

# WINNING TECHNOLOGY FOR STATE OF THE ART MEDIUM / HEAVY SECTION MILLS<sup>1</sup>

PSP – Profile Sizing Process and SCC - Stand Core Concept (stands)

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## Abstract

Competitiveness is the main goal common to all steel producers to hold a leading position in today's market which is more demanding and tougher than ever. Competitiveness means top quality products and high output capacity at the lowest possible transformation costs. The plant manufacturer's mission is to provide steel producers with the most advanced technology both in terms of machinery and production processes, in order to enable them to reach their targets. Continuous efforts in research & development have made it possible to introduce significant innovations in the production of structural steel. Danieli, front-runner in the field of equipment for long products, has developed the innovative process called PSP (Profile Sizing Process) – that is the right tool for the production of superior products combining the best tolerances, surface quality and at reduced conversion costs and maximum flexibility for our customers' future needs. The PSP-based plant represents therefore the front-head technology in medium and heavy section mills, now and in the years to come. This article introduces the Danieli state of the art in medium and heavy section mills.

**Key words:** Profile sizing process; Rolling optimization; Stand core concept stands.

## A TECNOLOGIA VENCEDORA PARA O ESTADO DA ARTE NA LAMINAÇÃO DE PERFIS MÉDIOS E PESADOS

PSP – Processo de calibração de perfis e SCC – Conceito de gaiola Auto Ajustável

### Resumo

Competitividade é a principal meta comum a todos os produtores de aço, imprescindível para assegurar uma posição de liderança no mercado de hoje, que é cada vez mais exigente. Competitividade hoje se traduz em plantas com produtos de alta qualidade e alta capacidade de produção com o menor custo de transformação possível. A missão dos fabricantes de equipamentos é proporcionar aos produtores de aço a mais avançada tecnologia, tanto em termos de máquinas quanto em processos de produção, a fim de lhes permitir alcançar as suas metas. Contínuos Esforços de pesquisa e desenvolvimento permitiram a atual introdução de inovações significativas na produção de aço estrutural, a Danieli, líder no campo de equipamentos e tecnologia para produtos longos, tem desenvolvido o processo inovador chamado de PSP (Processo de calibração de perfis) - que é a ferramenta ideal para a produção de produtos de qualidade superior combinando as melhores tolerâncias com melhores qualidades superficiais além da redução dos custos e uma máxima flexibilização para as necessidades futuras de nossos clientes. O PSP representa portanto uma inovação no campo da tecnologia de laminação de perfis médios e pesados e este artigo lhes apresenta o estado da arte Danieli para a laminação destes perfis.

**Palavras-chave:** PSP; Perfis leves e pesados; Otimização da laminação; SCC.

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## 1 Foreword

Competitiveness is the main goal common to all steel producers to hold a leading position in today's market which is more demanding and tougher than ever. Competitiveness means top quality products and high output capacity at the lowest possible transformation costs.

The plant manufacturer's mission is to provide steel producers with the most advanced technology both in terms of machinery and production processes, in order to enable them to reach their targets.

Continuous efforts in research & development have made it possible to introduce significant innovations in the production of structural steel.

Innovative operating processes and equipment such as PSP – Profile Sizing Process and SCC (Stand Core Concept) super heavy-duty stands are available today, with a common main goal (see installation examples in Fig.1):

Obtain superior finished products, higher productivity, efficiency and lower production costs.

This article introduces the Danieli state of the art in medium and heavy section mills.



Figure 1 – Break Down mill and UFR finishing mill in operation.

## 2 – PSP – Profile Sizing Process

It is the hearth of the rolling mill to achieve the correct shape, the strictest tolerances and finishing of the sections.

The process finds its ideal application in medium and heavy section mills.

The PSP is the intermediate and finishing rolling process, basically made up of a pre-finishing 3-stand UFR Ultra Flexible Reversing mill composed by two roughing “UR1” and “UR2” universal stands and an “E” Edging stand, followed by an independent “UF” universal continuous finishing/sizing stand where the single finishing/sizing pass is performed on the free-length bar coming from the UFR mill.

