PRIMETALS TECHNOLOGIES

ENDLESS HOT ROLLED COIL (eHRC)
THE GAME CHANGER IN ROLLING THROUGH ARVEDI ESP TECHNOLOGY

REVOLUTIONIZING ROLLED MATERIALS
THROUGH ARVEDI ESP TECHNOLOGY– ENDLESS HOT ROLLED COIL (eHRC)

The cradle of Arvedi ESP technology is based on the spirit of innovation and entrepreneurship of Mr. Giovanni Arvedi, Knight of Order for Merit of Labour of the Italian Republic.
As result of his vision, back in the eighties of 20th century, the concepts of ISP (In-line Strip Production) first and ESP (Endless Strip Production) later have been invented, forged and patented.

Over the last decades, Arvedi ESP technology has been perfected thanks to the unparalleled dedication, efforts, sacrifices and suffering of Cav. Arvedi and his team, finally imposing itself as the most advanced, profitable and environmental friendly technology for the production of hot rolled band ever developed. Arvedi ESP, representing a real quantum leap in casting & rolling technologies, is and will stay for long the benchmark for everyone interested in the production of hot rolled band.

At Primetals Technologies, we are proud of being partners of this inspiring success story.

Flat steel products have historically been divided into two main groups: hot-rolled coils (HRC) and cold-rolled coils (CRC).
The invention of Arvedi ESP Technology introduced a new class: endless hot-rolled coils (eHRC).
eHRC extends hot-rolled material into applications previously served only by cold-rolled products.

Giovanni Arvedi
Inventor of the
Arvedi ESP Technology

ENDLESS HOT ROLLED COIL (eHRC)
THE NEW STAR IN FLAT STEEL PRODUCTS

The endless hot rolled coil secures higher quality coils for the end customers, from ultra-light gauges, down to 0.6 millimeters to heavy gauges up to 25.4 millimeters (one inch), and allows for higher sales margins compared to conventional hot rolled coils due to the lowest production cost as well as the price premium for better quality.

SIMPLIFICATION OF FINISHING PROCESSES

Thanks to its superior geometrical and metallurgical properties the eHRC allows for a significant simplification of downstream finishing processes (e.g., omit cold rolling, omit annealing). The eHRC also overcomes the boundaries of the final products in terms of thinner gauges and a wider product range, tighter geometrical and metallurgical tolerances, high-quality mechanical properties, e.g., AHSS of third generation, thinner and more homogeneous GO (grain-oriented) and NGO (non-grain-oriented) strips. The endless hot rolled coil can be sold as a final product. It can substitute conventional cold rolled products in various direct applications: from low and medium carbon grades for commodity applications to advanced strip applications that require highly developed properties. Since downstream processing is not required, the direct application principle guarantees huge savings in CAPEX (Capital Expenses), OPEX (Operational Expenses), and CO_2.

eHRC FROM DEDICATED ENDLESS LINE

The Arvedi ESP process is the only line configuration dedicated to the endless production mode. There are no compromises considered for production in other modes because the advantages of the endless mode and the resulting high-quality eHRC are outstanding.

LESS EMISSIONS, LOWER COSTS

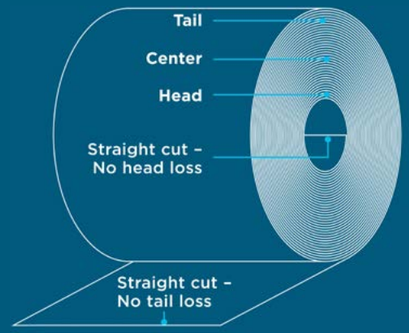
Arvedi ESP is a unique way of steel production with zero direct CO_2 emissions, zero fossil fuels, and the lowest energy use among all similar technologies. Producing green steel on an Arvedi ESP line is less expensive than expected. Besides the drastic energy savings of 50 percent and more, cost saving for carbon taxes is a decisive factor in most industrial countries.
Powered by the advanced Arvedi ESP technology, Acciaieria Arvedi in Cremona, Italy, stands as the world's first steel plant to receive official carbon-neutral certification.

