

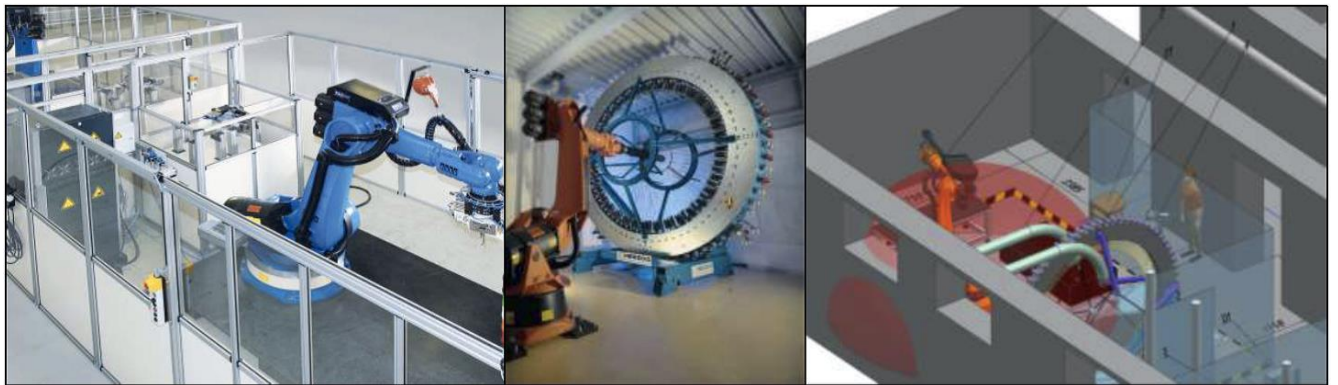
# TECHNICAL DATA SHEET

## SK1BS9ACHS

**Automated complex for creation of dry one layer and multilayer preforms**

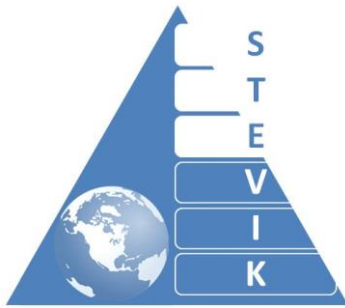
### ► DESCRIPTION

Unique automated complex for braiding, tufting and ultrasonic cutting of dry preforms consists of multi-axial manipulator designed on the basis of KUKA robot and radial braiding machine automatically controlled modules. The unit does not have analogs worldwide and it is used for preform manufacturing in aircraft, aerospace and automotive industries.



### ► EQUIPMENT CAPACITIES:

- Braiding of one layer and multi-layer preforms of round cross section with different diameter, thickness and length,
- Manufacturing of one layer and multi-layer preforms cone shaped section of different diameter, thickness and length,
- Manufacturing of hollow preforms of complex shape braiding method with preset parameters of mandrel surface area and angle of fiber placement relative to mandrel axis,
- Manufacturing of multi-layer preform with rectangular section and cone shaped profile,
- Radial braiding of carbon, woven or aramid fibers on a mandrel fixed by clamp system of manipulator of variable section and curved shape,
- Multi-layer braiding on a mandrel due to multiple feed of a mandrel at braiding zone,
- Braiding with preset parameters of mandrel surface area and of angle of fibre placement relatively to mandrel axis,
- Braided sleeveings with uniform section made of carbon fiber,
- Braiding of flat triaxial fabrics,

