

“FUL” speed ahead to the perfect spring

The FUL series of spring coiling machines from WAFIOS meets the highest standards. In combination with a high degree of user-friendliness, the machines are designed with maximum productivity and quality in mind. The models that end in a "6", which include the new FUL 166, represent the latest stage of development and feature cutting-edge mechanical systems and control technology. There were previously seven models available, covering spring wires ranging from 0.12 to 8 mm: FUL 16 to FUL 86 (see Fig. 2). With the recent addition of the FUL 166 for wires from 6.1 to 16 mm, WAFIOS is significantly expanding the upper end of the range. The features are largely identical to those of the smaller sister models.

Wire is transported via feed rollers with pneumatic clamping for all machines - the FUL 16 is the only model where the operator carries out clamping manually using spring assemblies. The larger the machine or the wire diameter, the more feed rollers are used (FUL 16 to FUL 46: 2 pairs, FUL 56 to FUL 86: 4 pairs). The pneumatic contact pressure can be adjusted on the screen for each pair of rollers. This concept makes it possible to achieve feed speeds of up to 220 m/min. The lack of hydraulic systems here offers a major advantage: Pneumatic components require significantly less maintenance. As a result, the cutting and coiling unit has also been designed without the use of hydraulics.

The FUL 166 is the first WAFIOS spring coiling machine with 6 pairs of feed rollers. The full complement is, however, only required for wires with a thickness greater than 14 mm. For thinner wires, the machine fitter equips the machine with fewer rollers as is appropriate. "There are two possibilities as far as the number and design of the feed rollers are concerned," explains Andreas Sigg from the design department at WAFIOS. "Either fewer pairs with a large diameter, or more with a smaller diameter. Large rollers are heavy. In order to make handling as easy as possible, we decided on six pairs of rollers that were smaller in diameter."

In addition to the new FUL 166, other WAFIOS models available for the production of suspension springs are the FUL 175 model (up to 17 mm), FUL 183 (up to 18 mm), and - as the largest suspension spring machine to date for up to 20 mm oil hardened and tempered wire - the FUL 203.

Easy handling

The feed rollers are fixed to their shaft in two ways: via positive locking with three driving pins and via force locking with a preloaded central nut. In the event of wear or if the spring wire thickness is changed, it is extremely easy to carry out the necessary modifications.

Keeping the (dis)assembly work to a minimum is a design principle that runs through the entire machine. This also applies to the slip control, for example, which only needs to be moved out of the work area rather than being dismantled. The basic idea is clear: minimize changeover time to maximize machine availability.

The machine safety concept is perfectly in line with this principle, simultaneously providing high accessibility and the best possible protection for operators. The protective hood opens electropneumatically. The lower protective cover can be used in three positions: on the far left for access to the coiling and cutting unit, on the far right for access to the feed rollers and cutting unit, and in the center for production operation.

Numerous options

The FUL 166 is a real powerhouse - it has to be, with wire thicknesses of up to 16 mm. The infeed force can be increased to such an extent that even the smallest of spring indexes can be realized. Whenever extreme forces are involved, stability is an absolute must. The entire modular machine assembly complete with infeed and coiling body is therefore connected to the base. A crossbeam also serves to increase rigidity. Furthermore, the shape and cutting slides have been designed in a particularly robust manner. The mandrel box now features exchangeable wear plates, which significantly increases the service life.

The FUL x6 machines provide eight CNC axes as standard, covering both the basic functions and options to suit customer requirements: infeed, cut, vertical pitch, parallel pitch, height adjustment of mandrel slides, mandrel displacement, and shape/coiling unit (2 axes). Additional axes can be installed on most models, for example a 4-axis coiling unit (2 axes), a spring leg unit, or a 3D former for complicated torsion springs, or alternatively a PTP coiling finger (2 axes) for varying the spring pitch. The FUL 166, however, is not intended for torsion springs; this option is only available for the smaller models.

