INTELLIGENT MOTION TECHNOLOGY PVT. LTD.

OIP/RIP/RIS BUSHING CONDENSER CORE WINDING MACHINE 3500-2

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Machine is used to wind condenser cores for bushing made of Kraft, crepe paper & Non-woven material with aluminum foils.

1.1 Machine concept

This machine is used to wind condenser core for condenser bushing made of OIP/RIP/RIS bushings with aluminum foils to form capacitor with two de-coiler (web) side by side.

- The maximum 3500mm paper can be used as De-coiler.
- De-coiler is controlled by magnetic brake with a feedback of load cell, if it is necessary to use 2 webs side by side , they are coming slightly overlapped from de-coiler unit behind the machine, a sinus cut is made in the overlapped area.
- The central part of machine is consisting of solid steel frame on which Bottom heated rollers, top pressure roller assembly, Cutter assembly, sinus cutter , foil insertion assembly are mounted
- Bottom heated rollers are heated with Thermic oil. Temperature of the heated oil will be 110 deg. (temperature can be customized as per requirement)
- The cutters are cutting the paper in correct width as per program. The paper ends are cut in straight, steps or cone. Step and cone cutting is possible on both sides.
- The reference line of the machine is always machine center.
- Top pressure roller movement is controlled by hydraulic system. The specific pressing force is adjustable in steps and remains constant & uniform throughout the winding. Load is programmable.
- One foil guide shows the exact position of foil insertion. Second side laser foil guide is optional(Which shows other end of foil), Both side laser guide can be provided.
- Accurate diameter measurement guarantees correct insertion of aluminum foils. Using both method by using linear scale mounted on TPR & by using rotary encoder i.e number of turns (As per customer requirement).
- Paper de-coiler will be installed at a rear side of winding assembly. One paper de-coiler each is installed for one paper roll.
- A table arrangement is installed to place the pre-cut aluminum foils.
- Separate Industry standard control cabinets for controller+ servo drives, VFDs & IR heater (optional)
- The machine is equipped with below major components,
  1. Paper Decoilers
  2. Paper trimming device at both the ends
  3. Top Pressure Rollers
  4. Winding assembly
  5. Diameter measurement system
  6. IR Heating system & heated bottom rollers by Thermic fluid.

7. Foil guide positioning for al. foils
8. Simple fix operator platform
9. Electrical control cabinet and control unit

- Depending on customer`s requirement machine can be equipped with optional features
  - Infra red heating system to dry paper during winding, which reduces the time for drying in autoclave.
  - Laser guide for another end of foil, to ensure correct foil insertion width.

1.2 Technical Specification:

A) Condenser core parameters-:

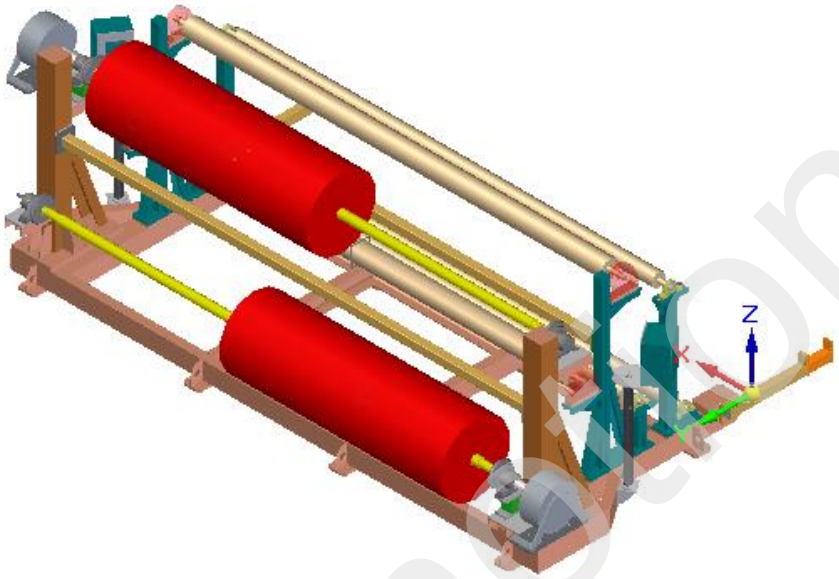
• Minimum winding width	700mm (Min)
• Diameter of finished core	250mm (Max)
• Maximum conductor length	4000mm (Max)
• Maximum Conductor weight	250kg (Max)
• Maximum Conductor OD	200mm (Max)
• Minimum conductor OD	40mm (Max)

2. Description of basic machine components

2.1 De-coiler/Un-winder:

Unwinder is located on back side of the machine. Unwinder consists of air shaft to hold the paper by pneumatic clamping. Web tension is adjusted automatically and kept constant by means of magnetic powder brake & load cells. Length of Un-winder shaft is 3600mm. Laser mark is provided for center mark. If 2 un-winder are installed it should install on two levels to ensure overlap of webs for the sinus cut.

