

# The new rail mill of Voestalpine Schienen

**The existing 2/3-high rail mill at Voestalpine is being revamped with a modern breakdown stand and universal finishing stands. Benefits will be lower costs through increased production, yield, mill utilisation and automation, and improved product dimensional tolerances and surface finish.**

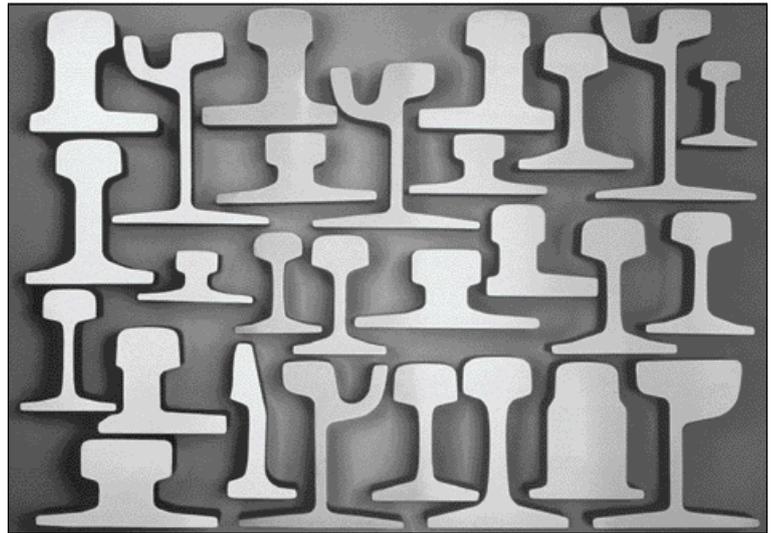
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Voestalpine Schienen GmbH and Danieli Morgårdshammar

High-quality products at ever lower production costs are the main objectives of producers of hot-rolled sections and, even though the existing rolling mill at Voestalpine Schienen GmbH, Leoben, Austria, still produces the highest quality rails, the equipment installed in the 1950s required more and more measures to maintain the same high-quality production. Therefore, in 2001 the company, European rail production market leader – began a project study to revamp the existing rail mill.

Following major investment in the finishing end of the mill 14 years ago when 120m rail production was introduced and quality assurance equipment was increased and modernised, the remaining major upgrading work still to be done was the replacement of the rolling mill train itself. This would involve the changing of the existing roughing mill and the existing 3-high/2-high rolling mill stands with the latest generation of breakdown mill stands, universal tandem rolling stands and roll pass design.

The main targets of the revamping project are to achieve:

- Increase in yearly production
- Increase in yield
- Higher mill utilisation
- Closer tolerances and better surface finish on the finished products
- Reduced conversion cost
- Stable and reliable operation of the plant
- Increased automation of the complete rolling process



● **Figure 1 VAS rail product range**

Various possible layout and process solutions to revamp the mill were studied in detail for two years with two potential equipment and process suppliers. In August 2003, Voest Bahnsysteme awarded the order to Danieli Morgårdshammar.

## History and current plant status

The tradition of rail production at Donawitz goes back to the beginning of the 20th century. In the intervening period, rails have developed into a high-technology product, because high axial loads, increasing speeds and a growing demand for passenger comfort imply ever-increasing rail quality.

The existing rail rolling mill started in 1953, rolling beams, U-profiles and rounds as well as rails, but for economic reasons production became concentrated on rails and supporting profiles, with rail production increasing from about 130,000t/yr in 1988 to the current level of 375,000t/yr. The planned product range extends from Vignolrails, crane rails, tongue rails, grooved rails and special rails, up to base plates and other products for the railway industry, as well as billets (see Figure 1).

This improvement in quantity, as well as quality and productivity, was reached only because of significant investment, such as:

- New 120m cooling bed (see Figure 2), including Voestalpine-patented rail head hardening equipment
- Revamping of the walking beam reheating furnace



● **Figure 2** Walking beam 120m cooling bed

- New H/V roller straightener
- New test centre
- New cold sawing machine
- Two new fully automatic 120m rail handling storage systems
- Partial automation of the breakdown stand
- Measures to increase stand stiffness
- Conversion of roll drive motor adjustment to digital mode
- New tilting table with roll manipulator

Although specific programmes have guaranteed a significant reduction in production costs, there are fundamental and serious weak points that cannot be removed by single measures. Therefore, since 1998, several technical solutions have been considered for revamping the plant, which has resulted in the view that only the replacement of the existing rail rolling mill (see Figures 3 & 4) with universal rolling stands and quick changing facilities can fulfill future market demands.

