

PRODUCT CATEGORIES and IMPACT LIMIT VALUES

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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.

Product categories are classified depending on the different base materials and surface 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.

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



PRODUCT CATEGORIES

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 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m thickness.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an utltrasound bath, pickling, 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 die-cast Zamak metal hardware and 1 square decimeter (dm²) 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	
Process phase: Polishing	accessory	
(Optional)		
(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	2000000.j	
	Spent plating baths in kg per accessory	
	Sludge from filter press in kg per accessory	
Process phase: Water	<u> </u>	
Regeneration System (Optional)		
	Water flow in m³/h	



, ,	of water is reused, 20%		
,	a resins and lifesnan		
3	•		
lifespan)	onic resins, 24 months		
Acid for cationic resi	ns regeneration in		
kg/month			
Base for anionic resi	ns regeneration in		
kg/month			
<u> </u>			
LIMIT VALUES FOR IMPACT CATEGORIES			
UNIT	LIMIT VALUES		
kg CO ₂ eq.	0.119		
(MJ – kg Sb eq.)	1.7 – 4.68 E-5		
2 .			
m³ water eq.	0.57		
kg CFC-11 eq.	2.52 E-09		
· ·			
eq.	6.2 E-03 – 1.7 E-4		
CTUh/kg	3.54 E-10		
	Acid for cationic resi kg/month Base for anionic resi kg/month S FOR IMPACT CATEGORIES UNIT kg CO ₂ eq. (MJ – kg Sb eq.) m³ water eq. kg CFC-11 eq. mol H+ eq. – mol P eq.		

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 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m thickness.

The die-cast metal hardware undergoes polishing after die-casting, degreasing in an utltrasound bath, pickling, 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 die-cast Zamak metal
	hardware and 1 square decimeter (dm²) of
	surface treatment with Nickel Plating (10-13



	did a la l	
	μm thickness) and Precious Metal Plating (0.25-0.35 μm thickness).	
	(0.23-0.33 μπ tinickness).	
	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 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 p	•
Process phase: Wastewater		,
•	Wastewater in m ³ per acc	essory
•	Cyanide destruction in	kg of reagent (e.g.
	Sodium hypochlorite 15 %	
•	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 in	kg per accessory
Process phase: Water		
Regeneration System		
(Optional)		
•	Water flow in m ³ /h	(-1'
•	Efficiency in % (e.g., 80% c	of water is reused, 20%
•	is waste)	a racine and lifeenan
	Number of ion-exchange (e.g., 2 cationic and 2 anic	•
	lifespan)	The resins, 24 months
•	Acid for cationic resi	ns regeneration in
	kg/month	
•	Base for anionic resi	ns regeneration in
	kg/month	
LIMIT VALUES	FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO₂ eq.	0.082
Resources Use Fossil (RUF) and	(MJ – kg Sb eq.)	
Non-Fossil (RUnF)	(1 9 1 1 1)	1.14 – 4.8 E-5
Water Deprivation Potential	m³ water eq.	
(WDP)	•	0.41
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	2.22 E-09
Ecotoxicity: Acidification potential	mol H+ eq. – mol P	
(AP) and Eutrophication Potential (EP)	eq.	2.2 E-03 – 1.6 E-4
Human Toxicity (UseTox2)	CTUh/kg	3.0 E-10
Human Toxicity (USETOXZ)	CTOTI/Kg	3.0 E-10

1.3. DIE-CAST ZAMAK + NICKEL 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 layer with 10-13 µm thickness and a final varnish layer.

