Environmental Product Declaration

In accordance with ISO 14025:2006 for

NICKEL ALLOY WIRE ROD

from

SeAH Changwon Integrated Special Steel

Programme:	The International EPD® System, www.environdec.com
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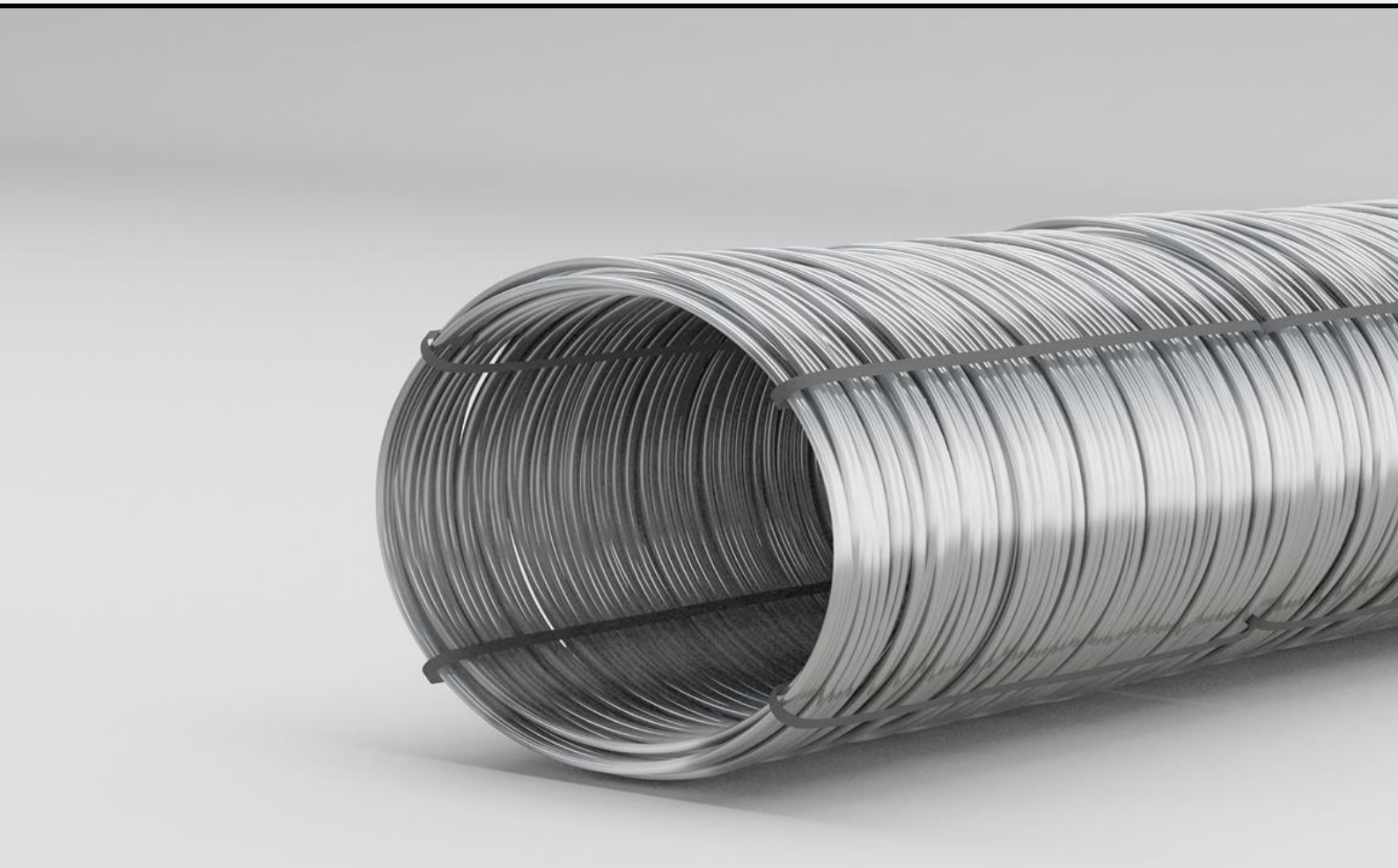

