Methods for Sampling and Testing Recycled Glass

RECYCLING TECHNOLOGY ASSISTANCE PARTNER

ReTAP

Methods for Sampling and Testing Recycled Glass

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Method 200 Guidelines for Using the Sampling and Test Methods for Recycled Glass Bottles (Broken and/or Whole) and Cullet

1.0 Scope

1.1 These guidelines describe how to use test procedures for evaluating attributes of recycled glass in the form of bottles (whole and/or broken) and cullet.

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 contractural matter. It is not necessary to perform all tests presented within these methods; only for those attributes in dispute.

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 validilty 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 These methods do not address the safety problems, if any, associated with their use. The user is responsible for following appropriate safety and health practices.

1.5 Recycled glass is traded in the following forms:

Form	Grade (Defined in Attachment 200-1)
Processed Cullet	A
Unprocessed Cullet	B
Fine Cullet	C
Coarse Cullet	D
Construction Aggregate Cullet	E
Open Specification Glass (Including Bottles)	F
Bottles (Whole and/or Broken)	H

1.6 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 Attributes - material parameters or contamination types which describe the form, quality and type of material.

2.2 Bottles (Whole and/or Broken) - post-consumer, container glass bottles in a whole and/or broken state. See Attachment 200-1, Grade H.

2.3 Construction Cullet - grade of cullet meeting quality needs of the construction industry. See Attachment 200-1, Grade E.

2.4 Coarse Cullet - grade of coarse cullet meeting quality needs of the fiberglass industry. See Attachment 200-1, Grade D.

2.5 Fine Cullet - grade of fine cullet meeting quality needs of the fiberglass industry. See Attachment 200-1, Grade C.

2.6 Open Specification Cullet - grade of cullet or other forms of glass with size and attributes open to negotiation between trading parties. See Attachment 200-1, Grade F.

2.7 Processed Cullet - grade of processed cullet meeting quality needs of the glass container industry. See Attachment 200-1, Grade A.

2.8 Unprocessed Cullet- grade of unprocessed cullet meeting quality needs of the glass container industry. See Attachment 200-1, Grade B.

3.0 Apparatus

Not applicable.

4.0 Test Procedures

4.1 Sampling

4.1.1 Procedures for collecting a representative gross field sample of bottles and cullet are discussed in Method 201 - *Obtain Glass Field Samples and Perform Initial Visual Inspection*.

4.1.2 Procedures for narrowing the gross field sample to a size appropriate for testing a specific attribute are discussed in Method 202 - *Reduce Glass Field Sample to Testing Sample Size.*

4.2 Testing

4.2.1 Perform test(s) on the test sample(s) as necessary to resolve disputes, if any, regarding the material attributes. Refer to Figures 200-1 and 200-2 to determine the applicable tests for the different forms of glass.

Figure 200-1 - Test Methods for Recycled Glass Bottles (Whole and/or Broken): Grade H

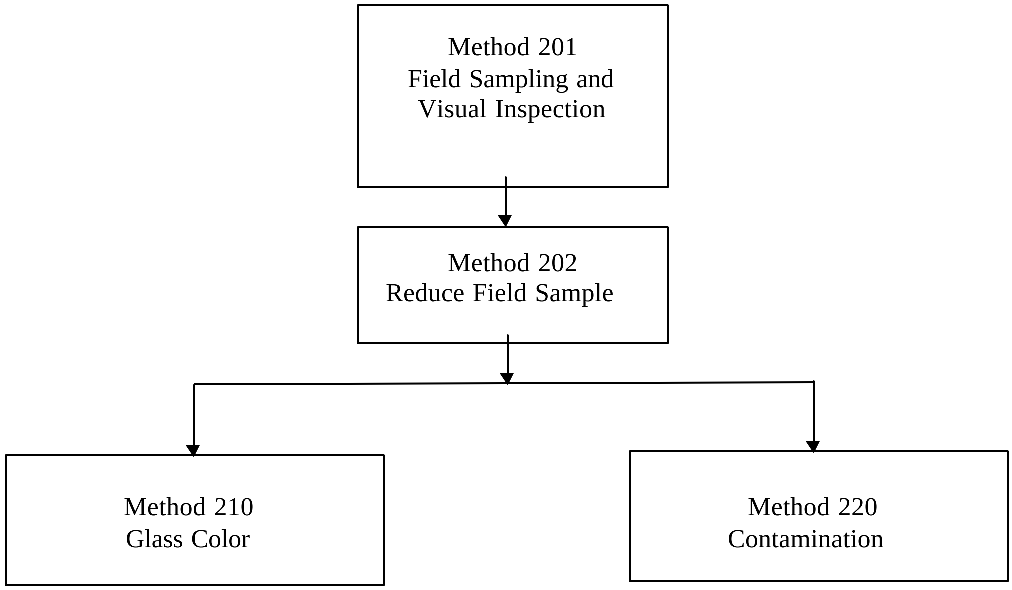
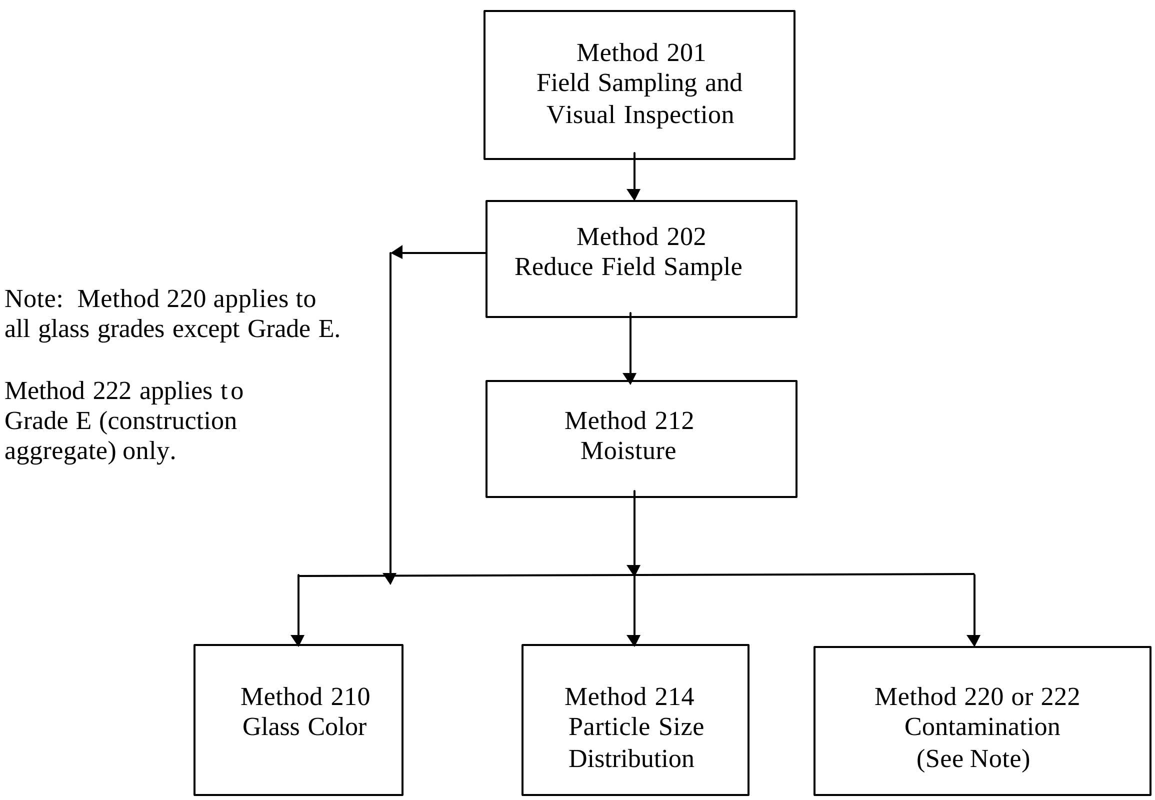


Figure 200-2 - Test Methods for Recycled Glass: Cullet



4.2.2 The attributes applicable to bottles (whole and/or broken) are listed in Table 200-1.

Table 200-1 - List of Attributes and Contaminants for Bottles

Attribute	Unit of Measurement	Method Number
Color	weight percent	210
Organic contaminants	weight percent	220
Ferrous contaminants	weight percent	220
Non-ferrous contaminants	weight percent	220
Ceramic and inorganic contaminants	weight percent	220

4.2.3 The attributes applicable to cullet (Grades A through D) are listed in Table 200-2.

Table 200-2 - List of Attributes and Contaminants for Cullet (Grades A through D, and F)

Attribute	Unit of Measurement	Method Number
Color	weight percent	210
Moisture	weight percent	212
Particle size distribution	percent passing or retained by specific screen sizes	214
Organic contaminants	weight percent	220
Ferrous contaminants	weight percent	220
Non-ferrous contaminants	weight percent	220
Ceramic and inorganic contaminants	weight percent	220

4.2.4 Attributes for cullet used in construction aggregate (Grade E) are listed in Table 200-3. Only two contamination limits exist for Grade E cullet (construction aggregate); percent debris (by visual examination) and lead content. Both are discussed in Method 222 - *Determination of Contamination in Glass Cullet for Use in Construction Aggregate*.

Table 200-3 - List of Attributes and Contaminants for Construction Aggregate Cullet (Grade E)

Attribute	Unit of Measurement	Method Number
Moisture	weight percent	212
Particle size distribution	percent passing or retained by specific screen sizes	214
Lead content	parts per million (converted from µg/L)	222 EPA Method 3050 EPA Method 6010
Debris level	percent composition by visual estimation	222 AGI Visual Methods (from American Geological Institute)

5.0 Calculations

Not applicable.

6.0 Report

6.1 Report applicable test results to the parties in dispute.

6.2 Use logsheets for recording data and results for each method. Logsheets are found in the Appendix at the end of this document.

7.0 Reference Documents

7.1 Method 201 *Obtain Glass Field Samples and Perform Initial Visual Inspection.*

7.2 Method 202 *Reduce Glass Field Samples to Testing Sample Size*.

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.

ATTACHMENT 200-1

SPECIFICATIONS FOR GRADES OF RECYCLED GLASS

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Grade A: Processed Cullet

This specification is representative of the quality needs of the glass container industry and covers glass food and beverage containers (soda-lime-silica) only. Any other types of glass are considered contaminants and may provide justification for load rejection based on agreement between negotiating parties and discretion of buyer. Other types of glass considered to be contaminants include: Pyrex®, crystal, ovenware, plate glass, windows, light bulbs, ceramics, art glass, mirror glass and others.

These specifications establish baseline parameters for Grade A cullet, and a classification scheme for buyer and seller advertising. The allowances and specifications herein may be further negotiated between trading parties.

1.0 Size Specification

Grade A cullet size ranges between 19 mm (3/4 inch) and 10 mm (3/8 inch). 100 weight percent of cullet must pass a 50 mm (2 inch) screen and no more than 10 weight percent shall pass a No. 140 screen.

2.0 Color Specification

2.1 Flint:
95 to 100 percent flint
0 to 5 percent amber,
0 to 1 percent green,
0 to 0.5 percent other colors (e.g., blue).

2.2 Amber:
90 to 100 percent amber
0 to 10 percent flint,
0 to 10 percent green,
0 to 5 percent other colors (e.g., blue).

2.3 Green:
70 to 100 percent green
0 to 15 percent amber,
0 to 15 percent flint,
0 to 10 percent other colors (e.g., blue).

Note: Deadleaf green may be sorted and included with green glass or amber glass based on agreement between negotiating parties.

3.0 Moisture Specification

3.1 No visible drainage of liquid when tipped. No visible snow or ice. Material shall be non-caking and free flowing.

4.0 Contamination Limits

4.1 Glass packaging (labels, plastic caps and plastic rings) and other organic material - not to exceed the following quantities for each color:

Flint: 0.2 weight percent
Amber 0.4 weight percent
Green: 0.4 weight percent

4.2 Ferrous metal - not to exceed 0.005 weight percent.

4.3 Non-ferrous metal - not to exceed five (5) particles per truck load and two (2) particles per truck load upon initial visual inspection.