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

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

Functional/declared unit:	1 gram (g) of die-cast Zamak metal
a ranctional, accidica anic.	hardware and 1 square decimeter (dm ²) of
	surface treatment with Nickel Plating (10-13
	μm thickness) with final varnish layer.
	pin enekness) with mar variish 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 access	
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,	
	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		
•	1	



<u> </u>		
	• kg of varnish per kg acc	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	only).
LIMIT VALU	ES FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO₂ eq.	0.095
Resources Use Fossil (RUF) and	(MAL lan Chann)	
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	1.41 – 3.5 E-5
Water Deprivation Potential	3atau aa	
(WDP)	m³ water eq.	0.43
Ozone Depletion Potential (ODP)	kg CF-C11 eq.	2.07 E-09
Ecotoxicity: Acidification potentia	mol Hung mol D	
(AP) and Eutrophication Potential	mol H+ eq. – mol P	
(EP)	eq.	4.6 E-03 – 1.3 E-4
Human Toxicity (UseTox2)	CTUh/kg	2.7 E-10

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 utltrasound bath, pickling, neutralization and the other plating steps. After the final plating steps, the plated metal hardware is varnished and dried in an oven.

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

Functional/declared unit:	1 gram (g) of die-cast Zamak metal hardware and 1 square decimeter (dm²) of surface treatment with Nickel-free Plating (3-4 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/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 ac	
	•	Cyanide destruction in	
		Sodium hypochlorite 15	•
	•	pH regulators (e.g., Sulf	foric Acid 50 %m/m)
		per accessory	
Process phase: Other Waste			
	•	Spent plating baths in kg	g per accessory
	•	Sludge from filter press i	n kg per accessory
Process phase: Water			
Regeneration System (Optional)			
	•	Water flow in m ³ /h	
	•	Efficiency in % (e.g., 809	% of water is reused,
		20% is waste)	
	•	Number of ion-exchang	e resins and lifespan
		(e.g., 2 cationic and 2	2 anionic resins, 24
		months lifespan)	
	•	Acid for cationic resi	ins regeneration in
		kg/month	
	•	Base for anionic resi	ns regeneration in
		kg/month	
Process phase: Varnish			
	•	kg of varnish per kg acce	essory
	•	Oven energy consum	ption in kWh per
		accessory (for hsnd-spra	ying only)
	•	Water consumption in m	n ³ per kg accessory
	•	DC rectifiers energy cons	sumption in kWh/dm ²
		(for cataphoretic varnish	only).
LIMIT VALU	UES	FOR IMPACT CATEGORIES	
IMPACT CATEGORY		UNIT	LIMIT VALUES
Global Warming Potential (GWP	P)	kg CO₂ eq.	0.053
Resources Use Fossil (RUF) and			
Non-Fossil (RUnF)		(MJ – kg Sb eq.)	0.78 – 2.9 E-5
Water Deprivation Potential		ma ³ vyoto z a z	
(WDP)		m³ water eq.	0.25
Ozone Depletion Potential (ODF	P)	kg CFC-11 eq.	1.47 E-09
Ecotoxicity: Acidification potenti		•	
(AP) and Eutrophication Potentia	al	mol H+ eq. – mol P	
(EP)		eq.	1.3 E-03 – 9.6 E-5



Human Toxicity (UseTox2)	CTUh/kg	1.8 E-10

1.5. DIE-CAST ZAMAK + NICKEL-FREE PLATING + PRECIOUS METAL + 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, a Precious Metal layer (Gold, 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 utltrasound bath, pickling, neutralization and the other plating steps. After the final plating steps, the plated metal hardware is varnished and dried in an oven.

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

Functional/declared unit:	1 gram (g) of die-cast Zamak metal hardware and 1 square decimeter (dm²) of surface treatment with Nickel-free Plating (3-4 μm thickness), Precious Metal Plating (0.25-0.35 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/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 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 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,
	20% is waste)



	 Number of ion-exchange (e.g., 2 cationic and 2 months lifespan) Acid for cationic reskg/month Base for anionic reskg/month 	2 anionic resins, 24 ins regeneration in
Process phase: Varnish	kg/month	
	 kg of varnish per kg according 	essory
	 Oven energy consum accessory (for hsnd-spra 	ption in kWh per
	 Water consumption in m 	n ³ per kg accessory
	 DC rectifiers energy cons (for cataphoretic varnish 	•
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IMPACT CATEGORY	S FOR IMPACT CATEGORIES 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 (WDP)	m³ water eq.	0.51
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	3.01 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	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 mold where it solidifies as it rapidly cools down.

