

Volume-to-Weight Conversion Factors

U.S. Environmental Protection Agency

Office of Resource Conservation and Recovery

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EPA's 1997 report, "Measuring Recycling: A Guide for State and Local Governments", was a guide to facilitate standardization of MSW data collection at the local level, which included volume-to-weight conversion factors for comparing recovery efforts between municipalities, regions and states. The factors are also valuable when planners work with the national recovery data presented in EPA's sustainable materials management report series.

This document provides updates to the volume-to-weight conversion factors found in the 1997 report Appendix B.

The goal of this update is to identify more current secondary data measurements of the various products. Of particular interest are products known to have been source reduced through light weighting since the early nineties such as plastic, glass and metal packaging. Some factors included on the original table are excluded from the revised table due to lack of updated data. Primary data collection was not performed.

The original Appendix B table included 12 materials categories; the updated table provides factors for 15 material categories, including the following.

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| • Appliances | • Municipal Solid Waste |
| • Automotive | • Paper |
| • Carpeting | • Plastic |
| • Commingled Recyclables | • Textiles |
| • Electronics | • Wood |
| • Food | • Yard Trimmings |
| • Glass | • Construction & Demolition Debris (C&D) |
| • Metals | |

All of the categories include multiple products and/or density measurements. Four product categories—carpeting, commingled recyclable material, electronics and construction and demolition debris—are new. Previously lead-acid batteries and scrap tires were separate categories but are combined into the single category "Automotive" in the updated table.

Other differences include the removal/addition of products within some of the categories to better reflect the current recycling industry. For example, eliminating "Tab Card" and adding "Mixed Paper" to the paper category reflects the move toward commingled recyclables collection. The addition of "Electronics" reflects the growth in these products since the original table was published.

The updated factors are shown in the table below.

Standard Volume-to-Weight Conversion Factors

Category	Recyclable Materials	Volume	Estimated Weight (lbs)	Source
Appliances	Major Appliances			
	<i>Dishwasher</i>	1 unit	125	1
	<i>Clothes Dryer</i>	1 unit	125	1
	<i>Stove</i>	1 unit	150	1
	<i>Refrigerator</i>	1 unit	250	1
	<i>Clothes Washer</i>	1 unit	150	1
Automotive	Lead-Acid Battery			
	<i>Auto</i>	one	36	3
	<i>Truck</i>	one	47	3
	Scrap Tire			
	<i>Light Duty Tires (passenger, light truck)</i>	one	22.5	5
	<i>Commercial Tires</i>	one	120	5
	Fluids			
	<i>Used Motor Oil</i>	gallon	7.4	2
	<i>Antifreeze</i>	gallon	8.42	2
	Other Automotive			
	<i>Oil Filters not crushed</i>	drum	175	1
	<i>Oil Filters crushed</i>	drum	700	1
	<i>Oil Filters</i>	gallon	5	1
Carpeting	Carpet			
	<i>Carpet</i>	cubic yard	147	6
	<i>Carpet Padding</i>	cubic yard	62	6
Commingled Recyclable Material	Containers (Plastic bottles, Aluminum cans, Steel cans, Glass bottles) and Paper			
	<i>Commingled Recyclables</i>	cubic yard	262	4
	Containers (Plastic bottles, Aluminum cans, Steel cans, Glass bottles), Corrugated Containers and Paper			
	<i>Campus Recyclables</i>	cubic yard	92	7
	<i>Commingled Recyclables</i>	cubic yard	111	4
	Containers (Plastic bottles, Aluminum cans, Steel cans, Glass bottles) – No paper			
	<i>Campus Recyclables</i>	cubic yard	70	7
	<i>Commingled Recyclables</i>	cubic yard	67	4
	<i>Commercial Recyclables</i>	cubic yard	113	8
	Containers (Cans, Plastic) - No glass			
	<i>Campus Recyclables</i>	cubic yard	32	7
	Containers (Cans, Plastic) and Paper - No glass			
	<i>Residential Recyclables</i>	cubic yard	260	2
	Containers (Food/beverage, Glass) Corrugated Containers and Paper			
	<i>Commercial Recyclables</i>	cubic yard	88	2
	<i>Commercial Recyclables</i>	cubic yard	58	21
	<i>Multifamily Recyclables</i>	cubic yard	96	2
	<i>Multifamily Recyclables</i>	cubic yard	51	21

