Environmental Product Declaration

In accordance with ISO 14025:2006 for

STAINLESS STEEL WIRE ROD

from

SeAH Changwon Integrated Special Steel

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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: *Vijay Thakur, 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

Contact:

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Contact: Kwon YongDal, sachool@seah.co.kr

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
STAINLESS STEEL WIRE ROD

Product identification
10088-3, 6527, A493, A493MOD, A580, A581, D3696, D3702, G4308, G4308MOD etc.

Product description
Our stainless steel wire rods are produced through an integrated production system, which involves steelmaking, wire rod rolling and heat treatment to pickling. Our reducing and sizing mill (RSM) allows for the production of 5 to 34mm products with dimension control of less than 0.1mm. We ensure precision and quality by using direct solution treatment (DST) facilities which controls the uniformity of grain size and strength, as well as nitric acid-free acid cleaning, an advanced, eco-friendly technology. Our steel grades include Austenitic, Ferritic and Martensitic series as well as high-level duplex.

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

Application & Characteristic
Wire ropes, bolts, nuts, springs etc

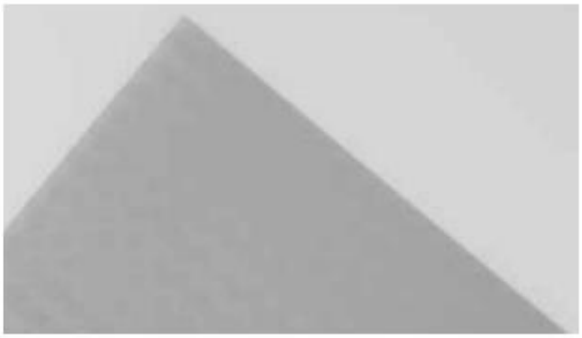
300 Series

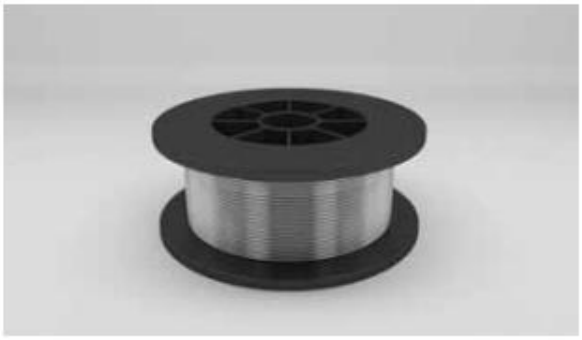
Product Characteristics

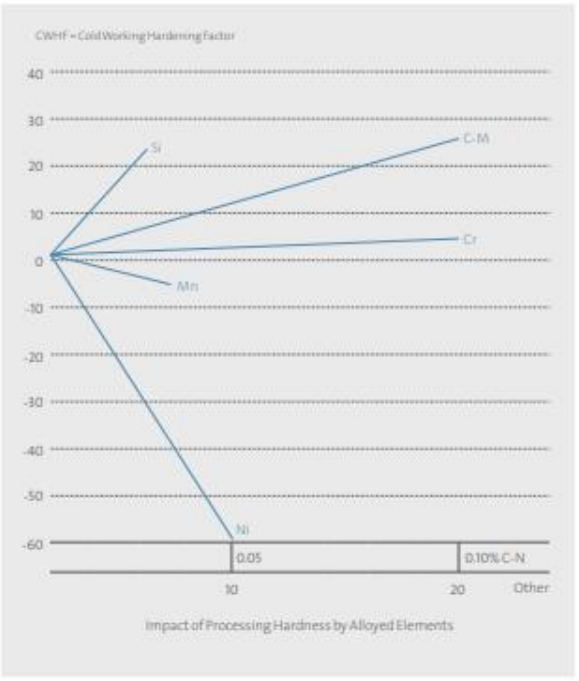
Corrosion Resistant	Non-magnetic	Free cutting	Reliable Weldability	Excellent Cold workability

Metal Nets / Fine Wire

Grade	Chemical composition(aim)	Applications
304M	0.04C-9Ni-18Cr	General use, general fine wire
S304MD	0.03C-9Ni-18Cr	High quality fine wire
304S	0.03C-10Ni-18Cr	Ultra fine wires
316	0.04C-10Ni-16Cr-2Mo	High corrosion resistant to seawater
316UL	0.02C-12Ni-16Cr-2Mo	High corrosion resistant, extremely low carbon