2.1. HOT-STAMPED BRASS + NICKEL 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 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 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.

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal hardware and 1 square decimeter (dm²) 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 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
Duogasa mbasas Balishina	accessory
Process phase: Polishing	
(Optional)	Polishing time per metal accessory.
	 Polishing waste processes per metal accessory
Process phase: Plating	1 Olishing waste processes per metal accessory
1 rocess phase. I family	DC rectifiers energy consumption in kWh/dm² for each plating both
	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., 8	0% of	water is reused, 20%
		is waste)	_		
	•	Number of	ion-exch	nange	resins and lifespan
				_	nic resins, 24 months
		lifespan)			
	•	Acid for	cationic	resin	s regeneration in
		kg/month			
	•	Base for	anionic	resins	s regeneration in
		kg/month			
LIMIT VAL	LUES	FOR IMPAC	T CATEGO	RIES	
IMPACT CATEGORY		UN	VIT		LIMIT VALUES
Global Warming Potential (GW	P)	kg CO₂	eq.		0.075
Resources Use Fossil (RUF) and	l	(MI – kı	g Sb eq.)		
Non-Fossil (RUnF)		(1415 14)	9 55 64.7		1.16 – 9.52 E-5
Water Deprivation Potential		m³ wate	er ea		
(WDP)		iii wat			0.38
Ozone Depletion Potential (OD	P)	kg CFC	-11 eq.		2.09 E-09
Ecotoxicity: Acidification poten	tial	mol ⊔⊥	eq. – mo	ı D	
(AP) and Eutrophication Potent	tial		eq. – 1110	יו ר	
(EP)		eq.			4.0 E-03 – 3.8 E-5
Human Toxicity (UseTox2)		CTUh/k	.g		9.31 E-11

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 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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.

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal
	hardware and 1 square decimeter (dm²) of



	surface treatment with Nickel-free Plating
	(3-4 µm thickness) and Precious Metal
	Plating (0.25-0.35 µm thickness).
LC	CA 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)	B. II. L
	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	
Process phase: Water Regeneration System	
-	
Regeneration System	Water flow in m ³ /h
Regeneration System	Water flow in m ³ /h Efficiency in % (e.g., 80% of water is reused, 20%
Regeneration System	
Regeneration System	Efficiency in % (e.g., 80% of water is reused, 20%
Regeneration System (Optional) •	Efficiency in % (e.g., 80% of water is reused, 20% is waste)
Regeneration System (Optional) •	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)
Regeneration System (Optional) •	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
Regeneration System (Optional) •	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
Regeneration System (Optional) •	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
Regeneration System (Optional) •	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
Regeneration System (Optional) • • • • • •	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
Regeneration System (Optional)	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
Regeneration System (Optional) LIMIT VALUE IMPACT CATEGORY	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 S FOR IMPACT CATEGORIES UNIT LIMIT VALUES
Regeneration System (Optional) LIMIT VALUE IMPACT CATEGORY Global Warming Potential (GWP)	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
Regeneration System (Optional) LIMIT VALUE IMPACT CATEGORY Global Warming Potential (GWP) Resources Use Fossil (RUF) and	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 S FOR IMPACT CATEGORIES UNIT LIMIT VALUES kg CO ₂ eq. (MJ – kg Sb eg.)
Regeneration System (Optional) LIMIT VALUE IMPACT CATEGORY Global Warming Potential (GWP) Resources Use Fossil (RUF) and Non-Fossil (RUF)	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 S FOR IMPACT CATEGORIES UNIT LIMIT VALUES
Regeneration System (Optional) LIMIT VALUE IMPACT CATEGORY Global Warming Potential (GWP) Resources Use Fossil (RUF) and Non-Fossil (RUF) Water Deprivation Potential	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 S FOR IMPACT CATEGORIES UNIT LIMIT VALUES kg CO ₂ eq. (MJ – kg Sb eq.) 0.98 – 2.87 E-5 m³ water eq.
Regeneration System (Optional) LIMIT VALUE IMPACT CATEGORY Global Warming Potential (GWP) Resources Use Fossil (RUF) and Non-Fossil (RUF)	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 S FOR IMPACT CATEGORIES UNIT LIMIT VALUES kg CO ₂ eq. (MJ – kg Sb eg.)



