Choice of advanced equipment technology merged with Danieli’s long lasting experience in upgrading and modernisation of existing plants, leads Trinecke Zelezarny to rank among the most modern and competitive wire rod producers in Europe.

**Foreword**

Trinecke Zelezarny is a fully privatised company in the Czech Republic and its major shareholder is the joint stock company Moravia Steel. The company was established in 1839 and is now an integrated steelmaking plant producing 2.2 million tpy of hot-rolled long products. An aggressive modernisation policy has been undertaken by Trinecke Zelezarny to allow the company to enter the 21st century with the aim of being ranked among the most advanced and competitive international industrial plants. The first modernisation stage is the revamping and upgrading of the existing 2-strand wire rod mill, for which the Danieli Group has been selected.

**Index**

1- Plant features and objectives of the modernisation.
2- Modernisation concepts.
3- Description of key components.
4- Project schedule.
5- Conclusion.

1- **Plant features and objectives of the modernisation.**

1.1- The existing Trinecke Zelezarny wire rod mill.
The plant was originally constructed and installed in 1973 as a 4-strand wire rod mill and underwent a major modification in 1997 when it was transformed into a 2-strand high-speed wire rod mill.
At that stage the mill produced 5.5 to 20-mm-dia wire rod into 1-ton coils, starting from 108x108-mm, 12-m-long billets.
Steel grades included Low to High-Carbon steels, Engineering Steel and Stainless steel for wide final application, ranging from concrete reinforcement to welding wire, cold heading, springs, chains, ball bearings and valves.
The existing mill, served by a 150-tph pusher-type reheating furnace, was made up of 14 stands arranged in continuous, plus two 10-pass finishing blocks (finishing speed 95÷100 mps), associated controlled cooling lines and coil finishing services.

1.2- Objectives of the modernisation.
To meet the ever-increasing market demands of the new century has led Trinecke Zelezarny to take the decision of modernising its wire rod mill. The key factors in taking this decision were:
- higher plant output capacity.
- higher plant efficiency,
- better material yield
- to supply the market with heavier coils (up to 3-ton) with superior final quality.
These objectives will be reached by completing and upgrading the existing plant with the installation of three Danieli technological packages, namely:

- A new 160/180-tph Danieli Centro Combustion top and bottom-fired walking beam reheating furnace to replace the existing 150-tph pusher type furnace.
- A new Danieli Morgårdshammar continuous roughing mill and a tunnel-type controlled process furnace upstream the existing mill in order to roll bigger size billets.
- New Sund-Co coil-handling and compacting facilities, downstream the existing controlled cooling lines, suitable to cope with the upgraded plant higher capacity and with the higher coil weight and size.

Plant modifications will make it possible to increase starting billet size from present 108 x 108 mm x 12 m (1-ton) to 160 x 160 mm x 12 m (2.3-ton).

The new facilities are designed for further coil weight increase of up to 3 ton by feeding the new roughing mill with 180 x 180 mm billets.

For general arrangement of new furnace, compact rougher and tunnel furnace please refer to Fig 1.

Present finished product range, 5÷20 mm plain wire rod and 8÷16 mm deformed rod, remain unchanged both in size dimensions and steel grades.

![Fig 1: General layout of new furnace and compact rougher](image)

**2- Modernisation concepts.**

Production of heavier coils, higher plant capacity and efficiency, together with superior final product quality are the key requirements that have led Trinecke Zelezarny to the upgrading of the existing plant.

An optimal technical/economical solution has been chosen in order to minimise investment costs, avoiding modification of existing equipment and reducing to a minimum plant shut down for the transformation.

Plant upgrading does not directly interfere with rolling concept, operation and performances of the existing rolling mill as such. In fact, other than providing a new modern reheating furnace with higher capacity, the modification is completely dedicated in adding new equipment before and after the existing facilities to enable dealing with higher billet and coil weight.

