

Film Extrusion Technologies



Macchi S.p.A.
Corporate Profile & Product Range

Philosophy Brand, Solutions

Ever since 1961, when Luigi Macchi, a dynamic and enterprising man started his activity in Venegono Inferiore, Macchi has never ceased to develop and is now considered one of the leaders in plastic processing systems. Loyal to the early vision, the company aims to take on challenges posed by the market and tackle them in close collaboration with its customers. A time honored statement -fully subscribed across the Company Staff- is that we believe in what we do, because we do it well. And because we do only film extrusion systems, we must be pretty sure of the quality of our work.

Research and development are fundamental to the company's strategy; it is in the best interest of both the company and its customers to have constant interaction and collaboration to seek out new opportunities, and to develop new solutions based on finished product quality, system reliability and a favorable system cost-to-performance ratio. A research that is not merely academic, but a real way of experimenting by innovative responses to the specific needs of the market. Our main target is to manufacture top quality machines. We build to specifications, not to cost.

The main reason why our customers buy, even in times of recession, is that in our mind quality and savings are synonymous. First of all on initial investment, where the performance-to-price ratio is one of the best available on the market. The careful selection of cost effective automation systems allows savings on labor costs. High quality components grant a long term performance and allow saving on maintenance costs. Last but not least, savings on energy costs, due to the use of innovative drive technologies.



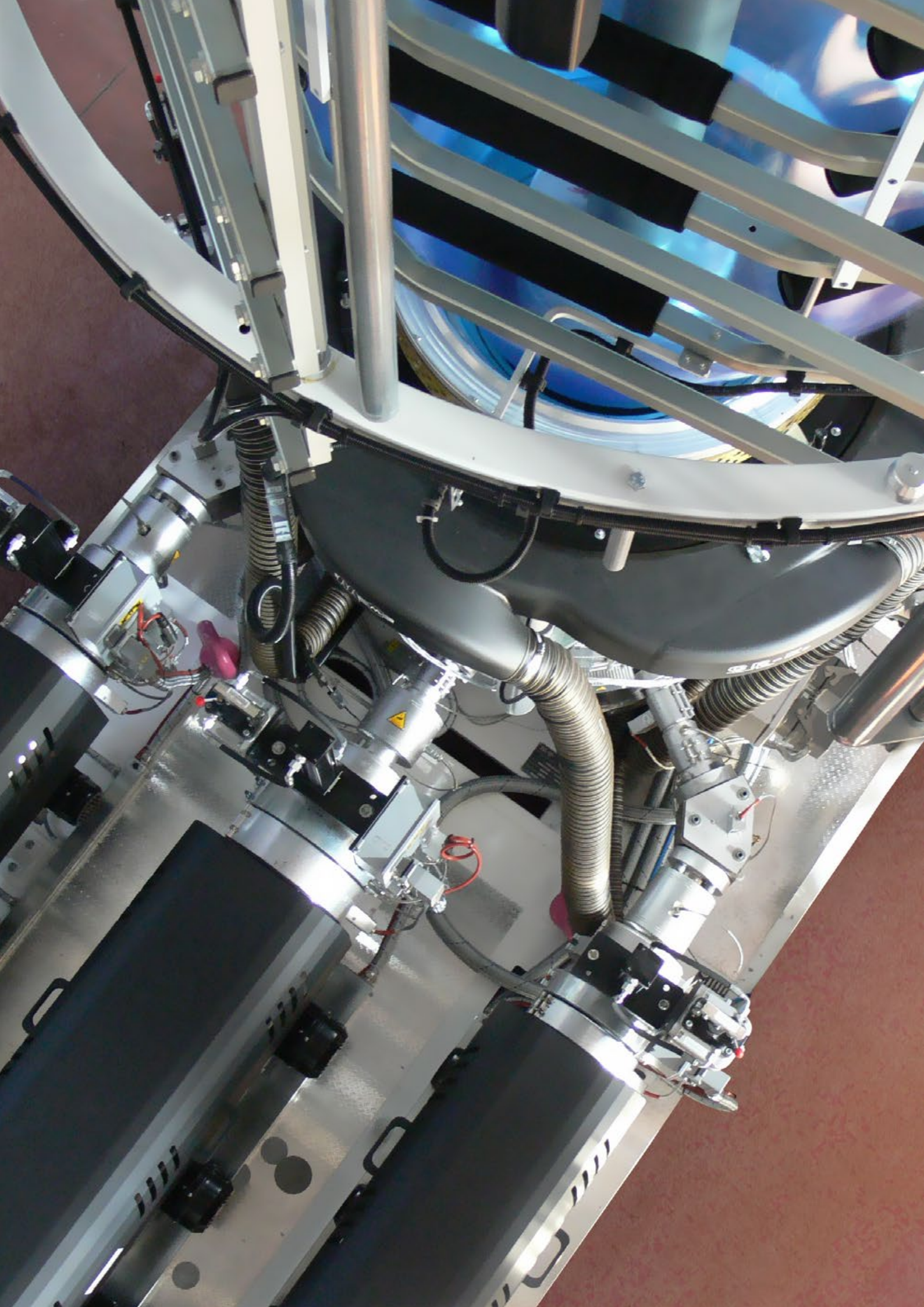
Quality Service

Quality has always been a top priority at Macchi, a "total quality" at all levels, from design to selection of the components, from construction to creation of the software, and right down to the collaboration with customers. It is a quality managed by a specialized team capable of controlling the production process all the way through, with perfectly integrated systems. A system's productive efficiency depends on various factors: one of the most important is the man/machine interface. Macchi constantly invests in this field. An example is the easy control of the line and fast optimization of production. Top attention is also paid to ergonomic detail to ensure a high standard safety.

Each system is set-up and given with thorough test and inspection in the presence of the customer, prior to delivery. Macchi offers its customers this essential service at no extra charge, as the service ensures not only much shorter assembly time, but also much faster set-up. Installation is carried out by experienced, well trained staff, supervisors and mechanical and electrical technicians who are able to assemble and start up the systems and offer their training services to the customer during the initial production phase.

Our post-sales service offers constant assistance to customers who purchase our machines. We have an excellent network of representatives all over the world. There is also a fast and efficient spare parts service supported by a team of inspection technicians who are able to help quickly on demand. For urgently required spare parts we keep a large inventory stock. We will arrange for delivery via express service within a few hours. This Macchi service is not just urgent parts shipment, but is able to supply you with parts packages that are matched to your specific machine or replacement of obsolete modules. Thanks to our service-hotline and an innovative system of remote tele-service, Macchi can offer solutions in real time at extremely competitive prices.





