

ROLLER GUIDES FOR HIGH-SPEED FINISHING BLOCKS: A WORLD OF CONTINUOUS INNOVATIONS¹

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Abstracts

Rolling at high speed and achieving both very high product tolerances and a superior surface quality are nowadays results obtainable only with reliable and efficient process. Roller guides represents one of the key to be a winning steel producer in terms of productivity and quality. The increasing of rolling speed and quality demand are the factors that are leading to significant changes on guide design to increase their performance in term of guide capability and reliability. The aim of this document is to give a guideline to understand the differences between older and new guides with an outlook on the trends for future modifications and improvements.

Key words: Roller guides; Wire rod blocks; Productivity.

GUIAS DE LAMINAÇÃO PARA BLOCOS ACABADORES DE ALTA VELOCIDADE. UM MUNDO DE INOVAÇÕES CONTÍNUAS

Resumo

Laminação a alta velocidade e obtenção de produtos com altas tolerâncias e qualidade de superfície superior são hoje em dia resultados obtidos apenas com processos eficientes e confiáveis. As guias de laminação representam uma das chaves para ser um produtor vitorioso de aço em termos de produtividade e qualidade. O aumento da velocidade de laminação e da demanda por qualidade são os fatores que estão conduzindo para mudanças significativas no design das guias para aumentar seu desempenho em termos de confiabilidade e capacidade. O alvo deste documento é fornecer instruções para entender as diferenças entre as guias antigas e as novas com um olhar nas tendências para futuras mudanças e melhorias.

Palavras-chave: Guias de laminação; “Wire rod block”; Produtividade.

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INTRODUCTION

The Wire Rod lines have been subjected to high performance increase in the last 10 years, with the goal to increase productivity and quality targets.

Several reasons pushed the steel producer to improve their quality and mainly:

- Market requirements for wire rod become stricter in terms of tolerances. Nowadays 5.5mm is requested with tolerance +0.1/-0.1 and 80% maximum ovality.
- The market requested an almost scratch free rolled product or anyhow with defects within 0.08mm depth maximum.

Besides this, the very competitive market pushed all steel producers to improve significantly the performances of the lines in terms of:

- Mill utilisation Factor. Reliable rolling process, procedures, and adequate quality equipment allows reaching high values.
- Production range: a competitive steel producer has to be able to be flexible in the market. Clearly high volumes on stock represent an economical problem for everybody. Therefore the tendency is to change production size very often, working almost with just in time logics with final customer orders. This of course affects the efficacy, due to the fact that production changing time has become one of the biggest issues.
- Transformation cost had to be lowered down so to generate the margin that allows the company to be cost winner in such competitive market.
- Quality: a concept that becomes a precise MUST all around the world. Tons of production is not anymore the main request if these tons are not fully matching the final customer needs. In a very competitive market this is the base to keep Customers for future orders and to reduce unsold production.

In 1950, 20m/sec was the top speed reached in a mill and Wire Rod Block did not exist yet as is the modern concept.

In the 90' the top speed was around 85-90 m/sec and a precise target was since then already clear in front of everybody. Speed and quality increasing.

Rolling speed nowadays can reach up 115-120m/sec with design speed of 140m/sec.

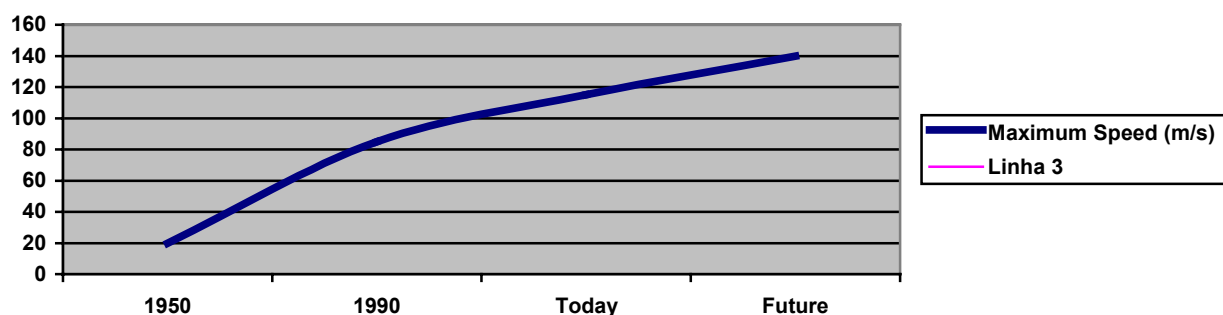


Figure 1. Fast Finishing Block speed

Roller Guide has been and actually is one of the most important points that influence the mill utilisation factor. Steel producer well knows that from the workshop to the line, a good guide makes the difference.

The best guide ever is the one that:

- Operators can easily set-up and align.
- Last in operation at least 3 shifts even in the fastest passes.

- Reduced cost of spares and necessary time for routine maintenance (mainly rollers and Entry Guides changing).