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/kg	2.2 E-10

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.

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

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal hardware and 1 square decimeter (dm²) 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 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)	5 1:1: ::		
	Polishing time per metal accessory. Polishing transfer and accessory.		
Dunana ulana Diatina	Polishing waste processes per metal accessory		
Process phase: Plating	DC restifiers are are a secure at in 194/b/das2		
	 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/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 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% o is waste)	f water is reused, 20%
•	Number of ion-exchange (e.g., 2 cationic and 2 anic lifespan)	'
•	Acid for cationic resi kg/month	ns regeneration in
•	Base for anionic residus kg/month	ns regeneration in
Process phase: Varnish		
•	kg of varnish per kg acces	ssory
•	Oven energy consumpaccessory (for hsnd-spray	•
•	Water consumption in m ³	
•	DC rectifiers energy cons (for cataphoretic varnish o	umption in kWh/dm²
		<i></i>
LIMIT VALUES	FOR IMPACT CATEGORIES	
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 (WDP)	m³ water eq.	0.26
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.56 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	2.7 E-03 – 2.6 E-5
Human Toxicity (UseTox2)	CTUh/kg	6.46 E-11

2.4. HOT-STAMPED BRASS + NICKEL-FREE 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-free layer with 3-4 μ m 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.

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

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal hardware and 1 square decimeter (dm²) 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)		
(aptional)	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	i i i i i i i i i i i i i i i i i i i
	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 decessory
	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 consump	•
	accessory (for hsnd-spray	ing only)
 Water consumption in m³ 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.	0.052
Resources Use Fossil (RUF) and	(NAL los Classes)	
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.81 – 2.1 E-5
Water Deprivation Potential	3	
(WDP)	m³ water eq.	0.20
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.64 E-09
Ecotoxicity: Acidification potential	mad III. an mad D	
(AP) and Eutrophication Potential	mol H+ eq. – mol P	
(EP)	eq.	1.2 E-03 – 8.4 E-5
Human Toxicity (UseTox2)	CTUh/kg	1.57 E-10

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 μ m thickness, a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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.

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

Functional/declared unit:	1 gram (g) of hot-stamped Brass metal	
	hardware and 1 square decimeter (dm²) 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
December 1981	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 consump accessory	otion in kWh per	
•	144	ccessory	
•	•	Emissions in air per metal accessory	
	Plating waste processes per metal accessory		
Process phase: Wastewater		•	
-	Wastewater in m ³ per acce	essory	
•	 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)			
•	Tracer now minning m		
•	=	f water is reused, 20%	
	is waste)		
•	rtaniber er fent ekendinge	•	
	(e.g., 2 cationic and 2 anio	nic resins, 24 months	
	lifespan)		
•	Acid for cationic resi	ns regeneration in	
	kg/month		
	Base for anionic resir kg/month	ns regeneration in	
Process phase: Varnish	ку/попш		
1 Tocess phase. Varinsii	kg of varnish per kg acces	son/	
	Oven energy consump	•	
	accessory (for hsnd-sprayi		
	Water consumption in m ³	_ • _ •	
	D.C. vic		
	(for cataphoretic varnish of	·	
	(2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	<i>,</i> ,	
LIMIT VALUE	S 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)	m³ 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

Cold-stamped brass hardware is tipically obtained from trimming of brass sheets the final form.

3.1. COLD-STAMPED BRASS + NICKEL 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 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 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.

