

CT Bolt and Domed Plates

**Environmental Product Declaration in accordance with
ISO 14025 and EN 15804:2012+A2:2019**

from DSI Underground Australia Pty Ltd (DSI Underground)



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AUSTRALASIA **EPD**®
ENVIRONMENTAL PRODUCT DECLARATION



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Program Information and Verification

An Environmental Product Declaration (EPD) is a standardised way of quantifying the potential environmental impacts of a product or system. EPDs are produced according to a consistent set of rules – Product Category Rules (PCR) – that define the requirements within a given product category.

These rules are a key part of ISO 14025 as they enable transparency and comparability between EPDs. This EPD provides environmental indicators for DSI Underground’s CT Bolt and domed plate products produced at our plant in Bennetts Green (Newcastle), NSW. This EPD is a “cradle-to-gate with module C and D” declaration covering cradle-to-gate production of the products, plus their end-of-life.

This EPD is verified to be compliant with EN 15804+A2. EPDs of construction products may not be comparable if they do not comply with EN15804. EPDs within the same product category but from different programs or utilising different standards or PCRs may not be comparable. DSI Underground, as the EPD owner, has the sole ownership, liability, and responsibility for the EPD.

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About Us



DSI Underground Australia Pty Limited (trading as DSI Underground)

DSI Underground is a leading Australian provider of Ground Support products and systems for the Underground Mining and Tunnelling industries.

Who We Are

DSI Underground is one of Australia's largest manufacturers and suppliers of specialist strata reinforcement and support products for the soft and hard rock underground mining and tunnelling sectors. Importantly DSI Underground is now part of Sandvik Mining and Rock Technologies.

Strengthening our local footprint, we have production sites in Australia (Newcastle, Perth and Brisbane) and Indonesia (Surabaya). We pride ourselves on producing locally to guarantee the best service and a short, secure supply chain to benefit our customers. We also have branches strategically placed to service our customers locally.

DSI Underground has a proven track record of driving progress and safety in underground operations. Formerly a specialist division within Dywidag-Systems International, we became an independent and standalone business in 2017.

In 2021 Sandvik acquired the business, opening opportunities for DSI Underground to access Sandvik's substantial R&D, global service and sales network. Keeping in line with our strategy of "Reinforcing Progress", we employ worldwide over 2,000 people, including specialist engineers, and have a presence in 70 countries.

Mining and tunnelling present unique engineering challenges and demand very specific skills and technical understanding. This expertise runs through our teams. Our team understands your business and brings the benefit of experience and first-hand insight into your challenges.

Significant production capacity and scalable resources enable us to meet every demand, including urgent and high-volume orders. Further, as a significant global player, we exercise our buying power to deliver competitive pricing in every market we serve.

Industry 4.0 and the digital mine are here now, while drones and even 3D printing may drive a major step change in logistics. Where we see potential, we explore. Where we see a benefit, we invest to drive improvements into our customers' operations, helping make underground operations safer, easier, and more cost-effective.

We have a long-term commitment to exceeding national and international standards and driving ethical and sustainable work practices. This is embedded within our code of conduct, the "The Sandvik Way".

Locations

We have production sites in Australia (Newcastle, Perth and Brisbane) and Indonesia (Surabaya). We pride ourselves on producing locally to guarantee the best service and a short, secure supply chain to benefit our customers. We also have branches strategically placed to service our customers locally.

The CT Bolt and Domed Plates covered by this EPD are produced at our Newcastle factory in New South Wales.



Our Products

The product range covered by this EPD:

- CT Corrosion Protected Mechanical Bolt
- Domed Plates
- Domed Plates Hanging

The CT Bolt and Domed Plates are produced at our Bennetts Green (Newcastle) factory. Our CT Bolts and Domed Plates are used in Tunnelling and Mining applications.

CT Bolt

The CT Bolt is designed to be used with cementitious grouts. The bolt is provided with an expansion shell for preloading, thus allowing for tunnel or mine heading to advance without immediate grouting. The Grout Bell allows for grouting after preloading. It has an anti-corrosion tube over the full length of the bolt for long life term protection. This bolt is available in differing material forms to suit design requirements.

Standard bolt lengths range from 1,200mm to 9,000mm in increments of 300mm. Non standard lengths are also available.

The CT Bolt is packaged in bundles with the threads protected by heavy duty polyethylene bags.

All bolts are supplied fitted with accessories with the exclusion of washer plates which are supplied loose.

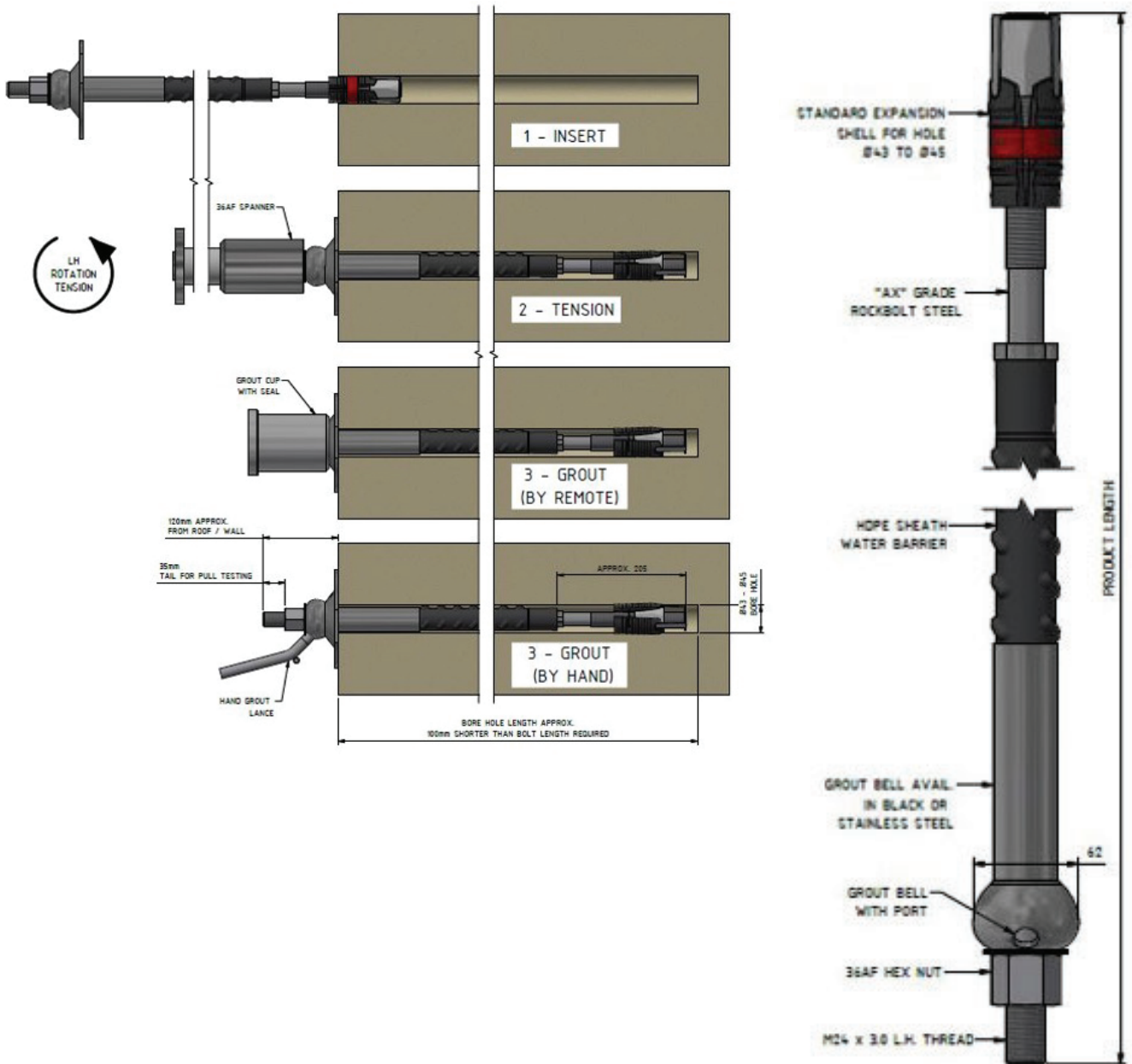
Optional Blind Nut End

- No thread protruding below nut
- Reduces bolt tail protruding below the roofline
- Existing bolts can be pull tested without the need for special pull rings – the pull test coupler threads straight onto the exterior nut thread
- Standard hex nut size – standard bolt dolly's



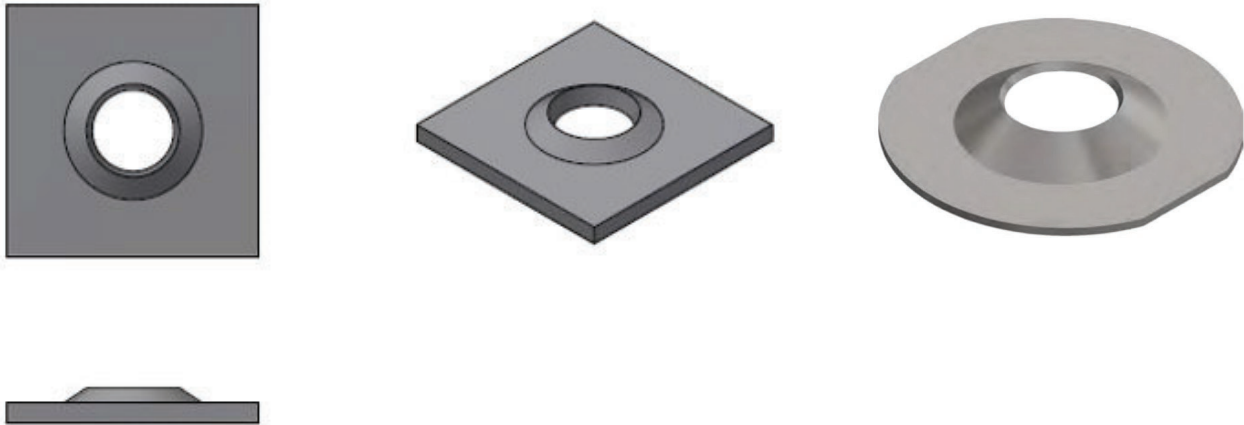
Installation Guidelines

- Drill 43-45mm hole diameters. The drill hole length must be longer than the bolt by approximately 50mm
- Domed washer plate is fitted to the bolt
- The bolt is inserted into the hole
- After placing the bolt in the hole to its full length, the bolt is then rotated to set the expansion shell to the required tension. DSI Underground recommend no more than 55kN
- Attach grouting adaptor to Grout Bell
- Mix 0.33 to 0.35 W/C Grout. Pump grout. Grout is pumped through the inner annulus to the bolt end and returns along the outer annulus
- Terminate grouting with visible grout return
- Detach adaptor and proceed to the next bolt