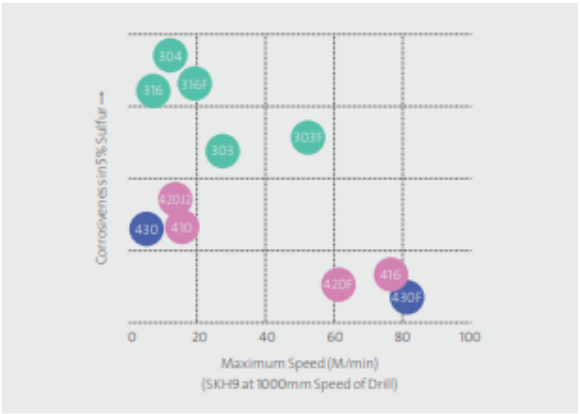
Products with excellent machinability and corrosion resistance.
Mainly manufactured into metal nets, fine wires for a general/redrawing purpose.

Figure 1 Characteristics and Applications of 300 series stainless steel Wire Rod

Free cutting

Grade	Chemical composition(aim)	Applications
303	0.20S-8Ni-17Cr	Corrosion Resistance, Free Cutting
303C	0.25S-8.5Ni-17Cr-2.5Cu	Non-magnetism, Cold Drawing, Free Cutting
303F	0.30S-8.5Ni-18Cr	Increased machinability by increasing Sulfur

Increased machinability by adding Sulfur.
Mainly used for precision machinery such as OA devices, and other free cutting shafts



Springs

Grade	Chemical composition(aim)	Applications
304H1	0.07C-1.3Mn-8Ni-18Cr	Precision springs
302	0.07C-8Ni-1.7Mn	High strength springs

Can be utilized in various spring products with minimization of mechanical property deviations. Mainly used for high quality springs, precision springs, chains, and etc.

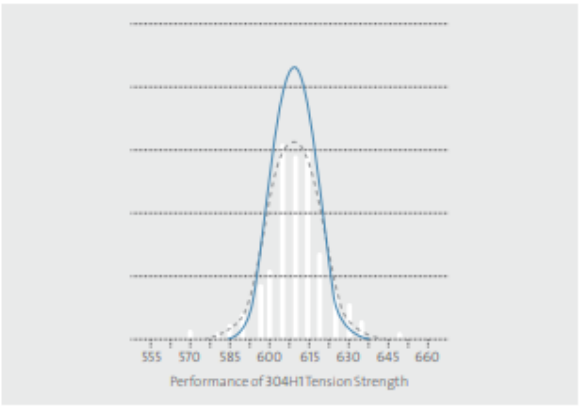


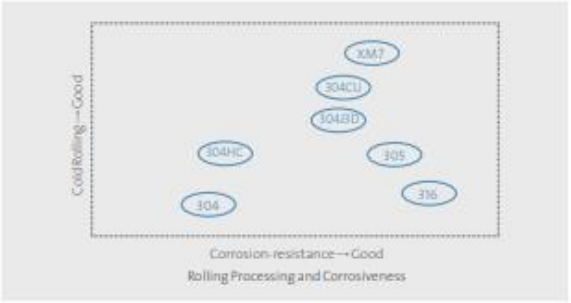
Figure 2 Characteristics and Applications of 300 series stainless steel Wire Rod

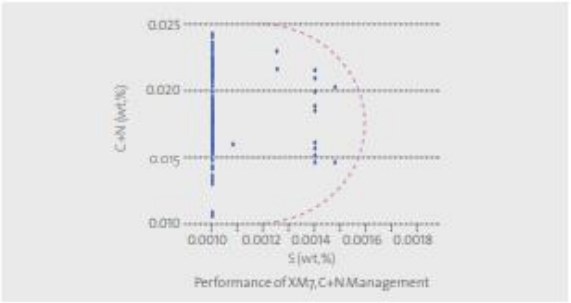
Fasteners (for cold heading)

(CHQ: Cold Heading Quality)

