

PRODUCT CATEGORIES and IMPACT LIMIT VALUES

V 1.2 – 05/09/2023



Table of Contents

3					
4	GOAL AND SCOPE				
5	PRODUC	T CATEGORIES	5		
6	1. M	ETAL HARDWARE MADE OF DIE-CAST ZAMAK	5		
7	1.1.	DIE-CAST ZAMAK + NICKEL PLATING + PRECIOUS METAL	5		
8	1.2.	DIE-CAST ZAMAK + NICKEL-FREE PLATING + PRECIOUS METAL	7		
9	1.3.	DIE-CAST ZAMAK + NICKEL PLATING + VARNISH	10		
10	1.4.	DIE-CAST ZAMAK + NICKEL-FREE PLATING + VARNISH	12		
11	1.5.	DIE-CAST ZAMAK + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH	15		
12	2. M	ETAL HARDWARE MADE OF HOT-STAMPED BRASS	18		
13	2.1.	HOT-STAMPED BRASS + NICKEL PLATING + PRECIOUS METAL	18		
14	2.2.	HOT-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL	20		
15	2.3.	HOT-STAMPED BRASS + NICKEL PLATING + VARNISH	23		
16	2.4.	HOT-STAMPED BRASS + NICKEL-FREE PLATING + VARNISH	25		
17	2.5.	HOT-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARN	ISH28		
18	3. M	ETAL HARDWARE MADE OF COLD-STAMPED BRASS	32		
19	3.1.	COLD-STAMPED BRASS + NICKEL PLATING + PRECIOUS METAL	32		
20	3.2.	COLD-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL	34		
21	3.3.	COLD-STAMPED BRASS + NICKEL PLATING + VARNISH	36		
22	3.4.	COLD-STAMPED BRASS + NICKEL-FREE PLATING + VARNISH	39		
23	3.5.	COLD-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARI	NISH41		
24	4. M	ETAL HARDWARE MADE OF CNC MILLED BRASS	45		
25	4.1.	CNC-MILLED BRASS + NICKEL PLATING + PRECIOUS METAL	45		
26	4.2.	CNC-MILLED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL	47		
27	4.3.	CNC-MILLED BRASS + NICKEL PLATING + VARNISH	49		
28	4.4.	CNC-MILLED BRASS + NICKEL-FREE PLATING + VARNISH	52		
29	4.5.	CNC-MILLED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISI	H55		
30	5. M	ETAL HARDWARE MADE OF TURNED BRASS	58		
31	5.1.	TURNED BRASS + NICKEL PLATING + PRECIOUS METAL	58		



	5.2.	TURNED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL	60
	5.3.	TURNED BRASS + NICKEL PLATING + VARNISH	62
	5.4.	TURNED BRASS + NICKEL-FREE PLATING + VARNISH	65
	5.5.	TURNED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH	67
6	. M	ETAL HARDWARE MADE OF MIM STEEL	71
	6.1.	MIM STEEL + PVD (PHYSICAL VAPOUR DEPOSITION)	71



GOAL AND SCOPE

The goal of the present document is to help the organization requesting LEAF Hardware certification to identify the correct product category to which the product subject to certification belongs.

45 Product categories are classified depending on the different base materials and surface46 treatmennts.

Once the correct product category has been identified, the LCA practitioner (whether it is internal to the organization requesting certification or an external consultant) shall follow the requirements for that specific product category in terms of functional/declared unit and processes to be reported in the LCA report, in order to enhance compatibility between products belonging to the same product category. The LEAF TC is responsible for monitoring that the correct functional/declared unit and all the mandatory LCA processes have been included in the LCA study.

In addition, the limit values for the six impact categories described in Section 8.2. of the "LEAF
Hardware Guidelines" document are reported for each product category. The LCIA phase of
the LCA study shall provide output values for the six impact categories that are lower than
the limit values for a specific product category in order to obtain the LEAF Hardware product
certification.

59 Additional information about LCA requirements, impact categories' methods and general 60 guidelines to perform an LCA study can be found in the "LEAF Hardware: General 61 Requirements for Certification" available at <u>www.leafoundation.org/documenti</u>.

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63 **PRODUCT CATEGORIES**

64 **1. METAL HARDWARE MADE OF DIE-CAST ZAMAK**

Die-cast Zamak metal hardware is obtained from die-casting melted Zamak ingots from a
 crucible into a mold where it solidifies as it rapidly cools down.

1.1. DIE-CAST ZAMAK + NICKEL PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of die-cast Zamak and a subsequent surface plating treatment for the
deposition of a Nickel layer with 10-13 µm thickness and a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an
ultrasound bath, pickling, neutralization and the other plating steps. After the final washing
step, the plated metal hardware is dried in an oven.

76 Requirements:

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Functional/declared unit:	1 gram (g) of die-cast Zamak metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	µm thickness) and Precious Metal Plating
	(0.25-0.35 µm thickness).

LCA PROCESSES:				
Process phase: Zamak Die-				
Casting				
	• Zamak ingot consumption per metal accessory.			
	• Recycled material in Zamak ingot (e.g., 50% of			
	Zinc is recycled).			
	• New ingots/recycled runners ratio at standard			
	operating conditions (e.g., 40/60).			
	Energy consumption for Zamak die-casting			
	machine in kWh.			
	Energy consumption for Zamak die-casting			
	machine chiller in kWh.			



	Number of die-cast accessories produced per minute.	
	Die-casting waste processes per metal	
	accessory	
Process phase: Polishing (Optional)		
	 Polishing time per metal accessory. 	
	Polishing waste processes per metal accessory	
Process phase: Plating		
	• DC rectifiers energy consumption in kWh/dm ² for each plating bath.	
	 Heaters energy consumption in kWh/dm² for each plating bath. 	
	 Pumping operations energy consumption in kWh/dm² for each plating bath. 	
	 Extraction system energy consumption in kWh/dm² for each plating bath. 	
	Consumption of plating material and/or additives per dm ² .	
	 Percentage of recycled material in plating material and/or additives. 	
	Oven energy consumption in kWh per accessory	
	Water consumption per accessory	
	Emissions in air per metal accessory	
	Plating waste processes per metal accessory	
Process phase: Wastewater		
	• Wastewater in m ³ per accessory	
	• Cyanide destruction in kg of reagent (e.g.	
	Sodium hypochlorite 15 %m/m) per accessory	
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 	
Process phase: Other Waste		
	Spent plating baths in kg per accessory	
	 Sludge from filter press in ka per accessory 	
Process phase: Water		
Regeneration System		
	Water flow in m ³ /h	



eq.

CTUh/kg

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1.2. DIE-CAST ZAMAK + NICKEL-FREE PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of die-cast Zamak and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness and a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an
ultrasound bath, pickling, neutralization and the other plating steps. After the final washing
step, the plated metal hardware is dried in an oven.

87 Requirements:

(EP)

Human Toxicity (UseTox2)

Functional/declared unit:	1 gram (g) of die-cast Zamak metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating

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6.2 E-03 – 1.7 E-4

3.54 E-10



	(3-4 μ m thickness) and Precious Metal Plating (0.25-0.35 μ m thickness).	
	LCA PROCESSES:	
Process phase: Zamak Die-		
Casting		
	Zamak ingot consumption per metal accessory.	
	• Recycled material in Zamak ingot (e.g., 50% of	
	Zinc is recycled).	
	New ingots/recycled runners ratio at standard operating conditions (e.g., 40/60).	
	Energy consumption for Zamak die-casting machine in kWh.	
	Energy consumption for Zamak die-casting machine chiller in kWh.	
	Number of die-cast accessories produced per minute.	
	Die-casting waste processes per metal accessory	
Process phase: Polishing (Optional)		
•	Polishing time per metal accessory.	
	Polishing waste processes per metal accessory	
Process phase: Plating		
	DC rectifiers energy consumption in kWh/dm ² for each plating bath.	
	• Heaters energy consumption in kWh/dm ² for	
	each plating bath.	
	Pumping operations energy consumption in kWh/dm ² for each plating bath.	
	 Extraction system energy consumption in kWh/dm² for each plating bath. 	
	 Consumption of plating material and/or additives per dm². 	
	 Percentage of recycled material in plating material and/or additives. 	
	Oven energy consumption in kWh per	
	accessory	
	Water consumption per accessory	



•	Emissions in air per metal accessory		
•	Plating waste processes per metal accessory		
Process phase: Wastewater			
Wastewater in m ³ per accessory		essory	
•	Cyanide destruction in kg of reagent (e.g.		
Sodium hypochlorite 15 %m/m) per ac		6m/m) per accessory	
•	pH regulators (e.g., Sulforic Acid 50 %m/m) per		
	accessory		
Process phase: Other Waste			
•	Spent plating baths in kg	per accessory	
•	Sludge from filter press ir	n kg per accessory	
Process phase: Water			
Regeneration System			
(Optional)	Mala (la 1 a 23/la		
•	Water flow in m ² /n	function is named 200/	
•	Efficiency in % (e.g., 80% of water is reused, 20%		
	Is waste)		
•	(o.g. 2 cationic and 2 anic	e resins and mespan	
	lifespan)	onic resins, 24 months	
•	Acid for cationic resi	ns regeneration in	
	kg/month		
•	Base for anionic resi	ns regeneration in	
	kg/month		
		•	
Clobal Warming Potential (CW/P)			
Bosources Use Fossil (PLIE) and	kg CO ₂ eq.	0.082	
Non-Eossil (PLInE)	(MJ – kg Sb eq.)	111 1955	
Water Deprivation Potential	m ³ water eq.	1.14 - 4.8 L-5	
(WDP)		0.41	
Ozone Depletion Potential (ODP)	ka CFC-11 ea	2.22 F-09	
Ecotoxicity: Acidification potential		2.22 2 05	
(AP) and Eutrophication Potential	mol H+ eq. – mol P		
(EP)	eq.	2.2 E-03 – 1.6 E-4	
Human Toxicity (UseTox2)	CTUh/kg	3.0 E-10	

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1.3. DIE-CAST ZAMAK + NICKEL PLATING + VARNISH

91 This paragraph reports the requirements and limit impact values for metal hardware
92 accessories made of die-cast Zamak and a subsequent surface plating treatment for the
93 deposition of a Nickel layer with 10-13 µm thickness and a final varnish layer.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an
ultrasound bath, pickling, neutralization and the other plating steps. After the final plating
steps, the plated metal hardware is varnished and dried in an oven.

