The home of core cutting and stacking technology

L.A.E. – Lughese Attrezzature per l’Elettromeccanica S.r.l. has been recognized for intensive research and development in the fields of core cutting and stacking technology. The company continues in the same direction, with most recent milestones including the extensions of the portfolio of core cutting lines with a new machine TO 45, and the portfolio of stacking robots with the model IRE 45, as well as an upgrade of the stacking robot IRE 25.

L.A.E’s core cutting line TO 25 and core stacking robot IRE 25 were presented last year in Transformers Magazine, Volume 3, Issue 2, pages 62-66. While the philosophy behind the machine TO 45 is quite similar to that of the machine TO 25, the new machine boasts improved electrical and electronic components, as well as the software, resulting in more values for transformer manufacturers.

The machine TO 45 is designed to cut wider lamination, up to 450 mm, while the machine TO 25 can cut lamination up to 250 mm in width. If we put this in reference to the size of transformers, the TO 45 machine is intended for cutting core material for transformers in the range from 160 kVA up to 6300 kVA, while the TO 25 is suitable for transformer cores between 50 kVA and 2500 kVA.
Core cutting line TO 45

Compactness

In line with one of the company’s key philosophies of compacting machine size, the new core cutting line TO 45 has lower dimensions compared to L.A.E. standard and other cutting lines on the market. This was achieved in two ways. First, by using swivelling cutting heads instead of two cutting heads, which shortened the machine’s longitudinal dimension for as much as one meter.

And second, by addressing the electrical cabin issue. The cabin is generally separated from the machine and, due to its size which is roughly two to three meters long and a half a meter wide, it sometimes causes problems to transformer manufacturers when they need to collocate the machine in the layout of their workshop. What LAE has done is integrated the cabin in the cutting line.

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L.A.E. has managed to develop and integrate into the new machine devices which solve the problem of the quality of cutting lamination of 0.18 mm, so that the tolerances, i.e. dimensions of the lamination and bars that are present on the lamination cuts stay within required limits.

Minimized pending time through innovative patented system

Normally, the process of production of transformer core requires that the operator repeatedly removes the lamination coil and replaces it with a coil of different lamination width. During the coil replacement, the cutting unit must be stopped, so at this time the line is pending and not producing, which lowers its efficiency.

Production flexibility

The core cutting line TO 45 provides other additional benefits, such as increased production flexibility. We know that in many countries upcoming regulations require reduced no-load losses of transformers. One of the ways to achieve this is to use core lamination of lower thickness. Generally, the thickness range used so far has been 0.23, 0.27, and 0.30 mm, but if we reduce the thickness of lamination by some 0.01 mm, this significantly decreases the core losses. This has prompted transformer manufacturers to start using thinner lamination, and for this reason, the new machine has been developed for cutting lamination with thickness as low as 0.18 mm. However, when using thinner lamination, the number of cuts that the machine performs increases because more sheets need to be stacked in order to get the core of the same volume. Nonetheless, transformer manufacturers have to use better grade material, and previous designs of cutting lines do not support processing material of that low thickness.

New core cutting line TO 45 is in keeping with L.A.E.’s key philosophy of compacting machine sizes, and enables cutting of lamination with thickness as low as 0.18 mm
L.A.E. has introduced a solution that allows fast replacement of lamination coils, as fast as within, let’s say, fifteen seconds, as opposed to, say, three minutes. Considering that coil replacement must be repeated many times throughout a work day, this gives the machine a big advantage, increasing its efficiency.

For example, let’s consider manufacturing cores for 400 kVA transformers – with this fast coil replacement we can increase the manufacturing capacity by up to 20 cores per day.

Reduced maintenance
Another benefit this machine brings is a reduction of maintenance. The machine is equipped with advanced self-diagnostics, which controls different measures of machine’s operation. A basic example is monitoring the length of the total lamination that was processed by the machine, which determines the consumption on some strategic part of the machine. Also, the machine is equipped with more cutting tools – some are standard, and some are optional such as different numbers and types of punching heads, v-notch tools, etc. Each cutting tool is monitored individually in order to ensure replacement of only those tools that need to be replaced, rather than replacing the whole set of tools.

All this helps the maintenance staff to detect when the machine must be stopped for maintenance, allowing smooth production planning and operation.

Supporting optimization
Another feature of this machine is communication with other processes and departments within the plant. For example, quality department can check at any time the batches produced every day, tonnes of lamination processed on each cutting machine, the operator supervising the machine on a certain day, how many times the automatic process of the machine stopped, what was the reason for the stops, such as crash of lamination, maintenance, coffee break and so on.