Grade	Chemical composition(aim)	Applications
XM7(302HQ)	0.015C-9.5Ni-17Cr-3Cu	Extremely low carbon cold heading
304Cu	0.015C-8Ni-17Cr-3Cu	Middle-class cold heading
304J3D	0.3C-9Ni-17.4Cr-2.5Cu	Middle-class cold heading
304HC	0.03C-8Ni-18Cr-2Cu	General cold heading
304J3	0.03C-8Ni-17Cr-2Cu	General cold heading

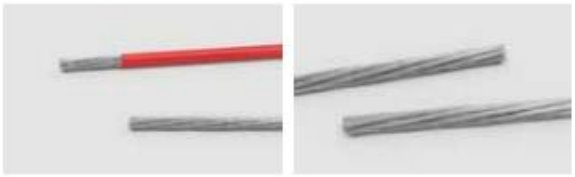
Mainly manufactured into cold heading fasteners such as bolts, screws, and nuts.





Wire Ropes/Springs

Grade	Chemical composition(aim)	Applications
304H	0.07C-1.3Mn-8Ni-18Cr	Wire rope
316	1.6Mn-10.5Ni-17Cr-2Mo	Rope for seawater



Manufactured into wire ropes with outstanding strength by adding carbon. These wire rope are used for seawater related products and various crains.

Figure 3 Characteristics and Applications of 300 series stainless steel Wire Rod

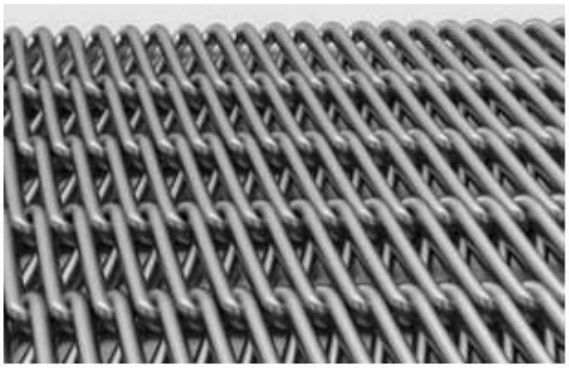
Exhaust Bellows

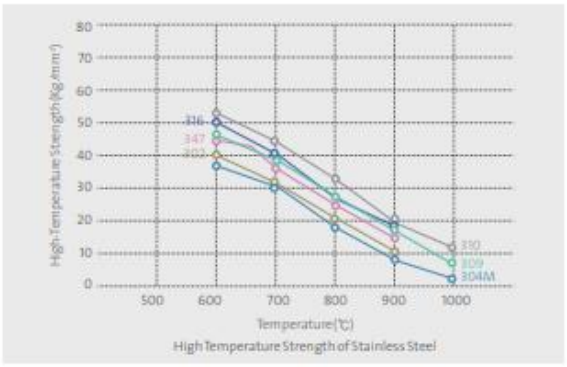
Grade	Chemical composition(aim)	Applications
316Ti	10Ni-16.6Cr-0.25Ti	Automobile exhaust systems

Products with outstanding intergranular corrosion resistance.Capable of heat resisting and oxidation resisting with addition of Ti.
Mainly used for automotive exhaust bellows.

Heat Resistant Meshes / Bolts

Grade	Chemical composition(aim)	Applications
310S	0.03C-0.6Si-20Ni-24.5Cr	Heat resisting mesh (Parts for heat treatment furnaces)
314	0.02C-2Si-19.5Ni-24Cr	Heat resisting mesh (Parts for heat treatment furnaces)
660	13.5Cr-24Ni-Mo-2Ti-V,B	Heat resisting bolts (Automotive engines)





High Temperature Strength of Stainless Steel

Excellent oxidation resistant products with high Ni and Cr. Mainly used for heat resisting mesh, bolt, heat treatment furnace conveyorbelt, etc.