Coex Flex 3

Extruders screw sizes	Die range (mm)	IBC
45 - 55 - 45	150 - 250	no IBC
55 - 65 - 55	150 - 250	jet 6
55 - 65 - 55	180 - 400	jet 6
55 - 80 - 55	180 - 400	jet 6
65 - 80 - 65	180 - 400	jet 6
65 - 90 - 65	180 - 400	jet 6
65 - 90 - 65	350 - 550	jet 7
65 - 105 - 65	350 - 550	jet 7
80 - 105 - 80	350 - 550	jet 7
80 - 105 - 80	400 - 600	jet 7
80 - 105 - 80	600 - 800	jet 8
80 - 120 - 80	400 - 600	jet 8
80 - 120 - 80	600 - 800	jet 8
90 - 120 - 90	400 - 600	jet 8
90 - 120 - 90	600 - 800	jet 8

Film coextrusion is becoming more and more widespread in the packaging industry and is quickly replacing monolayer film production. Macchi's Coex Flex compact extrusion systems are pre-set units equipped with three extruders, a three layer IBC die, melt lines, hydraulic movement screenchangers, wiring, piping and all required connectors. All components are assembled on a custom platform and result in a compact unit that is user friendly, economic to transport and easy to install. They have been originally designed to easily substitute an obsolete extruder and transforming the line into a fresh co-extrusion system, totally guaranteed, while limiting the cost of the investment. One of the great advantages of the Coex Flex systems is their ability to replace an existing monolayer extrusion systems and still taking the same floor space. This up-grade has been successfully applied in dozens of applications worldwide.

Today, companies that invest in a new film extrusion system typically choose a 3-layer co-extrusion line with the highest output designed into the center layer which optimizes productivity and line flexibility. Always in tune with the industry needs, Macchi can boast a large range of compact Coex Flex systems that meet any coextrusion film production requirements.

By virtue of our current level of design technology in dies, extrusion feed screws and carbon fiber air rings, the Coex Flex 3 platforms became instrumental to achieve a streamlined standard of manufacture resulting in a high quality product level incorporating worldwide available quality components. Energy efficient AC drives are standard.

The dies used in the Coex Flex platforms are featuring a minimum polymer content, and digitally controlled IBC system.

The Coex Flex units are currently built in a variety of sizes that may fit any capacity range, from 100 to 1000 Kg/h.





Coex Flex 5-7-9-11 Barrier and Non Barrier

The POD concept

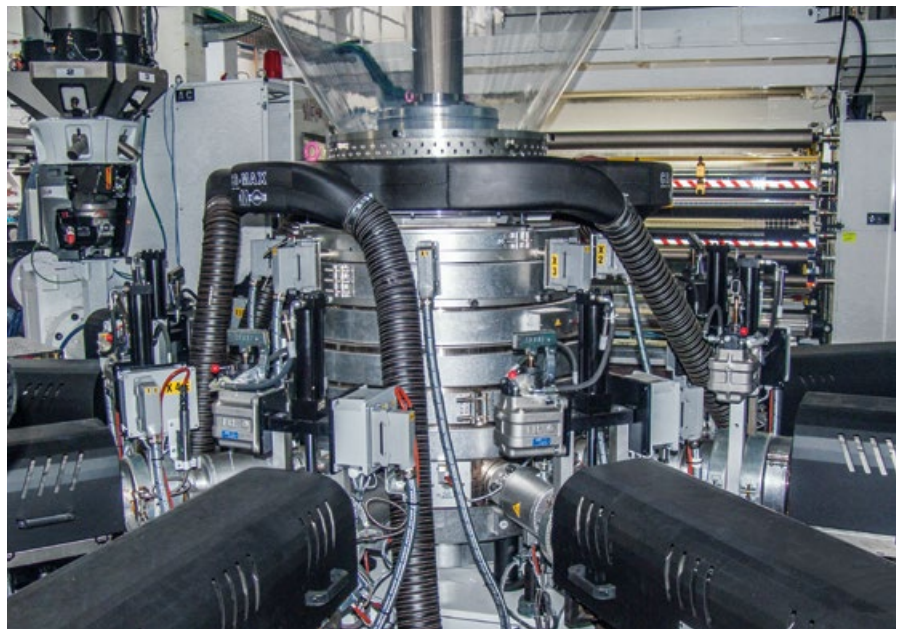
Recently, the film producers have enthusiastically embraced a new approach to the co-extrusion of films without barrier materials. The driving force for the development of non barrier five layers film comes from a strong market demand for sustainable specialty films with reduced thickness, good sealing and optical properties.

The five-layer technology for polyolefin dedicated film (POD) enables production economies and quality enhancement. From the machinery standpoint, the standard five layer co-extruders evolved to become instrumental in the continuous path towards the down-gauging of the final products. The same advantages and the same concepts apply to the film used as web converting substrates. All the efforts are aimed towards better, stronger, thinner and price competitive films.

The early inception and development of barrier film lines was required by the need to balance the strong curling effect of a simple PA/PE structure. This defect was the driving force to move the nylon onto the neutral central axis, thus developing a symmetrical five layer structure, which have universally consolidated the barrier films industry.

The introduction of EVOH has paved the way for the first asymmetrical structures with differentiated outer layers. Simultaneously there have also been developments and improvements in the packaging industry, resulting in the need to extend the application range of available films. Retorting and sterilization treatments started to show the application limits of the single barrier products, calling for machinery enabling barrier structures using simultaneously PA and EVOH layers. Seven and nine layers equipments produce double or triple barrier structures, to optimize the film performance and to provide for a further thickness reduction. Even more layers will be required to cater for new generation of packaging, with peelable/reclosable or other features.

Our present range of dedicated machines for the barrier film industry comprises five, seven, nine and eleven layers lines, all complete and equipped with the latest technologies in extrusion screws design, innovative coextrusion die-head concepts and with a fully integrated engineering of the entire production system, from take off units to winding systems.





Wide Webs

Die range

For agrifilm 80-250 micron
Open web BUR 1,7 - 2.7

Coex 3 diameter	Open web
1000	5500 – 8500 mm
1300	7000 – 11000 mm
1400	7500 – 12000 mm
1500	8000 – 13000 mm
1800	10000 – 15500 mm
2100	11000 – 18000 mm
2400	13000 – 21000 mm

Coex 5 diameter	Open web
1300	7000 – 11000 mm
1500	8000 – 13000 mm
1800	10000 – 15500 mm
2100	11000 – 18000 mm

A specific area of film extrusion is represented by the equipment used to produce wide web films, mostly used in agricultural applications, spanning from ground covering (mulching and fumigation) to horizontal silage and greenhouse tunnels covering. Common denominator to these setups is the extensive use of tailored coextrusion techniques based on three, five and seven layer technologies, applied to large sized die heads.

Extra large cooling rings are required to quench these gigantic bubbles, that ask for proportionately large collapsing frames and take-off arrangements. On web descent we have available an array of folding devices, before sending the product to purposely dedicated shaft-less AFS winding units.

