**Technical article**

**Producing spoke blanks by rolling instead of swaging increases throughput by a factor of ten**

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**The booming e-bike market has led to a growing demand for butted spokes, i.e. spokes that are thicker at one or both ends. AMBA’s new gauge reducing machines achieve throughputs of up to 40 pieces per minute in spoke blank production – many times over the rates achievable by conventional machines.**

The first two new-generation DD 350-II gauge reducing machines for spokes were supplied to customers in Asia. There they have been producing at the throughput rate of 40 blanks per minute as specified by AMBA. The machines achieve a roundness tolerance of two to three hundredths of a millimeter.

Compared to non-motorized bicycles, spokes for e-bikes are subjected to much higher loads due to bicycle riding becoming increasingly faster and more heavier-weight people practicing it. Especially during braking, the spoke ends connecting with the hub have to cope with increasingly higher loads and should therefore be made stronger. As the connection at the rim is not affected by the extra load, the rim ends of the spokes may still have the same diameter as commonly used in non-electric bikes. Consequently, there has been increasing demand for **single-butted spokes**, i.e. those with a thick end at the hub and the usual diameter of 2 mm at the rim. For wheel manufacturers these spokes provide the benefit that - while the spoke-hub connection becomes strong enough to accommodate the increased torque, they can still use rims of standard design.

**Double-butted spokes**, i.e. spokes with two thick ends, are predominantly used in high-end bicycles. The advantage of these spokes is that they save weight and reduce wind resistance.

Both spoke types have in common that the respective blanks cannot be manufactured by drawing or upsetting. Even swaging is not a viable alternative when spokes are to be produced in great quantities, as throughputs of just two or three spokes per minute have proved feasible in practice.

**The principle**

AMBA uses an entirely different concept: it reduces the gauge by servo-controlled rolling. Like all AMBA products, also the new DD 350-II gauge reducing machine is designed as an All-in-One machine. All production steps from the paying-off of the wire down the finished blanks are performed on a single machine.

First the wire is straightened in the roller straightener arranged upstream of the rolling unit (figure 2). Two servo-controlled ball screws actuate the clamping units on the slides which pull the wire through the various processing stages of the machine (figure 3). In the rolling unit, actuation of the radial movement of the two roll pairs, arranged at 90° relative to one another, is via servo-controlled actuation shafts (figure 4). While the first roller pair generates an oval cross-section, the second one achieves the round contour. As the wire runs through the rolling unit, the roll gap is adjusted to reduce the gauge of the blanks along their complete length down to the specified diameters.

Then the wire – now featuring sections of varying diameters – runs through the rotary straightener. Right after the straightener, it is cut to length. To produce double-butted spokes, the cut is made within the thicker section of the wire and, to produce single-butted spokes, the wire is cut in the transition from thin to thick gauge sections.

**The control system**

The machine is servo-controlled – a key feature that combines ultimate precision with highest user friendliness. All the operator has to do is enter the geometrical data of the spoke blank and the machine will automatically adjust all rolling parameters. This may seem simple, but here the devil is in the detail: changing one parameter – the roll gap, for example – has immediate effects on a great number of other linked parameter settings. Thanks to the digital controls, it is possible to adjust all parameters in a very short time to meet whatever the spoke manufacturer’s requirements are. The new-generation machines can be set up for a different product in less than ten minutes – a process that used to take several hours with older machines.

Also setting up the machine for different diameters has become much less time-consuming: instead of replacing each individual tool, the complete “tool module” is exchanged.

Now, as the first machines have proved their performance capability in practical bicycle spoke production, AMBA is working on a machine design capable of processing wire of up to 5 mm in diameter – for the motorbike industry as target market.

**750 words including the introduction**

Figures and captions

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| Fig. 1: Thanks to the high-speed slides of the gauge reducing machine, throughputs of up to 40 spokes per minute can be achieved.  File name: Amba\_IMG\_3690.jpg |  |
| Fig. 2: Before running into the rolling unit, the wire is straightened in a roller straightener.  File name: Amba\_IMG\_3551.jpg |  |
| Fig. 3: Servo-controlled ball screws actuate the slides that pull the wire through the various processing stages of the machine.  File name: Amba\_IMG\_3504.jpg |  |
| Fig. 4: Servo-controlled actuation shafts perform the radial movement of the two roll pairs positioned at 90° relative to one another.  File name: Amba\_IMG\_3494.jpg |  |
| Fig. 5: The new-generation machines produce double-butted spokes with a middle section of only about 1.5 mm in diameter.  File name: Amba\_IMG\_2867.jpg |  |

Photos by Aachener Maschinenbau GmbH

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**About AMBA**

Aachener Maschinenbau GmbH – generally referred to as “AMBA” – was founded in 1908, at a time when Aachen was worldwide famous for its high-quality needle production. The company has evolved into an internationally renowned builder of machines used to make cold-formed metal components.

Today AMBA specializes in machines for the production of long parts with varying cross–sections such as bolts between 60 and 2,500 mm long, tubes and spokes.

With its All-in-One design, AMBA is worldwide the only manufacturer of machines capable of producing such long and complex parts on one single machine. All process steps, from the input stock – wire or tube blanks – all the way down to the finished, packaged product, are handled by one machine, which is unique in the industry.At its headquarters in Alsdorf near Aachen, AMBA employs 80 people in its development and design departments, in the workshops and in after-sales service.