Figure 4. Characteristics and Applications of 300 series stainless steel Wire Rod

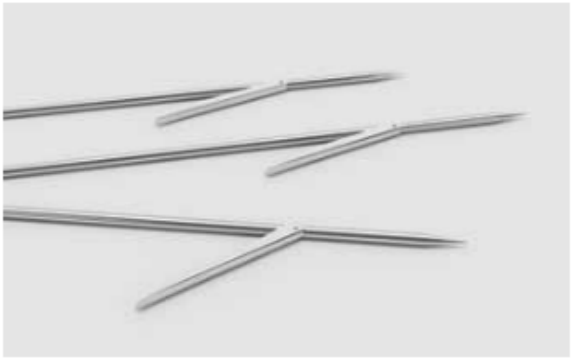
400 Series

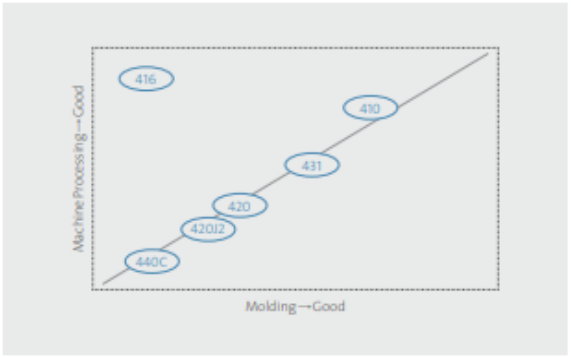
General Characteristics

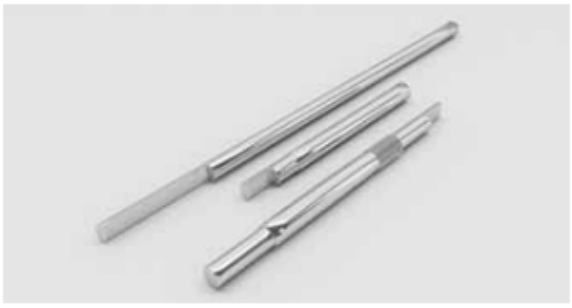
Type	Grade	Chemical composition(aim)	Characteristics	Applications
Martensitic	410 series 420 series	0.1C-12Cr 0.3C-13Cr	Corrosion resistance Good machinability Hardened through-heat treatment	Machinery, shaft, bolt, nut
Ferritic	430 series	0.3C-17Cr	Cold workability Corrosion resistance magnetism	Automotive parts, home appliances, parts for construction

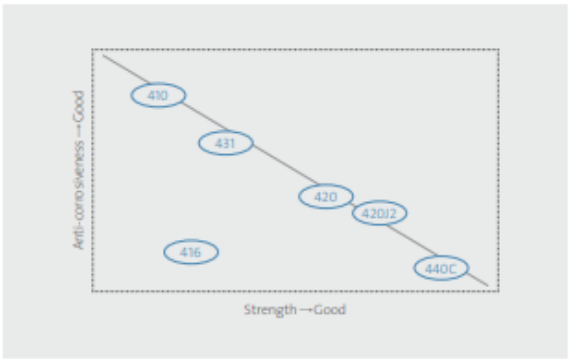
High Strength Martensitic Stainless Steel

Grade	Chemical composition(aim)	Applications
410	0.1C-12Cr	General shaft, bolt, nut
420J2	0.3C-13Cr	High strength shaft
440C	0.96C-16Cr-0.45Mo	High strength shafts with higher strength
SHP4A	0.6C-0.5Ni-12.5Cr-1Mo	High strength, corrosion resistant shaft









Hardened through heat treatment, composed of martensite tissues, used for products that tend to require higher strengths. Mainly manufactured into products such as, knives, fish hooks, and shafts for machinery, electronics.

Figure 5 Characteristics and Applications of 400 series stainless steel Wire Rod

High Corrosion Resistant Ferritic Stainless Steels

Grade	Chemical composition(aim)	Applications
409Nb	11Cr-0.35Nb-0.03C	Muffler hangers for vehicles
430	0.03C-17Cr	Bolts, nuts
446	23Cr	Electrode pins (of compressors)

Outstanding cold workability and corrosion resistance.
Mainly used for CHQ(Cold Heading Quality), and automotive parts.

Free Cutting Shafts

Grade	Chemical composition(aim)	Characteristic / Applications
416	0.12C-0.26S-12Cr	Free cutting, other general use of 400 series
420F	0.32C-0.2S-12Cr	High strength, free cutting
430F	0.10C-0.17S-16Cr	Free cutting, corrosion resistance
S410FST	0.02C-0.9Si-0.1S-13Cr	Free cutting, harmlessness
S430FSM	0.02C-1.3Si-0.15S-18Cr-1.5Mo-0.05Nb	Free cutting, corrosion resistance, soft magnetism

Added Sulfur(S) and Selenium(Se) to enhancemachinability with high strength. Mainly used in free cutting shaft, hard disk motor pin, and ball pen tip products.

