Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

Ring set

from

MMC RYOTEC CORPORATION

MMC RYOTEC Corporation
A Group Company of MITSUBISHI MATERIALS

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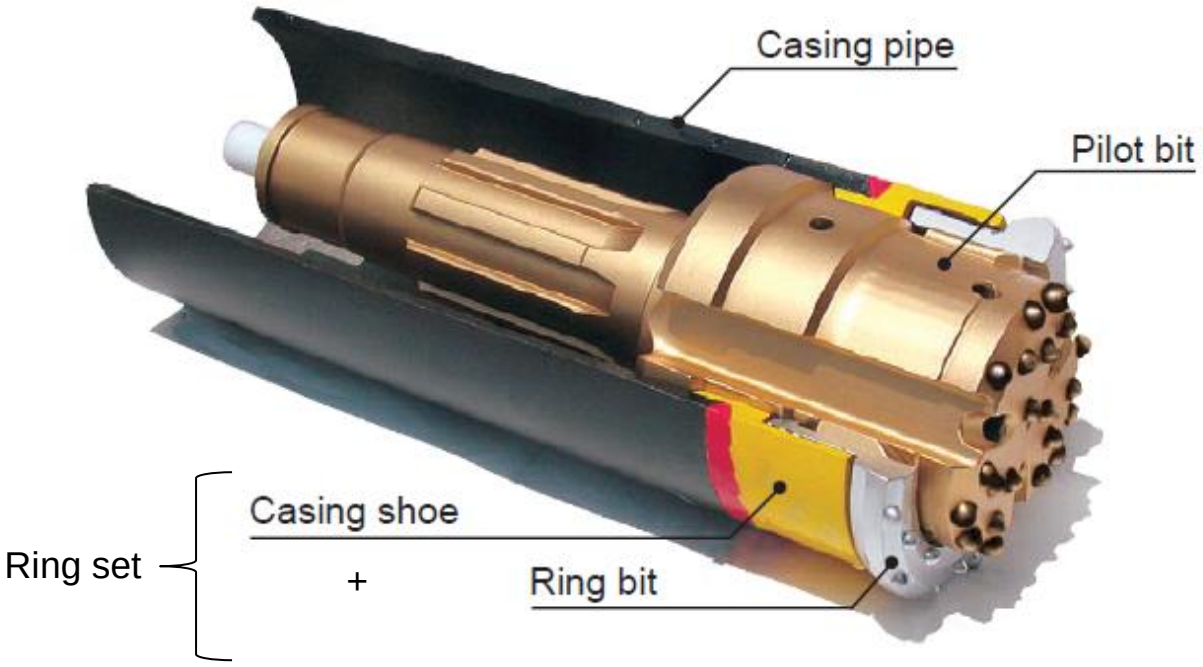


General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): *CONSTRUCTION PRODUCTS, PCR 2019:14, VERSION 1.3.4*
PCR review was conducted by: *The Technical Committee of the International EPD System*
Life Cycle Assessment (LCA)
LCA accountability: *(Dr.) Selim Karkour, TCO2 Co.,Ltd*
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier      Third-party verifier: *Mamoru Yanagisawa, Japan Gas Appliances Inspection Association (JIA)* Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply

identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD: MMC RYOTEC CORPORATION
Contact: Michihiko Yamamoto
Description of the organisation: Manufacture and Sale of the engineered carbide products (Wear Resistant Tools, Rock Tools, Carbide Materials etc.)
Product-related or management system-related certifications: ISO 9001
Name and location of production site(s): MMC Ryotec Corporation Rock Tools Plant, Gifu Japan

Product information

Product name: Ring set
Product identification: UB, UM, UN, US, UT series
Product description: The ring set is composed of ring bit and casing shoe. The ring set is a percussion drilling tool welded to the end of a steel pipe.
It is used for excavation and simultaneous burial of steel pipes in unstable formations such as sand, gravel, and cobble stones.
UN CPC code: 41286
Geographical scope: Product manufactured in Japan and sold in Sweden (EoL is performed in Sweden)