In order to cut the wire to size, the FUL 166 offers the straight cut and the additional torsion cut variant. This is still possible if the spring index is tight ($w_m < 4$) (mean spring diameter/wire diameter), however it does require a CrSi spring steel with a certain brittleness. With the additional scoring functions - a WAFIOS patent - torsion cutting is possible even with a value of $w_m > 4$. The scoring process uses a carbide-tipped, CNC-controlled mandrel. Torsion cuts leave behind burr-free, almost flat cuts that are perpendicular to the wire axis, which is an advantage for some applications.

The machines also meet high standards when it comes to quality control. This task is entrusted to the WAFIOS Vision System (WVS). The springs produced are measured in terms of length and diameter using a camera and backlight during production operation and the process is regulated. The system also controls the sorting of the springs.

Programming made easy

The programming of the different functions and axes is left to the high-end programming system WPS 3.2 EasyWay. The name speaks for itself: User-friendliness and easy learnability were key priorities during the development phase. Entering a spring for production is an intuitive process, no matter how complex the structure may be. In the case of chassis springs, for example, the pitch may vary, the spring axis may be bent, a cone or barrel shape may be required - everything is possible. The system supports the programmer step by step by suggesting prefabricated form elements and querying parameters until the desired spring type has been specified and the program can be calculated. The hardware is selected accordingly. It consists of a new console trolley with PC and 24" multi-touchscreen, which can be operated via touch gestures like a smartphone. It also includes a hand-held operating device, which is also equipped with a touchscreen for precise selection of all functions during set-up operation.

Further control-related highlights are provided by the *iQ* functions, which are available as options. These allow productivity and performance to be further optimized (see Fig. 5). An OPC UA interface is also available as an option, enabling modern digitization scenarios to be realized in the context of Industry 4.0. Last but

not least, a VPN Connect interface provides secured external access to the control system, allowing maintenance work to be performed remotely if required.

iQ software functions: That certain something for the control system

The **iQautopitch**, **iQbestspeed**, **iQcockpit**, and **iQcontrol** functions are available for the FUL-x6 product line. This enables a further improvement in terms of both productivity and quality.

iQautopitch:

If an existing spring is to be produced again, it must be measured and the spring coiling machine adjusted accordingly - often a time-consuming task. **iQautopitch** automatically calculates the parameters to be set for the pitch and diameter using the measured values and saved reference springs. In some cases, this can reduce machine downtimes considerably.

iQbestspeed:

Calculates the optimum operating point and production speed of the machine. The optimum quality in spring production is achieved at a particular coiling speed. The software varies the processing speed for several springs and finds the optimum setting fully automatically.

iQcockpit:

Enables the machine to be monitored using a mobile device (smartphone, tablet, etc.) via WLAN or UTMS irrespective of location. This ensures constant access to the production data.

iQcontrol:

Monitors the spring length using a dual camera system - even during the production process. Deviations in length occurring during the coiling process are immediately communicated to the control system and are then corrected. The variation in length is reduced so that no springs with in

correct length are passed as acceptable parts.



Fig. 1 The FUL 166 spring coiling machine is the latest high-end model from WAFIOS for wire diameters from 6.1 to 16 mm. Right: The central control system consists of the console trolley with PC and WPS 3.2 EasyWay programming system, a 24" touchscreen, and a hand-held operating device.

