

SML

EXTRUSION LINES – ENGINEERED TO PERFORM ▶

100%
eXtrusion
CAST FILM LINES

PP / PE / PET
BARRIER FILM

LINES FOR CPP / CPE / CAST-PET BARRIER AND MONO ORIENTED FILM



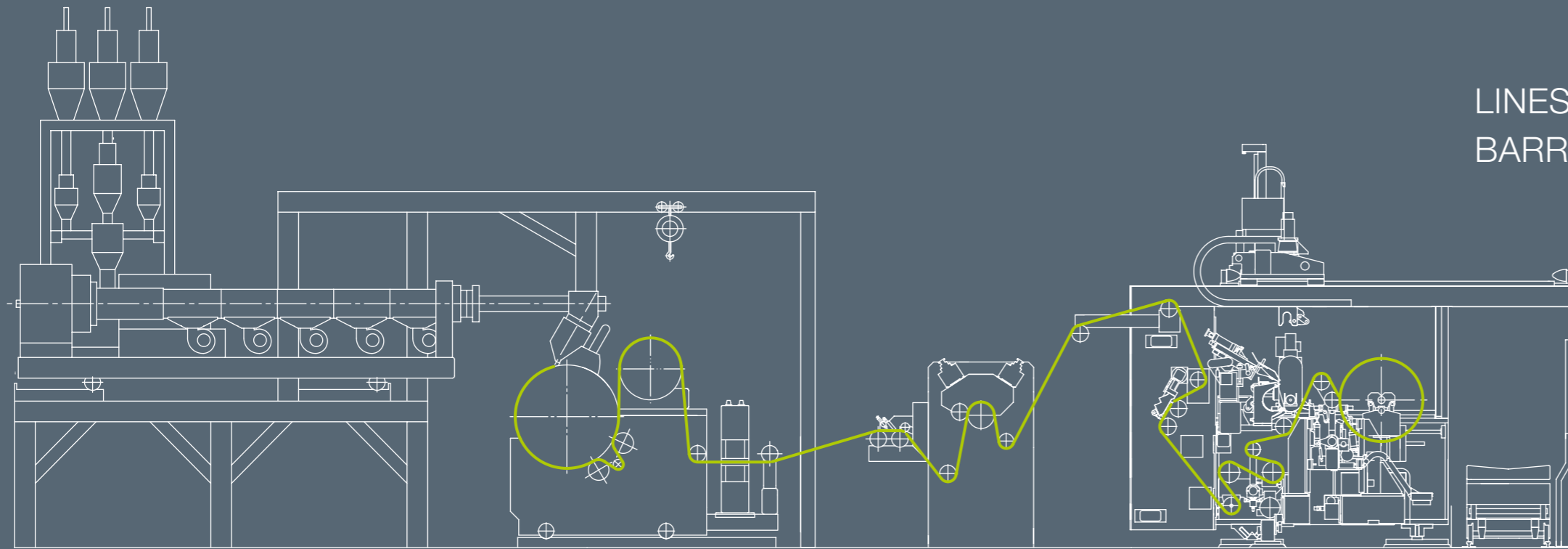
INTRODUCTION

Cast film products are mainly used in the packaging industry, but technical, medical and stationery films are also important sectors. Indeed, the worldwide market for flexible plastic packaging is predicted to grow steadily within the next years.

Owing to their good optical and mechanical properties, cast films play a significant role in the flexible packaging market. In most cases printing, metallizing or laminating with other materials represent the subsequent processes in the value chain.

Both, film producers and converters, expect high film quality and cost-efficient production. SML's experience in the entire range of cast films means that we are able to supply our customers with highly functional machines for their specific market requirements.

Aside from packaging applications, SML cast film lines are available for sophisticated technical films used in electronics, lithium ion batteries, for optical surface protection and for medical and pharmaceutical use.