No matter the size, the products obtained with these lines must undergo the very same requirements of performances and quality features demanded in the flexible packaging or medical applications. For this reason the same devices for product control, electronic process monitoring and data logging are used as standard implementation. Macchi is proud to offer to the industry we serve an extensive, time honored tradition and expertise in the production of large size coextruders, with massive capital investment in machining tool and infrastructure purposely targeted to complete a very comprehensive machinery offering.





Specialties

Agribusiness



Collation Shrink



Construction



Converting



Food Packaging



Industrial Packing



This page should be left blank, for our Customers to fill-in, with their unique way of using our equipment for challenging applications or for the ones which may be not generally considered mere plastic film extrusion.

Examples of this maybe the HDPE tapes –used in the textile business–undergoing fibrillation and orientation for the obtainment of raschel-type nettings (area where Macchi is the undisputed world leader) or variable thickness profile multilayer films used to promote plant growth or special barrier feature films designed to protect and enlarge the storage or shelf life of delicate and perishable food. Barrier silage films – both agricultural stretch baling film or silobag horizontal storage system – represent an interesting target where the coextruded film may bring added value to century old traditional ways to store products. Last but not least, thermoplastic films are instrumental elements for the environmental conscious management of solid waste or for the development of sustainable composting platforms.

Our contribution to plastic film applications is founded on a solid sustainability attitude. Plastic film banning is sought after by the same people who want it to disappear in one instance and expect it to last forever in another.

The science-minded among us see the truth about plastics: they are all different, some better than others, but mostly beneficial to the environment via lighter weight, hygiene, secondary uses possibilities and much more.



Extruders

Extrusion screws,

screen changer and extrusion die technology are always production-matched. In order to ensure this, Macchi feedscrews are always of barrier type design, available in five basic design concepts, engineered for optimum performance in processing a wide variety of materials including LDPE, HDPE, LLDPE, EVA, Metallocenes, PP, PA, EVOH, adhesive resins and the latest thermoplastic and Bio-polymers resins today available on the market. Screws metallurgy offers, as standard, high wear resistant surfaces, while different solutions can be provided - upon request - to cater for special applications.



The design criteria followed for the construction of our extruders, stand alone or assembled on a Coex Flex platform, have always been marked by attention to detail, choice of first quality materials and the desire to offer the industry an high standard, streamlined, reliable product range incorporating worldwide available Primary Standard quality components:

- Sturdy gearboxes and oversized thrust bearings, equipped with oil temperature control.
- A/C motors, air or (optional) water cooled, exhibiting low energy consumption, minimum maintenance and a greater drive dynamic control.
- Siemens AC Sychro Torque Motors directly coupled to the screws, available as alternative versions to the AC motors.
- Specially designed feed-zones, featuring smooth or multiple groove profiles.
- Bi-metallic extrusion barrels inherently high resistant to wear and corrosion.
- Extruder heating system with ceramic or (optional) infrared heaters for up to 20% energy savings.
- Technologically advanced electrical components focusing on the main drive speed control, where the advantages represent a cleaner and more efficient choice targeted to reduced electrical consumption, always keeping in mind the respect for international standards and safety regulations.

Particular attention has been paid to the consistency of our manufacturing processes and the quality of materials in order to guarantee a long product life-time.

screw diameter (mm)	45	55	65	80	90	105	120	140	160	180
drive (kw)	30	60	75	108	142	175	230	320	415	480
LPDE output (kg/h)	80	130	180	270	350	450	600	750	900	1100



CR-K3
CARBON FIBER

M MAGNET



Die Heads

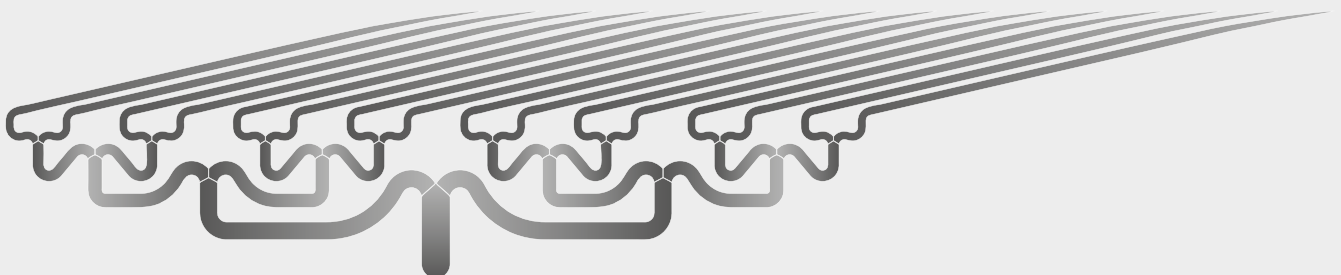
Extrusion dies

are the heart of the system. Our dies have proven their flexibility and quality right from the beginning of their serial production. Resulting in lower operating pressures while maintaining maximum output rates, this allows greater flexibility in processing a wider variety of materials even with high viscosity. The operating principles and material distribution are distinct and superior to the more traditional bottom fed or multi-level side fed die technologies available on the market today.

