Pre-stressed steel rope manufactured from steel scrap

Environmental Product Declaration
In accordance with ISO 14025:2006 and EN 14804:2012

Programme:	**The International EPD® System** **EPD registered through the fully aligned regional programme/hub:** **EPD Latin America**
Programme operator:	**EPD International AB** **Regional Hub: EPD Latin America**
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Geographical scope:	**Mexico**

Content

1. DEACERO

DEACERO is a world-class company that produces a wide range of steel products. Through productivity, excellence in quality and innovation in its products, as well as the focus on customer service, DEACERO has managed to meet the needs of local and international markets, positioning itself as a leader in the field.

DEACERO is a 100% Mexican company that has managed to transform and grow firmly to efficiently respond to the demands of an international market of high level of competition in more than 20 countries in America and Europe.

The quality of DEACERO is a tradition in the market, therefore, it has invested in more training, better products and in integrated production processes that allow serving the agricultural, industrial, construction and domestic sectors.

DEACERO conceives sustainability in its three dimensions: social, economic and environmental, in relation to the latter, it is a company that takes care of the environment of the communities through advanced water, air and soil protection systems. DEACERO conceives progress as productivity that develops with an ecological sense.

DEACERO is strongly committed to a sustainable strategy of growth that benefits the company, the environment, their employees and the communities in which operates. DEACERO is a fully integrated company with an infrastructure for recycling, processing waste, steel mills, finished product plants and distribution centers.

As an organization DEACERO strives for physical health and implementation of values, smart use of natural resources, and stable growth together with their customers and suppliers. The company owns developments in advanced technology for steel recycling facilities and its transformation to finish products.

This Environmental Product Declaration (EPD) is in accordance with ISO 14025 and EN 15804, for pre-stressed steel rope manufactured from steel scrap.

EPD of constructions products may not be comparable if they do not comply with EN 15804 Sustainability of constructions works – Environmental product declarations – Core rules for product category of construction products.

Environmental product declarations within the same product category from different programs may not be comparable.

2. General Information

Product	Pre-stressed steel rope manufactured from steel scrap
Declaration owner	DEACERO S.A.P.I. de C.V. Avenida Lázaro Cárdenas, Zona Loma Larga Oriente, San Pedro Garza García, Nuevo León, México. C.P. 66266 www.deacero.com Contact person: Daniel Armando Guajardo Hernández dguajardo@deacero.com
Description of the construction product	Pre-stressed steel rope is made from stranded steel wires allowing the construction of structures in dimensions higher to those made from conventional steel reinforcement.
Declared Unit	1 ton of pre-stressed steel rope
Construction product identification	Central Product Classification: CPC 4124 Bars and rods, hot rolled, of iron or steel.
Description of the main product components and or materials	100% steel manufactured from steel scrap
Life cycle stages not considered	Distribution, use, end of life
Content of the declaration	This EPD is based on information modules that do not cover the aspects of use and end of life of the product. It contains in detail, for Module A1, A2 and A3: - Product definition and physical data - Information about raw materials and origin - Specifications on manufacturing of the product - Notes on product processing - LCA based on a declared unit, cradle-to-gate - LCA results - Evidence and verifications
For more information consult	www.deacero.com/en/
Site for which this EPD is representative	Celaya plant: Carretera 45 Panamericana tramo Celaya -Salamanca Km 64.8 Poblado de Chinaco, Villagrán, Guanajuato C.P. 38080, México.
Public intended	B2B (Business to Business)

3. Product Description

The pre-stressed steel rope is made of six twisted steel cables through a central cable, twisted helically in braided constructions of 1x3, 1x7 and 1x19 allowing the construction of structures in dimensions higher to those made from conventional steel reinforcement. DEACERO produces the pre-stressed steel rope with electric arc furnace technology in Celaya, Guanajuato, following the manufacturing standard NMX-C-407-ONNCCE-2001 (DEACERO, 2018).

