

## HIGH SPEED SHEAR: AN OPEX REDUCING SOLUTION FOR MANPOWER SAVING\*

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### **Abstract**

The patented HSS High-Speed Shear, 120 m/s on-line automatic cropping of wire rod un-cooled (or out-of-tolerance) head and tail-ends, is the solution to improve product yield, coil quality and reduce manpower for decreasing transformation costs in wire rod mills. With its unique design, it enables trimming and chopping performed at the same “single-pair” blade holders, through a single driving group.

The first shear generation was installed already in the '80s, followed by seven units in operation.

The HSS of the second generation started operating in 2002 at İçdasÇelik high-speed wire rod mill, Turkey.

Nowadays, Danieli supplied 32 units worldwide.

**Keywords:** High Speed Shear, Wire Rod Line, Opex Reduction.

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## 1 INTRODUCTION

The strong competition in global wire rod production requires steel manufacturers to come up with new solutions for the process, aiming to reduce operational costs (OpEx) at high productivity while maintaining, or even strengthening, operational robustness. Coil trimming before compacting is one of the fundamental operations that requires time and manpower, and that is necessary for each coil on the production line. The possibility of cutting the head and tail of the coil directly on-line with an automatic process makes it possible to have at least two fewer operators per shift.

On the other side, continuous productivity increase and wider range production require different compromise between the cutting of small diameter at very high speed (bigger than 115-120 m/s) and bigger diameter at low speed.

The first-generation Danieli wire rod cropping shear was originally designed, patented, manufactured and tested in the late 1980s. The experience gained in subsequent years, with seven units in operation and the continuous effort in technology development, led Danieli to design and successfully put into operation its second generation, High Speed Cropping Shear (HSS). The first shear of the second generation started operation at the beginning of 2002 at IçdasÇelik high-speed wire rod mill in Turkey. At present, the Danieli scorecard includes a total of 32 HSS units, supplied worldwide.

## 2 DANIELI HSS: EVOLUTION

### 2.1 HSS Second generation (2008 - 2013)

In recent years, Danieli has consolidated the performance of HSS (Second Generation) in wire rod line for products in the range of 5.5-16 mm, with a stable running up to 115 m/s of material speed. Maximum speed is one of the key points for achieving higher productivity with lower diameters.

### 2.2 High Productivity

The first step to increasing the plant productivity is to reach a higher maximum speed with lower-diameter bars. The new target speed for future implementation is 150 m/s while the intermediate step is 130 m/s. The combination of small diameter (5.5 – 6 mm) with higher speed creates high instability in an advancing bar, which is increased with not aligned conveying and equipment. HSS also has several elements that must be assembled together with their own tolerance; final alignment between entry and exit side of the shear is a combination of these.

### 2.3 High Range

The production of high-quality steel in wire rod is moving - in recent years - towards a wider range of product offerings. Larger diameters are requested up to 26 mm, with new rolling conditions also for shear dimensioning. Also, the requests for increased quality in tolerance for the final product led to different applications for HSS that could be foresee also in front of a Sizing Stand. By considering these new requests, the

range of applications of HSS moved from 5.5-20 mm to 4.5-32 mm, with some new specific items that must be considered.

### **3HSS 3<sup>rd</sup> GENERATION (2013 – PRESENT)**

#### **3.1 A new concept: The introduction of the Beam**

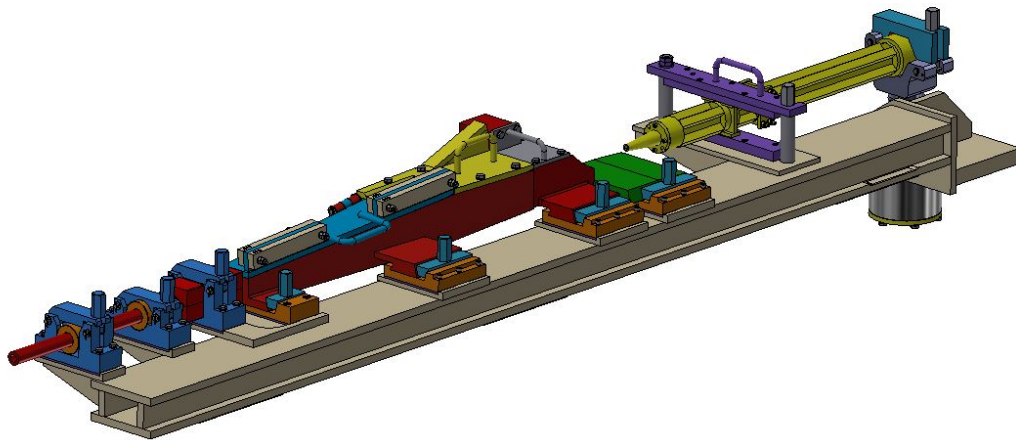
Shear equipment alignment is one of the fundamental points for increasing bar speed; each “deviation misalignment” is a potential cause of cobbles. The idea of a “gunmetal” for the line is a must.