97 This product category can be selected also for cataphoretic varnish coating.

98 Requirements:

 Functional/declared unit: 	1 gram (g) of die-cast Zamak metal	
	hardware and 1 square decimeter (dm ²) of	
	surface treatment with Nickel Plating (10-13	
	µm thickness) with final varnish layer.	

LCA PROCESSES:				
Process phase: Zamak Die- Casting				
	 Zamak ingot consumption per metal accessory. 			
	 Recycled material in Zamak ingot (e.g., 50% of Zinc is recycled). 			
	 New ingots/recycled runners ratio at standard operating conditions (e.g., 40/60). 			
	Energy consumption for Zamak die-casting machine in kWh.			
	Energy consumption for Zamak die-casting machine chiller in kWh.			
	Number of die-cast accessories produced per minute.			
	Die-casting waste processes per metal accessory			
Process phase: Polishing (Optional)				
-	Polishing time per metal accessory.			
	Polishing waste processes per metal accessory			





Process phase: Plating			
	• DC rectifiers energy consumption in kWh/dm ²		
	for each plating bath.		
	• Heaters energy consumption in kWh/dm ² for		
	each plating bath.		
	Pumping operations energy consumption in		
	kWh/dm ² for each plating bath.		
	• Extraction system energy consumption in		
	kWh/dm ² for each plating bath.		
	Consumption of plating material and/or		
	additives per dm ² .		
	 Percentage of recycled material in plating 		
	material and/or additives.		
	Oven energy consumption in kWh per		
	accessory		
	Water consumption per accessory		
	Emissions in air per metal accessory		
	Plating waste processes per metal accessory		
Process phase: Wastewater			
	• Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	• pH regulators (e.g., Sulforic Acid 50 %m/m)		
	per accessory		
Process phase: Other Waste			
	Spent plating baths in kg per accessory		
	Sludge from filter press in kg per accessory		
Process phase: Water			
Regeneration System (Optional)			
	Water flow in m ³ /h		
	• Efficiency in % (e.g., 80% of water is reused,		
	20% is waste)		
	Number of ion-exchange resins and lifespan		
	(e.g., 2 cationic and 2 anionic resins, 24		
	months lifespan)		
	Acid for cationic resins regeneration in		
	kg/month		
	Base for anionic resins regeneration in		
	kg/month		

Process phase: Varnish			
		kg of varnish per kg acce	essory
	•	Oven energy consum accessory (for hsnd-spra	ption in kWh per ying only)
	•	Water consumption in m	n ³ per kg accessory
DC rectifiers energy consumption in k' (for cataphoretic varnish only).		sumption in kWh/dm ² only).	
		·	
LIMIT V	'ALUES	FOR IMPACT CATEGORIES	
IMPACT CATEGORY		UNIT	LIMIT VALUES

IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.095
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	1.41 – 3.5 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.43
Ozone Depletion Potential (ODP)	kg CF-C11 eq.	2.07 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	4.6 E-03 – 1.3 E-4
Human Toxicity (UseTox2)	CTUh/kg	2.7 E-10

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1.4. DIE-CAST ZAMAK + NICKEL-FREE PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of die-cast Zamak and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness and a final varnish layer.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an
ultrasound bath, pickling, neutralization and the other plating steps. After the final plating
steps, the plated metal hardware is varnished and dried in an oven.

107 This product category can be selected also for cataphoretic varnish coating.

108 Requirements:

	-
Functional/declared unit:	1 gram (g) of die-cast Zamak metal hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating
	(3-4 µm thickness) with final varnish layer.

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LCA PROCESSES:		
Process phase: Zamak Die-		
Casting		
-	Zamak ingot consumption per metal	
	accessory.	
	• Recycled material in Zamak ingot (e.g., 50% of	
	Zinc is recycled).	
	• New ingots/recycled runners ratio at standard	
	operating conditions (e.g., 40/60).	
	• Energy consumption for Zamak die-casting	
	machine in kWh.	
	• Energy consumption for Zamak die-casting	
	machine chiller in kWh.	
	• Number of die-cast accessories produced per	
	minute.	
	• Die-casting waste processes per metal	
	accessory	
Process phase: Polishing		
(Optional)		
	 Polishing time per metal accessory. 	
	Polishing waste processes per metal accessory	
Process phase: Plating		
	• DC rectifiers energy consumption in kWh/dm ²	
	for each plating bath.	
	• Heaters energy consumption in kWh/dm ² for	
	each plating bath.	
	Pumping operations energy consumption in	
	kWh/dm ² for each plating bath.	
	Extraction system energy consumption in	
	kWh/dm ² for each plating bath.	
	Consumption of plating material and/or	
	additives per dm ² .	
	Percentage of recycled material in plating	
	material and/or additives.	
	Oven energy consumption in kWh per	
	accessory	
	Water consumption per accessory	
	Emissions in air per metal accessory	
	Plating waste processes per metal accessory	

Process phase: Wastewater	
	• Wastewater in m ³ per accessory
	• Cyanide destruction in kg of reagent (e.g.
	Sodium hypochlorite 15 %m/m) per accessory
	• pH regulators (e.g., Sulforic Acid 50 %m/m)
	per accessory
Process phase: Other Waste	
	 Spent plating baths in kg per accessory
	 Sludge from filter press in kg per accessory
Process phase: Water	
Regeneration System (Optional)	
	 Water flow in m³/h
	• Efficiency in % (e.g., 80% of water is reused,
	20% is waste)
	Number of ion-exchange resins and lifespan
	(e.g., 2 cationic and 2 anionic resins, 24 months lifespan)
	 Acid for cationic resins regeneration in kg/month
	 Base for anionic resins regeneration in kg/month
Process phase: Varnish	¥
	 kg of varnish per kg accessory
	Oven energy consumption in kWh per
	accessory (for hsnd-spraying only)
	• Water consumption in m ³ per kg accessory
	• DC rectifiers energy consumption in kWh/dm ²
	(for cataphoretic varnish only).
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LIMIT VALUES FOR IMPACT CATEGORIES		
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.053
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.78 – 2.9 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.25
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.47 E-09

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Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.3 E-03 – 9.6 E-5
Human Toxicity (UseTox2)	CTUh/kg	1.8 E-10

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1.5. DIE-CAST ZAMAK + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH

112 This paragraph reports the requirements and limit impact values for metal hardware 113 accessories made of die-cast Zamak and a subsequent surface plating treatment for the 114 deposition of a Nickel-free layer with 3-4 µm thickness, a Precious Metal layer (Gold, 115 Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness, and a final varnish layer.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an
ultrasound bath, pickling, neutralization and the other plating steps. After the final plating
steps, the plated metal hardware is varnished and dried in an oven.

- 119 This product category can be selected also for cataphoretic varnish coating.
- 120 Requirements:

Functional/declared unit:	1 gram (g) of die-cast Zamak metal hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating
	(3-4 µm thickness), Precious Metal Plating
	(0.25-0.35 μ m thickness) with final varnish
	layer.

LCA PROCESSES:		
Process phase: Zamak Die-		
Casting		
	Zamak ingot consumption per metal	
	accessory.	
	Recycled material in Zamak ingot (e.g., 50% of	
	Zinc is recycled).	
	• New ingots/recycled runners ratio at standard	
	operating conditions (e.g., 40/60).	
	• Energy consumption for Zamak die-casting	
	machine in kWh.	



	 Energy consumption for Zamak die-casting machine chiller in kWh
	 Number of die-cast accessories produced per minute.
	 Die-casting waste processes per metal accessory
Process phase: Polishing (Optional)	
	 Polishing time per metal accessory.
	 Polishing waste processes per metal accessory
Process phase: Plating	
	 DC rectifiers energy consumption in kWh/dm² for each plating bath.
	 Heaters energy consumption in kWh/dm² for each plating bath.
	 Pumping operations energy consumption in kWh/dm² for each plating bath.
	 Extraction system energy consumption in kWh/dm² for each plating bath.
	 Consumption of plating material and/or additives per dm².
	 Percentage of recycled material in plating material and/or additives.
	 Oven energy consumption in kWh per accessory
	Water consumption per accessory
	Emissions in air per metal accessory
	Plating waste processes per metal accessory
Process phase: Wastewater	
	• Wastewater in m ³ per accessory
	Cyanide destruction in kg of reagent (e.g.
	Sodium hypochlorite 15 %m/m) per accessory
	• pH regulators (e.g., Sulforic Acid 50 %m/m)
	per accessory
Process phase: Other Waste	
	 Spent plating baths in kg per accessory
	 Sludge from filter press in kg per accessory
Process phase: Water	
Regeneration System (Optional)	



	• Water flow in m ³ /h	
	• Efficiency in % (e.g., 80	% of water is reused,
	20% is waste)	
	 Number of ion-exchange 	ge resins and lifespan
	(e.g., 2 cationic and	2 anionic resins, 24
	months lifespan)	
	 Acid for cationic res 	ins regeneration in
	kg/month	
	Base for anionic res	ins regeneration in
	kg/month	
Process phase: Varnish		
	 kg of varnish per kg according 	essory
	Oven energy consum	ption in kWh per
	accessory (for hsnd-spra	ying only)
	Water consumption in n	n ³ per kg accessory
	DC rectifiers energy cons	sumption in kWh/dm ²
	(for cataphoretic varnish	i only).
· · · · · -		_
	S FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.109
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	1.61 – 5.9 E-5
Water Deprivation Potential	m ³ water eq	
(WDP)	in water eq.	0.51
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	3.01 E-09
Ecotoxicity: Acidification potential	mol H+ ea – mol P	
(AP) and Eutrophication Potential	eq. mort	
(EP)	~~·	2.8 E-03 – 2.0 E-4
Human Toxicity (UseTox2)	CTUh/kg	3.71 E-10



2. METAL HARDWARE MADE OF HOT-STAMPED BRASS

Hot-stamped brass hardware is obtained from hot-stamping of brass billets into a moldwhere it solidifies as it rapidly cools down.

126 2.1. HOT-STAMPED BRASS + NICKEL PLATING + PRECIOUS 127 METAL

128 This paragraph reports the requirements and limit impact values for metal hardware 129 accessories made of hot-stamped brass and a subsequent surface plating treatment for the 130 deposition of a Nickel layer with 10-13 µm thickness and a Precious Metal layer (Gold, 131 Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The hot-stamped metal hardware undergoes polishing after hot-stamping, degreasing,
neutralization and the other plating steps. After the final washing step, the plated metal
hardware is dried in an oven.

