In recent years, prefilled syringes have become an increasingly important area of focus for Marchesini Group, which has concentrated considerable technological efforts on this type of packaging system. Strategic investments, including the addition of two specific organisations to the Group, are of particular significance, and alliances between the various enterprises that have become part of the Group since 2000 have been of great importance.

In 2002, the Group acquired Farcon (Carpi, Italy), which specialises in deep-draw thermo forming machines, with applications in packaging ampoules, vials, needles and, of course, syringes. Then in 2004, Corima (Monteriggioni, Italy) joined the Group. Corima brought with it extensive experience and capabilities in filling, handling, labelling, plunger-insertion and nest-handling machines.

The Group’s know-how has expanded to the extent that today Marchesini’s capabilities incorporate the production of the machines required to form a complete syringe line: from filling to palletising.

Not only does the Group produce all the machines, but it also boasts a complete range of accessories required for handling and assembling the syringes with conventional but also new components, such as a backstops or needle-safety devices, amongst others, which are foreseen in new international standards concerning the safeguard and protection of healthcare workers.

How is a conventional filling and packaging line structured?

Naturally, the first stage in a conventional filling and packaging line is the filler (Series FSP by Corima) that fills the syringe in an aseptic and controlled environment and applies a rubber stopper. A true concentration of technology, the FSP machine is equipped with an innovative and extremely flexible robotic system that is able to process various sizes of syringes. Controlled totally by brushless motors, it guarantees maximum batching precision and is manufactured to fit all types of conventional protection systems, laminar air flow or the more advanced barriers for restricting access (RABS) to the processing area, either open or closed.

Once filling and stoppering is complete, the nest, containing the filled syringes, sealed with a rubber stopper, are placed back inside the container to then be transferred towards the subsequent secondary packaging steps.

The secondary packaging phase of the syringe lines requires the obligatory installation of a de-nester (Series MP by Corima). This unit automatically picks-up the filled syringes from the nests and feeds them to an inspection machine or to the plunger insertion and labelling machine (series AEC by Corima).

The insertion of the plunger on the syringe, likewise for the syringe pick-up and handling functions, is precise and safe and designed to avoid damage to the syringes (including aesthetic damage). The plunger is inserted perfectly vertical thanks to controlled distribution on just one line. Equipped with a complete set of controllers, the AEC machine is offered in different rig-outs based on the production requirements involved and is integrated with the most popular types of printers and vision systems available on the market.
Downstream from the plunger insertion and labelling machine, the assembly machine for syringes with back-stop (Series SMB by Corima) or the assembly machine for syringes with safety device (Series APS by Corima) can be installed alternatively.

The safety devices are designed to prevent all possibilities of the operator accidentally coming into contact with the potentially contaminated used needle. These safety devices normally trigger automatically, isolating the needle inside at the end of the injection, and are becoming increasingly popular. Indeed, they are becoming a permanent obligation in safety standard protocols in many countries worldwide. Both the SMB machine and the APS machine are designed and pre-arranged to be connected in line with other machines of the plant. They are reliable and versatile and can process the various sizes and shapes of back-stops and safety devices presently offered on the market.

Alternatively to separate machines, Marchesini Group offers Corima’s APS Combi machine (see figure 1), the first machine in the world designed and manufactured to assemble syringes with plungers, to label the plungered syringes and to assemble them with the safety devices. Compact and extremely reliable, the APS Combi machine is appreciated by many major enterprises in the industry. Available with various production rates, the APS Combi carries out all the steps automatically and avails of special solutions so that it can be easily integrated with the machines downstream.

A more detailed photograph of the APS Combi machine in action is shown in figure 2.

The SMB Combi is similar to the APS Combi, but is designed to apply the label, the plunger and the backstop on the syringe.

FIRST-CLASS LINE-INTEGRATION EXPERIENCE

Once this last phase is complete, the filled, labelled and assembled syringe is picked-up by the Farcon thermo former. The operational phase between Corima and Farcon machines features dynamic robotic connection systems manufactured by Marchesini, increasingly frequently integrated with buffering systems that drastically reduce machine downtimes and increase the overall performance of the line.

Marchesini Group has substantial comprehensive line-integration experience and is consequently able to offer highly customised con-
connection systems. For example, using special shuttles that carry the syringes together with secondary components, such as spare needles.

Syringe packaging in thermo formed containers is fulfilled by Farcon, which offers customers machines made entirely with balcony structure and in full compliance with the strictest of pertinent safety standards.

Farcon’s most recent innovation to reach the market is the FB320 machine. It is a totally mechanical thermo former controlled by brushless drives. Featuring many technological innovations, the FB anticipates the assembly of front-on sizing parts, which enables the operator to change size without using tools, simply and in just 20 minutes, with pitch selection from the operator panel.