### The new plant layout

The new rolling mill (see Figure 5) will consist of one reversing breakdown stand followed by a 3-stand reversing tandem mill to be installed in a separate line and fed with pre-rolled products from the roughing mill by a lifting car transfer. The new breakdown mill and the new tandem mill are the



● **Figure 3** Existing breakdown mill

latest generation of housingless Stand Core Concept (SCC) stands and will be able to change from one product to another in 20 minutes. Rolls and guides and (in universal rolling mode), also the vertical chocks will be changed simultaneously and fully automatically.

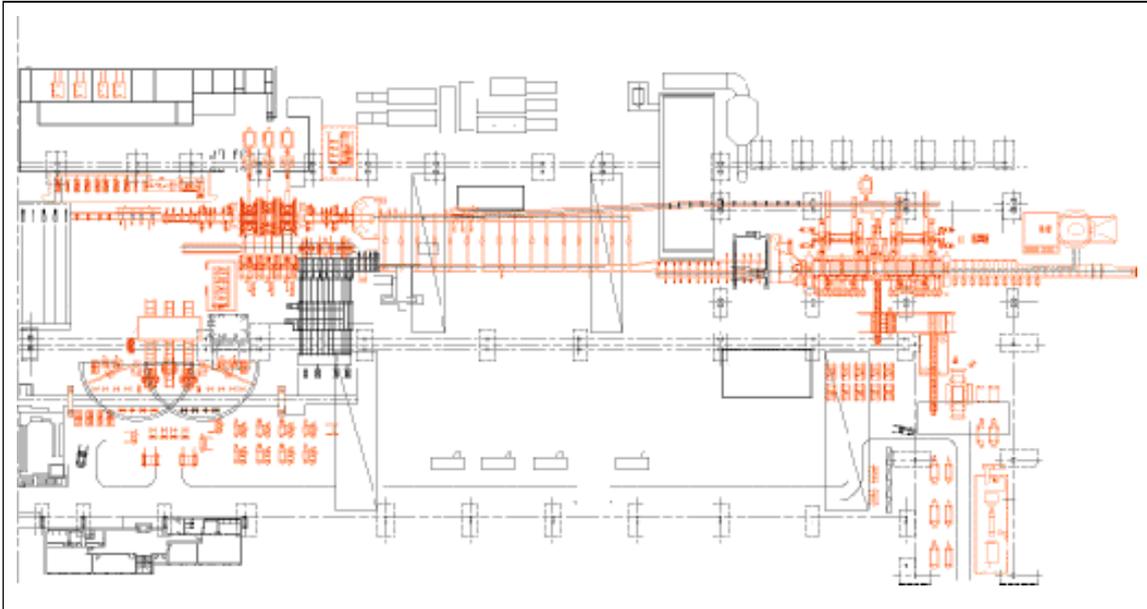
### The new breakdown mill area

After being discharged from the reheating furnace, the blooms will be fed in the opposite direction to that of today, through a high-pressure descaler. The wide barrel housing breakdown mill (BDM) stand will be able to roll the leader sections in up to 12 passes. Upstream and downstream of the stand, side guard manipulators and shifting devices are provided for automatic and fast manipulation of the bars, according to the corresponding grooves on the roll barrel length.



● **Figure 4** Existing finishing mill with two 3-high and one 2-high stands

● Figure 5 New mill layout



Additional grip-type filters are arranged for the rolling of billets. Figure 6 shows a similar BDM at Böhler Edelstahl.

The BDM stand is equipped with automatic quick changing facilities for rolls and guides to reduce product changing times to a minimum. After the roughing stand, the leader sections are transferred via a carrying transfer car in front of the new 3-stand tandem mill. Special care has been taken to avoid any kind of product scratching during processing.

