



Issuance date: 23.08.2021
Validity date: 23.08.2026

STEEL FIBRES for concrete reinforcement



Owner of the EPD:

ArcelorMittal Sheffield Ltd
Address: Vulcan Works, Birley Vale Close
Sheffield S12 2DB, United Kingdom
Tel.: +44 (0) 114 239 2601
Fax: +44 (0) 114 264 2514
Contact: fencingsales@arcelormittal.com

EPD Program Operator:

Instytut Techniki Budowlanej (ITB)
Address: Filtrowa 1, 00-611 Warsaw, Poland
Website: www.itb.pl
Contact: Justyna Tomaszewska
j.tomaszewska@itb.pl
energia@itb.pl



ITB is the verified member of The European Platform for EPD program operators and LCA practitioner www.eco-platform.org

Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment. Their aspects were verified by the independent body according to ISO 14025. Basically, a comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804 (see point 5.3 of the standard).

Life cycle analysis (LCA): A1-A3, C1-C4 and D modules in accordance with EN 15804
(Cradle-to-Gate with options)

The year of preparing the EPD: 2021

Product standard: EN 14889-1

Service Life: 100 years for standard product

PCR: ITB-PCR A (PCR based on EN 15804)

Declared unit: 1 ton

Reasons for performing LCA: B2B

Representativeness: British, European, Global

MANUFACTURER

ArcelorMittal is steel and mining company, present in 60 countries with an industrial footprint in 18 countries, spanning five continents. The company supplies steel products in all major markets including automotive, construction, household appliance and packing. ArcelorMittal Sheffield Ltd is part of the WireSolutions division of ArcelorMittal, specialized in the production of reinforcement solutions for concrete and fencing. The company offers a wide range of steel fibres for flooring, shotcrete, precast and structural applications. All fibres are made of cold drawn wire and are CE marked.

PRODUCT DESCRIPTION AND APPLICATION

Undulated Fibre trade named **TABIX** has been designed such from the point of view of amplitude and wave length that the workability is good for aspect ratios up to 45 and remains satisfactory for aspect ratios up to 60. Due to the shape TABIX provides shrinkage control and pull-out resistance from the concrete matrix. These features make TABIX especially suited for jointless industrial floors and for structural applications. TABIX needs a well compacted medium - to high - strength concrete to develop its full performance.



Fig. 1. A view of TABIX Fibres.

Hooked-End Fibre (HE) does not perform as well as undulated fibres with regard to shrinkage control, but shows better performances for high deformations of the concrete element, and it provides a good workability when using fibres with up to an aspect ratio of 60. HE can be used with any concrete mix and high concrete density is less mandatory than for undulated or for flat-end fibres.



Fig. 2. A view of Hooked-End Fibres (HE).

Flat-End Fibre (FE) is a straight fibre with flattened ends. It is sometimes referred to as fishtail. Through the flattening process, the ends become larger which significantly increases the anchorage of the fibre in the concrete matrix rather than relying solely on the friction between concrete and steel. FE is almost exclusively used in shotcrete applications due to its low rebound ratio. This fibre can however also be used in other applications such as precast elements. Flat-End fibre should not be used in applications where concrete shrinkage is a primary concern.

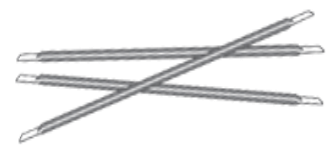


Fig. 3. A view of Flat-End Fibres (FE).

Hooked/Flat-End Fibre (HFE) is a combination of the HE (hooked end) and the FE (flat end) shapes. By flattening the extremities of the crimped fibres, the anchorage capacities are still improved especially for small strains. HFE can be used in any type of application. HFE shows static performance and shrinkage control in fresh and in hardened concrete. As with HE, all concrete grades can be used with HFE.



Fig. 4. A view of Hooked/Flat-End Fibres (HFE)

Type III Environmental Product Declaration No. 251/2021

Table 1. Specification of the steel fibres produced by ArcelorMittal Sheffield Ltd.

Name	Type of fibres	Diameter, mm	Length, mm
Hooked-End Steel Fibres	HE 1/50	1.0	50
	HE+ 1/50	1.0	50
	HE++ 1/50	1.0	50
	HE 1/60	1.0	60
	HE+ 1/60	1.0	60
	HE 55/35	0.55	35
	HE++ 55/35	0.55	35
	HE+ 70/50	0.70	50
	HE 75/35	0.75	35
	HE++ 75/35	0.75	35
	HE 75/50	0.75	50
	HE++ 75/50	0.75	50
	HE 75/60	0.75	60
	HE 80/50	0.80	50
	HE 90/60	0.90	60
	HE++ 90/60	0.90	60
Flat-End Steel Fibres	FE 60/36	0.60	36
	FE 65/35	0.65	35
Hooked/Flat-End Steel Fibres	HFE 90/60	0.90	60
Undulated Steel Fibres Tabix	1/50	0.1	50
	+1/60	0.1	60
	1.3/50	0.13	50
	90/35	0.90	35
	80/55	0.80	55
AFT Steel Fibres	0.8/55	0.08	55

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Allocation

The allocation rules used for this EPD are based on general ITB PCR A. Production of the steel fibres is a line process in a factory of ArcelorMittal Sheffield Ltd in Sheffield (United Kingdom). Allocation was done on product mass basis. All impacts from raw materials extraction and processing are allocated in module A1 of the LCA. Impacts from the global line production of ArcelorMittal Sheffield Ltd were inventoried and 44% were allocated to the steel fibres production. Water and energy consumption, associated emissions and generated wastes are allocated to module A3.