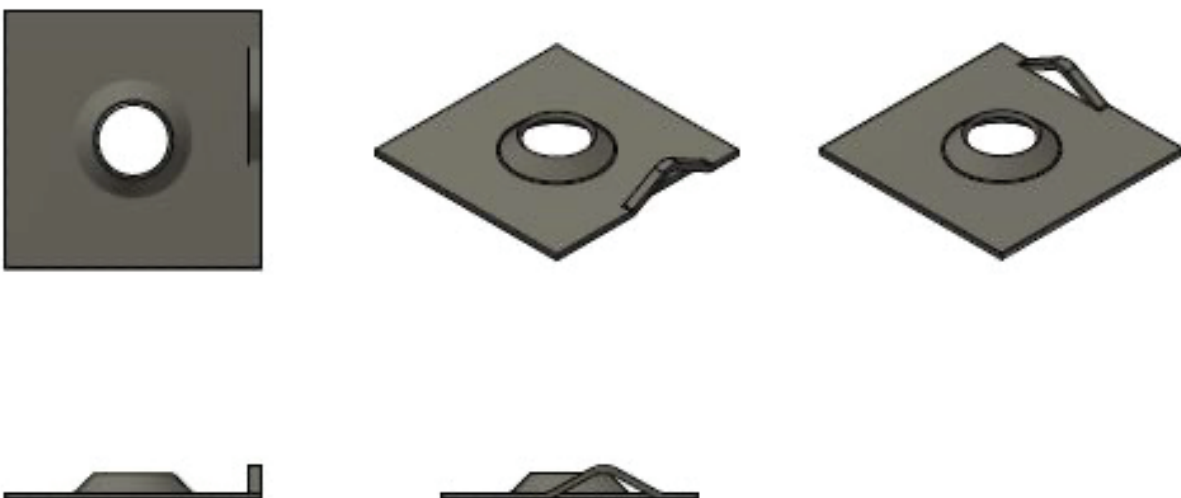
Domed Plate

- Domed Plates are compatible with DSI Underground Rock Bolts fitted with matching dome balls
- Domed Plates are complimentary to the Dome Ball and overcome the problems of surface angularity and allows development of a good torque tension ratio to be obtained
- The Domed Plate and Dome Ball assembly provides up to 18° angle of tilt
- Domed Plates can be square or round
- Grout holes can be provided on Domed Plates
- Corrosion protection may be provided by hot dip galvanizing



Domed Plate with Hanging Loop

- The Dome Plate yield load is close to the yield strength of the most widely used extra high strength bolt
- Assist in overcoming problems of minor surface angularity
- The Dome Plate is compatible with all current ball washers
- A hanging loop is optional
- 300kN minimum compression load based on lab testing, in service conditions may vary performance



Declared Products

The products covered by this EPD are presented in the following tables.

Table 1: Declared Products: CT Bolts with Black Steel Grout Bells (2000 – 6000mm long) (Group A)

Product Code	Product Type
CT20015065LH-NCX	CT BOLT STEEL 2000 150/65 L/H, BW24G
CT24015065LH-NCX	CT BOLT STEEL 2400 150/65 L/H, BW24G
CT26015065LH-NCX	CT BOLT STEEL 2600 150/65 L/H, BW24G
CT30015065LHA	CT BOLT STEEL 3000 150/65 L/H, BW24G
CT30015065LH-NCX	CT BOLT STEEL 3000 150/65 L/H, BW24G
CT33015065LH-NCX	CT BOLT STEEL 3300 150/65 L/H, BW24G
CT36015065LH-NCX	CT BOLT STEEL 3600 150/65 L/H, BW24G
CT40015065LHA	CT BOLT STEEL 4000 150/65 L/H, BW24G
CT40015065LH-NCX	CT BOLT STEEL 4000 150/65 L/H, BW24G
CT43015065LH-NCX	CT BOLT STEEL 4300 150/65 L/H, BW24G
CT45015065LH-NCX	CT BOLT STEEL 4500 150/65 L/H, BW24G
CT60015065LH-NCX	CT BOLT STEEL 6000 150/65 L/H, BW24G

Table 2: Declared Products: CT Bolts with Stainless Steel Grout Bells (2100 – 7500mm long) (Group B)

Product Code	Product Type
CTSS21015065LH-WCX	CT BOLT STEEL 2100 150/65 L/H
CTSS24015065LH-WCX	CT BOLT STEEL 2400 150/65 L/H
CTSS26015065LH-WCX	CT BOLT STEEL 2600 150/65 L/H
CTSS27015065LH-WCX	CT BOLT STEEL 2700 150/65 L/H
CTSS30015065LH-WCX	CT BOLT STEEL 3000 150/65 L/H
CTSS3501530LH-WCX	CT BOLT STEEL 3500X24 300/150 L/H
CTSS38015065LH-WCX	CT BOLT STEEL 3800 150/65 L/H
CTSS40015065LH-WCX	CT BOLT STEEL 4000 150/65 L/H
CTSS42015065LH-WCX	CT BOLT STEEL 4200 150/65 L/H
CTSS45015065LH-WCX	CT BOLT STEEL 4500 150/65 L/H
CTSS48015065LH-WCX	CT BOLT STEEL 4800 150/65 L/H
CTSS49015065LH-WCX	CT BOLT STEEL 4900 150/65 L/H
CTSS54015065LH-WCX	CT BOLT STEEL 5400 150/65 L/H
CTSS60015065LH-WCX	CT BOLT STEEL 6000 150/65 L/H
CTSS65015065LH-WCX	CT BOLT STEEL 6500 150/65 L/H
CTSS70015065LH-WCX	CT BOLT STEEL 7000 150/65 L/H
CTSS75015065LH-WCX	CT BOLT STEEL 7500 150/65 L/H

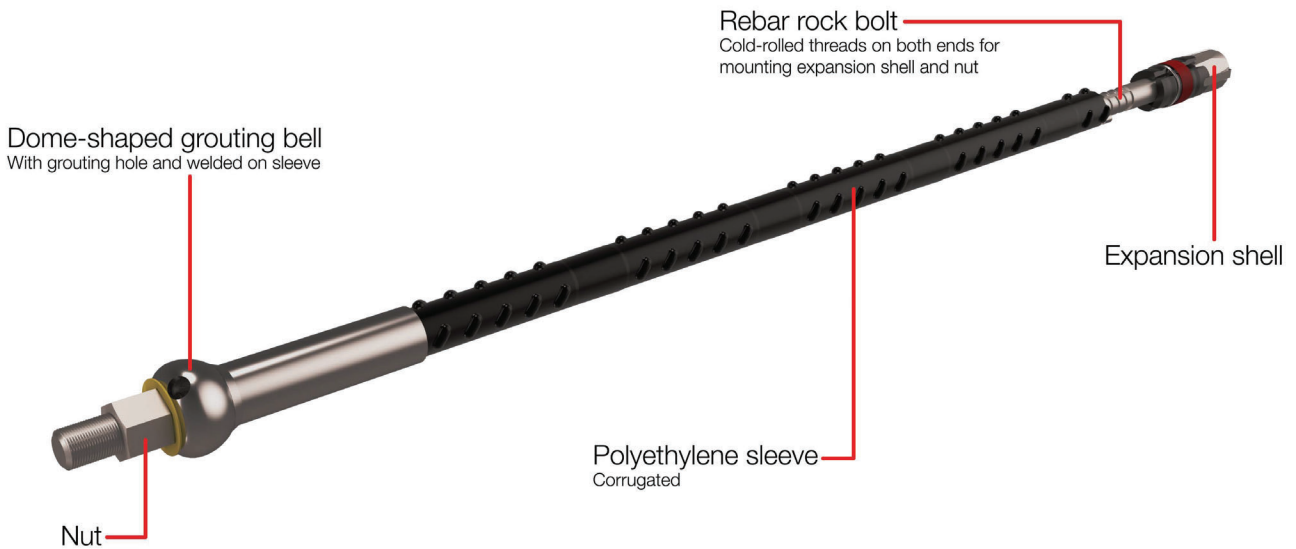
Results for our CT Bolt with stainless steel grout bell (1500mm long) (Code: CTSS15015065LH-WCX; Type: CT BOLT STEEL 1500 150/65 L/H) are presented separately from Group B, as these results fall outside the permitted range for grouping products.

Table 3: Declared Products: Domed Plates

Product Code	Material	Hanging Loop	Product Type
D1515549HANDLE8	Black steel	yes	Plate Dome (150X150X5MM 49H)
D20203401H	Black steel	no	Plate Dome (200X200X12 40H)
RD150649	Black steel	no	Round Plate Dome (150X150X6 49D)
D1515549HANDLE8SS316	Stainless steel 316	yes	Plate Dome (150X150X5MM 49H SS316)
D1515549HNDL8SS316Q	Stainless steel 316	yes	Plate Dome (150X150X5MM 49H SS316)
RD150549SS316	Stainless steel 316	no	Round Plate Dome (OD150 X 5MM SS316)

Figure 1: CT Bolt Components

The figure below shows how a CT bolt and domed plate (4) are used together.