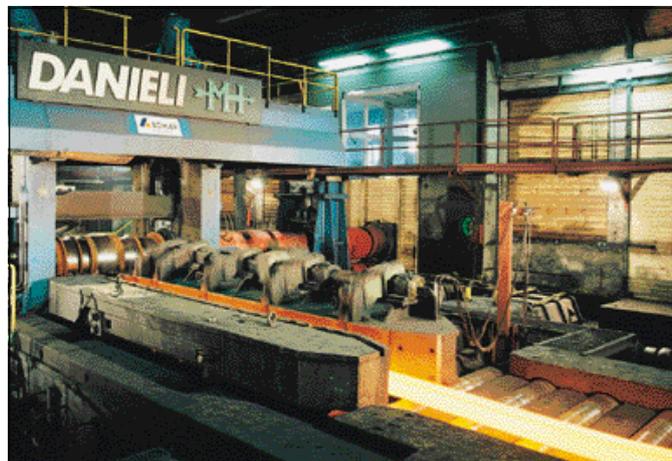
#### The tandem mill area

The tandem mill group consists of three identical mill stands, which can all operate either in universal or in two-high mode, depending on the optimal roll pass design requirements. The SCC super heavy duty stands (see Figure 7 & 8 showing a similar stand at Duferdofin Giammoro and a schematic 3-D view) feature:

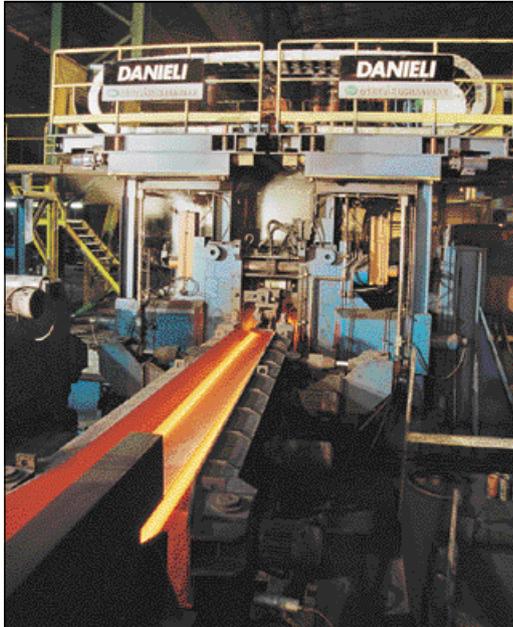
- High mill stand stiffness due to short-force pass flow resulting in small deflections under load
- Fully hydraulic adjustment system featuring under-load adjustment
- Automatic gauge control system
- Universal or two-high mode possible for all stands
- Fully automatic guide and roll set changing procedure (plant production stoppages for size changing in 20 minutes)
- Zeroing and mill modulus determination
- Different H-chock centreline for universal/two-high mode resulting in lower stand deflection
- Automatically adjustable guiding system for simultaneous movements resulting in close guiding of the stock during the reversing passes

- Standardisation of components on the three tandem stand resulting in capital investment savings for spare parts and roll pass design flexibility
- All stands are shiftable, thus the rolled stock always remains on the roller table centreline (fixed pass-line concept)
- Special design of the stands allows even a half stand change within 1 hour to reduce mill downtimes in case of any malfunctions of fixed mounted equipment

These mill stands, representing the latest generation of housingless stands, of which more than 4,800 units have been supplied worldwide, ensure the best tolerances along the complete bar length. All three drive systems are also standardised, thus allowing a



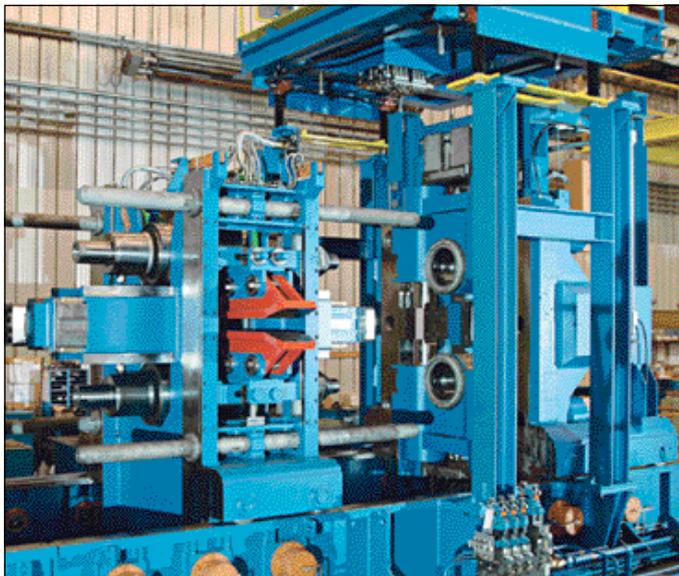
● Figure 6 Breakdown mill at Bohler Edelstahl



