

## **What Role for the Z-High® in Aluminum Mills?**

In 2001, Jupiter Aluminum placed a contract with Sendzimir for a Z-High® mill. More commonly associated with steels, what is the Z-High® and what can it do for aluminum rollers?

In 1943, the United States was fully engaged in World War II. Armament production was essential, and the steel company Armco, in Middletown, Ohio, had been asked to find a way to roll 3.5% oriented-grain silicon steel down to 0.002 inch for the production of small transformers that would make airborne radar possible. Armco's engineers tried a number of different approaches, but nothing worked. Even the narrow 4-high mill with very small diameter sapphire rolls failed because the high lateral force caused the rolls to snap in the middle.

It so happened that a Polish inventor named Tadeusz Sendzimir was visiting Armco at the time. Sendzimir had a patent for the world's first continuous galvanizing line, and Armco, which had purchased Sendzimir's patent rights for the United States, wanted to commercialize it. Together, they succeeded. In fact, most of today's galvanizing lines are based on that original design.

But Sendzimir had more than one patent to his name, and one of them was for a machine and process that would roll very hard materials down to very light gauges. The design used the idea of the small work roll, something that Armco was well aware of, but it went much further because it transferred the roll separating force to the housing while supporting the load uniformly across the width of the mill and avoiding any lateral bow effects.

Sendzimir and Armco joined forces, creating the company Armzen, and in the process launched commercial production of the Sendzimir ZR mill. Eventually, Sendzimir set off on his own, establishing T. Sendzimir, Inc., and over the next 60 years, almost 400 ZR mills were sold worldwide.

### **The ZR Mill**

The Sendzimir ZR mill quickly established a reputation for being able to roll extremely hard materials down to very light gauges with tight control over strip flatness, production of an excellent surface finish, and almost nonstop performance.

The work roll was the key element. Its small diameter took a much higher total reduction than was possible with larger work rolls, such as those found on the 4-high, thus reducing the number of intermediate anneals required. It could be reground quickly to assure a very high surface quality. And its small diameter meant that harder tool steels could be used in its fabrication, thus also contributing to the superior surface quality of Sendzimir-roll strip.

The work rolls were also chockless, a feature unique to Sendzimir's design, thus eliminating the necessity to remove and install the chocks each time work rolls were reground. The quick roll changes gave greater control over strip quality; any flaw in a work roll could be almost instantly corrected; roll crown could be quickly changed.

## **The Z-High® Mill**

But one of the most significant patents of all those granted Sendzimir to date is the 67<sup>th</sup>; for the Z-High® mill. This one broke Sendzimir out of the hard-metal identity that had been a place of both superiority and limitation. It opened up the market for rolling softer materials such as carbon steels and brass, copper, and aluminum alloys. It also reached out to smaller capital budgets, for the Z-High® could be configured as an insert in an existing 4-high housing.

The secret of the Z-High® mill is twofold. It has incorporated all of the advantages and improvements discovered by Sendzimir over the last 60 plus years. But the work roll is slightly oversized. For example, if a 32-inch wide ZR mill has a work roll diameter of 55 to 38 mm, the corresponding Z-High® work roll would be about 89 to 73 mm.

This intermediate-sized work roll, being larger than the ZR mill but smaller than the 4-high, gives the Z-High® the ability to take significant reductions on materials such as aluminum alloys without being unduly concerned with skidding, which can be a limitation when rolling softer materials with small work rolls.

Consequently, aluminum rollers can obtain Sendzimir's light gauges, strip flatness, and brilliant surface quality, and do it much more flexibly, and with greatly reduced setup times, than would be the case with conventional 4-high or 6-high mills.

The other significant improvement inherent in the Z-High® mill is its optional configuration as an insert into a 4-high housing. For example, Jupiter Aluminum, in Hammond, Indiana, ordered a Sendzimir Z-High® insert to be retrofitted into an existing Blaw-Knox reversing 4-high stand. The ZR 67-32 will roll 32-inch wide aluminum alloys from 3 mm down to 0.2 mm. According to Mr. Dietrick Gross, Chairman and CEO, Jupiter Aluminum is confident that the Sendzimir retrofit will make good economic sense.

Sendzimir has now been granted 96 patents and does not appear to be slowing down. The object of current interest is continuous casting and the role of what may become a hot Z-High® mill. There are several places within a continuous process line where the Z-High® can be extremely useful. For example, it can produce very high value-added material at the end of the line because of its superior ability to control strip flatness, profile, and surface quality. In the case of harder alloys, it can be useful in the production of thin hot band because of its ability to take greater reductions per pass.