Product Codes

The product codes for CT-Bolts and Domed plates are UN CPC 4299 (Other metal goods) and ANZSIC Class 2292 (Nut, bolt, screw and rivet manufacturing).

Product Compositions

Table 4: Product Composition, CT Bolts per Declared Unit (1 kg of CT Bolts)

Product Components	Mass, kg	Post-Consumer Material	Renewable Material
CT Bolts with black steel grout bells (2000 – 6000mm long; 34mm thick)		Mass -%	Mass -%
Steel bars	0.770 – 0.868	0%*	0%
Grout bell (black steel)	0.035 – 0.094	0%*	0%
O-clip (galvanised steel)	0.00005 – 0.0001	0%*	0%
Corrugated sheath (HDPE)	0.033 – 0.064	0%	0%
Expansion shell (steel)	0.025 – 0.066	0%*	0%
Nut (steel)	0.008 – 0.021	0%*	0%
Washer (HDPE)	0.0001 – 0.0002	0%	0%
Packaging materials	Mass, kg	Mass -% (versus the product)	
Timber gluts	0.018	1.8%	
Polyethylene foam	0.0007	0.07%	
Steel bands	0.0015	0.15%	
CT Bolts with stainless steel grout bells (1500 – 7500mm long; 34mm thick)		Mass -%	Mass -%
Steel bars	0.754 – 0.893	0%*	0%
Grout bell (stainless steel)	0.020 – 0.089	0%*	0%
O-clip (galvanised steel)	0.00004 – 0.0002	0%*	0%
Corrugated sheath (HDPE)	0.044 – 0.067	0%	0%
Expansion shell (steel)	0.019 – 0.086	0%*	0%
Nut (steel)	0.006 – 0.027	0%*	0%
Washer (HDPE)	0.0001 – 0.0003	0%	0%
Packaging materials	Mass, kg	Mass -% (versus the product)	
Timber gluts	0.015	1.5%	
Polyethylene foam	0.0006	0.06%	
Steel bands	0.0013	0.13%	

Table 5: Product Composition, Domed Plates per Declared Unit (1 kg of domed plates)

Product Components	Mass, kg	Post-Consumer Material	Renewable Material
Domed plates (black steel)		Mass -%	Mass -%
Steel	1.000	0%*	0%
Packaging materials	Mass, kg	Mass -% (versus the product)	
Timber pallet	0.014-0.044	1.4%-4.4%	
Cardboard box	0.004-0.011	0.4%-1.1%	
Shrinkwrap (LDPE)	0.00007-0.00021	0.007%-0.021%	
Domed plates (stainless steel)		Mass -%	Mass -%
Stainless steel (SS316)	1.000	0%*	0%
Packaging materials	Mass, kg	Mass -% (versus the product)	
Timber pallet	0.024-0.043	2.4%-4.3%	
Cardboard box	0.006-0.011	0.6%-1.1%	
Shrinkwrap (LDPE)	0.00011-0.00020	0.011%-0.020%	

* All steel contains recycled content. As our suppliers do not distinguish post-consumer recycled content from pre-consumer recycled content, the PCR requires declaration of zero percent.

The CT Bolt and Domed Plate products do not contain any biogenic carbon.

The products included in this EPD do not contain any substances of very high concern as defined by European REACH regulation in concentrations >0.1% (m/m).

Scope of the Environmental Product Declaration

This EPD covers the cradle-to-gate plus end-of-life life cycle stages (modules A1-A3, C1-C4, D).

Construction and use stages have not been included as we cannot define a typical scenario for our range of CT Bolts and Domed Plates. These impacts are best determined at project level. The modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation are shown in Table 6.

Table 6: Scope of the EPD

	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	AU, CN	AU	AU	-	-	-	-	-	-	-	-	-	AU	AU	AU	AU	AU
Specific Data Used	80-85% (Bolts) 1%/100% (Plates)*																
Variation - Products	<10% (Bolts) 0% (Plates)																
Variation - Sites	0%																

Description of Life Cycle Stages

Raw Material Supply (A1)

The main inputs used to produce CT Bolts are steel bars, grout bells, corrugated plastic sheaths, expansion shells, O-clips, nuts and washers. These components are manufactured by DSI underground's suppliers.

Domed plates are manufactured by DSI Underground from Australian hot rolled coil, or DSI Underground purchased finished domed plates from suppliers. DSI Underground uses one Australian supplier that uses Australian steel, while the Chinese supplier is assumed to use steel or stainless steel produced in China.

Transport (A2)

All raw materials and components are transported to DSI Underground in Bennetts Green by truck.

Most materials and components used to produce CT Bolts are sourced from Australian suppliers, with the exception of grout bells (China) and O-clips (Hong Kong). Local transport (by truck) from supplier to DSI Underground is included, as well as transport (by truck) from overseas suppliers to a local port, shipping from overseas ports to Sydney and transport (by truck) from Port Botany in Sydney to Bennetts Green.

Manufacturing (A3)

The manufacturing process of CT Bolts involves the following steps (see figure 2):

1. Crop Bar: The production begins with cutting steel bars to the desired length.
2. Peeling & Thread Bar: The bolt ends are first peeled, where material is removed from both ends of the bar to provide a smooth cylindrical surface. Threads are cut into the smooth surface (cold-forming process), enabling the expansion shell and nut to be mounted.
3. Bell & Sheath; Nuts & Expansion Shell: Grout bells, corrugated plastic sheets, nuts and expansion shells are manually attached to the CT Bolts.
4. Quality Control and Testing: Quality control measures are implemented to ensure that the bolts meet the required specifications. This includes dimensional checks, thread inspection, and testing for mechanical properties.
5. Packaging: Once the CT Bolts pass the quality control checks, they are typically tied in bundles with steel bands and heavy duty PE foam is wrapped around the ends to protect the threads.

Figure 2: Manufacturing Process of CT Bolt



Domed plates are stamped (cold-forming process) out of a steel sheet (i.e. hot rolled coil or stainless steel coil). The material that is removed to form the holes in the centre of the plates, as well as any offcuts, is collected for recycling. The domed plates are placed loose in boxes, which are then stacked on pallets and shrinkwrapped.

End of Life (C1-C4)

The end-of-life modules for CT Bolts and domed plates are perhaps somewhat unusual because the products stay in place “forever”, as they are used to stabilise the ground and are not removed once placed. As a result, no environmental impacts are recorded in end-of-life modules C1 (deconstruction / demolition), C2 (transport from the demolition site to a recycling centre or landfill site), C3 (recycling processes), and C4 (disposal in a landfill site).

Table 7: End-of-Life Scenario Details of Bolts and Plates, per kg

Processes	Quantity	Unit
Collection process specified by type	0	kg collected separately
	0	kg collected with mixed construction waste
Transport to from demolition site to recovery/disposal sites	0	No transport as the materials stay in place (underground)
Recovery system specified by type	0	kg for re-use
	0	kg for recycling
	0	kg for energy recovery
Disposal to landfill	1,000*	kg product or material for final deposition (*the materials stay in place (underground))
Assumptions for scenario development	n/a	

Loads and Benefits beyond the System Boundaries (D)

Module D sits outside the system boundaries and calculates the effect of the net flow of scrap over the life cycle of the product.

Since the bolts and plates stay in place at the end-of-life, the net flow of scrap is zero when the inputs consist of 100% virgin material, or negative when the input material contains recycled content.

Module D loads and benefits are calculated in line with the following formula from EN 15804:

$$e_{\text{module D1}} = \sum_i (M_{MR \text{ out}}|_i - M_{MR \text{ in}}|_i) \cdot \left(E_{MR \text{ after EoW out}}|_i - E_{VMSub \text{ out}}|_i \cdot \frac{Q_{R \text{ out}}|_i}{Q_{Sub}|_i} \right)$$

Table 8: Assumptions Relating to Module D of Bolts and Plates

Parameter	Unit / Effect
$M_{MR \text{ out}} = 0\%$	amount of bolts or plates exiting the system that will be recycled in a subsequent system
$M_{MR \text{ in}} = 95\%$	amount of recycled input material in steel bar component of bolts (based on Secondary Material parameter of InfraBuild bars (EPD S-P-00857)) amount of recycled input material in hot rolled coil used for plates manufactured in Australia (based on the declared recycled material (pre- and post-consumer) average across the range of steel products manufactured by BlueScope in Australia, including hot rolled coil and all other steel products (EPD S-P-00557)) amount of recycled input material in other components
$M_{MR \text{ in}} = 17.4\%$	
$M_{MR \text{ in}} = 0\%$	
$E_{MR \text{ after EoW out}} = \text{steel recycling (EAF process)}1$	specific emissions and resources consumed per unit of analysis arising from material recovery processes of a subsequent system after the end-of-waste state
$E_{VMSub \text{ out}} = \text{steel production (BOS process)}2$	specific emissions and resources consumed per unit of analysis arising from acquisition and pre-processing of the primary material, or average input material if primary material is not used, from the cradle to the point of functional equivalence where it would substitute secondary material that would be used in a subsequent system
$Q_{R \text{ out}}$	quality of the outgoing recovered material
Q_{Sub}	quality of the substituted material
$Q_{R \text{ out}} / Q_{Sub} = 1$	quality ratio between outgoing recovered material and the substituted material is assumed to be 1 (equal quality)

