaker of 500 ml capacity.

3.2 Spectrophotometer with an optical sensor at 45 degrees with 0 degree incident light. The spectrophotometer will have a built-in receptacle cup for holding the test sample. Only trained personnel can operate this equipment.

3.3 Logsheet for Method 452 (See Appendix A).

4.0 Procedure

4.1 Bring laboratory environment conditions to a temperature between 15 degrees C and 30 degrees C and humidity between 5% and 85% non-condensing.

4.2 Calibrate the spectrophotometer according to manufacturer's specifications. Set the equipment to measure values for L*, a*, and b* with a 10 observer.

4.3 Obtain three test samples of 125 ml each from the reduced sample generated from Method 410 - Sampling of HDPE and PET Regrind and Pellets.

4.4 In accordance with the manufacturer's specifications and instructions, fill the receptacle cup on the spectrophotometer with the test sample and conduct the test. Read the L*, a*, and b* coordinates as a result of the test run. Repeat for the second and third samples.
5.0 Calculations

5.1 Compute the three-sample average for each of the coordinate values: L*, a*, and b*.

Average L* = (L*₁ + L*₂ + L*₃) / 3

Average a* = (a*₁ + a*₂ + a*₃) / 3

Average b* = (b*₁ + b*₂ + b*₃) / 3

6.0 Report

6.1 Report the average L*, a*, and b* values.

7.0 Reference Documents

7.1 Method 410 Sampling of HDPE and PET Regrind and Pellets

7.2 Equipment Manufacturers Specifications and Instructions for the Spectrophotometer
Determination of Melt Index for High Density Polyethylene (HDPE) Regrind and Pellets

1.0 Scope

1.1 This test method covers measurement of the rate of extrusion of molten resin over time through a die of a specified length and diameter under prescribed conditions of temperature, load, and piston position in the barrel. An automatic melt indexer is preferred to minimize potential for human error.

1.2 The melt index obtained by an extrusion plastometer is an empirically defined parameter critically influenced by the physical properties and molecular structure of the polymer and the conditions of measurement. The rheological characteristics of polymer melts depend on a number of variables. Since the values of these variables occurring in this test may differ substantially from those in large-scale processes, test results may not correlate directly with processing behavior.

1.3 Polyethylene blends with widely varying melt indices for the different blends will give variable results.

1.4 Test results for regrind have greater potential for error compared to more homogeneous pellets.

1.5 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.6 This procedure does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices. Only trained and qualified personnel should operate this equipment.

2.0 Definitions

Not applicable.

3.0 Apparatus

3.1 Standard extrusion plastomer (melt indexer) that meets the specifications outlined in Section 10 of ASTM D 1238 Flow Rates of Thermoplastics by Extrusion Plastometer. Either automatic and manual plastomers can be used.

3.2 Thermometer with at least a range of 188 degrees C to 192 degrees C and graduated in 0.2 degree C divisions.

3.3 Extrusion die meeting specifications outlined in Section 10 of ASTM D 1238 Flow Rates of Thermoplastics by Extrusion Plastometer.

3.4 Calibrated scale with minimum capacity of 50 g and readability to 0.01 g. A scale is only required when a manual extrusion plastomer (melt indexer) is used. Note scale range, readability, model, and calibration date on logsheet.

3.5 Accessory equipment:
• Equipment for charging samples to the cylinder.
• Funnel, plunger, tweezers.
• Die plug.
• Cleaning equipment (including rod and swab patches).
• 2.16 kg weight.
• 21.6 kg weight.
• Mill grinder (high speed, stainless steel laboratory grinder).
• Calibrated electronic scale accurate to ± 0.01 g, and 100 g capacity.
  Note the scale(s) capacity, accuracy and model on the logsheet.
• Timer.

3.6 Level.

3.7 Dry ice or liquid nitrogen.

3.8 Logsheet for Method 455 (See Appendix A).

4.0 Procedure

4.1 Prepare test specimen.

4.1.1 Obtain a test sample of at least 250 ml, from the reduced test sample prepared in Method 410 - Sampling of HDPE and PET Regrind and Pellets. This will yield at least three individual test samples and material to complete a trial run.

4.1.2 If the test sample is regrind, first pelletize the sample or grind it into a powder using a Wiley (or equivalent) mill grinder. This promotes consistency in the melt indexer. Only experienced personnel should perform the grinding procedure. Before grinding, cool the sample by chilling with dry ice or liquid nitrogen. Continue cooling the sample during grinding. Allow the ground sample to dry.

4.2 Prepare equipment.

4.2.1 Follow manufacturers' procedures for calibration and care of equipment.

4.2.2 Preheat the plastomer to a set point of 190 ± 2 degrees C (for at least 15 minutes (if not already heated).

4.2.3 Check the alignment of the barrel to ensure it is vertical. Vertical alignment is essential to avoid subtractive loads resulting from rubbing or friction between the piston tip and sidewall. Most melt indexers have a built in level and adjustable legs screws for adjusting alignment.

4.2.4 Ensure the plastometer and all parts are clean. If cleaning is necessary it should be done while the machine is hot. Clean the machine and parts by rodding the barrel with cotton patches. If necessary, use a little mineral oil or copper gauze to remove burned polymer.