Uses

- Airport runways
- Building and parking lot slabs
- Storage and industrial parks facilities

Features

- 6 wires stranded across a central wire
- Post-formation that ensures union between wires
- Thermal treated

Advantages

- Better resistance to tension over time
- Allows for better foundations
- Bigger space between columns and budget cost savings

Table 1. Technical specifications

Diameter		Breaking resistance (min)		Nominal area		Weight		Yield strength at 1%		Elongation % (min)
In	mm	kg	lb-f	in²	mm²	kg/1 000 m	lb/1 000 ft	kg	lb-f	
0.375 (3/8″)	9.53	10 430	23 000	0.09	54	432	290	9 388	20 700	3.5
0.500 (1/2″)	12.7	18 730	41 300	0.15	98	775	520	16 850	37 170	3.5
0.600″	15.2	26 757	58 600	0.22	140	1 102	740	23 915	52 740	3.5

4. Content declaration

The pre-stressed steel rope manufactured by DEACERO is made of 100% low alloyed steel manufactured in electric arc furnace with 94% recycled material.

The typical composition of the low alloyed steel is presented in Table 2.

Table 2. Typical content of low alloyed steel

Element	Typical content
Iron	94.6 %
Carbon	3.4%
Manganese	1.4%
Silicon	0.2%
Phosphorus	0.1%
Sulfur	< 0.1%
Copper	0.3%

5. LCA Rules

Environmental potential impacts were calculated according to EN 15804:2012 and PCR 2012:01 Construction products and construction services Version 2.2 (2017-05-30). This EPD is in accordance with ISO 14025:2006.

Environmental potential impacts were calculated through Life Cycle Assessment (LCA) methodology according to ISO 14040:2006 and ISO 14044:2006. An external third-party critical review process of the LCA was conducted according to ISO/TS 14071:2014.

5.1 Declared unit

One metric ton of pre-stressed steel rope manufactured from steel scrap.

5.2 System boundary

This is a cradle to gate EPD. The following life cycle stages were considered: A1 – Raw materials supply, A2 – Transport, A3 – Manufacturing. Excluded lifecycle stages are construction process, use and end-of-life. The description of the system boundary is presented in Table 3

Table 3. Pre-stressed steel rope product system.

Environmental information in the life cycle of pre-stressed steel rope manufactured from 100% scrap							**Additional environmental information**
A1 - A3			A4 - A5		B1 - B7	C1 - C4	D
Product stage			Construction stage		Use stage	End-of-life stage	Reuse and recovery
A1	A2	A3	A4	A5	B1 - B7	C1 - C4	
Wire rod manufacturing. Generation of electricity and production and processing of natural gas used during manufacturing.	Transport of steel scrap, transport of other raw materials, transport of auxiliary inputs from the production site to the DEACERO plant and internal transports.	Production and consumption of auxiliary materials: oxygen, argon, nitrogen, oil, grease, etc. Waste transport and waste treatment. Emissions to air and water from the operations of DEACERO.	Product distribution	Construction and instalation	Use, maintenance, replacement, refurbishment on, repair, use of energy and water during the operation.	Demolition, deconstruc-tion, transport, waste processing and final disposal.	Reuse- recovery-recycling potential
X	X	X	MND	MND	MND	MND	MND
(Cradle-to-gate) Declared unit							

(X = included in LCA; MND = Module Not Declared).

5.3 Manufacturing process

The manufacturing process of pre-stressed steel rope by DEACERO is described in Figure 1.