4.3 Other inorganic materials - upon initial visual inspection, no more than one (1) particle over the size of 12.5 mm (1/2 inch) mesh per truck load and three (3) particles under 12.5 mm (1/2 inch) mesh per truckload.

4.4 Medical, toxic and/or hazardous materials (Prohibited contaminants) - any amount present may be justification for load rejection based on discretion of buyer.

Grade B: Unprocessed Cullet

This specification is representative of the quality needs of the glass container industry and covers glass food and beverage containers (soda-lime-silica) only. Any other types of glass are considered contaminants and may provide justification for load rejection based on agreement between negotiating parties and discretion of buyer. Other types of glass considered to be contaminants include: Pyrex®, crystal, ovenware, plate glass, windows, light bulbs, ceramics, art glass, mirror glass and others.

These specifications establish baseline parameters for Grade B cullet, and a classification scheme for buyer and seller advertising. The allowances and specifications presented herein may be further negotiated between trading parties.

1.0 Size Specification

Grade B cullet may be broken but not pulverized. If crushed, no more than 25 weight percent shall pass a 19 mm (3/4 inch) screen.

2.0 Color Specification

2.1 Flint:
95 to 100 percent flint
0 to 5 percent amber,
0 to 1 percent green,
0 to 0.5 percent other colors (e.g., blue).

2.2 Amber:
90 to 100 percent amber
0 to 10 percent flint,
0 to 10 percent green,
0 to 5 percent other colors (e.g., blue).

2.3 Green:
70 to 100 percent green
0 to 15 percent amber,
0 to 15 percent flint,
0 to 10 percent other colors (e.g., blue).

Note: Deadleaf green may be sorted and included with green glass or amber glass based on agreement between negotiating parties.

3.0 Moisture Specification

3.1 No visible drainage of liquid when tipped. No visible snow or ice. Material shall be non-caking and free flowing.

4.0 Contamination Limits

4.1 Organic materials - only glass packaging material inherent to the glass container (labels, plastic caps and plastic rings) may be present in quantities equivalent to normal amounts of glass packaging. Non-glass packaging materials (wood, paper, rubber, etc.) shall be no greater than 0.5 weight percent.

4.2 Ferrous and non-ferrous metals - permitted are those glass packaging materials (closures, foil, etc.) present in quantities equivalent to normal amounts inherent to glass packaging.

4.3 Other inorganic materials - upon initial visual inspection, no more than one (1) particle over the size of 12.5 mm (1/2 inch) mesh per truck load and three (3) particles under 12.5 mm (1/2 inch) mesh per truckload.

4.4 Medical, toxic and/or hazardous materials (Prohibited contaminants) - any amount present may be justification for load rejection based on discretion of buyer.

5.0 General Acceptability - Cullet must be in such a condition, that after beneficiation by a conventional cullet processor, the material will be suitable for the production of glass containers.

Grade C: Fine Cullet

This specification is representative of the quality needs of the fiberglass industry and covers glass food and beverage containers (soda-lime-silica) only. Any other types of glass are considered contaminants and may provide justification for load rejection based on agreement between negotiating parties and discretion of buyer. Other types of glass considered to be contaminants include: Pyrex®, crystal, ovenware, windows, light bulbs, ceramics, plate glass, art glass, mirror glass and others.

These specifications establish baseline parameters for Grade C cullet, and a classification scheme for buyer and seller advertising. The allowances and specifications presented herein may be further negotiated between trading parties.

1.0 Size Specification

Grade C fine cullet must yield 100 weight percent passing a 6.3 mm (1/4 inch) screen, with no more than 0.5 weight percent retained on a No. 12 screen, and no more than 15 weight percent passing a No. 200 screen.

2.0 Color Specification

In the fiberglass industry, color-sorting is optional and specific color quantities and mixes-may be negotiated between supplier and purchaser. The established color specification will ensure a consistent color mix from shipment to shipment.

2.1 Flint - a color distribution with flint as the predominant color. The percent by weight composition of flint and other allowable color(s) will be established by trading parties. This color composition will vary no more than ± 3 weight percent for each color from shipment to shipment.

2.2 Amber - a color distribution with amber as the predominant color. The percent by weight composition of flint and other allowable color(s) will be established by trading parties. This color composition will vary no more than ± 3 weight percent for each color from shipment to shipment.

2.3 Green - a color distribution with green as the predominant color. The percent by weight composition of green and other allowable color(s) will be established by trading parties. This color composition will vary no more than ± 3 weight percent for each color from shipment to shipment.

2.4 Mixed color cullet - a color distribution with up to 25 weight percent amber content allowed, and an established weight percent content for each other color that varies no more than ± 3 weight percent from shipment to shipment.

3.0 Moisture Specification

3.1 Moisture not to exceed 0.5 weight percent.

4.0 Contamination Limits

4.1 Organic material -not to exceed 0.1 weight percent.

4.2. Ferrous metal - not to exceed 0.005 weight percent.

4.3 Non-ferrous metal - not to exceed 0.01 weight percent.

4.4 Other inorganic material - not to exceed 0.3 weight percent of the entire sample weight, with no inorganic particles retained on a No. 12 screen, and no more than 0.1 weight percent retained on a No. 20 screen, and no more than 0.2 weight percent retained on a No. 20 screen.

4.5 Medical, toxic and/or hazardous materials (Prohibited contaminants) - any amount present may be justification for load rejection based on discretion of buyer.

5.0 Chemical Composition of Cullet

5.1 Table C-1 describes the compositional range of oxides and carbon for grade C cullet. Any particular supply of grade C cullet will fall within these compositional ranges if the material contains only glass food and beverage containers.

For long term buying and selling relationships, an average weight percent for each oxide and upper and lower range limits will be established. This compositional range must not vary beyond specified limits from shipment to shipment.

Table C-1 - Chemical Compositional Range of Grade C Cullet

Oxide or Chemical	Weight Percent Range	+/-
SiO_2	66-88	1.00
$Al2O_3$	0-7	0.50
CaO	0-15	0.50
MgO	0-5	0.50
Na_2O	8-18	0.50
K_2O	0-4	0.50
Fe_2O_3	<0.5	0.05
Cr_2O_3	<0.1	0.02
SO_3	<0.2	0.02
All other oxides	<0.1	0.02
Carbon	<0.1	0.02

This table has been adapted, in part, from the American Society for Testing and Materials (ASTM) standard D 5359-93, copyright ASTM, 1916 Race Street, Philadelphia, PA 19103-1187. As such, the table has neither been approved nor endorsed by ASTM.

Grade D: Coarse Cullet

This specification is representative of the quality needs of the fiberglass industry and covers glass food and beverage containers (soda-lime-silica) only. Any other types of glass are considered contaminants and may provide justification for load rejection based on agreement between negotiating parties and discretion of buyer. Other types of glass considered to be contaminants include: Pyrex®, crystal, ovenware, windows, light bulbs, ceramics, plate glass, art glass, mirror glass and others.

These specifications establish baseline parameters for Grade D cullet, and a classification scheme for buyer and seller advertising. The allowances and specifications presented herein may be further negotiated between trading parties.

1.0 Size Specification

Grade D coarse cullet size must yield 100 weight percent passing a 6.3 mm (1/4 inch) screen with at least 25 weight percent retained on a No. 12 screen and no more than 15 weight percent passing a No. 200 screen.

2.0 Color Specification

In the fiberglass industry, color-sorting is optional and specific color quantities and mixes-may be negotiated between supplier and purchaser. The established color specification will ensure a consistent color mix from shipment to shipment.

2.1 Flint - a color distribution with flint as the predominant color. The percent by weight composition of flint and other allowable color(s) will be established by trading parties. This color composition will vary no more than ± 3 weight percent for each color from shipment to shipment.

2.2 Amber - a color distribution with amber as the predominant color. The percent by weight composition of flint and other allowable color(s) will be established by trading parties. This color composition will vary no more than ± 3 weight percent for each color from shipment to shipment.

2.3 Green - a color distribution with green as the predominant color. The percent by weight composition of green and other allowable color(s) will be established by trading parties. This color composition will vary no more than ± 3 weight percent for each color from shipment to shipment.

2.4 Mixed color cullet - a color distribution with up to 25 weight percent amber content allowed, and an established weight percent content for each other color that varies no more than ± 3 weight percent from shipment to shipment.

3.0 Moisture Specification

3.1 Moisture not to exceed 0.5 weight percent.

4.0 Contamination Limits

4.1 Organic material -not to exceed 0.1 ± 0.02 weight percent.

4.2. Ferrous metal - not to exceed 0.005 weight percent.

4.3 Non-ferrous metal - not to exceed 0.01 weight percent.

4.4 Other inorganic material - not to exceed 0.3 weight percent of the entire sample weight, with no inorganic particles retained on a No. 12 screen, and no more than 0.1 weight percent retained on a No. 20 screen, and no more than 0.2 weight percent retained on a No. 20 screen.

4.5 Medical, toxic and/or hazardous materials (Prohibited contaminants) - any amount present may be justification for load rejection based on discretion of buyer.

5.0 Chemical Composition of Cullet

5.1 Table D-1 describes the compositional range of oxides and carbon for grade D cullet. Any particular supply of grade D cullet will fall within these compositional ranges if the material contains only glass food and beverage containers.

For long term buying and selling relationships, an average weight percent for each oxide and upper and lower range limits will be established. This compositional range must not vary beyond specified limits from shipment to shipment.

Table D-1 - Chemical Compositional Range of Grade D Cullet

Oxide or Chemical	Weight Percent Range	+/-
SiO_2	66-88	1.00
$Al2 0_3$	0-7	0.50
CaO	0-15	0.50
MgO	0-5	0.50
Na_2O	8-18	0.50
K_2O	0-4	0.50
Fe_2O_3	<0.5	0.05
Cr_2O_3	<0.1	0.02
SO_3	<0.2	0.02
All other oxides	<0.1	0.02
Carbon	<0.1	0.02

This table has been adapted, in part, from the American Society for Testing and Materials (ASTM) standard D 5359-93, copyright ASTM, 1916 Race Street, Philadelphia, PA 19103-1187. As such, the table has neither been approved nor endorsed by ASTM.

Grade E: Construction Cullet

This specification addresses glass food and beverage containers (soda-lime-silica) only and is representative of the quality needs of the construction aggregate industry.

1.0 Size Specification

Grade E cullet must yield 100 weight percent passing a 19 mm (3/4 inch) screen, with no more than 5 percent weight passing a No. 200 screen.

2.0 Color Specification

Not applicable.

3.0 Moisture Specification

3.1 No visible drainage of liquid when tipped. No visible snow or ice. Material shall be non-caking and free flowing.

4.0 Contamination Limits

4.1 Debris level - an average maximum debris level of 5 percent, by visual examination of the total two-dimensional surface area of representative test sample(s). At least one sample for every 39 cubic meters (50 cubic yards) of material should be evaluated.

Debris is defined as any non-container-glass material which may impact the performance of engineered fill, including labels (paper aluminum or tin foil, and plastic) caps and cap fragments (metal and plastic), and organic contents (corks, food residue, etc.).

4.2 Lead - the average of five (5) samples shall not exceed a total lead content of 80 ppm.

4.3 Medical, toxic and/or hazardous materials (Prohibited contaminants) - any amount present may be justification for load rejection based on discretion of buyer.

Grade F: Open (or Proprietary) Specification Glass

1.0 Form and Type Specification

1.1 Form and type of Grade F glass shall be determined by negotiating parties. “Open” glass may include post-consumer or post-industrial glass in any form. Types of glass may include, but are not limited to: containers, Pyrex®, crystal, ovenware, plate glass, light bulbs, ceramics, art glass, and mirror glass.

2.0 Size Specification

2.1 Size of particulate or whole Grade F glass shall be determined by negotiating parties. “Open” glass may range in unit sizes from very fine cullet to whole panes or plates of glass.