THE eHRC (ENDLESS HOT ROLLED COIL) PRODUCED WITH ARVEDI ESP ENABLES

- **PREMIUM QUALITY**
  - Tightest geometrical tolerances
  - Uniform mechanical properties
- **NEW MARKETS**
  - Cold rolled substitution / direct application
- **HIGHEST PROFIT**
  - End-customers love it and pay for it
- **LOWEST COST**
  - Lowest energy demand, highest yield, highest availability
- **GREEN STEEL**
  - Zero direct CO_2 emissions

GEOMETRICAL PROPERTIES

Endless hot rolled coil shapes the future of the steel industry, offering unprecedented uniformity and geometrical tolerances, the lowest production costs, and zero carbon footprint.



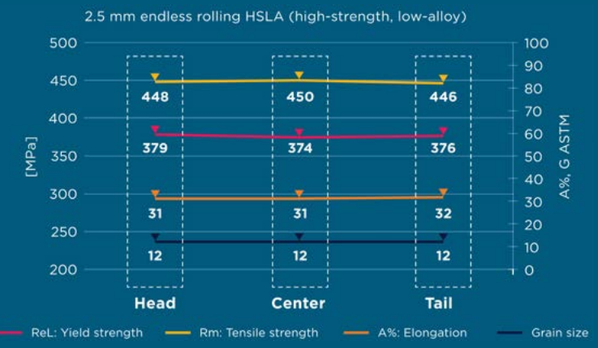
Thickness tolerance
T<2 mm: ±14 µm
T3-4 mm: ±18 µm

Flatness tolerance
T<2 mm : 13 IU
T3-4 mm: 11 IU

Profile tolerance (C_{40})
T<2 mm: ±6 µm

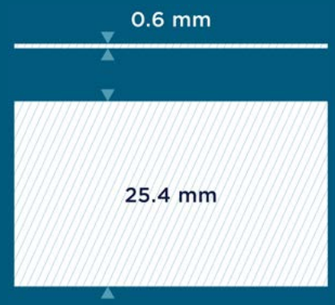
UNIFORM COIL QUALITY

Uniform coil quality for serveral thousand tons, within a sequence and within a single coil.



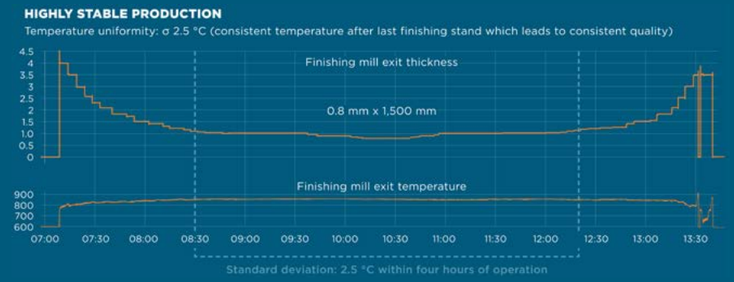
THICKNESS RANGE

The endless hot rolled coil secures higher quality for the end customers, from ultra-light gauges, minimum of 0.6 mm to heavy gauges up to 25.4 mm.



TEMPERATURE UNIFORMITY

Temperature uniformity: σ 2.5°C (consistent temperature after last finishing stand which lead to consistent quality).



VARIOUS MARKETS FOR eHRC
FROM COMMODITY TO HIGH ADDED VALUES GRADES FROM THIN TO THICK

Over the years, a diverse range of eHRC grades has been developed to meet the needs of various markets. HSLA (High Strength Low Alloy) components, which ensure lightness and robustness for vehicle structures, have seen impressive development in recent years for the automotive market. With typical thicknesses between one and two millimeters, eHRC with strengths up to 700 MPa are ideal for such applications.

These automotive applications constituted almost 30% of the market served by the Acciaieria Arvedi plant in Italy, the cradle of Arvedi ESP Technology, out of 42% of HSLA, with thicknesses ranging from one to over eight millimeters. These materials are used for structural components (e.g., car bodies), mechanical components (e.g., distribution shafts), and precision tubes.

Endless hot-rolled coils (eHRC) have emerged as more than just a product of the advanced production method. They represent a distinct product class with unique characteristics. Successful products with their specific properties, such as the Arvtech® steel family (from Arvedi Steel), RE® (Rizhao Endless), DE® (Dingsheng Endless),and TE® (Taihang Endless) from Rizhao Steel, Fujian Dingsheng Steel, and Taihang Steel, respectively, showcase the metallurgical precision and uniformity of eHRC.
This makes them a viable alternative to CRC in various applications. With faster production cycles and reduced environmental impact, Arvedi ESP Technology redefines the standards of rolled steel.