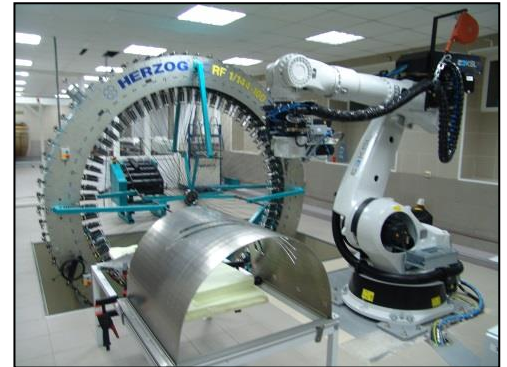


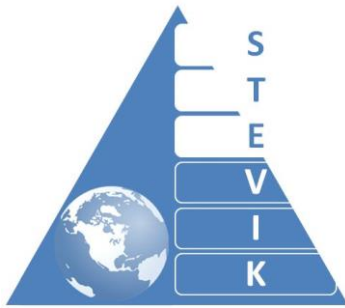
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- Stitching of multilayer preforms in transversal direction over double curved surface,
- Manufacturing of multi-layer complex preforms cylinder shaped with further stitching by tufting method using different thickness,
- Connection of separated sub preforms in one complex three dimensional preform by one side stitching method,
- Additional lateral reinforcement with aramid fibers of complex preforms, made of carbon, fiberglass or organic fabrics, having irregular shape,
- One side lateral stitching with aramid fibers for creation of local reinforcements in complex three dimensional preforms,
- One side lateral stitching of multilayer preforms long curved space line to form bending line,
- One side stitching of three dimensional multilayer preforms with aramid fiber to create permanent local seal areas to guide resin flow during preform impregnation,
- One side local stitching of three dimensional multilayer preforms to create crack stoppers,
- Quilting over the surface of three dimensional preforms for layer compression to achieve defined thickness,
- Lateral reinforcement of foam fillers of aircraft three dimensional form by tufting technology,
- Carrying of single thread seam with one-needle yarn, which enters material upside with two needles,
- Lay out and cutting along the outline of one layer and multilayer preforms.





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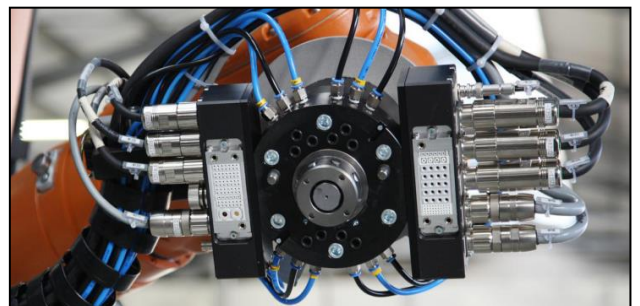
### ► COMPLETENESS OF SET:

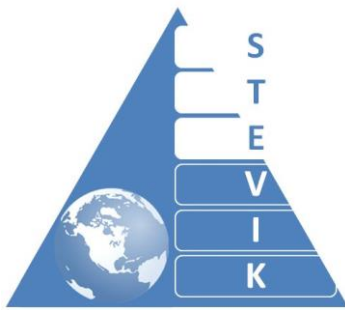
Following elements and blocks can be supplied, depending on aims and demands for process standardization:

- Multiaxial manipulator with CNC with safeguard and booster frame
- Automatic tool swapping device, mounted on manipulator
- Head of one side stitching for blind stitch
- Head of one side stitching with tufting technology
- Biangular head
- Head for ultrasonic cutting
- Roving winding workstation for bobbins of tufting heads
- Tool set for automatic head swapping
- Device for automatic swapping of stitching heads
- Radial braiding machine with CNC
- Vibration stimulator for braiding concentration
- Carriers for carbon and fiberglass roving
- Carrier base unit for fast change system
- Braiding carriers for carbon and fiberglass
- Multi-roller take-off
- Manipulator kit to connect to braiding machine
- Semi-automatic bobbin winder
- Creel for carbon roving
- Creel for fiberglass roving
- Specially developed software

### ► MULTIAXIAL MANIPULATOR

Manipulator has 9 controlled synchronized axes, provides working with tufting head and is adapted for mandrel replacement during braiding machine function. Unit provides automatic change of tufting and cutting heads from tool set in 60 sec. Electric and pneumatic system connections run in pre-set automatic mode without operator assistance.