4.3 Establish initial testing conditions.

4.3.1 Obtain a trial sample of material based on Table 455-1 (adopted, in part, from ASTM D 1238, but not approved nor endorsed by ASTM). If a manual indexer is used, weigh the sample to 0.01 g and record weight as \( W_0 \).
### Table 455-1 Guidelines For Establishing Actual Test Conditions

<table>
<thead>
<tr>
<th>Flow Range (g/10 minutes)</th>
<th>Suggested Weight of Sample in Cylinder</th>
<th>Time Interval (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15 to 1.0</td>
<td>2.5 - 3.0 g</td>
<td>6.0</td>
</tr>
<tr>
<td>&gt;1.0 to 3.5</td>
<td>3.0 - 5.0 g</td>
<td>3.0</td>
</tr>
<tr>
<td>&gt;3.5 to 10</td>
<td>5.0 - 8.0 g</td>
<td>1.0</td>
</tr>
<tr>
<td>&gt;10 to 25</td>
<td>4.0 - 8.0 g</td>
<td>0.5</td>
</tr>
<tr>
<td>&gt;25 to 50</td>
<td>4.0 - 8.0 g</td>
<td>0.25</td>
</tr>
</tbody>
</table>

4.3.2 Place the test material in the plastomer and heat for 3 minutes.

4.3.3 Begin the test with a 2.16 kg load weight and an initial temperature of 190 degrees C. If the material does not flow through the indexer under these conditions, repeat the procedure at 190 degrees C using a load weight of 21.6 kg. ASTM D 1238- Flow Rates of Thermoplastics by Extrusion Plastometer, Section 8.2 lists the allowable temperature and weight combinations for various material.

4.4 If manual indexer; weigh three samples (not required for automatic indexer).

4.4.1 Weigh (to 0.01 g) three individual samples of the weight determined from results of the initial test conditions. Label the samples (1, 2, and 3) and record the net weights as $W_1$, $W_2$, and $W_3$ respectively.

4.5 Conduct timed flow rate measurement.

4.5.1 Allow the machine to preheat at least 15 minutes (if not already heated) at the established set point before beginning the test. Record the set point temperature and load weight.

4.5.2 With the die secure in the bottom of the barrel, load the test sample into the barrel. Packing the material well to prevent air pockets in the chamber.

4.5.3 For an automatic melt indexer, start the machine. This will lower the piston and start the material preheat time of 3 minutes. After preheating, the piston and weight will travel freely.

4.5.4 For a manual melt indexer, set the timer for 3 minutes preheat. After the preheat, place the selected weight on top of the piston. Set the timer for 10 minutes and allow the melt indexer to run. Note and record the actual time of flow in seconds $T_i$ where $i$ is 1 for the first run, 2 for second run and 3 for the third run.

4.5.5 Check for any leakage around the die. Discard any test results if leakage occurs around the die.

4.5.6 When the test is complete, return the piston to its beginning position. In an automatic melt indexer, the piston will automatically go up. Clean the barrel, piston, and die thoroughly.

4.5.7 An automatic melt indexer will automatically calculate the melt index in grams per 10-minutes. Record this value as MI$i$ where $i$ is 1 for the first run, 2 for second run and 3 for the third run.

4.5.8 For a manual melt indexer, weigh the melt index strand. Weigh to the nearest 01 g and record the weight as $W_i$ where $i$ is 1 for the first run, 2 for second run and 3 for the third run.
4.5.9 Repeat steps 4.5.2 through 4.5.8 for the two additional samples.

4.5.10 Save the melt index strand for polymer density testing per Method 459 - *Determination of Polymer Density and Specific Gravity for High Density Polyethylene (HDPE) Regrind and Pellets.*

5.0 Calculations

5.1 Melt index \( M_{i} \) for a manual melt indexer:

\[
M_{i} = \frac{W_{i}}{T_{i}} \times 600 \quad \text{(Units are grams per 10 minutes)}.
\]

where \( i \) is 1 for the first run, 2 for second run and 3 for the third run.

5.2 Average melt index \( M_{AVG} \):

\[
M_{AVG} = \frac{M_{1} + M_{2} + M_{3}}{3} \quad \text{(Units are grams per 10 minutes)}.
\]

6.0 Report

6.1 Report the average melt index in grams per 10 minutes.

7.0 Reference Documents

7.1 Method 410 *Sampling of HDPE and PET Regrind and Pellets*

7.2 ASTM D 1238 *Flow Rates of Thermoplastics by Extrusion Plastometer*

Note: This method has been adapted, in part, from ASTM D 1238, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, this method has neither been approved nor endorsed by ASTM.
1.0 Scope

1.1 This method describes the determination of the polymer density of solid plastics in the form of HDPE regrind or HDPE pellets. The melt index strand from Method 455 - Determination of Melt Index for HDPE Regrind and Pellets is required.

1.2 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.3 This procedure does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

2.1 Melt index strand - the extrudate produced when HDPE regrind or pellets are extruded in accordance with Method 455 - Determination of Melt Index for HDPE Regrind and Pellets.