ADVANCED HIGH STRENGTH STEELS (AHSS)

- Process temperature control ensures the required multi-phase structure.
- DP (Dual Phase) and TRIP (Transformation Induced Plasticity) grades

SILICON STEEL

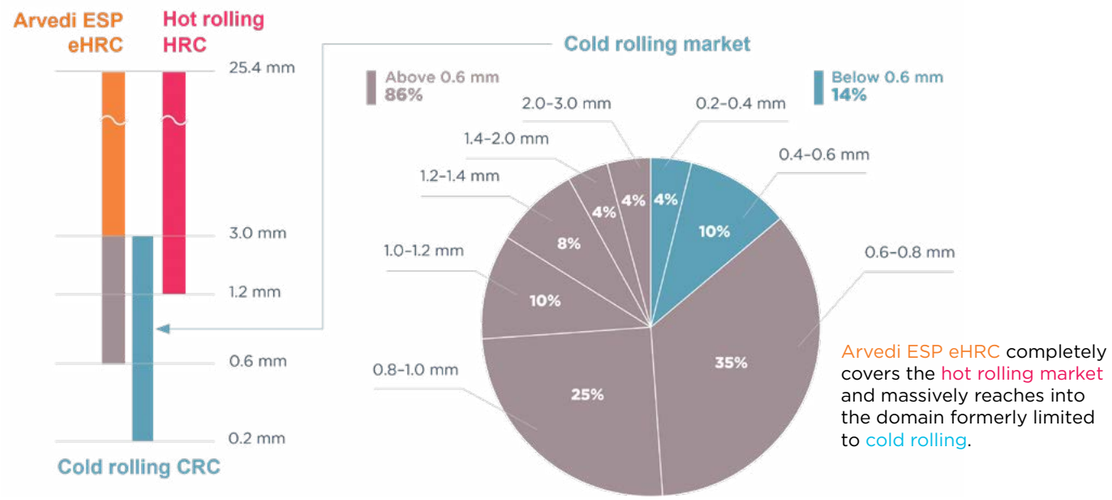
- Uniform microstructure and properties
- Wide thermomechanical adjustability
- Superior, stable cold-rolling performance

API PIPE GRADES

- 2-step rolling configuration enables perfect control over the process temperature.
- Thermomechanical rolling and “pancaking” achieve the desired fine-grain structure.
- Reduced alloying element content lowers the Niobium needed for grain structure refinement.
- Production capability: API X70 grades up to 25.4 mm

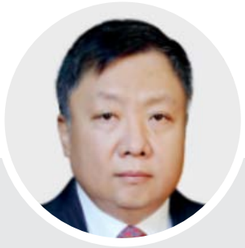
WEATHER-RESISTANT STEELS

- CORTEN grades
- 1.0 mm thickness for container manufacturing

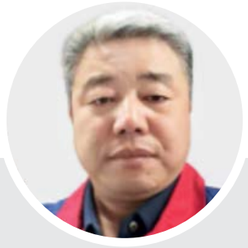


Arvedi ESP eHRC completely covers the hot rolling market and massively reaches into the domain formerly limited to cold rolling.

SELECTED CUSTOMER STATEMENTS



Since 2012, we have visited the endless rolling plant of Mr. Arvedi in Cremona many times. Finally, I decided to build five ESP lines.
Du Shuang Hua
Chairman of Rizhao Steel



Our main focus was on mature technology, stable performance and reliable execution. The first linen started production in time and quickly reached design capacity, producing hot rolled coils with the thickness of 0.8 mm in only one and half months after start up.
Zhang Xing Kai
Hebei Taihang Iron & Steel Gr., Executive Vice President

We prioritized environmental impact, emissions, energy consumption, and overall transformation cost when selecting our technology.

Our facility in Fuding City is a world reference plant for its low environmental impact and high-quality green steel production.
Li Jing Zhong
Chairman of Yaxin Group

The endless technology offers huge advantages with respect to stability and quality of production and supports our development of new steel grades, such as U. S. Steel's XG3 for the automotive industry.
David B. Burritt
President & Chief Executive Officer
United States Steel Corporation

I want to benefit from maximum product and operational flexibility to optimally serve our customers, with the best quality and the lowest impact on the environment.
Zheng Ting Wen
Chairman of Zhongshou

We selected Primetals Technologies for this strategic project because of the proven performance and reliability of its Arvedi ESP lines, innovative technical solutions tailored to the required product mix, deep process know-how, and collaborative partnership approach.
Li Qiang
Chairman of Shanxi Jingang

I COULD NOT BE MORE PROUD OF THE ARVEDI ESP. THE TECHNOLOGY WAS REVOLUTIONARY FROM THE START, AND WE NEVER STOPPED REFINING IT.