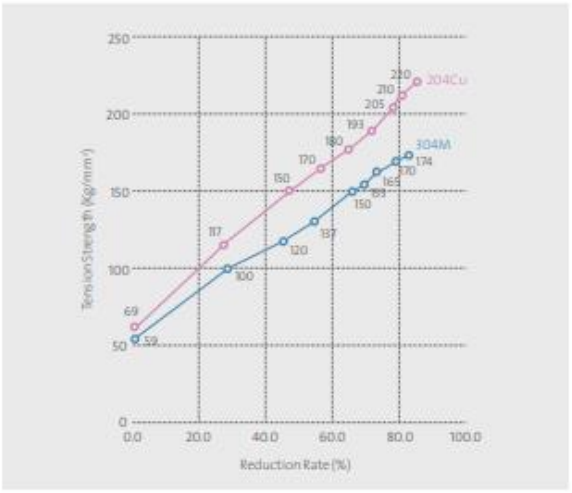
Figure 6 aracteristics and Applications of 400 series stainless steel Wire Rod

200 Series · Welding Rods · Special Alloy

200 Series

200 series' overall characteristics are relatively similar to the 300 series, but instead of Ni (due to its expansive cost), low cost substitute elements such as Mn and N are added. 200 series' mechanical and hardening characteristics are similar to the 300series. With its lack of Ni content, 200 series has a lower corrosion resisting ability than the 300series.

Grade	Chemical composition(aim)	Applications
204Cu	8.0Mn-2.0Ni-15.5Cr-2.0Cu-0.15N	General drawing, kitchen appliance
201Cu	13.6Mn-0.7Ni-13.6Cr-2.0Cu-0.12N	General drawing, anchor bolt
201H	15.1Mn-0.55Ni-11.7Cr-0.6Cu-0.16N	



Austentic stainless steel- low cost substitute elements such as Mn and N are added due to Ni's expansive cost. Mainly used for anchor bolts, and general kitchen appliances.

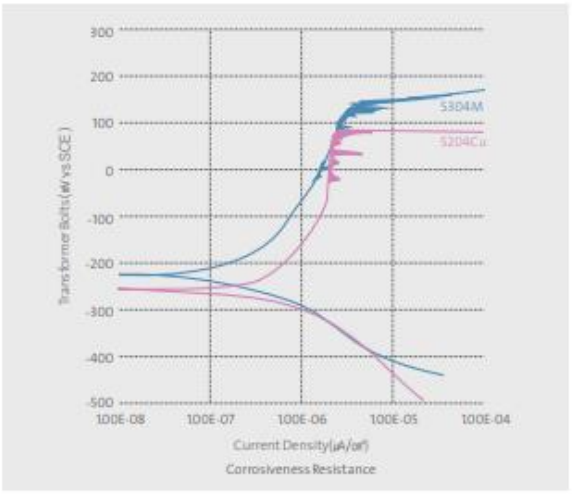
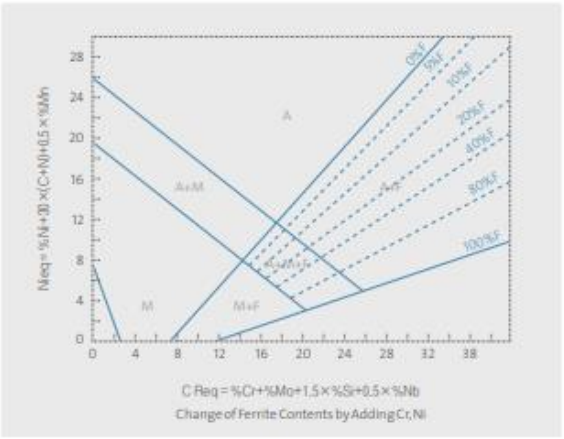


Figure 7 Characteristics and Applications of 200 series stainless steel Wire Rod

Wire Rod for Welding

Grade	Chemical composition(aim)	Applications
308	1.9Mn-9.7Ni-19.7Cr-0.03N	Welding for shaft/valve
308LDSI	0.1Si-1.9Mn-9.85Ni-20.3Cr	Forultra-low carbon welding
309	1.7Mn-13.6Ni-23.4Cr-0.06N	For cast steel/wrought steel welding
316L	1.6Mn-11.6Ni-18Cr-2Mo	For 316 series welding
430LNB	0.02C-18Cr-0.4Nb-0.02N	For exhaust valve welding

Suitable for 300 and 400 series welding.
Used forstainless steel welding rods (MIG, TIG).