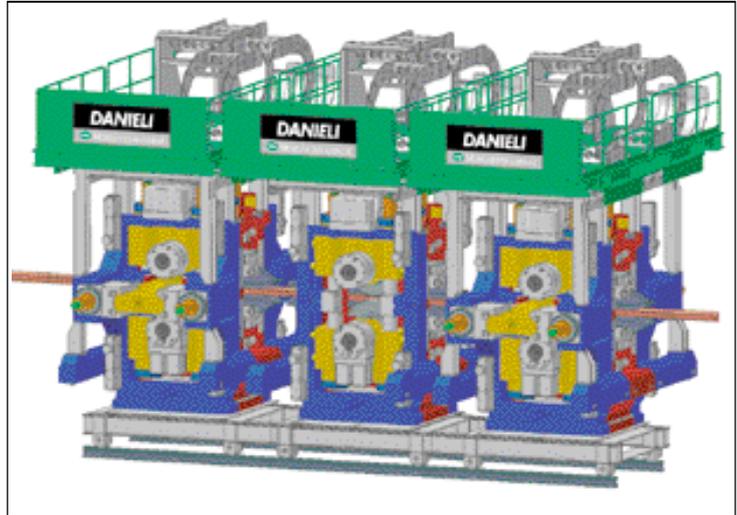
● **Figure 7** SCC stand at Duferdofin Giammoro

completely flexible arrangement of 2-high/universal stand configurations of these three stands. This means that the mill has the flexibility to adopt the best roll pass design for current as well as any future products.

Parallel liftable roller tables that follow the height reductions of the products during the reversing rolling operation will be installed in front of and behind the tandem mill, thus always allowing parallel biting of the rolled stock by the rolls. High-pressure water descaling headers will eliminate secondary



● **Figure 9** SCC stands – core set-up



● **Figure 8** Schematic of proposed SCC stands

scale before the passes in both directions, and thus ensure the highest surface quality of the finished products.

### The roll and guide preparation area

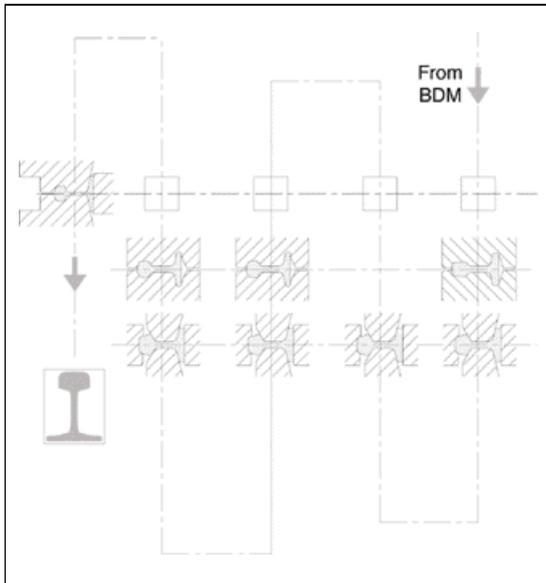
Special attention has been paid to the quick preparation of the new roll and guide sets in a separate preparation bay. Before entering this bay, the used sets transported in a special container, will proceed through a washing cabin to keep the preparation bay free of rolling mill scale. Each stand has a dedicated roll and guide preparation area, where the used set is dismantled, then the container is equipped with a new set of prepared rolls and guides already in standby (see Figure 9). The minimum preparation time for the complete tandem mill is three hours, thus enabling Voestalpine Schienen GmbH to react quickly to market demands and reduce the production time for a minimum lot size to only three hours.

