

# PRODUCTION OF MECHANICAL GRADE PROFILES BY SLIT ROLLING<sup>1</sup>

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## SUMMARY

VAI POMINI Ltd. (Ashlow Guides) & Metalform Konsult have developed slitting technology a step further to be used for rolling 3/8" sharp edged squares and 3/8" plain rounds by 2-slit rolling. The material rolled was mechanical grade A-36.

This new development gave our client the possibility to use the cost effective Slitting technologies on a wide range of product and materials, the final product quality we achieved with our technology will open new markets for slitting applications. Previously, 99.9% of slit rolled product was re-bar.

The challenge with slit rolling is the torn edge, made when the two halves of a figure 8 are forced apart. In rebar rolling, a slight witness remains in the product, which is acceptable. But to roll a plain round and a good quality sharp edged square, the implementation necessitates a much greater control in the guide shop and in the mill than is required for single strand rolling plus strong design capabilities for guides and roll pass design.

**Key Words:** slitting, profiles, mechanical grade

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<sup>1</sup> Paper presentation at ABM Rolling Seminar, Joinville, SC / Brazil, October 2004

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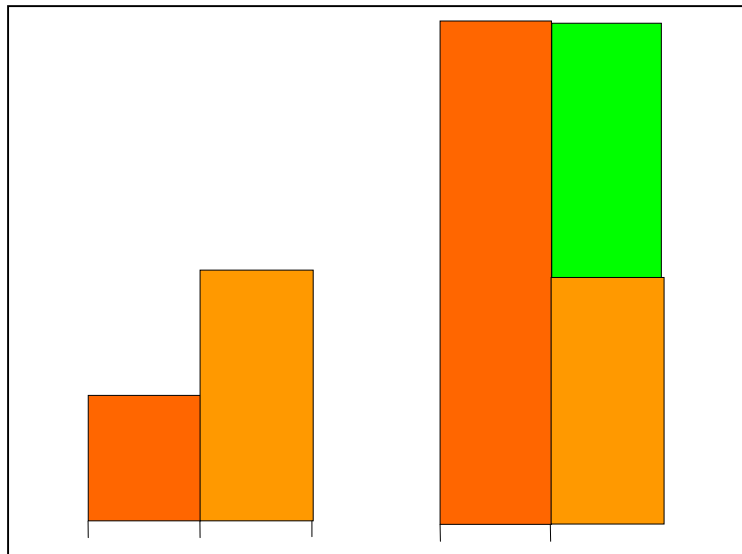
Introduction

Ashlow Guides (a VAIPOMINI company) & Metalform Konsult (MFK) have developed guides and roll pass design for rolling 3/8" sharp edged squares and 3/8" plain rounds by 2-slit rolling.

Previously, 99.9% of slit rolled product was re-bar. For this type of product the increased efficiency in rolling twice the amount of bars in the same length of time, sometimes utilizing less stands in operation that slitting offers, has been well documented by Ashlow in the past. (See figure 1)

Now we have developed slitting technology a step further giving to the clients and to slitting technology a new market opportunity making it applicable even for better quality products. In the paper we are going to show the application we have developed for our client In Mexico