Change of Ferrite Contents by Adding Cr, Ni

Special Alloy (Ni-base Alloy)

Grade	Chemical composition(aim)	Characteristics / Applications
CIMA35	Fe-36Ni-0.5Cr-2.5Mo-0.7Co	Low co-efficient of thermal expansion Used as reinforcement for high voltage transmission wires
INVAR36	Fe-36Ni	Precision nuts/screws for electronic devices
COVAR29-18	Fe-28Ni-17Co	Used as power inlets for acrystal oscillator. Similar thermal expanding co-efficient to the glass.

Used for products such as high voltage transmission wires and crystal oscillators with a special purpose by adding Ni, Co, and etc.

Figure 8 Characteristics and Applications of 200 series stainless steel Wire Rod

Manufacturing Process

Stainless steel wire rod is available in various dimensions to suit different applications. Our highly flexible production facilities can meet ordering needs for multiple products in small lots and allow full integration of new steel grades.

Our stainless steel wire rods are produced through an integrated production system, which involves steelmaking, wire rod rolling and heat treatment to pickling. We incorporate world-class technology and offer unmatched quality based on our continued investment in facilities and R&D efforts.

Steelmaking processes determine quality based on melt consistency, refining and casting thresholds. The melting facility is equipped with electric furnace for the production of high-clean quality steel. Purification can take place outside the furnace using LF, VD, AOD and VOD facilities. 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.

Wire rods are produced through continuous rolling process, which consists in three facilities: Roughing Mill — Kocks Mill — and Precision Sizing Block.

Our reducing and sizing mill (RSS) allow for the production of 5 to 34 mm products with dimension control of less than 0.l mm. We ensure precision and quality by using direct solution treatment (DST) facilities which controls the uniformity of grain size and strength, as well as nitric acid-free acid cleaning, an advanced, eco-friendly technology. Our steel grades include Austenitic, Ferritic and Martensitic series as well as high-level duplex.

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 9.

