Stina Inc., on behalf of the Europe Plastic and Laminate Tube Recyclability Project investigated the impact of size dimensions (diameter and length with cap) on the sortability of small plastic squeeze tubes. The two sort tests were performed with samples ranging in size from 16 mm x 80 mm to 40 mm x 125 mm as shown in Annex 1. Tests were carried out following the procedures described by RecyClass Sorting Evaluation Protocol.

The samples were provided by several tube manufacturers and brand companies doing business in Europe and consisted of fifteen sets of samples (100 of each tube) with seven sets tested in 2022 and eight sets tested in 2023. Between the two tests, eight sets of tubes were decorated, and seven sets of tubes were white.

Tube (in Test Order)	Description (all caps are white except where noted)	Cap	Diameter (mm)	Length (mm)	Length w/ Cap* (mm)	Crimped End (mm)
T1-1	White PE with gold cap	PP screw closure	16	70	80	22
T1-2	White PE	PE screw closure	19	76	99	29
T1-3	White PE	PP screw closure	25	80	93	40
T1-4	White PE	PP screw closure	35	100	117	55
T1-5	Decorated PE Polyfoil MMB	PE screw closure	40	105	125	62
T1-6	Decorated PE red, white, and blue	PP screw closure	28	160	176	43
T1-7	Decorated PE green and white	PE screw closure	30	153	171	46
T2-1	Decorated PE orange and silver	Screw closure	22	72	84	37
T2-2	Decorated PE white and teal	Flip cap	30	80	101	50
T2-3	Decorated PE orange stripe	Flip cap	35	82	102	54
T2-4	Decorated PE red, green, and blue	Screw closure	28	100	120	44
T2-5	Decorated PE silver and green	Screw closure	25	100	129	39
T2-6	White PE	Screw closure	19	90	110	32
T2-7	White PE	Screw closure	16	110	125	25
T2-8	White PE	Screw closure	19	110	130	31

*Length with cap used in following results summaries and tables.
NOTE: Tubes of the same diameter may have slightly different crimped end widths; this may be due to the different sealing techniques used.

The samples were tested at a Veolia lightweight packaging sorting facility in Ochtendung, Germany, a recognized testing facility, according to the RecyClass Sorting Evaluation Protocols. The facility sorting test results showed that tubes of sufficient size can pass initial screens (typically 5x5 cm openings) and pass onto the rigid container lines at rates of greater than 50 %.

Results

For the smallest tubes tested, the specific dimensions of the tube impact tube sortability. For tubes of the same diameter, those with longer lengths generally sorted at higher rates. Further, when brands or tube manufacturers have a choice about the final dimensions for a given volume, longer tubes with a smaller diameter generally sort better than larger diameter tubes with shorter lengths. This is especially true for the smallest volumes tested. In Figure 1 and Table 1, the main results can be seen.