**COMPARISON OF SAVINGS - SINGLE STRAND V 2 SLIT**  
**GRAPHS COMPARING TONNES ROLLED AND TIME**



**Figure 1-** Comparison of saving between a single strand production and a 2 slitting production

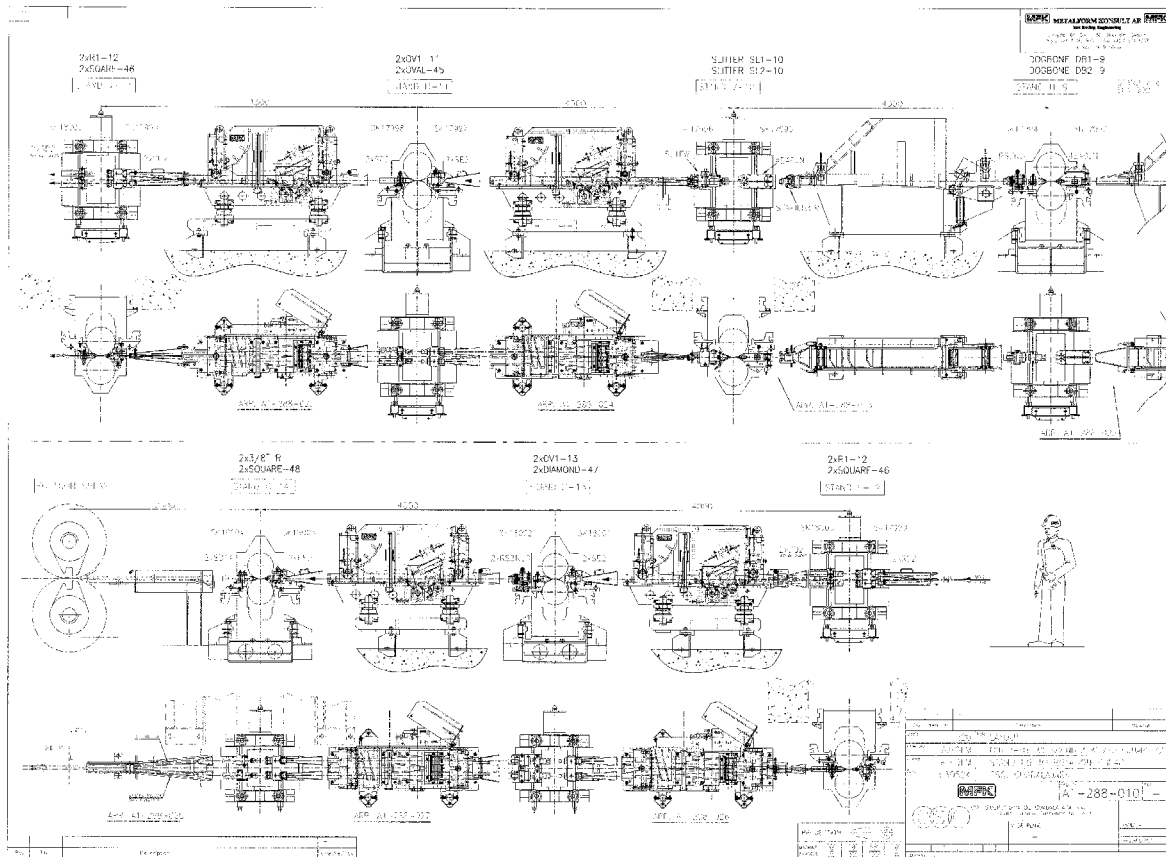
## Description of the plant

Cia Siderurgica de Guadalajara SA de CV (CSG) of the Grupo SIMEC is an ambitious client wanting to develop efficient rolling technology for mechanical grade A-36 steel billets, 160mm X 160mm X 8,000mm.

The plant originally supplied by SACK produced 18,000 tons per annum of 3/8" squares single strand. After modifications to the pass design, guides and inter-stand equipment the achievable target was increased to produce up to 50,000 tons  
The rolling programme also includes an additional 15,000 tons of 3/8" plain rounds and 25,000 tons of 3/8" rebar from 2-slit rolling.

The original mill layout (see fig. 2) consisted of the following:

### **V8-Loop-H9-Loop-V10-Loop-H11-Loop-V12-Loop-H13-Loop-H14**



**Figure 2- Plant Lay-out**

The Slitting process and the guides

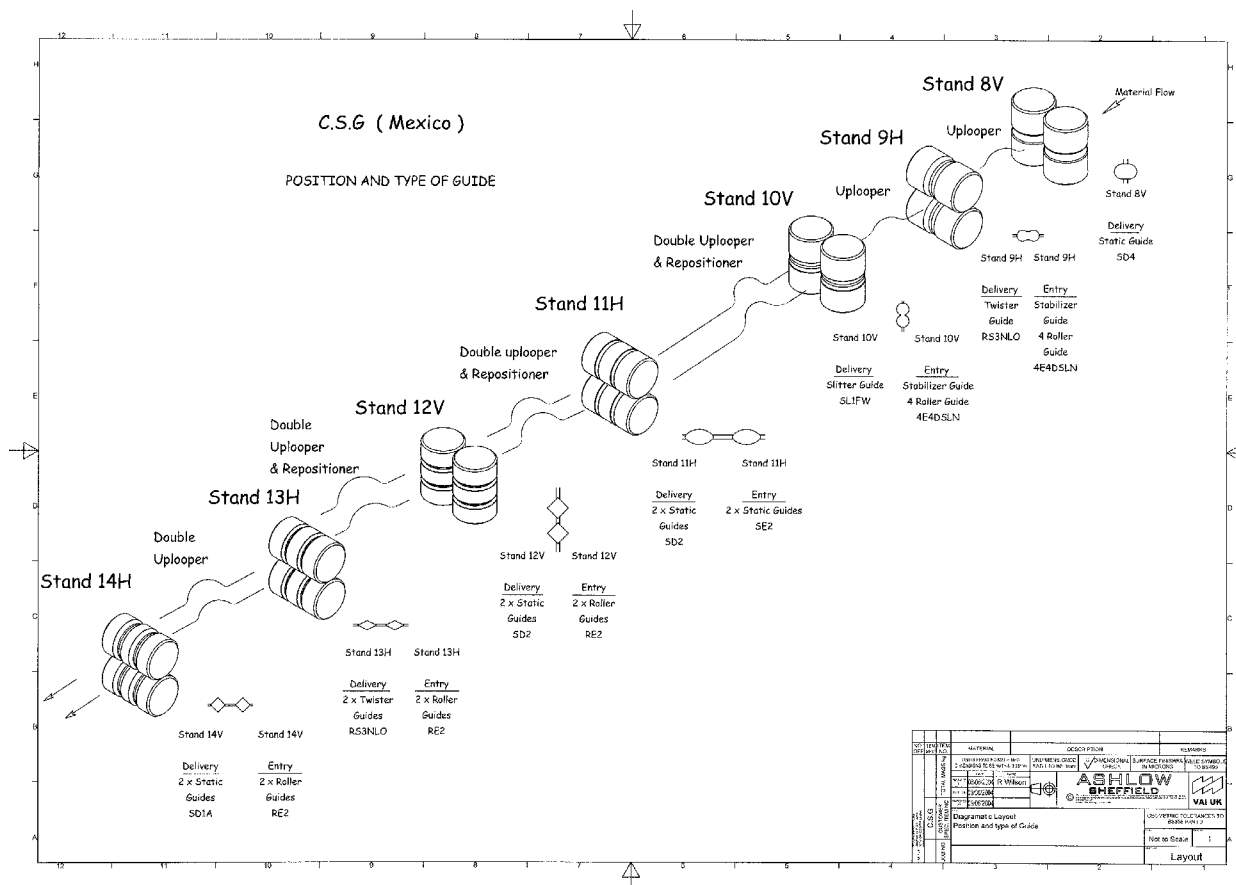
The most common problem with slit rolling is the torn edge, made when the two halves of a figure ∞ are forced apart. In rebar rolling, a slight witness remains in the product which is acceptable. But to roll a plain round and a good quality sharp edged square, an improved rolling technology has to be applied.

In the remaining part of this paragraph, the roll pass design and the overall process are described, in detail.

The roll pass design for the two products was implemented with the following sequence (see figure 3):

**Oval-Edge-Dogbone-Slitter-2xOval-2xRound-2xOval-2x3/8"Round  
Oval-Edge-Dogbone-Slitter-2xOval-2xSquare-2xDiamond-2x3/8"Square**

Both pass schedules have been successfully proven to remove the torn edge giving an acceptable quality round as well as the quality square with the sharp edges (produced in a special final pass).



**Figure 3- Roll pass schematic**

Process steps:

*Stand V8*

The width of the bar entering the dogbone is controlled in the edging pass in stand V8. It is very important to control the filling of the dogbone pass. Only with correct filling of the dogbone is it possible to maintain full control of the slitting process.

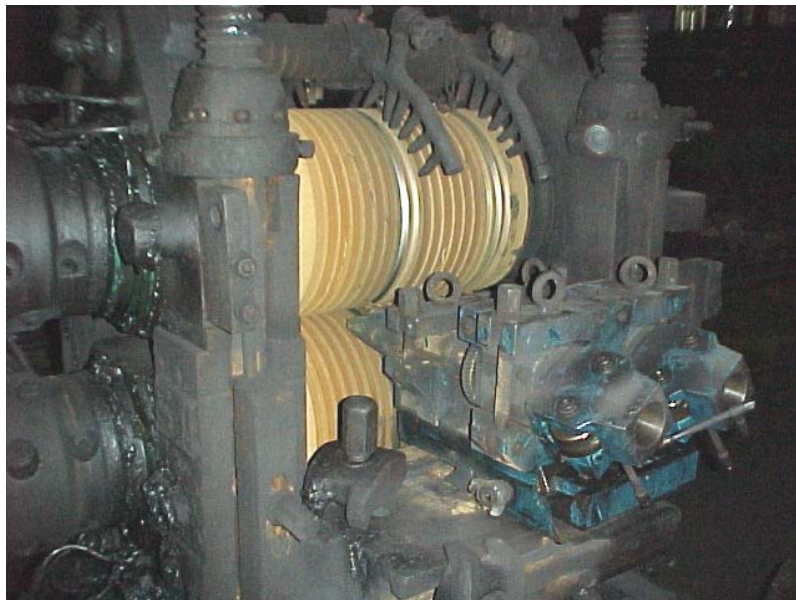
*Stand H9 (produces the dogbone)*

The Ashlow 4E4DSLN four roller guide is utilized in this position due to its rigidity and strength. Having single point adjustment and its major items manufactured in heat treated stainless steel, this guide guarantees rigid and positive four-point contact on the bar to ensure straight entry of the bar in the stand.