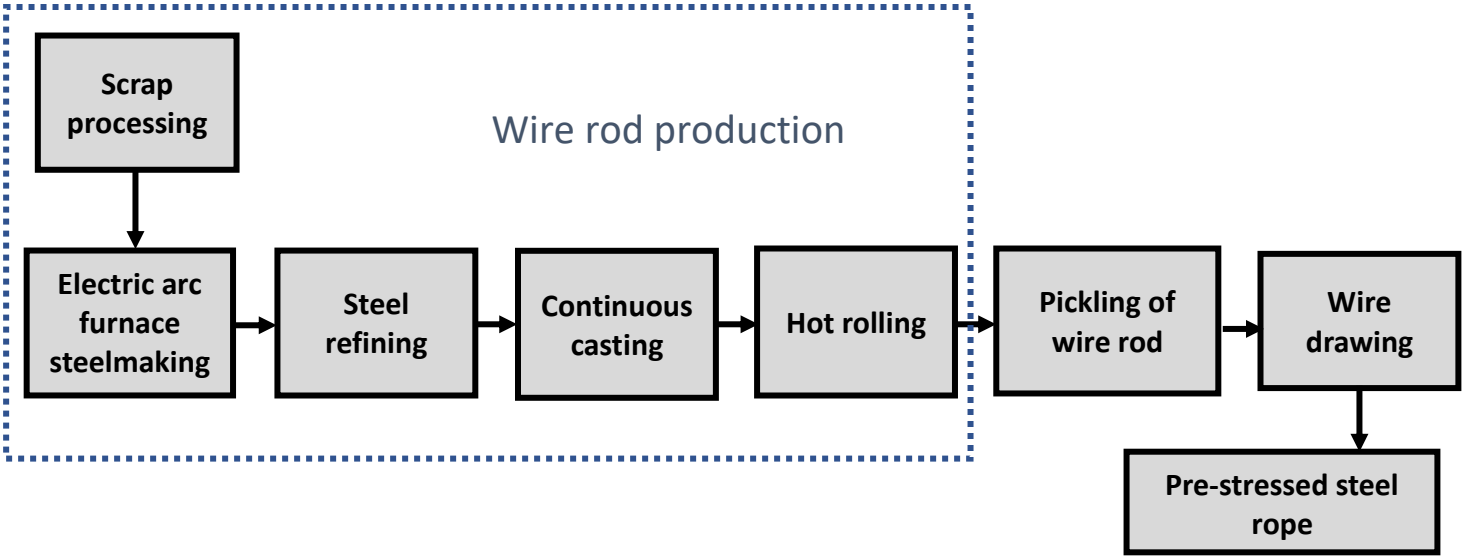

Figure 1. Flow diagram of the manufacturing process of pre-stressed steel rope.

5.4 Assumptions

- It was considered the most representative scrap yard for scrap collection, being that of Mexicali, assuming that all scrap yards operate in the same way.
- The packing material of ferroalloys is made of polypropylene bags.
- Plastic waste is recycled in the municipality of Monterrey at a distance of 251 km from Celaya.
- Hazardous waste is spent oil and impregnated solids.
- The hazardous waste is confined in Monterrey at a distance of 251 km from Celaya.
- The pickling supplies are transported in drums and plastic containers, from Celaya, Guanajuato.
- Powdered lubricants are transported in drums and metal trays, from Italy.

5.5 Cut-off criteria

A minimum of 95% of the total flows (matter and energy) in the A1 and A3 modules were included. Company infrastructure, employee's transportation and administrative activities were kept out of the scope of this study.

5.6 Allocation

In this study, allocation of inputs and outputs of the system between product and coproducts was based on a mass relation, considering the quantity produced per year of each product and coproduct at the level of unit process.

Table 4 shows the coproducts obtained during pre-stressed steel rope manufacturing process.

Table 4. Coproduct generated during pre-stressed steel rope manufacturing process.

Unit process	Coproduct
Electric Arc Furnace	Slag and steel scale
Hot rolling	Steel scale

The polluter pays principle was applied for the allocation procedure during recycling. In this way, in each case when there was an input of secondary material to the pre-stressed steel rope product system, recycling process and transportation to the site were included in life cycle inventory (for example, steel scrap). In those cases, in which output of material to recycling were presented, material transportation to recycling plant was included. This principle was applied to plastic and metal containers recycled by a third party.