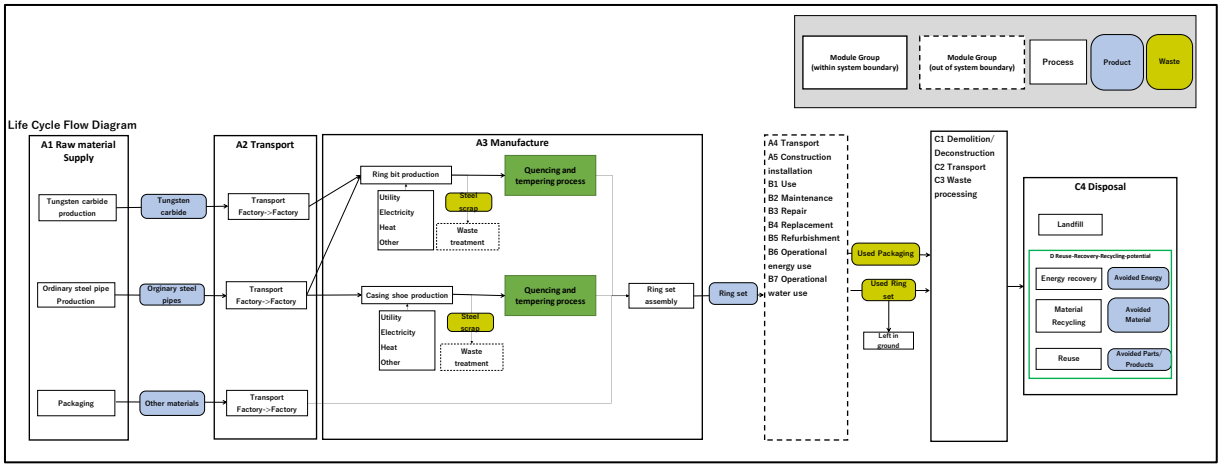
LCA information

Declared unit: 1 kg of a Ringset
Reference service life: Not applicable
Time representativeness: The time representativeness of the primary data used in this study is the year 2021-2022 (April 2021 to March 2022).
Database(s) and LCA software used: SimaPro was used as software with Ecoinvent 3.10 database with the cut-off system model.
In this study, cut-offs were made for processes for which data collection was presumed to be difficult or for which the contribution of the load was considered small. The cut-off items are listed below.

- Construction of production facilities such as factories, transportation facilities such as cars, ships, trains, and roads, and capital goods used for multiple years
- Processes (utilities for production of packaging materials (raw materials for the packaging materials were included)
- It was verified that the Life cycle inventory data in accordance with EN 15804 includes a minimum of 95% of total inflows (mass and energy) per module.

Description of system boundaries:
Cradle to gate with modules C1–C4 and module D (A1–A3 + C + D)

System diagram:



More information: http://www.ryotec.co.jp/en/pdf/products/mrt/RT12-E-1_UltraMaxbit_20210324.pdf
Name and contact information of LCA practitioner: LCA conducted by Selim Karkour, TCO2 Co. Ltd.
Additional information: The LCA was conducted using the LCI database ecoinvent 3.10 contained inside SimaPro v9.6.

This EPD covers UB, UM, UN, US, UT series of the ring sets. It was chosen to conduct an LCA for the representative product as proposed as one of the options by the PCR. To conduct the LCA for the representative product, the mass and the annual stock of each product were provided by MMC. By multiplying the mass with the number of units it was decided to conduct the LCA for UB123LLR-1103WRS. The details concerning the annual stock of the representative product as well as a description of each model is provided below:

Product number	Total production (Units)	Share (%)
UB123LLR-1103WRS	5,350	28%
Total	19,215	

Model	Type		Description
UB	Big Bore Type		・Suitable for larger bored piling which offers stronger foundations. ・Interlinked ring set.
UN	Standard Type	Normal use	・Suitable for heavy duty single pass and longer hole depth. ・Leaving a casing pipe in the ground. ・Thread connection ring set.
US		Single pass model	・Suitable for relatively soft ground and short hole depth. ・Leaving a casing pipe in the ground. ・Thread connection ring set.
UM		Multi use	・Pulling force to remove casing is reduced. ・This enables the casing pipe to be re-used. ・Interlinked ring set.
UT	Top Hammer Type		・Suitable for small hole tunneling. ・Thread connection ring set.