2.2 Polymer density - the mass in air per unit volume of material at 23 degrees C. Units are grams per cubic centimeter (g/cc).

2.3 Specific gravity (or relative density) - the ratio of the mass in air of a unit volume of material at 23 degrees C to the mass in air of equal density and equal volume of gas-free distilled water at 23 degrees C.

3.0 Apparatus

3.1 Analytical balance of minimum capacity of 10 g and sensitivity to 0.001 g. Balance must have a stationary support for the immersion vessel above the balance pan ("pan straddle").

Assure the balance meets the performance requirements by frequently checking the adjustments of zero points and sensitivity, and by periodic calibration using standard masses for absolute accuracy.

3.2 Fine wire, corrosion-resistant, for suspending the specimen.

3.3 Corrosion-resistant sinker that has specific gravity of not less than 7.0; smooth surfaces; regularity of shape; and (4) heavy enough to sink the specimen. The sinker should have an opening to facilitate attachment to the specimen and wire.

3.4 Immersion vessel or beaker for holding the water and immersed specimen.

3.5 Thermometer with minimum range of 30 to 40 degrees C and accuracy of ± 0.1 degrees C.

3.6 Laboratory glassware: two 250-ml beakers, 500 ml beaker, watchplates.

3.7 Standard laboratory hot plate.
3.8 Single-edged safety razor blade.

3.9 Reverse-osmosis (RO) filtered (air-free) water, or distilled water, or deionized water (listed in order of preference). Note: Water may be rendered sufficiently air-free by boiling and cooling or by shaking under vacuum in a heavy-walled vacuum flask.

3.10 Logsheet for Method 459 (See Appendix A).

4.0 Procedure

4.1 Condition the sample.

4.1.1 Prepare or obtain a melt index strand of HDPE by extruding the sample in accordance with Method 455 - Determination of Melt Index for HDPE Regrind and Pellets.

4.1.2 Add about 225 ml of RO water, or distilled, or deionized water to a 250 ml beaker and bring to a brisk boil. In a 500 ml beaker, bring another 200 ml of RO, or distilled, or deionized water to a brisk boil and cover with a watch glass.

4.1.3 Drop the melt index strand into the briskly boiling water, and cover with a watch glass. Set a timer for 30 minutes. Periodically check the water level in the first beaker to ensure it does not drop below 200 ml. If the level drops below 200 ml add boiling water from the second beaker as needed to maintain 200 ml level for the full 30 minutes.

4.1.4 At the end of the boiling time, remove the beaker from the hot plate, making sure the water level is at approximately 200 ml, and allow it to stand at standard laboratory conditions for one hour.

4.1.5 When handling the sample use tweezers or gloves to avoid contaminating the sample. Bare hands may introduce body oils and other contaminants.

4.1.6 Remove the strand from the water. Use a sharp blade to cut off a 65 mm (1/4”) length from the thicker end of the strand and discard. From the remaining strand, cut at least three pieces that weigh at least 1 g each (up to 2 g is acceptable). The test specimens must have smooth surface and edges.

4.2 Weigh the sample.

4.2.1 Equilibrate enough RO, or distilled, or deionized water to fill the immersion vessel, to 23 ± 1 degrees C.

4.2.2 Weigh the specimen in air to the nearest 0.001 g. Record this mass as \( A_i \) where \( i \) is 1 for the first sample, 2 for the second sample and 3 for the third sample.

4.2.3 Cut a piece of fine wire that is long enough to reach from the hook above the balance pan to the support for the immersion vessel. Attach the wire to the balance hook and to the specimen so the specimen is suspended about 2.5 cm (1") above the vessel support. Attach the sinker to the specimen.

4.2.4 Mount the immersion vessel on the support, and completely immerse the suspended specimen and sinker in the temperature equilibrated water (step 4.2.1). Do not allow the wire or specimen to touch the vessel. Remove any bubbles adhering to the specimen, wire or sinker, especially in gaps or holes.
in the specimen and sinker. Bubbles are usually removable by rubbing them with another wire. If bubbles cannot be removed, discard this sample.

4.2.5 Weigh the assembly (including the suspended specimen, the partially immersed wire, and the fully immersed sinker in liquid) to 0.001 g. Record this mass as $B_i$, where $i$ is 1 for the first sample, 2 for the second sample and 3 for the third sample.

4.2.6 Weigh the wire and sinker in water, immersed to the same depth as in the previous step, to 0.001 g. Record this mass as $W_i$ (mass of the partially immersed wire and fully immersed sinker in liquid), where $i$ is 1 for the first specimen, 2 for the second, and 3 for the third.