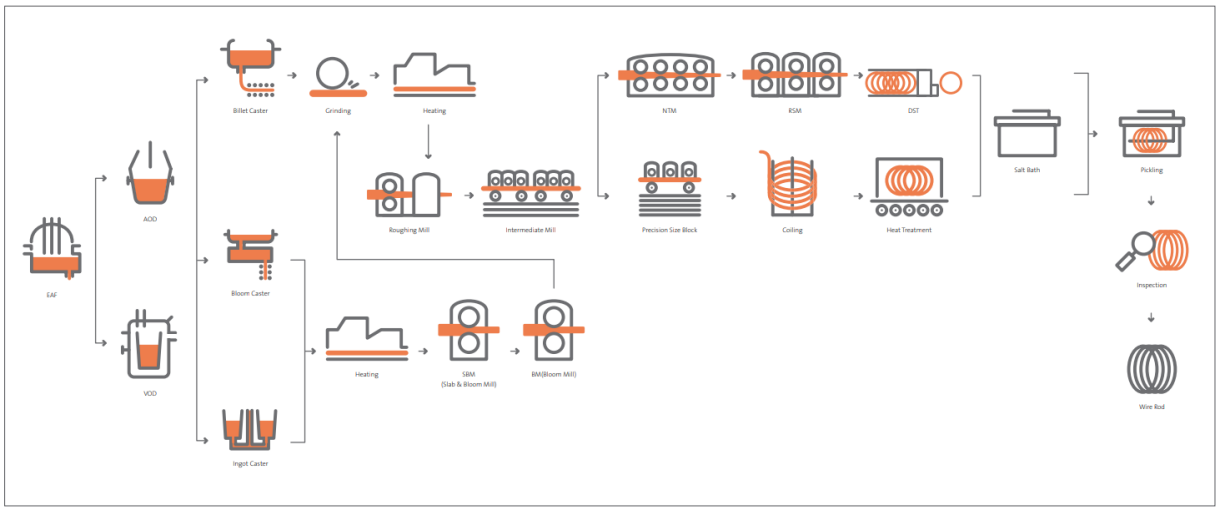


Figure 9 Manufacturing Process

UN CPC code

CPC412

Geographical scope

South Korea

LCA information

Declared unit
This study was used declared unit for1 ton (1,000 kg) of stainless steel 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

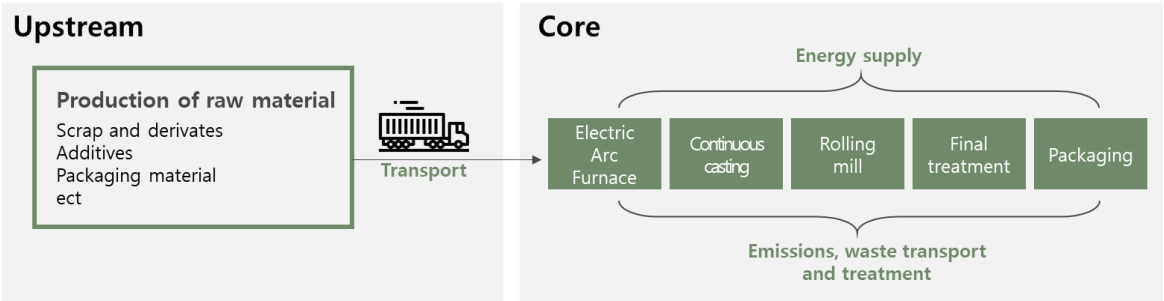


Figure 10 System boundary

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.) 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%	0
Chemical Composition			
Fe	698	69.8%	0
Ni	87	8.7%	0
Cr	177	17.7%	0
Mn	17	1.7%	0
Others	21	2.1%	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 49.9% 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.	3.32E+03	1.33E+03	4.65E+03
	Biogenic	kg CO_2 eq.	1.45E+01	2.72E+00	1.72E+01
	Land use and land transformation	kg CO_2 eq.	5.59E+00	5.33E-01	6.13E+00
	TOTAL	kg CO_2 eq.	3.34E+03	1.34E+03	4.68E+03
Ozone layer depletion (ODP)		kg CFC 11 eq.	1.55E-04	1.05E-04	2.61E-04
Acidification potential (AP)		mol H^+ eq.	4.22E+01	5.20E+00	4.74E+01
Eutrophication potential (EP)	Aquatic freshwater	kg P eq.	1.21E+00	6.16E-01	1.82E+00
	Aquatic marine	kg N eq.	4.04E+00	1.32E+00	5.37E+00
	Aquatic terrestrial	mol N eq.	4.25E+01	1.37E+01	5.62E+01
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	1.33E+01	3.33E+00	1.66E+01
Abiotic depletion potential (ADP)	Metals and minerals	kg Sb eq.	1.95E-01	6.71E-04	1.96E-01
	Fossil resources	MJ, net calorific value	4.87E+04	2.32E+04	7.19E+04
Water deprivation potential (WDP)		m^3 world eq. deprived	1.80E+03	1.79E+02	1.98E+03

Resource use indicators

PARAMETER		UNIT	Upstream	Core	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	1.39E+04	5.22E+02	1.44E+04
	Used as raw materials	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	1.39E+04	5.22E+02	1.44E+04
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	4.92E+04	2.32E+04	7.24E+04
	Used as raw materials	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	4.92E+04	2.32E+04	7.24E+04
Secondary material (optional)		kg	8.44E+02	0.00E+00	8.44E+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	4.20E+01	4.30E+00	4.63E+01

Waste indicators

PARAMETER	UNIT	Upstream	Core	TOTAL
Hazardous waste disposed	kg	8.94E-08	2.82E-08	1.18E-07
Non-hazardous waste disposed	kg	8.68E+00	3.92E+00	1.26E+01
Radioactive waste disposed	kg	1.95E-02	4.81E-02	6.76E-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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