135 Requirements:

 Functional/declared unit: 	1 gram (g) of hot-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	µm thickness) and Precious Metal Plating
	(0.25-0.35 µm thickness).

	LCA PROCESSES:
Process phase: Brass Hot	
Stamping	
	 Brass bar consumption per metal accessory.
	• Recycled material in Brass bar (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	• Energy consumption for Brass hot-stamping
	machine in kWh.
	• Natural gas consumption for Brass hot-
	stamping machine in Nm ³ h.
	• Number of hot-stamped accessories produced
	per minute.

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	• Energy consumption for trimming machine in kWh (including compressed air)	
	Number of accessories trimmed per minute	
	Hot-stamping waste processes per metal	
	accessory	
Process phase: Polishing		
(Optional)		
	 Polishing time per metal accessory. 	
	Polishing waste processes per metal accessory	
Process phase: Plating		
	 DC rectifiers energy consumption in kWh/dm² for each plating bath. 	
	 Heaters energy consumption in kWh/dm² for each plating bath. 	
	 Pumping operations energy consumption in kWh/dm² for each plating bath. 	
	 Extraction system energy consumption in kWh/dm² for each plating bath. 	
	 Consumption of plating material and/or additives per dm². 	
	 Percentage of recycled material in plating material and/or additives. 	
	 Oven energy consumption in kWh per accessory 	
	Water consumption per accessory	
	Emissions in air per metal accessory	
	 Plating waste processes per metal accessory 	
Process phase: Wastewater		
	 Wastewater in m³ per accessory 	
	 Cyanide destruction in kg of reagent (e.g. 	
	Sodium hypochlorite 15 %m/m) per accessory	
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 	
Process phase: Other Waste		
	 Spent plating baths in kg per accessory 	
	Sludge from filter press in kg per accessory	
Process phase: Water		
Regeneration System		
(Optional)		



	 Water flow in m³/h 		
Efficiency in % (e.g., 80% of water is reused is waste)		of water is reused, 20%	
Number of ion-exchange resins and li (e.g., 2 cationic and 2 anionic resins, 24 n lifespan)		e resins and lifespan onic resins, 24 months	
	 Acid for cationic resi kg/month 	ns regeneration in	
	 Base for anionic resi kg/month 	ns regeneration in	
LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO₂ eq.	0.075	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	1.16 – 9.52 E-5	
Water Deprivation Potential (WDP)	m ³ water eq.	0.38	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	2.09 E-09	
Ecotoxicity: Acidification potentia (AP) and Eutrophication Potentia (EP)	I mol H+ eq. – mol P eq.	4.0 E-03 – 3.8 E-5	
Human Toxicity (UseTox2)	CTUh/kg	9.31 E-11	

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2.2. HOT-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of hot-stamped brass and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness and a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The hot-stamped metal hardware undergoes undergoes polishing after hot-stamping,
degreasing, neutralization and the other plating steps. After the final washing step, the plated
metal hardware is dried in an oven.

146 Requirements:

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of

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	surface treatment with Nickel-free Plating
	(3-4 µm thickness) and Precious Metal
	Plating (0.25-0.35 µm thickness).
Dresses where Dress list	LCA PROCESSES.
Process phase: Brass Hot	
stamping	
	Brass bar consumption per metal accessory.
	Recycled material in brass bar (e.g., 70% of Conportion recycled)
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	Operating Conditions (e.g., 40/60).
	Energy consumption for Brass not-stamping machine in kWh.
	Natural gas consumption for Brass hot-
	stamping machine in Nm ³ h.
	Number of hot-stamped accessories produced
	per minute.
	Energy consumption for trimming machine in
	kWh (including compressed air).
	Number of accessories trimmed per minute.
	Hot-stamping waste processes per metal
	accessory
Process phase: Polishing (Optional)	
	Polishing time per metal accessory.
	Polishing waste processes per metal accessory
Process phase: Plating	
· · · · · · · · · · · · · · · · · · ·	• DC rectifiers energy consumption in kWh/dm ²
	for each plating bath.
	• Heaters energy consumption in kWh/dm ² for
	each plating bath.
	Pumping operations energy consumption in
	kWh/dm ² for each plating bath.
	Extraction system energy consumption in
	kWh/dm ² for each plating bath.
	Consumption of plating material and/or
	additives per dm ² .



	Percentage of recycled	material in plating
		ation in kWh par
	Water consumption per a	ccessory
	 Emissions in air per metal 	
	 Plating waste processes p 	er metal accessory
Process phase: Wastewater		
	• Wastewater in m ³ per acc	essorv
	Cyanide destruction in	kg of reagent (e.g.
	Sodium hypochlorite 15 %	%m/m) per accessory
	 pH regulators (e.g., Sulfor 	ic Acid 50 %m/m) per
	accessory	
Process phase: Other Waste		
	• Spent plating baths in kg	per accessory
	• Sludge from filter press ir	n kg per accessory
Process phase: Water		
Regeneration System		
(Optional)		
	• Water flow in m ³ /h	
	• Efficiency in % (e.g., 80% c	of water is reused, 20%
	is waste)	
	Number of ion-exchange	e resins and lifespan
	(e.g., 2 cationic and 2 anic	onic resins, 24 months
	lifespan)	
	 Acid for cationic resi kg/month 	ns regeneration in
	 Base for anionic resi 	ns regeneration in
	kg/month	
LIMIT VALU	ES FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.067
Resources Use Fossil (RUF) and	(MJ – ka Shieal)	
Non-Fossil (RUnF)		0.98 – 2.87 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.27
Ozone Depletion Potential (ODP	kg CFC-11 eq.	2.08 E-09



Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.7 E-03 – 1.1 E-4
Human Toxicity (UseTox2)	CTUh/ka	2 2 F-10

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2.3. HOT-STAMPED BRASS + NICKEL PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of hot-stamped brass and a subsequent surface plating treatment for the
deposition of a Nickel layer with 10-13 µm thickness and a final varnish layer.

The hot-stamped metal hardware undergoes polishing after hot-stamping, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

155 This product category can be selected also for cataphoretic varnish coating.

156 Requirements:

 Functional/declared unit: 	1 gram (g) of hot-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	μm thickness) and final varnish layer.

	LCA PROCESSES:
Process phase: Brass Hot	
Stamping	
	 Brass bar consumption per metal accessory.
	• Recycled material in Brass bar (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	Energy consumption for Brass hot-stamping
	machine in kWh.
	Natural gas consumption for Brass hot-
	stamping machine in Nm ³ h.
	Number of hot-stamped accessories produced
	per minute.
	• Energy consumption for trimming machine in
	kWh (including compressed air).



	Number of accessories trimmed per minute.		
	Hot-stamping waste processes per metal accessory		
Process phase: Polishing (Optional)			
• •	Polishing time per metal accessory.		
	Polishing waste processes per metal accessory		
Process phase: Plating			
	• DC rectifiers energy consumption in kWh/dm ² for each plating bath.		
	Heaters energy consumption in kWh/dm ² for each plating bath.		
	Pumping operations energy consumption in kWh/dm ² for each plating bath.		
	Extraction system energy consumption in kWh/dm ² for each plating bath.		
	Consumption of plating material and/or additives per dm ² .		
	 Percentage of recycled material in plating material and/or additives. 		
	 Oven energy consumption in kWh per accessory 		
	Water consumption per accessory		
	Emissions in air per metal accessory		
	Plating waste processes per metal accessory		
Process phase: Wastewater			
	Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	• pH regulators (e.g., Sulforic Acid 50 %m/m) per		
	accessory		
Process phase: Other Waste			
	Spent plating baths in kg per accessory		
	Sludge from filter press in kg per accessory		
Process phase: Water			
Regeneration System			
	• Water flow in m ³ /h		



	 Efficiency in % (e.g., 80% c is waste) 	of water is reused, 20%
	• Number of ion-exchang	e resins and lifespan
	(e.g., 2 cationic and 2 anio	onic resins, 24 months
	lifespan)	
	Acid for cationic resi	ns regeneration in
	kg/month	
	Base for anionic resi	ns regeneration in
	kg/month	
Process phase: Varnish		
	kg of varnish per kg acces	ssory
	 Oven energy consumption 	otion in kWh per
	accessory (for hsnd-spray	ring only)
	 Water consumption in m³ 	³ per kg accessory
	 DC rectifiers energy cons 	sumption in kWh/dm ²
	(for cataphoretic varnish	only).
LIMIT VALU	ES FOR IMPACT CATEGORIES	5
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO₂ eq.	0.055
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.89 – 6.4 E-5
Water Deprivation Potential	m ³ water og	
(WDP)	m [°] water eq.	0.26
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.56 E-09
Ecotoxicity: Acidification potentia		
(AP) and Eutrophication Potential		
(EP)	દપ.	2.7 E-03 – 2.6 E-5
Human Toxicity (UseTox2)	CTUh/kg	6.46 E-11

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2.4. HOT-STAMPED BRASS + NICKEL-FREE PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware 160 accessories made of hot-stamped brass and a subsequent surface plating treatment for the 161 deposition of a Nickel-free layer with 3-4 µm thickness and a final varnish layer. 162

163 The hot-stamped metal hardware undergoes polishing after hot-stamping, degreasing,
164 neutralization and the other plating steps. After the plating steps, the plated metal hardware
165 is varnished and dried in an oven.

- 166 This product category can be selected also for cataphoretic varnish coating.
- 167 Requirements:

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal hardware and 1 square decimeter (dm ²) of	
	surface treatment with Nickel-free Plating	
	(3-4 µm thickness) and final varnish layer.	

	LCA PROCESSES:
Process phase: Brass Hot Stamping	
	 Brass bar consumption per metal accessory.
	 Recycled material in Brass bar (e.g., 70% of Copper is recycled).
	• New Brass/recycled Brass ratio at standard operating conditions (e.g., 40/60).
	• Energy consumption for Brass hot-stamping machine in kWh.
	 Natural gas consumption for Brass hot- stamping machine in Nm³h.
	 Number of hot-stamped accessories produced per minute.
	• Energy consumption for trimming machine in kWh (including compressed air).
	Number of accessories trimmed per minute.
	 Hot-stamping waste processes per metal accessory
Process phase: Polishing (Optional)	
	 Polishing time per metal accessory.
	Polishing waste processes per metal accessory
Process phase: Plating	
	• DC rectifiers energy consumption in kWh/dm ² for each plating bath.