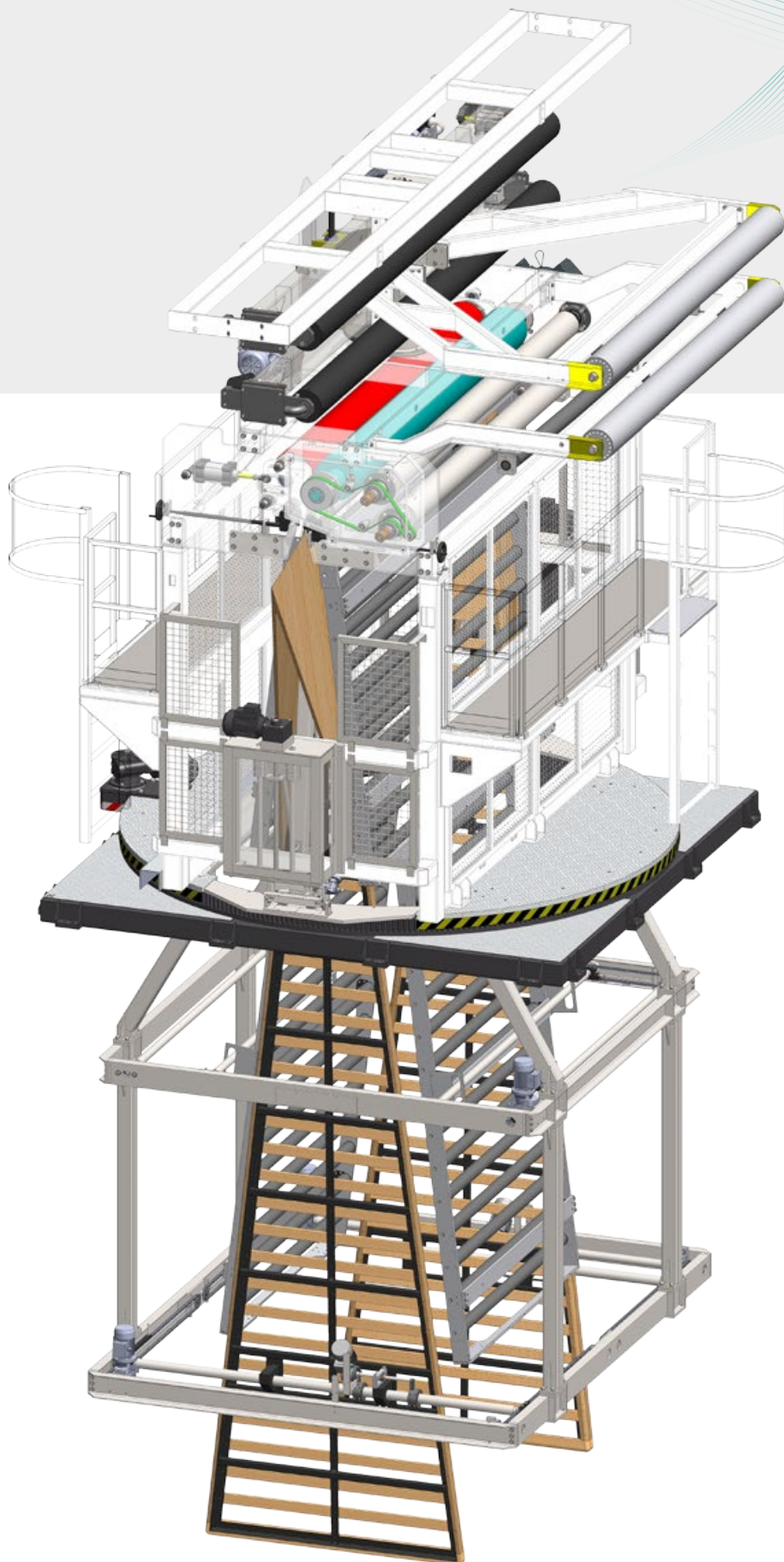
Macchi patented Coex Flex die heads are all designed to be extremely compact, with reduced body mass, a result achieved by eliminating the traditional multiple channel radial distributor below the die block. The melt flows from the different extruders are all fed at the same level to the designated entry ports. Each individual distributor is machined with a design distribution based on two melt flow path design.

A first section is designed on the so called melt splitting theory, based upon a perfectly symmetrical division of the different flows, followed by a traditional spiral section where the laminar flows are generated to obtain the correct co-extrusion stream. This system, where the length of the spirals has been reduced, has proved to be extremely efficient and guarantees a uniform distribution. With a very low resin inventory volume in the different layers and a consequently shortened residence time, this concept also ensures excellent results in terms of layer-to-layer thickness distribution.

As additional benefit, the transition times between product changeovers are shorter and generate less scrap. A further advantage lies in the mechanical aspects of the die-head engineering, where, thanks to the large size and the accuracy of the mating surfaces, a leak-proof sealing is obtained without the need of any kind of gaskets or sealing element. In an industry where die disassembly and re-assembly for cleaning are routine jobs, this exclusive Macchi Coex Flex design offers a highly positive contribution toward less expensive and simplified operations.



Melt flow distribution concept



stationary	800-1000-1200-1400-1600-1800-2000-2200-2400-2600-2800-3000-3200-3600-4000-4200-4400-4600
oscillating	800-1000-1200-1400-1600-1800-2000-2200-2400-2600-2800-3000-3200-3600-4000-4200-4400-4600

Take Offs

Remotely operated

gusseting arrangements are available, all featuring multi-axis control points. Specialty folding such as "C-shaped" or "8 centrefolds" are available for the larger units designated for agrifilm applications.

Collapsing frames

length is project-customized to enable the minimum possible bubble collapsing angle, beneficial to the obtainment of wrinkle free webs with optimum flatness features.

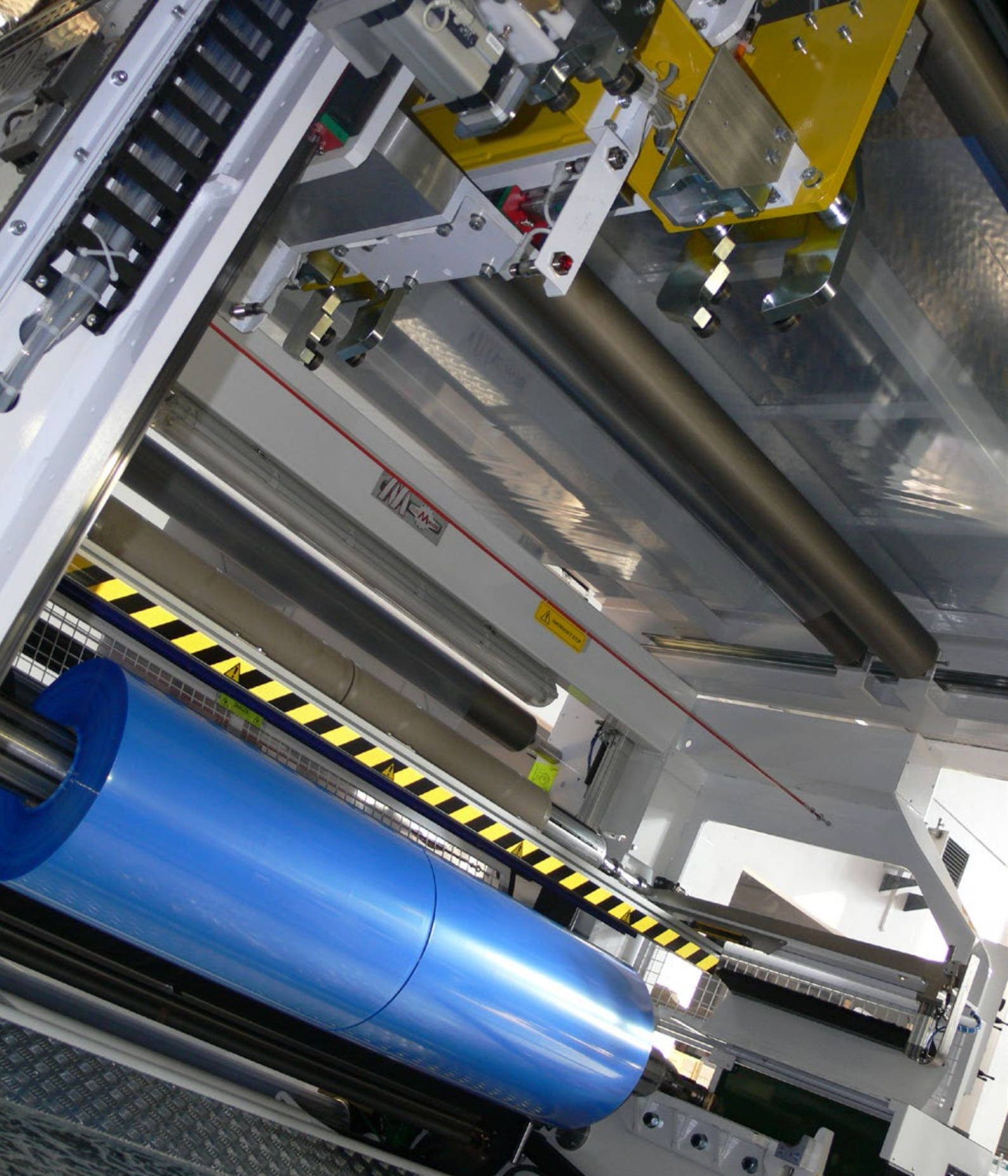
Macchi offer foresee a complete range of digitally controlled, gearless operated, fixed as well as horizontally oscillating take off units. Fixed executions are selected for all the applications where the extrusion die is rotating/oscillating, or for the handling of extra wide webs such as the ones used in the agricultural greenhouse business.

