Technical specification for weaving machine of carbon fibre production line

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Introduction

The machine is designated to form cloth from precursor tows within the framework of CF production from PAN fibre.

Raw material characteristics

Raw materials: PAN-tows with filaments from 3000 to 54000 (3K-54K), linear density of filament is 0.08-0.17 tex. 
Table 1 contain source data, which the Vendor has to use to calculate width of operating zone.

Source data for calculation of operating zone

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovens operating zone, (mm)</td>
<td>~3000 (machine maximum operating zone is defined by Vendor from any of typical solutions to provide operation of line filled in with any of tow types listed below, operating zone should be in the range of cloth)</td>
</tr>
<tr>
<td>Filaments per tow, (K)</td>
<td>3 6 12 24 48 54 12</td>
</tr>
<tr>
<td>Estimated gap between PAN-tows in an oven, (mm)</td>
<td>1.5±0.3 1.5±0.3 1.5±0.3 3±0.3 4±0.3 4±0.3 1.5±0.3</td>
</tr>
<tr>
<td>Gap between PAN-tows in an oven, estimated (center-center)</td>
<td>3.0±0.3 4.5±0.3 7.5±0.3 15.0±0.3 28.0±0.3 31.0±0.3 7.5±0.3</td>
</tr>
<tr>
<td>Number of tows</td>
<td>~1000 ~667 ~400 ~200 ~107 ~97 400</td>
</tr>
<tr>
<td>Operating hours per year</td>
<td>7200 7200 7200 7200 7200 7200 ~7000</td>
</tr>
<tr>
<td>Distance between tows entering furnace (center-center)</td>
<td>7.5±0.3 7.5±0.3 7.5±0.3 15.0±0.3 28.0±0.3 31.0±0.3 7.5±0.3</td>
</tr>
<tr>
<td>Number of tows (1-st step)</td>
<td>400 400 400 200 107 97 400</td>
</tr>
</tbody>
</table>
3. Process description
Bobbins with precursor mounted on the creel. Fibre unwound and pulled under tension through weaving machine operating zone, where free weft yarn is inserted, 3K, distance 50-100 cm, to form plain weave with specified width. After that the cloth is delivered to oxidizing system.

4. Equipment
4.1 Rapier waving machine
Controlled positive centre weft transfer and open shed weft insertion, dobbý for 6 harness drive units, provided for the production of technical fabrics.

Nominal width 310 cm
Maximum usable reed space 301 cm
Minimum usable reed space 222 cm
Maximum mechanical speed
- at maximum reeded speed 240 rpm
- at minimum reeded speed 275 rpm
- Operating machine speed 180 rpm

4.2 Machine support
Single machine footing 80 mm., horizontal.
Elastic mounting pads Sylodamp type.
Shock absorbers to eliminate vibration (EWL with electronic control).

4.3 Back rest assembly
Back rest roll assembly continuously adjustable in vertical and horizontal direction by means of scales.
Back rest roller made of steel tube 125 mm.
Back rest roller surface is matt chromium plated.
Springs, 5 mm, left and right side.
Chromium plated oval tube 40x20 mm in order to support absolute tension sensor.

4.4 Shedding
Rotary dobbý STAUBLI 2668/2 12/6
Electronic high speed rotary dobbý with non-requiring maintenance oil bath lubrication.
Compact monoblock housing with positive harness drive via toothed belt. Control unit with magnet block for electronic functions.
Floor mounted on RHS seen from weaver stand for user-friendly access from the top.
Dobby housing for 12 rotors maximum
Pitch 12 mm
No. of rotors installed 6

Universal undermotion type for positive harness drive. Automatic lubrication of needle bearings connected to central lubrication system.
Weaving machine equipped with 6 undermotions consisting of 3 sets of harness levers in 12 mm pitch.
Push rods for harness frames with STAUBLI DRC snap closures.
Individual shaft guidance.Heddle length: 331 mm.
Heald slide bar: Type TRA-J, 16 x 2,1 mm

4.5 Weft insertion
Electronic weft stop motion ELTEX, to control single weft insertion during the whole insertion phase. Function of detection and elimination of unwanted double picks,
Electronically controlled weft tensioner EFC type with stepping motor, chromium plated.
Weft pitch: 50-200 cm.
Range of speeds shall provide capability to insert weft with required pitch at tow speed equal to 9 m/min.