	Heaters energy consumption in kWh/dm ² for		
	each plating bath.		
	 Pumping operations energy consumption in kWh/dm² for each plating bath. 		
	 Extraction system energy consumption in kWb/dm² for each plating bath 		
	Consumption of plating material and/or		
	additives per dm ² .		
	Percentage of recycled material in plating material and/or additives.		
	 Oven energy consumption in kWh per accessory 		
	Water consumption per accessory		
	Emissions in air per metal accessory		
	Plating waste processes per metal accessory		
Process phase: Wastewater			
	Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 		
Process phase: Other Waste			
	 Spent plating baths in kg per accessory 		
	Sludge from filter press in kg per accessory		
Process phase: Water			
Regeneration System			
(Optional)			
	• Water flow in m ³ /h		
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)		
	Number of ion-exchange resins and lifespan		
	(e.g., 2 cationic and 2 anionic resins, 24 months		
	lifespan)		
	 Acid for cationic resins regeneration in kg/month 		
	Base for anionic resins regeneration in		
	kg/month		
Process phase: Varnish			
	kg of varnish per kg accessory		



•	Oven energy consumption in kWh per accessory (for hsnd-spraying only)
•	Water consumption in m ³ per kg accessory
•	DC rectifiers energy consumption in kWh/dm ²
	(for cataphoretic varnish only).

LIMIT VALUES	FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO₂ eq.	0.052
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.81 – 2.1 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.20
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.64 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.2 E-03 – 8.4 E-5
Human Toxicity (UseTox2)	CTUh/kg	1.57 E-10

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2.5. HOT-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of hot-stamped brass and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness, a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness, and a final varnish layer.

The hot-stamped metal hardware undergoes polishing after hot-stamping, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

178 This product category can be selected also for cataphoretic varnish coating.

179 Requirements:

 Functional/declared unit: 	1 gram (g) of hot-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating
	(3-4 µm thickness), Precious Metal Plating



	(0.25-0.35 µm thickness) and final varnish
	layer.
	LCA PROCESSES:
Process phase: Brass Hot	
Stamping	
	Brass bar consumption per metal accessory.
	Recycled material in Brass bar (e.g., 70% of Copper is recycled).
	• New Brass/recycled Brass ratio at standard operating conditions (e.g., 40/60).
	• Energy consumption for Brass hot-stamping machine in kWh.
	 Natural gas consumption for Brass hot- stamping machine in Nm³h.
	 Number of hot-stamped accessories produced per minute.
	 Energy consumption for trimming machine in kWh (including compressed air).
	Number of accessories trimmed per minute.
	Hot-stamping waste processes per metal
	accessory
Process phase: Polishing (Optional)	
	Polishing time per metal accessory.
	Polishing waste processes per metal accessory
Process phase: Plating	
	• DC rectifiers energy consumption in kWh/dm ² for each plating bath.
	 Heaters energy consumption in kWh/dm² for each plating bath.
	Pumping operations energy consumption in kWh/dm ² for each plating bath.
	 Extraction system energy consumption in kWh/dm² for each plating bath.
	 Consumption of plating material and/or additives per dm².
	• Percentage of recycled material in plating material and/or additives.



	 Oven energy consumption in kWh per 				
	accessory				
	Water consumption per accessory				
	Emissions in air per metal accessory				
	Plating waste processes per metal accessory				
Process phase: Wastewater	2				
	Wastewater in m ³ per accessory				
	• Cyanide destruction in kg of reagent (e.g.				
	Sodium hypochlorite 15 %m/m) per accessory				
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 				
Process phase: Other Waste					
	Spent plating baths in kg per accessory				
	Sludge from filter press in kg per accessory				
Process phase: Water					
Regeneration System					
(Optional)					
	• Water flow in m ³ /h				
	• Efficiency in % (e.g., 80% of water is reused, 20%				
	is waste)				
	• Number of ion-exchange resins and lifespan				
	(e.g., 2 cationic and 2 anionic resins, 24 months				
	Acid for cationic resins regeneration in				
	• Acto for cationic resins regeneration in				
	Rese for anionic resins regeneration in				
	• Base for amonic resins regeneration in kg/month				
Process phase: Varnish					
	 kg of varnish per kg accessory 				
	Oven energy consumption in kWh per				
accessory (for hsnd-spraying only)					
Water consumption in m ³ per kg accessory					
	• DC rectifiers energy consumption in kWh/dm ²				
	(for cataphoretic varnish only).				
LIMIT VALU	ES FOR IMPACT CATEGORIES				
IMPACT CATEGORY	UNIT LIMIT VALUES				
Global Warming Potential (GWP)	kg CO ₂ eq. 0.064				



Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	1.00 – 2.5 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.24
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	2.01 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.5 E-03 – 1.0 E-4
Human Toxicity (UseTox2)	CTUh/kg	1.93 E-10



3. METAL HARDWARE MADE OF COLD-STAMPED BRASS

183 Cold-stamped brass hardware is tipically obtained from trimming of brass sheets into the final184 form.

185 3.1. COLD-STAMPED BRASS + NICKEL PLATING + PRECIOUS METAL

187 This paragraph reports the requirements and limit impact values for metal hardware 188 accessories made of cold-stamped brass and a subsequent surface plating treatment for the 189 deposition of a Nickel layer with 10-13 µm thickness and a Precious Metal layer (Gold, 190 Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The cold-stamped metal hardware undergoes polishing after cold-stamping, degreasing,
neutralization and the other plating steps. After the final washing step, the plated metal
hardware is dried in an oven.

194 Requirements:

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	µm thickness) and Precious Metal Plating
	(0.25-0.35 µm thickness).

	LCA PROCESSES:
Process phase: Brass Cold	
Stamping	
	• Brass sheet consumption per metal accessory.
	• Recycled material in Brass sheet (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	Energy consumption for Brass col-stamping
	trimming machine in kWh.
	• Number of cold-stamped accessories produced
	per minute.
	Cold-stamping waste processes per metal
	accessory

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Process phase: Polishing	
(Optional)	
	 Polishing time per metal accessory.
	 Polishing waste processes per metal accessory
Process phase: Plating	
	• DC rectifiers energy consumption in kWh/dm ²
	for each plating bath.
	• Heaters energy consumption in kWh/dm ² for
	each plating bath.
	Pumping operations energy consumption in
	kWh/dm ² for each plating bath.
	• Extraction system energy consumption in
	Kwn/um ⁻ for each plating bath.
	• Consumption of plating material and/or
	additives per dm ⁻ .
	Percentage of recycled material in plating material and (or additives
	Oven energy consumption in kwn per
	Water consumption per accessory
	Emissions in air per metal accessory
	Plating waste processes per metal accessory
Brocoss phase: Wastewater	• Flating waste processes per metal accessory
Process phase. Wastewater	• Wastowator in m^3 par accessory
	Wastewater III III per accessory
	• Cyande destruction in kg of reagent (e.g.
	pH regulators (e.g. Sulforis Asid 50 % m/m) per
	• pH regulators (e.g., Sulforic Actu 50 %ill/lll) per
Brocoss phase: Other Waste	
Process phase. Other waste	 Spont plating baths in kg par accessony
	 Sperit plating batils in kg per accessory Sludge from filter press in kg per accessory
Process phase: Water	- Sludge from filter press in ky per accessory
Regeneration System	
(Ontional)	
	• Water flow in m ³ /h
	• Efficiency in % (e.g. 80% of water is reused 20%
	is waste)



	•	Number of (e.g., 2 cation lifespan)	f ion-excl onic and 2	nange 2 anion	resins and lifes _f ic resins, 24 mon	oan iths
	•	Acid for kg/month	cationic	resins	regeneration	in
	٠	Base for kg/month	anionic	resins	regeneration	in
LIMIT VA	UES	FOR IMPAC	T CATEGO	DRIES		
IMPACT CATEGORY		U	NIT		LIMIT VALU	ES
Global Warming Potential (GW	P)	kg CO2	eq.		0.067	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)		(MJ – k	g Sb eq.)		0.95 – 9.34 E-5	
Water Deprivation Potential (WDP)		m ³ wat	er eq.		0.33	
Ozone Depletion Potential (OD	P)	kg CFC	2-11 eq.		1.79 E-09	
Ecotoxicity: Acidification poten (AP) and Eutrophication Poten (EP)	tial tial	mol H- eq.	+ eq. – mo	ol P	4.0 E-03 – 3.6 E-5	5
Human Toxicity (UseTox2)		CTUh/l	<g< td=""><td></td><td>8.72 E-11</td><td></td></g<>		8.72 E-11	

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3.2. COLD-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of cold-stamped brass and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness and a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The cold-stamped metal hardware undergoes polishing after cold-stamping, degreasing,
neutralization and the other plating steps. After the final washing step, the plated metal
hardware is dried in an oven.

205 Requirements:

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal bardware and 1 square decimeter (dm^2) of
	surface treatment with Nickel free Disting
	surface treatment with Nickel-free Plating
	(3-4 µm thickness) and Precious Metal
	Plating (0.25-0.35 µm thickness).