Programme information

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

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
PCR: *BASIC IRON OR STEEL PRODUCTS & SPECIAL STEELS, EXCEPT CONSTRUCTION STEEL PRODUCTS, PCR 2015:03, VERSION 2.1.0 and UN CPC 4112 AND 412*
PCR review was conducted by: *The Technical Committee of the International EPD® System. Chair: Massimo Marino Contact via info@environdec.com*
Life Cycle Assessment (LCA)
LCA accountability: Jihee Kim, SMaRTeco, e-mail: jihee@smart-eco.co.kr Jimin Lee, SMaRTeco, e-mail: jimin@smart-eco.co.kr
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: *Kripanshi Gupta, Intertek Assuris* Approved by: The International EPD® System Technical Committee, supported by the Secretariat
Procedure for follow-up of data during EPD validity involves third-party verifier: ☐ Yes ☒ No

EPDs within the same product category but from different programmes may not be comparable.
EPD owner has the sole ownership, liability, and responsibility for the EPD.

Company information

Owner of the EPD: SeAH Changwon Integrated Special Steel

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Description of the organisation

SeAH CSS has founded in 1966 in the city of Changwon, Gyeong-sang South Province of Korea. Since its birth, SeAH CSS has led the growth of the country's special steel sector by producing high-grade steel products and bringing the optimized steel production process to the next level. Our great product portfolio and sophisticated manufacturing techniques allow us to be responsive to rapidly changing market needs and emerging industry trends. We continue to develop innovative solutions of great customer value based on market demand and industry trend.

Stretching over an area of 670,000 square meters, the Changwon Plant produces 1.2 million tons of crude steel annually. The entire manufacturing process has an integrated system, which takes place at a single factory. Changwon Plant produces a wide variety of high- grade special steel of different applications and offers products and services that target specific customer needs with its customized post-treatment services, such as heat treatment and processing. SeAH CSS is the seamless stainless-steel pipes & tubes manufacturer in Korea that uses the integrated steel manufacturing system. The Changwon Plant produces seamless large diameter steel pipes, and this recent addition of the new plant to the company successfully brings the company a step closer to becoming a leading special steel maker in the world.

SeAH CSS is the company in Korea to produce stainless steel round bars and wire rods. With our integrated production system dedicated to high-grade specialty steel, we are able to maintain market-leading positions in multiple product categories in Korea; including stainless steel, tool steel and special alloy. Our goal is to optimize the products to fulfill customers' needs and ensure the stable availability of supply by using our innovative technology.

Our advanced technology and production are based on over 50 years of experience of innovating high-grade special steel products and developing new materials to ultimately promote customers' Value.

Product-related or management system-related certifications

ISO 9001, ISO 14001, KS Q 9100(AS 9100) certificates

Name and location of production site(s)

147 Jeokhyeon-Ro, Seongsan-Gu, Changwon, Gyeongsangnam-Do, Republic of Korea

Product information

Product name

NICKEL ALLOY WIRE ROD

Product identification

AWS A5.14, AMS 5853C, JIS G4311,
ASTM B163, B164, B166, B167, B348, B425, B574, B637, F30 etc.

Product description

SeAH Changwon Integrated Special Steel has VIM, ESR, VAR, and RFM equipment, which is essential for manufacturing special alloys, and produces high-quality, high-purity alloys required by API, GE, NORSOK by special heat treatment facilities.
Ni-Alloys with excellent oxidation resistance and high strength at high temperatures are used in jet engines, boiler valves for power generation, and other applications.
In particular, Ni-Alloy wire rods are used in various fields such as welding wire, springs, and drawing processing.
In general, in order to meet the physical properties required by the customer, the solution or annealing heat treatment is applied and provided to the customer.

Further information is available on http://www.seahss.co.kr/eng/pr/brochure.jsp

Application & Characteristic

Grades	Application	Production				Size Range
		EAF	VIM	ESR	VAR	
ALLOY 625/600/601	Welding Solid Wire, CHQ, Mash	●	●	●		Ø5.5~Ø34
ALLOY 718/X750	Welding Solid Wire, Spring, Mash		●	●	●	
ALLOY 825/800H	Welding Solid Wire, Washer, CHQ	●	●	●		
ALLOY C276/C22/C4	Welding Solid Wire		●	●		
ALLOY 36/42	STACIR(Al Clad Invar Wire)	●	●			
ALLOY 200/201	Electronic Components		●	●		
ALLOY 400	Mesh, Spring	●	●			
ALLOY A286(Gr660)	Fastener, CHQ	●	●	●		