Horizontally oscillating units are another Macchi trademark, as we have been pioneering the use of these take offs, with continuous design development that reflects in key operational features targeted to the processing of any kind of film surfaces:

- Specially coated air-bar surfaces with variable pitch perforation
- Inverter controlled, individually managed air flows, to generate a sinusoidal airflow outlet
- 360° adjustable oscillation speed with $\pm 15^\circ$ slow motion feature to enable the production of gusseted films
- Machine structure assembled on extremely sturdy gear-bearing
- S-wrap cooling roller with built-in fluid thermoregulation
- On-demand supply of release-coated roller and nip arrangements for the handling of extremely sensitive or tacky products
- Aluminium or carbon fiber roller on low inertia bearings with thermally insulating textile compound
- Combined Rollers/slats execution

The collapsing frames associated to the take off arrangements are available in a wide variety of surface configurations, to provide for the optimal handling of different films.





	working width	film thickness	winding speed	max reel diameter	shafts diameter
Bo Basic	1000-2400 mm	6-250 micron	7 to 110 m/min	950 mm	76/152 mm (3"/6")
Bo Plus	1000-4000 mm	6-250 micron	7 to 200 m/min	1200 mm 1500 mm jumbo FFS	76/152 mm (3"/6")

Winders

BO Basic

is designed on simple but extremely functional and reliable concepts. It provides an exceptional quality/price ratio when compared with winders with similar features. Essentially it's a peripheral tangential winder (contact winding) featuring shaft support by means of horizontal sliding guides, and pneumatic, parallel control through connecting rods for the motion.

Even an excellent film, if incorrectly wound can seriously affect the subsequent stages of printing or web converting. Peculiar on co-extrusion systems, the characteristics of the films are often very different and present issues that are not easy to solve.

The winning product in the Macchi production range is the BO winding concept, a horizontal operation winding centre. Thanks to its great versatility, the BO series of winders is nowadays considered to be one of the best performing on the world market.

They are offered in two types of construction, both built on the same sturdy basic structure, BO Basic e BO Plus.

Macchi has developed a modular shaft handling system applicable to any BO Plus winder. The levels of shafts automation are carried out by means of the basic version of the Easy Load system, standard on all BO Plus winders. Different options for the automation of shafts loading are available:

- By means of service hoists, for shafts lifting and positioning on the Easy Load
- By means of the C Modules, automatic system for rolls and shafts handling, inflation/deflation, and removal. Robotic arms and product palletizers are available as further, operation enhancing option.

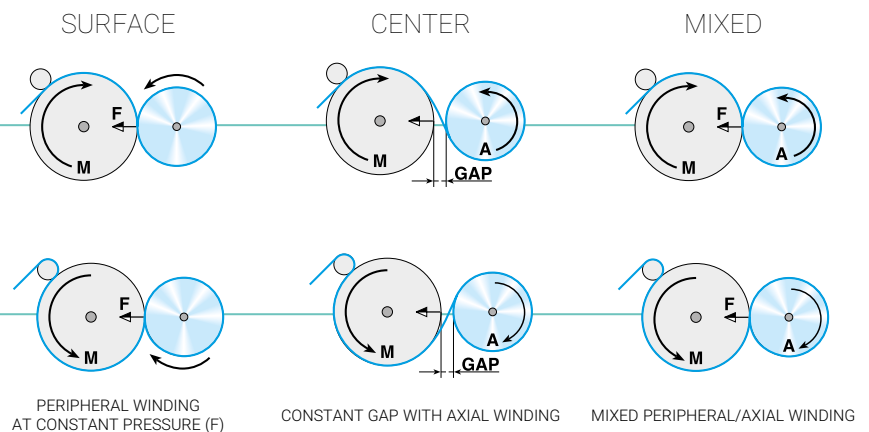
BO Plus

is a multifunctional winding machine, featuring contact, gap and centre-surface winding capabilities, always with the exclusive Macchi automatic reel change system. The winder modular units can be arranged in different patterns. The most complete configurations, equipped with (optional) automated movement systems for the shafts and the produced reels obtains a fully automatic winding centre.



Normal
Direction
Winding

Reverse
Winding



RECOIL®



Recotrim

Automation

The control panel allows to perform two additional operations in automatic mode:

- synchro – function that allows the shape and size of the pellet to be set in proportion to the extrusion speed, useful during start-up of the extrusion line.
- auto-blades – function that allows the constant shape of the produced pellet to be automatically obtained by controlling the extrusion pressure. This function is specially useful when the feeding of the trim is not constant, for example when trims are added or removed, or when a single RECOTRIM® serves multiple extrusion lines.

Trim feeding

Two methods of trim feeding are possible:

- the RECOTRIM® comes standard with an air/trim separation hopper. Whenever the extrusion line winder is equipped with a Venturi suction system, this is considered the easiest feeding solution
- as an alternative, for challenging applications such as the production of tacky films, the unit can be fitted with an optional nip roll, speed-matched with the winder.

The RECOTRIM® has been developed to enable the immediate recovery of side trims produced during film winding providing an almost un-manned usage, extremely simple and effective. Essentially, this device is considered a peripheral service unit within the production department, to be simply used without spending long time for start-up and fine-tuning.