Dracase phases Brass Cold	LCA PROCESSES.			
Stomping				
Stamping	Brass sheet consumption per metal accessory			
	 Brass sheet consumption per metal accessory. Recycled material in Brass sheet (e.g. 70% of 			
	Copper is recycled)			
	New Brass/recycled Brass ratio at standard			
	operating conditions (e.g., 40/60).			
	Energy consumption for Brass col-stamping			
	trimming machine in kWh.			
	Number of cold-stamped accessories produced			
	per minute.			
	Cold-stamping waste processes per metal			
	accessory			
Process phase: Polishing				
(Optional)				
	Polishing time per metal accessory.			
	Polishing waste processes per metal accessory			
Process phase: Plating				
	• DC rectifiers energy consumption in kWh/dm ²			
	for each plating bath.			
	• Heaters energy consumption in kWh/dm ² for			
	each plating bath.			
	• Pumping operations energy consumption in			
	kWh/dm ² for each plating bath.			
	Extraction system energy consumption in			
	kWh/dm² for each plating bath.			
	Consumption of plating material and/or			
	Percentage of recycled material in plating			
	 recentage of recycled material in plating material and/or additives 			
	Oven energy consumption in kWh per			
	accessory			
	Water consumption per accessory			
	Emissions in air per metal accessory			
	 Plating waste processes per metal accessory 			
Process phase: Wastewater				
•	Wastewater in m ³ per accessory			



	Cyanide destruction in kg of reagent (e.g. Sodium hypochlorite 15 %m/m) per accessory		
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 		
Process phase: Other Waste			
	 Spent plating baths in kg per accessory 		
	Sludge from filter press in kg per accessory		
Process phase: Water			
Regeneration System			
(Optional)			
	• Water flow in m ³ /h		
	 Efficiency in % (e.g., 80% of water is reused, 20% is waste) Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan) 		
	 Acid for cationic resins regeneration in kg/month 		
	Base for anionic resins regeneration in kg/month		
	· · · · · ·		
LIMIT	VALUES FOR IMPACT CATEGORIES		
IMPACT CATEGORY	UNIT LIMIT VALUES		
Global Warming Potential (

IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.060
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.80 – 2.71 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.22
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.81 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.6 E-03 – 1.1 E-4
Human Toxicity (UseTox2)	CTUh/kg	2.1 E-10

3.3. COLD-STAMPED BRASS + NICKEL PLATING + VARNISH


This paragraph reports the requirements and limit impact values for metal hardware
 accessories made of cold-stamped brass and a subsequent surface plating treatment for the
 deposition of a Nickel layer with 10-13 µm thickness and a final varnish layer.

The cold-stamped metal hardware undergoes polishing after cold-stamping, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

- 215 This product category can be selected also for cataphoretic varnish coating.
- 216 Requirements:

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	μm thickness) and final varnish layer.

LCA PROCESSES:			
Process phase: Brass Cold Stamping			
	• Brass sheet consumption per metal accessory.		
	 Recycled material in Brass sheet (e.g., 70% of Copper is recycled). 		
	New Brass/recycled Brass ratio at standard operating conditions (e.g., 40/60).		
	Energy consumption for Brass col-stamping trimming machine in kWh.		
	Number of cold-stamped accessories produced per minute.		
	 Cold-stamping waste processes per metal accessory 		
Process phase: Polishing (Optional)			
	 Polishing time per metal accessory. 		
	 Polishing waste processes per metal accessory 		
Process phase: Plating			
	• DC rectifiers energy consumption in kWh/dm ² for each plating bath.		
	• Heaters energy consumption in kWh/dm ² for each plating bath.		



	 Pumping operations energy consumption in kWh/dm² for each plating bath 		
	 Extraction system energy consumption in kWh/dm² for each plating bath. 		
	 Consumption of plating material and/or additives per dm². 		
	 Percentage of recycled material in plating material and/or additives. 		
	 Oven energy consumption in kWh per accessory 		
	Water consumption per accessory		
	Emissions in air per metal accessory Plating waste processes per metal accessory		
Process phase: Wastewater	Flating waste processes per metal accessory		
	Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	• ph regulators (e.g., Suitoric Acid 50 %ill/lli) per accessory		
Process phase: Other Waste			
	Spent plating baths in kg per accessory		
	Sludge from filter press in kg per accessory		
Process phase: Water Regeneration System (Optional)			
•	• Water flow in m ³ /h		
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)		
	 Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan) 		
	 Acid for cationic resins regeneration in kg/month 		
	Base for anionic resins regeneration in kg/month		
Process phase: Varnish			
	kg of varnish per kg accessory		
	Oven energy consumption in kWh per accessory (for hsnd-spraying only)		



	• Water consumption in m ³ per kg accessory		
	• DC rectifiers energy consumption in kWh/dm ² (for cataphoretic varnish only).		
LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	

Global Warming Potential (GWP)	kg CO₂ eq.	0.050
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.75 – 6.3 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.23
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.35 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	2.7 E-03 – 2.5 E-5
Human Toxicity (UseTox2)	CTUh/ka	6.06 E-11

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3.4. COLD-STAMPED BRASS + NICKEL-FREE PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
 accessories made of cold-stamped brass and a subsequent surface plating treatment for the
 deposition of a Nickel-free layer with 3-4 µm thickness and a final varnish layer.

The cold-stamped metal hardware undergoes polishing after cold-stamping, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

226 This product category can be selected also for cataphoretic varnish coating.

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating
	(3-4 µm thickness) and final varnish layer.
	LCA PROCESSES:
Process phase: Brass Cold	
Stamping	



	Brass sheet consumption per metal accessory.		
	 Recycled material in Brass sheet (e.g., 70% of Copper is recycled). 		
	New Brass/recycled Brass ratio at standard		
	operating conditions (e.g., 40/60).		
	Energy consumption for Brass col-stamping		
	trimming machine in kWh.		
	Number of cold-stamped accessories produced		
	per minute.		
	Cold-stamping waste processes per metal		
	accessory		
Process phase: Polishing (Optional)			
-	Polishing time per metal accessory.		
	Polishing waste processes per metal accessory		
Process phase: Plating			
	• DC rectifiers energy consumption in kWh/dm ²		
	for each plating bath.		
	• Heaters energy consumption in kWh/dm ² for		
	each plating bath.		
	 Pumping operations energy consumption in kWh/dm² for each plating bath. 		
	• Extraction system energy consumption in kWh/dm ² for each plating bath		
	 Consumption of plating material and/or additives per dm². 		
	 Percentage of recycled material in plating material and/or additives. 		
	 Oven energy consumption in kWh per accessory 		
	Water consumption per accessory		
	Emissions in air per metal accessory		
	Plating waste processes per metal accessory		
Process phase: Wastewater			
	Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	• pH regulators (e.g., Sulforic Acid 50 %m/m) per		
	accessory		



Process phase: Other Waste			
•	Spent plating baths in kg per accessory		
•	Sludge from filter press ir	n kg per accessory	
Process phase: Water			
Regeneration System			
(Optional)			
•	Water flow in m ³ /h		
•	Efficiency in % (e.g., 80% c	of water is reused, 20%	
	is waste)		
•	Number of ion-exchange	e resins and lifespan	
	(e.g., 2 cationic and 2 anic	onic resins, 24 months	
	lifespan)		
•	Acid for cationic resi	ns regeneration in	
	kg/month		
•	Base for anionic resi	ns regeneration in	
	kg/month		
Process phase: Varnish			
•	kg of varnish per kg acces	ssory	
•	Oven energy consump	otion in kWh per	
	accessory (for hsnd-spray	ing only)	
•	Water consumption in m ²	² per kg accessory	
•	(for cataphoretic varnish only)		
	(for cataphoretic varnish o	oniy).	
		•	
Global Warming Potential (GWP)			
Besources Use Fossil (BLIF) and	kg CO2 CQ.	0.047	
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.67 – 1.9 F-5	
Water Deprivation Potential		0.07 1.52 5	
(WDP)	m³ water eq.	0.16	
Ozone Depletion Potential (ODP)	ka CFC-11 ea.	1.44 F-09	
Ecotoxicity: Acidification potential			
(AP) and Eutrophication Potential	mol H+ eq. – mol P		
(EP)	eq.	1.2 E-03 – 8.2 E-5	
Human Toxicity (UseTox2)	CTUh/kg	1.53 E-10	

3.5. COLD-STAMPED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH



This paragraph reports the requirements and limit impact values for metal hardware accessories made of cold-stamped brass and a subsequent surface plating treatment for the deposition of a Nickel-free layer with 3-4 µm thickness, a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness, and a final varnish layer.

The cold-stamped metal hardware undergoes polishing after cold-stamping, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

- 238 This product category can be selected also for cataphoretic varnish coating.
- 239 Requirements:

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating
	(3-4 µm thickness), Precious Metal Plating
	(0.25-0.35 µm thickness) and final varnish
	layer.

LCA PROCESSES:			
Process phase: Brass Cold Stamping			
	Brass sheet consumption per metal accessory.		
	 Recycled material in Brass sheet (e.g., 70% of Copper is recycled). New Brass/recycled Brass ratio at standard operating conditions (e.g., 40/60). Energy consumption for Brass col-stamping trimming machine in kWh. 		
	Number of cold-stamped accessories produced per minute.		
	Cold-stamping waste processes per metal accessory		
Process phase: Polishing (Optional)			
	Polishing time per metal accessory.		
	Polishing waste processes per metal accessory		
Process phase: Plating			



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	Oven energy consumption in kWh per		
	accessory		
	Water consumption per accessory		
	Emissions in air per metal accessory		
	Plating waste processes per metal accessory		
Process phase: Wastewater			
	• Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sourium nypocniorite 15 %m/m) per accessory		
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 		
Process phase: Other Waste			
	Spent plating baths in kg per accessory		
	Sludge from filter press in kg per accessory		
Process phase: Water			
Regeneration System (Optional)			
	• Water flow in m ³ /h		
	 Efficiency in % (e.g., 80% of water is reused, 20% is waste) Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan) 		
	Acid for cationic resins regeneration in kg/month		
	Base for anionic resins regeneration in kg/month		



Process phase: Varnish			
	kg of varnish per kg accessory		
	•	Oven energy consump accessory (for hsnd-spray	otion in kWh per ing only)
	٠	Water consumption in m ³	per kg accessory
	•	DC rectifiers energy cons (for cataphoretic varnish c	umption in kWh/dm ² only).
IMPACT CATEGORY	ALOLS	UNIT	LIMIT VALUES
Global Warming Potential (GWP)		kg CO ₂ eq.	0.058
Resources Use Fossil (RUF) and Non-Fossil (RUnF)		(MJ – kg Sb eq.)	0.83 – 2.4 E-5
Water Deprivation Potential (WDP)		m ³ water eq.	0.20
Ozone Depletion Potential (ODP)		kg CFC-11 eq.	1.78 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)		mol H+ eq. – mol P eq.	1.5 E-03 – 1.0 E-4
Human Toxicity (UseTox2)		CTUh/kg	1.89 E-10



241 **4. METAL HARDWARE MADE OF CNC MILLED BRASS**

242 CNC-milled brass hardware is tipically obtained from milling of brass blocks into the final243 form.

244 245 4.1. CNC-MILLED BRASS + NICKEL PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware accessories made of CNC-milled brass and a subsequent surface plating treatment for the deposition of a Nickel layer with 10-13 µm thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The CNC-milled metal hardware undergoes polishing after milling operations, degreasing,
neutralization and the other plating steps. After the final washing step, the plated metal
hardware is dried in an oven.

