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Evaluation of Size Sorting Potential for Articles with at least 2 Dimensions Less than 2 Inches

Introduction – Scope, significance and use – This test is one in the series of "Sorting Potential Test Methods" developed by the Association of Plastics Recyclers.

The sorting potential test methods describe laboratory-scale representations of the most commonly used collection and Material Recovery Facility (MRF) processes for handling single-stream post consumer recyclables. The test methods assume that these co-mingled recyclables are collected curbside, compacted in a typical recycling collection truck, transported to and processed through an automated MRF into bales of similar plastics, then further processed at the plastics reclaimer in their original form before being reduced in size.

These tests do not consider the plastics recycling process starting from or after size reduction at the plastics reclaimer. Nor do they represent other processes that may use different methods of collection and separation with different results. Furthermore, plastic sorting processes have some degree of variability in commercial practice. It is not the intent of this protocol to model every possible process outcome but to choose a common set of parameters widely employed and which fall squarely within those used in industry.

The sorting potential tests are intended to identify specific design features that may cause an entire package to be lost in the recycling process. The consequences of a plastic article being mis-sorted prior to size reduction are more significant than in processes that follow size reduction, since the entire package is lost to the plastics recycling stream rather than a mere component of the package. The modeling of sorting behavior in this test enables design engineers to focus their improvement efforts and is designed to complement the wide range of tests offered by APR that form the foundation of APR's Design Guidance for plastic package recyclability.

One of the first steps in the MRF process is glass removal. This is accomplished by impacting the entire mixed material stream with solid objects. The material then passes over a screen where the broken glass falls through the openings. Items that pass through the screen are processed through the glass system and lost to other material recovery systems. The material retained on the screen proceeds through the rest of the material recovery process. This sorting potential test method simulates the screening process.

The size of the glass screen openings differ between machine manufacturers. The screen openings used in this test method are an average of the four most common manufacturers and therefore, represent the average screen throughout the industry. It is important to note that screens in MRF's are inundated with material that will support some smaller items that by all rights, should have fallen through the holes. This inefficiency should not be interpreted to mean that the item will be recovered since most plastics recyclers employ similar screens to remove small items heavily laden with contaminates.

This specific size sorting potential test method provides a means of evaluating whether a plastic article will correctly pass over a lab scale average sized glass screen that performs similarly to that used in production facilities. Good results in this screening test indicate that a plastic article has the potential to be sorted well in production conditions. Poor results indicate that an improvement in plastic product design is desirable to promote recovery.

Hazards and safety statement: This test method involves handling, lifting and carrying plastic items.

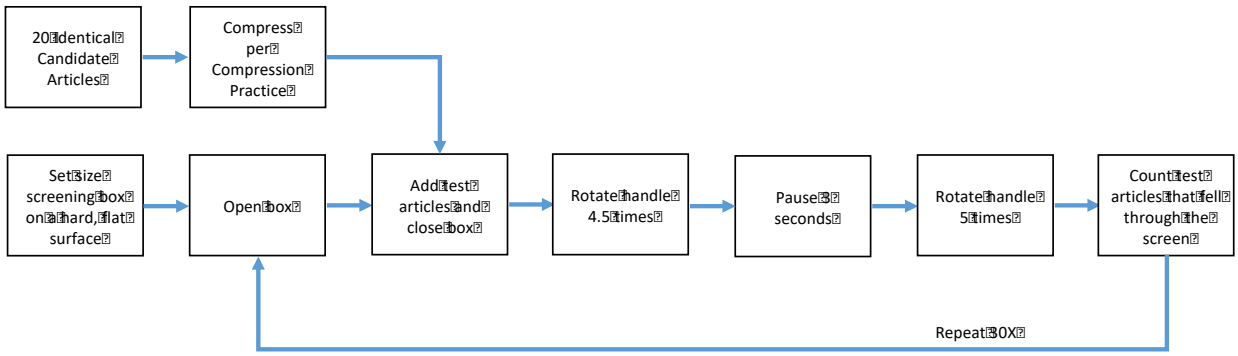
Reference Documents:

- Compression Practice
https://plasticsrecycling.org/images/pdf/design-guide/test-methods/Compression_Practice_for_Sorting.pdf

- APR Candidate Laboratories for Testing
https://plasticsrecycling.org/images/pdf/design-guide/Resources/Candidate_Test_Labs.pdf

Test/Method Summary and Flow Diagram

The flow diagram below outlines the test process. 20 test articles are compressed using the APR compression device, then placed into the screening box. The operator then rotates the box handle 5 times, pauses, then another 5 times. He then counts the articles that fell through the screen. This is repeated 30 times with the same test articles to establish repeatable results.