4.6 Weft presentation
Waste saving device, for weaving without catch salvages.
Suction nozzle for pic-a-pic insertion. Electronic colour selector (ECS) with stepping motor.
Point feed for fine coarse yarns.
Weft insertion from LHS.
Positively controlled tip-to-tip centre transfer to ensure accurate and gentle weft handling.
Multiple pick insertion possible. (Shed remains open during complete insertion phase.)
Aluminium rapier heads in low profile execution HS3 type, (with tytanum clamp levers).
Rapier rods consisting of carbon profile and plastic toothed rack (10 mm) reinforced with carbon fibre.
Chromium plated rapier heads with longitudinally grooved, exchangeable hard metal clamps mounted on elastic material (10 mm). (Nylatron distance piece on the rapier head guarantees exact distance to the reed).
Contact-free rapier rod guiding by perfect aerostatic system, as well as integrated temperature control.
For automatic rapier lubrication compressed air of 6.0 to max 9,0 bar.
Lubrication is monitored on the oil tank by filling level sensor.
Reinforced multiple ball bearing reed drive shaft with short reed supports.
Reed clamping rail provided for 8 mm bottom reed profile.
Weft yarn cutter, scissors.

4.7 Cloth take-up system
Trough temple support hard chromium plated, prepared for conversion to full-width bar temple.
Adjustment range of drawing-in width: standard.
Spreader bar with smooth surface.
Electronic Cloth Take-up motion ECT
Controlled by servomotor.

4.8 Cloth wind-up
Without cloth wind-up.
Guide roller of 120 mm diameter below inside the machine for continued transportation of fabric to separate on-line carbonation.

4.9 Salvage formation
Without catch selvedge cutters.
Without cloth selvedge device.
Without catch selvedge spool brackets, catch selvedge draw-off device and catch selvedge winding device.

4.10 Motor and gearbox
Frequency: 50 Hz
Operating voltage: 400 V:
CEE socket for connection of weft feeders.
Variable speed drive connection at distribution cabinet.
Direct Drive: A servo-controlled motor directly drives the weaving machine (without drive belt and clutch-brake- combination), controlling operational speed and inching function.
Bilateral, synchronized gearboxes for rapier and reed movement mounted inside machine frame.
Rapier cams with fast retraction of rapiers out of the shed, thus minimizing contact with the shed.
Supervised lubrication with oil filter and pump integrated into the gearbox. Change of weaving width through stepless, easily accessible rapier stroke adjustment.
Programmed reverse motion for automatic finding of broken pick. Synchronous movement of reverse motion with shedding motion, warp let-off and take-up motions.

5. Weaving machine operation
Machine frames of first class cast iron provided for installation of different shedding motions.
Sturdy profile traverse with milled guide for mounting of all adjustable devices and for stepless width change.

Protection covers LHS, RHS and in the area of the take-up rollers.

Infra red light beam barrier device for supervision of reed area. As well as Flashing light cautions operator while automatic functions are performed after machine stop.

Protection cover for centre control cams.

Automatic central lubrication system with pneumatic pump.

There should be envisaged:
- Mechanical keyboard for control of the machine,
- Controls protected in dust-proof sheet steel cabinet, technology CAN bus CAN and built in integrated PC-control with modular input/output components.
- with external ErgoWeave touch screen.
- Electrical part of the machine shall meet the following directives and regulations.
  - EN ISO 11111-1 Safety requirements for textile machinery
  - Elements of electric system should be protected from touch as per VGB4 and VDE 0160.
  - Indication of warp and weft breaks, piece length and machine stop through signal lamp divided in zones. Fully automatic positioning of weaving machine at weft break. Touchscreen Panel permanently indicates important production data such as production speed and machine angle during machine stop.

Control panel ErgoWeave touch screen.

15” Touchscreen.
- Film key padLHS and RHS on the front side of the weaving machine.
- Full text display of stop causes.
- Automatic diagnostics.
- Style and pattern data manager for max. storage capa city 1.000.000 picks, reduction of storage requirement using pattern loops for up to 3 levels. Selective loading and erasing of style data.
- Flexible electronic shift and production counter. Sensor evaluation for pick and meter counter, piece counter, repeat length measuring, multi-width weaving and cutpiece separation.
- User-oriented statistics, style and shift statistics for 50 shifts with storage capacity for 50 shifts, with message storage capacity for the last 500 events. Efficiency calculation with graphic display of efficiency changes and machine stops per 100.000 picks.
  --Data transfer via two USB stick interfaces. Style data can be selectively loaded, stored and erased. Software updates can be easily loaded.
  -Integrated Ethernet connection for network applications and bi-directional production data monitoring.
  -Non-contacting key cards ensure effective access authorization control (function cards)
  -Control module
  -Automatic break search
  -Automatic return in case of warp break or manual stop.