GIOVANNI ARVEDI
INVENTOR OF THE ARVEDI ESP TECHNOLOGY

12 ARVEDI PLANTS AT PEAK PERFORMACE

Operating a similar line setup, the ESP line still allows to flexibly react to market conditions. Business models range from profitable thinnest soft steel direct applications over demanding advanced high-strength steels, and uniform automotive steel grades to thick gauge applications.

ITALY
1x ARVEDI ESP MASTER PLANT

Installation of world's first real Endless Strip Production line with a thin-slab casting machine directly connected to a specially designed continuous roughing mill, followed by an inductive heater, finishing mill and run-out area
Production capacity: 3.0 million tons per year.
Steel grades: Ultra-low, Low, Medium and High Carbon Steels, High-strength low alloyed Steels, API grades, Advanced high-strength Steels, Si-Steels.
Product dimensions: Widths up to 1,600 mm and thicknesses down to 0.8 mm.

CHINA
5x ARVEDI ESP PLANTS RIZHAO 1-5

China's first and the world's largest Endless Strip Production complex comprising five lines. Liquid steel supply from a new 300 t converter melt shop. The exceptional performance and tolerances of ESP products prompt Rizhao Steel to market them as a distinct product line separate from their conventional hot rolled coils.
Production capacity: 3 x 2.55 + 2 x 2.2 million tons per year.
Steel grades: Ultra-low to High Carbon Steels, HSLA, Advanced high-strength, Si-Steels.
Product dimensions: Widths up to 1,600 mm and thicknesses down to 0.6 mm.

CHINA
2x ARVEDI ESP PLANTS TAIHANG 1-2

First coil in endless mode, and the successful production of the first 0.7 millimeters hot rolled coils was achieved within only two months after startup. After twelve weeks, nominal capacity was achieved for the first line.
Production capacity: 2 x 2.55 million tons per year.
Steel grades: Ultra-low to High Carbon Steels, HSLA, Advanced high-strength Steels.
Product dimensions: Widths up to 1,600 mm and thicknesses down to 0.7 mm.

CHINA
1x ARVEDI ESP PLANT FUJIAN DINGSHENG (HENAN YAXIN GROUP)

The first eco-friendly mini mill installation in China combines EAF Quantum with Arvedi ESP. The extremely low electric energy consumption contributes to a reduction of CO_2 emissions as well as to reduced operating costs.
Production capacity: 2.5 million tons per year.
Steel grades: Low, Medium and High Carbon Steels, High-strength low alloyed Steels.
Product dimensions: Widths up to 1,600 mm. Thicknesses down to 0.8 mm as per contract, during execution 0.7 mm achieved.

USA
1x ARVEDI ESP PLANT U.S. STEEL

ESP is considered the ideal technology for developing the new generation of advanced high-strength steel (AHSS), including the third generation of the U. S. Steel's industry-leading XG3™ product.
Production capacity: 3.00 million tons per year.
Steel grades: Ultra-low, Low, Medium and High Carbon Steels, High-strength low alloyed Steels, Advanced high-strength Steels.
Product dimensions: Widths up to 1,956 mm and thicknesses down to 0.8 mm.

CHINA
1x ESP ARVEDI ESP ZHONGSHOU

The most powerful ESP line in China, consisting of a long casting machine, four high-reduction mill stands, and five finishing mill stands. The high reduction capability enables to supply the commodity market at high productivity rates, as well as high-strength low-alloy steel (HSLA) niches, including the automotive sector.
Production capacity: 2.90 million tons per year.
Steel grades: Ultra-low to High Carbon Steels, HSLA, Advanced high-strength Steels.
Product dimensions: Widths up to 1,600 mm and thicknesses down to 0.7 mm.

CHINA
1x ESP ARVEDI ESP SHANXI JINGANG

Four high-reduction and five finishing mill stands. A vertical edger increases flexibility and improves strip edge quality for electrical steels. The down coiler pinch roll features a polisher and ensures enhanced strip and roller surface quality. The line is equipped with an in-line work roll change system in the last three finishing stands.
Production capacity: 2.60 million tons per year.
Steel grades: Ultra-low to High Carbon, HSLA, AHSS, High-end Si-Steels.
Product dimensions: Widths up to 1,600 mm and thicknesses down to 0.7 mm.

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