RPRA
Resource Productivity & Recovery Authority

DRAFT FOR CONSULTATION

Weight Conversion Factors for Rechargeable Batteries

June 2020

Purpose

This document presents the methodology and resulting weight conversion factors to calculate the weight of rechargeable batteries developed by the Authority to be used by rechargeable battery producers when meeting their reporting requirements under Ontario's Batteries Regulation.

The calculations included in this document are not final and are presented here for discussion as part of the Authority's public consultation to develop the weight conversion factors. Stakeholders can provide their feedback to the Authority by email to consultations@rpra.ca on or before June 23, 2020.

Methodology

The Authority worked with a research team from the United Nations Institute for Training and Research to develop the draft weight conversion factors. The team has extensive experience in waste statistics and quantifying material flows, including battery and e-waste flows.

The researchers carried out three steps to develop draft weight conversion factors:

1. Classification of all rechargeable batteries, including loose rechargeable batteries and replacement batteries for rechargeable batteries embedded within or sold with electronic products. Batteries were classified by chemistry, size, and application.

2. Development of weight conversion factors by size, using desktop research to compile a comprehensive list of average weights by battery size (including the casing/housing). For most battery chemistries, standard sizes and average weights from different data sources were found to be comparable and consistent.

3. Development of weight conversion factors by application, where the average weight of secondary batteries by application (g/unit) was obtained by dividing the average energy usage per application (Wh/unit) by the average energy flow per grams of battery (Wh/g). Calculated weight for battery casings were then added to the battery weight. The average weight by application were validated by comparing them to a sample of batteries in the marketplace.

Weight Conversion Factor Tables

The following tables list the calculated weights for rechargeable batteries by size and by application, as determined using the preceding methodology.

Weight Conversion Factors by Size

Size		Chemistry	Weight (kg)
4 V		Lead acid	0.0013
6 V		Lead acid	0.0016
9 V		Nickel-Cadmium	0.035
		Nickel-Metal Hydride	0.042
12 V		Lead acid	0.002
N		Nickel-Cadmium	0.010
		Nickel-Metal Hydride	0.011
AAA		Nickel-Cadmium	0.0105
		Nickel-Metal Hydride	0.013
		Other	0.011
AA		Nickel-Cadmium	0.0215
		Nickel-Metal Hydride	0.0271
		Other	0.022
A		Nickel-Cadmium	0.032
		Nickel-Metal Hydride	0.040
C		Nickel-Cadmium	0.073
		Nickel-Metal Hydride	0.080
		Other	0.058
Sub C		Nickel-Cadmium	0.0529
		Nickel-Metal Hydride	0.055
D		Nickel-Cadmium	0.145
		Nickel-Metal Hydride	0.1628
		Other	0.104
F		Nickel-Cadmium	0.231
		Nickel-Metal Hydride	0.2613
Pin cell		Lithium-ion	0.001
Button cell		Lithium-ion	0.0025
Prismatic single cell		Lithium-ion	0.0217
Cylindrical single cell		Lithium-ion	0.0418
Pouch cell	55-500 typical nominal mAh	Lithium-ion	0.0052
	501-1000 typical nominal mAh	Lithium-ion	0.0158
	1001-2000 typical nominal mAh	Lithium-ion	0.030
	2001-5000 typical nominal mAh	Lithium-ion	0.055
	>5001 typical nominal mAh	Lithium-ion	0.112

Weight Conversion Factors by Application

Application	Chemistry	Weight (kg)
Cell phones E.g. cellular phones, smartphones	Lithium Cobalt Oxide (LCO)	0.028
	Lithium Nickel Manganese Cobalt Oxide (NMC)	0.053
Cameras/games E.g. video game controller	Lithium-ion (Includes: Lithium Cobalt Oxide, Lithium Nickel Manganese Cobalt Oxide, Lithium Manganese Oxide)	0.215
Others portable E.g. power banks, shavers, toothbrushes, drones, cordless mice, remote controls, MP3, cordless landline phones	Nickel-Metal Hydride (NiMH)	0.042
	Lithium-Ion (Includes: Lithium Nickel Manganese Cobalt Oxide, Lithium Manganese Oxide, Lithium Iron Phosphate)	0.215
	Lead acid (PbA)	0.806
Tablets	Lithium-ion (Includes: Lithium Cobalt Oxide, Lithium Nickel Manganese Cobalt Oxide)	0.246
Laptops/Portable PC	Lithium Cobalt Oxide (LCO)	0.341
	Lithium Nickel Manganese Cobalt Oxide (NMC)	0.438
Cordless tools E.g. gardening tools, cordless tools, power tools	Lithium Nickel Manganese Cobalt Oxide (NMC)	0.495
	Nickel-Metal Hydride (NiMH)	0.923
	Nickel-Cadmium (NiCd)	1.182
	Lead acid (PbA)	1.556
E-bikes	Lithium Ion (Includes: Lithium Nickel Manganese Cobalt Oxide, Lithium Manganese Oxide, Lithium Cobalt Oxide, Lithium Iron Phosphate)	2.802
Industrial excluding mobility E.g. pallet lifters, forklifts, energy storage for industrial use, other non-portable	Any Nickel (Includes Nickel-Cadmium Nickel-Metal Hydride)	2.963
	Lithium-ion (Includes Lithium Manganese Oxide, Lithium Cobalt Oxide, Lithium Nickel Manganese Cobalt Oxide, Lithium Nickel Cobalt Aluminium Oxide, Lithium Iron Phosphate)	2.984
Lighting E.g. security lighting, shielded or full cut-off lamps, control and power lines	Nickel-Cadmium (NiCd)	2.963
Medical E.g. measuring instruments, medical carts and beds, portable defibrillators	Lithium Cobalt Oxide (LCO)	2.984
Uninterruptible Power Supply (UPS)	Lithium Iron Phosphate (LFP)	2.984
Telecom	Lithium Nickel Manganese Cobalt Oxide (NMC)	2.984
Personal Mobility Devices/ Light Electric Vehicles E.g. golf carts, mobility scooters	Lithium Nickel Manganese Cobalt Oxide (NMC)	3.284