• Number of Un-winder	2
• Core inner diameter	76 mm
• Paper roll outer diameter	800 mm (Max)
• Maximum length of the paper roll	3500 mm (Max)
• Minimum length of paper roll	1000 mm (Min)
• Maximum weight of the roll	800 Kg (Max)
• Paper tension (Programmable)	500 N/m



2.2 Winding part

Paper feeding up to conductor during paper setting is manual. Two bottom heated rollers (BHR) are provided. The BHR is driven by induction motor & controlled through VFD. The maximum temperature of bottom heated roller is 120^0C , this temperature can be customized. Heating is done with Thermic oil circulation. Top pressure roller is provided for constant pressure. This top pressure roller is not heated.

One end of conductor is connected to revolution measurement unit. Diameter sensing is done with indirect method. Foil insertion guide is provided on one end of the machine. This guide will move as per program automatically to ensure correct foil insertion position. Other end foil guide i.e. laser guide is optional.

2.3 Trimming of paper ends & sinus cut:

Two cutters are used on both sides of paper. The cutters are automatically driven & controlled by servo motors. The cutters blades are pneumatically pressed against driven hardened roller. With this system it is possible to trim both end of the paper to the correct design. Through programming both cutters can be programmed for straight cutting, step cutting or conical cutting.

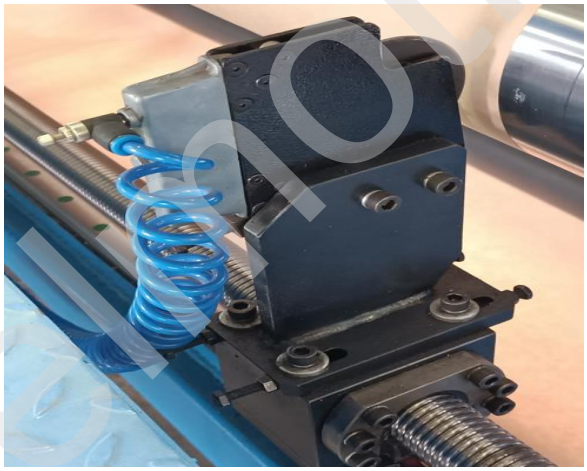
When two webs are used parallel they are overlapped on each other. At the overlapped area webs are trimmed in sinus manner to overcome gap between webs in previous layer. This trimming

device installed at the center of machine with lateral guiding & motor driven. Trimming blades are installed at same level.

- No. of Trimming blades — 3 Nos
- Cutting Tolerances — +/- 1mm
- Paper trimming range left side — 1750mm
- Paper trimming range Right side — 1750mm

Sinus Cut (Zigzag cut)

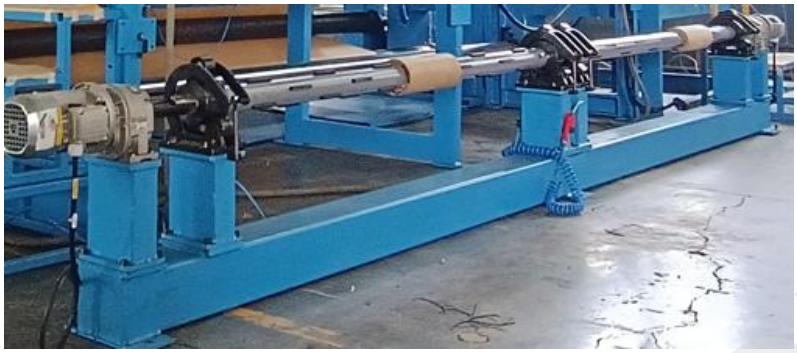
- Paper Overlap — 300mm-500mm
- Oscillating range — +/- 65mm
- Slot allowance — 0-2 mm
  (Gap between paper in sinus cut)



2.4 waste paper re-winder (Re-spooler):

The cut paper winding is done on re-spoolers. The shaft of re-spooler is pneumatically expandable to hold the paper & for easy removal of waste paper.

- For the waste strips, Independent spooler units are provided. These units are driven by induction motor & controlled by VFD.
- The shaft of respooler unit is pneumatically expandable.
- Before waste strip is fixed, a carton tune is installed on the shaft
- The tension of rewound waste paper is regulated by installing though beam light sensor



2.5 Winder with driven support roller

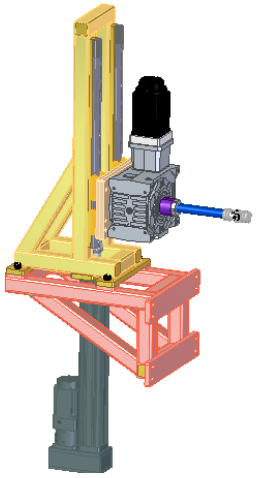
The winder consist of mainly 2 mechanism/components

1. Driven winder
2. Fixes support rollers (bottom heated rollers)

Winding speed 7 m/min (Max)

2.5.1 Driven Winder:

This mechanism is installed in center line between 2 fixed support rollers. The winder is motor driven & connected to the conductor with unique adaptor while winding. Depending on the conductor sizes different adapters will required. During winding process the winder will support the rotation of conductor. In vertical direction the winder is adjusted & lifted by servo axis & it is synchronized with center height of bushing.