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal hardware and 1 square decimeter (dm²) 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



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 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 VALUES	LIMIT VALUES FOR IMPACT CATEGORIES					
IMPACT CATEGORY	UNIT	LIMIT VALUES				
Global Warming Potential (GWP)	kg CO₂ eq.	0.067				
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.95 – 9.34 E-5				
Water Deprivation Potential (WDP)	m³ water eq.	0.33				
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.	4.0 E-03 – 3.6 E-5				
Human Toxicity (UseTox2)	CTUh/kg	8.72 E-11				

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 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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.

Functional/declared unit:	1 gram (g) of cold-stamped Brass metal		
	hardware and 1 square decimeter (dm²) 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 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/dm²		
	for each plating bath.		
	Heaters energy consumption in kWh/dm² for and plating both		
	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 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	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	ns regeneration in	
	kg/month		
LIMIT VALUE	S 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.)	0.80 – 2.71 E-5	
Water Deprivation Potential (WDP)	m³ water eq.	0.22	
Ozone Depletion Potential (ODP)	kg CFC-11 eg.	1.81 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential			
(EP)	CTUb/ka	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 μ m 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.

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 (dm²) 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/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	1 lating 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, 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		
•	DC rectifiers energy consumption in kWh/ (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)	m³ 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/kg	6.06 E-11	

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 μ m 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.

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 (dm²) 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)	a Doliching time nor motal accessory	
	Polishing time per metal accessory. Polishing waste processes per metal accessory.	
Process phase: Plating	Polishing waste processes per metal accessory	
Process phase. Plating	• DC rectifiers energy consumption in kWh/dm²	
	 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/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		
1 10ccss phase. Other waste	 Spent plating baths in kg 	per accessory
	Sludge from filter press in kg per accessory	
Process phase: Water Regeneration System (Optional)		<u> </u>
	 Water flow in m³/h 	
	 Efficiency in % (e.g., 80% c is waste) 	of water is reused, 20%
	 Number of ion-exchange resins and lifespare (e.g., 2 cationic and 2 anionic resins, 24 month lifespan) 	
	 Acid for cationic resinglesized kg/month 	ins regeneration in
	 Base for anionic resi kg/month 	ns regeneration in
Process phase: Varnish		
	kg of varnish per kg accessory	
	Oven energy consumption in kWh per accessory (for hsnd-spraying only)	
	 Water consumption in m³ 	³ per kg accessory
	 DC rectifiers energy cons (for cataphoretic varnish) 	·
LIMIT VALU	ES FOR IMPACT CATEGORIES	5
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO ₂ eq.	0.047
Resources Use Fossil (RUF) and Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.67 – 1.9 E-5
Water Deprivation Potential (WDP)	m³ water eq.	0.16
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.44 E-09
Ecotoxicity: Acidification potentia (AP) and Eutrophication Potentia	$M \cap M \cap$	
(EP)		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 μ m thickness, a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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.

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 (dm²) of surface treatment with Nickel-free Plating (3-4 µm thickness), Precious Metal Plating (0.25-0.35 µm thickness) and final varnish layer.
	TA DDOCECCE.
	CA 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/dm² 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		
	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	
Due cose whose Other Wests	accessory	
Process phase: Other Waste	. Count plating baths in kg par accessor.	
	Spent plating baths in kg per accessory Sludge from filter press in kg per accessory	
Dragoss phases Water	Sludge from filter press in kg per accessory	
Process phase: Water Regeneration System (Optional)		
(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	



Process phase: Varnish				
•	 kg of varnish per kg acces 	ssory		
	 Oven energy consumply accessory (for hsnd-spray) 	•		
	 Water consumption in m³ 	³ per kg accessory		
	 DC rectifiers energy cons (for cataphoretic varnish) 	•		
LIMIT VALU	LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES		
Global Warming Potential (GWP)	kg CO₂ 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)	m³ water eq.	0.20		
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.78 E-09		
Ecotoxicity: Acidification potentia (AP) and Eutrophication Potentia (EP)	MOLH + ea - mol P	1.5 E-03 – 1.0 E-4		
Human Toxicity (UseTox2)	CTUh/kg	1.89 E-10		



4. METAL HARDWARE MADE OF CNC MILLED BRASS

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

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.