1 EAF = Electric Arc Furnace

2 BOS = Basic Oxygen Steelmaking

System Boundary Diagrams

Figure 3: System Boundary Diagram of CT Bolt Products

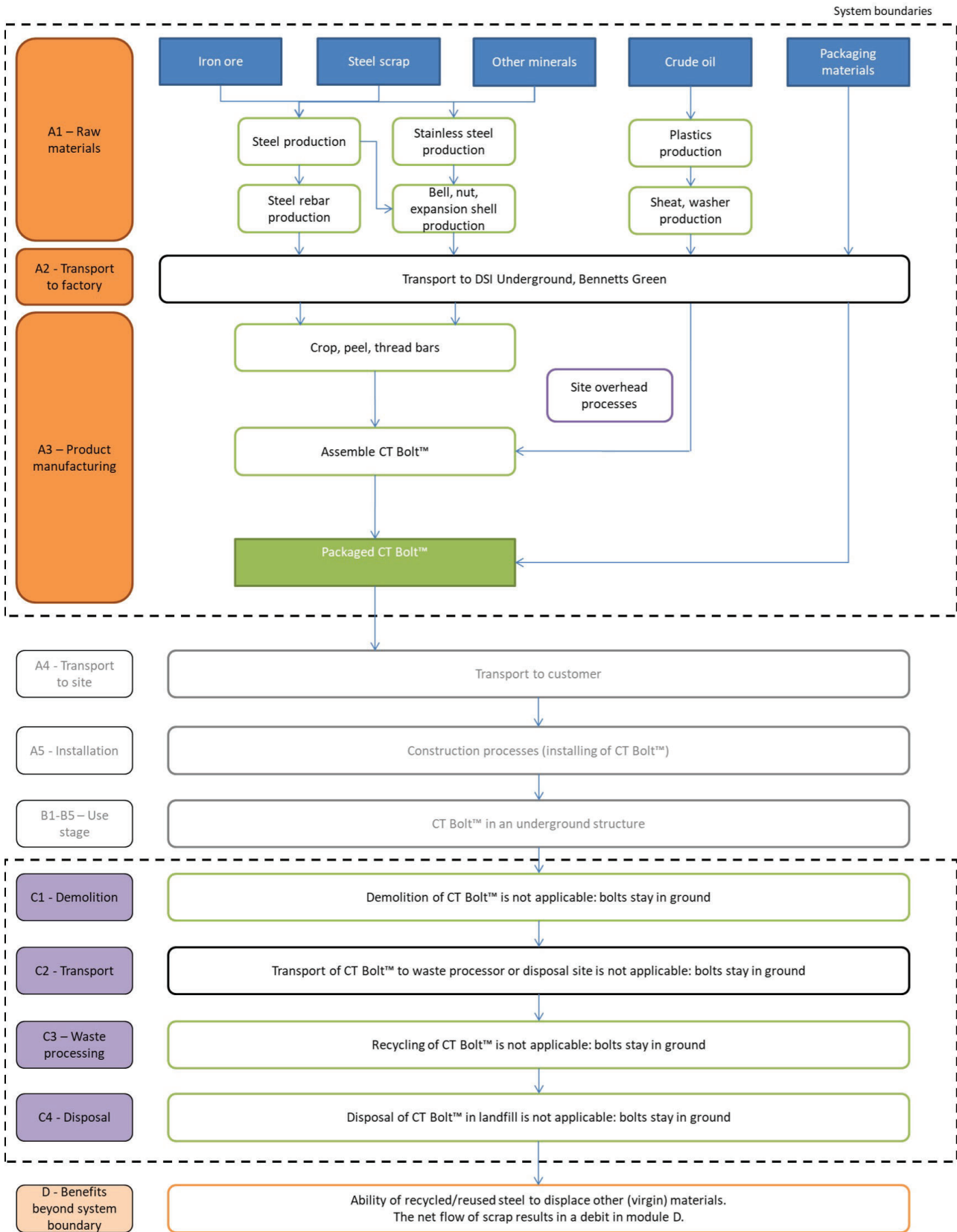
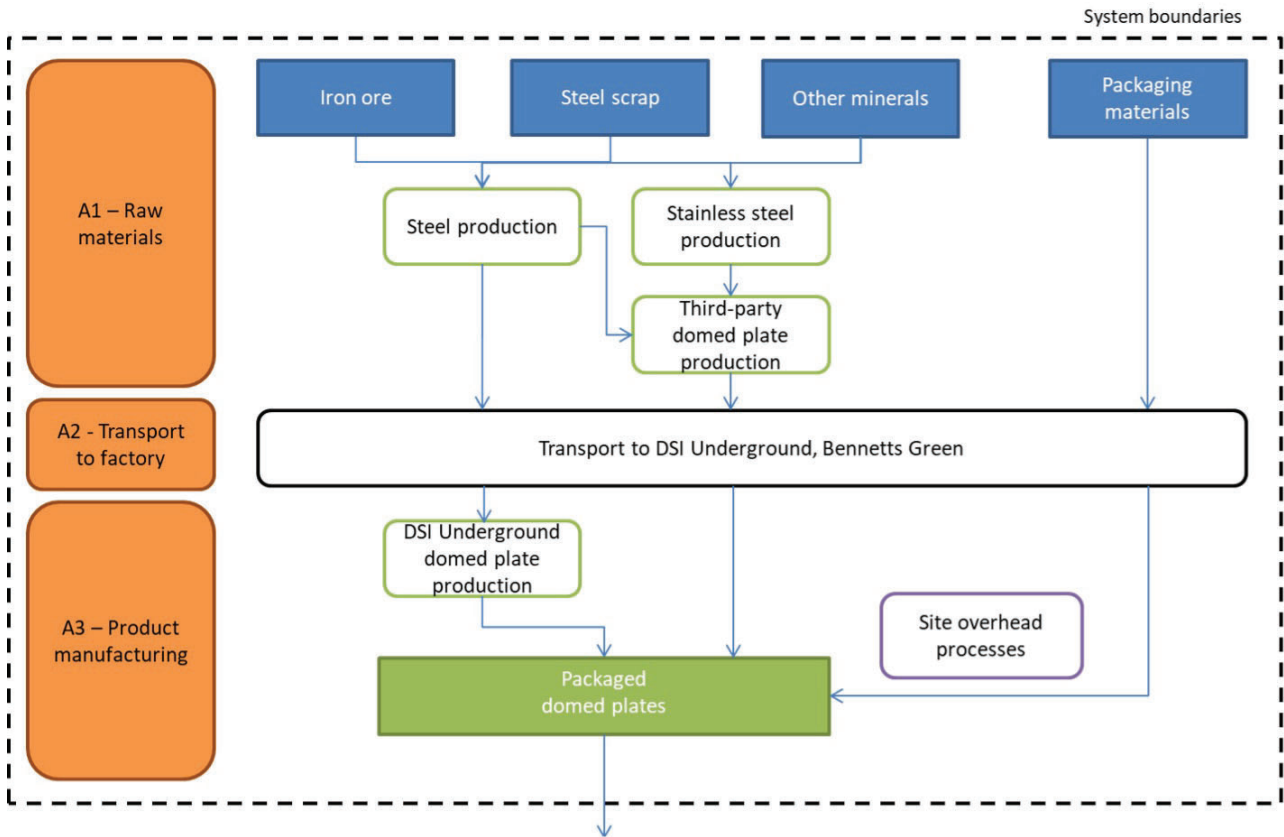


Figure 4: System Boundary Diagram of Domed Plates

The system boundary diagram for domed plates is similar to the system boundaries covered for the CT Bolts. As downstream stages are identical for bolts and plates, we have only included a depiction of the cradle-to-gate (modules A1-A3) in the figure below.



Life Cycle Assessment (LCA) Methodology

Declared Unit

- The main declared unit is 1 kg of CT Bolts
- The Domed Plates are an accessory to CT Bolts and have been included

Background Data

DSI Underground has supplied primary data from our Bennetts Green production facility, in Newcastle (NSW). We produce a range of bolts, including CT Bolt at this facility, as well as a limited amount of domed plates. We also receive domed plates from suppliers in Australia and China that are repackaged in Bennetts Green. The production data have been collected for calendar year 2020 (1 January 2020 – 31 December 2020).

Background data (e.g. for energy and transport processes, and materials/component for which we don't have supplier specific data) have predominantly been sourced from AusLCI and the AusLCI shadow database (v1.36) and ecoinvent (v3.9.1).

The data used for key raw materials and components are:

- Steel bars: InfraBuild EPD S-P-00857 Version 1.2 (Reinforcing bar). The EPD includes EN 15804+A1 results. InfraBuild has calculated and provided the EN 15804+A2 results from its LCA-model as a one-off for use in this LCA.
- Grout bells (black steel): ecoinvent process Steel, low-alloyed {CN}| steel production, converter, low-alloyed | Cut-off, U
- Grout bells (stainless steel): AusLCI/ecoinvent process Steel, converter, stainless steel 316, at plant/CN U/AusSD U*
- Corrugated sheath: ecoinvent process high density polyethylene, average, at plant/AU U
- Expansion shell: ecoinvent process Steel, unalloyed {AU}| steel production, converter, unalloyed | Cut-off, U
- Australian steel hot rolled coil for domed plates: BlueScope Steel EPD S-P-00557 Version 2.0 (medium carbon steel)
- Carbon steel domed plates produced in China: ecoinvent process Steel, unalloyed {CN}| steel production, converter, unalloyed | Cut-off, U
- Stainless steel domed plates produced in China: AusLCI/ecoinvent process Steel, converter, stainless steel 316, at plant/RER U/AusSD U*

* The stainless steel process is based on the AusLCI process for Chromium Steel 18/8 (based on ecoinvent v2.2). The composition has been adjusted to reflect 316 S/S, which contains 17% chromium and 12% nickel.

The environmental profiles of our CT Bolts and Australian manufactured plates are predominantly based on life cycle data that are less than five years old. Background data used (including for domed plates produced in China) is less than ten years old or has been reviewed for relevance within this period.

Methodological choices have been applied in line with EN 15804+A2; deviations have been recorded.

Allocation

The materials, products and processes in the life cycle of DSI Underground's products that require allocation are:

- Co-production of CT-Bolt, Domed plates and other products: DSI Underground manufactures a range of tunneling products and accessories at its site. Energy use for CT-Bolt and dome plate production has been allocated to the products based on a mass basis (total tonnage of products produced).
- Co-production of steel products and steel offcuts collected for recycling. The steel offcuts have a positive value, which indicates economic allocation is an option. Nonetheless, we have opted for a cut-off approach, assigning all impacts to the bolts and plates. This approach is conservative, respects the main purpose of the process, reflects the polluter-pays-principle, and ensures consistency in allocation with scrap entering the product system.
- Co-production of steel and slag follows the InfraBuild EPD that is used for rebar inputs: "No allocation is applied to EAF and BOS slag produced by the steel works, which are managed on site to reach end-of-waste state and either used in site construction works or given away at no cost to a third party."