With a forming area and depth of up to 42 mm, the FB unit is also available in the zero-reject version (FBZ).

The syringes, enclosed and protected in the tray, continue at this stage towards the final packaging step. The FB unit is then backed-up by the most advanced transfer system available; the Robocombi, Marchesini’s cutting-edge robotic feeder, which places the syringe trays in the containers of the cartoning machine with tracking motion (see figure 3 on page 27).

The Robocombi system is able to pick up 400 pieces per minute, consequently guaranteeing production speed. It also features pick-up flexibility. In the case of containers with lids (either in PVC or paper), the pieces are picked-up with normal suckers from the top. If, on the other hand, the container is open without a lid, the suckers are replaced by side pick-up grippers.

Another important feature is the possibility to turn the container, either flat or upright in rows, before placing it in the boxes. This ability to handle the container in a very small space, together with outstanding reliability, is another of the system’s strengths.

Together with the possibility to create the required number of stacks in the boxes of the cartoning machine, Robocombi can also place them in an especially designed mobile box system, to create a buffering system for accumulation or inspection purposes off-line.

The choice of the cartoner (series MA by Marchesini) is comprehensive and guided based on the various characteristics required: number of trays to be stacked, their size, and any other components to be added to the carton, such as leaflets or booklets, and the requested production speed.

To overcome the need to safeguard the integrity of the package, Marchesini also offers a series of labellers produced by another of the Group companies, Neri (Barberino di Mugello, Italy), which not only apply normal labels on the carton body but also tamper-evident labels on the side flaps.

Made entirely with balcony structure, the labelling machines of the BL series by Neri are again a true blend of technology and versatility.

After identifying the product and checking the integrity of the package, it can be sent to the next step. The cartons can be bundled and wrapped in heat-sealed film (series MF), or bundled and wrapped in heat-shrink film (Multipack), even if the most popular type of packaging method for syringes is just cardboard cartons.

Controlled by brushless motors and made with balcony structure, the case-packers and palletisers of the MC series complete the line. These can be installed as separate machines (MC820 and MP830) or as a single monobloc structure (MCP840 or MCPV840 Top Loader) guaranteeing a compact and efficient end-of-line solution for speeds of up to 10-15 cases per minute.

In the handling compartment of all the components, and likewise for all of the machines just listed, Marchesini Group boasts an unparalleled and unrivalled offer, guaranteeing automatic connections between all the machines making up the line, not only standardising all the electrical and pneumatic components but also guaranteeing uniformity of the design and supervision of the production cycle. All this at various production speeds: from 2,000 to 24,000 pieces per hour.

**THE SIGNIFICANCE OF INTER-MACHINE CONNECTIONS**

Having travelled along the syringe line, from filling to case-packing, describing the various stages and machines we can now focus specifically on the connections between each stage. The connections are as important as the stages themselves.

Of critical importance are the buffer systems designed to ensure correct feeding continuity throughout the various steps of the packaging line. Strategic steps are, for example, those between the plunger inserter and the thermo former, which must never stop because, unlike many other machines, stoppages could compromise operation, even causing serious damage.

To pre-empt this problem arising and thus avoid it, a buffer is installed upstream from the thermo former to create a stock for the required number of minutes, that the thermo former can exploit if the machine upstream should stop. This guarantees regular operation of the line.

The buffers offered do not have a permanent structure, but each unit has its own configuration, designed to meet individual lay-out requirements.

The common feature of all the machines is the robotic system, manufactured by Marchesini. Robocombi, Robovision and Robomaster (see figure 4), all fill and empty the buffer containers with PC logic.

The Robovision is a second-generation top-loader robot with four axes that can be integrated with a vision system. Developed to pick-up loose objects sent randomly from a belt and to feed them to the cartoning machine with continuous motion, Robovision can pick up to 120 pieces per minute.

Thanks to the camera and software with which it can be equipped, this innovative robotic solution recognises the image of the product to be fed and is able to turn the product itself to be able to insert it correctly in a conveyor, for example, that of a cartoning machine.

Complete with tracking motion, thanks to the characteristic bridged structure, it can also be slaved with a parallel belt and also a trans-

**Figure 4: The Marchesini Robomaster feeder**
Everything you may need for syringe packaging

Marchesini Group is your unique partner for filling, handling, labelling and packaging syringes. Everything under one roof.