- Eunstianal/declared unit:	1 gram (g) of CNC milled Prace metal	
Functional/declared unit:	1 gram (g) of CNC-milled Brass metal hardware and 1 square decimeter (dm²) of	
	surface treatment with Nickel Plating (10-13	
	um thickness) and Precious Metal Plating	
	(0.25-0.35 µm thickness).	
	(0.23-0.33 μπ τπισκτιεςς).	
	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/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 peraction 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, 20% is waste)	



•	Number of ion-exchange resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan)		
•	Acid for cationic resikg/month	ns regeneration in	
•	Base for anionic resikg/month	ns regeneration in	
LIMIT VALUES	FOR IMPACT CATEGORIES		
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO₂ 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)	m³ water eq.	0.35	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.93 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	4.1 E-03 – 3.7 E-5	
Human Toxicity (UseTox2)	CTUh/kg	9.09 E-11	

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 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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 (dm²) 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.	
	 per minute. Water consumption per accessory in m³ 	
	Oil consumption per accessory in kg	
	CNC-milling waste processes per metal	
	accessory	
Process phase: Polishing	uccessory	
(Optional)		
(0)	Polishing time per metal accessory.	
	Polishing waste processes per metal accessory	
Process phase: Plating	j	
	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 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 acc	essorv
•	Cyanide destruction in	
	Sodium hypochlorite 15 %	
•	pH regulators (e.g., Sulfor	
	accessory	
Process phase: Other Waste	•	
•	Spent plating baths in kg	per accessory
•	Sludge from filter press in	nkg 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.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	ns regeneration in
	кулпони	
LIMIT VALUES	FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO₂ eq.	0.066
Resources Use Fossil (RUF) and	(NAL Los Clo c o)	
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.88 – 2.79 E-5
Water Deprivation Potential	m³ water eq.	
(WDP)	iii watei eq.	0.24
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.96 E-09
Ecotoxicity: Acidification potential	mol H+ eq. – mol P	
(AP) and Eutrophication Potential	eq.	
(EP)		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.

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

 Functional/declared unit: 1 gram (g) of CNC-milled Brass method by the surface and 1 square decimeter (dm² surface treatment with Nickel Plating (10 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 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/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	, _F
•	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)	
C. P. C. P.	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 consumpaccessory (for hsnd-spray	•
•	Water consumption in m ³ DC rectifiers energy cons (for cataphoretic varnish of	umption in kWh/dm ²
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)	m³ 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

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 μ m 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.

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 (dm²) of surface treatment with Nickel-free Plating (3-4 µm thickness) and final varnish layer.
LCA PROCESSES:	



Process phase: Brass CNC Milling		
3	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/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 9	
	 pH regulators (e.g., Sulfor 	
	accessory	ic Acid 30 70m/m/ per
Process phase: Other Waste	uccessory	
Trocess phase. Other truste	 Spent plating baths in kg 	per accessory
	 Sludge from filter press ir 	
Process phase: Water		. ng por accessory
Regeneration System		
(Optional)		
	 Water flow in m³/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 	
	Oven energy consumptions of the consumption of	·
	accessory (for hsnd-spray	
	 Water consumption in m³ DC rectifiers energy cons 	
	 DC rectifiers energy considers (for cataphoretic varnish of the control of the contro	
	(10) Cataphoretic variish	orny).
LIMIT VALL	ES FOR IMPACT CATEGORIES	
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)		0.049
Resources Use Fossil (RUF) and	·	3.3.3
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.69 - 1.9 E-5
Water Deprivation Potential	2 .	
(WDP)	m³ water eq.	0.16
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.45 E-09
Ecotoxicity: Acidification potentia	1	
(AP) and Eutrophication Potentia	MOI H+ eq. – MOI P	
(EP)	eq.	1.1 E-03 – 7.9 E-5



Human Toxicity (UseTox2)	CTUh/kg	1.49E-10

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 μ m thickness, a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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.