### The advantages of the new roll pass design for rail rolling

The use of universal rolling in combination with SCC stands provides superior product tolerances, lower friction between roll and rail resulting in a better surface of the finished rails and higher roll life, symmetrical shaping of the rails, and reduced inner stresses. Furthermore, by designing all the stands as 'full working' stands, customers will have maximum flexibility in increasing their product mix variety. Figure 10 shows the roll pass design sequence.

### The automation system

An advanced level 1 and level 2 automation system controls equipment and process on-line function (see Figure 11) namely:



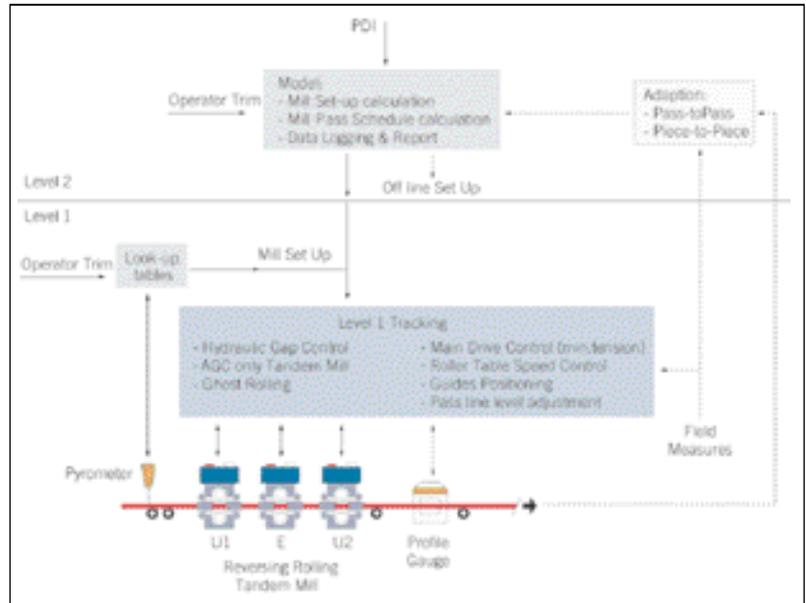
● Figure 10 Rail roll pass design sequence

- Sequential control of the movements of the mechanical equipment
- Material tracking
- Minimum tension control
- Closed-loop control functions
- Set-up calculation function such as automatic gap control
- Logging of process parameters

A PLC and microprocessor-based system automatically controls the equipment in the reversible stand area. Level 1 is in charge of the drive systems ensuring their fastest dynamic performance and actuator set-up is provided either by look-up tables (operator adjustable) or by level 2. Level 2 calculates the mill pass schedule by means of the mill pass schedule calculation program (PSP) and sends it to mill level 1. The model is adapted using field measurements both in a 'pass to pass' and 'piece to piece' mode, and can be executed in off-line mode for trial runs. Level 1 and 2 fully control mill automation, including the key functions of hydraulic gap control, automatic gauge control, section control system and pass schedule calculation and adaptation.

#### Project time schedule

Project revamping will be done in two phases. Phase one involves the installation in October 2005 of the new breakdown mill area during regular plant production and without any production stoppages. For two months between December 2005 and



● Figure 11 Structure of new tandem mill automation

January 2006 the plant will be shut down for phase two when the old equipment will be dismantled and the new equipment installed and commissioned. Thanks to the single supplier concept, the mill stands can be assembled and tested together with all the automation equipment in Danieli's workshop in Buttrio, Italy. During this time the Voestalpine personnel will be trained on the equipment, will participate in the test period, and hence will already be familiar with the equipment before it even arrives on site. The tandem mill stands do not need to be dismantled for transportation, thereby minimising any risk of malfunctions.

#### Summary

Voestalpine and Danieli have joined forces to develop the optimum process to revamp the existing rail rolling mill at Donawitz, Austria using Danieli Morgårdshammar's most modern rolling mill equipment for this kind of section mill.

The close efficient working relationship between the two project teams developed over the past two years has been the key to their success. With this modernisation, the final phase of the complete rail mill revamping will be concluded in 2006 to enable Voestalpine to step ahead in the market and continue to set high standards in the future.

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