The actual solution foresees several “independent” components that must be assembled directly on the shear foundation; mechanical references are machined directly on to the shear foundation to guarantee high precision but without any possibility of adjustment if higher precision is required (Figure 1).

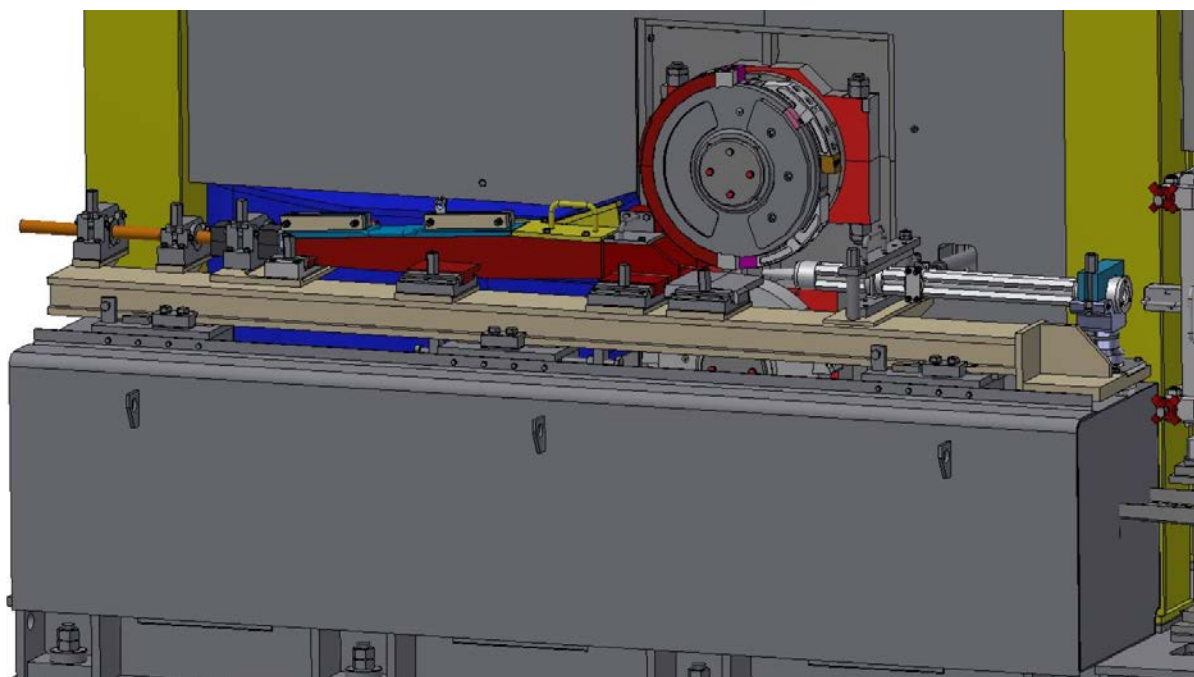
To guarantee the alignment, the shear equipment has been moved from the structural shear foundation to a separate beam (figure 2-3); the alignment of different conveying is done in the workshop where – by optical instrument – we can mount the different element with a higher precision. The beam is aligned on shear frame at the first mounting by machined reference and optical system; relative position between theoretical rolling axis (given by the equipment) and shear blades is fixed and guaranteed. For each beam repositioning (depending on the equipment setting given by product range) the mechanical references are the same and already fixed. At the end, each shear setting is “certified” by workshop activity and must be done off-line during rolling production.