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 (dm²) 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/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, 20% is waste)	



•	Number of ion-exchange (e.g., 2 cationic and 2 anic lifespan)	•	
•	Acid for cationic resi kg/month	ns regeneration in	
•	Base for anionic resikg/month	ns regeneration in	
Process phase: Varnish	-		
•	kg of varnish per kg acces	ssory	
•	Oven energy consumpaccessory (for hsnd-spray		
•	Water consumption in m ³		
•	DC rectifiers energy cons		
	(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)	m³ 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	



5. METAL HARDWARE MADE OF TURNED BRASS

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

5.1. TURNED BRASS + NICKEL 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 layer with 10-13 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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 (dm²) 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 m³ 	
	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	
	 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)	
(aparan)	Water flow in m³/h
	• Efficiency in % (e.g., 80% of water is reused, 20% is waste)
	is waste)



•	Number of ion-exchange (e.g., 2 cationic and 2 anic lifespan)	•	
•	Acid for cationic resikg/month	ns regeneration in	
•	Base for anionic resikg/month	ns regeneration in	
LIMIT VALUES	FOR IMPACT CATEGORIES		
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO₂ 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)	m³ water eq.	0.16	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.82 E-09	
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	3.8 E-03 – 3.5 E-5	
Human Toxicity (UseTox2)	CTUh/kg	8.53 E-11	

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 μ m thickness and a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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 (dm²) 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 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/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	



T		
•	Cyanide destruction in Sodium hypochlorite 15 %	
•	pH regulators (e.g., Sulfor accessory	
Process phase: Other Waste		
•	Spent plating baths in kg	per accessory
•	Sludge from filter press in	
Process phase: Water Regeneration System (Optional)	,	J 1
•	Water flow in m ³ /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 anic lifespan)	onic resins, 24 months
•	Acid for cationic resi kg/month	ns regeneration in
•	Base for anionic resi kg/month	ns regeneration in
LINALT VALLEG		•
	S FOR IMPACT CATEGORIES	
IMPACT CATEGORY Clobal Warming Potential (CWP)	UNIT	0.051
Global Warming Potential (GWP) Resources Use Fossil (RUF) and Non-Fossil (RUnF)	kg CO ₂ eq. (MJ – kg Sb eq.)	0.70 – 2.16 E-5
Water Deprivation Potential (WDP)	m³ water eq.	0.07
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.83 E-09
Ecotoxicity: Acidification potential (AP) and Eutrophication Potential (EP)	mol H+ eq. – mol P eq.	1.5 E-03 – 1.1 E-4
Human Toxicity (UseTox2)	CTUh/kg	2.07 E-10
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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.



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.

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 (dm²) of surface treatment with Nickel Plating (10-13 µm thickness) and final varnish layer.
	LCA PROCESSES:
Process phase: Brass Turning	EGATING CESSES.
	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 m³
	 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 dm ² .	
	Percentage of recycled material in plating material and/or additives.	
	 Oven energy consumption in kWh per accessory 	
	Water consumption per accessoryEmissions 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, 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 m³ per kg accessory	
	DC rectifiers energy consumption in kWh/dm² (for cataphoretic varnish only).	



LIMIT VALUES FOR IMPACT CATEGORIES		
IMPACT CATEGORY	UNIT	LIMIT VALUES
Global Warming Potential (GWP)	kg CO₂ 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)	m³ 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

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.