The reduced height front rollers and added nose-piece gives positive guiding further into the roll bite than is normally possible, preventing the bar from sticking to the collars of the shaped passes.

Fine pass adjustment of the guide across the roll barrel is incorporated into the guide adaptor plate and, together with the use of a specially designed setting bar, guarantees alignment of the guide to the pass.

The exit guide is a circular bodied cassette roller twister guide Ashlow RS3NLO mounted with rollers in the outboard configuration (See figure 4). The circular bodied design enables simple angular adjustment, and single point adjustment of the guide roller parting, about the pass line. A twister guide is necessary in this position since the dogbone has to be delivered to stand V10 in the vertical mode.



**Figure 4-** *Stand and RS3NLO twister guide*

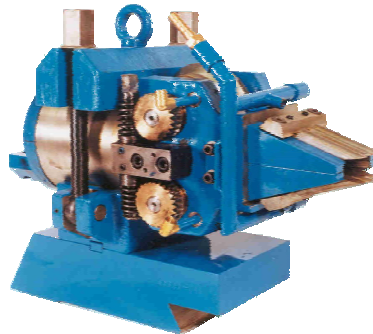
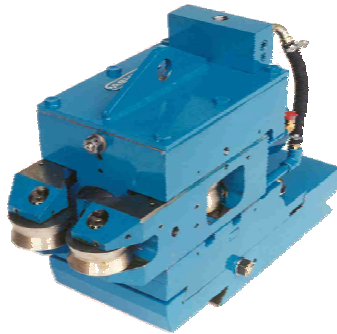
*Stand V10* (the slit rolling stand).

Again, on the entry side the Ashlow 4E4DSLN guide (see figure 5) is applied to ensure that the dogbone profile is entered accurately into the slitting pass ensuring equal weight in the slit bars. Fine pass adjustment is essential to set the guide accurately to the pass.

The entry guide on this stand is extremely critical in order to ensure that a tightly guided and straight bar is presented centrally into the pass. Weak guiding will prevent successful slit-rolling.

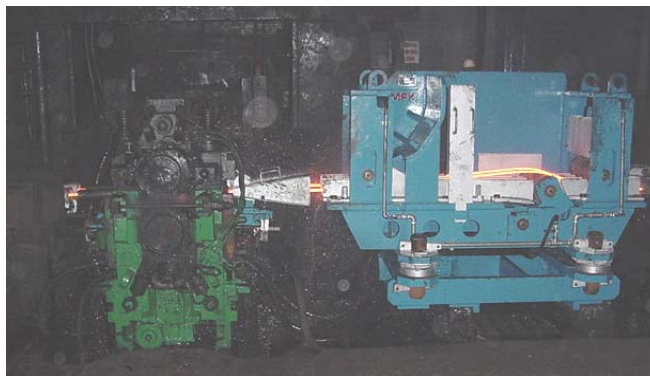
A pre-entry Ashlow Stabilizer guide is mounted at the exit end of the looper to give added guiding to the twisting dogbone and also to control the dogbone when a loop is formed in the looper.

The exit guide on stand V10 actually separates the single bar into two bars and Ashlow SL1FW slitter guide (see figure 6) is used for this purpose. Detail design of the rollers and nozzles is very critical in this guide to ensure a continuous and smooth slit rolling operation. This guide is extremely rigid and the use of 'Ashlite' materials offers critical long service life. Single point adjustment of the rollers about the pass line gives ease of setting and maintenance.



**Figure 5** - 4E4DSLN four roller guide    **Figure 6** SL1FW slitter delivery guide

Additionally, the two slit strands are repositioned from the vertical mode to the horizontal mode using pipes between the slitter guide and looper so that the entry of the two bars to the horizontal stand is smooth. A looper (see Figure 7) is necessary to ensure that rolling without tension is maintained to obtain accurate size control.



**Figure 7** - Looper

### *Stand H11*

The two slit bars are rolled into ovals. Simple circular bodied cassette type static guides, Ashlow SE2 on entry and Ashlow SD2 on delivery, mounted in twin strand guide holders, with fine pass adjustment, offers the most reliable guiding solution.