Cut-off Criteria

Where possible (i.e. for which data are available), all inputs and outputs to a process have been included. The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of a process. The contribution of capital goods (production equipment and infrastructure) and personnel is excluded, as these processes are non-attributable and they contribute less than 10% to GWP-GHG.

The materials and processes that have been excluded are:

- Ancillary materials used in the plant, including but not limited to conveyor belts and other machinery wear and tear replacements.
- Waste from overhead processes (e.g. offices)

Other ancillary materials (greases and lubricating oils, acetylene) used during production, have been included even though they fall well below the cut-off threshold.

Key Assumptions

The key choices and assumptions in the LCA are:

- Electricity used at the DSI Underground manufacturing plant has been modelled on 2018 state electricity grids (source: AusLCI 2021, i.e. we used: "electricity, low voltage, New South Wales/AU U"). However, start2see adjusted the greenhouse gas emissions intensity so that it aligns with the latest factors in NGA 2022. Therefore, the electricity has a GWP-GHG of 0.79 kg CO₂e/kWh.
- Electricity used in potable water production background data is modelled on Australian average electricity. We have not made further changes to this process due to the limited impact on the results.
- Transport fuel use is based on average Australian transport processes, 2011. Modifications were made to account for DSI Underground's specific situation (e.g. average load), when known.
- Stainless steel for plates and grout bells is based on generic data, adjusted to reflect the composition of stainless steel 316.
- The percentage waste (offcuts) generated during production of domed plates is calculated based on the ratio between the size of the plate and size of the hole respectively.
- Steel offcuts from the production of bolts and plates have a positive economic value. Nonetheless, we applied a conservative cut-off approach and allocated all production impacts to the main products (bolts and plates). This also ensures the allocation applied to offcuts leaving the product system matches the allocation applied to scrap entering the product system.
- For Module D calculations, we have assumed all components contain 100% virgin content (i.e. no net flow of scrap to module D), except for steel bars (95% recycled content) and Australian hot rolled coil (17.4% recycled content).

Life Cycle Assessment Results

The background LCA serves as the foundation for this EPD. An LCA analyses the environmental processes in the value chain of a product.

The LCA provides a comprehensive evaluation of all upstream (and sometimes downstream) material and energy inputs and outputs. The results are provided for a range of environmental impact categories, in line with EN 15804:2012+A2:2019.

The results from the impact assessment are only relative statements which give no information about the endpoint of the impact categories, exceeding of threshold values, safety margins or risk.

Environmental Profiles for CT Bolts

The environmental profiles for the CT Bolts are expressed per declared unit (1 kg of CT Bolt).

The bolts are divided into three groups:

- A. CT Bolts with black steel grout bells (2000 – 6000mm long) (tables A1-A5)
- B. CT Bolts with stainless steel grout bells (2100 – 7500mm long) (tables B1-B5)
- C. CT Bolts with stainless steel grout bells (1500mm long) (tables C1-C5)

Environmental Profiles for Domed Plates

The environmental profiles for the domed plates are expressed per declared unit (1 kg of Domed Plate).

The plates are divided into five types:

- D. Black steel domed plate (150X150X5MM 49H) (tables D1-D5)
- E. Black steel domed plate (200X200X12 40H) (tables E1-E5)
- F. Black steel round domed plate (150X150X6 49D) (tables F1-F5)
- G. Stainless steel domed plate (150X150X5MM 49H SS316) (tables G1-G5)
- H. Stainless steel round domed plate (OD150 X 5MM SS316) (tables H1-H5)

Table A.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of CT BOLT Group A (CT Bolts with Black Steel Grout Bells (2000 – 6000mm long))							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	1.95E+00	0	0	0	0	7.31E-01
GWP Fossil	kg CO ₂ -eq.	1.95E+00	0	0	0	0	7.38E-01
GWP-Biogenic	kg CO ₂ -eq.	-1.06E-02	0	0	0	0	-5.92E-03
GWP-Luluc	kg CO ₂ -eq.	1.56E-04	0	0	0	0	-5.09E-04
ODP	kg CFC 11 eq.	1.70E-08	0	0	0	0	1.74E-08
AP	mol H ⁺ eq.	7.38E-03	0	0	0	0	2.75E-03
EP-Freshwater	kg P eq.	1.80E-05	0	0	0	0	1.37E-06
EP-Marine	kg N eq.	1.69E-03	0	0	0	0	3.96E-05
EP-Terrestrial	mol N eq.	1.82E-02	0	0	0	0	7.16E-03
POCP	kg NMVOC eq.	6.21E-03	0	0	0	0	4.08E-03
ADP-Minerals & metals*	kg Sb eq.	1.69E-06	0	0	0	0	2.01E-05
ADP-Fossil*	MJ	3.97E+01	0	0	0	0	5.65E+00
WDP	m ³	1.43E+01	0	0	0	0	-2.07E-01
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table A.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of CT BOLT Group A (CT Bolts with Black Steel Grout Bells (2000 – 6000mm long))							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ -eq.	1.90	0	0	0	0	0.69
PM	Disease Incidence	1.56E-07	0	0	0	0	3.64E-08
IRP**	kBq U235 equivalent	4.78E-03	0	0	0	0	-1.23E-02
ETP-fw*	CTUe	5.65E+00	0	0	0	0	1.53E+01
HTP-c*	CTUh	1.70E-09	0	0	0	0	-7.21E-09
HTP-nc*	CTUh	3.57E-08	0	0	0	0	-4.53E-08
SQP	-	4.66E+00	0	0	0	0	1.64E+00
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table A.3: Use of Resources

Results per 1 kg of CT BOLT Group A (CT Bolts with Black Steel Grout Bells (2000 – 6000mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.50E+00	0	0	0	0	7.36E-01
PERM	MJ	0.00E+00	0	0	0	0	0.00E+00
PERT	MJ	1.50E+00	0	0	0	0	7.36E-01
PENRE	MJ	3.97E+01	0	0	0	0	5.97E+00
PENRM	MJ	0.00E+00	0	0	0	0	0.00E+00
PENRT	MJ	3.97E+01	0	0	0	0	5.97E+00
SM	kg	8.06E-01	0	0	0	0	0.00E+00
RSF	MJ	0.00E+00	0	0	0	0	0.00E+00
NRSF	MJ	5.36E-02	0	0	0	0	0.00E+00
FW	m ³	7.87E-01	0	0	0	0	8.82E+00
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						

Table A.4: Waste Production and Output Flows

Results per 1 kg of CT BOLT Group A (CT Bolts with Black Steel Grout Bells (2000 – 6000mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	3.88E-09	0	0	0	0	0.00E+00
NHWD	kg	3.08E-01	0	0	0	0	-3.72E-07
RWD	kg	2.81E-05	0	0	0	0	0.00E+00
CRU	kg	0.00E+00	0	0	0	0	0.00E+00
MFR	kg	8.57E-02	0	0	0	0	0.00E+00
MER	kg	2.46E-04	0	0	0	0	0.00E+00
EE	MJ	0.00E+00	0	0	0	0	0.00E+00
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table A.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of CT BOLT Group A (CT Bolts with Black Steel Grout Bells (2000 – 6000mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	1.88E+00	0	0	0	0	6.81E-01
ODP	kg CFC11 eq	1.57E-08	0	0	0	0	2.71E-08
AP	kg SO ₂ eq	5.42E-03	0	0	0	0	2.21E-03
EP	kg PO ₄ ³⁻ eq	6.71E-04	0	0	0	0	-4.73E-05
POCP	kg C ₂ H ₄ eq	1.23E-03	0	0	0	0	5.50E-04
ADPE	kg Sb eq	1.72E-06	0	0	0	0	2.01E-05
ADPF	MJ _{NCV}	2.52E+01	0	0	0	0	9.31E+00
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Variation within CT Bolts Group A

We have assessed the variation between the different types of CT-Bolts included in Group A to ensure variations in GWP-GHG impacts (measured across modules A1-A3) do not exceed ±10% from the declared value. On a per kg basis, the variation in greenhouse gas emissions is less than 5% from the declared value. The largest potential spread within this group is found in water use (-29%/+54%), depletion of abiotic resources (minerals and metals) (-29%/+52%), freshwater eutrophication (-22%/+39%) and ozone depletion (-13%/+27%). The spread in other core indicators is below +/-10%.