The PSP – Profile Sizing Process enhances dramatically the product quality since:

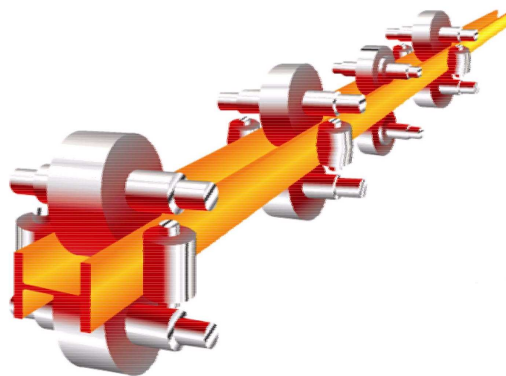
- Avoids the bending and re-bending of the beam flanges during the rolling sequence;  
Prevents the severe roll wear at the web–flange junction area of the product since there isn't flange bending (see fig 2 below);
- Good grain refinement in the web–flange junction area due to the homogeneous temperature distribution;
- Proper draught in the web–flange radii;  
Limited roll changing due to a balanced roll wear (same wear between the plain and radius area of the roll);
- Roughing and edging stand grooves life time not determined by the finishing stand, thus resulting in longer rolls life;
- Limited number of spare rolls in the workshop since deep roll redressing is no needed;
- Highest product surface finish due to the use of UF only in the last finishing pass.  
(See an example cost save difference in Figure 3).

Furthermore the PSP allows:

- Reverse rolling through the Roughing and Edging Stands until the bar is ready for the final pass. Then the bar is transported to the Finishing Stand which is used for the final pass only, therefore providing a high level of surface accuracy and finish over a long campaign;
- Use of Finishing Stand as sizing stand;
- Precise set-up of the rolls and guides of the UF in the workshop (clean and protected area) without any stand adjustment in the production line;
- No tension between the penultimate and the last pass;
- Possibility of Thermo-mechanical Rolling, by applying high reduction in the correct range of bar temperature;

Additionally the PSP process provides:

- - Increased productivity for channel and sheet piles;
- - More flexibility for future products due to the separated finishing stand;
- - High plant productivity also for small product sizes thanks to the independent finishing stand;
- - Easier installation of a gauge measurement system.



**Figure 2** – The PSP – Profile Sizing Process concept Rolling stands rolls arrangement.

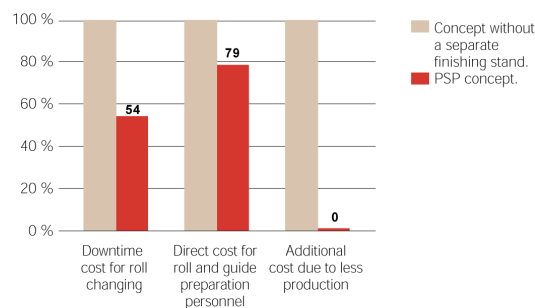
A dedicated PSP Mill Pass Schedule Calculation Program calculates the main rolling parameters, the rolled stock temperature development along the mill and the intermediate dimensions on the different runs. In addition, it verifies the uses of the motors (allowing the correct reduction ratio choice for each gear unit) as well as that the loads acting on the rolls are lower than the maximum admissible ones.

All calculations are carried out separately for bar head, tail and intermediate section. Moreover, Danieli provides pass to pass roll settings generated by a design computer and controlled by the mill automation system so that the mill operator will have a supervisory role only. The model links the web and flange elongation to avoid web buckle or flange wave.

A Danieli Automation HiPROFILE® Laser Gauge unit is installed at delivery side of the mill, for constant contact-less measurement of the product final dimensions and for feedback control to the roll stands. This arrangement, through SCS Section Control System and the hydraulic caps on board of the stands, enables automatic adjustment of the rolling parameters within the same bar, or from bar to bar.

An alternative solution of the PSP is available, without jeopardizing the final product quality, for heavy sections or for reduced available space.

In this case, the rolling line is made up of a 3-stand UFR Ultra Flexible Reversing compact mill composed of a roughing “UR” universal stand, an “E” Edging stand and a “UF” universal finishing/sizing stand.



Remark: (\*)  
Above comparison is based on a typical Medium Section Mill Product Mix  
(HE 100-260, IPE 100-550, Channels 100-400, Angles 100-200)

**Figure 3** – Cost comparison between PSP concept and process without separate finishing stand.

### 3- SCC (Stand Core Concept) stands:

The UFR Ultra Flexible Reversing mill 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 so-called SCC (Stand Core Concept) super heavy-duty housing stands feature the cutting edge technology for rolling of sections (Figure 4).