System limits

The life cycle analysis (LCA) of the declared products covers: product stage – modules A1-A3, end of life – modules C1-C4 and benefits and loads beyond the system boundary – module D (cradle-to-gate with options) in accordance with EN 15804+A1 and ITB PCR A. The details of systems limits are provided in the background report. Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included in the calculations. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804+A1, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA.

Modules A1 and A2: Raw materials supply and transport

Steel wire rod, drawing soap, sanding paper, drawing dies, additives and packaging materials come from both local and foreign suppliers. Means of transport include railway, ships, planes and lorries. For calculation purposes British and European fuel averages were applied.

Module A3: Production

A scheme of the steel fibres production process is presented in Fig. 5. In first step a coil of wire rod is loaded on pay off using a forklift. Then, the wire rod is mechanically and chemically cleaned and lubricated before drawing. The cold drawing process is carried out with the use of 14 blocks allowing to obtain a required diameter. In the next step, the wire rods is shaped, cut and packed in carton boxes or big bags, labelled and palletised.

Modules C1-C4 and D: End-of-life (EoL)

Steel fibers are most often added in the amount of 0.3% - 3.0% of the total weight of a concrete mixture. It is assumed that at the EoL 98% of steel fibres is recovered from a concrete matrix using a mobile crusher station equipped with a magnetic separatory system (estimated efficiency 150 t/h) while remaining 2% is forwarded to landfill in the form of mixed construction and demolition (c&d) wastes. Recovered material (steel scrap) do not requires future processing, thus is transported directly to a steel mill distant of about 75 km on > 24t lorry with 85% capacity utilization and fuel consumption of 35 L per 100 km (module C2). Environmental burdens declared in module C4 are associated with landfilling of inert c&d wastes. A potential credit resulting from the recycling of 92% the recovered steel scrap are presented in module D.

Data quality

The values determined to calculate the LCA originate from verified ArcelorMittal Sheffield Ltd inventory data.

Data collection period

The data for manufacture of the declared products refer to period between 01.01.2020 – 31.12.2020 (1 year). The life cycle assessments were prepared for United Kingdom as reference area.

Assumptions and estimates

The impacts of the representative steel fibres were aggregated using weighted average. Impacts were inventoried and calculated for all products of steel fibres.

Calculation rules

LCA was done in accordance with ITB PCR A document.

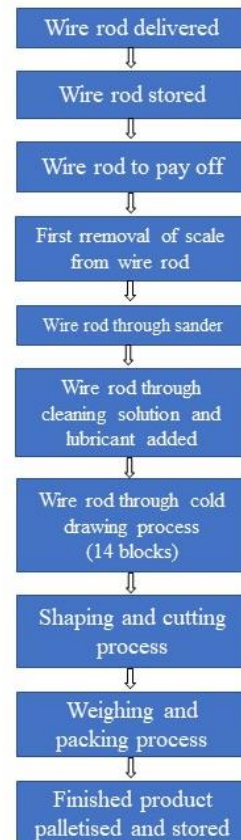


Fig. 5. Production process of the steel fibres by ArcelorMittal Sheffield Ltd.

Type III Environmental Product Declaration No. 251/2021

Databases

The data for the processes come from the following databases: Ecoinvent v.3.7, specific EPDs for steel products, ITB-Database. Specific data quality analysis was a part of external ISO 14001 audit.

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) – 1 ton of the steel fibres produced by ArcelorMittal Sheffield Ltd.

Table 2. System boundaries for the environmental characteristic of the steel fibres.

Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
MD	MD	MD	MND	MND	MND	MND	MND	MND	MND	MND	MND	MD	MD	MD	MD	MD

List of abbreviations:

- GWP** – Global warming potential;
- ODP** – Depletion potential of the stratospheric ozone layer;
- AP** – Acidification potential of land and water;
- EP** – Eutrophication potential;
- POCP** – Formation potential of tropospheric ozone photochemical oxidants;
- ADPE** – Abiotic depletion potential for non-fossil resources;
- ADPF** – Abiotic depletion potential for fossil resources;
- 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 resources;
- SM** – Use of secondary material;
- RSF** – Use of renewable secondary fuels;
- NRSF** – Use of non-renewable secondary fuels;
- FW** – Use of net fresh water;
- HWD** – Hazardous waste disposed; **NHWD** – Non-hazardous waste disposed;
- RWD** – Radioactive waste disposed;
- CRU** – Components for re-use;
- MFR** – Materials for recycling;
- MER** – Materials for energy recovery;
- EE** – Exported energy.

Type III Environmental Product Declaration No. 251/201

Table 3. Life cycle assessment (LCA) results of the steel fibres produced by ArcelorMittal Sheffield Ltd.