In other words the perfect guide is the one that will be forgotten and that does not force to stop production.

The continuous improvements and research on High Speed roller Guides brought to a strong evolution. The requirements become really impressive.

Nowadays with final speed of 110m/sec the rollers (dia.50mm) can reach up to 37.000RPM.

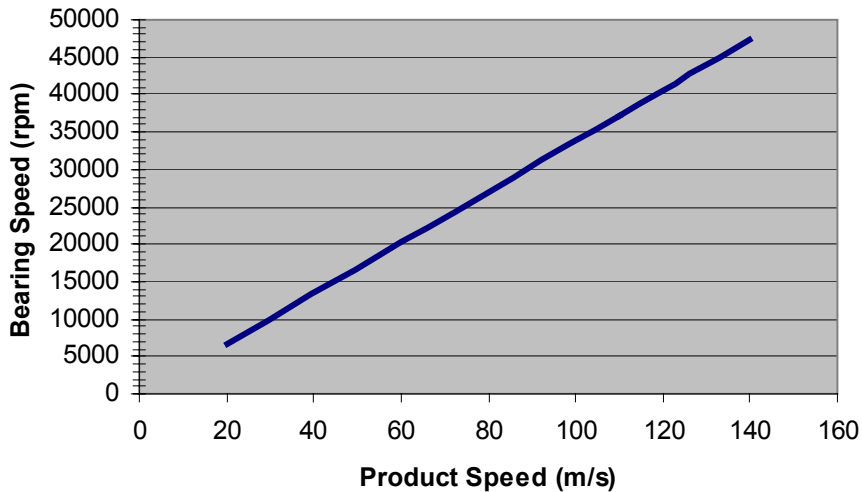


Figure 2. Bearing speed vs product speed for a roller of dia 50mm

A good reference value, so to get the proper feeling, can be the Ferrari Formula 1 engine. Motor RPM are around 20-21.000RPM.

From this value we can all understand the sensibility about the particularities of these guides and the real need to have proper guide specialists in the mill capable of properly handling the equipment.

For the above reasons roller guides has been subjected to tremendous improvements in order to operate at today and future working conditions. Today's roller guides are completely different from the older one; they are stronger, enable more precise setting, longer utilisation on the mill, Let's analyse which are the main feature of modern technology, state of the art of roller guides.



Figure 3. New SRW guides compared with older 0820 guide for WRB

Angular bases

This feature was introduced so to improve the reliability of guide centring on bases. With this feature the alignment of the guide is more precise since it is granted by a tapered surface. Moreover this feature enable quicker guide changes and easier dust/scale removal. This type of mounting grants a longer lifetime compared to the old key-type mounting, where key is subject to wear and therefore needs to be replaced to grant a precise alignment.

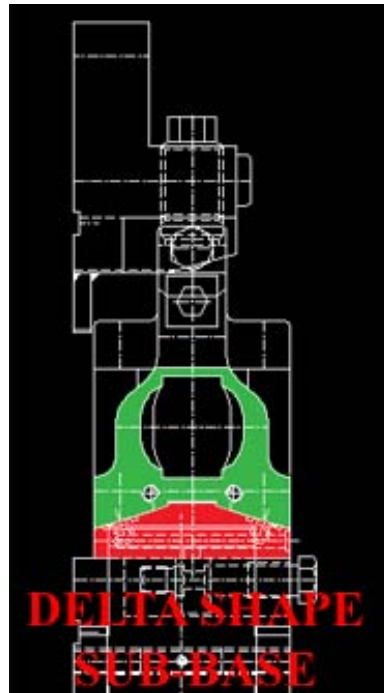


Figure 4. Angular auto-centring base

Wider range

In the past the guides of the block have been foreseen only with two rollers of about 24 mm height. Nowadays guides are available in different configurations and sizes:

- the market offer the possibility to choose between two and four roller guides; the former are preferably utilised in the last passes but also to guide the round passes; four roller guides are preferably utilised in the first passes of the WRB, since they give the the possibility to stabilise the product reducing the typical vibration of the WRB.

- the guides are available with different roller height. Bigger rollers have been introduced for bigger products (typically with 30 mm roller it is possible to guide the oval necessary for a round up to 22 mm). Moreover the tendency on the market is to increase the range of production in the fast finishing block; therefore also solutions with 35-40 mm roller height are under development. Smaller rollers have been introduced to improve guide capability for smaller products at high speed (typically more than 80 m/s). This because the guide can be installed closer to the rolling rings; as an example an 18 mm roller can be installed the 14% closer to the rolling rings