Table B.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of CT BOLT Group B (CT Bolts with Stainless Steel Grout Bells (2100 – 7500mm long))							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	2.04E+00	0	0	0	0	7.57E-01
GWP Fossil	kg CO ₂ -eq.	2.04E+00	0	0	0	0	7.63E-01
GWP-Biogenic	kg CO ₂ -eq.	-1.10E-02	0	0	0	0	-6.13E-03
GWP-Luluc	kg CO ₂ -eq.	1.07E-04	0	0	0	0	-5.26E-04
ODP	kg CFC 11 eq.	1.69E-08	0	0	0	0	1.80E-08
AP	mol H ⁺ eq.	8.20E-03	0	0	0	0	2.84E-03
EP-Freshwater	kg P eq.	1.16E-05	0	0	0	0	1.42E-06
EP-Marine	kg N eq.	1.78E-03	0	0	0	0	4.10E-05
EP-Terrestrial	mol N eq.	1.93E-02	0	0	0	0	7.41E-03
POCP	kg NMVOC eq.	6.28E-03	0	0	0	0	4.23E-03
ADP-Minerals & metals*	kg Sb eq.	6.85E-06	0	0	0	0	2.08E-05
ADP-Fossil*	MJ	4.18E+01	0	0	0	0	5.85E+00
WDP	m ³	2.58E+02	0	0	0	0	-2.15E-01
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table B.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of CT BOLT Group B (CT Bolts with Stainless Steel Grout Bells (2100 – 7500mm long))							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ -eq.	1.99	0	0	0	0	0.71
PM	Disease Incidence	1.63E-07	0	0	0	0	3.77E-08
IRP**	kBq U235 equivalent	1.31E-02	0	0	0	0	-1.28E-02
ETP-fw*	CTUe	9.05E+00	0	0	0	0	1.59E+01
HTP-c*	CTUh	3.43E-09	0	0	0	0	-7.46E-09
HTP-nc*	CTUh	3.77E-08	0	0	0	0	-4.69E-08
SQP	-	4.31E+00	0	0	0	0	1.70E+00
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table B.3: Use of Resources

Results per 1 kg of CT BOLT Group B (CT Bolts with Stainless Steel Grout Bells (2100 – 7500mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.88E+00	0	0	0	0	7.61E-01
PERM	MJ	0.00E+00	0	0	0	0	0.00E+00
PERT	MJ	1.88E+00	0	0	0	0	7.61E-01
PENRE	MJ	4.18E+01	0	0	0	0	6.17E+00
PENRM	MJ	0.00E+00	0	0	0	0	0.00E+00
PENRT	MJ	4.18E+01	0	0	0	0	6.17E+00
SM	kg	8.34E-01	0	0	0	0	0.00E+00
RSF	MJ	0.00E+00	0	0	0	0	0.00E+00
NRSF	MJ	5.55E-02	0	0	0	0	0.00E+00
FW	m ³	5.48E-02	0	0	0	0	9.13E+00
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						

Table B.4: Waste Production and Output Flows

Results per 1 kg of CT BOLT Group B (CT Bolts with Stainless Steel Grout Bells (2100 – 7500mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	4.02E-09	0	0	0	0	0.00E+00
NHWD	kg	3.19E-01	0	0	0	0	-3.85E-07
RWD	kg	2.91E-05	0	0	0	0	0.00E+00
CRU	kg	0.00E+00	0	0	0	0	0.00E+00
MFR	kg	8.87E-02	0	0	0	0	0.00E+00
MER	kg	2.55E-04	0	0	0	0	0.00E+00
EE	MJ	0.00E+00	0	0	0	0	0.00E+00
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table B.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of CT BOLT Group B (CT Bolts with Stainless Steel Grout Bells (2100 – 7500mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	1.97E+00	0	0	0	0	7.04E-01
ODP	kg CFC11 eq	1.45E-08	0	0	0	0	2.80E-08
AP	kg SO ₂ eq	6.04E-03	0	0	0	0	2.29E-03
EP	kg PO ₄ ³⁻ eq	6.82E-04	0	0	0	0	-4.89E-05
POCP	kg C ₂ H ₄ eq	1.15E-03	0	0	0	0	5.69E-04
ADPE	kg Sb eq	6.88E-06	0	0	0	0	2.08E-05
ADPF	MJ _{NCV}	2.61E+01	0	0	0	0	9.63E+00
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Variation within CT Bolts Group B

We have assessed the variation between the different types of CT-Bolts included in Group B to ensure variations in GWP-GHG impacts (measured across modules A1-A3) do not exceed ±10% from the declared value. On a per kg basis, the variation in greenhouse gas emissions is between -4% and +10% from the declared value. The largest potential spread within this group is found in water use (-40%/+96%), depletion of abiotic resources (minerals and metals) (-38%/+92%), ozone depletion (-16%/+38%) and freshwater eutrophication (-14%/+34%). The spread in other core indicators is below +/-20%.

Table C.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of CT BOLT Group C (CT Bolts with Stainless Steel Grout Bells (1500mm long))							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	2.40E+00	0	0	0	0	6.60E-01
GWP Fossil	kg CO ₂ -eq.	2.39E+00	0	0	0	0	6.65E-01
GWP-Biogenic	kg CO ₂ -eq.	4.53E-03	0	0	0	0	-5.34E-03
GWP-Luluc	kg CO ₂ -eq.	1.46E-04	0	0	0	0	-4.59E-04
ODP	kg CFC 11 eq.	2.81E-08	0	0	0	0	1.57E-08
AP	mol H ⁺ eq.	1.07E-02	0	0	0	0	2.48E-03
EP-Freshwater	kg P eq.	1.86E-05	0	0	0	0	1.24E-06
EP-Marine	kg N eq.	2.19E-03	0	0	0	0	3.57E-05
EP-Terrestrial	mol N eq.	2.36E-02	0	0	0	0	6.46E-03
POCP	kg NMVOC eq.	7.76E-03	0	0	0	0	3.68E-03
ADP-Minerals & metals*	kg Sb eq.	1.77E-05	0	0	0	0	1.82E-05
ADP-Fossil*	MJ	4.29E+01	0	0	0	0	5.10E+00
WDP	m ³	6.86E+02	0	0	0	0	-1.87E-01
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table C.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of CT BOLT Group C (CT Bolts with Stainless Steel Grout Bells (1500mm long))							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ -eq.	2.33	0	0	0	0	0.62
PM	Disease Incidence	1.89E-07	0	0	0	0	3.28E-08
IRP**	kBq U235 equivalent	2.96E-02	0	0	0	0	-1.11E-02
ETP-fw*	CTUe	1.70E+01	0	0	0	0	1.38E+01
HTP-c*	CTUh	8.90E-09	0	0	0	0	-6.50E-09
HTP-nc*	CTUh	5.11E-08	0	0	0	0	-4.09E-08
SQP	-	4.53E+00	0	0	0	0	1.48E+00
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table C.3: Use of Resources

Results per 1 kg of CT BOLT Group C (CT Bolts with Stainless Steel Grout Bells (1500mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	2.69E+00	0	0	0	0	6.63E-01
PERM	MJ	0.00E+00	0	0	0	0	0.00E+00
PERT	MJ	2.69E+00	0	0	0	0	6.63E-01
PENRE	MJ	4.29E+01	0	0	0	0	5.38E+00
PENRM	MJ	0.00E+00	0	0	0	0	0.00E+00
PENRT	MJ	4.29E+01	0	0	0	0	5.38E+00
SM	kg	7.30E-01	0	0	0	0	0.00E+00
RSF	MJ	0.00E+00	0	0	0	0	0.00E+00
NRSF	MJ	4.85E-02	0	0	0	0	0.00E+00
FW	m ³	1.21E-01	0	0	0	0	7.96E+00
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						

Table C.4: Waste Production and Output Flows

Results per 1 kg of CT BOLT Group C (CT Bolts with Stainless Steel Grout Bells (1500mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	3.52E-09	0	0	0	0	0.00E+00
NHWD	kg	2.79E-01	0	0	0	0	-3.35E-07
RWD	kg	2.55E-05	0	0	0	0	0.00E+00
CRU	kg	0.00E+00	0	0	0	0	0.00E+00
MFR	kg	7.75E-02	0	0	0	0	0.00E+00
MER	kg	2.23E-04	0	0	0	0	0.00E+00
EE	MJ	0.00E+00	0	0	0	0	0.00E+00
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table C.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of CT BOLT Group C (CT Bolts with Stainless Steel Grout Bells (1500mm long))							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	2.32E+00	0	0	0	0	6.14E-01
ODP	kg CFC11 eq	2.52E-08	0	0	0	0	2.44E-08
AP	kg SO ₂ eq	7.90E-03	0	0	0	0	2.00E-03
EP	kg PO ₄ ³⁻ eq	8.56E-04	0	0	0	0	-4.27E-05
POCP	kg C ₂ H ₄ eq	1.38E-03	0	0	0	0	4.96E-04
ADPE	kg Sb eq	1.77E-05	0	0	0	0	1.82E-05
ADPF	MJ _{NCV}	2.91E+01	0	0	0	0	8.39E+00
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Table D.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of Black Steel Domed Plate (150X150X5MM 49H)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	2.84E+00	0	0	0	0	1.41E-01
GWP Fossil	kg CO ₂ -eq.	2.89E+00	0	0	0	0	1.41E-01
GWP-Biogenic	kg CO ₂ -eq.	-4.68E-02	0	0	0	0	-1.72E-04
GWP-Luluc	kg CO ₂ -eq.	7.21E-05	0	0	0	0	-3.38E-05
ODP	kg CFC 11 eq.	3.64E-08	0	0	0	0	4.27E-09
AP	mol H ⁺ eq.	1.21E-02	0	0	0	0	5.09E-04
EP-Freshwater	kg P eq.	7.54E-07	0	0	0	0	-1.51E-05
EP-Marine	kg N eq.	2.75E-03	0	0	0	0	6.60E-05
EP-Terrestrial	mol N eq.	3.10E-02	0	0	0	0	1.36E-03
POCP	kg NMVOC eq.	9.25E-03	0	0	0	0	8.24E-04
ADP-Minerals & metals*	kg Sb eq.	1.03E-07	0	0	0	0	2.24E-06
ADP-Fossil*	MJ	2.86E+01	0	0	0	0	1.14E+00
WDP	m ³	4.67E-01	0	0	0	0	2.30E-01
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table D.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of Black Steel Domed Plate (150X150X5MM 49H)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ -eq.	2.84	0	0	0	0	0.13
PM	Disease Incidence	1.26E-07	0	0	0	0	6.10E-09
IRP**	kBq U235 equivalent	3.67E-03	0	0	0	0	-8.92E-04
ETP-fw*	CTUe	3.87E+00	0	0	0	0	-9.42E+00
HTP-c*	CTUh	2.15E-10	0	0	0	0	-1.54E-09
HTP-nc*	CTUh	5.63E-08	0	0	0	0	-2.13E-08
SQP	-	6.01E+00	0	0	0	0	3.46E-01
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table D.3: Use of Resources