For generic data Mexicaniuh and Ecoinvent 3.3 (Allocation - Recycled Content version) databases were used.

5.7 Time representativeness

Direct data obtained from DEACERO is representative for 2017.

5.8 Data quality assessment

Data quality assessment per information module is provided in Tables 5, 6 and 7.

Table 5. Raw material supply module data quality assessment.

Data quality **Data**	*Time related coverage*	*Geographical coverage*	*Technological covegare*	*Data source*	*Measured or estimated*
Raw materials consumption	2017	Mexico	Modern	DEACERO	M
Transport distance of scrap to DEACERO scrap yard	2017	Mexico	Modern	DEACERO	M
Consumption of energy and materials for the processing of scrap in scrap yards, as well as waste and generated emissions	2017	Mexico	Modern	DEACERO	M
Consumption of fuels and emissions related to the generation and distribution of electricity in Mexico	2017	Mexico	Mexican energy mix	Mexicaniuh	M&E
Energy consumption and generation of emissions related to natural gas production in Mexico	2017	Mexico	Mexican context	Mexicaniuh	M&E
Consumption of energy and materials for the manufacture of raw materials for the steelworks	1990-2016	European	Modern	Ecoinvent 3.3	M&E

Table 6. Transport module data quality assessment.

Data quality **Data**	*Time related coverage*	*Geographical coverage*	*Technological covegare*	*Data source*	*Measured or estimated*
Transport distance of scrap and other raw materials	2017	Mexico	Not Applicable	DEACERO	M
Transport distance of auxiliary supplies	2017	Mexico	Not Applicable	DEACERO	M
Transport distance of maintenance materials	2017	Mexico	Not Applicable	DEACERO & Google Maps	M
Transport distance of natural gas	2017	Mexico	Not Applicable	DEACERO & Google Maps	M&E
Consumption of materials and energy and emissions related to the transport requirements of raw materials and auxiliary inputs.	1992-2014	World average based on Europe	World average based on Europe	Ecoinvent 3.3	M&E

Table 7. Manufacturing module data quality assessment.

Data quality **Data**	*Time related coverage*	*Geographical coverage*	*Technological covegare*	*Data source*	*Measured or estimated*
Production efficiency and generation of by-products.	2017	Mexico	Modern	DEACERO	M
Consumption of auxiliary materials during manufacturing	2017	Mexico	Modern	DEACERO	M&E
Consumption of energy and materials for the manufacture of auxiliary materials	1990 – 2016	World average based on Europe	World average based on Europe	Ecoinvent 3.3	M&E
Generation of waste during manufacturing	2017	Mexico	Modern	DEACERO	M
Consumptions of materials and related energy during waste treatment	1990 - 2016	World average based on Europe	World average based on Europe	Ecoinvent 3.3	M&E
Emissions to air and water during the manufacturing process	2017	Mexico	Modern	DEACERO EPA AP42	M&E
Distance for waste transportation	2017	Mexico	Modern	DEACERO & Google Maps	M&E
Consumption of materials and energy and emissions related to waste transport requirements	1992-2014	World average based on Europe	World average based on Europe	Ecoinvent 3.3	M&E

6. Environmental performance

SimaPro 8.4 was used for Life Cycle Impact Assessment

6.1 Use of resources

Parameters describing resource use were evaluated with the Cumulated Energy Demand method version 1.09 (Frischknecht et al. 2007) except for the indicator of use of net fresh water that was evaluated with Recipe 2016 Midpoint (H) version 1.00 (Huijbregts et al. 2017). The detailed description of the use of resources is provided in Table 8.

Table 8. Resource indicators per metric ton of pre-stressed steel rope.

