



EWR® ENDLESS WELDING ROLLING SYSTEM AND SPOOLER LINE. RESULTS AND COMBINED APPLICATION FOR ENDLESS ROLLING OF SPOOLED COILS

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Abstract

Some of the most significant Danieli innovations in the field of long products are the: i) The EWR® system, through automatic continuous head-to-tail flash welding of billets at reheating furnace exit side, enables uninterrupted production of the mill for endless rolling of straight bars, wire rod and bar in coils. The process is particularly beneficial to wire rod and bar-in-coil mills as it enables production of “customized-size coils” (any coil weight according to specific Customer request) and with extra-high final coil weight, even starting from low-weight billets; ii) The Spooler process is based on twist-free winding of hot-rolled rebars into highly-compact/ultra-heavy coils featuring a unique cobble-free un-coiling capability. This enables high-speed feeding of the downstream cold-processing lines with hot-rolled spooled coils coming directly from the rolling mill without the need of any traditional off-line operation (such as de-coiling, stretching & re-winding). The system results highly beneficial both to bar-in-coil producers and to the downstream lines operators. The latest step forward is the combined application of these two systems that has made it possible for endless rolling of spooled bar in coils, enabling to cumulate the benefits of the two processes, particularly as far as transformation costs are concerned.

Keywords: EWR® Endless Welding Rolling system; Uninterrupted production of the rolling mill; Customized coil weight; Spooler system for bar-in-coil production; Twist-free winding of hot-rolled rebars.

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1 INTRODUCTION

Today, effective solutions are available for increasing productivity and efficiency in rolling mills for long products and for substantial reduction of production costs thereof. Danieli in recent years has developed and optimized the two systems aims for the continuous production of bars and bars in spooled coils, which are the Endless Welding Rolling and the Spooler Line processes. After a long experience started in 1995 with pioneeristic first prototypes of EWR[®] and in the early 2000's with the first industrial installation coiling line at Ferriere Nord - Italy, has made good results in on the two technologies, imposing itself over the years as the undisputed leader for reliability and installed machines, able to provide its customers high productivity and reduced production costs.

2 THE EWR[®] SYSTEM

Endless rolling of long products is made possible by the EWR[®] Endless Welding Rolling line installed at re-heating furnace exit side.

By automatic continuous on-line head-to-tail flash-welding of billets, this innovative process enables uninterrupted rolling operation at the mill, resulting in higher production capacity, better plant efficiency, higher material yield, homogeneous and repetitive material quality, better production planning, easier plant management and lower production costs.

All of this is made possible as the EWR[®] process eliminates interbillet time, bar head & tail cropping during rolling (as well as short bars in cooling bed for bar mills and coil trimming in wire rod production), minimizing possibility of cobbles and significantly reducing maintenance, spare parts & consumables demand, resulting in average 3.5÷4.5 €/ton savings in production cost.

This process is particularly appreciated in wire rod and bar-in-coil production. In fact, by giving the possibility to supply the market with “customized-weight” coils and by granting consistent and repetitive quality between coil and coil, it contributes to enhance product marketability.

Furthermore, extra-high coil weights can be obtained even using low-weight starting billets.

3 TODAY AND FUTURE EWR[®] INSTALLATIONS

Particularly worth to be mentioned is the billet welding line in full industrial operation since March 2010 at Suez Steel Company's bar and wire rod mill for commercial steel grades in Attaka - Egypt.

Here, the new EWR[®] line operation has shown an amazing start and a fast learning curve. First test-weldings were performed at the end of February 2010 and, significantly, normal production operation started just one week later, to full Customer satisfaction. The line performs automatic continuous welding of 130x130 mm, 12-m-long billets at rates of up to 70-t/h, in low and medium carbon steel qualities for concrete-reinforcement manufacturing industries.