2.5.2 Fixes support rollers (bottom heated rollers)

During winding the bushing is lying on the two well aligned & driven support rollers. Rollers are driven by induction motor and rotating the bushing at the outside diameter. Two rollers are giving the winding speed. The speed is controlled by VFD.

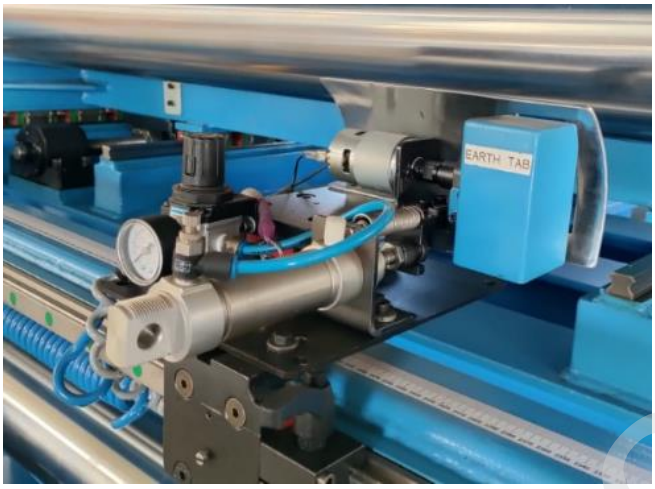
2.6 Top pressure roller-:

Top pressure roller(TPR) is mounted on the base structure. The up down movement of the top pressure roller is controlled by hydraulic system. The force is adjusted as per value given in the job card. This guarantees a constant quality and density of the condenser core. With this roller the conductor stays in the center of the support rollers. The pressure from top pressure roller guarantees also the needed friction between bushing and support roller to avoid slipping. Load cell also mounted on TPR to maintain accurate & constant load. A laser point set also mounted on TPR.

Pressure force 5000 N/m (Max)

2.7 Earth Tab unit-:

A cutting unit is provided for earth tab. This unit will cut a small paper strip so that last foil of the job will be visible. Electric DC motor is provided to move the cutter. The position of earth tab cutter setting is manual. Locate the earth tab cutter at certain position as per job drawing & lock firmly.



2.8 Spreader Roller-:

This roller is provided to remove the wrinkles and maintain the paper tension throughout the width.

2.9 Foil Guide Unit & laser pointer unit:

For manual insertion of foil a special design Guide will provide to straight & errorless insertion, it is driven by servo & it automatic positioned depending on program of winding process with accuracy of +/- 1 mm.

Laser pointer unit are installed on top pressure roller assembly and it is independent driven by by servo & it automatic positioned depending on program of winding process.

2.10 Light curtain safety sensor:

During manual insertion of foil during winding it is necessary to care of safety of hands of the operator for that we provided safety sensor to avoid accidents, whenever manual interference is there machine will stop & resumes only when operator will be away from winder.

2.11 Machine control system

Machine control system is divided into three parts.

Control panels , field wiring, HMI

- Control panels-:
  - Separate control panels are provided controller & servo part, VDF & IR heater (optional)
  - Omron make controller used to control the machine. In the first control panel controller with all servo drives are placed. The communication between drives & controller is through ETHERCAT.

  - In second control panel all VFD(variable frequency drives) are placed along with Beckhoff Ethercat coupler, analog input/output card & digital input/output cards. The communication between first control panel & this panel is through ETHERCAT.
- HMI- 10 inch touch screen HMI is provided for machine control. The bushing data (Recipe) has to be prepared as per format which is jointly decide by customer & IMTPL. This bushing data can be downloaded in controller via HMI through Ethernet.
  - HMI can control following things
    - Paper tension adjustment
    - Pressure(Load) adjustment
    - All motor movements
    - Checking of input outputs in Maintenance mode.
    - Top pressure roller up down movement.
    - Speed adjustment
  - For cycle start/ stop/ Pause separate industrial push buttons are provided.
  - Measuring System
    - Winding speed
    - Number of turns
    - Roller temperature
    - IR Heater temperature
    - Winding Diameter
    - AL foil position
    - Paper tension
    - Load during winding
- Field wiring- all inputs & outputs on machine are controlled by remote I/O method. Different junction boxes are provided for machine I/O. The communication between controller & different junction boxes is through ETHERCAT.