3.0 Color Specification

3.1 Color of particulate or whole Grade F glass shall be determined by negotiating parties.

4.0 Moisture Specification

4.1 Allowable moisture content of Grade F glass shall be determined by negotiating parties.

5.0 Contamination Limits

5.1 Allowable contaminant levels of Grade F glass shall be determined by negotiating parties. Limits should be considered for any or all of the following contamination types as applicable: organic, inorganic, ferrous metal, non-ferrous metal, debris, medical, toxic and/or hazardous materials), and different glass types.

Grade H: Bottles (Whole and/or Broken)

This specification covers post-consumer food/beverage glass containers (soda-lime-silica) only, in the form of whole and/or broken bottles, and is representative of the quality needs of the glass container industry.   Any other types of glass are considered contaminants and may provide justification for load rejection based on agreement and discretion of negotiating parties. Other types of glass considered to be contaminants include: Pyrex®, crystal, ovenware, plate glass, windows, light bulbs, ceramics, art glass, mirror glass and others.

These specifications establish baseline parameters for whole or broken bottles, and a classification scheme for buyer and seller advertising. The allowances and specifications presented herein may be further negotiated between trading parties.

1.0 Size Specification

Not applicable.

2.0 Color Specification

2.1 Flint: 95 to 100 percent flint
0 to 5 percent amber,
0 to 1 percent green,
0 to 0.5 percent other colors (e.g., blue).

2.2 Amber: 90 to 100 percent amber
0 to 10 percent flint,
0 to 10 percent green,
0 to 5 percent other colors (e.g., blue).

2.3 Green: 70 to 100 percent green
0 to 15 percent amber,
0 to 15 percent flint,
0 to 10 percent other colors (e.g., blue).

Note: Deadleaf green may be sorted and included with green glass or amber glass based on agreement between negotiating parties.

2.4 Mixed Color: Sorting and mix depends on end-use and may be established by negotiating parties.

3.0 Moisture Specification

3.1 No visible drainage of liquid when tipped. No visible snow or ice. Bottles must be drained and all free moisture removed prior to delivery.

4.0 Contamination Limits

4.1 Organic materials - only glass packaging material inherent to the glass container (labels, plastic caps and plastic rings) may be present in quantities equivalent to normal amounts of glass packaging. Non-glass packaging materials (wood, paper, rubber, etc.) shall be no greater than 0.5 weight percent.

4.2 Ferrous and non-ferrous metals - permitted are those glass packaging materials (closures, foil, etc.) present in quantities equivalent to normal amounts inherent to glass packaging.

4.3 Other inorganic materials (rocks, stones, ceramics, vision ware, etc.) - upon initial visual inspection, no more than one (1) particle over the size of 12.5 mm (1/2 inch) per truck load, and one (1) particle under 12.5 mm (1/2 inch) per truckload.

4.4 Medical, toxic and/or hazardous materials (Prohibited contaminants) - any amount present may be justification for load rejection based on discretion of buyer.

Method 201 Obtain Glass Field Samples and Perform Initial Visual Inspection

1.0 Scope

1.1 This method describes methods for obtaining field samples of glass representative of a given lot. This method applies to glass in the form of bottles or cullet. Bottles may be whole and/or broken, but will heretofore be referred to as "bottles".

1.2 The procedures for visual inspection and obtaining field samples are:

1.2.1 Initial Visual Inspection.

1.2.2 Method 201A: *Sampling from a Flow Stream.*

1.2.3 Method 201B: *Sampling from a Conveyor Belt.*

1.2.4 Method 201C: *Composite Sampling with Power Equipment from a Large Stockpile or Large Bunker.*

1.2.5 Method 201D. *Composite Sampling from a Small Bunker*.

1.2.6 Method 201E: *Composite Sampling from a Bulk Container or Transportation Unit*.

1.2.7 Method 201F *Composite Sampling of Fine, Dry Cullet from Bulk Container(s) and Gaylords*

1.3 Gross materials in storage may become segregated by size. Additionally, segregation of material from contaminants (such as closures, labels, or miscellaneous debris) may occur. The preferred methods described herein, attempt to capture a sample containing representative particle sizes and representative amounts of all contaminants. In certain instances, the less preferred, but likely more practical methods may be used, but may not provide as representative sample as preferred methods.

1.4 For reduction of the field sample to test sample, refer to Method 202 - *Reduce Glass Field Samples to Testing Sample Size*.

1.5 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 validilty 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.

1.6 These methods are intended for the resolution of disputes regarding the quality of recyclable materials that may arise during trading.

1.7 These procedures do 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 <u>Composite Field sample</u> - a representative composite of sample material collected from one lot, composed of one or more sample increments, on which neither reduction nor division has been performed.

2.2 Lot - a collection or shipment of 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. In a sales transaction, a lot is the collection of materials offered at the same terms by one seller.

2.3 Nominal particle size - the size opening that retains 10 weight percent of a representative sample of the cullet (and 90 weight percent of the cullet passing same screen size).

2.4 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.

2.5 Retained sample - the portion of the field sample remaining after reduction of the field sample to a test sample.

2.6 Sample increment - a individual sample from the lot, collected during one operation of a sampling device, and normally combined with other increments from the lot to generate a field sample.

3.0 Apparatus

3.1 Sample collection containers such as plastic, 19 liter (five gallon) buckets. Containers must be clean, have a cover or seal, and be non-metallic.

3.2 Calibrated scale of 50 kg (or 100 pound) minimum capacity, with readability to 1 g (or 0.005 pounds). Note the scale(s) capacity, accuracy and model on the logsheet.

3.3 Straight-edged scoop, shovel or trowel.

3.4 Broom or brush, and dust pan.

3.5 Logsheet for Method 201 (See Appendix)

3.6 **Apparatus Specific to Method 201A**, ***Sampling from a Flow Stream:***

3.6.1 Sampling pelican (or equivalent device) tailored for specific facility or processing system. This device consists of a pan of sufficient size to intercept the entire cross section of the discharge stream and hold the required quantity of material without overflowing. Rails may be necessary to support the pelican as it passes under the discharge stream.

3.7 **Apparatus Specific to Method 201B, *Sampling from a Conveyor Belt:***

3.7.1 Template(s) tailored for specific facility or processing system. Template(s) shall conform to the shape of the conveyor belt, with a pan width about ten percent wider than the conveyor belt.

3.7.2 Transfer pan that is at least 10 percent wider than the conveyor belt.

3.8 Apparatus Specific to Method 201C, *Composite Sampling with Power Equipment from a Large Stockpile or Large Bunker Belt*

3.8.1 Power equipment such as a bobcat loader.

3.9 Apparatus Specific to Method 201D, *Sampling from a Small Bunker*

3.9.1 Sample thief (also called trier, coring tool, or grain probe, but heretofore referred to as a thief) to extract samples from containers. Use a thief with outside tube diameter of about 35 mm (or 1-3/8 inches). Sample thieves with auger blades around the probe tip work best with compacted moist or fine particle packing. Aluminum sample thieves are not recommended.

The thief is a double-tube system with the inner tube holding 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.

Thieves are available in several standard lengths. The required length is determined by the container size. For sampling gaylord boxes, a thief of length 1.5 m (5 feet) is sufficient since it will reach from the top corner to the opposite bottom corner. For sampling rail cars, a thief of length 3 m (10 feet) thief may be sufficient if it reaches from the top opening to the bottom of the container at a slight angle.

If the cullet is caking and not free-flowing, (due to moistness, compaction or residues), use a shovel or scoop instead of a thief.

3.9.2 Non-metallic bucket, five to ten gallon capacity. The bucket may be used to extract samples in lieu of a shovel or trowel.

3.10 Apparatus Specific to Method 201E, *Sampling from a Transportation Unit*

3.10.1 Sample thief of lengt h sufficient to obtain sample material from the entire depth the container at an angle. For open top units, a 15 to 30 degree angle of entry is preferred. For sampling rail cars, the opening prevents an entry angle much greater than 5 to 10 degrees.

3.10.2 Long, narrow spade, with a head of approximately 30 x 12 cm (12 x 4 inch).

3.10.3 Power equipment such as a bobcat loader, if available.

3.11 **Apparatus Specific to Method 201F, *Composite Sampling of Fine, Dry Cullet from Bulk Containers***

3.11.1 Sample thief of sufficient length to obtain material from the entire depth the container entering from one corner at the top and reaching to the opposite bottom corner. For sampling gaylord boxes, a 1.5 meter (5 foot) long thief is sufficient.

4.0 Procedure

4.1 Composite field sample quantities based on nominal particle size are listed in Table 201-1. Refer to subsequent steps to draw each field sample. Composite field samples will be reduced to conduct given test(s) per Method 202 - *Reduce Glass Field Samples to Testing Sample Size*. The number of composite field samples required depends on the desired confidence level of test results and the total mass of the lot of material.

Table 201-1 - Composite Field Sample Mass Based on Nominal Particle Size

Maximum Nominal Size of Glass Particles or Cullet		Approximate Minimum Mass of One Composite Field Sample (c)
(Fine)	No. 8 Mesh (2.36 mm) to 9.5 mm (0.375 inch)	10 kg (25 pounds)
(Coarse)	12.5 mm (0.5 inch)	15 kg (35 pounds)
(Coarse)	19.0 mm (0.75 inch)	25 kg (55 pounds)
(Coarse)	25.0 mm (1 inch)	50 kg (110 pounds)
(Coarse)	37.5 mm (1-1/2 inch)	75 kg (165 pounds)
(Coarse)	50 mm (2 inch)	100 kg (220 pounds)
(Coarse)	63 mm (2.5 inch)	125 kg (275 pounds)
(Coarse)	75 mm (3 inch)	150 kg (330 pounds)
(Coarse)	90 mm (3.5 inch)	175 kg (385 pounds)

Notes: a) This table has been adapted, in part, from ASTM D 75 - 87, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. As such, this table has neither been approved nor endorsed by ASTM.

b) The nominal particle size is defined as the size opening that retains 10 weight percent of a representative sample of the cullet (and 90 weight percent of the cullet passing same screen size).

c) For combined coarse and fine cullet, the field sample weight is the minimum weight for the coarse cullet plus 10 kg (25 pounds).

4.2 Perform initial visual inspection lot quality before extracting the field sample. Qualified, trained personnel should perform the visual inspection. Establish an observation viewing point no farther than 1.6 meters (5 feet) from the material.

4.2.1 For material in motion (e.g. conveying system), view the flow of material for a minimum of ten minutes. Note any fluctuation or unevenness in the flow, or cyclic behavior in volume. Any noted variations will determine the time required for sample extraction in building a composite sample.

4.2.2 For material in a stockpile or a bunker, walk slowly along the edge of the pile, viewing as much as is readily accessible. Prod the edge of the pile with a clean shovel or broom to seek out obvious heavy particles that roll to the edge during normal pile building dynamics.

4.2.3 For material in a transportation unit, use a ladder to view as much of the load as is readily accessible. Remove any tarps or covers and open all hatches. Prod the edge of the compartments with a clean shovel to seek out heavy particles along the edge, or to grab debris, fluff, or papers floating about the compartment. Inspect the outside of the unit for damage or leakage.

4.2.4 For material in a bulk container, view the outside of the container for damage or leakage. Prod the edges and in the center top of the container with a small shovel to seek out heavy particles along the edge, or to grab debris, fluff, or papers.

4.3 Observe and record information on the logsheet for the following attributes:

4.3.1 Obvious inhomogeniety in the bulk of the material, such as color or particle size distribution.

4.3.2 Large (greater than 50 mm (2 inches)) pieces of material that are not container glass. Remove any such contamination and place the contaminant piece(s) in a labeled zip-lock plastic bag. Record findings on the log sheet.

4.3.3 Moisture, including ice and snow. Bottles must be drained and all free moisture removed prior to delivery. There should be no visible drainage or leakage of liquid from bottles or cullet. Cullet should be non-caking.

4.3.4 Prohibited materials (see definition in Section 2.0). Determine whether load is acceptable or should be rejected based on established agreements between negotiating parties and/or discretion of buyer.