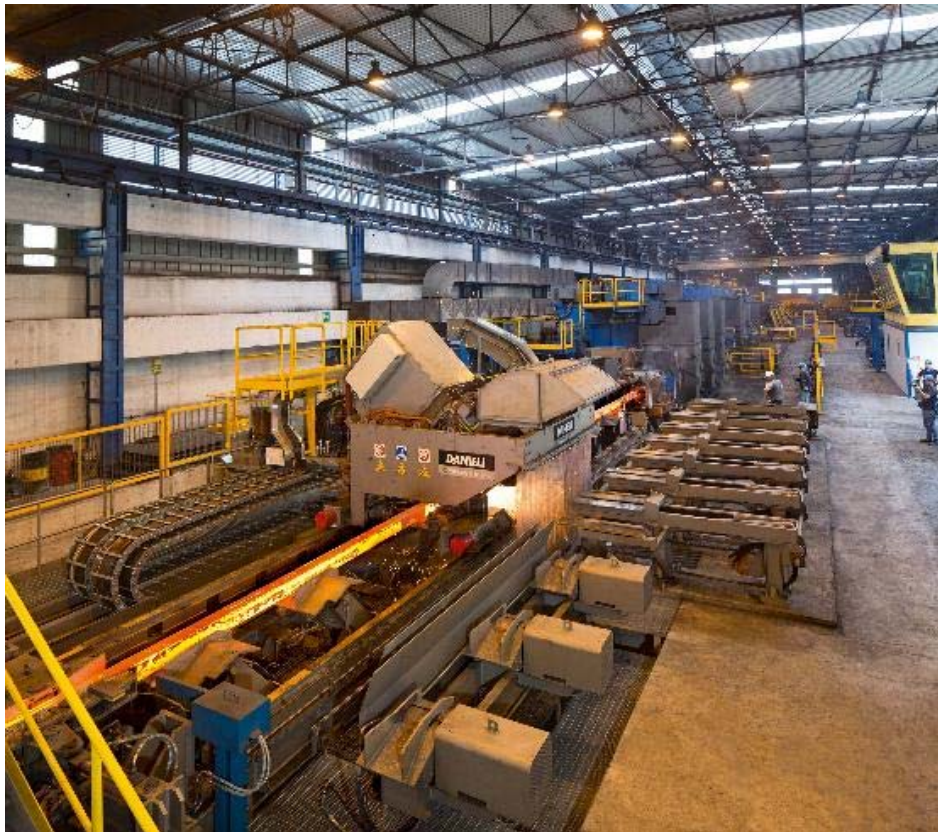


Figure 1: EWR® in operation at Ferriere Nord - Italy

Thanks to the reliability of the welding machine, other major customers have believed in Danieli technology. Following the installation in Egypt, other EWR have followed and will be installed and launched in 2016

In fact, Beshay Steel in Egypt was the first process in the world for the production of flats and sections with a production of 80 t/h. Subsequently Cape Gate in South Africa, Dana Y in Vietnam, Ferriere Nord in Italy, Tosyali I & S in Algeria, CMC South Carolina in the US and Baku Steel in Azerbaijan have chosen the “road” of continuous rolling for their plants bringing productivity per hour to over 180 t / h as in the case of Tosyali I & S in Algeria. In fact the latter will be the most productive lines in the world with the use of EWR® technology.

Operation of the new billet welders has brought in substantial benefits in plant productivity and efficiency (85% to 90% for section mill and from 95.5% to 99.5% yield value for the second mill, mainly thanks to the extra-rolling time coming from the elimination of roll gaps) and significant savings in plant manpower. The consequent positive effects on production cost will end up in very short return of investment. These orders will increase the Danieli scorecard of a total of 28 EWR® units supplied or under construction worldwide since 1997.

4 THE EWR® & SPOOLER COMBINED TECHNOLOGIES.

The latest technological innovation was the joint application of the endless welding rolling and the spooler processes. The first plant to experience this winning combination of advanced technologies was Alfa Acciai in Italy where an EWR® unit operates in connection to a spooler line since March 2005. Today Ferriere Nord

followed this combined technology and surpassed the other installation with the production of heavy-customized coils of 5 tons, becoming the first producer worldwide adopting this technology. This enabled production of spooled coils in endless rolling mode for the first time in the world, with all consequent benefits coming from the combined operation of the two processes.