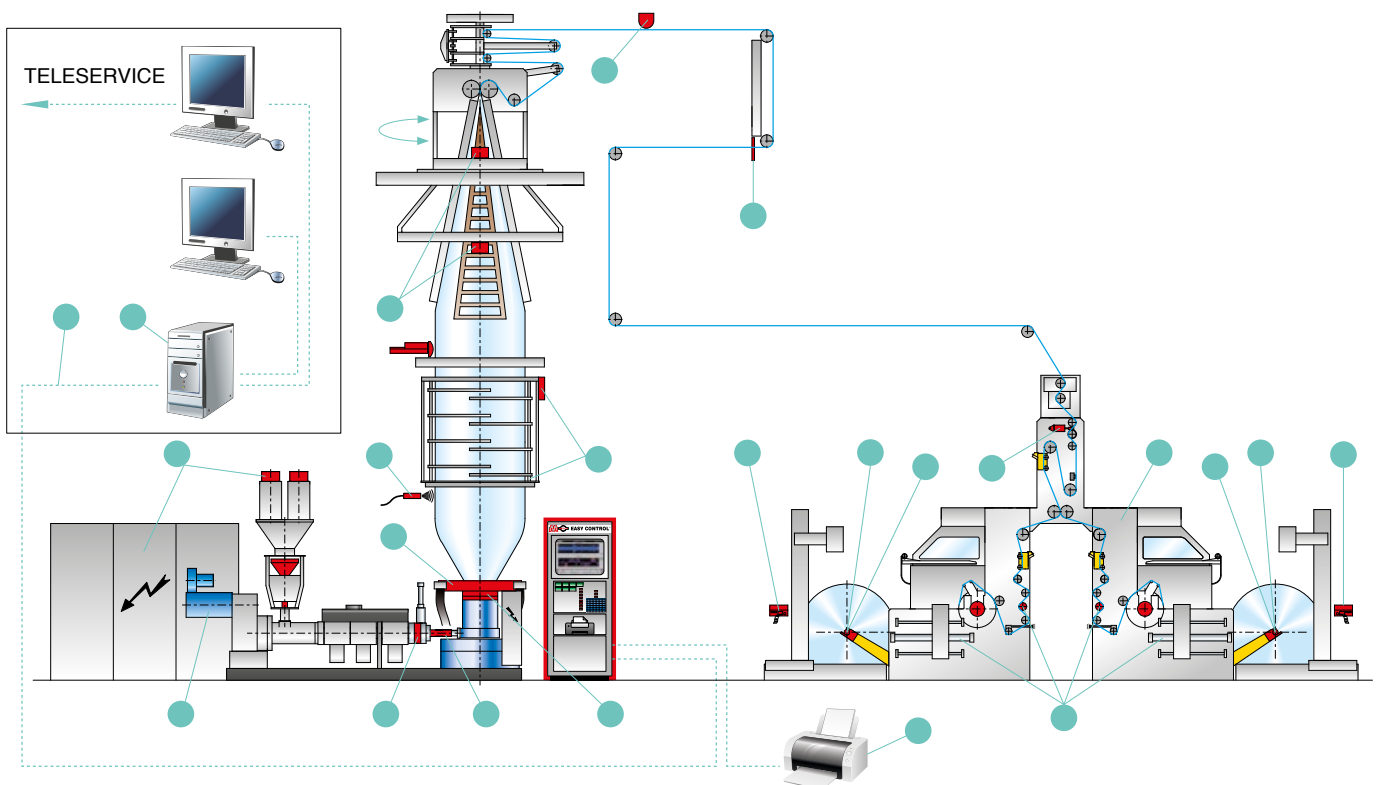
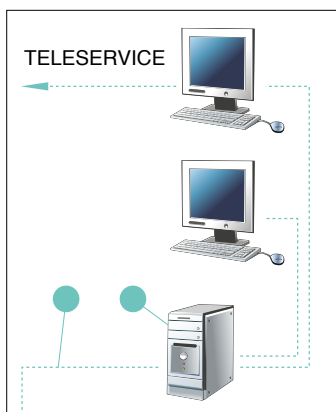
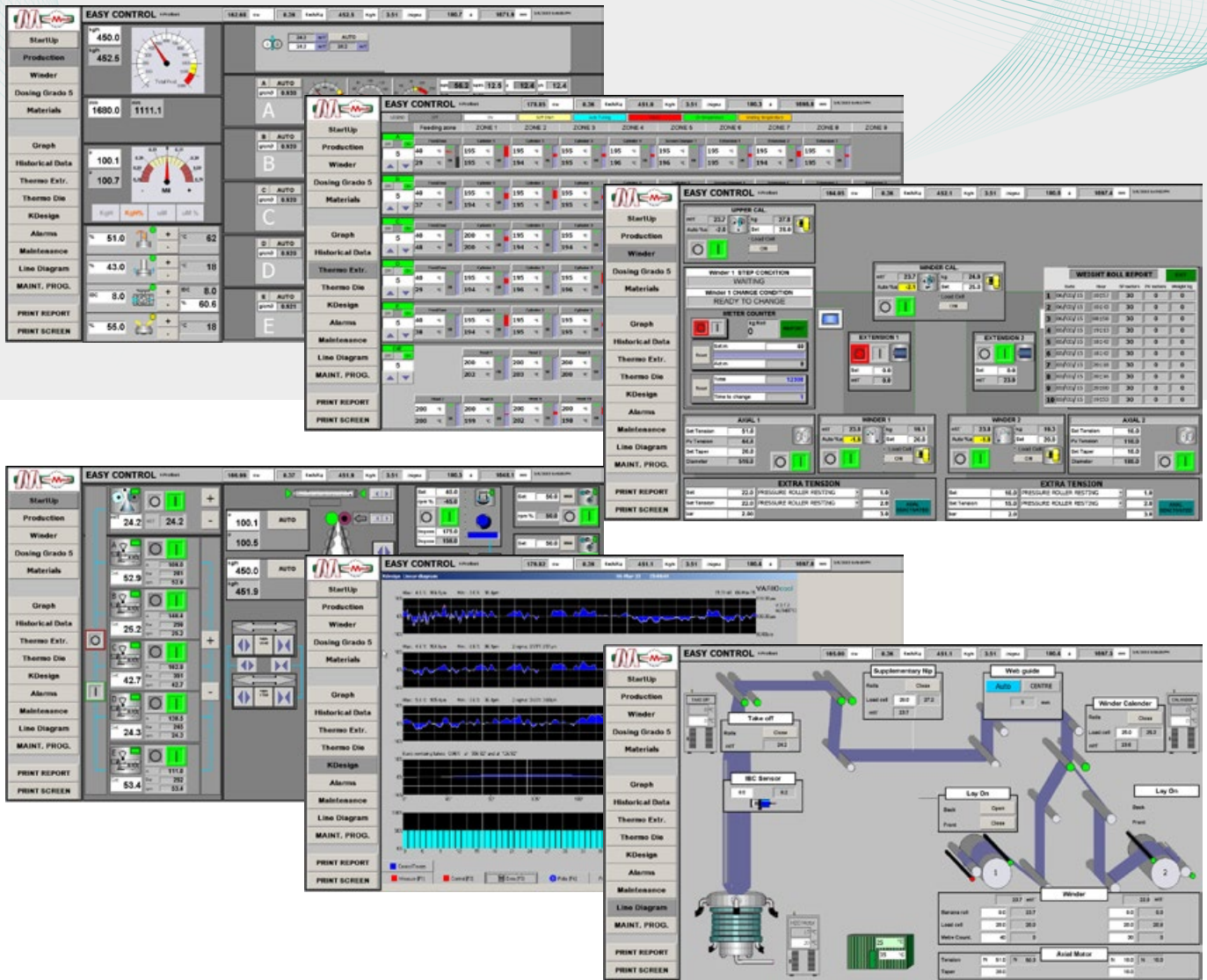
RECOTRIM® uses a patented trim infeed system, based on a counter-rotating twin screw that is capable to take-in thin or very thick trims. The material is melted and plasticized in the screw, then fed to a specially designed extrusion die -designed upon melt flow concept derived from the film sector- and exits through a strand die. An adjustable speed rotary cutting system transforms the extruded strands into pellets of the desired dimensions. By using the side opening in the hopper, also waste reels can be simultaneously or separately reclaimed. The production capacity varies according to the requirements and the types of material, and it may reach up to 40/50 kg/h.