**Figure 1.**HSS II Generation: equipment mounted directly on shear foundation.

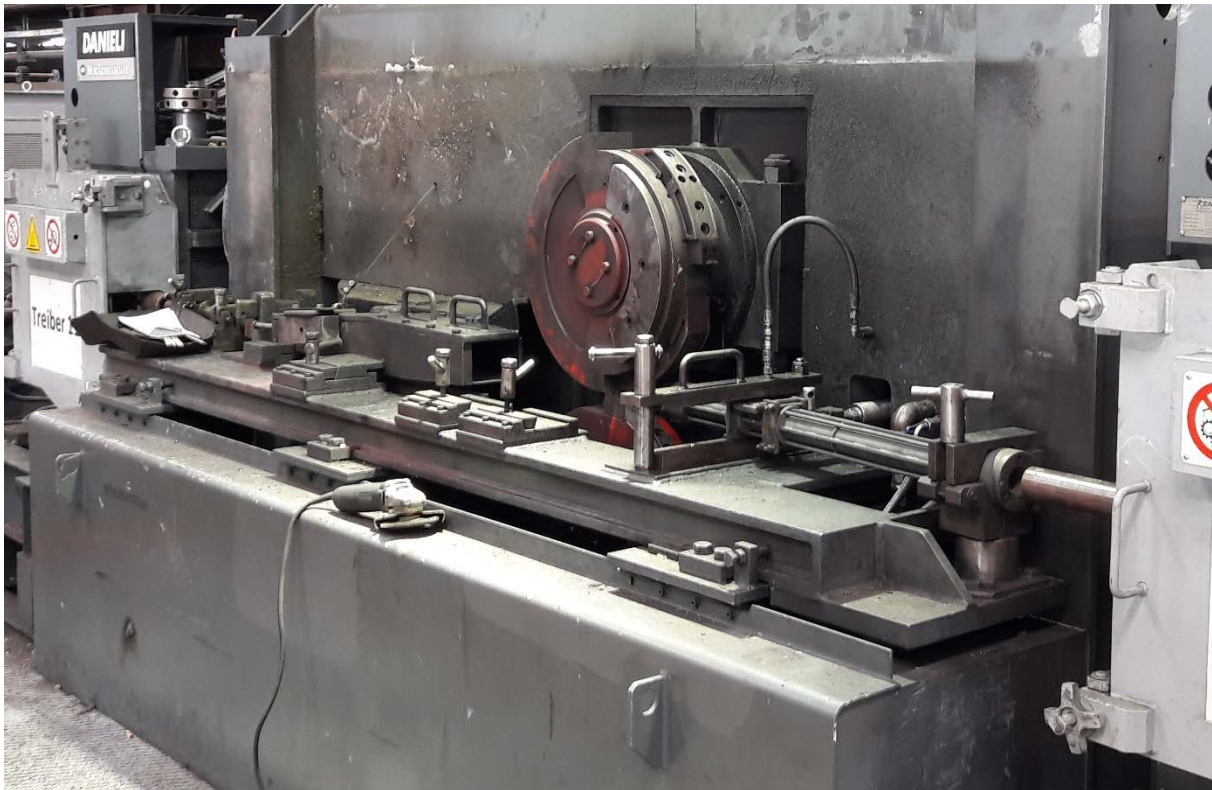


**Figure 2.**Equipment Beam Design



**Figure 3.**Equipment Beam mounted on shear structural foundation





**Figure 4.**The Beam application in a plant

This implementation was done for the first time at Ferriere Nord (Osoppo Plant – Italy), and reached the present wire rod line speed record of 126.2 m/s in October 2013 (Figure 4).

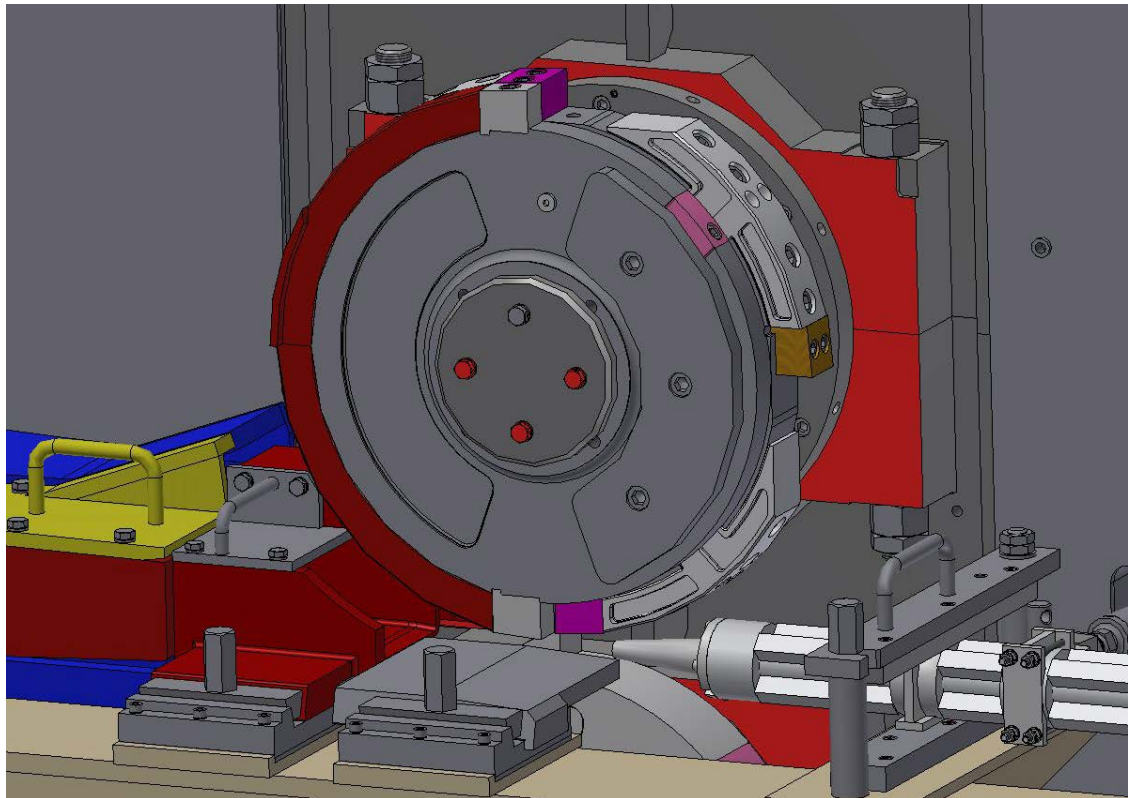
Also, the speed increasing, request dynamic movement that must be faster. To obtain this type of performance, a revision for material also was made in the diverter with a different solution to guarantee the structural behavior.