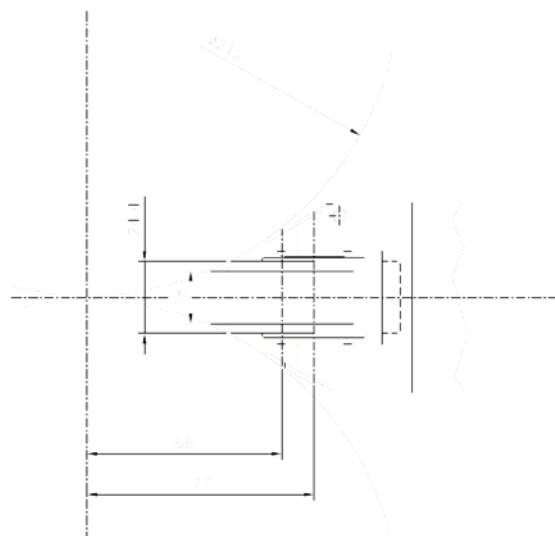


Figure 5. Roller height comparison

than a 24,4 mm roller. To further improve this feature nose pieces are mounted on the guides for the production up to round 8-10mm.

No external pipes

To reduce the downtime for guide replacement or cobble removal lubrication and cooling are not supplied with external pipes but through the bases. This increases the machining requested on the guides. Drillings must be precise to grant the requested cooling and lubrication and also high quality body castings are necessary without internal holes.

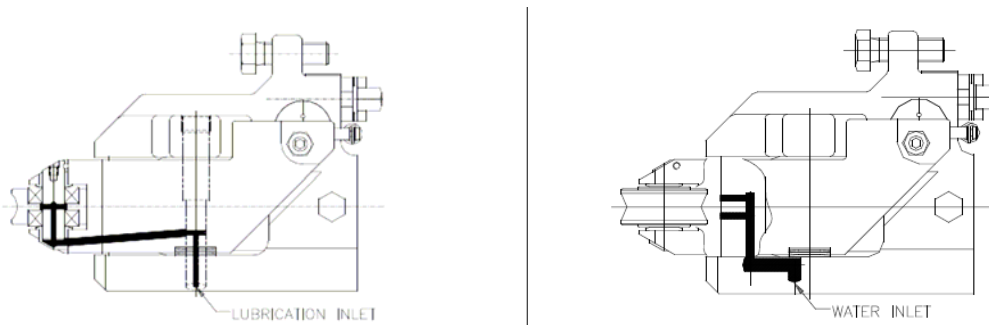


Figure 6. Internal distribution of water and lubrication

From the base the lubricant (air-oil) is then supplied via the pivot shaft and further through internal drillings to the bearings. It is of highest importance that the bearings are shielded on the outside so that an overpressure is obtained inside the bearings to prevent water and residue from penetrating. As a standard, lubrication frequency is higher compared than in the past, but oil quantities is reduced. Usually air is always entering the bearings so to keep them cooled and clean.

Guide rollers needs to be cooled to increase roller life considerably. In block roller guides the cooling water enters the guide through the bottom from the guide adapter. In order to avoid pick-ups on the guide rollers, which can badly mark the rolled stock, cooling water is also flushed through the static entry guides to keep the entire guide channels free of scale and other particles.

Roller assembly and bearings

High speed rolling requires special roller assembly. In particular:

- Replaceable hardened bushings of tool steel are pressed into the front part of the roller holders for shaft location.
- The shafts are made of hardened chrome nickel material. Simple shaft design is important for low replacement cost.
- The cup springs in the bearing assembly have a special design to permit proper pre-stressing of the bearings. Pre-stressing guarantees contact between balls and bearing races at all time.
- The bearings are provided with ball cages of fibreglass-reinforced plastic to reduce the weight and therefore to enable quicker acceleration thanks to lower inertia.

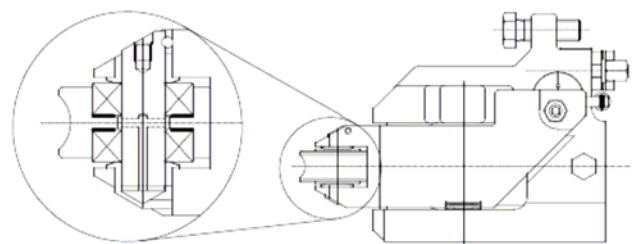


Figure 7. Roller assembly

This is the area that will be subject to further improvements in the future, to increase guide lifetime in the mill. In particular to further increase the speed, new bearing assembly will be necessary to resist to the extreme severe application. But once the bearing will grant

longer lifetime, the rollers will become the critical part of the application and therefore carbide or ceramic rollers need to be utilised.

Guide setting

Together with the increase of the speed also guide set up needs to be more precise. Computerised tools have been developed to precisely set up the guide in the workshop and to align it on the mill. The best tooling enable able to reach precision of $\pm 0,015\text{mm}$, about ten times better than standard optics working with the magnification principles.



Figure 8. Example of computerised setting device

Modern guides require more precise and quicker guide setting capabilities. Therefore they are studied to have both independent and central point adjustment. The former is utilised for quick macro setting, the latter is utilised to the last micro adjustment, opening and closing all the levers at the same time. Also vertical roller adjustment is requested for perfect setting, preventing therefore scratches or in the worst cases bar twisting.