4.3.5 Flowability. Cullet should be non-caking and free flowing.

4.4 Method 201A - Sampling from a Flow Stream

4.4.1 Calculate the number of pelican (or equivalent collection container) samples to draw to form the composite sample. First, determine the weight of material the sample pelican will hold. Record the net weight as WP. Second, determine and record the weight of the composite field sample (as WF).

To calculate the number of pelican samples to draw (n) from the composite field sample, divide WF by WP and round up to the nearest integer. A minimum of three pelican samples of approximately equal volume are required.

4.4.2 Determine random time intervals to draw the n pelican samples.

Record the estimated flow time (T) for the entire lot of material to pass the sampling point (discharge). Based on the flow time (T) and the number of samples (n), select random times within the flow time to collect the pelican samples. Avoid sampling the initial discharge or the final few tons to reduce the chance of obtaining segregated material.

If the flow is uneven or cyclic, attempt to learn the cause of the fluctuation. Adjust the sampling time intervals depending on the cause, to ensure a representative sample of the entire lot is obtained.

4.4.3 Using sample pelicans, extract n sample increments from the entire cross section of the discharge mechanism. Collect all material, including fines. Combine sample increments on a clean surface to form the composite sample.

4.4.4 Repeat the process if more than one composite field sample is required.

4.5 Method 201B - Sampling from a Conveyer Belt

4.5.1 Calculate the number of template (or equivalent collection container) samples to form the composite sample. First, determine the weight of material that two templates will hold. Record the combined net weight as WT. Second, determine and record (as WF) the weight of the field sample.

To calculate the number of sample increments (two templates worth) to draw (*n*), divide WF by WT and round up to the nearest integer. A minimum of three sample increments of approximately equal volume are required.

4.5.2 Determine random time intervals to draw the *n* samples.

Record the estimated flow time (T) for the entire lot of material to pass the sampling point (discharge). Based on the flow time (T) and the number of samples (*n*), select random times within the flow time to collect the pelican samples. Avoid sampling the initial discharge or the final few tons to reduce the chance of obtaining segregated material.

If the flow is uneven or cyclic, attempt to learn the cause of the fluctuation. Adjust the sampling time intervals depending on the cause, to ensure a representative sample of the entire lot is obtained.

4.5.3 Stop the conveyor belt while extracting the sample increments. Using two templates for each sample extraction, draw a sample from the entire cross section of the belt discharge. Scoop all the material into a sample collection container. Collect all fines on the belt with a brush and dust pan and add to the container. Repeat until all *n* sample increments are extracted and combined to form the composite sample in the collection container.

4.5.4 Repeat the process if more than one composite field sample is required.

4.6 Method 201C - Composite Sampling with Power Equipment from Large Stockpiles or Bunkers

4.6.1 This method is appropriate for glass in bunkers or large stockpiles with base area of 60 square meters (500 square feet) and/or a width greater than or equal to 1.5 times the width of the bucket on the power equipment. Power equipment to collect the sample is recommended because of the large volume of material required to comprise a representative field sample.

4.6.2 Calculate the number of power equipment buckets (sample increments) to form the composite sample. First, determine the weight of material that one bucket full will hold. Record this net weight as WT. Second, determine and record (as WF) the weight of each composite field sample.

To calculate the number of sample increments to draw (*n*), divide WF by WT and round up to the nearest integer. A minimum of three sample increments of approximately equal volume are required. If necessary, adjust the fill level of the bucket if three full bucket loads will produce more weight than required in the composite field sample.

4.6.3 Prepare a clean surface at least 4 m x 4 m (13 ft x 13 ft) to collect and compile sample increments. A non-porous concrete pad is preferred. Sweep clean as necessary.

4.6.4 Clean the bucket of the equipment to remove dirt, oil, moisture, residue, and other material.

4.6.5 Remove the top 150 mm (~6 inches) of material from the surface layer where samples will be extracted. This will ensure samples from the top third of the stored material are extracted where gradation segregation is minimal.

4.6.6 With the selected power equipment, collect sample increments (of approximately equal volume), from a minimum of three individual sample locations at different heights. Vary the sampling height to obtain one sample each from the top third, mid third, and bottom third of the pile. Record approximate sampling locations.

4.6.7 Place the material from each sampling location on the concrete pad in a random lateral sequence.

4.6.8 Mix the total volume of the material together, using the power equipment to turn the layers into each other.

4.6.9 Repeat the process if more than one composite field sample is required.

4.7 Method 201D - Composite Sampling from Small Bunkers or Small Stockpiles

4.7.1 This method is appropriate for glass in bunkers or stockpiles with base area of 6 square meters (50 square feet) and/or a width less than 1.5 times the width of the bucket on available power equipment. (Power equipment is not used in this method.)

To calculate the number of sample increments to draw (*n*), divide WF by WT and round up to the nearest integer. A minimum of three sample increments of approximately equal volume are required. If necessary, adjust the fill level of the bucket if three full bucket loads will produce more weight than required in the composite field sample.

4.7.2 Determine the necessary total field sample weight per Table 201-1. Record this weight as WF.

4.7.3 Calculate the number of samples (*n*) to draw to form the composite sample. First, determine the weight of sample material that the collection tool (shovel, trowel, bucket, or sample thief) will hold in one extraction. Record this net weight (of the material) as WT.

To calculate the number of samples to draw (*n*), divide WF by WT and round up to the nearest integer. For bottles and cullet of nominal particle size greater than 37 mm or 1.5 inch, a minimum of three sample increments of approximately equal volume are needed to form a composite sample. For finer cullet, nominal particle size less than 37 mm or 1.5 inch), a minimum of five sample increments of approximately equal volume are needed to form a composite sample. Record *n*.

4.7.4 Prepare a clean, dry surface at least 3 m x 3 m (10 ft x 10 ft), or a collection container large enough to collect and combine all sample increments. A concrete pad is preferred. Asphalt surfaces are not recommended. Sweep area clean.

4.7.5 Remove the surface layer of the stored material before extracting samples. To prevent material segregation during sampling, place a plywood sheet or board vertically into the pile just above the sampling point.

4.7.6 For bottles and cullet of nominal size greater than 19 mm (0.75 inch), or moist, caking cullet, use a straight-edged, shovel, trowel, or bucket to extract *n* sample increments. Collect at least one sample increment from the top third, at least one from the mid third, and at least one from the bottom third of the bunker pile. If more than three samples are taken, continue varying the sample height in the same manner. Combine sample increments on the clean surface or in a collection container to form a composite field sample.

4.7.7 For finer, non-caking cullet, a sample thief of length that will penetrate as much of the pile as possible is preferred to obtain material representative of all depths. To collect the sample increments, close the thief, and insert into the pile (at random locations and random angles) with the zone openings facing upward. Turn the handle to open the sample zones. Move the thief up and down with two short strokes to fill the zones. Close the thief and remove. Combine sample increments on the clean surface or in a collection container to form a composite field sample.

4.7.8 Repeat the process if more than one composite field sample is required.

4.8 **Method 201E - Composite Sampling from Transportation Units**

4.8.1 For this method, one transportation unit is considered to be a truck, or hopper truck, one sea container, or one compartment of a rail car. Collection of sample material from transportation units with power equipment is the preferred method to obtain material at various levels and locations within the unit. Where power equipment is unavailable or impractical, sampling with a thief is the next preferred method but will only work for dry, fine cullet. If neither of these options are possible, trenching may be employed.

4.8.2 Determine the weight of sample material that one extraction with the selected sampling tool (power equipment bucket, shovel, trowel, bucket, or sample thief) will hold. Record this net weight (of the material) as WT. Record the required weight of the composite field sample (WF) from Table 201-1.

4.8.3 To calculate the number of samples to draw (n), divide WF by WT and round up to the nearest whole integer. For bottles and cullet of nominal particle size greater than 37 mm or 1.5 inch, a minimum of three sample increments of approximately equal volume are needed to form a composite sample. For finer cullet, nominal particle size less than 37 mm or 1.5 inch), a minimum of five sample increments of approximately equal volume are needed to form a composite sample. Record n.

4.8.4 Remove the top 150 mm (~6 inches) of material from the surface layer to ensure samples from the top third of the stored material are extracted where gradation segregation is minimal.

4.8.5 When using power equipment, clean the bucket of the equipment. Extract n sample increments (of approximately equal volume) at various positions across the horizontal and vertical planes within the unit.

Combine sample increments on a clean, dry surface until all sample increments have been drawn. Record the equipment and method used.

4.8.6 For fine dry cullet, an alternative to power equipment is sampling with a thief or probe. When sampling from rail cars, use the sampling pattern shown in Figure 201-1. Record the equipment or method used.

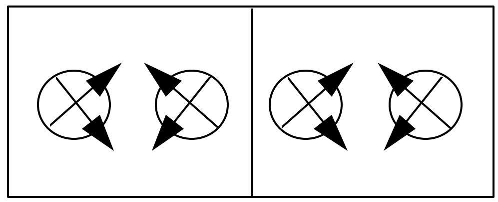
Combine sample increments on a clean, dry surface until a composite sample of mass equal to or exceeding the minimum recommendation in Table 201-1 is collected.

4.8.7 When using the trenching method, excavate three or more trenches across the unit at points that will give a representative estimate of the load characteristics. The trench bottom should be approximately level, and at least 30 cm (~1 foot) in width and depth below the top surface. As necessary, construct plywood dams on the sides of the trenches to hold back material from higher areas. Extract n sample increments (of approximately equal volume) with a hand shovel, from equally spaced points along each trench.

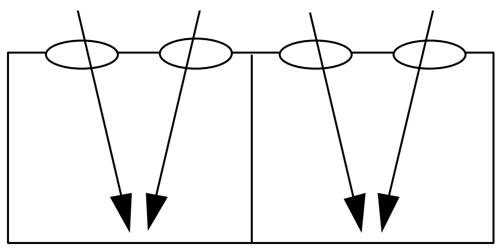
4.8.8 Combine sample increments on a clean, dry surface until a sample of mass equal to or exceeding the minimum recommendation in Table 201-1 is collected.

4.8.9 Repeat the process if more than one composite field sample is required.

Figure 201-1 - 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.

4.9 **Method 201F - Composite Sampling of Fine, Dry Cullet from Small Bulk Containers (e.g. Gaylord Boxes)**

4.9.1 Bulk, dry, cullet, that is less than about 19 mm (~0.75 inch) nominal particle size may be sampled from containers (e.g., gaylord) with a sample thief about 1.5 m (5 feet) in length.

4.9.2 Identify a number (e.g., 1, 2, 3, etc.) and assign to each gaylord or container in the lot. Write each identification number on a separate tag or piece of paper and place in a box or bag.

4.9.3 Using Table 201-2, determine the number of containers to sample (N) and record this number. Draw N tags, one at a time. Record the identification numbers of the gaylords to be sampled.

Table 201-2 - Number of Containers to Sample from a Given Lot

Total Number of Gaylords in Lot	Number of Gaylords to Sample (N)
2 - 8	2
9 - 15	3
16 - 25	5
26 - 50	8
51 - 90	13
91 - 150	20

151 - 280	32
281 - 500	50

4.9.4 Determine the weight of sample material in one draw with a sample thief. Weigh to 1.0 g and record the net weight (of the material) from the thief as WT. Record the required weight of the composite field sample (WF) from Table 201-1.

4.9.5 To calculate the total number of samples to draw (*n*), divide WF by WT and round up to the nearest whole integer. Record *n*.

4.9.6 To calculate the number of samples to draw from each sample container (*nc*), divide *n* by the number of sample containers. Record *nc*.

4.9.7 Draw *n* samples from each container following a sampling pattern per Figure 201-2. The method for drawing a sample follows: Insert a closed sample thief into the material at one corner of the container 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. Close the thief and remove it from the container.

4.9.8 Combine sample increments on a clean, dry surface until a sample of mass equal to or exceeding the minimum recommendation in Table 201-1 is collected.