Now the ovals are repositioned from horizontal to vertical using open troughs to enter the vertical stand.

Up to this point in rolling, the previous steps were common for both rounds and squares, however, in the next steps we will detail the square only, although the same concept is applicable to the rounds.

### *Stand V12*

Two Ashlow RE2 cassette bodied roller guides enter the ovals accurately into the square passes of stand V12. The RE2 guide is manufactured from heat treated stainless steel to give long life and stiffness. Because the alignment of the guide in this position is very important to the success of slit rolling, optical setting equipment is employed to set the guide in the guide shop and ensure that the twin strand guide holders are set true to the passes after fine pass adjustment.

SD2 exit stripper guides, mounted in twin strand guide holders, strip the squares from stand V12.

Repositioning of the squares, as described previously for stands H11 and V12, is also required between stands V12 and H13.

### *Stand H13*

The RE2 cassette bodied roller guides are again set up in twin strand guide holders with fine pass adjustment to enter the squares into the diamond pass of stand H13. Since the final stand H14 is also horizontal the RS3NLO outboard twister/stripper guide is positioned at the exit of stand H13 to twist the diamond through 90 degrees. These twisters are set up in a twin strand guide holder arrangement and have fine pass adjustment.

Entry of the diamonds to final square passes in stand H14 is by RE2 roller guides similarly arranged to those on stand V12 and H13.

The final delivery stripper guide at stand H14 is the Ashlow SD1A guide. Hardened stripper inserts fixed to heavy wall tubular bodies mounted in a twin strand arrangement with fine pass adjustment on the guide holder gives long life and reliable stripping of final product.

A high quality square is produced through this pass sequence with no witness of the slit edge.

For smooth operation and continuous high production using the slitting process it is an advantage to have tension free rolling utilizing loopers between the final seven stands and a stable automatic loop control system. Although slitting can be performed without loopers, the onus on the mill operators to physically eliminate the tension and manually trim the speeds at each stand, in addition to the more intensive control of guide equipment and stock size necessary with slitting, emphasizes the advantages of an automatic system.

The Ashlow patented automatic dual-line air/oil lubrication system is strongly recommended for all roller guides and loopers in the slit rolling system. This guarantees trouble free operation of the guide and looper rollers and reduces maintenance time in the guide shop.

Due to the special roll passes used in slit rolling in addition to the special guides, it is most critical to ensure roll coolant is applied liberally and accurately to the wear areas to maximize mill roll and guide roller life and maintain a stable process.

### Conclusion

This project was unique in that it was the first time the process had been applied on mechanical grade steels. We also believe this now to be the only plant in the world consistently producing smooth rounds and small profiles in these grades of steel.

One of the main keys to the success of this particular project was the development of a specialized re-positioning guiding system, multi-strand loopers and interstand equipment.

In conclusion it may be said that the investment to introduce slit rolling to an existing mill is one of the few investments in a rolling mill which will repay the investment within twelve months.

Nevertheless, the implementation necessitates a much greater control in the guide shop and in the mill than is required for single strand rolling plus strong design capabilities for guides and roll pass design. VAI Pomini (Ashlow) in collaboration with Metalform Konsult (MFK) of Sweden are able to supply a complete package of design study, pass design, engineering, loopers, inter-stand equipment, guide equipment and commissioning to install slitting in existing or new mills.

The engineering, training and commissioning is an essential requirement supplied by the collaborators to ensure a smooth start-up and continuous achievement of the projected increased performance.



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The challenge with slit rolling is the torn edge, made when the two halves of a figure 8 are forced apart. In rebar rolling, a slight witness remains in the product, which is acceptable.

But to roll a plain round and a good quality sharp edged square, an improved rolling technology has to be applied.

Slitting takes place in the fifth from final stand in the same way as rolling rebar. For plain round, an oval / round / oval / round pass progression is satisfactory to remove the torn edge giving an acceptable quality round. An oval / square / diamond / square pass progression gives the quality square and the sharp edges are produced by a special final pass.

The material rolled was mechanical grade A-36 and customer was very pleased with the final quality helping him to develop new markets.

Since now 99.9% of slit rolled product is rebar, so this project developed slitting technology a step further giving to the clients and to slitting technology a new market opportunity. Ashlow Guides & Metalform Konsult are proud to have contributed to it.

VAI POMINI Ltd. (Ashlow Guides) & Metalform Konsult have successfully developed guides and roll pass design for rolling 3/8" sharp edged squares and 3/8" plain rounds by 2-slit rolling.

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