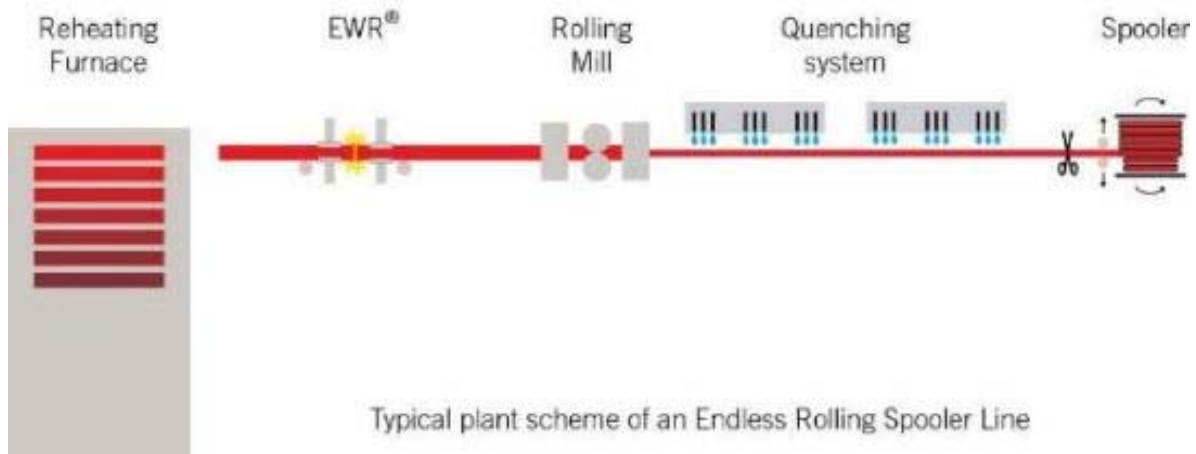


Figure 2: Typical plant scheme of an Endless Rolling Spooler Line

5 THE SPOOLER LINE

The spooling process adopted by Danieli group is one of the best and proven technological innovations that introduce a major change in bar-in-coil production, with significant benefits for both rolled coil producers and for the downstream coil end-users.

This process is based on twist-free winding of the rolled bar into high-quality, ultra-compact, heavy-weight coils, provides cobble-free un-coiling, enabling high-speed feeding of the downstream cold-processing lines with “as-rolled” coils coming directly from the rolling mill.

This makes the traditional “off-line” un-coiling, stretching & re-coiling operations no longer necessary, with significant savings in transformation cost.

Further technological and operational benefits are:

- On-line optimized bar cooling before spooling for consistent product quality, fully complying with tensile and ductility requirements;
- Ultra-high weight and high coil compactness results in minimized storage requirements, handling and transportation costs;
- Twist-free spooling avoids residual axial torsion in the material (as occurs in traditional coiling where this is often the cause of cobbles in the downstream cold processing lines).

Danieli was pioneer in designing and developing the patented torsion-free spooler process. The first Spooler line was installed at the Ferriere Nord bar mill in Italy, is in full industrial production since the end of 2002, and upgraded with latest spooling technologies on 2015 this year. To date, Danieli has supplied 48 Spooler units, worldwide (situation at May 2015).



Figure 3: A spooler unit installed at Celsa Barcelona plant - Spain

5.1 Spooler Line Main Concepts and Benefits

The Spooling process basically consists in twist-free coil formation by regular and “intelligent” distribution of the rolled and on-line control-cooled bar into subsequent homogeneous layers on the Spooler rotating drum. The result is an extremely compact and regularly-shaped coil, featuring an unbeatable “0.7” filling factor (against 0.3 of Garret coilers and 0.1 of wire rod coils).

Spoiled coils feature fixed height and fixed inner diameter, whilst outer diameter varies in relation to coil weight and bar size.

Twist-free winding is a remarkable step forward in coiling technology.

In traditional coiling (wire rod and Garret process), in fact, axial torsion remains in the material as internal stress, which very often causes problems (cobble and material losses) in the downstream cold processing lines.

The Spoiled coil, thanks to its regular formation & twist-free winding, is therefore the right answer to today’s more demanding bar-in-coil market.



Figure 4: A 5-t spooled coil under forming stage at Ferriere Nord - Italy



Figure 5: The result of a 5-t spooled coil at Ferriere Nord – Italy – March 2015

Bar controlled cooling (through Danieli Automation Process Control), before spooling cycle, is another key factor playing an important role in this innovative process. Optimized bar cooling throughout the bar section makes it possible to obtain a homogeneous product, fully complying with ductility requirements. Furthermore, optimized-cooling capability provides constant quality with extremely small deviations in material characteristics amongst the various heats that form a production lot of the same steel grade.

As previously mentioned, the system results highly beneficial, and the main benefits to this process are:

High finishing speed (40 m/s) leads to high rolling mill productivity, also with the smallest bar sizes.

Higher material yield and plant efficiency.

Big coils weight, in order to guarantee a continuously decoiling cycle (less changing time and more final productivity).

Better make-up of Rebar stirrup, due to the absence of residual axial torsion.

Possibility to create a lot of personalized bar's length thanks to the whole uncoiled bar length.

Cheaper transportation, handling and storage.