Figure 1: Sorting Rate Past Initial Screens

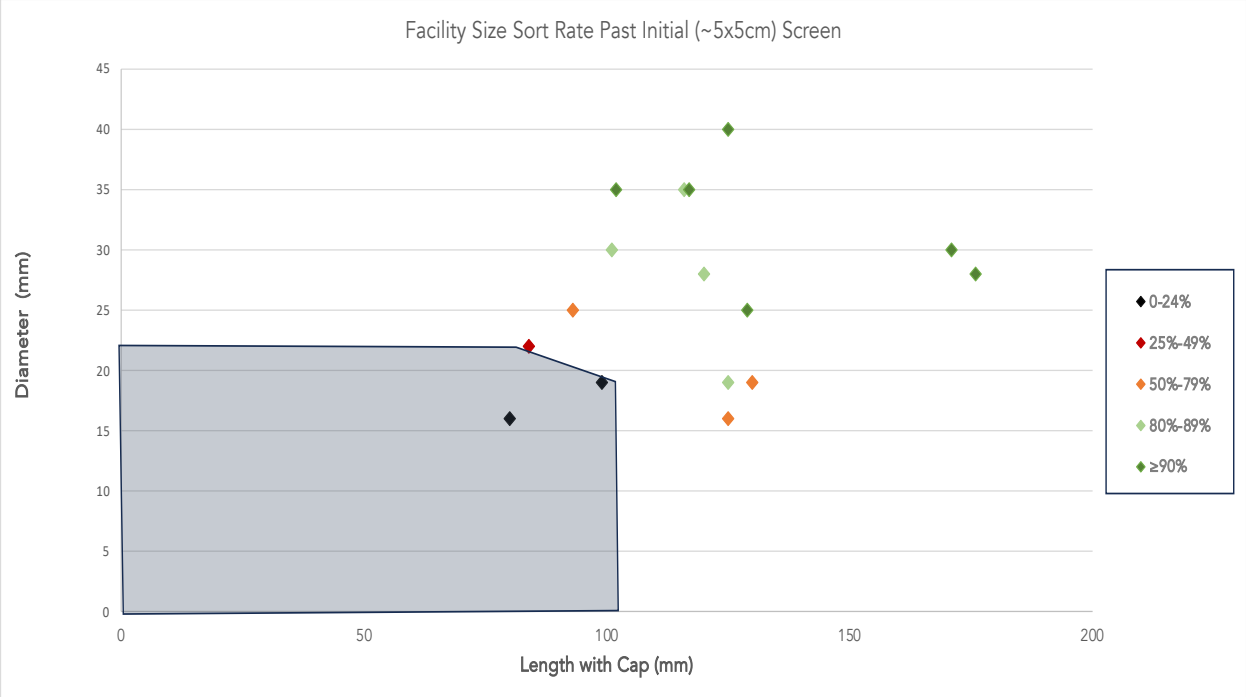

Table 1: Size, Volume, and Sort Results

Tube Sample (in order of vol)	Approx Volume (ml)	Diameter (mm)	Crimped End (mm)	Length w/ Cap (mm)	% Lost as Undersized at Initial Screen (5x5cm)	% Pass Initial Screen	% To CHPDE	% To Mixed Plastics	% To End Residue or Other Stream	Total
T1-1	8 ml	16	22	80	49	51	10	19	22	100
T1-2	12 ml	19	29	99	17	83	67	12	4	100
T2-1	15 ml	22	37	84	63	37	2	6	29	100
T2-7	15 ml	16	25	125	43	57	31	10	16	100
T2-6	16 ml	19	32	125	18	82	59	20	3	100
T1-3	20 ml	25	40	93	0	100	74	21	5	100
T2-8	20 ml	19	31	130	21	79	59	14	6	100
T2-5	27 ml	25	39	129	0	100	76	15	9	100
T2-2	30 ml	30	50	101	22	78	54	18	6	100
T2-4	30 ml	28	44	120	15	85	67	13	5	100
T2-3	42 ml	35	54	102	9	91	69	17	5	100
T1-4	50 ml	35	55	117	0	100	88	11	1	100
T1-5	75 ml	40	62	125	0	100	84	14	2	100
T1-6	75 ml	28	43	176	0	100	83	13	4	100
T1-7	75 ml	30	46	171	0	100	91	6	3	100

Recommendations

All tubes greater than 35 mm diameter, which creates a crimped end greater than 5 cm in width show a good performance in the 5x5 cm size sorting (higher than 91 %)

For smaller diameter tubes, total length with cap impacts the rate past the initial screen. As a conservative guide, other tubes of these dimensions can pass the size sorting test of the sorting evaluation protocol with more than 70 % efficiency. It should be highlighted that even those passing the size sorting step of the protocol would be required to test against the NIR and final destination parts of the protocol.

Diameter (mm)	Tested Length (mm)	Size Sorting rate shown by testing	Proposed length to obtain a higher rate (> 90 %)	Estimated Sorting rate for proposed length
19	130	75%	-- all need testing	n/a
22	125	Est 70-80%	-- all need testing	n/a
25	100	>72%	125	90-100%
28	100	Est 70-80%	125	90-100%
30	100	80%	125	90-100%

Annex 1

Test 1 (T1) Samples

Test 2 (T2) Samples

About Stina Inc.

Stina Inc. is a mission-based company striving to harmonize human behavior with the natural world. Our work helps businesses and individuals take actionable steps in the transition to a society that prioritizes sustainable use of resources. We gather and assess critical data, facilitate engagement and collaboration, and raise awareness of key issues for better decision-making. Our services include research, data analysis, stakeholder engagement, technical assistance, data visualization, and web-based tool development.

The company's information management system, relationships, and understanding of the plastic recycling landscape have made it the trusted organization to deliver the annual plastic recycling reports for the U.S. and Canada for more than 10 years. We often serve as liaison between industry, government, and NGOs to address and work through barriers to more sustainable management of resources.