Results per 1 kg of Black Steel Domed Plate (150X150X5MM 49H)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.20E+00	0	0	0	0	1.77E-01
PERM	MJ	0.00E+00	0	0	0	0	0.00E+00
PERT	MJ	1.20E+00	0	0	0	0	1.77E-01
PENRE	MJ	5.36E+01	0	0	0	0	1.20E+00
PENRM	MJ	0.00E+00	0	0	0	0	0.00E+00
PENRT	MJ	5.36E+01	0	0	0	0	1.20E+00
SM	kg	2.21E-01	0	0	0	0	0.00E+00
RSF	MJ	0.00E+00	0	0	0	0	0.00E+00
NRSF	MJ	0.00E+00	0	0	0	0	0.00E+00
FW	m ³	2.80E-03	0	0	0	0	1.98E+00
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						

Table D.4: Waste Production and Output Flows

Results per 1 kg of Black Steel Domed Plate (150X150X5MM 49H)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	3.27E-09	0	0	0	0	0.00E+00
NHWD	kg	8.90E-03	0	0	0	0	-8.10E-08
RWD	kg	2.03E-05	0	0	0	0	0.00E+00
CRU	kg	0.00E+00	0	0	0	0	0.00E+00
MFR	kg	4.36E-01	0	0	0	0	0.00E+00
MER	kg	0.00E+00	0	0	0	0	0.00E+00
EE	MJ	0.00E+00	0	0	0	0	0.00E+00
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table D.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of Black Steel Domed Plate (150X150X5MM 49H)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	2.75E+00	0	0	0	0	1.31E-01
ODP	kg CFC11 eq	2.87E-08	0	0	0	0	6.24E-09
AP	kg SO ₂ eq	9.26E-03	0	0	0	0	4.07E-04
EP	kg PO ₄ ³⁻ eq	1.00E-03	0	0	0	0	-6.43E-05
POCP	kg C ₂ H ₄ eq	1.48E-03	0	0	0	0	2.56E-04
ADPE	kg Sb eq	1.04E-07	0	0	0	0	2.24E-06
ADPF	MJ _{Ncv}	2.84E+01	0	0	0	0	1.80E+00
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Table E.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of Black Steel Domed Plate (200X200X12 40H)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	2.65E+00	0	0	0	0	1.41E-01
GWP Fossil	kg CO ₂ -eq.	2.66E+00	0	0	0	0	1.41E-01
GWP-Biogenic	kg CO ₂ -eq.	-1.79E-02	0	0	0	0	-1.72E-04
GWP-Luluc	kg CO ₂ -eq.	6.49E-05	0	0	0	0	-3.38E-05
ODP	kg CFC 11 eq.	2.46E-08	0	0	0	0	4.27E-09
AP	mol H ⁺ eq.	9.36E-03	0	0	0	0	5.09E-04
EP-Freshwater	kg P eq.	5.16E-07	0	0	0	0	-1.51E-05
EP-Marine	kg N eq.	2.19E-03	0	0	0	0	6.60E-05
EP-Terrestrial	mol N eq.	2.48E-02	0	0	0	0	1.36E-03
POCP	kg NMVOC eq.	7.56E-03	0	0	0	0	8.24E-04
ADP-Minerals & metals*	kg Sb eq.	9.59E-08	0	0	0	0	2.24E-06
ADP-Fossil*	MJ	2.61E+01	0	0	0	0	1.14E+00
WDP	m ³	3.12E-01	0	0	0	0	2.30E-01
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table E.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of Black Steel Domed Plate (200X200X12 40H)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO₂-eq.	2.62	0	0	0	0	0.13
PM	Disease Incidence	1.18E-07	0	0	0	0	6.10E-09
IRP**	kBq U235 equivalent	3.45E-03	0	0	0	0	-8.92E-04
ETP-fw*	CTUe	3.38E+00	0	0	0	0	-9.42E+00
HTP-c*	CTUh	1.92E-10	0	0	0	0	-1.54E-09
HTP-nc*	CTUh	5.27E-08	0	0	0	0	-2.13E-08
SQP	-	2.65E+00	0	0	0	0	3.46E-01
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

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Table E.3: Use of Resources

Results per 1 kg of Black Steel Domed Plate (200X200X12 40H)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	7.05E-01	0	0	0	0	1.77E-01
PERM	MJ	0.00E+00	0	0	0	0	0.00E+00
PERT	MJ	7.05E-01	0	0	0	0	1.77E-01
PENRE	MJ	4.98E+01	0	0	0	0	1.20E+00
PENRM	MJ	0.00E+00	0	0	0	0	0.00E+00
PENRT	MJ	4.98E+01	0	0	0	0	1.20E+00
SM	kg	2.09E-01	0	0	0	0	0.00E+00
RSF	MJ	0.00E+00	0	0	0	0	0.00E+00
NRSF	MJ	0.00E+00	0	0	0	0	0.00E+00
FW	m ³	2.35E-03	0	0	0	0	1.98E+00
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						

Table E.4: Waste Production and Output Flows

Results per 1 kg of Black Steel Domed Plate (200X200X12 40H)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	3.09E-09	0	0	0	0	0.00E+00
NHWD	kg	8.40E-03	0	0	0	0	-8.10E-08
RWD	kg	1.92E-05	0	0	0	0	0.00E+00
CRU	kg	0.00E+00	0	0	0	0	0.00E+00
MFR	kg	4.12E-01	0	0	0	0	0.00E+00
MER	kg	0.00E+00	0	0	0	0	0.00E+00
EE	MJ	0.00E+00	0	0	0	0	0.00E+00
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table E.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of Black Steel Domed Plate (200X200X12 40H)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	2.56E+00	0	0	0	0	1.31E-01
ODP	kg CFC11 eq	1.94E-08	0	0	0	0	6.24E-09
AP	kg SO ₂ eq	7.09E-03	0	0	0	0	4.07E-04
EP	kg PO ₄ ³⁻ eq	8.02E-04	0	0	0	0	-6.43E-05
POCP	kg C ₂ H ₄ eq	1.31E-03	0	0	0	0	2.56E-04
ADPE	kg Sb eq	9.66E-08	0	0	0	0	2.24E-06
ADPF	MJ _{Ncv}	2.59E+01	0	0	0	0	1.80E+00
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Table F.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of Black Steel Round Domed Plate (150X150X6 49D)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	2.43E+00	0	0	0	0	0
GWP Fossil	kg CO ₂ -eq.	2.48E+00	0	0	0	0	0
GWP-Biogenic	kg CO ₂ -eq.	-5.32E-02	0	0	0	0	0
GWP-Luluc	kg CO ₂ -eq.	8.11E-04	0	0	0	0	0
ODP	kg CFC 11 eq.	5.73E-08	0	0	0	0	0
AP	mol H ⁺ eq.	1.10E-02	0	0	0	0	0
EP-Freshwater	kg P eq.	9.46E-05	0	0	0	0	0
EP-Marine	kg N eq.	2.37E-03	0	0	0	0	0
EP-Terrestrial	mol N eq.	2.66E-02	0	0	0	0	0
POCP	kg NMVOC eq.	1.25E-02	0	0	0	0	0
ADP-Minerals & metals*	kg Sb eq.	3.86E-07	0	0	0	0	0
ADP-Fossil*	MJ	2.41E+01	0	0	0	0	0
WDP	m ³	9.04E-01	0	0	0	0	0
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table F.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of Black Steel Round Domed Plate (150X150X6 49D)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ -eq.	2.38	0	0	0	0	0
PM	Disease Incidence	1.83E-07	0	0	0	0	0
IRP**	kBq U235 equivalent	1.34E-02	0	0	0	0	0
ETP-fw*	CTUe	7.79E+00	0	0	0	0	0
HTP-c*	CTUh	1.30E-08	0	0	0	0	0
HTP-nc*	CTUh	4.90E-08	0	0	0	0	0
SQP	-	9.10E+00	0	0	0	0	0
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table F.3: Use of Resources

Results per 1 kg of Black Steel Round Domed Plate (150X150X6 49D)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.59E+00	0	0	0	0	0
PERM	MJ	0.00E+00	0	0	0	0	0
PERT	MJ	1.59E+00	0	0	0	0	0
PENRE	MJ	2.49E+01	0	0	0	0	0
PENRM	MJ	0.00E+00	0	0	0	0	0
PENRT	MJ	2.49E+01	0	0	0	0	0
SM	kg	0.00E+00	0	0	0	0	0
RSF	MJ	0.00E+00	0	0	0	0	0
NRSF	MJ	0.00E+00	0	0	0	0	0
FW	m ³	1.10E+00	0	0	0	0	0
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						

Table F.4: Waste Production and Output Flows

Results per 1 kg of Black Steel Round Domed Plate (150X150X6 49D)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	0.00E+00	0	0	0	0	0
NHWD	kg	4.36E-05	0	0	0	0	0
RWD	kg	0.00E+00	0	0	0	0	0
CRU	kg	0.00E+00	0	0	0	0	0
MFR	kg	0.00E+00	0	0	0	0	0
MER	kg	0.00E+00	0	0	0	0	0
EE	MJ	0.00E+00	0	0	0	0	0
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table F.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of Black Steel Round Domed Plate (150X150X6 49D)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	2.28E+00	0	0	0	0	0
ODP	kg CFC11 eq	6.99E-08	0	0	0	0	0
AP	kg SO ₂ eq	8.80E-03	0	0	0	0	0
EP	kg PO ₄ ³⁻ eq	1.16E-03	0	0	0	0	0
POCP	kg C ₂ H ₄ eq	3.09E-03	0	0	0	0	0
ADPE	kg Sb eq	3.90E-07	0	0	0	0	0
ADPF	MJ _{Ncv}	3.27E+01	0	0	0	0	0
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Table G.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of Stainless Steel Domed Plate (150X150X5MM 49H SS316)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	6.38E+00	0	0	0	0	0
GWP Fossil	kg CO ₂ -eq.	6.43E+00	0	0	0	0	0
GWP-Biogenic	kg CO ₂ -eq.	-4.86E-02	0	0	0	0	0
GWP-Luluc	kg CO ₂ -eq.	2.14E-04	0	0	0	0	0
ODP	kg CFC 11 eq.	1.12E-07	0	0	0	0	0
AP	mol H ⁺ eq.	4.24E-02	0	0	0	0	0
EP-Freshwater	kg P eq.	1.08E-05	0	0	0	0	0
EP-Marine	kg N eq.	6.57E-03	0	0	0	0	0
EP-Terrestrial	mol N eq.	7.35E-02	0	0	0	0	0
POCP	kg NMVOC eq.	2.18E-02	0	0	0	0	0
ADP-Minerals & metals*	kg Sb eq.	1.71E-04	0	0	0	0	0
ADP-Fossil*	MJ	7.74E+01	0	0	0	0	0
WDP	m ³	7.06E+03	0	0	0	0	0
Acronyms	GWP-total = Global Warming Potential - total; 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						

Table G.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of Stainless Steel Domed Plate (150X150X5MM 49H SS316)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO ₂ -eq.	6.35	0	0	0	0	0
PM	Disease Incidence	4.74E-07	0	0	0	0	0
IRP**	kBq U235 equivalent	2.75E-01	0	0	0	0	0
ETP-fw*	CTUe	1.16E+02	0	0	0	0	0
HTP-c*	CTUh	7.22E-08	0	0	0	0	0
HTP-nc*	CTUh	1.68E-07	0	0	0	0	0
SQP	-	1.31E+01	0	0	0	0	0
Acronyms	GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential – human health; ETP-fw = Eco-toxicity potential – freshwater; HTP-c = Human toxicity potential – cancer effects; HTP-nc = Human toxicity potential – non-cancer effects; SQP = Land use related impacts / soil quality						

* 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.