4.2.7 Repeat this procedure for the second and third specimen samples of the melt index strand.

5.0 Calculations

5.1 Specific gravity (or relative density) ($SG_i$) of the HDPE:

$$SG_i = \frac{A_i}{A_i + W_i - B_i}$$

where $A = \text{mass of the specimen without wire or sinker, in air.}$
$B = \text{mass of specimen, sinker, and partially immersed wire, in water.}$
$W = \text{mass of totally immersed sinker and partially immersed wire, in water.}$
$i = \text{1 for the first specimen, 2 for the second, and 3 for the third.}$

5.2 Average specific gravity (relative density) ($SG_{AVG}$)

$$SG_{AVG} = \frac{SG_1 + SG_2 + SG_3}{3} \quad \text{(Unitless)}$$

5.3 Polymer density in g/cc:

$$\text{Polymer Density} = 0.99756 \times SG_{AVG} \quad \text{(Units: g/cc)}$$

6.0 Report

6.1 Description of the original material prior to obtaining the melt index strand.

6.2 Polymer density.

6.3 Specific gravity.

6.4 Any evidence of problems while running the test, for example, porosity of the material, excessive air bubbles, etc.
7.0 Reference Documents

7.1 Method 455  
Determination of Melt Index for HDPE Regrind and Pellets

7.2 ASTM D 792  
Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

7.3 ASTM D 2839  
Standard Practice for Use of a Melt Index Strand for Determining Density of Polyethylene  
Note: This method has been adapted, in part, from ASTM D 792 and ASTM D 2839, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, this method has neither been approved nor endorsed by ASTM.
467 Determination of Intrinsic Viscosity for Polyethylene Terephthalate (PET) Regrind and Pellets

1.0 Scope

1.1 This guidance addresses determination of the relative viscosity of PET, and the derivation of intrinsic viscosity from relative viscosity. Due to the complexity of determining intrinsic viscosity in PET regrind or pellets, only certified technicians or a certified analytical laboratory should perform this test.

1.2 This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

1.3 This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices and determining the applicability of any regulatory limitations. Both the compounds and the mixture employed in this method are toxic and require care in handling. If performed in-house by qualified technicians, always use a fume hood for adequate ventilation, and wear rubber gloves to protect skin. Refer to the appropriate Material Safety Data Sheets (MSDS) for further guidance.

2.0 Definitions

2.1 Intrinsic viscosity - a common descriptor of PET flowability, calculated by comparing flow time of PET in a specific solvent with the flow time of that pure solvent in a capillary viscometer at fixed temperature.

2.2 Viscosity - a measure of the internal friction of a fluid, which indicates a measure of resistance to flow.

3.0 Apparatus

3.1 Refer to the following procedures for required apparatus and reagents:

- ASTM D 446 Specifications and Operating Instructions for Glass Capillary Kinematic Viscometers
- ASTM D 4603 Standard Test Method for Determining Inherent Viscosity of Polyethylene Terephthalate (PET)

3.2 Logsheet for Method 467 (See Appendix A).

4.0 Procedure

4.1 Obtain one (or more) 10 g sample(s) from the reduced sample prepared in Method 410 - Sampling Procedure for HDPE and PET Regrind and Pellets.

4.2 Label and seal the sample. Send the sample to an analytical laboratory certified to analyze for intrinsic viscosity per ASTM D 4603 Standard Test Method for Determining Inherent Viscosity of Polyethylene Terephthalate (PET). One testing laboratory known to analyze for intrinsic viscosity is:
   Poly-Materials
   931 Highway 80 West
4.3 If a certified technician and equipment are available in-house to perform this test per ASTM D 4603 *Standard Test Method for Determining Inherent Viscosity of Polyethylene Terephthalate (PET)*, conduct the test as described in the ASTM method.

5.0 Calculations

Not applicable if test conducted by outside laboratory. If the test was conducted in-house:

5.1 Average the solvent time flow and record as $t_0$ (seconds).

5.2 Average PET solution time flow and record as $t$ (seconds).

5.3 Relative viscosity (RV):

$$RV = \frac{t}{t_0}$$

5.4 Intrinsic viscosity ($n$):

$$n = 0.25 \times \left[ RV - 1 + 3 \ln (RV) \right] / C$$

(deciliters per gram)

where $C$ is the polymer solution concentration in grams per deciliter.

6.0 Report

6.1 Report the intrinsic viscosity in deciliter/gram (dl/g).

7.0 Reference Documents

7.1 Method 410 *Sampling Procedure for HDPE and PET Regrind and Pellets*

7.2 ASTM D 446 *Specifications and Operating Instructions for Glass Capillary Kinematic Viscometers*

7.3 ASTM D 4603 *Standard Test Method for Determining Inherent Viscosity of Polyethylene Terephthalate (PET)*.

473 Determination of Polyvinyl Chloride (PVC) and Glycol-Modified Polyethylene Terephthalate (PETG) Content of Polyethylene Terephthalate (PET) Regrind

1.0 Scope

1.1 This method describes the measurement of PVC and PETG contamination in PET regrind.
This method is intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading. The method does not provide an Acceptance Quality Level (AQL) or acceptance criteria, and does not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractual matter.

This method does not address the safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices.

2.0 Definitions

2.1 Glycol-Modified Polyethylene Terephthalate (PETG) - PET which contains glycol. PETG is undesirable in the normal processing of recycled PET.

2.2 Polyvinyl Chloride (PVC) - a vinyl-based resin containing chloride, which is incompatible with processing of recycled PET. Clear PVC containers are often indistinguishable from clear PET containers by visual examination.