4.9.9 Repeat the process if more than one composite field sample is required.

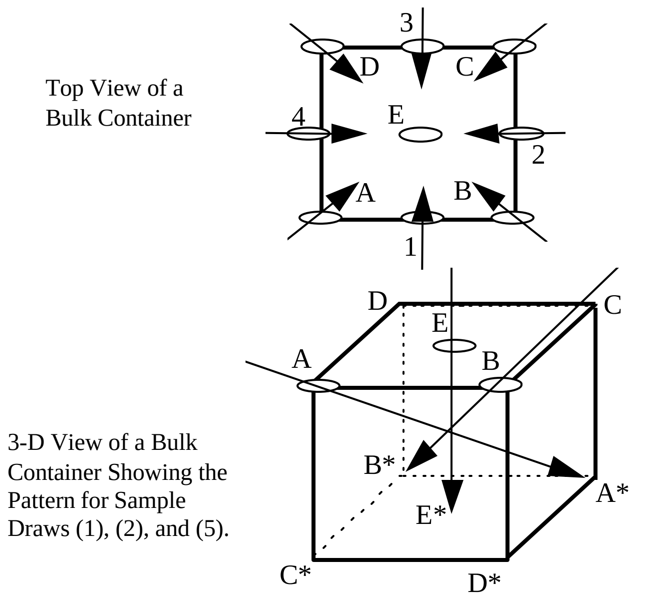
5.0 Calculations

Not applicable.

6.0 Reporting

Not applicable.

Figure 201-2 - Sampling Patterns for Gaylords/Containers



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*

7.0 Reference Documents

7.1 ASTM D 75 - 87 *Standard Practice for Sampling Aggregates*

Note: This method has been adapted, in part, from ASTM D 75 - 87, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. This method has neither been approved nor endorsed by ASTM.

7.2 MIL-STD-105 Level II *Sampling Procedures and Tables for Inspection by Attributes.*

7.3 Code of Federal Regulations, 40 CFR 260, Subpart C, Chapter 1, *Characteristics of Hazardous Waste.*

Method 202 Reduce Glass Field Samples to Testing Sample Weight

1.0 Scope

1.1 This method describes three procedures to reduce gross field samples to a smaller but still representative size for conducting tests. This method applies to glass in the form of bottles or cullet.

1.2 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 validilty of sampling is entirely their own responsibility. Other methods for acquiring a field samples, 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 The procedures for reducing field samples to testing samples are shown in Table 202-1. Mechanical splitting with a riffler is the preferred method.

Table 202-1 - Splitting Methods for Different Glass Forms

Method	Splitting Method	Applicable For Glass in the Form of:
202A	Mechanical Splitting	• Dry cullet only. Not appropriate for material that exhibits moisture, cakes together, or retains shape when molded in the hand.
202B	Coning and Quartering	• Bottles, whole and/or broken. • All cullet.
202C	Miniature Stockpile Sampling	• Damp, fine cullet only.

1.4 The number of iterations of these reduction processes necessary to produce a sufficient test sample depends on the required test sample weight for the specific test(s).

1.5 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 contractural matter.

1.6 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

Not applicable.

3.0 Apparatus

3.1 Calibrated scale(s) or balance(s) accurate within 0.1 percent of the initial or maximum test sample.

3.2 **Apparatus Specific to Method 202A - Mechanical Splitting**

3.2.1 Mechanical splitter (riffler) with equal-width chutes that discharge material alternately to each of two side receptacles of the splitter. A single-side discharge (pinball style) splitter is undesirable because it segregates particle sizes and clogs readily.

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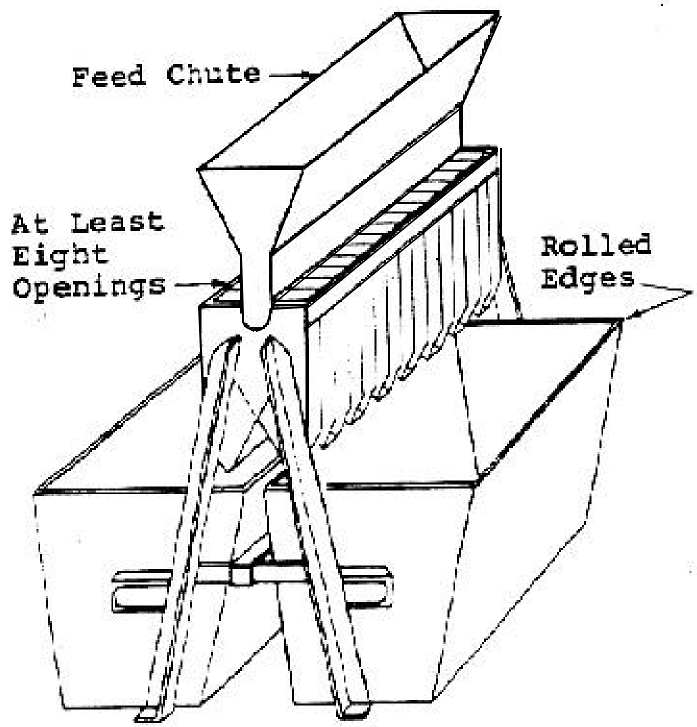
The riffler should have a hopper or straight-edged pan feeding the sample at a controlled rate. The splitter and accessory equipment must be designed to allow the sample to flow smoothly without restriction or loss of material (see Figure 202-1).

Select a chute width approximately 50% wider than the largest particle.

For cullet of maximum particle size less than 50 mm (2”), a minimum of eight (8) chutes is optimum. For cullet of maximum particle size less than 20 mm (3/4”), a minimum of twelve (12) chutes is optimum.

Figure 1 - Riffle Sampler
(Source: ASTM 702 - 87 *Standard Practice for Reducing Field Samples of Aggregate to Testing Size)*



3.3 **Apparatus Specific to Method B - Coning and Quartering**

3.3.1 Straight-edged scoop, shovel, or trowel.

3.3.2 Broom or brush.

3.3.3 Power equipment (if necessary), such as a backhoe, to reduce large samples.

3.4 **Apparatus Specific to Method 202C - Miniature Stockpile**

3.4.1 Straight-edged scoop, shovel, or trowel.

3.4.2 Small sample thief, small scoop, or spoon.

3.4.3 Plastic tarp, approximately. 2 x 2.5 m (6 x 8 feet).

4.0 Procedure

4.1 Collect a field sample per Method 201 - *Obtain Glass Field Samples and Perform Initial Visual Inspection.*

4.2 Select a reduction method based on the form of the material. Refer to Table 202-1.

4.3 Determine the required testing sample weight, based on the test(s) to be conducted and the form of the glass. Refer to Table 202-2.

Table 202-2 - Reduced Test Sample Weight Required for Specific Test(s) and Glass Form(s)

Method and Attribute	Glass Form	Approximate Test Sample Weight (Per Sample)
210 Color	Bottles (Whole and/or Broken)	18 kg (40 pounds)
210 Color	Cullet	2.2 kg (5 pounds)
212 Moisture Content	Cullet	2.2 kg (5 pounds)
214 Particle Size Distribution	Cullet	4.54 g (10 pounds)
220 Organic Contamination	Bottles and Cullet (except Grade E)	454 g (1 pound)
220 Ferrous Metal Contamination	Bottles and Cullet (except Grade E)	4.54 kg (10 pounds)
220 Inorganic Contamination (Including Non-Ferrous)	Bottles and Cullet (except Grade E)	18 kg (40 pounds)
222 Debris Level	Cullet (Grade E only)	0.9 kg (2 pounds)
222 Lead Contamination (Five (5) samples needed at about 10 g per sample.)	Cullet (Grade E only)	55 g (2 ounces) total

4.4 **Method 202A - Mechanical Splitting**

4.4.1 Place the gross field sample in the hopper or pan. Distribute sample uniformly from edge to edge in the hopper to ensure equal amounts flow through each chute. Introduce the sample at a rate that allows free flow through the chutes into the receptacles below. Keep the presenting channel full to ensure even distribution into the chutes.

4.4.2 Reserve the portion of material collected in one receptacle (for each splitting) as the retained sample. Reintroduce the portion of the sample in the other receptacle into the splitter as many times as necessary to reduce the desired test sample quantity, each time .

4.5 Method 202B - Coning and Quartering

4.5.1 This method reduces the sample by one-half with each iteration.

4.5.2 Place the field sample on a dry, clean surface where material will not be lost and foreign material will not be introduced. Non-porous concrete surfaces are preferred.

4.5.3 Mix the material thoroughly by turning the entire sample over three times with equipment best suited to the quantity of material (power equipment, hand shovel, etc.)

4.5.4 Clean the equipment that will be used to handle the material.

4.5.5 If shoveling, form a conical pile by depositing each shovelful on top of the preceding one. Each quarter sector (or quadrant) of the resulting pile should contain its original material contents.

If using power equipment, shape the material into a round or square pile of uniform thickness. Each quarter sector (or quadrant) of the resulting pile should contain its original material contents.

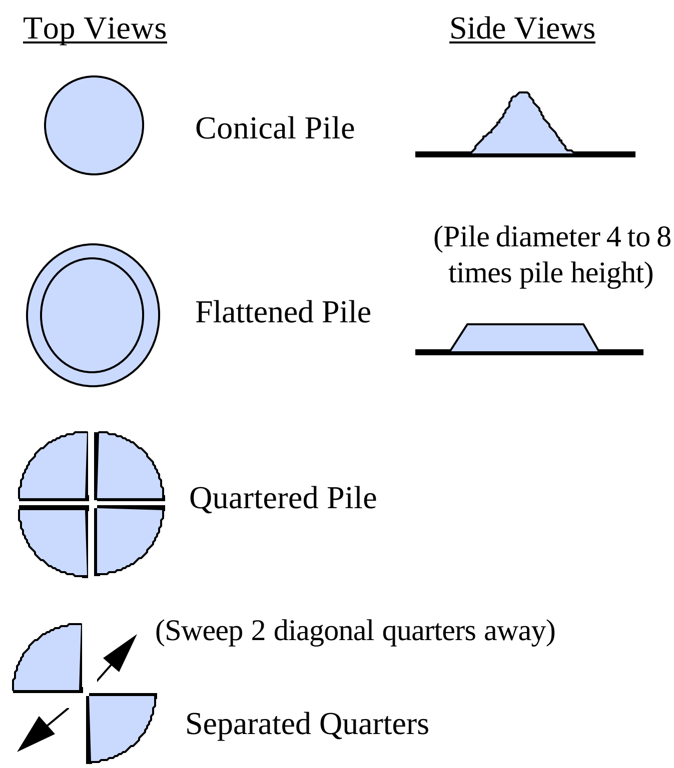
4.5.6 Flatten the conical pile to a uniform thickness and diameter. The diameter of the flattened pile should measure approximately four to eight times the height. Reference Figure 202-2.

4.5.7 Divide the flattened mass into four equal quarters per Figure 202-2. Remove two diagonally opposite quarters, including all fine material and retain. Brush the cleared spaces clean.

4.5.8 Successively mix the remaining two quarters to achieve homogeneity, and form another conical pile. Repeat the coning and quartering procedure until the desired test quantity is obtained. Combine all discarded material and store for future reference.

4.5.9 Record the number of iterations of coning and quartering. Record the final weight of the test sample.

Figure 202-2 Coning and Quartering



4.5.6 Record the number of iterations of coning and quartering. Record the final weight of the test sample.

4.6 Method 202C - Miniature Stockpile Sample Reduction.

4.6.1 Place the field sample of damp fine cullet on a clean polyester tarp or on a hard, clean surface where material cannot be lost and foreign material will not be introduced.

4.6.2 Mix the material thoroughly by turning the entire sample over several times with a hand shovel, or lifting the edges of the tarp and rolling the material around on the tarp. Ensure no material is lost. Use caution not to puncture the tarp (if used).

4.6.3 Shovel the entire sample into a conical pile by depositing each shovelful on top of the preceding one. Alternatively, hold the edges of the tarp upward to form a conical pile.