Environmental impacts: (DU) 1 ton										
Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
GWP	kg CO ₂ eq.	1.91E+03	1.58E+01	9.74E+01	2.03E+03	3.27E+01	2.98E+00	0.00E+00	1.03E-01	-1.07E+03
ODP	kg CFC 11 eq.	5.65E-07	0.00E+00	1.75E-05	1.81E-05	5.58E-06	0.00E+00	0.00E+00	3.42E-08	2.65E-12
AP	kg SO ₂ eq.	5.03E+00	2.59E+00	4.03E-03	7.62E+00	1.04E-01	4.16E-02	0.00E+00	7.48E-04	-2.11E+00
POCP	kg Ethene eq.	1.14E+00	4.04E-02	1.12E-03	1.18E+00	4.20E-03	3.03E-03	0.00E+00	5.64E-05	-5.19E-01
EP	kg (PO ₄) ³⁻ eq.	4.17E-01	3.93E-01	5.53E-04	8.11E-01	2.27E-02	7.34E-03	0.00E+00	1.60E-04	-1.48E-01
ADPE	kg Sb eq.	6.09E-04	0.00E+00	3.61E-04	9.70E-04	1.30E-05	0.00E+00	0.00E+00	2.33E-07	-3.27E-04
ADPF	MJ	1.94E+04	3.73E+02	1.25E+03	2.10E+04	4.46E+02	4.06E+01	0.00E+00	2.95E+00	-1.01E+04
Environmental aspects on resource use: (DU) 1 ton										
Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
PERE	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
PERM	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
PERT	MJ	7.70E+02	2.61E+01	1.30E+03	2.10E+03	2.33E+00	2.84E+00	0.00E+00	2.37E-02	6.29E+02
PENRE	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
PENRM	MJ	INA	INA	INA	INA	INA	INA	INA	INA	INA
PENRT	MJ	2.09E+04	3.92E+02	1.80E+03	2.31E+04	4.46E+02	4.27E+01	0.00E+00	3.12E+00	-1.01E+04
SM	kg	3.54E+02	0.00E+00	0.00E+00	3.54E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.19E+00
RSF	MJ	1.58E-02	1.96E+01	0.00E+00	1.96E+01	0.00E+00	2.13E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	1.60E-01	0.00E+00	0.00E+00	1.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	INA	INA	INA	INA	INA	INA	INA	INA	INA
Other environmental information describing waste categories: (DU) 1 ton										
Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
HWD	kg	1.74E-01	1.27E-03	0.00E+00	1.75E-01	1.21E-03	1.38E-07	0.00E+00	4.34E-06	-3.20E-06
NHWD	kg	1.09E+02	5.66E-01	2.19E+02	3.29E+02	5.41E-01	6.16E-05	0.00E+00	2.00E+01	6.55E+00
RWD	kg	2.81E-02	3.27E-03	0.00E+00	3.14E-02	3.13E-03	3.56E-07	0.00E+00	1.93E-05	-3.38E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	2.39E-03	0.00E+00	7.76E+00	7.76E+00	9.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	2.22E-01	0.00E+00	1.19E+00	1.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.48E-02
EE	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Type III Environmental Product Declaration No. 251/2021

Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3.) <input checked="" type="checkbox"/> external <input type="checkbox"/> internal
External verification of EPD: PhD. Eng. Halina Prejzner LCA, LCI audit and input data verification: PhD. Eng. Justyna Tomaszewska, j.tomaszewska@itb.pl Verification of LCA: PhD. D.Sc. Eng. Michał Piasecki, m.piasecki@itb.pl

Normative references

- ITB PCR A General Product Category Rules for Construction Products
- ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A1:2013 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- EN 15942:2011 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- EN 14889-1:2006 Fibres for concrete - Part 1: Steel fibres - Definitions, specifications and conformity
- Department for Business, Energy & Industrial Strategy. Calorific values and density of fuels, 2021. <https://www.gov.uk/>
- Department for Business, Energy & Industrial Strategy. UK Government GHG Conversion Factors for Company Reporting 2020.

KIEROWNIK
Zakładu Fizyki Ciepłoty, Akustyki i Środowiska
dr inż. Agnieszka Winkler-Skalna



Instytut Techniki Budowlanej

00-611 Warsaw, Filtrowa 1

Thermal Physics, Acoustics and Environment Department
02-656 Warsaw, Ksawerów 21

CERTIFICATE No 251/2021 of TYPE III ENVIRONMENTAL DECLARATION

Products:

Steel fibres for concrete reinforcement

Manufacturer:

ArcelorMittal Sheffield Ltd.

Vulcan Works, Birley Vale Close, S12 2DB Sheffield United Kingdom

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

PN-EN 15804+A1

Sustainability of construction works.

Environmental product declarations.

Core rules for the product category of construction products.


This certificate, issued for the first time on 23rd August 2021 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics
and Environment Department


Agnieszka Winkler-Skalna, PhD



Deputy Director
for Research and Innovation


Krzysztof Kuczyński, PhD

Warsaw, 23 August 2021