6. Synchronization of weaving machine and the process line
- Speed of weaving machine should be synchronized with speed of seven rollers located in front and in the rear of the machine. Accordingly, the machine control system should by able to receive signals from line control system to adjust the speed.
- In case of emergency or scheduled line shut down, the machine stopping time should be the same as that of the line. In this case there should not be any collection of material before the machine or tensioning after the machine.

7. Installation supervision
The Vendor shall provide documentation required for installation as well as high qualified technical specialist(s) to manage installation of the equipment.

8. Start up and commissioning
The Vendor shall provide documentation required for start up and commissioning installation as well as high qualified technical specialist(s) to manage start up and commissioning.

9. Post-start up support
The Vendor shall provide high qualified technical specialist(s) for post-start up support. Together with signing the contract for equipment supply there shall be signed contract for technical support for three years after commissioning.

10. Drawings and instructions
The Vendor shall provide the Client with layout drawings, electric circuits diagrams. One of electronic copies of all drawings shall be in PDF format. Within 1 month after signing the contract, the Vendor shall provide a package of documents enough for designing. The list of documentation is to be approved by the Parties prior to signing the contract.

11. Warranty
The Vendor guaranties to the Client, that the equipment does not have faults of structure, materials and quality of production for the period of one year after signing acceptance act and no longer than 18 months after shipping from the factory, depending on what event comes first. The Vendor shall provide commercial offer for extended up to two years warranty program.

12. Standards and services
12.1 Regulations and standards
Regulations for basic engineering and production of equipment
Engineering and manufacturing of the equipment, offered by the Vendor should match to this technical specification, and should not contradict to rules and regulations on operation of the equipment in the Russian Federation. Required standards are attached to purchasing documents.

12.2 General Technical Specification for the Equipment
The Vendor shall provide the following within one month after signing the contract:
Cable lines, supplied by the Vendor should have labelled connecting blocks inside relevant junction boxes or automatic switches or other devices as per requirements of Electric Installation Code of the Russian Federation. Diagrams and drawings for all equipments should be enclosed into user's manual.
All parts of design and manufacturing of the Vendor's equipment, including inspection, tests and documentation shall be carried out in accordance with procedures envisaged in user's guide provided by the Vendor.

12.3 Spare and replaceable parts
The Vendor offers full range of spare and quickly wearing parts, as well as solutions to replace or reconstruct system segments. Besides, the Vendor shall guarantee maintenance and repairing of the equipment made by Vendor's qualified personnel at the equipment operation site.
The Vendor shall provide draft list of spare parts with cost estimation within the package of contractual documents.

12.4 Additional services
Client's personnel instructions
Additionally, there may be provided technical training, operation and maintenance of the equipment by Vendor's personnel.

12.5 Management and Human Resources
Installation supervision
To manage personnel of the Client during installation of the equipment there shall be sent one or several technical specialists for the Vendor. The Supervisor shall monitor installation and correct placement of the equipment, unpacking of thermal elements, refractory materials packed separately and (or) electric components. The Supervisor shall pay attention to connection wiring of the system and the equipment including any sealing tests, which might be required. Technical specialist(s) of the Vendor shall submit the time sheet daily to Client's representative on site for signature.

Start-up supervision
To manage personnel of the Client during start up and commissioning of the equipment there shall be sent one or several technical specialists for the Vendor. The Supervisor shall test all equipment systems and fine tune them to provide correct and uninterrupted operation. The Supervisor shall control purging (if necessary) and drying of heating equipment. Purging includes removal of air in heating equipment and its thermal insulation. Drying is a process of gradual removal of moisture from thermal insulation. Technical specialist(s) of the Vendor shall submit the time sheet daily to Client's representative on site for signature.

Labour sources for installation and start up
The Client shall provide all necessary labour sources for both installation and start up, if this aspect has not been included into the Annex.

12.6 Documentation
Package of documentation shall include layout and detailed drawings of process and auxiliary equipment, list of all utilities, required for normal operation of the whole equipment complex, as well as other information required for construction and installation. The Vendor shall supply 2 paper copies and one electronic copy of documentation. One of electronic copies of all drawings shall be in PDF format.