4.6.4 Flatten the conical pile to a uniform thickness and diameter by pressing down the apex with a shovel so that each quarter sector of the resulting pile contains the original material content.

4.6.5 Successively mix and quarter the remaining material as shown in Figure 202-2. Repeat the coning and quartering up to a maximum of four times. Record the number of iterations of coning and quartering. Combine all discarded material for future reference.

4.6.6 Using a small sample thief, small scoop, or spoon, compile one composite sample for each test by selecting at least five increments of material at different locations from the last iteration miniature stockpile.

4.7 Label samples.

4.7.1 Store and label the retained portion. Label with the date, gross field sample number, lot number and/or reference number from bill of lading.

4.7.2 Store and label test samples with the date, gross field sample number, lot number and/or reference number from bill of lading, a unique test sample number, sample weight, and number of reduction iterations (if applicable).

5.0 Calculations

Not applicable.

6.0 Report

6.1 Record the number of reduction iterations for each final reduced sample.

7.0 Reference Documents

7.1 ASTM C 702-87 Standard Practice for Reducing Field Samples of Aggregate to Testing Size
Note: This method has been adapted, in part, from ASTM C 702-87, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. This method has neither been approved nor endorsed by ASTM.

7.2 Method 202 *Obtain Glass Field Samples and Perform Initial Visual Inspection.*

Method 210 Determination of Glass Color Composition

1.0 Scope

1.1 This method describes how to measure the color composition of glass. This method applies to color-sorted glass only, in the form of bottles, or cullet that is plus 1.18 mm particle size.

1.2 This method does not apply to Grade C fine cullet of nominal particle size minus 1.18 mm (0.046 inch). This particle size distribution is not adequately separated through visual inspection. Thus, chemical analysis is required per ASTM C 169 - 92 *Standard Test Method for Chemical Analysis of Soda-Lime and Borosilicate Glass* (not described herein) or other procedures mutually agreeable to buyer and seller.

1.3 Color-sorting of glass shall fall into one of the following classifications:

- Flint
- Amber
- Green
- Mixed

1.4 These methods are intended for 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 contractural matter.

1.5 This method does not address safety problems, if any, associated with its use. The user is responsible for following appropriate safety and health practices. Handle bottles (whole and/or broken) with extreme caution.

2.0 Definitions

2.1 <u>Mixed color glass</u> - glass particles of color other than flint, amber or green.

2.2 <u>Nominal particle size</u> - the size opening that retains 10 weight percent of a representative sample of the cullet (and 90 weight percent of the cullet passing same screen size).

2.3 <u>Off-color glass</u> - glass particles of color other than the predominant color-sort being tested for.

3.0 Apparatus

3.1 Naturally daylighted inspection area, or inspection area with artificial light at a minimum of 2150 lux (200 ft-candle).

3.2 For bottles: calibrated scale of minimum capacity 20 kg (or 45 pounds) and readability to within 0.1 g (or 0.005 pounds).

3.3 For cullet: calibrated scale of minimum capacity 2500 g (or 6 pounds) and readability to within 0.01 g (0.0005 pounds).

3.4 Clean trays, free of dirt, oil, moisture, sample residue, etc. Glass, aluminum, or plastic trays are preferred for easy removal of the material from the tray.

3.5 U.S. Standard Series sieves of 12.5 mm (1/2 inch) for bottles (whole and/or broken), and 3.35 mm (No. 6) screen for cullet. Sieves must be frame-mounted, with top and bottom covers to prevent spillage and to collect fines.

4.0 Procedure

4.1 Obtain a test sample of the following weight from the reduced sample generated in Method 202 - *Reduce Glass Field Samples to Testing Sample Size*:

- Bottles and cullet with nominal particle size greater than 50 mm (~2 inches) — 18 $\pm$ 0.25 kg (40 $\pm$ 0.5 pounds)
- Cullet with nominal particle size less than 50 mm (~2 inches) — 2.2 $\pm$ 0.03 kg (5 $\pm$ 0.6 pounds).

4.2 Weigh the trays to the nearest 1.0 gram and record.

4.3 Prepare material for sieve.

4.3.1 Ensure sieve(s) are clean and dry before use. Inspect sieve(s) for wavy or torn wires and discard defective sieves. Wavy wires indicate improperly-stretched wire cloth, which will affect test results. Assemble sieve with bottom cover.

4.3.2 For cullet, place the entire test sample on a 3.35 mm (No. 6) mesh sieve.

4.3.3 For bottles, first remove all whole bottles and glass pieces larger than 8 cm (about 3”) in one dimension. Sort and place the bottles (and large pieces) on a different tray for the specific color classification and off-color designation per Table 201-1 and Section 4.6). Place the remaining (smaller size) material on a 12.5 mm (1/2 inch) mesh sieve.

4.3.4 Place top cover on sieve.

4.3.5 Shake sieve assembly briskly with a side-to-side motion until no material falls through.

4.3.5 Open the assembly avoiding spillage. The material remaining on the sieve will be color sorted.

4.3.6 Retain, store and label the material that passed the screen.

4.4 Spread the sample fraction retained on the top of the sieve on a clean dry surface illuminated to at least 2150 lux (200 ft-candle). Daylight is preferable but artificial illumination is acceptable. Separate the particles for better observation.

4.5 Sort the glass into various color classification(s) as described in Table 210-1. Place all glass of the predominant color being tested, on a separate tray. Place separated off-color sorted material on preweighed trays for each color classification. For bottles, combine the sieved portion (remaining on the sieve), with the whole bottles and larger pieces of glass already placed on separate trays.

4.6.1 For mixed glass, the only off-color category is amber.

4.6.2 Sort blue and light blue shades contain cobalt or chrome as green. However, if there is a significant amount of blue glass, sort and categorize the blue glass as “other”.

4.6.3 Sort "wine cooler" and "Georgia cola" light green shades as green.

4.6.4 Sort "dead leaf" green or slight yellow shades as amber.

4.6.5 Sort all other opaque or deep colored container glasses such as white, opals, blacks, reds or blues as other.

Table 210-1 Sorting Off-Color Glass for Specific Color Classifications.

Predominant Color Classification	Sort Out as an Off-Color Category?				
	Flint	Amber	Green	Mixed	Other
Flint		Yes	Yes	No	Yes
Amber	Yes		Yes	Yes	Yes
Green	Yes	Yes		No	Yes
Mixed	Yes	Yes	Yes		Yes

4.7 Weigh the sorted material on each tray as follows:

For bottles, weigh to $\pm$ 0.1 g ($\pm$ 0.005 pounds) precision.

For cullet, weigh to $\pm$ 0.01 g ($\pm$ 0.0005 pounds) precision.

4.8 Record the weight of the predominant color being tested as W_P.

4.9 For all applicable off-color glass (excluding predominant test color), record the weight(s) as:

W_A for amber.
W_G for green.
W_F for flint.
W_M for mixed.
W_O for other (if significant amount found per step 4.6.5).

Note: Depending on the predominant test color, some off-color categories may not exist.

4.9 If desired, the glass color composition results may be useful in specifying glass grade per Attachment 200-1 *Specifications For Grades of Recycled Glass*

5.0 Calculations

5.1 Weight of off-color glass (W_{OFF}):

$$W_{OFF} = W_A + W_G + W_F + W_M$$

5.2 Percent weight of predominant color glass:

$$\% W_P = W_P / (W_P + W_{OFF}) \times 100$$

5.3 Percent weight of total off-color glass ($\%W_{OFF}$):

$$\%W_{OFF} = W_{OFF} / (W_P + W_{OFF}) \times 100$$

5.4 Percent weight of each off-color glass (as applicable):

$$\%W_A = W_A / (W_P + W_{OFF}) \times 100$$

$\%W_G = W_G / (W_P + W_{OFF}) \times 100$

$\%W_F = W_F / (W_P + W_{OFF}) \times 100$

$\%W_M = W_M / (W_P + W_{OFF}) \times 100$

$\%W_O = W_O / (W_P + W_{OFF}) \times 100$

6.0 Report

6.1 Report the weight percent of the predominant color being tested.

6.2 Report the weight percents of the various off-color glass.

7.0 Reference Documents

7.1 ASTM E 688 - 94 *Standard Test Methods for Waste Glass as a Raw Material for Glass Manufacturing*.

ASTM C 169 - 92 *Standard Test Method for Chemical Analysis of Soda-Lime and Borosilicate Glass.*
Note: This method has been adapted, in part, from ASTM E 688-94 and ASTM C 169-92, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. This method has neither been approved nor endorsed by ASTM.

7.2 Attachment 200-1 Specifications For Grades of Recycled Glass.

7.3 Method 202 *Reduce Glass Field Samples to Testing Sample Size*.

Method 212 Determination of Moisture Content for Glass Cullet

1.0 Scope

1.1 This method describes how to measure moisture content of glass cullet.

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 contractural 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

Constant weight. - the weight at which less than 1.0 gram additional weight loss would occur with additional heating or drying.

3.0 Apparatus

3.1 Calibrated scale or balance with minimum capacity of 2500 g and readability to 0.1 g. Record the scale range, readability, and calibration date on the log sheet.

Note: If a sample larger than 2.2 kg (5 pounds) is tested for use in subsequent tests, use a calibrated scale with minimum capacity of 5000 g and readability to 0.1 g.

3.2 Circulating air oven capable of maintaining internal temperature at 110 ± 5 °C (230 ± 9 °F).

3.3 Sample drying tray (oven-proof) and of such shape that the depth of sample will not exceed one fifth of the least lateral dimension.

4.0 Procedure

4.1 Obtain a 2.2 kg (5 pounds) test sample per Method 202 - *Reduce Glass Field Samples to Testing Sample Size*. Weigh the test sample to the nearest 0.1 gram and record the weight as W_O.

Note: If testing for particle size distribution will follow, the dried material from this method may be used in Method 214 - *Determination of Particle Size Distribution for Glass Cullet*. However, a sample size of 4.450 grams (10 pounds) is required for Method 214. In this case, a larger sample than 2.2 kg (5 pounds) can be dried during Method 212 - *Determination of Moisture Content for Glass Cullet*.

4.2 Weigh the tray to the nearest 0.1 gram and record the weight W_T.

4.3 Spread the sample on the clean drying tray so that the depth of sample is less than one-fifth of the least lateral dimension. Place the tray and sample in the oven for 2 hours at 110 °C ± 5 °C (230 ± 9 °F), or until constant weight is reached.

4.4 After the sample has cooled, weigh the dried sample to the nearest 0.1 gram and record the weight as W_{DRY}.

5.0 Calculations

5.1 Total moisture content (%MC):

$$\% MC = (W_O - W_{DRY}) / (W_{DRY}) \times 100.$$

6.0 Report

6.1 Report percent moisture.

7.0 Referenced Documents

7.1 ASTM E 688 -94 *Waste Glass as a Raw Material for Manufacture of Containers*

7.2 ASTM C 566 *Standard Test Method for Total Moisture Content of Aggregate by Drying*
Note: This method has been adapted, in part, from both ASTM E 688-94 and ASTM C 566, copyright American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187. This procedures has neither been approved nor endorsed by ASTM.

7.2 Method 202 Reduce Glass Field Samples to Testing Sample Size.

Method 214 Determination of Particle Size Distribution for Glass Cullet

1.0 Scope

1.1 This method describes how to measure the particle size distribution of glass cullet. This method applies to glass in the form of cullet.

1.2 These methods are intended for 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 contractural 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 Sieves (U.S. Standard Series) as designated in Table 214-1. Sieves must be frame-mounted, with top and bottom covers to prevent spillage and to collect fines.

3.2 Accessories for cleaning sieves such as brush, vacuum cleaner, air hose.

3.3 Calibrated scale with minimimum capacity of 5000 g and readability to 0.1 g. Record the scale range, readability, and calibration date on the log sheet.

3.4 Circulating air oven capable of maintaining internal temperature at 110 ± 5 °C (230 ± 9 °F).

4.0 Procedure

4.1 Select a sieve that is one size above the largest particle size present in the test sample. This sieve will provide the value of 100% passing which defines the upper bound particle size distribution.