Category	Recyclable Materials	Volume	Estimated Weight (lbs)	Source
Commingled Recyclable Material	<i>Single family Recyclables</i>	cubic yard	126	2
	Containers (Food/beverage, Glass) Corrugated Containers and Paper- No glass			
	<i>Campus Recyclables</i>	cubic yard	139	2
	<i>Commercial Recyclables</i>	cubic yard	155	2
Electronics	Computer Equipment			
	<i>Desktop</i>	one	27	24
	<i>Laptop</i>	one	9.8	24
	Monitor			
	<i>CRT</i>	one	40	1
	<i>15"</i>	one	30	2
	<i>17"</i>	one	45	2
	<i>21"</i>	one	60	2
	<i>Flat Panel</i>	one	24	1
	<i>Mixed Monitors</i>	one	29.4	24
	Televisions			
	<i>CRT < 19 inch</i>	one	41	1
	<i>CRT ≥ 19 inch</i>	one	73	1
	<i>Flat Panel</i>	one	29	1
	<i>Mixed TVs</i>	one	67.3	24
	Peripheral Devices			
	<i>Printers</i>	one	16.1	24
	<i>Mice</i>	one	0.2	9
	<i>Keyboards</i>	one	2.9	9
	Mobile Devices			
	<i>Cellular Phone</i>	one	0.22	9
	Mixed Electronics			
	<i>Brown Goods</i>	cubic yard	343	6
	<i>Computer-related Electronics</i>	cubic yard	354	6
	<i>Other Small Consumer Electronics</i>	cubic yard	438	6
Food				
	Fats, Oils, Grease	55-gallon	412	2
	Organics - commercial	cubic yard	135	21
	Source Separated Organics - commercial	cubic yard	1,000	15
	Food Waste - restaurants	cubic yard	396	21
	Food Waste	cubic yard	463	4
	Food Waste	cubic foot	22-45	4
	Food waste - university	gallon	3.8	22
	Food Waste	64 gallon toter	150	4
	Food waste	2 cubic yard full towable	2,736	4
Glass	Bottles			
	<i>Loose</i>	cubic yard	380	4

Category	Recyclable Materials	Volume	Estimated Weight (lbs)	Source
Metals	Aluminum Cans			
	<i>Uncompacted</i>	cubic yard	46	4
	<i>Uncompacted</i>	case = 24 cans	0.7	11
	<i>Baled</i>	cubic yard	250-500	10
	Steel Cans			
	<i>Whole</i>	cubic yard	50-175	10
	<i>Baled</i>	cubic yard	700-1,000	10
	Steel Cans - Institution			
	<i>Whole</i>	can	0.09	7
	<i>Whole</i>	cubic yard	136	7
Paper	Newsprint			
	<i>Loose</i>	cubic yard	360-800	1
	<i>Baled</i>	cubic yard	750-1,000	10
	Books - paperback, loose	cubic yard	428	23
	Old Corrugated Containers			
	<i>Flattened</i>	cubic yard	106	4
	<i>Baled</i>	cubic yard	700-1,100	10
	Old Corrugated Containers and Chip Board			
	<i>Uncompacted</i>	cubic yard	74.54	4
	Office Paper			
	<i>Computer Paper</i>			
	<i>Loose</i>	cubic yard	375-465	1
	<i>Compacted/Baled</i>	cubic yard	755-925	1
	<i>Mixed</i>			
	<i>Loose</i>	cubic yard	110-380	1
	<i>Loose</i>	cubic yard	323	4
	<i>Compacted</i>	cubic yard	610-755	1
	<i>Shredded</i>	cubic yard	128	4
	<i>Mixed Baled</i>	cubic yard	1,000-1,200	10
	Miscellaneous			
	<i>Cartons (milk and juice) uncrushed</i>	cubic yard	50	7
Plastic	PET			
	<i>PET Bottles - baled</i>	30"x42"x 48"	525-630	12
	<i>PET Thermoform - baled</i>	30"x42"x 48"	525-595	12
	HDPE			
	<i>HDPE Dairy - baled</i>	30"x42"x 48"	525-700	12
	<i>HDPE Mixed - baled</i>	30"x42"x 48"	525-700	12
	Mixed PET and HDPE			
	<i>Loose</i>	cubic yard	32	7
	Mixed Bottles/Containers #1 - #7			
	<i>Loose</i>	cubic yard	40.4	4
	Mixed Bottles/Containers #3 - #7			