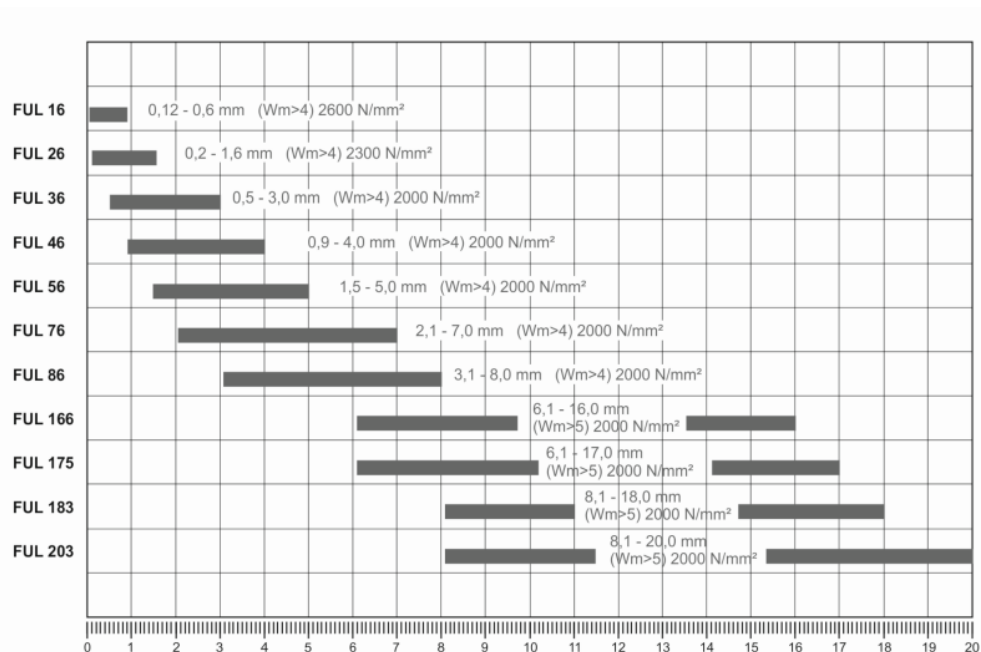


Fig. 2 Overview of the FUL spring coiling machines from WAFIOS and the ductile wire diameters

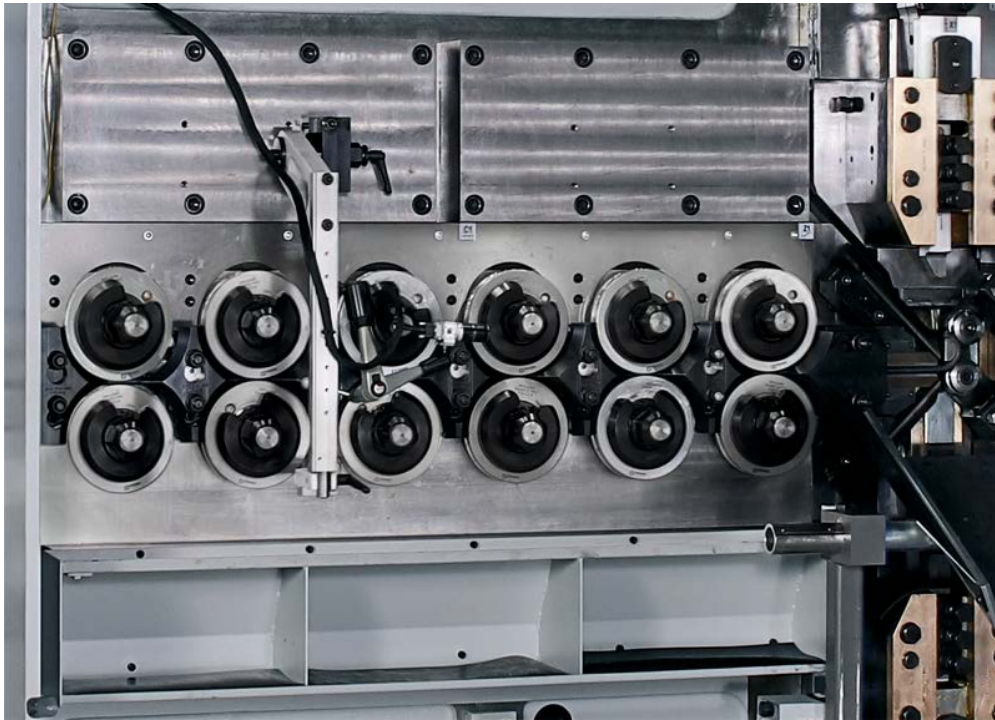


Fig. 3 The FUL 166 is the first spring coiling machine from WAFIOS with six pairs of feed rollers. Far right: cutting device and PTP coiling finger.