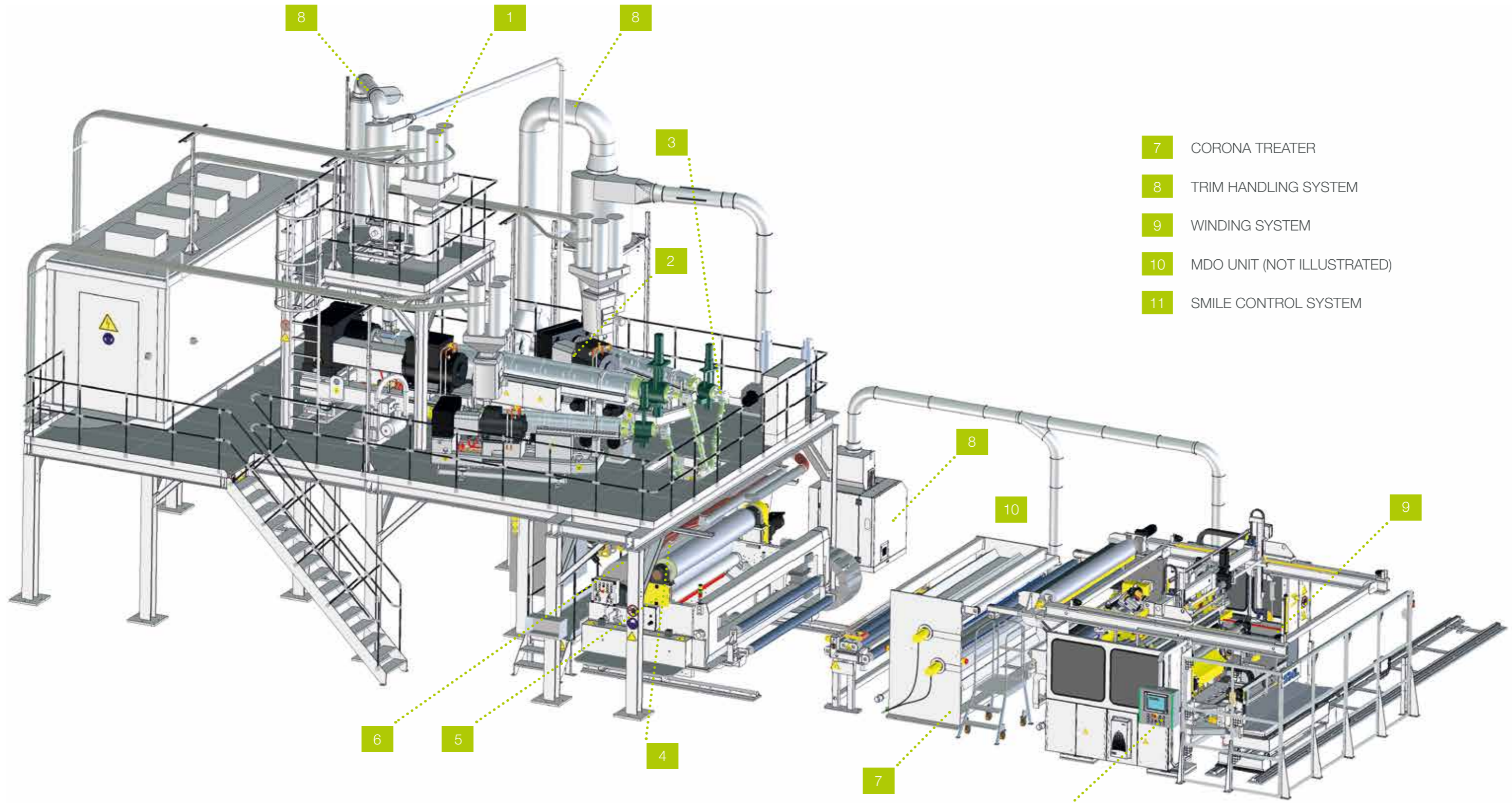


LINES FOR CPP / CPE / CAST-PET
BARRIER AND MONO ORIENTED FILM

CONTENTS

Line Description	6
Extrusion Unit	8
Downstream Equipment	15
Winding Systems	19





- 1 RAW MATERIAL HANDLING AND DOSING
- 2 EXTRUDER
- 3 MELT FILTRATION
- 4 FEEDBLOCK AND FLAT DIE
- 5 CASTING STATION
- 6 AIR KNIFE / SOFTBOX