Category	Recyclable Materials	Volume	Estimated Weight (lbs)	Source
Plastic	<i>Loose</i>	cubic yard	25.7	4
	Film			
	<i>LDPE, loose</i>	cubic yard	35	13
	<i>LDPE, compacted</i>	cubic yard	150	13
	<i>LDPE, baled</i>	30" x 42" x 48"	1,100	13
	Miscellaneous			
	<i>Trash Bags</i>	cubic yard	35	6
	<i>Grocery/Merchandise Bags</i>	cubic yard	35	6
	<i>Expanded Polystyrene Packaging/Insulation</i>	cubic yard	32	6
Textiles	Mixed Textiles			
	<i>Loose</i>	cubic yard	125-175	10
	<i>Baled</i>	cubic yard	600-750	10
Wood	Wood			
	<i>Wood Chips, green</i>	cubic yard	473	1
	<i>Wood Chips, dry</i>	cubic yard	243	1
	<i>Saw Dust, wet</i>	cubic yard	530	1
	<i>Saw Dust, dry</i>	cubic yard	275	1
	<i>Pallets</i>	one	25	1
	<i>Pallets and Crates</i>	cubic yard	169	18
	<i>Christmas Trees, loose</i>	cubic yard	30	1
Yard Trimmings	Yard Trimmings			
	<i>Leaves</i>	cubic yard	250-500	1
	<i>Leaves (Minnesota)</i>	cubic yard	300 - 383	15
	Mixed Yard Waste			
	<i>Uncompacted</i>	cubic yard	250	1
	<i>Compacted</i>	cubic yard	640	1
	Prunings & Trimmings	cubic yard	127	6
	Branches & Stumps	cubic yard	127	6
Municipal Solid Waste	MSW - Commercial			
	Commercial - dry waste	cubic yard	56-73	16, 8
	Commercial - all waste, uncompacted	cubic yard	138	21
	Mixed MSW - Residential, Institutional, Commercial			
	<i>Uncompacted</i>	cubic yard	250-300	14
	<i>Compacted</i>	cubic yard	400-700	14
	Mixed MSW - Multifamily uncompacted	cubic yard	95	21
	MSW - Landfill			
	<i>Compacted - MSW Small Landfill with Best Management Practices</i>	cubic yard	1,200-1,700	17
	<i>Compacted - MSW Large Landfill with Best Management Practices</i>	cubic yard	1,700-2,000	17

Category	Recyclable Materials	Volume	Estimated Weight (lbs)	Source
Municipal Solid Waste	<i>Compacted - MSW Very Large Landfill with Best Management and Cover Practices, Combined MMSW/Industrial/and other solid waste, or/and Leachate Recirculation</i>	cubic yard	>2,000	17
C & D	Concrete			
	<i>Large Concrete with Re-bar</i>	cubic yard	860	18
	<i>Large Concrete without Re-bar</i>	cubic yard	860	18
	<i>Small Concrete with Re-bar</i>	cubic yard	860	18
	<i>Small Concrete without Re-bar</i>	cubic yard	860	18
	Asphalt Paving			
	<i>Large Asphalt Paving with Re-bar</i>	cubic yard	773	19
	<i>Large Asphalt Paving without Re-bar</i>	cubic yard	773	19
	<i>Small Asphalt Paving with Re-bar</i>	cubic yard	773	19
	<i>Small Asphalt Paving without Re-Bar</i>	cubic yard	773	19
	Roofing			
	<i>Composition Roofing</i>	cubic yard	731	18
	<i>Other Asphalt Roofing</i>	cubic yard	731	18
	Other Aggregates	cubic yard	860	18
	Wood			
	<i>Clean Dimensional Lumber</i>	cubic yard	169	18
	<i>Clean Engineered Wood</i>	cubic yard	268	18
	<i>Other Recyclable Wood</i>	cubic yard	169	18
	<i>Painted/Stained Wood</i>	cubic yard	169	18
	<i>Treated Wood</i>	cubic yard	169	18
	Gypsum Board			
	<i>Clean Gypsum Board</i>	cubic yard	467	18
	<i>Painted/Demolition Gypsum</i>	cubic yard	467	18
	Aggregate			
	<i>Large Rock</i>	cubic yard	999	18
	<i>Small Rock/Gravel</i>	cubic yard	999	18
	Dirt and Sand	cubic yard	929	18
	Remainder/Composite Construction and Demolition	cubic yard	417	18
	Construction & Demolition Bulk	cubic yard	484	20
	Metal			
	<i>Major Appliances</i>	cubic yard	145	18
	<i>Other Ferrous</i>	cubic yard	225	18
	<i>Other Non-Ferrous</i>	cubic yard	225	18
	<i>Remainder/Composite Metal (avg of metals, without used oil filters)</i>	cubic yard	143	18
	<i>HVAC Ducting</i>	cubic yard	47	18