Higher weight rolled material means, in fact, higher plant availability and better material yield, ending up in increased overall plant productivity and lower
transformation costs whilst, market-wise, higher coil weight opens the door to new niches in the wire rod in coils market. Main areas involved with the upgrading are:

2.1-Reheating furnace.
The upgraded mill is fed by a new Danieli Centro Combustion 160/180-tph top and bottom gas-fired walking-beam reheating furnace for 180 x180 mm, 12-m-long billets. Fig 2 shows a similar installation. The new unit replaces the existing pusher type furnace and enables for a mill output increase from previous150-tph to 160÷180-tph, along with:
- Superior heated billet quality
- Better heating efficiency
- Very low fuel consumption
- Minimum scale loss, contributing to achieving high material yield.
- Low decarburization, for higher quality steel grades
- Maximum operation flexibility and good working conditions even at low productivity.
- Manpower minimisation thanks to furnace full automation and control system.

2.2- Furnace exit area.
A 250 bar high-pressure, low-flow water descaler is installed at delivery side of the new reheating furnace, for scale removal from billet surface (See Fig 3). This way, only scale-free billets are fed to the first roughing stand thus avoiding any possibility of “rolled-in” scale which could result in surface defects on the rolled stock, which is an absolutely undesirable aspect in special steels production. Higher quality of the final product is therefore granted.

2.3-The new roughing mill.
The new compact roughing mill is made up of four super-heavy-duty SHS Star Housingless Stands arranged in horizontal and vertical configuration for high-speed, twist-free breakdown rolling operation of up to180x180 mm billets.
A typical arrangement of a compact SHS rougher in operation is shown in Fig 4. The new Danieli Morgårdshammar rougher is located at a distance of approximately 33m far from the first stand of the existing mill to enable free-length rolled stock between the two mills. A roller conveyor with heat-retaining covers and tunnel-type process furnace are installed in between the new rougher and first existing stand for rolled stock temperature holding and control. The new single strand rougher high-speed operation makes it possible for
The existing mill will continue operation on two strands at the present rolling speeds, without any modification.

Superior product quality thanks to single strand twist-free breakdown billet rolling

Safer rolling condition with minor possibility of cobbles at rougher.

Longer life of rolls and grooves of the new roughing mill thanks to operation at higher speed and consequent optimal cooling rate/rolling speed ratio.

Billet deviation occurs in the free space between the two mills, in order to re-create the two strands rolling condition at the existing mill.

The tunnel furnace between the two mills makes it possible to reduce and control rolled stock temperature drop due to the different exposure to air of the bar head and tail, keeping uniform temperature along the whole bar length (maximum 30°C between head and tail).

2.4-The new coil handling and finishing services.
A new Sund Birsta coil handling and finishing line, installed after the two existing controlled-cooling conveyors and coil forming pits (See Fig 5), replaces the previous system.

The new line, designed to cope with coil weight and output capacity of the upgraded mill, is basically composed of:

- A 420-m long SUNDCO-H conveyor line for coil transport and finishing in horizontal position. The line is complete with associated trimming facilities, weighing, marking and unloading stations.
- Two PCH heavy-duty horizontal coil compactors for automatic coil compacting and wire binding in four points. The two units are also foreseen for future operation as strapping units.

Selection of an optimal layout arrangement for the new coil finishing services makes it possible for easy and safe operation procedures, rational utilisation of the available space and ideal material flow up to the final collection stations in the coil storage area.

3-Description of the key components.
3.1-Re heating furnace
Main technical features and characteristics of the new walking-beam furnace are:
- Output capacity: nominal 160-tph / maximum output 180-tph (with cold charge of billets).
- Material to be heated: up to 180x80 mm, 12-m-long billets.
- Furnace overall dimensions: length 23 m, width 14 m approximately.
The new top and bottom gas-fired furnace features double zone re-heating system with the possibility of optimising the temperature along the whole billet length. Both heating and soaking zones are top and bottom-fired. Burners on the top zones are flat-flame type whilst those on the bottom zones arranged in the tunnel, are long-flame type. Separation screens are located between zones to allow split-heating curve. The dual gas circuit system enables an optimised economical policy of energy cost.