3.0 Apparatus

3.1 Laboratory oven capable of maintaining temperature at 270 degrees C (518 degrees F).

3.2 Timer.

3.3 Calibrated scale with minimum capacity of 1100 g and readability to 0.01 g. Note the scale capacity, accuracy and model on the logsheet.

3.4 Tweezers

3.5 Metal baking pans or flat, metal cookie sheets.

3.6 Magnifier with 3X power.

3.7 Clean inspection area, preferably a white surface, with good lighting.

3.8 Logsheet for Method 473 (See Appendix A).

4.0 Procedure

4.1 Obtain a test sample of about 1000 g from the reduced sample generated in Method 410 - Sampling of HDPE and PET Regrind and Pellets.
4.2 Weigh the sample to 0.01 g and record the net weight as T.

4.3 Spread the test sample out on a clean metal baking pan. Do not stack the particles more than 5 mm (1/4") deep. Use as many baking sheets as needed.

4.4 Bake the test sample at 260 degrees C (500 degrees F) for 15 minutes if the sample is dry, or 18 minutes if wet. If the sample is wet, closely observe the material during the last three minutes to ensure melt is not occurring.

4.5 Place the baked sample on a clean white surface that receives good lighting.

4.6 Using the magnifier (3X) as needed, sort out the PVC (black flakes) in the baked sample. Weigh the material to 0.01 g and record the net weight as $W_{PVC}$.

4.7 Store the separated PVC flakes in a zip-lock plastic bag labeled with “PVC”, the date, lot number and weight of flakes.

4.8 Using the magnifier (3X) as needed, remove any PETG flakes (melted, honey colored particles). Weigh the material to 0.01 g and record the net weight as $W_{PETG}$. Bag and label this material with “PETG”, the date, lot number and weight of flakes.

4.9 Store the separated PETG flakes in a zip-lock plastic bag labeled with “PETG”, the date, lot number and count or weight of flakes.

5.0 Calculations

5.1 PVC concentration in parts per million (ppm):

$$\text{PVC (ppm)} = \frac{W_{PVC}}{T} \times 1,000,000$$

5.2 PETG concentration in parts per million (ppm):

$$\text{PETG (ppm)} = \frac{W_{PETG}}{T} \times 1,000,000$$

6.0 Report

6.1 Report the PVC concentration in parts per million (ppm).

6.2 Report the PETG concentration in parts per million (ppm).

7.0 Reference Documents

7.1 Method 410 "Sampling of HDPE and PET Regrind and Pellets"

7.2 This method was developed from:

I. National Association for Plastic Container Recovery (NAPCOR) - Detection of PVC in PET by Oven Degradation.

## Logsheets for Sampling and Testing Methods for High Density Polyethylene (HDPE) and Polyethylene Terephthalate (PET)

### Appendix A

<table>
<thead>
<tr>
<th>Method</th>
<th>Title</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>402</td>
<td>Logsheet for Method 402</td>
<td>A-2</td>
</tr>
<tr>
<td>410</td>
<td>Logsheet for Method 410</td>
<td>A-3</td>
</tr>
<tr>
<td>419</td>
<td>Logsheet for Method 419</td>
<td>A-4</td>
</tr>
<tr>
<td>424</td>
<td>Logsheet for Method 424</td>
<td>A-5</td>
</tr>
<tr>
<td>425</td>
<td>Logsheet for Method 425</td>
<td>A-6</td>
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<tr>
<td>430</td>
<td>Logsheet for Method 430</td>
<td>A-7</td>
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<td>434</td>
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<tr>
<td>467</td>
<td>Logsheet for Method 467</td>
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</tr>
<tr>
<td>473</td>
<td>Logsheet for Method 473</td>
<td>A-16</td>
</tr>
</tbody>
</table>
## Logsheet for Method 402 - Baled HDPE or PET

<table>
<thead>
<tr>
<th>Field Sample/Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performed By:</strong></td>
<td><strong>Lot ID</strong></td>
</tr>
<tr>
<td><strong>Current Date:</strong></td>
<td><strong>Source:</strong></td>
</tr>
<tr>
<td><strong>Total Number of Bales in Lot:</strong></td>
<td><strong>HDPE or PET (Circle One)</strong></td>
</tr>
</tbody>
</table>

### Qualitative Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Notes from Initial Visual Inspection of Bales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bale integrity</td>
<td></td>
</tr>
<tr>
<td>Photodegradation</td>
<td></td>
</tr>
<tr>
<td>Moisture level</td>
<td></td>
</tr>
<tr>
<td>Bottles rinsed</td>
<td></td>
</tr>
<tr>
<td>Feedstock origin: source and grade:</td>
<td></td>
</tr>
<tr>
<td>Feedstock origin: post-consumer content:</td>
<td></td>
</tr>
<tr>
<td>Caps/closures removed:</td>
<td></td>
</tr>
<tr>
<td>Toxic/hazardous/medical:</td>
<td></td>
</tr>
</tbody>
</table>