Parameter	Unit	Total	A1) Raw materials supply	A2) Transport	A3) Manufacturing
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	411	404	0.12	7.17
Use of renewable primary energy as raw materials	MJ	0	0	0	0
Total use of renewable primary energy resources	MJ	411	404	0.12	7.17
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	10 012	9 925	7.24	79.8
Use of non-renewable primary energy used as raw materials	MJ	0	0	0	0
Total use of non-renewable primary energy resources	MJ	10 012	9 925	7.24	79.8
Use of secondary material	kg	1 092	1 092	0	0
Use of renewable secondary fuels	MJ	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0
Use of net fresh water	m^3	4.04	2.82	1.5E-3	1.22

6.2 Potential environmental impact

Parameters describing environmental potential impacts were calculated using CML-IA method version 3.04 (Guinee et al. 2001; Huijbregts et al. 2003; Wegener et al. 2008) as implemented in SimaPro 8.4. Water scarcity potential was calculated using AWARE method (Boulay et al. 2018). Table 9 shows the LCA results and Figure 2 depicts the impact contribution per information module.

Table 9. Potential environmental impact indicators per metric ton of pre-stressed steel rope

Impact category	Unit	A1) Raw materials supply	A2) Transport	A3) Manufacturing	Total (A1 - A3)	A4-A5, B1-B2, CI-C4, D
Abiotic resource depletion (minerals)	kg Sb eq	2.42E-04	7.68E-07	4.55E-05	2.88E-04	Modules not declared
	%	84.0%	0.3%	15.8%	100.0%	
Abiotic resource depletion (fossil)	MJ	9 447	7	75	9 529	
	%	99.1%	0.1%	0.8%	100.0%	
Global warming (100y)	kg CO2 eq	637	4.64E-01	22	660	
	%	96.5%	0.1%	3.4%	100.0%	
Ozone layer depletion potential	kg CFC-11 eq	1.08E-04	7.96E-08	7.81E-07	1.09E-04	
	%	99.2%	0.1%	0.7%	100.0%	
Photochemical oxidant formation	kg C2H4 eq	0.65	1.91E-04	2.51E-03	0.65	
	%	99.6%	0.0%	0.4%	100.0%	
Acidification	kg SO2 eq	4.70	5.56E-03	0.05	4.75	
	%	98.9%	0.1%	1.0%	100.0%	
Eutrophication	kg PO4--- eq	0.31	6.94E-04	0.01	0.32	
	%	95.7%	0.2%	4.1%	100.0%	
Water scarcity	m3-eq	2.42E-04	7.68E-07	4.55E-05	2.88E-04	
	%	84.0%	0.3%	15.8%	100.0%	