All this enables assessment and improvement of the efficiency of each line, determining the correct distribution of the load among cutting lines, and optimizing processes in the workshop so that the production runs smoothly and efficiently.

The importance of the robotic stacking lays in the significant reduction of cutting-stacking time – which is up to 30-50 %

Core stacking robots IRE 45 and 25
New features for automatic stacking
The stacking robot IRE 45 is a stacker intended for use with the core cutting line TO 45. The new features developed for this model have been also implemented in the upgraded model IRE 25.

One of such features is the ability to stack cores automatically with flat yoke and an increase in the dimension of the lamination the robot can manage.

The ideal shape of the transformer core cross-section is circular. To make a perfect circular cross-section, each and every successive lamination steel sheet should be cut in different dimension and size. As this would be absolutely uneconomical for practical manufacturing, manufacturers use different blocks, each of the blocks containing predefined number of laminations. The core is an assembly of these blocks in such a successive manner as per their size from the core central line, which results in an optimum circular shape of the cross-section.

Flat yoke is a particular type of yoke where the vertical section of the yoke is not symmetrical to the central axis, so the upper-most and lower-most parts of the lamination are moved laterally in order to get one side of the yoke flat. In this way, the dimensions of the yoke, i.e. its volume, are reduced, consequently reducing the consumption of the core material and the costs, while the core’s performance remains at the same level.

In order to enable automatic stacking of flat yoke, the core stacking robot has been upgraded. The flat yoke solution for power transformers was invented some years ago, but now it is entering the segment of distribution transformers.

Improved productivity
The IRE core stackers can stack a closed or open core, i.e. the core with upper and lower yokes assembled into assembled closed position, but of course, they can also stack a core with the upper and/or lower yoke assembled into opened position (without contact between columns and jokes) if this is a solution required by the customer.

The importance of the robotic stacking lays in a significant reduction of cutting-stacking time. If we consider these two phases of production and compare the process of automatic cutting and manual stacking to the process of automatic cutting and automatic stacking, we will see a reduction of time of about 30-50 %.

The core stacker is able to stack up to four cores of the same or of a different design.

A big advantage of robotized stacking compared to manual stacking is high precision and ability to repeat every movement with high reliability.

High production flexibility
In the traditional production, the cutting unit cuts the material required for only one type of core. After the lamination for that type of core has been prepared, the cutting for another design of the core can begin. This order of activities is required to prevent mixing the lamination of different designs.

With the robot stacker, different core designs can be managed at the same time. Assembling the core by the robotic arm directly after the lamination is cut, it is possible to sequentially cut different lamination for different core types, without any possibility for mistake or mishandling of the material in the production.

This is a big advantage for transformer manufacturers. For example, when the manufacturer uses the lamination of the same width for more cores of the same design, but also for different core designs, they don’t have to wait for the material to be cut for one design first, and then for another design, but they can cut it at the same time. Transformer manufacturers
With the core stacker, the output of the line is the already assembled core, which eliminates the need for a lot of past procedures and makes the production leaner.

are thus interested in increasing the number of these lines in their workshops.

**Leaner production and additional saving on floor space and scrap material**

In the traditional production, the cut material must be stored somewhere, and then moved to the stacking area in order to stack the core. This requires space in the workshop, as well as time and people to execute, supervise and control all these processes. With the core stacker, the output of the line is the already assembled core, which eliminates the need for the above-mentioned processes and makes the production leaner.

For the core of a typical small power transformer, manufacturers use six to eight different lamination widths; and three to four lamination widths for distribution transformers. When cutting, lamination coils have to be loaded on the cutting unit roughly twice as much as the number of the used lamination widths. This is where LAE cutting machines with their fast coil replacement system provide big advantage, reducing the throughput time, and even more so when combined with the automatic stacker which enables cutting the material for up to four cores at a time, thus reducing the total number of coil replacements by a factor of four! Furthermore, the robotic stacker can calibrate the target height for each width, permitting a reduction of scrap material (2–4%).

Generally, the same lamination widths are used for different cores. Different cores can have different dimensions, different number of laminations in individual blocks and so on, but the lamination coil width is more or less always the same. This means that it is very easily possible to manage different designs of power transformers with the same coils, i.e. with the same sheet width, and to achieve a significant reduction in the core cutting-stacking time, thus improving the productivity.

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