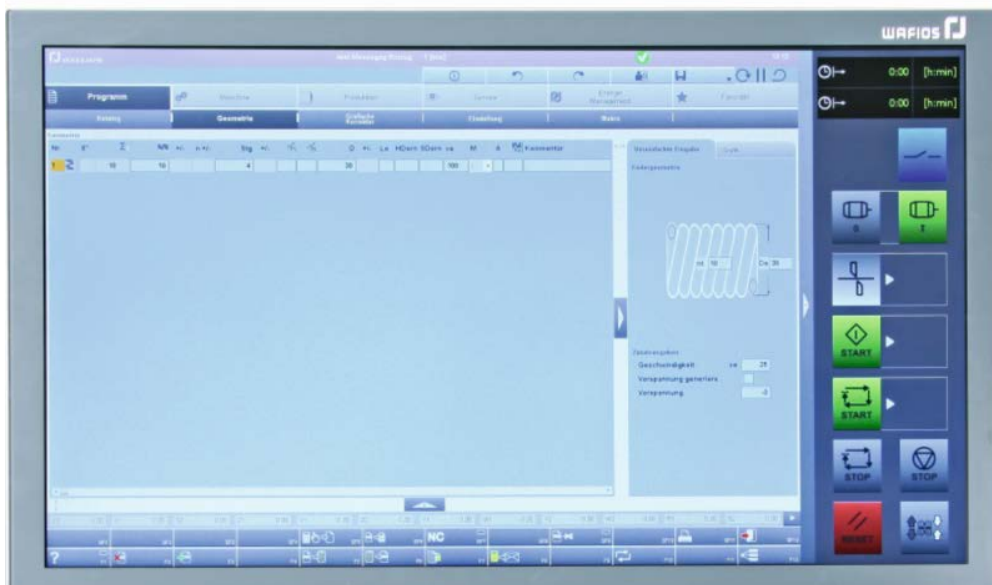


Fig. 4 The intuitive WPS 3.2 EasyWay programming system effortlessly guides the operator through the steps required to achieve the desired spring type. The large 24" multi-touchscreen also contributes greatly toward safe and reliable operation.

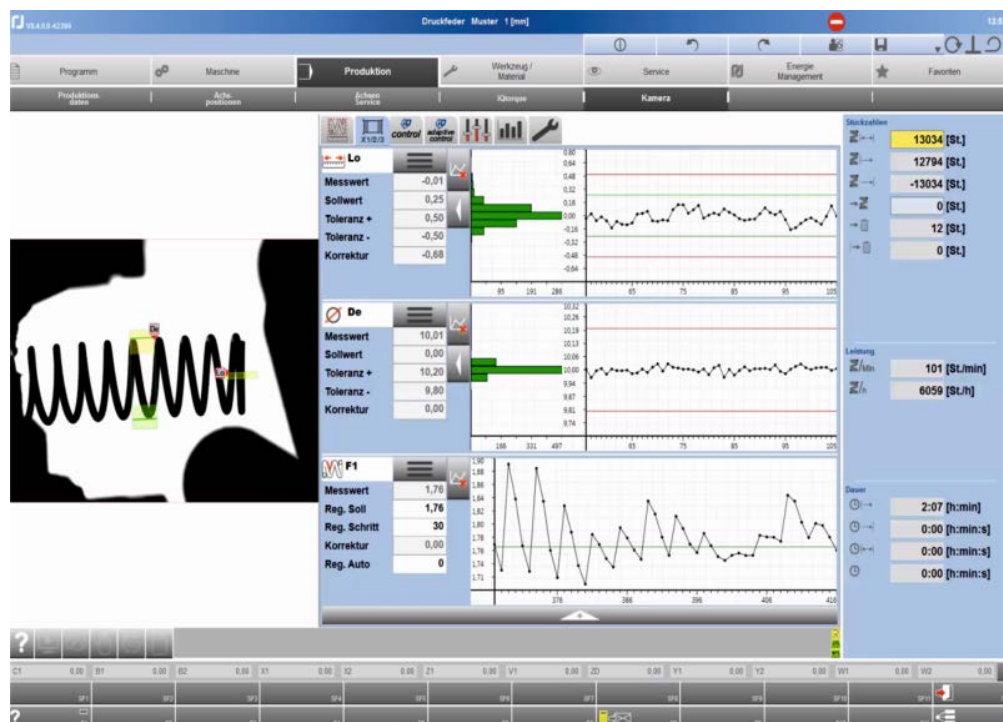


Fig. 5 Interface of the optional iQcontrol system that, together with the WVS camera system (WAFIOS Vision System), monitors the spring lengths during the production process.