- 1 Oregon Department of Environmental Quality. 2007 Oregon Material Recovery and Waste Generation Rates Report September 2008 08-LQ-092. Attachment B: Measurement Standards and Reporting Guidelines 07-LQ-134.
<http://www.deq.state.or.us/lq/pubs/docs/sw/MRAttachmentB.pdf>
- 2 Department of Ecology, State of Washington. Coordinated Prevention Grant Conversion Sheet. March, 2014.
www.ecy.wa.gov/pubs/1107016.pdf
- 3 Factor developed using lead per battery data from Battery Council International. Recycling Rates 2009 to 2013. April 2014.
http://c.ymcdn.com/sites/batterycouncil.org/resource/resmgr/BCI_Recycling_Rate_Study_200.pdf applied to battery composition data from Sullivan, JL and Gaines, L. 2010. A Review of Battery Life Cycle Analysis: State of Knowledge and Critical Needs. October 2010. Center for Transportation Research, Energy Systems Division, Argonne National Laboratory ANL/ESD/10-7.
- 4 Keep America Beautiful. Volume-to-Weight Recycling and Trash Conversion Factors Report. December 2013.
- 5 Rubber Manufacturers Association (RMA). 2013 U.S. Scrap Tire Management Summary. November 2014.
http://www.rma.org/download/scrap-tires/market-reports/US_STMarket2013.pdf
- 6 California Integrated Waste Management Board. Targeted Statewide Waste Characterization Study: Detailed Characterization of Construction and Demolition Waste. June 2006. <http://www.calrecycle.ca.gov/publications/Documents/Disposal%5C34106007.pdf>
Brown Goods: larger, non-portable electronic goods that have some circuitry. Examples include microwaves, stereos, VCRs, DVD players, radios, audio/visual equipment, and non-CRT televisions (such as LCD televisions).
Computer-related Electronics: electronics with large circuitry that is computer-related. Examples include processors, mice, keyboards, laptops, disk drives, printers, modems, and fax machines.
Other Small Consumer Electronics: portable non-computer-related electronics with large circuitry. Examples include personal digital assistants (PDAs), cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras.
- 7 Keep America Beautiful, Recycle-Bowl Competition. Accessed February 2015. <http://recycle-bowl.org/wp-content/uploads/Recycle-Bowl-Estimating-Data-Fact-Sheet.pdf>
- 8 Great Forest. Volume to Weight Conversion Ratios for Commercial Office Waste in New York City. January 2013. Primary data; Commingled; large commercial properties (500,000 sq. ft – 1m sq. ft) in the New York metropolitan area.
<http://www.greatforest.com/files/FileUpload/files/Great%20Forest%20-%20Waste%20Conversion%20Paper%20->
- 9 US EPA Electronics Waste Management in the United States Through 2009 . May 2011.
- 10 WasteCare Corporation. Some Typical Loose and Baled Weights of Various Materials. Accessed April 2015.
<http://www.wastecare.com/Products-Services/Balers/aboutbalers.htm>.
- 11 The Aluminum Association. U.S. Aluminum Beverage Can Recycling.
http://www.aluminum.org/sites/default/files/section_images/UBCRecyclingRate2013.pdf
- 12 The Association of Postconsumer Plastic Recyclers (APR). Model Bale Specifications. <http://www.plasticsrecycling.org>
- 13 Caldwell, Maggie. Recycling Plastic Film and Shrink Wrap. May 16, 2014. <http://www.federalinternational.com/blog/recy>
- 14 Caterpillar Performance Handbook. 40th Edition. January 2010.
- 15 Minnesota Pollution Control Agency. Data provided by professional composter. 2015. Source separated organics - food scraps, non-recyclable paper (paper plates/towels/etc) and compostable plastics.
- 16 Minnesota Department of Administration 2015 hauler records (excludes organics).
- 17 Minnesota Pollution Control Agency. 2013 MPCA MSW Landfill Annual Report Data.
- 18 California Integrated Waste Management Board. Targeted Statewide Waste Characterization Study: Detailed Characterization of Construction and Demolition Waste. June 2006
- 19 Tellus scaled down by factor from Florida C&D study -- Converting C&D Debris from Volume to Weight: A Fact Sheet for C&D Debris Facility Operators, University of Florida, 2000.
- 20 Florida Dept of Environmental Protection <http://www.dep.state.fl.us/waste/categories/recycling/cd/canddmain.htm>
- 21 CalRecycle. 2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California. September 10, 2015.
<http://www.calrecycle.ca.gov/Publications/Documents/1543/20151543.pdf>
Organics - putrescible material hauled by a contracted third party to a permitted facility mainly engaged in producing compost or mulch, or in anaerobic digestion of organics. Minor mechanical separation of contaminants or recyclable materials may occur at the facility prior to composting or digestion.
- 22 Goldstein, Nora. "Food Scraps Composting Laboratory". *BioCycle*. January 2013, Vol. 54, No. 1, p. 33.
<https://www.biocycle.net/2013/01/22/food-scraps-composting-laboratory/>
- 23 U.S. EPA. Standard Volume-to-Weight Conversion Factors. Last updated: February 28, 2006. <https://www.epa.gov/smm/metrics-waste-reduction>
- 24 National Center for Electronics Recycling (NCER). <http://www.electronicrecycling.org/>
Mixed monitors and TVs: total pounds collected divided by total units collected.