The most important features of the SCC stands are:

- Highest mill stand stiffness due to a short-stress path and hydraulic capsules design resulting in very limited deflections under load;
- Fully hydraulic adjustment system featuring under load adjustment;
- Universal or two-high mode possible for all and any stand;
- Fully automatic guide and roll set changing procedure (only 20 min);
- No manual operation during stand changing thanks to the roll unlock robot provided in the mill;
- Zeroing and mill modulus determination after each changing procedure;
- Completely sealed hydraulic circuit during roll change (no flushing needed);
- Different H-chock centerline for universal/two-high mode resulting in close guiding of the stock during the reversing passes;

- Adjustable guiding system for automatic, simultaneous movements resulting in close guiding of the stock during the reversing passes;
- All stands are shiftable, thus the rolled stock always remains on the roller table centreline (fixed pass-line concept);
- Standardization of components on the UFR mill and in the UF finishing stand resulting in capital investment savings for spare parts;
- Possibility to change automatically half of a stand for maintenance purpose in a very short time thus, allow for off-line maintenance in a clean environment.



**Figure 4** – Detail of a SCC stand during manufacturing.

#### **4 – Stand preparation area**

To achieve high rolling schedule flexibility the SCC stand is designed in such way that only rolls, guides and vertical chocks package (the so-called stand “Core”) is changed and automatically replaced with a new one previously prepared as a changing set before the changing operation starts in the mill.

Special care is dedicated to the automated, simultaneous roll and guide changing procedure to ensure the minimum possible production lot size and highest mill availability, minimizing rolling on-stock and reducing cash costs. The complete stand converting operation from two-high to universal (or vice-versa) is performed without using the main building crane (necessary just for new rolls/guide set handling at the preparation area) with associated reduced converting times and lower investment cost for main cranes and buildings.

#### **5 – Latest installations and new orders**

##### **Major modernization at Arcelor Mittal Differdange plant (Luxemburg)**

In September 2007, the “Grey-mill” in Differdange restarted, after completion of a major modernization project carried out by Danieli Morgårdshammar and aimed at enhancing plant operation, efficiency and final product quality.

The mill’s product range includes up to 1,100-mm parallel-flange beams, rolled in up to 120-m-lengths.

The plant modernization involved the replacement of the existing intermediate stands and the associated mechanization equipment with a 2-stand UFR mill with automatic fast changing system, installed in-line with the present UF finishing stand.





**Figure 5** – UFR mill in operation at Arcelor Mittal Differdange (Luxemburg).

Danieli was responsible for the supply of equipment and services on a complete turnkey basis.

Electricals and an advanced automation system have been supplied by Danieli Automation (See installation example in Figure 5).

### **Danieli PSP concept at Siderurgica Balboa (Spain)**

The new 750,000-tpy medium section mill (RM #1) for the production of up to 600-mm beams and medium-size profiles started the commissioning at Siderurgica Balboa (part of the Alfonso Gallardo Group) in April 2008.

This was one of the steps of the new 1.2-Mtpy minimill startup program, that includes a 130-ton EAF-based steelmaking / conticasting plant for billets, blooms and beam blanks and the 500,000-tpy multi-line superflexible mill (RM #2) for production of round bars, spooled bar-in-coils, wire rod coils, small and the lower range of sections. The new minimill, completely supplied by Danieli, is located in the Jerez de los Caballeros complex which already features another minimill for bars and a combined galvanizing/colour coating line, also supplied by Danieli.

Danieli Centro Combustion has supplied the 180-tph walking beam-type reheating furnace.

All electrical and an advanced automation system for the whole minimill are from Danieli Automation (See installation example in Figure 6).



**Figure 6** - Commissioning of medium section mill at Siderurgica Balboa (Spain).

## **6 – Conclusions**

Danieli, front-runner in the field of equipment for long products, has developed the innovative process called PSP (Profile Sizing Process) – that is the right tool for the production of superior products combining the best tolerances, surface quality and at reduced conversion costs and maximum flexibility for our customers' future needs. The PSP-based plant represents therefore the front-head technology in medium and heavy section mills, now and in the years to come.