4.2 In addition to the 100% passing sieve, select at least two sieve sizes from Table 214-1, that will adequately measure the particle size distribution of the cullet. If greater definition of size distribution is needed, select additional intervening sieve sizes. For Grade F cullet (Open Specification), select two sieve sizes based on the form and particle size of the material.

Table 214-1 Sieve Screen Size Selection

Screen Size	Cullet Grade (per Attachment 200-1)	End Use Product
50 mm (2")	A, B	Container
19 mm (3/4")	A, B, E	Container or Construction Aggregate
10 mm (3/8")	A, B	Container
6 mm (1/4")	C, D	Fiberglass
No. 12	C, D	Fiberglass
No. 140	A	Container
No. 200	C, D, E	Fiberglass or Construction Aggregate

4.3 Obtain a 4.5 kg (~10 pound), oven-dried sample. If a large enough sample was previously dried in Method 212 - *Determination of Moisture Content for Glass Cullet*, that material may be used directly for the remainder of this test. Otherwise, obtain a new sample per Method 202 - *Reduce Glass Field Samples to Testing Sample Size*. Dry the test sample at 110 °C to constant weight per Method 212.

4.4 Weigh the dried test sample to the nearest 0.1 g. Record this weight as W.

4.5 Inspect sieves for wavy or torn wires and discard defective sieves. Wavy wires indicate improperly-stretched wire cloth, which will affect test results. Clean sieves with brush, vacuum cleaner, air hose as necessary.

4.6 Place the test sample in the sieve assembly and install top and bottom covers.

4.7 Shake the sieve mechanically or by hand with side to side motion until no material falls through.

4.8 Carefully open the assembly avoiding spillage.

4.9 Weigh the material remaining on the top sieve to the nearest 0.1 g. Record weight as W1.

4.10 Weigh the material between the intermediate screens to the nearest 0.1 g. Record weight as W2, W3, W4, etc. depending on the number of intermediate screens used.

4.11 Weigh the material passing through the smallest screen (the material retained in the bottom cover) to the nearest 0.1 g. Record weight as W_B.

5.0 Calculations

5.1 Weight percent retained by largest screen (%W1):

$$\%W1 = (W1 / W) \times 100.$$

5.2 Weight percent retained between screens (%W2, %W3, %W4, etc.):

$$\%Wn = (Wn / W) \times 100 \qquad \text{where } n = 2, 3, 4, \text{etc.}$$

5.3 Weight percent passing bottom screen ($\%W_B$):

$$\%W_B = (W_B / W) \times 100.$$

6.0 Report

6.1 The upper bound particle size distribution at which 100 percent of particles pass.

6.2 Weight percent of each particle size.

7.0 Reference Documents

7.1 ASTM E 688 - 94 *Standard Test Methods for Waste Glass as a Raw Material for Glass Manufacturing*

Note: This method has been adapted, in part, from ASTM E 688-94, 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.

7.2 Method 202 *Reduce Glass Field Samples to Testing Sample Size*

Method 220 Determination of Organic, Ferrous, and Inorganic Contamination of Glass (Excluding Grade E - Construction Aggregate)

1.0 Scope

1.1 This method describes the measurement of the following types of contaminat ion in all grades of glass except Grade E cullet.

- Organic materials.
- Ferrous metals.
- Non-ferrous metals
- Ceramics, and other inorganic materials.

1.2 These methods are intended for 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 contractural 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

2.1 <u>Constant weight</u> - occurs when less than 1.0 gram additional loss would occur from additional heating.

2.2 <u>Ferrous metals</u> - iron and steel, which are magnetic metals. Ferrous contaminants include many beverage container lids, as well as other metals that may enter the recoverd glass stream.

2.3 <u>Inorganic contaminants</u> - types of glass other than soda-lime silica food or beverage-containers, and other non-glass contaminants. Examples include: ceramics, Pyrex®, china, mugs, porcelain, electric lamp bulbs and tubes, window glass, mirrors, ovenware, lead crystal, art glass, rocks, concrete, pottery, and refractory.

2.4 <u>Nominal particle size</u> - the size opening that retains 10 weight percent of a representative sample of the cullet (and 90 weight percent of the cullet passing same screen size).

2.5 <u>Non-ferrous metals</u> - aluminum, lead, brass, stainless steel and other non-magnetic metals. Non-ferrous metal contaminants may include neck wraps, foil or metallic labels, or other non-metallic metal scrap that may enter the recoverd glass stream.

2.6 <u>Organic contaminants</u> - paper labels, bags, plastic closures, food residue, cork, wood debris, plants, and other combustibles or degradable material.

3.0 Apparatus

3.1 For organic contamination: a calibrated scale with minimum capacity of 500 g and readability to 0.001 g. Record the scale range, readability, and calibration date on the log sheet.

For ferrous contamination: a calibrated scale with minimum capacity of 5000 g and readability to 0.1 g. Record the scale range, readability, and calibration date on the log sheet.

For inorganic and non-ferrous contamination: a calibrated scale with minimum capacity of 20 kg and readability to 1.0 g. Record the scale range, readability, and calibration date on the log sheet.

3.2 Horseshoe magnet (or equivalent) with 20 pounds (about 9 kg) lift strength.

3.3 Clean, dry inspection surface with lighting source of at least 2150 lux (200 ft-candle).

3.4 Circulating air oven capable of maintaining the temperatures at 110 ± 5 °C (230 ± 9 °F).

3.5 Large crucible of porcelain or other ceramic material.

3.6 Furnace with temperature capacity of 540 degrees C (1000 degrees F).

3.7 Magnifier with 5X power.

3.8 U.S. Standard series sieves: 6.3 mm. (1/4 inch), and 1.70 mm (No. 12). Sieves must be frame-mounted, with top and bottom covers.

3.9 Accessories for cleaning sieves such as brush, vacuum cleaner, air hose.

3.10 Glass crushing equipment (Only required for samples of whole and semi-broken bottles).

4.0 Procedure

4.1 Obtain separate test samples of the following weights for the required tests by following Method 202 - *Reduce Glass Field Samples to Testing Sample Size.* Oven-dried material at constant weight is required for all three tests.

Testing For:	Test Sample Weight	
• Organic contamination for whole and semi-broken bottles)	4.5 ± 0.1 kg	(10 ± 0.25 pounds)
• Organic contamination (cullet)	454 ± 0.01 g	(1.0 ± 0.0005 pounds)
• Ferrous metal contamination -	4.5 ± 0.1 kg	(10 ± 0.25 pounds)
• Inorganic and non-ferrous contamination	18 ± 0.25 kg	(40 ± 0.5 pounds)

4.2 Test for organic contamination.

4.2.1 For bottles and semi-broken bottles only, crush the 4.5 kg (10 pound) sample down to a nominal particle size of about 12.5 mm (0.5 inch) in a glass crusher. Reduce the sample to 454 g (1 pound) per Method 202 - *Reduce Glass Field Samples to Testing Sample Size*.

4.2.2 Dry the 454 g (1 pound) test sample (cullet, or crushed bottles from step 4.2.1) to constant weight as described in Section 4.0 of Method 212 - *Determination of Moisture Content for Glass Cullet*. If a large enough sample of cullet was previously dried in Method 212, that sample may be used directly in this test.

4.2.3 Weigh the test sample to 0.001 g. Record the weight as W1.

4.2.4 Weigh the ceramic crucible to 0.001 g. Record the weight as W_C.

4.2.5 Place the test sample in the crucible, uncovered, and heat to 540 °C (1000 °F). Maintain this temperature until all flame and smoke have ceased (usually a minimum of 30 minutes). Avoid higher temperatures to prevent fusing of glass particles.

4.2.6 Allow the sample to cool. Weigh the crucible and material to 0.001 g. Subtract the weight of the crucible (W_C) and record the net weight of the residual as W_{ORG}.

4.3 Test for ferrous metal contamination:

4.3.1 For bottles and semi-broken bottles only, crush 4.5 kg (10 pound) test sample down to a nominal particle size between 12.5 mm (0.5 inch) and 25 mm (1 inch) in a glass crusher.

4.3.2 Dry the 4.5 kg (10 pound) test sample to constant weight as described in Section 4.0 of Method 212 - *Determination of Moisture Content for Glass Cullet*. If a large enough sample was previously dried in Method 212, and the sample has not been used in testing for organic contaminants, that sample material may be used directly in this test.

4.3.3 Weigh the oven-dried test sample to the nearest 0.1 g. Record the net weight as W2.

4.3.4 Spread the test sample on a clean dry surface.

4.3.5 Hold a clean sheet of paper between the magnet and the sample. Pass the magnet slowly over the test sample. Hold the paper and magnet above a weighing container, then lift the magnet from the paper, transferring the magnetic materials into the container. Continue this process until all the sample has been exposed to the covered magnet.

4.3.6 Weigh the ferrous metal in the container to the nearest 0.1 g and subtract the weight of the container. Record the net weight of the ferrous metal as W_{FER}.

4.4 Test for non-ferrous and inorganic contamination.

4.4.1 For bottles and semi-broken bottles only, crush the 18 kg (40 pound) test sample down to a nominal particle size of 6.3 mm (0.25 inch) in a glass crusher.

4.4.2 Dry the test sample to constant weight as described in Section 4.0 of Method 212 - *Determination of Moisture Content for Glass Cullet*.

4.4.3 Weigh the test sample to the nearest 1 g. Record the net weight as W3.

4.4.4 Inspect sieves for wavy or torn wires and discard defective sieves. Wavy wires indicate improperly-stretched wire cloth, which will affect test results.

4.4.5 Clean sieves with brush, vacuum cleaner, air hose as necessary.

4.4.6 Place the test sample in the sieve assembly of 6.3 mm. (1/4 inch) and 1.70 mm (No. 12) sieves. Install the top and bottom covers.

4.4.7 Shake the sieve mechanically or by hand with side to side motion until no material falls through.

4.4.8 Open the assembly avoiding spillage. Discard the minus No. 12 screen material, as it is assumed to have the same distribution of contamination as in the larger fraction of the test sample.

4.4.9 Weigh the 6.3 mm (1/4 inch) plus material to the nearest 0.1 g. Record the net weight as W4.

4.4.10 Spread the 6.3 mm (1/4 inch) plus material on a clean dry surface illuminated to at least 2150 lux (200 ft-candle). Daylight is preferable but artificial illumination is acceptable. Spread particles out to a thickness that is less than three times the maximum particle size or less than 1.25 cm (~1/2 inch), whichever is less.

4.4.11 Sort out the non-ferrous metals and/or inorganic (including ceramics) particles from the 6.3 mm (1/4 inch) plus material. Weigh the non-ferrous metal and inorganic particles together. Record the net weight as W_{IN1}.

4.4.12 Weigh the plus 1.70 mm (No. 12) to minus 6.3 mm (1/4 inch) material to the nearest 0.1 g. Record the net weight as W5.

4.4.13 Spread the plus 1.70 mm (No. 12) material (and minus 6.3 mm (1/4 inch)) on a clean dry surface illuminated to at least 2150 lux (200 ft-candle). Daylight is preferable but artificial illumination is acceptable. Spread particles out to a thickness that is less than three times the maximum particle size or less than 12.5 mm (~1/2 inch), whichever is less.

4.4.14 Using 5X magnification, sort out the non-ferrous metals and/or inorganic (including ceramics) particles from the 6.3 mm (1/4 inch) plus material. Weigh the non-ferrous metal and inorganic particles together. Record the net weight as W_{IN2}.