Figure 1. Main Production Steel Grades & Sizes

Figure 2. Application of Nickel Alloy Wire Rod

Industry	End-Products	Materials	Reference
Ship Building & On/Off Shore Plant	Exhaust Valve Seat Welding Pipe Welding	ALLOY 625 ALLOY 718 ALLOY 825	Kowel(KumYong) Kiswel DSR
Automotive	Muffler Valve Spring	ALLOY 718 ALLOY C22 ALLOY X750	Kowel(HMC)
Power Plant	Exhaust Valves For Shipbuilding Engines	ALLOY 600	Kowel(DHI)
Electric Wire	STACIR (Al Clad Invar Wire)	ALLOY 36 (INVAR)	LSCNS

Figure 3. Main Products & References

Manufacturing Process

Nickel alloy wire rods of various dimensions are available to suit various applications. Our highly flexible production facilities can meet ordering requirements for multiple products in small lots and allow full integration of new steel grades.

Steelmaking processes such as melt consistency, refining and casting critically determine quality. The melting facility is an electric furnace and VIM for the production of high-clean quality steel.

Refining is possible outside the furnace using LF, VD, and VOD facilities, and special ESR and VAR refining can be applied to high-performance materials. Casting includes continuous casting and ingot casting.

The forging process is a process in which steel ingots produced in the steelmaking process are heated and then placed in a press to create products of various shapes.

In rolling, large steel bars are produced using the latest SBM large rolling mills, and the HV Mill performs horizontal and vertical continuous rolling to precisely control dimensions.

Our quality management system integrates advanced inspection and testing practices, including hot-rolled surface defect detection using Eddy Current Testing (ECT), Non-Destructive Testing (NDT) and Ultrasonic Testing (UT), ensuring full compliance with key international standards.

Finally, optimized packaging is applied at each stage from handling to transportation and delivery to ensure that the perfect product reaches the customer.

A detailed manufacturing process diagram is shown in Figure 4.

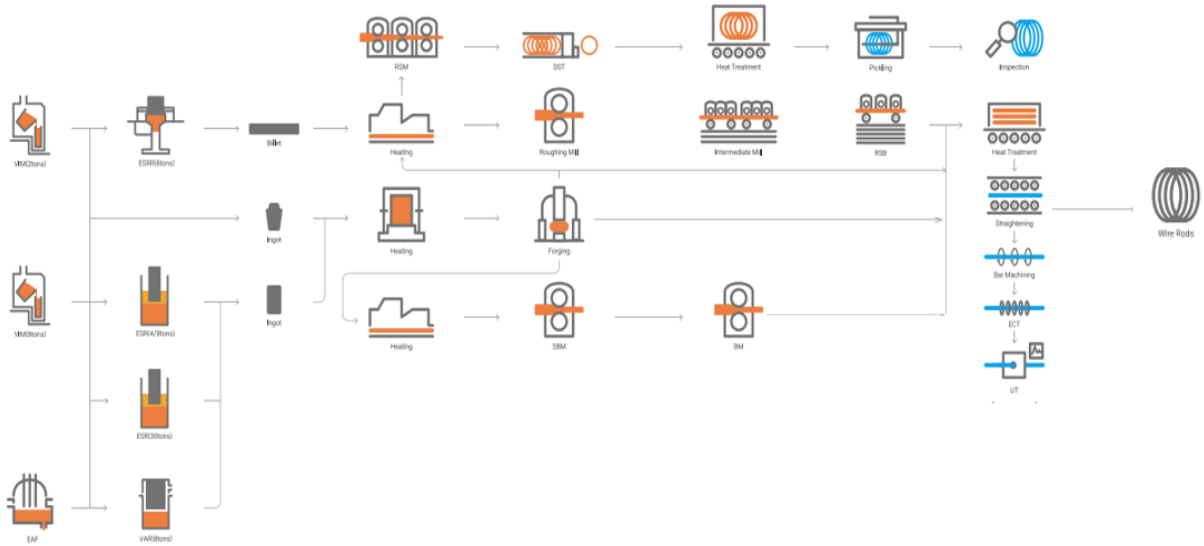

Figure 4 Manufacturing Process

UN CPC code
CPC412

Geographical scope
South Korea

LCA information

Declared unit
This study was used declared unit for1 ton (1,000 kg) of nickel alloy wire rod

Reference service life
Not applicable

Time representativeness
Primary on-site data were collected during fiscal year (FY) 2022.