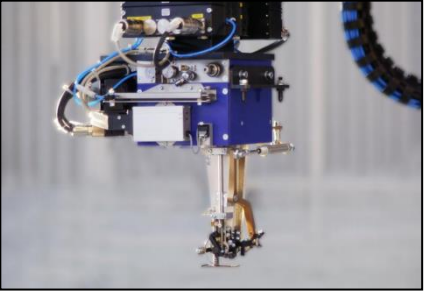
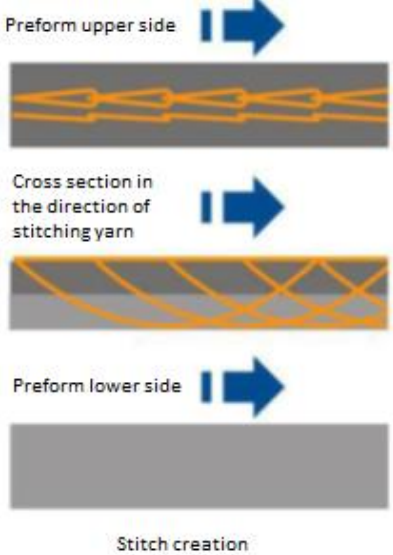
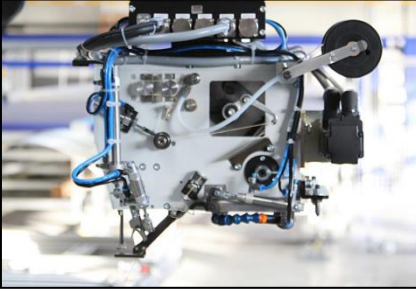
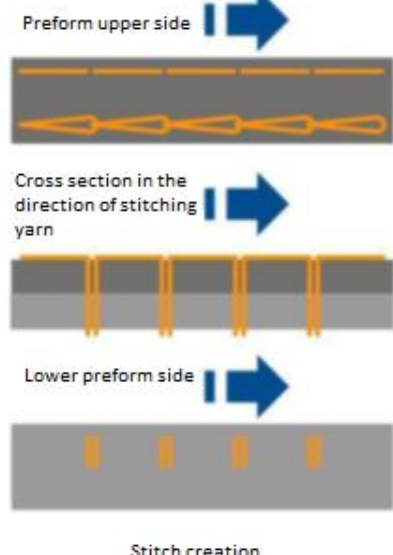


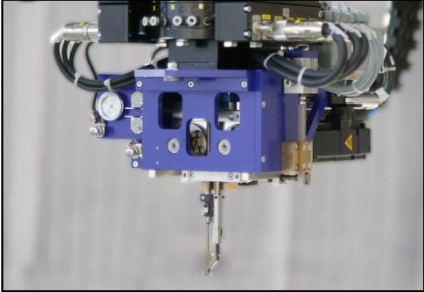
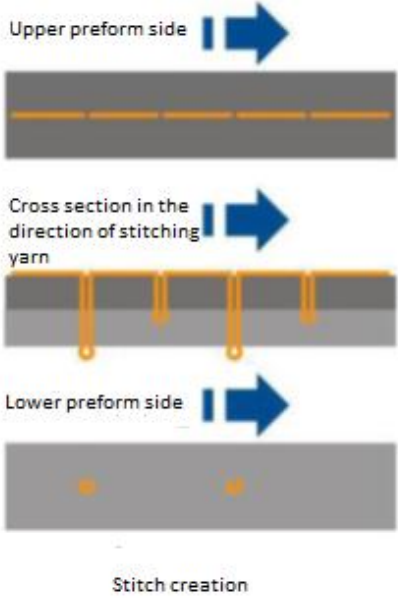

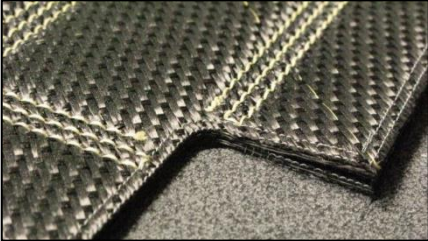
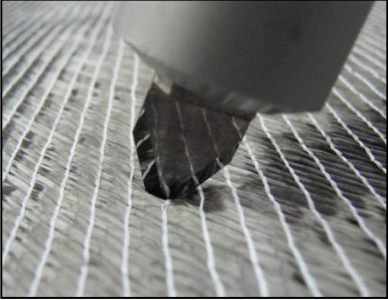
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Manipulator positioning accuracy is  $\pm 0,06$  mm. Manipulator frame provides increase of manipulator access range while ergonomic high of manufacturing for operator is 910 mm.