Stages A1-A3 were assessed using primary data, while C1-C4, D were assessed using secondary data.
Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

Process	Source type	Source	Reference year	Data category	Share of primary data, of GWP-GHG results for A1-A3
Amount of raw materials for product	Collected data	EPD owner	2021-2022	Primary data	29%
Amount of packaging	Collected data	EPD owner	2021-2022	Primary data	1%
Transportation distance to the manufacturing site	Collected data	EPD owner	2021-2022	Primary data	1%
Manufacturing of product (utilities)	Collected data	EPD owner/Confidential	2021-2022	Primary data	69%

In A1-A3, the electricity is based on the Japanese grid mix (678 g CO2 eq./kWh, technological reference year 2014 with the shares of electricity technologies on this market are valid for the year 2020)

Transportation of raw materials to the ring set manufacturing plant is assumed to be made by a 3.5-7.5 metric ton, Euro 6 lorry. Transportation to the heating treatment is assumed to be made by 7.5-16 metric ton, Euro 6 lorry.

The technology of the manufacturing process of the ring bit and casing shoe consists of the following steps:
->Lathing
->Milling
->Heat treatment
->Cutting

In C3, D, average recycling/recovery rates were assumed based on the secondary data for Sweden. Only the packaging is recycled, the ring set is left in the ground after utilization. The following assumptions were taken for the End-of-life based on the product category rule documentation and the information contained inside the ecoinvent database:

Cardboard packaging recycling rate	75%
Plastic packaging recycling rate	34%
Incineration rate when the material is not recycled	99%
Landfill rate when the material is not recycled	1%

Credits from the recycling stage were taken into account, while the credits for energy recovery were considered negligible. For the recycling stage, the GHG emissions from the recycling process were collected from secondary sources. The credits were calculated by multiplying the recycling rates with the average weight of each material contained in the packaging. It was then considered that the average recycled packaging weight can avoid the same amount of production of virgin materials.

No original impact assessment method was implemented; therefore, the calculation can be reproduced. The following impact assessment methods were used for this assessment:

Note that in accordance with the PCR; to balance the biogenic carbon, a virtual emission of biogenic CO2 was added to the module from which the carbon leaves the studied product system i.e. in module C (C3).

ID	Impact Category	Indicator	Unit	Model
1	Climate change -total	Global Warming Potential total (GWP-total)	kg CO2 eq.	Baseline model of 100 years of the IPCC based on IPCC 2013
2	Climate change -fossil	Global Warming Potential fossil fuels (GWP-fossil)	kg CO2 eq.	Baseline model of 100 years of the IPCC based on IPCC 2013
3	Climate change -biogenic	Global Warming Potential biogenic (GWP-biogenic)	kg CO2 eq.	Baseline model of 100 years of the IPCC based on IPCC 2013
4	Climate change -land use and land use changeb	Global Warming Potential land use and land use change (GWP-luluc)	kg CO2 eq.	Baseline model of 100 years of the IPCC based on IPCC 2013
5	Ozone Depletion	Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	Steady-state ODPs, WMO 2014
6	Acidification	Acidification potential, Accumulated Exceedance (AP)	mol H+ eq.	Accumulated Exceedance, Seppala et al. 2006, Posch et al., 2008
7	Eutrophication aquatic freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg PO4 eq.	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
8	Eutrophication aquatic marine	Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-marine)	kg N eq.	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
9	Eutrophication terrestrial	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	mol N eq.	Accumulated Exceedance, Seppala et al. 2006, Posch et al.
10	Photochemical ozone formation	Formation potential of tropospheric ozone (POCP);	kg NMVOC eq.	LOTOS-EUROS ,Van Zelm et al., 2008, as applied in ReCiPe
11	Depletion of abiotic resources - minerals and metals	Abiotic depletion potential for non-fossil	kg Sb eq.	CML 2002, Guinee et al., 2002, and van
12	Depletion of abiotic resources - fossil fuels	Abiotic depletion potential for fossil resources (ADP-fossil)	MJ, net calorific value	CML 2002, Guinee et al., 2002, and van Oers et al. 2002.
13	Water use	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	m3 world eq. deprived	Available WAter REmaining (AWARE) Boulay et al., 2016

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results)