Database(s) and LCA software used
Gabi LCA software (Version 10.6.1.35) was used to measure the lifecycle inventory profile and lifecycle impact results. All the background data relevant for modelling were taken from the Gabi professional database (version 2022) with DB extension by Sphera and Ecoinvent database (version 3.8)

Electricity Mix

The dataset for Korean national grid mix (reference year 2018) in this EPD study has climate change impact - total, 0.69kg CO2/kWh.

Description of system boundaries:
The system boundary on the products adapted Cradle to Gate according to PCR section 4.2. The detailed information for manufacturing process from Module A3 is described in the product information above.

1. Upstream process
   a. Steel Scrap collection & processing
   b. Production of raw materials
   c. Transportation of raw/auxiliary materials from the supplier to manufacturing plant

2. Core process
   a. Production of auxiliary materials in the form of solid, liquid or gas (e.g., Argon, Nitrogen, Oxygen, LNG, etc.)
   b. Production of electricity from electricity mix in Korea from Ecoinvent Database
   c. Manufacturing of steel products and co-products
   d. Treatment of process wastes and emissions
   e. Direct emission to the environment

System diagram

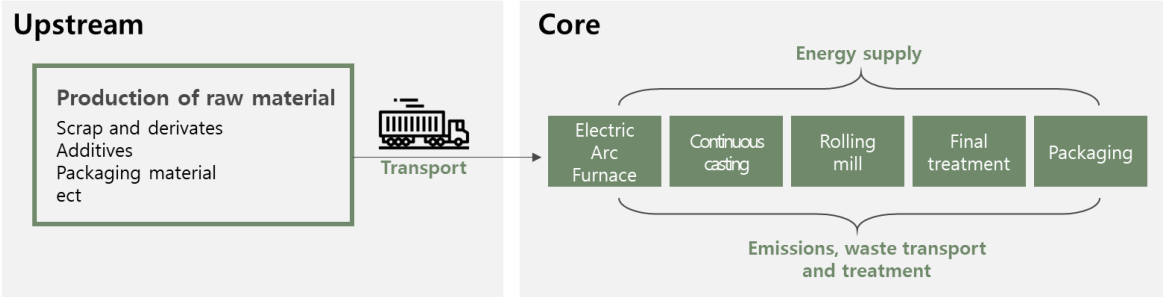

Figure 5 System boundary

Excluded life cycle stages

Use and End-of-life stages were not included, since they are out of the scope of the PCR.

Cut-Off Rule

In accordance with the PCR criteria, the gross weight/volume of all materials used in the manufacturing process has been included in the LCA, so that at least 99% of the weight of the product unit and environmental impacts is considered.

According to the cutoff rules, small amounts of metals (Zr, W etc.), energy for air production, diesel, LPG and the like have been excluded.

Assumptions and Limitations

1) Upstream

a. Steels input

Steel scrap input is divided into purchased scrap and internally recycled scrap. The usage of each scrap is managed through the system at the plant, and the environmental impact of internally recycled scrap is not considered.

b. Transport

The transportation distance of domestic scrap was applied to the actual address of the scrap collecting company and the shortest distance to our plant site. The transportation distance of overseas scrap was applied as the shortest distance from the actual address of the scrap collection company to our factory site. For land transportation, the distance between the business site and the port was applied, and for sea transportation, the distance between the port of the country and Busan port was applied.

The transportation distance was calculated based on the addresses of the companies corresponding to each item. In cases where there are multiple suppliers for a single item, a weighted average was taken based on the amount of goods received to determine the distance. The transportation distance for each item was calculated by multiplying the corresponding distance by the inventory data value, and the sum of these values was indicated as the total in the inventory data.

2) Product stage (A3)

a. Waste

In module A3, the manufacturing phase, spills do not include wastes not directly related to production (e.g., packaging materials for raw materials, dust cloths for machine maintenance). The secondary database for waste treatment was classified into household waste and hazardous waste.

b. Waste Transportation

The distance from the manufacturing plant to the waste disposal site is set at 30 km taking site-specific data into account.

c. Wastewater

The plant operates an on-site wastewater treatment plant. A total of five wastewater treatment plants are in operation, and in this study, the data of one wastewater treatment plant was created by integrating the data.