3.2-Roughing mill
The new compact breakdown mill is composed of four super-heavy-duty Star Housingless Stands of the latest generation with SHS 6548 cartridge-type roll stand that can be used in both horizontal and vertical position. The housingless cartridge unit is show in Fig 6. Maximum roll diameter is 650-mm with 700-mm barrel length.
In-line stand changing is foreseen in the mill, whilst a "Rapidomatic" special robotized system allows a quick disassembly of the stand and quick changing of the old rolls with a new set in the stand preparation area.
The SHS stand was first developed by Danieli Morgårdshammar in the 1940’s and the ones installed at Trinecke Zelezarny wire rod mill are their latest generation featuring the following main highlights:
- Ultra compact housingless design and sturdy construction, with F.E.M.-calculated main components (See Fig 7) to withstand high rolling loads, granting optimised stress configuration of roll chocks and even load distribution on the roller bearings.
- Large diameter mill screws close to the bearing to achieve limited elongation and low stress path.
- Chocks free to adapt to the roll deflection thanks to a floating spherical joint inside the chocks. This guarantees an improvement of the bearing life of more than 30% and no edge loads on the bearings.
• Symmetrical roll gap adjustment with the possibility of independent adjustment of each roll side of the unit for parallel settings.
• No axial loads on the mill screws thanks to the chock frames designed to carry the axial loads as well as the forces in the rolling direction.
• Maintenance-free mechanical counterbalancing system to eliminate any clearance and the need of hydraulic devices
• Fully interchangeable for horizontal and vertical units.
• Quick changing in the mill and robotized roll changing in the workshop.

3.3-Coil handling and finishing services.
Coil handling and finishing services are of the latest SUNDCO generation. SUNDCO-H C-hook conveyor system has been custom built and shaped to suit the Trinecke Zelezarny layout and operational requirements, in terms of capacity, number of working stations, buffer zone, coil trimming station (designed to give the operator full access to coil open end), number and location of unloading stations. A detail of the C hook and associated conveying system is shown in Fig 8.

Main features of SUNDCO-H conveyor system are:
• Simple and sturdy construction
• Excellent hook stability in all directions
• Low-maintenance belt drive system
• Reduced coil-to-coil cycle time at coil compactor and at various working stations, due to optimised integrated handling equipment.

Two PCH compactors take care of compacting and wire bundling of the coils in four points. The units are suitable to enable coil strapping at a future stage.

3.4-Electricals and Automation System
Danieli Automation supplied all electrical and automation systems for the new facilities. Supply included MV/LV step-down and distribution system, main and auxiliary driving motors and associated controls.

The automation system enables a user-friendly operation of the mill and guarantees a constant high-quality production even with small crews. The technological areas covered by the automation are the new reheating furnace, associated feeding and delivery services, new roughing mill, and coil finishing area. The fully integrated automation system allows high efficiency levels in product heating, rolling and finishing, as well as production flexibility and consistency in rolling practices.

The automation system is based on an open architecture with distributed controls allowing a high specialisation of the automation units. A level-2 automation system is in charge of reheating furnace, providing fully automatic control of heating curves and fuel consumption optimisation, through a sophisticated mathematical model.
4-Project schedule
Start up of the upgraded facilities is scheduled in Autumn of the year 2000. Total plant shut down time to carry out the modification (and the consequent interruption of wire rod production) will be limited to less than four weeks. Long lasting experience in upgrading and revamping of existing mills world-wide has enabled the Danieli team (namely: Danieli Centro Combustion, Danieli Morgårdshammar, Danieli Automation and Sund Birsta), to set a dedicated reliable planning of all activities. Proper planning and joint efforts with Trinecke Zelezarny will enable this program to be successful.

5-Conclusion
By joining the respective experience acquired, Trinecke Zelezarny and Danieli have created the basis of a successful and fruitful co-operation in high-quality wire rod production. The collaboration is extended to the know-how transfer to produce and offer special quality products that comply with TÜV and ISO 9001 Standards, to the satisfaction of end users. With this modernisation, Trinecke Zelezarny achieves the objectives of increasing mill productivity, improving the final product quality and last, but not least, supplying very high coil weight, in line with the present and future market demands.