### Quantitative Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Results and Notes on Sorted and Weighed Bale Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lot weight</td>
<td>Total number of sample bales:</td>
</tr>
<tr>
<td>Total number of sample bales:</td>
<td></td>
</tr>
<tr>
<td>Average bale volume</td>
<td>Average bale weight:</td>
</tr>
<tr>
<td>Average bale density</td>
<td></td>
</tr>
<tr>
<td>Contaminants</td>
<td></td>
</tr>
<tr>
<td>Ferrous (weight percent):</td>
<td></td>
</tr>
<tr>
<td>Non-ferrous (weight percent):</td>
<td></td>
</tr>
<tr>
<td>Plastic (include closures, but exclude PVC) (weight percent):</td>
<td></td>
</tr>
<tr>
<td>PVC (weight percent):</td>
<td></td>
</tr>
<tr>
<td>Average weight per bale of desired material (HDPE / PET):</td>
<td></td>
</tr>
</tbody>
</table>

### Color composition (weight percent):

- **HDPE - natural:**
- **HDPE - pigmented:**
- **HDPE - specified:**
- **PET - clear:**
- **PET - green:**
- **PET - other:**
Logsheets for Method 410 - Sampling of HDPE or PET Regrind or Pellets

Field Sample / Test Sample Log

Date and Time Material Received:

Performed By: Lot ID # (or Bill of Lading #).

Current Date: Source:

Total Lot weight: HDPE or PET (Circle One)

Type and Number of Containers in Lot:

Notes from Initial Visual Inspection and Sampling Results:

Condition of containers:

Scale(s) (model, accuracy, calibration):

Number of containers to be sampled:

Sampling pattern:

Weight of initial sample:

Number of samples drawn from each sample container:

Comments on samples collected:

Sample 1
Sample 2
Sample 3
Sample 4
Sample 5
Sample 6
Sample 7
Sample 8
Sample 9
Sample 10
Sample 11
Sample 12
### Logsheet for Method 419 - Particle Size of HDPE or PET Regrind or Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td>HDPE or PET (Circle One)</td>
</tr>
</tbody>
</table>

### Results and Notes from Conducting Test Method:

Sample conditioned to ambient?  
Scale(s) (model, accuracy, calibration):  
Weight of 500 ml sample (W1):  

Is sample free flowing and non-caking?  
Antistat agent (if used):  

**Particle or pellet size distribution - weight of different sizes:**

<table>
<thead>
<tr>
<th>Sample Size Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plus 12.5 mm (or 1/2&quot;) particles (A):</td>
<td></td>
</tr>
<tr>
<td>Minus 12.5 mm (or 1/2&quot;) plus 9.5 mm (or 3/8&quot;) (B):</td>
<td></td>
</tr>
<tr>
<td>Minus 9.5 mm (or 3/8&quot;) particles (C):</td>
<td></td>
</tr>
</tbody>
</table>

**Weight percent of different particle or pellet sizes:**

<table>
<thead>
<tr>
<th>Sample Size Description</th>
<th>Weight Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plus 12.5 mm (or 1/2&quot;) particles:</td>
<td></td>
</tr>
<tr>
<td>Minus 12.5 mm (or 1/2&quot;) plus 9.5 mm (or 3/8&quot;):</td>
<td></td>
</tr>
<tr>
<td>Minus 9.5 mm (or 3/8&quot;) particles:</td>
<td></td>
</tr>
</tbody>
</table>

### Pellet count

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of 10.0 ± 0.1 g sample:</td>
<td></td>
</tr>
<tr>
<td>Number of pellets per gram:</td>
<td></td>
</tr>
<tr>
<td>Number of pellets counted in sample:</td>
<td></td>
</tr>
</tbody>
</table>

### Percent fines (HDPE regrind only):

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of 100 ml sample (W1):</td>
<td></td>
</tr>
<tr>
<td>Weight of fines (T):</td>
<td></td>
</tr>
<tr>
<td>Percent weight of fines:</td>
<td></td>
</tr>
</tbody>
</table>

### Additional notes:

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
### Logsheet for Method 424 - Contamination of HDPE Regrind or Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

### Results and Notes from Conducting Test Method:

- Scale(s) (model, accuracy, calibration):

- Weight of 500 ml sample (T):

<table>
<thead>
<tr>
<th>Weight of Sorted Contaminants:</th>
<th>Weight Percent of Sorted Contaminants:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floatable plastics (P1):</td>
<td>Floatable plastics (%P1):</td>
</tr>
<tr>
<td>Non-floatable plastics (P2):</td>
<td>Non-floatable plastics (%P2):</td>
</tr>
<tr>
<td>Ferrous metals (F):</td>
<td>Ferrous metals (%F):</td>
</tr>
<tr>
<td>Non-ferrous metals (NF):</td>
<td>Non-ferrous metals (%NF):</td>
</tr>
<tr>
<td>Wood and paper (W):</td>
<td>Wood and paper (%W):</td>
</tr>
<tr>
<td>Other contaminants (Z):</td>
<td>Other contaminants (%Z):</td>
</tr>
</tbody>
</table>

- Total weight of all contaminants: ____________________________

- Weight percent of all contaminants combined: ____________________________

- Additional notes:
  - 
  - 
  - 
  - 
  - 
  -
## Logsheet for Method 425 - Volatile Organic Chemical Contaminants in HDPE Regrind

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

### Results and Notes from Conducting Test Method:

Scale(s) (model, accuracy, calibration):