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	JP	JP	JP										SE	SE	SE	SE	SE
Specific data used	>90%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	<10%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	Not relevant					-	-	-	-	-	-	-	-	-	-	-	-

Content information

Product components	Weight, kg	Post-consumer material, weight-%	Biogenic material, weight-% and kg C/kg
Carbon Steel pipes	9.82E-01	0.00E+00	1.08E-02
Tungsten carbide	1.76E-02	0.00E+00	3.81E-01
TOTAL	1.00E+00	0.00E+00	1.73E-02
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C/kg**
Cardboard	5.86E-02	5.86%	3.27E-01
Rust Prevention Film	9.77E-04	0.10%	4.21E-03
Band	1.73E-04	0.02%	2.50E-01
TOTAL	5.97E-02	5.97%	1.92E-02

Results of the environmental performance indicators

Mandatory impact category indicators according to EN 15804

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO_2 eq.	1.51E+01	0.00E+00	1.68E-04	5.15E-02	5.11E-06	-5.53E-02
GWP-biogenic	kg CO_2 eq.	-6.91E-02	0.00E+00	1.02E-07	6.88E-02	3.24E-04	2.75E-02
GWP-luluc	kg CO_2 eq.	1.88E-02	0.00E+00	5.68E-08	1.34E-07	3.80E-09	-3.27E-04
GWP-total	kg CO_2 eq.	1.51E+01	0.00E+00	1.68E-04	1.20E-01	3.29E-04	-2.82E-02
ODP	kg CFC 11 eq.	2.45E-07	0.00E+00	3.37E-12	7.20E-12	7.03E-14	-2.60E-09
AP	mol H^+ eq.	7.06E-02	0.00E+00	7.53E-07	4.40E-06	4.78E-08	-2.90E-04
EP-freshwater	kg P eq.	5.67E-03	0.00E+00	1.15E-08	6.42E-08	7.88E-10	-2.69E-05
EP-marine	kg N eq.	1.32E-02	0.00E+00	2.96E-07	2.30E-06	2.64E-07	-1.30E-04
EP-terrestrial	mol N eq.	1.81E-01	0.00E+00	3.22E-06	2.00E-05	1.15E-07	-8.38E-04
POCP	kg NMVOC eq.	4.55E-02	0.00E+00	1.16E-06	5.08E-06	1.17E-07	-2.65E-04
ADP-minerals&metals*	kg Sb eq.	1.36E-04	0.00E+00	5.20E-10	9.91E-10	7.66E-12	-1.96E-07
ADP-fossil*	MJ	1.94E+02	0.00E+00	2.40E-03	3.79E-03	6.91E-05	-7.46E-01
WDP*	m^3	3.52E+00	0.00E+00	1.05E-05	5.45E-04	-3.05E-05	-1.79E-02
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption						

Disclaimer: The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

Additional mandatory and voluntary impact category indicators

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	kg CO_2 eq.	1.51E+01	0.00E+00	1.68E-04	5.15E-02	5.11E-06	-5.53E-02

Resource use indicators

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	1.40E+01	0.00E+00	4.15E-05	1.53E-04	2.70E-06	-6.18E-01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.40E+01	0.00E+00	4.15E-05	1.53E-04	2.70E-06	-6.18E-01
PENRE	MJ	1.94E+02	0.00E+00	2.40E-03	3.79E-03	6.91E-05	-7.46E-01
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.94E+02	0.00E+00	2.40E-03	3.79E-03	6.91E-05	-7.46E-01
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.52E+00	0.00E+00	1.05E-05	5.45E-04	-3.05E-05	-1.79E-02
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water						

[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

Waste indicators

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	1.54E-04	0.00E+00	0.00E+00
Radioactive waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Output flow indicators

Results per declared unit							
Indicator	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	9.04E-01	0.00E+00	0.00E+00	4.43E-02	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	1.53E-02	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

References

General Programme Instructions of the International EPD® System. Version 5.0.
• PCR 2019:14 Construction products (EN 15804:A2) (version 1.3.4)
• ISO 14020:2000 Environmental labels and declarations - General principles.
• ISO 14040:2006 Environmental management - Life Cycle Assessment - Principles and framework.
• ISO 14044:2006 Environmental management - Life Cycle Assessment - Requirements and guidelines.

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