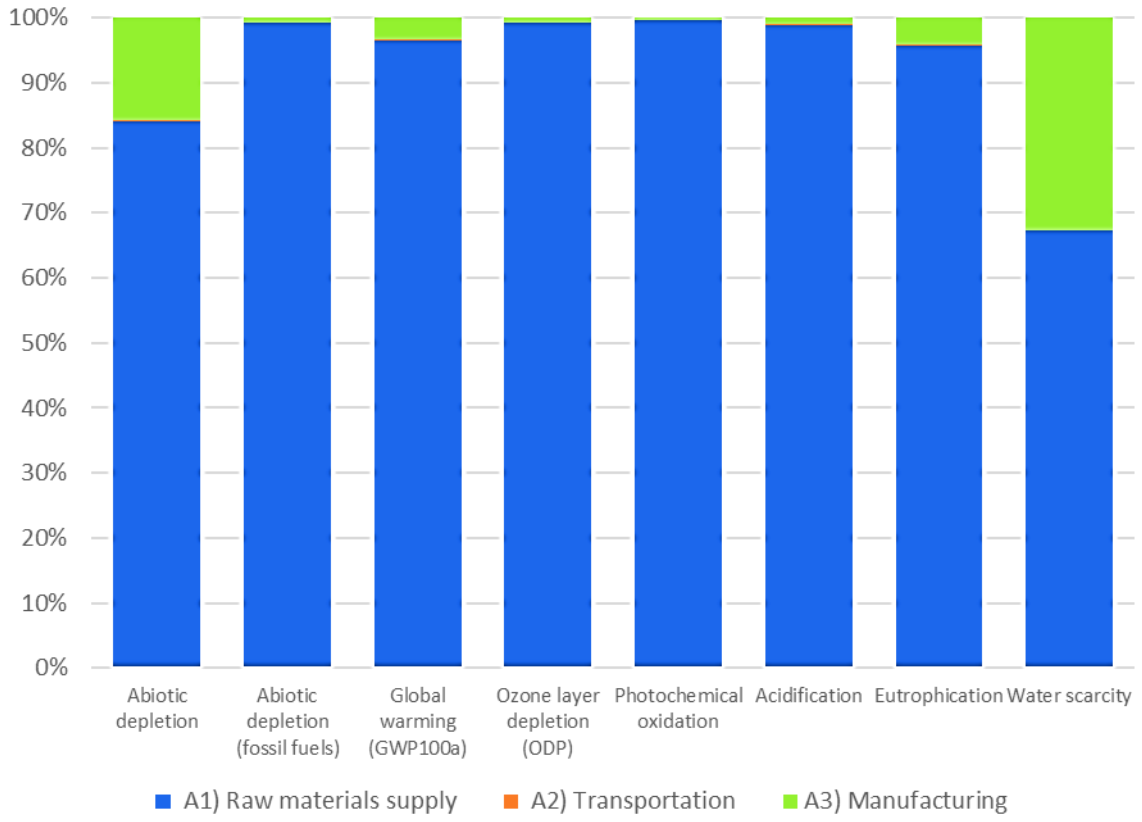

Figure 2. Potential environmental impact contribution per information module

6.3 Waste production

Environmental indicators describing waste generation were obtained from LCI except for background information which has been calculated using EDIP 2003 method (Hauschild and Potting, 2005). Table 10 shows waste and other outputs generated during each information module.

Table 10. Waste and other outputs per metric ton of pre-stressed steel rope.

Parameter	Unit	Total	A1) Raw materials supply	A2) Transport	A3) Manufacturing
Hazardous waste	kg	2.01	0.02	4.03E-06	1.99
Non hazardous waste	kg	57.8	56.8	0.18	0.83
Radioactive waste*	kg	0.02	0.02	4.57E-05	3.19E-04
Components for reuse	kg	0	0	0	0
Materials for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Exported electricity	MJ	0	0	0	0
Exported heat	MJ	0	0	0	0

*No radioactive waste is produced during DEACERO operation.

7. Verification and registration

CEN standard EN 150804 served as the core PCR	
Programme	International EPD® System www.environdec.com EPD registered through the fully aligned regional programme/hub: EPD Latin America www.epdlatinamerica.com
Programme operator	EPD International AB Box 210 60 SE-100 31 Stockholm, Sweden EPD Latin America Chile: Alonso de Ercilla 2996, Ñuñoa, Santiago, Chile. Mexico: Av. Convento de Actopan 24 Int. 7A, Colonia Jardines de Santa Mónica, Tlalnepantla de Baz, Estado de México, México, C.P. 54 050
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Product group classification:	UN CPC 4124
PCR:	PCR 2012:01 construction products and construction services, Version 2.2 (2017-05-03)
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration data, according to ISO 14025:2006.	☐ EPD process certification (Internal) ☒ EPD verification (External)
External third-party verifier and critical reviewer of the LCA:	Claudia A. Peña ADDERE Research & Technology Approved EPD verifier cpena@addere.cl, claudia@epd-americalatina.com
Accredited or approved by:	The International EPD® System

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ISO 14044:2006 Environmental management -- Life cycle assessment -- Requirements and guidelines.

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