A 6" LCD color touch screen connected to a PLC unit controls the machine functions, including:

- Temperature control of the extrusion unit zones.
- Melt pressure control.
- Cutter blade speed.
- Alarm displays.

The machine is wheel-mounted, with quick electrical connections allowing for easy placement and positioning.





Easy Control

Real-time continuous monitoring

of both equipment status and product quality controls ensure a strict product compliance and production reports can be printed, also as barcode labels, to grant product traceability.

Transition times and changeovers

are unavoidable part of an extrusion line management, and the more the layers the more delicate is the purging procedure, to be implemented, fast and effectively. To help the Operators in this task another built-in feature enables product changeover/purging program, to automatically change, at pre-set intervals, the various extruders throughput, minimising the time and the resin wastage.

Alarm and planned maintenance

are the very useful sections of the supervising system that enable fast troubleshooting and reduced downtimes. Remote serviceability also comes as standard on all our lines.

Based on a CIM industrial system, designed to work on hyper-fast Profinet communication protocol, our man-machine interface ensures operation and quality controls within an user-friendly environment, with large color touch screen panels displaying easily readable icons and mimic panels showing the actual status of any line component and device. As Profinet is a standard for industrial automation using a computer network, its modular structure allows to select only needed functions for different requirements, such as the ones found in an extrusion line, managing them as a system consisting of various automation components, e.g one component covers all mechanical, another the temperature another the electronic variables.

A planning tool enables the logical interconnections between the individual components to be generated for implementing the total line control. The engineering that is associated with it is manufacturer-neutral, so the tuning and the servicing of components or the integration of systems that are not of our manufacture is easy and effective. The intensive use of graphic elements and the availability of display pages in over 25 languages makes the line operations and parameters setting an easy task. The built-in, editable resin database enables the error free automatic retrieval of the key rheological data required to setup any specific product recipe.

The production recipes can be stored and recalled from a dedicated system section, reducing the line pre-setting times and smoothly integrating within all the other manufacture variables. Decades of experiences in managing our lines with these concepts in mind confirm the soundness of the principle that a machine should never be down due to a control failure. Even if all the used electronics are heavy duty industrial grade ones, a built-in UPS protects the supervision system from data loss due to electric power surges.

1961



Established by Luigi Macchi to manufacture blown film lines for the production of film for **milk pouches**. **Patent grant** for the design of the first two layer **coextrusion** die for liquid packaging films.

1980



Growth with consolidated positioning in European key markets of BENELUX, France, UK. Market **supremacy** in small and mid sized Coex 3 lines. **Expansion** of marketing actions in extra European Territories.

1997



Establishment of Macchi North America. **The Coex Flex concept** is extended to the **full family of Coex 3 lines**. Development of the **BoPlus winder**.

2000



Introduction of **Coex 5 layers**. Market Leader in the rafia/Raschel net business. **Development of Coex 7 technologies**.

Timeline

*Looking ahead
of the curve...*

2009



Running, World First, **the first Coex 9 with nanolayers** of EVOH. Consolidating leading position amongst the Key-Players in the flexible packaging business. **Development of large size lines for Coex 5** layer silage tunnels. Launch of dedicated Coex lines for five layers polyethylene films (POD Concept).