** Disclaimer: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table G.3: Use of Resources

Results per 1 kg of Stainless Steel Domed Plate (150X150X5MM 49H SS316)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.62E+01	0	0	0	0	0
PERM	MJ	0.00E+00	0	0	0	0	0
PERT	MJ	1.62E+01	0	0	0	0	0
PENRE	MJ	7.75E+01	0	0	0	0	0
PENRM	MJ	0.00E+00	0	0	0	0	0
PENRT	MJ	7.75E+01	0	0	0	0	0
SM	kg	0.00E+00	0	0	0	0	0
RSF	MJ	0.00E+00	0	0	0	0	0
NRSF	MJ	0.00E+00	0	0	0	0	0
FW	m ³	1.63E-01	0	0	0	0	0
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						

Table G.4: Waste Production and Output Flows

Results per 1 kg of Stainless Steel Domed Plate (150X150X5MM 49H SS316)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	0.00E+00	0	0	0	0	0
NHWD	kg	3.73E-03	0	0	0	0	0
RWD	kg	0.00E+00	0	0	0	0	0
CRU	kg	0.00E+00	0	0	0	0	0
MFR	kg	0.00E+00	0	0	0	0	0
MER	kg	0.00E+00	0	0	0	0	0
EE	MJ	0.00E+00	0	0	0	0	0
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table G.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of Stainless Steel Domed Plate (150X150X5MM 49H SS316)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	6.25E+00	0	0	0	0	0
ODP	kg CFC11 eq	9.61E-08	0	0	0	0	0
AP	kg SO ₂ eq	3.26E-02	0	0	0	0	0
EP	kg PO ₄ ³⁻ eq	2.39E-03	0	0	0	0	0
POCP	kg C ₂ H ₄ eq	2.59E-03	0	0	0	0	0
ADPE	kg Sb eq	1.71E-04	0	0	0	0	0
ADPF	MJ _{Ncv}	7.03E+01	0	0	0	0	0
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Table H.1: Potential Environmental Impact – EN 15804+A2 Mandatory Indicators

Results per 1 kg of Stainless Steel Round Domed Plate (OD150 X 5MM SS316)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-Total	kg CO ₂ -eq.	6.57E+00	0	0	0	0	0
GWP Fossil	kg CO ₂ -eq.	6.59E+00	0	0	0	0	0
GWP-Biogenic	kg CO ₂ -eq.	-2.26E-02	0	0	0	0	0
GWP-Luluc	kg CO ₂ -eq.	2.17E-04	0	0	0	0	0
ODP	kg CFC 11 eq.	1.15E-07	0	0	0	0	0
AP	mol H ⁺ eq.	4.34E-02	0	0	0	0	0
EP-Freshwater	kg P eq.	1.09E-05	0	0	0	0	0
EP-Marine	kg N eq.	6.72E-03	0	0	0	0	0
EP-Terrestrial	mol N eq.	7.52E-02	0	0	0	0	0
POCP	kg NMVOC eq.	2.23E-02	0	0	0	0	0
ADP-Minerals & metals*	kg Sb eq.	1.75E-04	0	0	0	0	0
ADP-Fossil*	MJ	7.94E+01	0	0	0	0	0
WDP	m ³	7.26E+03	0	0	0	0	0
Acronyms	<p><i>GWP-total = Global Warming Potential - total; 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</i></p>						

Table H.2: Potential Environmental Impact – EN 15804+A2 Additional Indicators

Results per 1 kg of Stainless Steel Round Domed Plate (OD150 X 5MM SS316)							
Indicator	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP-GHG	kg CO₂-eq.	6.51	0	0	0	0	0
PM	Disease Incidence	4.86E-07	0	0	0	0	0
IRP**	kBq U235 equivalent	2.83E-01	0	0	0	0	0
ETP-fw*	CTUe	1.20E+02	0	0	0	0	0
HTP-c*	CTUh	7.42E-08	0	0	0	0	0
HTP-nc*	CTUh	1.73E-07	0	0	0	0	0
SQP	-	1.03E+01	0	0	0	0	0
Acronyms	<p><i>GWP-GHG = Carbon footprint (Global Warming Potential Greenhouse Gas emissions); PM = Particulate Matter emissions; IRP = Ionising Radiation Potential - human health; ETP-fw = Eco-toxicity potential - freshwater; HTP-c = Human toxicity potential - cancer effects; HTP-nc = Human toxicity potential - non-cancer effects; SQP = Land use related impacts / soil quality</i></p>						

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Table H.3: Use of Resources

Results per 1 kg of Stainless Steel Round Domed Plate (OD150 X 5MM SS316)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.62E+01	0	0	0	0	0
PERM	MJ	0.00E+00	0	0	0	0	0
PERT	MJ	1.62E+01	0	0	0	0	0
PENRE	MJ	7.95E+01	0	0	0	0	0
PENRM	MJ	0.00E+00	0	0	0	0	0
PENRT	MJ	7.95E+01	0	0	0	0	0
SM	kg	0.00E+00	0	0	0	0	0
RSF	MJ	0.00E+00	0	0	0	0	0
NRSF	MJ	0.00E+00	0	0	0	0	0
FW	m ³	1.67E-01	0	0	0	0	0
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						

Table H.4: Waste Production and Output Flows

Results per 1 kg of Stainless Steel Round Domed Plate (OD150 X 5MM SS316)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
HWD	kg	0.00E+00	0	0	0	0	0
NHWD	kg	3.82E-03	0	0	0	0	0
RWD	kg	0.00E+00	0	0	0	0	0
CRU	kg	0.00E+00	0	0	0	0	0
MFR	kg	0.00E+00	0	0	0	0	0
MER	kg	0.00E+00	0	0	0	0	0
EE	MJ	0.00E+00	0	0	0	0	0
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal						

Table H.5: Potential Environmental Impacts – Indicators According to EN 15804:2012+A1:2013

Results per 1 kg of Stainless Steel Round Domed Plate (OD150 X 5MM SS316)							
Parameter	Unit	Total A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	6.44E+00	0	0	0	0	0
ODP	kg CFC11 eq	9.80E-08	0	0	0	0	0
AP	kg SO ₂ eq	3.34E-02	0	0	0	0	0
EP	kg PO ₄ ³⁻ eq	2.44E-03	0	0	0	0	0
POCP	kg C ₂ H ₄ eq	2.66E-03	0	0	0	0	0
ADPE	kg Sb eq	1.75E-04	0	0	0	0	0
ADPF	MJ _{Ncv}	7.21E+01	0	0	0	0	0
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources						

Additional Information

Quality Assurance

DSI Underground is Quality Assured to ISO 9001:2015 and ISO 14001:2015.



Safety Certification

DSI Underground is certified to ISO 45001:2018 for Occupational and Safety

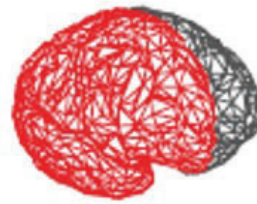


Our Values



Customer Focus

We are agile, decentralized and make decisions close to customers.



Innovation

We are technology leaders, through innovation.



Fair Play

We are ethical and compliant, dedicated to health, safety and sustainability.



Passion To Win

We establish market leadership through empowered people, strong performance management, and continuous improvements.

Our EHS vision is to achieve Zero Harm to our people, to the environment we work in, to our customers and our suppliers.



References

AEPDP 2018

Australasian EPD Programme, Instructions of the Australasian EPD programme v3.0 - a regional annex to the general programme instructions of The International EPD® System, Version 3.0, 18 September 2018

AusLCI 2021

Australian Life Cycle Inventory database v 1.36, published by the Australian Life Cycle Assessment Society, 2021

EN 15804+A1

EN 15804:2012+A1:2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, European Committee for Standardization (CEN), Brussels, August 2013

EN 15804+A2

EN 15804:2012+A2:2019, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, European Committee for Standardization (CEN), Brussels, October 2019

Environdec 2021a

PCR2019:14 (version 1.11), Product category rules for Construction products (EN 15804:A2), registration number 2019:14, published on 5 February 2021

Environdec 2021b

International EPD System, General Programme Instructions for the International EPD System, Version 3.01, 29 March 2021

IPCC 2013

Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

ISO 14040

ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework. International Organization for Standardization, Geneva, Switzerland, 2006

ISO 14044

ISO14044:2006, Environmental management - Life cycle assessment - Requirements and guidelines. International Organization for Standardization, Geneva, Switzerland, 2006

ISO 14025

ISO14025:2006, Environmental labels and declarations - Type III environmental declarations - Principles and procedures. International Organization for Standardization, Geneva, Switzerland, 2006



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