<p><b>Head of blind stitch</b></p> 	<p>Stitch forming with one special yarn and one curved needle during one pass without needle penetration into a base. Stitch type – upper side thread chain plus additional chain.</p> <p><u>Examples of usage:</u></p> <p>Connection of separate sub preforms (for example skin stringers) in one complex three dimensional preform.</p>	
<p><b>Two needle head</b></p> 	<p>Single thread chain stitch seam is formed with one single needle thread, which is brought into the material by one curved needle from the top side of the material.</p> <p><u>Examples of usage:</u></p> <p>Quilting over the surface for layer compression to achieve defined thickness;</p> <p>lateral reinforcement with fibers of complex preforms, having irregular form;</p> <p>one side local stitching of multilayer three dimension preforms to create crack stoppers.</p>	

<p style="text-align: center;"><b>Tufting head</b></p> 	<p>Stitch is formed by single yarn method with straight needle without interlace using a pad, at which the needle penetrates. Penetrating into material, the needle inserts the thread forming a loop at the lower end of the needle position. The loop can be placed either within or outside the material.</p> <p><u>Examples of usage:</u> Reinforcement in transversal direction with pre-set angle of reinforcement;  Reinforcement of foam filler aircraft multilayer three dimensional panels.</p>	
<p><b>Ultrasonic cutting head</b></p> 	<p>Layout and cutting of multilayer three dimensional preforms</p> 	

► **BRAIDING MACHINE**

The unique braiding machine of radial type is made by «August Herzog Maschinenfabrik GmbH & Co. KG». Dedicated for carbon roving in horizontal version (preform is braided in horizontal direction), braiding machine is used to overbraid component parts and for sleeving, as well as for flat triaxial fabrics made of carbon, fiberglass or aramid roving. The machine is unique in the class of braiding machines and does not have analogs worldwide.



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Construction, control system and software provide machine operation with separate multi-roller take-off and multiaxial manipulator on the base of robot type KUKA according to programmed algorithm.



Radial braiding machine type with 128 carriers



Radial braiding machine type with 144 carriers with multiaxial manipulator

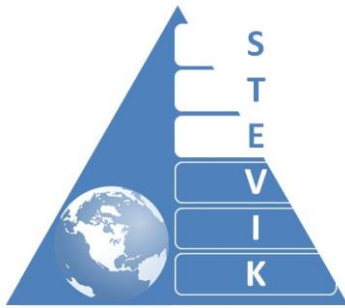
Quantity of braiding carriers, moved by horn gears during braiding, is defined by customer depending on a size and complicity of preform manufactured and can vary from 48 to 288.

Braiding body is a segment construction. Carriers' axes are directed toward machine center, and carriers' axes for warp threads roving are directed along machine axis. Warp threads can be placed on the original bobbins, without using of carriers.

Roving stretching during braiding is under control, horn gear actuator is realized by gear wheel. Rotating of horn gears is made by electric motor.



Handling of braiding machine is performed by PLC. Electric control box is free-standing with carbon dust protection and its electric lines length supplying the machine is 25 m. The machine is equipped with separate electric box cable with length of 25 m. Software of PLC, multiaxial manipulator and multi-roller take-off is interlinked.



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Machine control system is setup according to the following parameters:

- Speed of horn gear rotation;
- Braiding gauge;
- Braiding diameter.

Speed of horn gear rotation is infinitely variable in the range of 50 rpm to 150 rpm. The machine is provided with a carrier positioning unit for easy bobbin exchange.

Braiding machine and take-off function provides braiding angle accuracy for fiber from axis  $\pm 1^\circ$ , by gauge  $\pm 0,5$  mm;

Range of braiding roving angle to the axis relative to mandrel depending on machine model can vary from  $25^\circ$  to  $85^\circ$ , ignoring angle of wrap roving.

All yarn guides are particularly suitable for carbon fiber yarns.

Braiding compaction for one pass of mandrel with diameter of 150 mm is 95% of mandrel surface without using of warp thread feed.

The machine can be equipped with standard attachment equipment at customers' option:

- polished braiding rings with different diameter;
- set of braiding bobbins;
- set of tension springs for roving.

### ► NOTE

Please contact us for more detailed information as well as for system development according to your technical specification.

Standard warranty period: 12 months.