Allocation Rules

In accordance with the PCR criteria, physical allocation has been applied.

At SeAH CSS, utilities, packaging, and waste data are managed for each unit process. Therefore, physical allocation coefficients were derived based on the total production quantity (mass) and the

product production quantity (mass) for each unit process. The derived allocation coefficients were then applied to the utilities, packaging, and waste for each unit process.

Content declaration

Product

Product components	Value[kg]	%	Environmental / hazardous properties
Steel	1.00E+03	100%	
Chemical Composition			
Ni	411	41.1%	0
Cr	124	12.4%	0
Mo	43	4.3%	0
Nb	12	1.2%	0
Others	411	41.1%	0
TOTAL	1,000		0

Packaging

Packaging is not relevant in case of semi-finished steel products manufacturing & delivery.

Recycled material

Recycled materials come from scrap and derivatives used in the manufacturing process, with a proportion of 19.0% post-consumer (External scrap).

Results of the environmental performance indicators

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

Impact category indicators

PARAMETER		UNIT	Upstream	Core	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	1.14E+04	3.85E+03	1.52E+04
	Biogenic	kg CO_2 eq.	7.13E+01	8.55E+00	7.99E+01
	Land use and land transformation	kg CO_2 eq.	2.59E+01	1.81E+00	2.77E+01
	TOTAL	kg CO_2 eq.	1.15E+04	3.86E+03	1.53E+04
Ozone layer depletion (ODP)		kg CFC 11 eq.	8.38E-04	1.97E-04	1.04E-03
Acidification potential (AP)		mol H^+ eq.	6.92E+02	2.83E+01	7.20E+02
Eutrophication potential (EP)	Aquatic freshwater	kg P eq.	9.01E+00	2.22E+00	1.12E+01
	Aquatic marine	kg N eq.	1.98E+01	1.04E+01	3.02E+01
	Aquatic terrestrial	mol N eq.	2.06E+02	1.09E+02	3.15E+02
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	9.81E+01	2.68E+01	1.25E+02
Abiotic depletion potential (ADP)	Metals and minerals	kg Sb eq.	2.20E+00	2.01E-03	2.20E+00
	Fossil resources	MJ, net calorific value	1.80E+05	7.22E+04	2.53E+05
Water deprivation potential (WDP)		m^3 world eq. deprived	2.77E+04	6.48E+02	2.84E+04

Resource use indicators

PARAMETER		UNIT	Upstream	Core	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	9.56E+04	1.38E+03	9.70E+04
	Used as raw materials	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	9.56E+04	1.38E+03	9.70E+04
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	1.92E+05	7.22E+04	2.65E+05
	Used as raw materials	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	1.92E+05	7.22E+04	2.65E+05
Secondary material (optional)		kg	4.22E+02	0.00E+00	4.22E+02
Renewable secondary fuels (optional)		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels (optional)		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (optional)		m^3	6.46E+02	1.53E+01	6.61E+02

Waste indicators

PARAMETER	UNIT	Upstream	Core	TOTAL
Hazardous waste disposed	kg	6.99E-08	2.56E-08	9.54E-08
Non-hazardous waste disposed	kg	5.07E+00	4.17E+00	9.24E+00
Radioactive waste disposed	kg	1.47E-02	7.82E-02	9.29E-02

Output flow indicators

PARAMETER	UNIT	Upstream	Core	TOTAL
Components for reuse	kg	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ per energy carrier	0.00E+00	0.00E+00	0.00E+00

References

The International EPD® System, The International EPD® System is a programme for type III environmental declarations, maintaining a system to verify and register EPD® s as well as keeping a library of EPD® s and PCRs in accordance with ISO 14025, www.environdec.com

Product Category Rules (PCR): Basic iron or steel products & special steels, except construction steel products 2015:3, version 2.1.0

General Programme Instructions of the International EPD® System. Version 3.01

ISO 14020:2000 Environmental labels and declarations - General principles

ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures

ISO 14040:2006 Environmental management- Life cycle assessment - Principles and framework

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

Impact assessment methods: Version 2.0 of the default list of indicators

: EN 15804. Version: August 2021.

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