Equipment required:

- Bottle compression device built per the instructions found at https://plasticsrecycling.org/images/pdf/design-guide/test-methods/Compression_Practice_for_Sorting.pdf
- Size screening box built per the instructions found in annex 1.

Materials and reagents required:

20 identical candidate test articles provided by the test applicant. These articles should be fully decorated ie with label, closures, etc as if they were placed in a curbside bin after consumer use. Note that these articles are empty, whereas some residual product may remain in the articles found in the actual recycling stream.

Method/Practice steps.

1. Take pictures of all articles for submission including:

    a. One candidate test article before compression
    b. All candidate test articles after compression (one collective picture)

2. Obtain 20 empty candidate articles complete with all closures attachments and labeling.

3. Compress the candidate articles according to the APR compression practice found at http://plasticsrecycling.org/images/pdf/design-guide/Compression_Practice_Lab_Testing.pdf

1. Place the size screening box, constructed per the instructions found in annex 1, on a solid flat surface.

2. Open the screen and place the test articles inside

3. Close and latch the screen.

4. Rotate the box handle at the approximate rate of one turn per 1 ¼ seconds, 4 ½ turns (stopping so that the screen faces downward)

5. Pause 3 seconds

6. Rotate the box handle at the same rate, 5 turns, stopping so the screen faces downward.

7. Count the test articles that fell from the screen and record the number.

8. Return to step 5 and repeat 29 more times for a total of 30 iterations.

Measurements: For each iteration, record the count of the test articles falling through the screen.

Report Form: Found in Annex 2

Assessment:
If the average % of items remaining inside the size screening box is:

>= 90%: The candidate article is most likely to be sorted correctly through the glass screening process and the APR Design Guidance category for the design feature of "size sorting potential" is preferred

>= 51% and <90%: A high percentage of the test articles will be lost during size sorting but most will likely move correctly with the other materials . The APR Design Guidance category for the design feature " size sorting potential" is detrimental

Capture rate % is < 51%: The candidate article will most likely be lost during size sorting and therefore the APR Design Guidance category for the design feature " optical sorting potential" is renders the package unrecyclable per the APR definition of recyclability.

Annex 1: Rotating Screened Box Construction:

Materials required

Reference	QTY	Description
1	1	4' x 8' x 3/4" (23/32) B-C or better plywood
2	1	1" x 8" x 8' clear pine or fir lumber
3	1 lb	1 5/8" coarse thread drywall screws
4	2	Door hinges (3 1/2" shown in example)
5	1	2" x 3" x 8' Framing grade lumber
6	24	#10 x 5/8" flat head wood screws
7	2	galvanized floor flange for 1/2" pipe
8	2	1/2" x 3" galvanized nipple
9	1	1/2" x 6" galvanized nipple
10	1	1/2" x 4 1/2" galvanized nipple
11	2	1/2" galvanized cap
12	1	safety latchpost hasp (3 1/2" shown)
13	2	1/2" galvanized elbow, 90 degrees
14	2	3/4" EMT 2 hole strap

Tools Required:

Circular or panel saw
Philips screw driver or screw gun
Miter or hand saw
¾" Dado blade on a table or radial arm saw
Tape measure
Chalk line or straight edge
2 Channel-lock pliers
Wood glue
1 ½" stapler or finish nailer

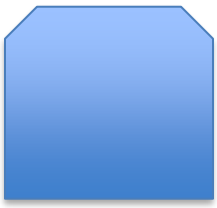
Instructions:

1. <u>Fabricate the Box:</u>
    a. Cut the following pieces from the plywood:
    2 sides: 14 ¼" x 18 ½"
    2 ends: 13" x 14 ¼"
    1 bottom: 17" x 13"
        b. Assemble and screw together with 1 5/8" screws as shown:

2. Fabricate the Stand:

   a. Cut the following pieces from the plywood:

      2 sides: 17w" x 16h" with 4" x 4" corners cut as shown:

      1 bottom: 17" x 19 ¾"

   b. Assemble and screw together with 1 5/8" screws as shown:

3. Fabricate the screen:

   a. Using the 1 x 8, cut:

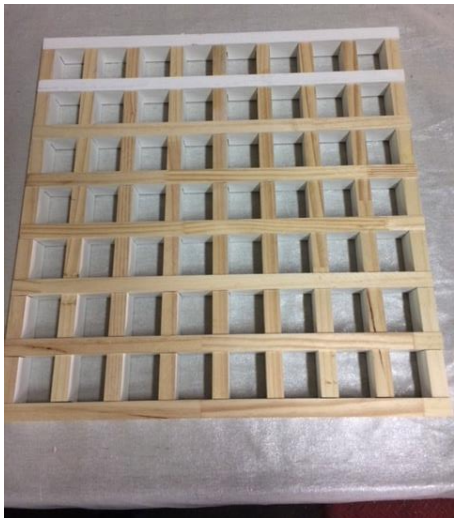
      5 pieces 1 3/8" x 18 9/16" long
      9 pieces 1 3/8" x 14 ½" long