2012

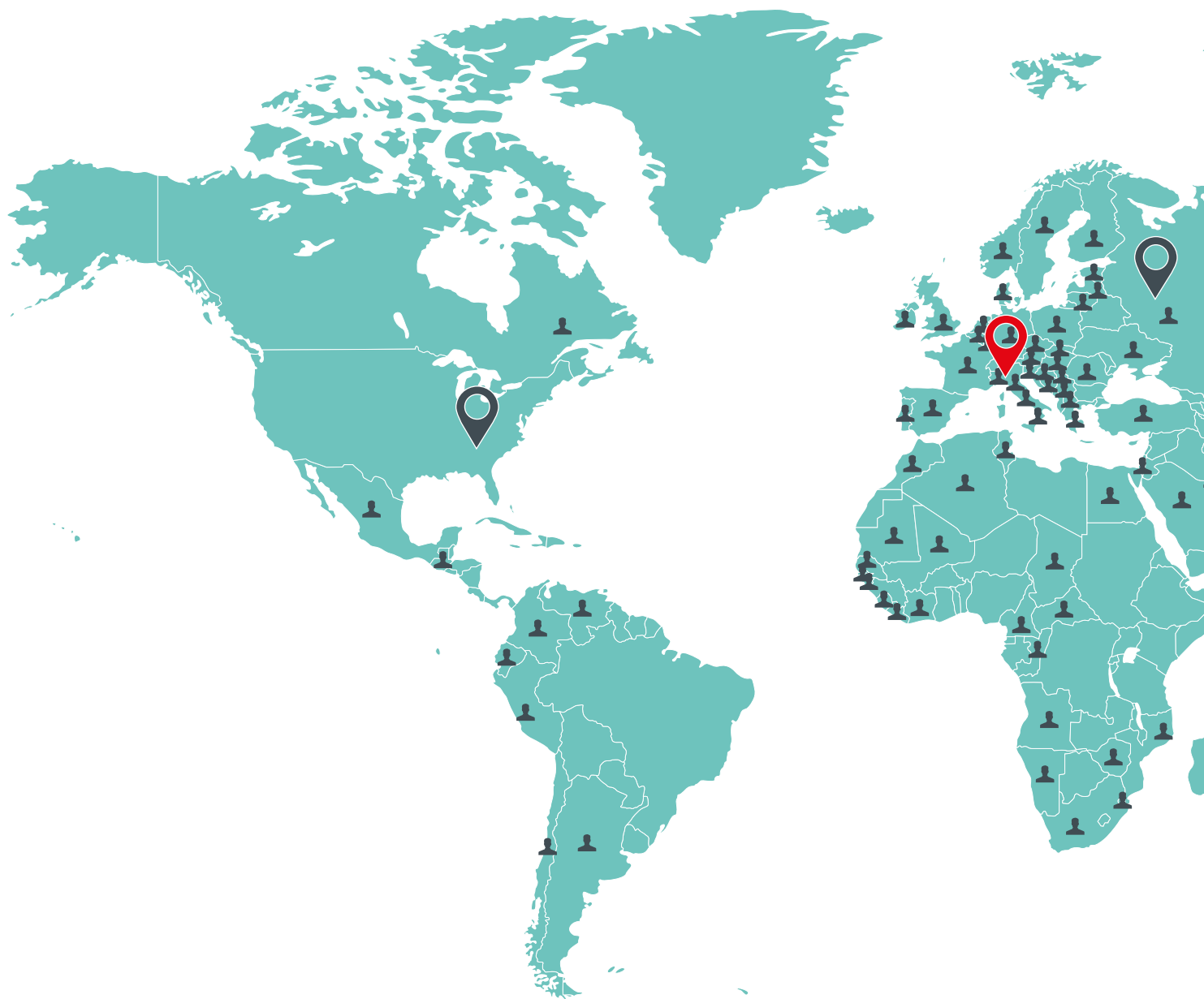


Factory expansion with 25 mts high-rise. **Development of large size Coex 7 lines for agriculture** and specialty applications. Implementation, **World First of full gearless extrusion** lines motion.

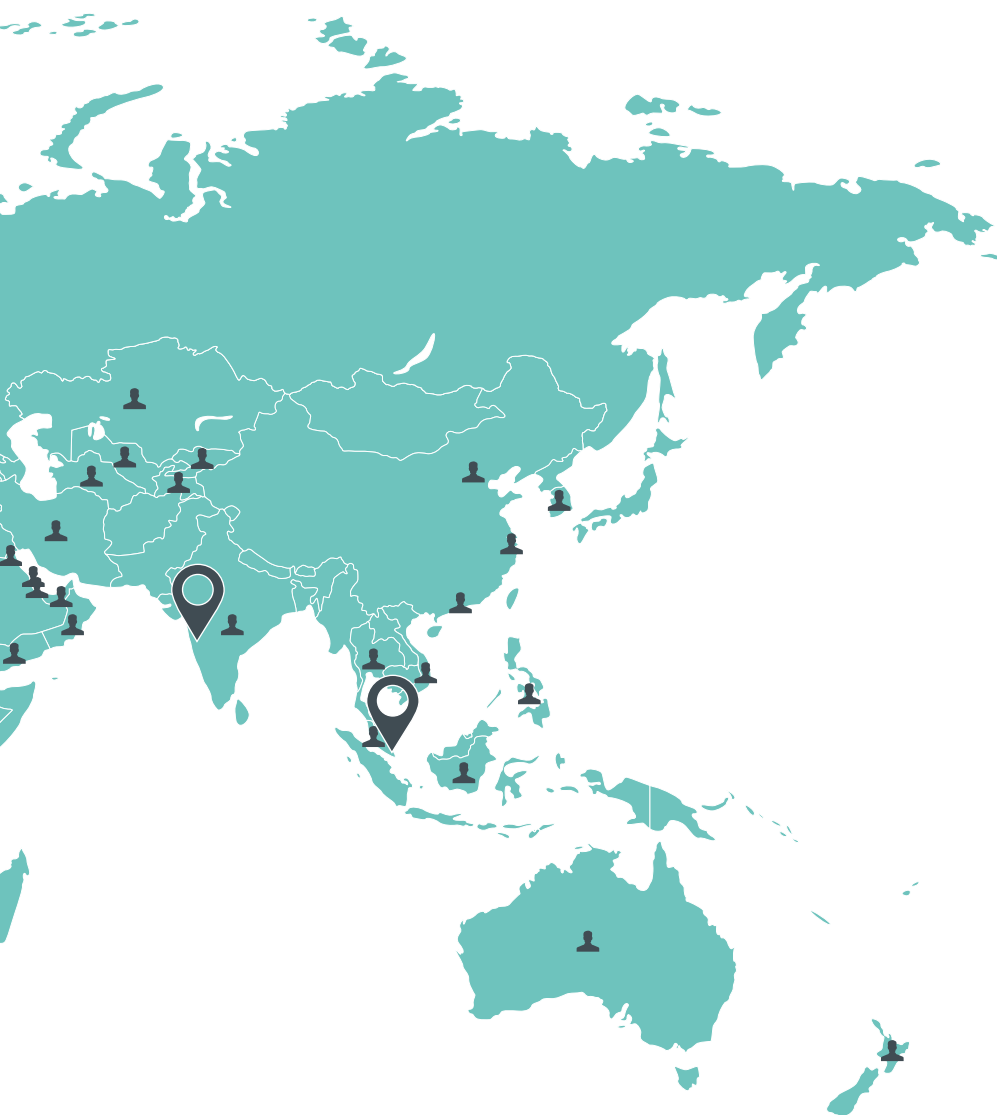
2015



Full scale implementation of line control with **Profinet protocols**. The **Coex 5 POD** Concept demonstrates its brilliant potential creating a domino effect with sales results exceeding the expectations. **Further machining capabilities and factory area extended**, with 35 mts high-rise planned.



Macchi Worldwide



Macchi S.p.A.

21040 Venegono Inferiore
Varese - Italy
via Papa Paolo VI, 5
tel. +39 0331 827 717
fax +39 0331 827 750
macchi@macchi.it

Macchi North America Plastic Machinery Inc.

1225 Coronet Dr. Suite 3
Dalton, GA 30720
P.O. Box 1185
Dalton, GA 30722
maurilio@millefanti.com

Macchi Russia

Andronovskoe Shosse 26
Bldg 5/Office 9
111024 Moscow
tel. +7 495 6625858
fax +7 495 6625858
coex@macchi-russia.ru

Macchi Asia

122 Serangoon av. 3 unit 15-01
554775 Singapore
tel./fax +65.66.809284
tel. +65.85.358973
mob. +65.82.961409
mob.+39.335.1048971
flavio.sesia@macchi.it

Macchi India

A-1/502 Shubharambh Phase II
Thane West 400607
Maharashtra-India
Mob. +91 9920812244-9320712831
Mr P.Ramachandran
macchi.ram@gmail.com



Macchi S.p.A.

21040 Venegono Inferiore • Varese - Italy
via Papa Paolo VI, 5
tel. +39 0331 827 717 - fax +39 0331 827 750
macchi@macchi.it • www.macchi.it