 Functional/declared unit: 	1 gram (g) of CNC-milled Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	µm thickness) and Precious Metal Plating
	(0.25-0.35 µm thickness).

	LCA PROCESSES:				
Process phase: Brass CNC					
Milling					
	Brass block consumption per metal accessory.				
	• Recycled material in Brass block (e.g., 70% of				
	Copper is recycled).				
	New Brass/recycled Brass ratio at standard				
	operating conditions (e.g., 40/60).				
	• Energy consumption for Brass CNC-milling				
	machine in kWh.				
	• Number of CNC-milled accessories produced				
	 per minute. Water consumption per accessory in m³ Oil consumption per accessory in kg 				



	CNC-milling waste processes per metal			
	accessory			
Process phase: Polishing (Optional)				
•	Polishing time per metal accessory.			
	Polishing waste processes per metal accessory			
Process phase: Plating				
	• DC rectifiers energy consumption in kWh/dm ²			
	for each plating bath.			
	• Heaters energy consumption in kWh/dm ² for			
	each plating bath.			
	Pumping operations energy consumption in kWh/dm ² for each plating bath.			
	• Extraction system energy consumption in kWh/dm ² for each plating bath.			
	• Consumption of plating material and/or additives per dm ² .			
	 Percentage of recycled material in plating material and/or additives. 			
	Oven energy consumption in kWh per accessory			
	Water consumption per accessory			
	Emissions in air per metal accessory			
	Plating waste processes per metal accessory			
Process phase: Wastewater				
	• Wastewater in m ³ per accessory			
	• Cyanide destruction in kg of reagent (e.g.			
	Sodium hypochlorite 15 %m/m) per accessory			
	• pH regulators (e.g., Sulforic Acid 50 %m/m) per			
	accessory			
Process phase: Other Waste				
	Spent plating baths in kg per accessory			
	Sludge from filter press in kg per accessory			
Process phase: Water Regeneration System (Optional)				
	• Water flow in m ³ /h			
	• Efficiency in % (e.g., 80% of water is reused, 20%			
	is waste)			



· · · · · · · · · · · · · · · · · · ·						
	Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan)					
	 Acid for cationic resi kg/month 	ns regeneration in				
	 Base for anionic resi kg/month 	ns regeneration in				
LIMIT VALU	ES FOR IMPACT CATEGORIES					
IMPACT CATEGORY	UNIT	LIMIT VALUES				
Global Warming Potential (GWP)	kg CO ₂ eq.	0.073				
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	1.03 – 9.48 E-5				
Water Deprivation Potential (WDP)	m ³ water eq.	0.35				
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.93 E-09				
Ecotoxicity: Acidification potentia (AP) and Eutrophication Potentia (EP)	I mol H+ eq. – mol P eq.	4.1 E-03 – 3.7 E-5				
Human Toxicity (UseTox2)	CTUh/kg	9.09 E-11				

254 255

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4.2. CNC-MILLED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of CNC-milled brass and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness and a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The CNC-milled metal hardware undergoes polishing after milling operations, degreasing,
neutralization and the other plating steps. After the final washing step, the plated metal
hardware is dried in an oven.

 Functional/declared unit: 	1 gram (g) of CNC-milled Brass metal			
	hardware and 1 square decimeter (dm ²) of			
	surface treatment with Nickel-free Plating			
	(3-4 µm thickness) and Precious Metal			
	Plating (0.25-0.35 µm thickness).			



	LCA PROCESSES:				
Process phase: Brass CNC					
Milling					
	 Brass block consumption per metal accessory. 				
	• Recycled material in Brass block (e.g., 70% of				
	Copper is recycled).				
	New Brass/recycled Brass ratio at standard				
	operating conditions (e.g., 40/60).				
	Energy consumption for Brass CNC-milling				
	machine in kWh.				
	Number of CNC-milled accessories produced				
	per minute.				
	 Water consumption per accessory in m³ 				
	Oil consumption per accessory in kg				
	CNC-milling waste processes per metal				
	accessory				
Process phase: Polishing					
(Optional)					
	 Polishing time per metal accessory. 				
	 Polishing waste processes per metal accessory 				
Process phase: Plating					
	• DC rectifiers energy consumption in kWh/dm ²				
	for each plating bath.				
	• Heaters energy consumption in kWh/dm ² for				
	each plating bath.				
	• Pumping operations energy consumption in				
	kWh/dm ² for each plating bath.				
	• Extraction system energy consumption in				
	kWh/dm ² for each plating bath.				
	• Consumption of plating material and/or				
	additives per dm ² .				
	Percentage of recycled material in plating				
	material and/or additives.				
	Oven energy consumption in kWh per				
	accessory				
	 Water consumption per accessory 				
	Emissions in air per metal accessory				
	 Plating waste processes per metal accessory 				



Process phase: Wastewater					
•	Wastewater in m ³ per accessory				
•	Cyanide destruction in kg of reagent (e.g.				
	Sodium hypochlorite 15 %m/m) per accessory				
•	pH regulators (e.g., Sulfor	ric Acid 50 %m/m) per			
	accessory				
Process phase: Other Waste					
•	Spent plating baths in kg	per accessory			
•	Sludge from filter press ir	n kg per accessory			
Process phase: Water					
Regeneration System					
(Optional)	2				
•	 Water flow in m³/h 				
•	Efficiency in % (e.g., 80% of water is reused, 20%				
	is waste)				
•	Number of ion-exchange resins and lifespan				
	(e.g., 2 cationic and 2 anionic resins, 24 months				
	litespan)				
•	Acid for cationic resins regeneration in				
	kg/month				
•	Base for anionic resins regeneration kg/month				
ĸg/month					
Global Warming Potential (GWP)		0.066			
Besources Use Fossil (BUF) and		0.000			
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.88 – 2.79 F-5			
Water Deprivation Potential	2				
(WDP)	m [°] water eq.	0.24			
Ozone Depletion Potential (ODP)	kg CFC-11 eg.	1.96 E-09			
Ecotoxicity: Acidification potential					
(AP) and Eutrophication Potential	mol H+ eq. – mol P				
(EP)	eq.	1.7 E-03 – 1.1 E-4			
Human Toxicity (UseTox2)	CTUh/kg	2.2 E-10			

4.3. CNC-MILLED BRASS + NICKEL PLATING + VARNISH



This paragraph reports the requirements and limit impact values for metal hardware accessories made of CNC-milled brass and a subsequent surface plating treatment for the deposition of a Nickel layer with 10-13 µm thickness and a final varnish layer.

The CNC-milled metal hardware undergoes polishing after milling operations, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

- 273 This product category can be selected also for cataphoretic varnish coating.
- 274 Requirements:

Functional/declared unit:	1 gram (g) of CNC-milled Brass met			
	surface treatment with Nickel Plating (10-13			
	μm thickness) and final varnish layer.			

	LCA PROCESSES:			
Process phase: Brass CNC Milling				
	• Brass block consumption per metal accessory.			
	 Recycled material in Brass block (e.g., 70% of Copper is recycled). 			
	• New Brass/recycled Brass ratio at standard operating conditions (e.g., 40/60).			
	 Energy consumption for Brass CNC-milling machine in kWh. 			
	 Number of CNC-milled accessories produced per minute. 			
	• Water consumption per accessory in m ³			
	Oil consumption per accessory in kg			
	 CNC-milling waste processes per metal accessory 			
Process phase: Polishing (Optional)				
	 Polishing time per metal accessory. 			
	Polishing waste processes per metal accessory			
Process phase: Plating				
	• DC rectifiers energy consumption in kWh/dm ² for each plating bath.			



	 Heaters energy consumption in kWh/dm² for each plating bath 				
	each plating bath.				
	Pumping operations energy consumption in kWh/dm ² for each plating bath.				
	 Extraction system energy consumption in kWh/dm² for each plating bath 				
	 Consumption of plating material and/or additives per dm². 				
	 Percentage of recycled material in plating material and/or additives. 				
	 Oven energy consumption in kWh per accessory 				
	Water consumption per accessory				
	Emissions in air per metal accessory				
	 Plating waste processes per metal accessory 				
Process phase: Wastewater					
	Wastewater in m ³ per accessory				
	 Cyanide destruction in kg of reagent (e.g. Sodium hypochlorite 15 %m/m) per accessory 				
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 				
Process phase: Other Waste					
	 Spent plating baths in kg per accessory 				
	Sludge from filter press in kg per accessory				
Process phase: Water Regeneration System					
(Optional)					
• •	• Water flow in m ³ /h				
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)				
	 Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan) 				
	Acid for cationic resins regeneration in kg/month				
	 Base for anionic resins regeneration in kg/month 				
Process phase: Varnish					
	kg of varnish per kg accessory				



•	Oven access	energy ory (for h	consumption snd-spraying o	in nly)	kWh	per
•	Water	consump	tion in m ³ per l	kg ac	cessory	/
•	DC red	tifiers en	ergy consumpt	ion i	n kWh/	/dm²
	(for ca	taphoreti	c varnish only).			
			-			

LIMIT VALUES FOR IMPACT CATEGORIES				
IMPACT CATEGORY	UNIT	LIMIT VALUES		
Global Warming Potential (GWP)	kg CO₂ eq.	0.052		
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.77 – 6.1 E-5		
Water Deprivation Potential (WDP)	m ³ water eq.	0.23		
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.39 E-09		
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	2.3 E-03 – 2.5 E-5		
Human Toxicity (UseTox2)	CTUh/kg	6.07 E-11		

275 276 277

4.4. CNC-MILLED BRASS + NICKEL-FREE PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of CNC-milled brass and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness and a final varnish layer.