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 (dm²) 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% 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/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 resins and lifespan (e.g., 2 cationic and 2 anionic resins, 24 months lifespan)		
•	Acid for cationic resikg/month	ns regeneration in	
•	Base for anionic resikg/month	ns regeneration in	
Process phase: Varnish			
•	kg of varnish per kg acces	ssory	
•	Oven energy consump	otion in kWh per	
	accessory (for hsnd-spray		
•	Water consumption in m ³		
•	DC rectifiers energy consumption in kWh/dm ²		
	(for cataphoretic varnish of	only).	
LIMIT VALUES FOR IMPACT CATEGORIES			
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO₂ 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)	m³ 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	
ridilian roxidity (03c rox2)	L CTOTI/NG	1.4/L-10	

5.5. TURNED BRASS + NICKEL-FREE PLATING + PRECIOUS METAL + 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 μ m thickness, a Precious Metal layer (Gold, Palladium, or Palladium/Nickel alloy) of 0.25-0.35 μ m 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.

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 (dm²) 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 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 m³ 	
	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	<u> </u>	
•	 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	1 lating 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, 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 m³ 	Water consumption in m ³ per kg accessory	
	 DC rectifiers energy cons 	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	(MAL less Clauses)		
Non-Fossil (RUnF)	(MJ – kg Sb eq.)	0.73 – 1.9 E-5	
Water Deprivation Potential	-3 -1		
(WDP)	m³ water eq.	0.07	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	1.75 E-09	
Ecotoxicity: Acidification potentia	l malli as mal D		
(AP) and Eutrophication Potentia	mol H+ eq. – mol P		
(EP)	eq.	1.3 E-03 – 9.7 E-5	
Human Toxicity (UseTox2)	CTUh/kg	1.81 E-10	



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.

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 metal, 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 oven and, eventually, the PVD treatment.

Functional/declared unit:	1 gram (g) of MIM Steel metal hardware and 1 square decimeter (dm²) 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 m³ 	
	Energy consumption for bath heating machine in kWh.	



	Energy consumption of furnace for thermal de-	
	waxing machine in kWh.	
Cintoring	Number of "brown" parts produced per hour. Forgy consumption of furnace for sintering.	
-Sintering	 Energy consumption of furnace for sintering machine in kWh. 	
	 Technical gases consumption for sintering in Nm³ per accessory. 	
	Number of MIM steel accessories produced per	
	hour.	
	 MIM steel waste processes per metal accessory 	
Process phase: Polishing (Optional)		
	Polishing time per metal accessory.	
	 Polishing waste processes per metal accessory 	
Process phase: Pre-PVD		
	 Water consumption in m³ per accessory. 	
	 Sonicator energy consumption in kWh per accessory 	
	Pumping operations energy consumption in	
	kWh per accessory	
	 Oven energy consumption in kWh per accessory 	
	Pre-PVD waste processes per metal accessory	
Process phase: Water Regeneration System		
(Optional)	- Matauflauria as 3 /la	
	Water flow in m³/h Efficiency in % (a.g. 80% of water is roused 20%)	
	 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: PVD Treatment	-	



•	Recycled material in so	ource (e.g., 65% of	
	Titanium is recycled).		
•	Energy consumption	of PVD machine	
(including pumping operations) in kWh.		ations) in kWh.	
•	 Technical gas consumption for PVD treatment 		
	in Nm³ per accessory.		
•	Reaction gas consumption (if any) for		
	treatment in Nm³ per accessory.		
Number of PVD coat		produced per hour.	
•	PVD waste processes per metal accessory		
		_	
LIMIT VALUES	LIMIT VALUES FOR IMPACT CATEGORIES		
IMPACT CATEGORY	UNIT	LIMIT VALUES	
Global Warming Potential (GWP)	kg CO₂ eq.	0.400	
Resources Use Fossil (RUF) and	(MJ – kg Sb eq.)		
Non-Fossil (RUnF)		4.75 – 3.26 E-6	
Water Deprivation Potential	m³ water eq.		
(WDP)		0.15	
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	5.05 E-09	
Ecotoxicity: Acidification potential	mol H+ eq. – mol P		
(AP) and Eutrophication Potential	· ·		
(EP)	eq.	2.0 E-03 – 8.2 E-5	
Human Toxicity (UseTox2)	CTUh/kg	1.4 E-10	