<table>
<thead>
<tr>
<th>Absorbed Contaminants</th>
<th>Surface Contaminants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent:</td>
<td>Solvent:</td>
</tr>
<tr>
<td>Weight of washed/dried HDPE (W&lt;sub&gt;A&lt;/sub&gt;):</td>
<td>Weight of washed/dried HDPE (W):</td>
</tr>
<tr>
<td>Weight of empty weigh dish (WDISH2):</td>
<td>Weight of empty weigh dish (WDISH1):</td>
</tr>
<tr>
<td>Weight of dried weigh dish (W2):</td>
<td>Weight of dried weigh dish (W1):</td>
</tr>
<tr>
<td>Weight of absorbed contaminants: (W&lt;sub&gt;A&lt;/sub&gt;):</td>
<td>Weight of surface contaminants: (W&lt;sub&gt;S&lt;/sub&gt;):</td>
</tr>
<tr>
<td>Weight percent of absorbed contaminants:</td>
<td>Weight percent of surface contaminants:</td>
</tr>
<tr>
<td>Concentration (ppm):</td>
<td>Concentration (ppm):</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analytes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Methods for Sampling and Testing Recycled HDPE and PET Bales, Pellets and Regrind

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# Logsheet for Method 430 - Contamination for PET Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

## Results and Notes from Conducting Test Method:

- Scale(s) (model, accuracy, calibration):
- Weight of 500 ml sample (T):

## Weight of Sorted Contaminants:

<table>
<thead>
<tr>
<th>Floatable plastics (P1):</th>
<th>Weight Percent of Sorted Contaminants:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Floatable plastics (%P1):</td>
</tr>
<tr>
<td>Weight of PVC and PETG (C1):</td>
<td>PVC and PETG (%C1):</td>
</tr>
<tr>
<td>Non-floatable plastics (P2):</td>
<td>Non-floatable plastics (%P2):</td>
</tr>
<tr>
<td>Ferrous metals (F):</td>
<td>Ferrous metals (%F):</td>
</tr>
<tr>
<td>Non-ferrous metals (NF):</td>
<td>Non-ferrous metals (%NF):</td>
</tr>
<tr>
<td>Other contaminants (Z):</td>
<td>Other contaminants (%Z):</td>
</tr>
<tr>
<td>Total weight of all contaminants:</td>
<td>Weight percent of all contaminants combined:</td>
</tr>
</tbody>
</table>

Additional notes and comments:

- 
- 
- 
- 
- 
-
Logsheet for Method 434 - Odor of HDPE Regrind

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

**Results and Notes from Conducting Test Method:**

<table>
<thead>
<tr>
<th>Sample ID Number</th>
<th>Characteristic Odors: (e.g. sour milk or dairy, detergent, motor oil, pesticide, other)</th>
<th>Odor Intensity:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None - no detectable odor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight - detectable odor, but not pervasive or over-powering.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strong - pervasive or over-powering odor.</td>
</tr>
</tbody>
</table>

If an unknown odor is detected and will be analyzed by chromatographic or other methods, record the sample ID number, notes about the sample, and the lab where the sample(s) will be analyzed. Also record results of laboratory analysis when complete. Additional notes and comments:
# Logsheet for Method 440 - Moisture of HDPE and PET Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td>HDPE or PET (Circle One)</td>
</tr>
</tbody>
</table>

## Results and Notes from Conducting Test Method:

Scale(s) (model, accuracy, calibration):

Weight of undried sample ($W_{\text{WET}}$):

Oven temperature:

Drying time:

Weight of oven dried sample ($W_{\text{DRY}}$):

Moisture content (percent of dry weight)

\[
(W_{\text{WET}} - W_{\text{DRY}}) / (W_{\text{DRY}}) \times 100
\]

Additional notes:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
# Logsheet for Method 444 - Color of HDPE and PET Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td>HDPE or PET (Circle One)</td>
</tr>
</tbody>
</table>

## Results and Notes from Conducting Test Method:

- **Weight of 500 ml sample (W):**
- **Scale(s) (model, accuracy, calibration):**

### Weight of HDPE Sorted Colors:
- **HDPE natural (N):**
- **Describe pigment:**
- **HDPE pigmented (P):**
- **Describe mixed colors:**
- **HDPE mixed (M):**
- **Describe discoloration:**
- **HDPE discolored (D):**

### Weight Percent of HDPE Sorted Colors:
- **HDPE natural:**
- **HDPE pigmented:**
- **HDPE mixed:**
- **HDPE discolored:**

### Weight of PET Sorted Colors:
- **PET clear (C):**
- **PET green (G):**
- **PET other (C):**
- **Describe “other”:**

### Weight Percent of PET Sorted Colors:
- **PET clear:**
- **PET green:**
- **PET other:**

Additional comments:

---

---

---
## Logsheet for Method 448 - Bulk Density of HDPE Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

### Results and Notes from Conducting Test Method:

Scale(s) (model, accuracy, calibration):

<table>
<thead>
<tr>
<th>Volume of cup (V):</th>
</tr>
</thead>
</table>

Weight of empty cup:

<table>
<thead>
<tr>
<th>Weight of empty cup:</th>
</tr>
</thead>
</table>

Weight of full cup:

<table>
<thead>
<tr>
<th>Weight of full cup:</th>
</tr>
</thead>
</table>

Material weight (W):

<table>
<thead>
<tr>
<th>Material weight (W):</th>
</tr>
</thead>
</table>

Bulk density (= W / V):

<table>
<thead>
<tr>
<th>Bulk density (= W / V):</th>
</tr>
</thead>
</table>

Additional notes and comments:

<table>
<thead>
<tr>
<th>Additional notes and comments:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional notes and comments:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional notes and comments:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional notes and comments:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional notes and comments:</th>
</tr>
</thead>
</table>
## Logsheet for Method 452 - Clarity of PET Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

### Results and Notes from Conducting Test Method:

Laboratory ambient conditions - temperature and humidity: ____________________________________________________________________________________________

Equipment calibration notes: __________________________________________________________________________________________________________________________________

**First sample results:**

- L*: ____________________________
- a*: ____________________________
- b*: ____________________________

**Additional notes:** __________________________________________________________________________________________________________________________________

**Second sample results:**

- L*: ____________________________
- a*: ____________________________
- b*: ____________________________

**Additional notes:** __________________________________________________________________________________________________________________________________

**Third sample results:**

- L*: ____________________________
- a*: ____________________________
- b*: ____________________________

**Additional notes:** __________________________________________________________________________________________________________________________________

**Averages:**

- L*: ____________________________
- a*: ____________________________
- b*: ____________________________

**Additional notes:** __________________________________________________________________________________________________________________________________
# Logsheet for Method 455 - Melt Index for HDPE Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

## Results and Notes from Conducting Melt Index Test Method:

- **Scale(s) (model, accuracy, calibration):**
- **Equipment calibration date:**
- **Set point temperature:**
- **Flow time - first run (T1):**
- **Flow time - second run (T2):**
- **Flow time - third run (T3):**

If automatic indexer:
- **Melt index for first run (MI1):**
- **Melt index for second run (MI2):**
- **Melt index for third run (MI3):**

If manual melt indexer:
- **Weight of MI strand - first run (W1):**
- **Weight of strand - second run (W2):**
- **Weight of strand - third run (W3):**
- **MI1 (= ( W1 / T1 ) x 600):**
- **MI2 (= ( W2 / T2 ) x 600):**
- **MI3 (= ( W3 / T3 ) x 600):**

- **Average melt index ($M_{AVG}$):**

Additional comments:
Logsheet for Method 459 - Polymer Density and Specific Gravity for HDPE Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

**Results and Notes from Conducting Test Method:**

Scale(s) (model, accuracy, calibration): ________________________________

Weight of specimen in air:

<table>
<thead>
<tr>
<th>Sample 1 (A1):</th>
<th>Weight of assembly:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample 1 (B1):</td>
</tr>
<tr>
<td></td>
<td>Sample 2 (B2):</td>
</tr>
<tr>
<td></td>
<td>Sample 3 (B3):</td>
</tr>
</tbody>
</table>

Weight of wire and sinker in water:

<table>
<thead>
<tr>
<th>Sample 1 (W1):</th>
<th>Specific gravity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 2 (W2):</td>
<td>Sample 1 (SG1):</td>
</tr>
<tr>
<td>Sample 3 (W3):</td>
<td>Sample 2 (SG2):</td>
</tr>
</tbody>
</table>

Average specific gravity (SG\text{AVG }): ________________________________

Polymer density ( = 0.99756 x SG\text{AVG }): ____________________________

Additional comments:

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
## Logsheet for Method 467 - Intrinsic Viscosity for PET Regrind and Pellets

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

### Results and Notes from Conducting Test Method:

- Name and contact of certified laboratory:

- Date sample sent to laboratory:

- Relative viscosity (RV):

- **Polymer solution concentration (C):**

- **Intrinsic viscosity \((n)\):**
  \[ n = 0.25 \times \left[ \frac{RV - 1 + 3 \ln(RV)}{C} \right] \]

- *Values may be provided by laboratory.*

- Additional comments:
  ...
  ...
  ...
  ...
  ...
  ...

---

Methods for Sampling and Testing Recycled HDPE and PET Bales, Pellets and Regrind

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Logsheet for Method 473 - Polyvinyl Chloride (PVC) and Glycol-Modified Polyethylene Terephthalate (PETG) Content for PET Regrind

<table>
<thead>
<tr>
<th>Field Sample / Test Sample Log</th>
<th>Date and Time Material Received:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed By:</td>
<td>Lot ID # (or Bill of Lading #).</td>
</tr>
<tr>
<td>Current Date:</td>
<td>Source:</td>
</tr>
<tr>
<td>Field Sample Weight:</td>
<td></td>
</tr>
</tbody>
</table>

**Results and Notes from Conducting Test Method:**

Scale(s) (model, accuracy, calibration):

Weight of field sample (T):

Weight of PVC ($W_{\text{PVC}}$), (black flakes):

Weight of PETG ($W_{\text{PETG}}$), (melted, honey colored particles):

PVC concentration (ppm):

PETG concentration (ppm):

Additional notes and comments:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________