### **3.2 The New Blade-holder Solution**

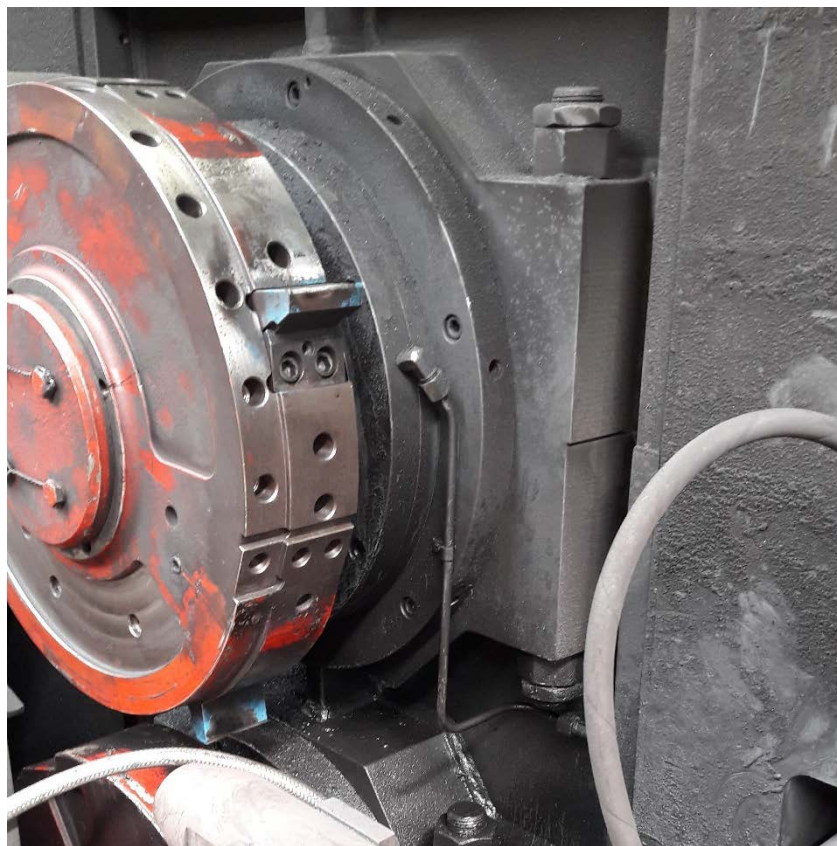
In recent years wire rod lines – especially for high-quality steel – have required a larger product range, up to 26 mm. for some applications, and so this kind of shear must be utilized in a wider range for cutting at the sizing entry side (up to 32-33 mm). The present HSS design allows a maximum bar diameter of 20 mm, and all the relative distances between guiding elements and blades are optimized for these. The concept of “fast” deviation between one position to another (time between blade is about 4 msec) is guaranteed by minimum distances and several cams that guide the bar toward the right position. Increasing bar size led to an increase of free space and distances that could have a negative effect on small and fast bar dimension.

To obtain the best compromise between the two different requirements, Danieli has developed a new blade-holder with different blade position and size. Several elements fixed by screws make it easy to change the configuration. A different guide and diverter concept has been done for larger sizes, and this configuration can be changed easily by the “beam”.

Due to high revolution speed, the blade-holder has been perfectly balanced for the two different configurations by positioning different counterweights in different positions.



**Figure 5.**HSS blade-holder in High Speed cutting configuration



**Figure 6.**HSS blade-holder in Low Speed cutting configuration

## 4 CONCLUSIONS

The wire rod market is continuously demanding higher productivity and larger-dimension bars; the Danieli High Speed Shear was developed to answer this request and the first results give Danieli the confidence that the design is a success. After the first two installations, two more customers in Europe will adopt this solution during the next year.

## REFERENCES

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