- Automatic machine for loading and positioning products in single-line from bulk
- Feeding syringes from hypak nest
- Feeding syringes or safety device from rondo flat tray
  traditional or robotized systems
- Retrayer: handling equipment to collect syringes into rondo flat
- Traybuffer “FIFO”: handling equipment to buffer syringes into tray
- Renester: handling equipment to collect syringes into nest
- Safety device assembling machine
- Backstop assembling machine
- Plungering, labelling and assembling machines combi
- Filling and stoppering machines
- High speed labelling machines
- Deep draw thermoformers
- Cartoner with Robotized automatic syringes loading systems
- Robocombi
- Robovision
- Robomaster
- End of line equipment
verse belt. Maximum lay-out versatility, a large work area and precision are the special features of this product, whose software, just like the whole project, is developed entirely by Marchesini. Thanks to this special feature and to its impressive adaptability, Robovision can be implemented for a large number of applications, in both the pharmaceutical and cosmetic field.

Robomaster is perfect for requirements of higher speeds and more advanced dynamics; this robot also has four axes and features a cutting-edge design, studied specifically by Marchesini Group to feed syringes and ampoules for thermo formers (see figure 5). It works at a maximum speed of **400 pieces per minute** and can be equipped with an integrated vision system, just like the Robovision unit.

**ROBOCOMBI, ROBOVISION, ROBOMASTER: ADVANTAGES IN 7 MOVES**

The most innovative syringe-handling and feeding products from Marchesini are two – Robovision and Robomaster – and they are paired with unique specifications compared with what the rest of the market has to offer:

1) They are not just commercial robots simply adapted to a certain pharmaceutical product, but are designed right from the very start exclusively for the world of syringes; they merely enhance the specifications required for this type of product.

2) Since they are exclusive products of Marchesini’s development department, which also supervises the design of the machines themselves, they are extremely compact in order to better adapt to lay-out configurations that may require a considerable level of complexity and cannot be standardised. They are also all integrated for the optimum handling of the actual syringes.

3) Compared with a conventional mechanical feeding system, Marchesini’s robots drastically reduce transfer movements performed by complex mechanical parts, consequently drastically reducing size-changing times.

4) They enable positive conveyance; consequently the syringe is always accompanied throughout the whole route and is subject to fewer transfer movements, which could be rather critical for the integrity of the product itself.

5) They enable outstanding cost reductions compared with a conventional mechanical feeder, in terms of the structure’s extreme simplicity, which is consequently maintenance free, and in terms of a much longer lifetime.

6) Extreme flexibility and precision in transferring the syringes.

7) A final yet extremely important aspect is the fact that the Software and Hardware of Marchesini Robots are integrated in the same PC.

The last point should be stressed. In line with the overarching integration philosophy that characterises the lines produced by Marchesini, an outstanding strong point of the machines is that they all use the same PC, with the same operator interface. This naturally makes the entire line extremely user friendly.

**Summary of Marchesini Group machines mentioned in the article, with web references:**

<table>
<thead>
<tr>
<th>Name/Series</th>
<th>Function</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series SMB (Corima)</td>
<td>Syringe assembly</td>
<td><a href="http://www.marchesini.com/prodotti/liquidi/syringe-assembler/smb/">http://www.marchesini.com/prodotti/liquidi/syringe-assembler/smb/</a></td>
</tr>
<tr>
<td>Series APS (Corima)</td>
<td>Syringe assembly (with safety device)</td>
<td><a href="http://www.marchesini.com/prodotti/liquidi/syringe-assembler/aps1/">http://www.marchesini.com/prodotti/liquidi/syringe-assembler/aps1/</a></td>
</tr>
<tr>
<td>APS (Combi)</td>
<td>Syringe assembly, plunger insertion and labelling (with safety device)</td>
<td><a href="http://www.marchesini.com/prodotti/liquidi/syringe-assembler/aps-combi/">http://www.marchesini.com/prodotti/liquidi/syringe-assembler/aps-combi/</a></td>
</tr>
<tr>
<td>FB320 (Farcon)</td>
<td>Thermo former</td>
<td><a href="http://www.marchesini.com/prodotti/packaging/termoformatrici/fb320/">http://www.marchesini.com/prodotti/packaging/termoformatrici/fb320/</a></td>
</tr>
<tr>
<td>MC820 &amp; MP830</td>
<td>Case packer and palletiser (separate machines)</td>
<td><a href="http://www.marchesini.com/prodotti/packaging/cartonatrici-pallet/mp830/">http://www.marchesini.com/prodotti/packaging/cartonatrici-pallet/mp830/</a></td>
</tr>
<tr>
<td>MCP840 or MCPV840 Top Loader</td>
<td>Case packer and palletiser (mono-block)</td>
<td><a href="http://www.marchesini.com/prodotti/packaging/cartonatrici-pallet/mcp840/">http://www.marchesini.com/prodotti/packaging/cartonatrici-pallet/mcp840/</a></td>
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**Figure 5:** The Robomaster feeder, photographed in action