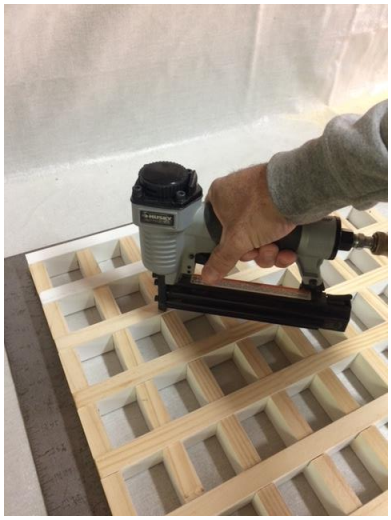
   b. Set the dado blade to be ¾" wide and to make a 11/16" deep cut

      - Starting at the very end of the 9 pieces, make cross cuts leaving 1.97" between cuts
      - Starting at the very end of the 5 pieces make cross cuts leaving 1.46" between cuts as shown (note that the pictures below represent the process, not the correct number or size of the pieces)

c. Lay the pieces so the cut slots are facing each other and intertwine. Glue and staple/nail at each connection.





Assemble the Screened Box:

d. With the open end of the box facing up, place the screen on the open end of the box and attach one end of the hinges to the screen and one to the box using the 5/8" screws.

e. On the opposite side attach the security hasp as shown:

f. On either end of the box, mark lines from the top corners of the screen to the bottom corners of the box to locate the center. Using the 5/8” screws, mount the floor flanges to the box sides, centering them on the intersection of these lines.

g. Into one floor flange thread one 3” nipple and a cap.

h. Into the other floor flange thread a 3” nipple, elbow, 6” nipple, elbow, 4 ½” nipple, and a cap, tightening and aligning them to create a crank handle as shown.

i. Set the box onto the stand so that the floor flanges sit between and are centered on the uprights. Attach the nipples to the stand using the ¾” EMT straps and 1 5/8” screws as shown.

Annex 2: Report Form

SIZE SORTING POTENTIAL OF A WHOLE PLASTIC ARTICLE
Record Sheet APR Test #

BACKGROUND		
TESTING FACILITY		
TESTING FACILITY TECHNICIAN		
DATE		
CANDIDATE ARTICLE DESCRIPTION	Volume	
	Label Material	
	Closure material	
	Body material	
	Brand/Description	

SCREEN TEST OF 20 COMPRESSED ARTICLES

	# Items through screen		# Items through screen
TEST #1		TEST #16	
TEST #2		TEST #17	
TEST #3		TEST #18	
TEST #4		TEST #19	
TEST #5		TEST #20	
TEST #6		TEST #21	
TEST #7		TEST #22	
TEST #8		TEST #23	
TEST #9		TEST #24	
TEST #10		TEST #25	
TEST #11		TEST #26	
TEST #12		TEST #27	
TEST #13		TEST #28	
TEST #14		TEST #29	
TEST #15		TEST #30	

AVERAGE THROUGH SCREEN _____

% RECOVERY _____ ((20 average # through screen)/20) x 100)

ASSESSMENT			
% Recovery		*Applicable APR Recyclability Category for "NIR Sorting Potential" (see category definitions in APR Design Guide for Plastics Recyclability Home Page)*	*Check Applicable Box*
>= 90%		APR Design Guide Preferred	
>= 51% and < 90%		Detrimental to Recycling	
< 51%		Renders Package non-Recyclable per APR Definition	

Testing Facility Technician Signature

Comments: What features cause negative results?, What could be done to improve sorting? etc.

Disclaimer This document has been prepared by the Association of Plastic Recyclers as a service to the plastic packaging industry to promote the most efficient use of the nation's plastics recycling infrastructure and to enhance the quality and quantity of recycled postconsumer plastics. The information contained herein reflects the input of APR members from a diverse cross-section of the plastics recycling industry, including professionals experienced in the recycling of PET packaging articles. The information in this document is offered without warranty of any kind, either expressed or implied, including WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, which are expressly disclaimed. APR and its members accept no responsibility for any harm or damages arising from the use of or reliance upon this information by any party. APR intends to update this document periodically to reflect new developments and practices.

DOCUMENT VERSION HISTORY

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