The CNC-milled metal hardware undergoes polishing after milling operations, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

284 This product category can be selected also for cataphoretic varnish coating.

• Functional/declared unit:	1 gram (g) of CNC-milled Brass metal hardware and 1 square decimeter (dm ²) of surface treatment with Nickel-free Plating (3-4 μm thickness) and final varnish layer.
LCA PROCESSES:	



Process phase: Brass CNC	
	Brass block consumption per metal accessory
	 Recycled material in Brass block (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	• Energy consumption for Brass CNC-milling machine in kWh.
	Number of CNC-milled accessories produced
	per minute.
	Water consumption per accessory in m ³
	Oil consumption per accessory in kg
	CNC-milling waste processes per metal
	accessory
Process phase: Polishing (Optional)	
	Polishing time per metal accessory.
	Polishing waste processes per metal accessory
Process phase: Plating	
· · · · · ·	• DC rectifiers energy consumption in kWh/dm ²
	for each plating bath.
	• Heaters energy consumption in kWh/dm ² for
	each plating bath.
	 Pumping operations energy consumption in kWh/dm² for each plating bath.
	• Extraction system energy consumption in kWh/dm ² for each plating bath.
	 Consumption of plating material and/or additives per dm².
	 Percentage of recycled material in plating material and/or additives.
	Oven energy consumption in kWh per
	accessory
	Water consumption per accessory
	Emissions in air per metal accessory
	Plating waste processes per metal accessory
Process phase: Wastewater	
	Wastewater in m ³ per accessory



	Cyanide destruction in	kg of reagent (e.g.
	Sodium hypochlorite 15 %	%m/m) per accessory
	 pH regulators (e.g., Sulfor 	ric Acid 50 %m/m) per
	accessory	
Process phase: Other Waste		
	 Spent plating baths in kg 	per accessory
	 Sludge from filter press in 	n kg per accessory
Process phase: Water Regeneration System (Optional)		
	 Water flow in m³/h 	
	 Efficiency in % (e.g., 80% c is waste) 	of water is reused, 20%
	Number of ion-exchange	e resins and lifespan
	(e.g., 2 cationic and 2 anio lifespan)	onic resins, 24 months
	 Acid for cationic resi 	ns regeneration in
	kg/month	-
	 Base for anionic resi 	ns regeneration in
	kg/month	
Process phase: Varnish		
	 kg of varnish per kg acces 	ssory
	 Oven energy consumption 	otion in kWh per
	accessory (for hsnd-spray	ring only)
	 Water consumption in m³ 	³ per kg accessory
	 DC rectifiers energy cons 	sumption in kWh/dm ²
	(for cataphoretic varnish	only).
LIMIT VALU	ES FOR IMPACT CATEGORIES	5
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.049
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.69 – 1.9 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.16
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.45 E-09
Ecotoxicity: Acidification potentia (AP) and Eutrophication Potentia (EP)	l mol H+ eq. – mol P eq.	1.1 E-03 – 7.9 E-5



Human Toxicity (UseTox2)

CTUh/kg

1.49E-10

286 287

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4.5. CNC-MILLED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of CNC-milled brass and a subsequent surface plating treatment for the
deposition of a Nickel-free layer with 3-4 µm thickness, a Precious Metal layer (Gold,
Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness, and a final varnish layer.

The CNC-milled metal undergoes polishing after milling operations, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

296 This product category can be selected also for cataphoretic varnish coating.

 Functional/declared unit: 	1 gram (g) of CNC-milled Brass metal
	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel-free Plating
	(3-4 µm thickness), Precious Metal Plating
	(0.25-0.35 µm thickness) and final varnish
	layer.

	LCA PROCESSES:
Process phase: Brass CNC	
Milling	
	Brass block consumption per metal accessory.
	• Recycled material in Brass block (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	Energy consumption for Brass CNC-milling
	machine in kWh.
	• Number of CNC-milled accessories produced
	per minute.
	• Water consumption per accessory in m ³
	Oil consumption per accessory in kg



	CNC-milling waste processes per metal	
	accessory	
Process phase: Polishing (Optional)		
•	Polishing time per metal accessory.	
	Polishing waste processes per metal accessory	
Process phase: Plating		
	• DC rectifiers energy consumption in kWh/dm ²	
	for each plating bath.	
	• Heaters energy consumption in kWh/dm ² for	
	each plating bath.	
	 Pumping operations energy consumption in kWh/dm² for each plating bath. 	
	Extraction system energy consumption in	
	kWh/dm ² for each plating bath.	
	Consumption of plating material and/or	
	additives per dm ² .	
	Percentage of recycled material in plating	
	material and/or additives.	
	Oven energy consumption in kWh per accessory	
	Water consumption per accessory	
	Emissions in air per metal accessory	
	Plating waste processes per metal accessory	
Process phase: Wastewater		
	• Wastewater in m ³ per accessory	
	• Cyanide destruction in kg of reagent (e.g.	
	Sodium hypochlorite 15 %m/m) per accessory	
	• pH regulators (e.g., Sulforic Acid 50 %m/m) per	
	accessory	
Process phase: Other Waste		
	Spent plating baths in kg per accessory	
	Sludge from filter press in kg per accessory	
Process phase: Water		
Regeneration System		
(Optional)		
	Water flow in m ³ /h	
	• Efficiency in % (e.g., 80% of water is reused, 20%	
	is waste)	



•	Number of ion-exchange (e.g., 2 cationic and 2 anic lifespan)	e resins and lifespan onic resins, 24 months	
•	Acid for cationic resi kg/month	ns regeneration in	
•	Base for anionic resi kg/month	ns regeneration in	
Process phase: Varnish			
•	kg of varnish per kg acces	ssory	
•	Oven energy consump accessory (for hsnd-spray	otion in kWh per ing only)	
•	Water consumption in m ³	³ per kg accessory	
•	DC rectifiers energy cons	umption in kWh/dm ²	
	(for cataphoretic varnish o	only).	
LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO₂ eq.	0.060	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.85 – 2.3 E-5	
Water Deprivation Potential (WDP)	m ³ water eq.	0.21	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.79 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.4 E-03 – 9.8 E-5	
Human Toxicity (UseTox2)	CTUh/kg	1.83 E-10	

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301 **5. METAL HARDWARE MADE OF TURNED BRASS**

302 Turned brass hardware is tipically obtained from turning brass bars with lathe machines into303 the final form.

3045.1. TURNED BRASS + NICKEL PLATING + PRECIOUS305METAL

This paragraph reports the requirements and limit impact values for metal hardware accessories made of turned brass and a subsequent surface plating treatment for the deposition of a Nickel layer with 10-13 µm thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The turned metal hardware undergoes polishing after turning operations, degreasing, neutralization and the other plating steps. After the final washing step, the plated metal hardware is dried in an oven.

Functional/declared unit:	1 gram (g) of turned Brass metal hardware and 1 square decimeter (dm ²) of surface treatment with Nickel Plating (10-13 μm thickness) and Precious Metal Plating (0.25-
	0.35 µm thickness).

LCA PROCESSES:	
Process phase: Brass Turning	
	 Brass bar consumption per metal accessory.
	• Recycled material in Brass bars (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	Energy consumption for Brass turning machine
	in kWh.
	Number of turned accessories produced per
	minute.
	• Water consumption per accessory in m ³
	Oil consumption per accessory in kg







	 Number of ion-exchange (e.g., 2 cationic and 2 anional lifespan) 	e resins and lifespan onic resins, 24 months
	 Acid for cationic resi kg/month 	ns regeneration in
	 Base for anionic resi kg/month 	ns regeneration in
LIMIT VALU	ES FOR IMPACT CATEGORIES	5
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.058
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.84 – 8.61 E-5
Water Deprivation Potential (WDP)	m ³ water eq.	0.16
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.82 E-09
Ecotoxicity: Acidification potentia (AP) and Eutrophication Potentia (EP)	mol H+ eq. – mol P eq.	3.8 E-03 – 3.5 E-5
Human Toxicity (UseTox2)	CTUh/kg	8.53 E-11

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5.2. TURNED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL

This paragraph reports the requirements and limit impact values for metal hardware accessories made of turned brass and a subsequent surface plating treatment for the deposition of a Nickel-free layer with 3-4 µm thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness.

The turned metal hardware undergoes polishing after turning operations, degreasing,
neutralization and the other plating steps. After the final washing step, the plated metal
hardware is dried in an oven.

Functional/declared unit:	1 gram (g) of turned Brass metal hardware and 1 square decimeter (dm ²) of surface
	treatment with Nickel-free Plating (3-4 μ m
	thickness) and Precious Metal Plating (0.25-
	0.35 µm thickness).



Process phase: Brass Turning	
	Brass bar consumption per metal accessory
	Recycled material in Brass bars (e.g., 70% of
	Copper is recycled).
	New Brass/recycled Brass ratio at standard
	operating conditions (e.g., 40/60).
	• Energy consumption for Brass turning machine
	in kWh.
	• Number of turned accessories produced per
	minute.
	• Water consumption per accessory in m ³
	Oil consumption per accessory in kg
	Turning waste processes per metal accessory
Process phase: Polishing (Optional)	
	Polishing time per metal accessory.
	Polishing waste processes per metal accessory
Process phase: Plating	
	• DC rectifiers energy consumption in kWh/dm ²
	for each plating bath.
	• Heaters energy consumption in kWh/dm ² for
	each plating bath.
	Pumping operations energy consumption in kWh/dm ² for each plating bath.
	• Extraction system energy consumption in
	kwn/dm ⁻ for each plating bath.
	• Consumption of plating material and/or additives per dm ² .
	Percentage of recycled material in plating material and/or additives
	• Oven energy consumption in kWh per
	Water consumption per accessory
	Emissions in air per metal accessory
	Plating waste processes per metal accessory
Process phase: Wastewater	
	• Wastewater in m ³ per accessory

Water Deprivation Potential

Human Toxicity (UseTox2)

Ozone Depletion Potential (ODP)

Ecotoxicity: Acidification potential

(AP) and Eutrophication Potential

(WDP)

(EP)



	Cyanide destruction in kg of reagent (e.g. Sodium hypochlorite 15 %m/m) per accessory			
	 pH regulators (e.g., Sulfor accessory 	pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory		
Process phase: Other Waste				
	• Spent plating baths in kg	Spent plating baths in kg per accessory		
	• Sludge from filter press ir	Sludge from filter press in kg per accessory		
Process phase: Water				
Regeneration System (Optional)				
	Water flow in m ³ /h			
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)			
	 Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan) 			
	 Acid for cationic resi kg/month 	ns regeneration in		
	 Base for anionic resi kg/month 	ns regeneration in		
LIMIT VALU	ES FOR IMPACT CATEGORIES	5		
IMPACT CATEGORY	UNIT	LIMIT VALUES		
Global Warming Potential (GWP)	kg CO ₂ eq.	0.051		
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.70 – 2.16 F-5		

m³ water eq.

kg CFC-11 eq.

eq.