5.2 Main Benefits to End-Users Are:

For material handling:

- No need for special handling devices like spreader bars, etc.
- Possibility to change orientation of the feedstock.
- Safer / faster truck unloading and equipment loading operation.
- For equipment footprint requirements and operation
- Up to 50% less space requirement for equipment layout.
- Up to 50% faster equipment setup at beginning of campaigns.
- Up to 50% faster production cycles.
- 65%-plus equipment utilization factor.
- Zero cobbles due to the unique unwinding procedure and no residual axial torsion.

For material yield

- Up to 6% increase of material yield (yield losses using spooler product are practically reduced to zero).
- Possibility to use feedstock in coil up to 32-mm rebar (#11 rebar).
- Spooler process main benefits are summarized in Table N°1.

Table 1: summary of the Spooler process main benefits

Benefits	Thanks to
<ul style="list-style-type: none"> - Safe uncoiling capability, enabling downstream processing lines direct feeding with hot-rolled coils coming right from the rolling mill. - Traditional “off-line” intermediate processes (Un-coiling/stretching/re-winding), no longer necessary. Up to 18 €/t cost saving (not operating with EWR) 	Twist-free winding of hot-rolled/on-line control-cooled bars.
<ul style="list-style-type: none"> - No residual internal stress on the material, from axial torsion (as in the case of traditional coiling systems), which are possible cause of cobbles. -Thus, safe coil feeding for the downstream processing lines. 	
<ul style="list-style-type: none"> - Constant & consistent material quality, within the same production lot. 	Optimised on-line controlled cooling.
<ul style="list-style-type: none"> - High mechanical characteristics & good weldability, stating from low-carbon steel. 	
<ul style="list-style-type: none"> - Higher efficiency & productivity of the downstream cold processing lines, as well as higher material-yield. 	High-speed, cobble-free uncoiling. Ultra high coil weight.
<ul style="list-style-type: none"> - Substantial reduction in coil handling, transportation and storage. 	Ultra high coil weight & compactness
<ul style="list-style-type: none"> - Uninterrupted production of “Customized-weight” coils, if operating jointly with EWR-Endless Welding Rolling line. - Production of spooled coils of any weight up 5,000 Kg, even starting from low-weight billets. - Up to 22-24 €/t transformation cost saving by joint operation with the EWR 	Joint operation with EWR billet welding line for rolling mill endless rolling.

6 AUTOMATION AND CONTROL SYSTEM

The entire spooling process is led by an intelligent control system, particularly dedicated to supervise both bar temperature adjustment & control before spooling and regular bar winding distribution of the on the spooler drum for layer formation and layer step-up, until coil formation is completed.

With this new control system, and one special application, we offer the possibility to weight automatically the coil during the Spooler process, and avoid off-line weighing cycle, in order to reduce the “Loss time” and increase daily productivity of the final customer.

For a better control of sensitive machines, as for gearbox and drum, we could foresee an “Automatic vibration monitoring system” as for Laying Head and Fast Finishing Block in Wire Rod Line.



Figure 6: A spooled coil warehouse

The excellent results achieved in the various plants in operation and the large number of Spooler lines under supply and construction are the best confirmation of this revolutionary technology, which reconfirms indisputable Danieli leadership worldwide in long products.

7 CONCLUSIONS

Spooler process is the breakthrough technological innovation that has led significant technological step-forward in bar-in-coil production, enabling bar producers to reduce transformation costs and to create important new niches in the market. The joint application of the EWR[®] process for endless rolling of spooled coils has further enhanced the benefits of the two systems. We want to underline some of more significant results that we achieved in last year during the performance and production activity:

- Continuously production of 8, 10 and 12 (depend for each plants) at 35 m/s, without any type of cobble (Halyvourgiki Inc. in Greece, SN Longos in Portugal and Balboa in Spain).
- Production of Smooth round coils (from 20 to 42, special steel quality), for bolts and screw (Baotou P.R. Of China).
- Big coils with quenched deformed bars (4.000 Kg with 39 mm).
- Reduced Yield strength losses inside the coil, achieved value near $\pm 25/30$ N/mm² (depend on size diameters).
- Best results and high productivity due to 2-strand rolling lines at CELSA Group (UK, Spain, Poland and NERVACERO; from 150 to 180 T/h).
- Application of the Spooler process coupled together an EWR[®] line for Endless Rolling Process, with final big-coils obtained with consequent increase of productivity at ALFA Acciai – Italy, SUEZ STEEL – Egypt and the recent installation and start-up at Ferriere Nord – Italy with the heaviest coil of 5 ton even and first produced in the world!
- UGF-Ultra Fine Grain process, performed during the production cycle at Ferriere Nord – Italy as for SBQ process in Bar Line, in order to reduce internal Coils Yield losses path

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