5.0 Calculations

5.1 Percent weight organics as follows ($\%W_{ORG}$):

$$\%W_{ORG} = 100 - \{ (W_{ORG}) / (W1) \times 100\}.$$

5.2 Percent weight ferrous metals ($\%W_{FER}$):

$$\%W_{FER} = (W_{FER}) / (W2) \times 100$$

5.3 Percent weight non-ferrous and inorganics of 6.3 mm (1/4 inch) plus material ($\%W_{IN1}$):

$$\%W_{IN1} = (W_{IN1}) / (W4) \times 100$$

5.4 Percent weight non-ferrous and inorganics of plus 170 mm (No. 12) but minus 6.3 mm (1/4 inch) material ($\%W_{IN2}$):

$$\%W_{IN2} = (W_{IN2}) / (W5) \times 100$$

5.5 Average percent weight of non-ferrous and inorganics ($\%W_{INORG}$):

$$\%W_{INORG} = (\%W_{IN1} + \%W_{IN2}) / 2$$

6.0 Report

6.1 Weight percent organic contamination.

6.2 Weight percent ferrous metal contamination.

6.3 Weight percent of non-ferrous and inorganic material of 6.3 mm (1/4 inch) plus particle size.

6.4 Weight percent of non-ferrous and inorganic material of plus 1.70 mm (No. 12) but minus 6.3 mm (1/4 inch) particle size.

6.5 Average weight percent of non-ferrous and inorganic material.

7.0 Reference Documents

7.1 ASTM E 688-94 *Waste Glass as a Raw Material for Manufacture of Glass Containers.*
Note: This method has been adapted, in part, from ASTM E 688-94, 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.

7.2 Method 202 *Reduce Glass Field Samples to Testing Sample Size.*

Method 222 Determination of Lead and Debris Contamination in Glass Cullet for Use in Construction Aggregate

1.0 Scope

1.1 This method describes how to measure lead and debris content in cullet for use in construction aggregate. Grade E cullet is defined in Attachment 200-1 as 100 weight percent at minus 19 mm (3/4 inch) screen with no more than 5 weight percent passing a No. 200 screen.

1.2 Debris level is determined by two-dimensional, visual estimation based on comparison to charts developed by the American Geological Institute (AGI) for estimating percentage composition of various mineral aggregates.

1.3 Lead content is determined by inductively coupled plasma-atomic emission spectroscopy per the Environmental Protection Agency (EPA) Methods:

3050 *Acid Digestion of Sediments, Sludges, and Soils.*
6010 *Inductively Coupled Plasma-Atomic Emission Spectroscopy.*

1.4 These methods are intended for 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 other than the acceptable total lead content. The methods do not intend to guide the disposition of material that is found to be off-specification by sampling and inspection. Disposition is a contractural matter.

1.5 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 Debris - any non-glass material, and any glass that is not originating from a beverage container, which may impact the performance of engineered fill. This includes but is not limited to: labels (paper, aluminum or tin foil, and plastic), neck wraps, caps and cap fragments (metal and plastic), and organic contents (corks, food residue, etc.).

2.2 Total lead content- the concentration of lead (a heavy metal) in construction cullet as measured by EPA Methods 3050 and 6010.

3.0 Apparatus

For Debris Testing:

3.1 Pan or tray with a lip, and of surface area between 325 and 500 square centimeters (approximately 50 to 75 square inches). A round or rectangular shaped pan is acceptable.

3.2 Thin gloves (cloth or rubber).

3.3 For debris testing: a calibrated scale with minimum capacity of 1000 g (~2 pounds) and readability to 10 g (0.1 pounds).

3.4 Data sheets 23.1 and 23.2, "Comparison Chart for Estimating Percentage Composition" from the American Geological Institute (AGI) (or equivalent).

For lead testing:

3.5 A calibrated scale with minimum capacity of 100 g and readability to 0.1 g.

4.0 Procedure

4.1 Estimate debris level. Note that this two-dimensional visual inspection will generally produce a higher percent debris level than the level measured physically by weight or volume, due to the platy nature of recycled glass.

4.1.1 Obtain one test sample (reduced from field sample) for every 39 cubic meters (50 cubic yards) of material in the lot. Each test sample should weigh approximately the same as the other samples, and contain enough mass to cover the entire surface area of the pan or tray in one layer. The recommended weight of the sample(s) is between 450 g and 900 g (approximately 1 to 2 pounds) each. Weigh each sample and record weight for reference information only.

4.1.2 One at a time, spread the test sample(s) evenly in the pan or tray so the entire surface area of the pan or tray is covered in one layer.

4.1.3 Look straight down at the spread sample to view the sample from a two-dimensional perspective. Place the AGI data sheets 23.1 and 23.2, "*Comparison Chart for Estimating Percentage Composition*" (or equivalent), next to the pan for comparison. Visually estimate the percent of debris by surface area of the test sample by comparing the amount of debris seen in the sample to the pictorals on the AGI data sheets. Record the percent debris for each sample.

4.2 Prepare samples for total lead content test.

4.2.1 Obtain five laboratory test samples (reduced from the field sample) of approximately 10 g each per Method 202 - *Reduce Glass Field Samples to Testing Sample Size.*

4.2.2 Label and seal the five samples and send to accredited lab for testing of total lead content. If in-house equipment and certified staff are available, follow EPA Method 3050 - *Acid Digestion of Sediments, Sludges, and Soils* and EPA Method 6010 - *Inductively Coupled Plasma-Atomic Emission Spectroscopy* to determine the total lead content of five (5) distinct samples.

4.2.3 Record total lead content of all five samples the relative percent difference between replicate determinations.

5.0 Calculations

5.1 For debris testing: calculate the average percent debris of all five samples.

5.1 For lead testing: calculate the average total lead content (PB_{AVG}) of all five samples.

6.0 Report

6.1 Report the average percent debris and the number of samples tested.

6.2 Report the average total lead content and the relative percent difference between replicate determinations.

7.0 Reference Documents

7.1 Method 201 *Obtain Glass Field Samples and Perform Initial Visual Inspection*.

7.2 Method 202 *Reduce Glass Field Samples to Testing Sample Size*.

7.3 Method 210 *Determination of Moisture Content for Glass Cullet*.

7.4 EPA Method 3050 *Acid Digestion of Sediments, Sludges, and Soils*.

7.5 EPA Method 6010 *Inductively Coupled Plasma - Atomic Emission Spectroscopy*.

7.6 AGI 23.1 and 23.2 *Comparison Chart for Estimating Percentage Composition - Data Sheets*.

Appendix for:

Methods for Sampling and Testing Recycled Glass

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Logsheet for Method 201: Field Samples and Perform Initial Visual Inspection

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Grade (per Attachment 200-1) or Material Description:	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Field Sampling Method	**Sampling Locations Within Sample Unit or Area:**

<u>Notes from Field Sample Collection and Initial Visual Inspection</u>

Container damage: ____________________________

Visible moisture/drainage: ____________________________

Visible debris in lot: ____________________________

Prohibited material: ____________________________

Flowability (cullet only): ____________________________

Fluctuation or unevenness in flow, or cyclic behavior in volume: ____________________________

Obvious bulk inhomogeniety (color or particle size distribution): ____________________________

Large contamination pieces (greater than 50 mm (2 inches)): ____________________________

Test(s) to be conducted on sample: ____________________________

Total field sample weight (WF) required: ____________________________

Sampling implement (thief, shovel, power equipment, etc.): ____________________________

Weight of sample from one draw of sampling implement (WT): ____________________________

Total number of samples to draw *(n)* with sampling implement: ____________________________

Sampling pattern and/or sampling locations: ____________________________

Logsheet for Method 202: Reducing Field Samples to Test Sample Weights

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Grade (per Attachment 200-1) or Material Description:	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Field Sampling Method	**Reducing Method (Circle One):** Mechanical Split Coning/Quartering Miniature Stockpile

Notes from Field Sample Reduction

Equipment used to reduce sample: ______________________________

Make and Model of riffler/splitter (if used): ______________________________

Obvious bulk inhomogeniety (color or particle size distribution): ______________________________

Number of test sample(s) needed: on sample (circle one):	1	2	3	4	5	6	7
Name of test(s):							
Individual required weights of reduced sample for each test:							
Number of reduction iterations:							

Additional Observations: ______________________________

Logsheet for Method 210   Determination of Glass Color

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Grade (per Attachment 200-1) or Material Description:	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Field Sampling Method	**Reducing Method (Circle One):** Mechanical Split Coning/Quartering Miniature Stockpile

<u>Notes from Conducting Test:</u>

Scale model, accuracy, and calibration date: ______________________________

Bottles or Cullet? Average particle size: ______________________________

Color Classifications: Identify predominant color with *	Flint	Amber	Green	Mixed	Off-Color
Weights					
Weight Percents					

Additional Observations: ______________________________

____

____

____

Logsheet for Method 212   Determination of Moisture

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Grade (per Attachment 200-1) or Material Description:	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Field Sampling Method	**Reducing Method (Circle One):** Mechanical Split Coning/Quartering Miniature Stockpile

Notes from Conducting Test:

Scale model, accuracy, and calibration date: ____________________

Estimated average particle size of cullet: ____________________

Flowability (non-caking? free-flowing?) ____________________

Net weight of undried test sample: (W_O): ____________________

Oven temperature: ____________________

Net weight of oven-dried test sample: (W_{DRY}): ____________________

Total moisture content (% MC):
(% MC = $(W_O - W_{DRY}) / (W_{DRY}) \times 100$) ____________________

____

Additional Observations: ____________________

____

____

____

Logsheet for Method 214 Determination of Particle Size Distribution for Glass Cullet

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Grade (per Attachment 200-1) or Material Description:	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Field Sampling Method	**Reducing Method (Circle One):** Mechanical Split Coning/Quartering Miniature Stockpile

Notes from Conducting Test:

Scale model, accuracy, and calibration date: ____________________

Net weight of oven-dried test sample: (W): ____________________

Results of sieve condition inspection: ____________________

Sieve size for 100% passing: ____________________

Additional sieve sizes chosen (list all):	1)	2)	3)	4)	Bottom
Weight of material retained on each sieve ($W1$, $W2$, $W3$, ... and W_B):					
Percent weight of material retained on sieves ($W1$, $W2$, $W3$, ... and W_B):					

Additional Observations: ____________________

Logsheet for Method 220 Determination of Contamination of Glass (Excluding Construction Aggregate)

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Grade (per Attachment 200-1) or Material Description:	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Field Sampling Method	**Reducing Method (Circle One):** Mechanical Split Coning/Quartering Miniature Stockpile

Notes from Conducting Test:

Scale model, accuracy, and calibration date: ______________________________

Bottles or Cullet? Aaverage particle size of test sample: ______________________________

Results of inspection of seive condition: ______________________________

Contaminant Category	Organic	Ferrous	Inorganic	
Net weight of oven-dried sample:	(W1)	(W2)	(W3)	
Net weight of plus 1.70 mm (No. 12) to minus 6.3 mm (1/4 inch):			(W4)	
Net weight of plus 6.3 mm (1/4 inch):			(W5)	
Weight of crucible:	(W_C)			
Temperature and time of incineration:				
Net weight of contaminant:	(W_{ORG})	(W_{FER})	(W_{IN1})	(W_{IN2})
Percent weight of contaminant:	(W_{ORG})	(W_{FER})	(W_{IN1})	(W_{IN2})
Average percent weight of inorganic contamination:			(W_{IN1})	(W_{IN2})

Additional Observations: ______________________________

Logsheet for Method 222 Determination of Contamination of Glass Cullet for Use in Construction Aggregate

Field Sample / Test Sample Log	**Sample ID:**
Performed By:	**Lot ID**
Date:	**Source:**
Field Sampling Method	**Circle One:** Stockpile Bunker Bulk Containers Stream/Conveyor Transportation Unit
Reducing Method (Circle One): Mechanical Split Coning/Quartering Miniature Stockpile	

<u>Notes from Conducting Test:</u>

Scale model, accuracy, and calibration date: ______________________________

Debris Test:

	1	2	3	4	5	6	7
Net weight of test sampe(s):							
Approximate depth of layer in pan:							
Estimated % debris by visual examination:							

Lead Test:

Name, location, and contact of accredited laboratory performing the test (if applicable): ______________________________

Unique Identification number for each sample:	1	2	3	4	5
Net weight of each sample:					
Total lead content determined by test:					
Net weight of each sample:					

Additional Observations: ______________________________