CTUh/kg

mol H+ eq. – mol P

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5.3. TURNED BRASS + NICKEL PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
accessories made of turned brass and a subsequent surface plating treatment for the
deposition of a Nickel layer with 10-13 µm thickness and a final varnish layer.

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0.07

1.83 E-09

1.5 E-03 – 1.1 E-4

2.07 E-10

The turned metal hardware undergoes polishing after turning operations, degreasing,
 neutralization and the other plating steps. After the plating steps, the plated metal hardware
 is varnished and dried in an oven.

- 333 This product category can be selected also for cataphoretic varnish coating.
- 334 Requirements:

Functional/declared unit:	1 gram (g) of turned Brass metal hardware and 1 square decimeter (dm ²) of surface	
	treatment with Nickel Plating (10-13 µn thickness) and final varnish layer.	

LCA PROCESSES:			
Process phase: Brass Turning			
	 Brass bar consumption per metal accessory. 		
	• Recycled material in Brass bars (e.g., 70% of		
	Copper is recycled).		
	New Brass/recycled Brass ratio at standard		
	operating conditions (e.g., 40/60).		
	 Energy consumption for Brass turning machine in kWh. 		
	• Number of turned accessories produced per minute.		
	• Water consumption per accessory in m ³		
	Oil consumption per accessory in kg		
	Turning waste processes per metal accessory		
Process phase: Polishing (Optional)			
	 Polishing time per metal accessory. 		
	 Polishing waste processes per metal accessory 		
Process phase: Plating			
	• DC rectifiers energy consumption in kWh/dm ²		
	for each plating bath.		
	• Heaters energy consumption in kWh/dm ² for		
	each plating bath.		
	Pumping operations energy consumption in		
	kWh/dm ² for each plating bath.		
	Extraction system energy consumption in		
	kWh/dm ² for each plating bath.		





	• Consumption of plating material and/or additives per dm ² .		
	 Percentage of recycled material in plating material and/or additives. 		
	Oven energy consumption in kWh per accessory		
	Water consumption per accessory		
	Emissions in air per metal accessory		
	Plating waste processes per metal accessory		
Process phase: Wastewater			
•	• Wastewater in m ³ per accessory		
	Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	• pH regulators (e.g., Sulforic Acid 50 %m/m) per		
	accessory		
Process phase: Other Waste			
	• Spent plating baths in kg per accessory		
	Sludge from filter press in kg per accessory		
Process phase: Water			
Regeneration System (Optional)			
	• Water flow in m ³ /h		
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)		
	• Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan)		
	Acid for cationic resins regeneration in kg/month		
	Base for anionic resins regeneration in kg/month		
Process phase: Varnish			
	kg of varnish per kg accessory		
	Oven energy consumption in kWh per		
	accessory (for hsnd-spraying only)		
	• Water consumption in m ³ per kg accessory		
	• DC rectifiers energy consumption in kWh/dm ²		



LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO ₂ eq.	0.043	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.68 – 5.7 E-5	
Water Deprivation Potential (WDP)	m ³ water eq.	0.11	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.36 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	2.6 E-03 – 2.4 E-5	
Human Toxicity (UseTox2)	CTUh/kg	5.89 E-11	

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5.4. TURNED BRASS + NICKEL-FREE PLATING + VARNISH

This paragraph reports the requirements and limit impact values for metal hardware
 accessories made of turned brass and a subsequent surface plating treatment for the
 deposition of a Nickel-free layer with 3-4 µm thickness and a final varnish layer.

The turned metal hardware undergoes polishing after turning operations, degreasing,
neutralization and the other plating steps. After the plating steps, the plated metal hardware
is varnished and dried in an oven.

343 This product category can be selected also for cataphoretic varnish coating.

Functional/declared unit:	1 gram (g) of turned Brass metal hardware	
	and 1 square decimeter (dm ²) of surface	
	treatment with Nickel-free Plating (3-4 µm	
	thickness) and final varnish layer.	

LCA PROCESSES:			
Process phase: Brass Turning			
	Brass bar consumption per metal accessory.		
	Recycled material in Brass bars (e.g., 70%		
	Copper is recycled).		
	New Brass/recycled Brass ratio at standard		
	operating conditions (e.g., 40/60).		



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LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO ₂ eq.	0.040	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.59 – 1.52 E-5	
Water Deprivation Potential (WDP)	m ³ water eq.	0.06	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.42 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.1 E-03 – 7.9 E-5	
Human Toxicity (UseTox2)	CTUh/kg	1.47E-10	

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5.5. TURNED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + VARNISH

348 This paragraph reports the requirements and limit impact values for metal hardware 349 accessories made of turned brass and a subsequent surface plating treatment for the



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- deposition of a Nickel-free layer with 3-4 µm thickness, a Precious Metal layer (Gold,
 Palladium, or Palladium/Nickel alloy) of 0.25-0.35 µm thickness, and a final varnish layer.
- The turned metal hardware undergoes polishing after turning operations, degreasing,
 neutralization and the other plating steps. After the plating steps, the plated metal hardware
 is varnished and dried in an oven.
- 355 This product category can be selected also for cataphoretic varnish coating.
- 356 Requirements:

Functional/declared unit:	1 gram (g) of turned Brass metal hardware
	and 1 square decimeter (dm ²) of surface
	treatment with Nickel-free Plating (3-4 μ m
	thickness), Precious Metal Plating (0.25-0.35
	µm thickness) and final varnish layer.

LCA PROCESSES:			
Process phase: Brass Turning			
	 Brass bar consumption per metal accessory. 		
	 Recycled material in Brass bars (e.g., 70% of Copper is recycled). 		
	New Brass/recycled Brass ratio at standard operating conditions (e.g., 40/60).		
	Energy consumption for Brass turning machine in kWh.		
	 Number of turned accessories produced pe minute. 		
	• Water consumption per accessory in m ³		
	Oil consumption per accessory in kg		
	 Turning waste processes per metal accessory 		
Process phase: Polishing (Optional)			
	 Polishing time per metal accessory. 		
	 Polishing waste processes per metal accessory 		
Process phase: Plating			
	 DC rectifiers energy consumption in kWh/dm² for each plating bath. 		
	 Heaters energy consumption in kWh/dm² for each plating bath. 		



	 Pumping operations energy consumption in kWh/dm² for each plating bath 		
	 Extraction system energy consumption in kWh/dm² for each plating bath. 		
	 Consumption of plating material and/or additives per dm². 		
	 Percentage of recycled material in plating material and/or additives. 		
	 Oven energy consumption in kWh per accessory 		
	Water consumption per accessory		
	Emissions in air per metal accessory Plating waste processes per metal accessory		
Process phase: Wastewater	Flating waste processes per metal accessory		
	Wastewater in m ³ per accessory		
	• Cyanide destruction in kg of reagent (e.g.		
	Sodium hypochlorite 15 %m/m) per accessory		
	 pH regulators (e.g., Sulforic Acid 50 %m/m) per accessory 		
Process phase: Other Waste			
	Spent plating baths in kg per accessory		
	Sludge from filter press in kg per accessory		
Process phase: Water Regeneration System (Optional)			
•	• Water flow in m ³ /h		
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)		
	 Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan) 		
	 Acid for cationic resins regeneration in kg/month 		
	Base for anionic resins regeneration in kg/month		
Process phase: Varnish			
	kg of varnish per kg accessory		
	 Oven energy consumption in kWh per accessory (for hsnd-spraying only) 		



•	Water consumption in m ³ per kg accessory		
•	DC rectifiers energy consumption in kWh/dm ²		
	(for cataphoretic varnish only).		
LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO ₂ eq.	0.050	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.73 – 1.9 E-5	
Water Deprivation Potential (WDP)	m ³ water eq.	0.07	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.75 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.3 E-03 – 9.7 E-5	
Human Toxicity (UseTox2)	CTUh/kg	1.81 E-10	



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6. METAL HARDWARE MADE OF MIM STEEL

Metal Injection Molded (MIM) Steel is tipically obtained starting from a powder supply of mixed metals and waxes (polymers). The supply is melted and injected into molds to obtain the so-called "green" part. The green part is then generally solvent-dewaxed (with eater or organic solvent) and thermally de-waxed in a furnace to obtain a metal porous part called "brown" part. The brown part undergoes eventually sintering in a furnace to obtain the final metal accessory.

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6.1. MIM STEEL + PVD (PHYSICAL VAPOUR DEPOSITION)

This paragraph reports the requirements and limit impact values for metal hardware accessories made of MIM steel and a subsequent surface PVD treatment for the deposition of a metat, metal nitride or metal carbide layer of 0.3-0.6 µm thickness.

The MIM metal hardware undergoes polishing, washing in an sonicated water, drying in ovenand, eventually, the PVD treatment.

Functional/declared unit:	1 gram (g) of MIM Steel metal hardware and
	1 square decimeter (dm ²) of PVD surface
	treatment (0.3-0.6 µm thickness).

LCA PROCESSES:	
Process phase: Metal Injection	
Moulding of Steel	
-Injection	Supply powder consumption per metal
	accessory.
	• Recycled material in supply powder (e.g., 90%
	of Iron is recycled).
	• Energy consumption for injection machine in
	kWh.
	• Energy consumption for injection chiller
	machine in kWh.
	• Number of "green" parts produced per minute.
-De-waxing	• Water/solvent consumption per accessory in m ³
	• Energy consumption for bath heating machine
	in kWh.



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LEAF HARDWARE - PRODUCT CATEGORIES and IMPACT LIMIT VALUES

(AP) and Eutrophication Potential

Human Toxicity (UseTox2)

(EP)



	 Recycled material in security Titanium is recycled). 	ource (e.g., 65% of	
	Energy consumption (including pumping operation)	of PVD machine ations) in kWh.	
	Technical gas consumption for PVD treatment in Nm ³ per accessory.		
	 Reaction gas consumption (if any) for PVD treatment in Nm³ per accessory. 		
	Number of PVD coatings produced per hour.		
	PVD waste processes per metal accessory		
LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO ₂ eq.	0.400	
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	4.75 – 3.26 E-6	
Water Deprivation Potential (WDP)	m ³ water eq.	0.15	
Ozone Depletion Potential (ODP	kg CFC-11 eq.	5.05 E-09	
Ecotoxicity: Acidification potentia			

mol H+ eq. – mol P

eq.

CTUh/kg

374

2.0 E-03 – 8.2 E-5

1.4 E-10