- 7 CORONA TREATER
- 8 TRIM HANDLING SYSTEM
- 9 WINDING SYSTEM
- 10 MDO UNIT (NOT ILLUSTRATED)
- 11 SMILE CONTROL SYSTEM



multilayer extrusion unit

1 RAW MATERIAL FEEDING AND DOSING

In view of the fact that raw material account for the major portion of the cost for the production of cast films, it is essential to ensure their efficient use in every film layer. A wide range of gravimetric batch blenders and continuous gravimetric feeders, if needed also suitable for high-temperature polymer processing and with up to six components per extruder, enable recipes to be run with great accuracy and repeatability.



gravimetric batch dosing system



continuous gravimetric dosing system

Moreover, the complete dosing system, as well as all the material supply vacuum pumps, filters and valves are fully integrated into the SMILE control system.



extruder 150/33

2 EXTRUDER

SML extruders for cast film are designed according to the processing requirements for all the relevant polymers used in this market segment. A selection of standard versions with screw diameters from 45 to 220mm is available. As a rule, the extruders with an L/D ratio of 28 or 33 and bimetallic barrels are powered by energy-efficient, low-maintenance, water-cooled AC drives.

Depending on the size of the extruder and the processed materials, the screws are available with armoured flights for extended wear resistance.

All extruder barrels are heated using the SML advanced heating system. A gravity-closing flap prevents escape of hot air from the system, thus retaining the heat in the barrel.

As an option all adapters can be equipped with heat insulation between extruder and feedblock.

EXTRUDER OUTPUT

	45/28	60/33	75/33	90/33	105/33	120/33	135/33	150/33	180/33	220/33
No. of zones	3	4	5	5	6	6	7	8	10	12
CPP film [kg/h]	80	135	200	300	430	550	640	820	1,050	1,400
CPE film [kg/h]	100	150	230	320	450	570	660	850	1,100	1,500
A-PET film [kg/h]	100	150	230	320	450	570	660	850	1,150	1,600



HO-LT extruder 35/34

HO-LT EXTRUDER

This patented extruder is especially designed for the processing of temperature-sensitive polymers such as EVOH or adhesives. It is also used for the thin functional layers in coextruded structures.

HO-LT stands for “High Output – Low Temperature”. The special screw and barrel configuration enables these machines to plasticize large amounts of polymer at relatively low screw speeds.

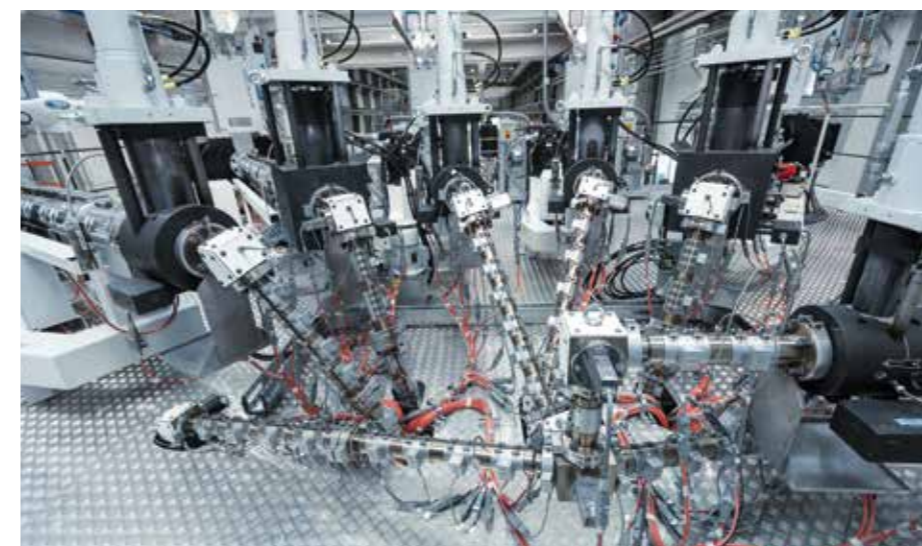
The result is a very low melt temperature, extremely stable output and high pressure generation.

SML offers the HO-LT extruder in two different sizes, which are typical for co-extruders in multilayer lines.



EXTRUDER OUTPUT HO-LT EXTRUDERS

		EVOH	Tie	PP	PE	A-PET	PA6
HO-LT 35/34	kg/h	120	110	120	110	110	100



extrusion tool unit

3 MELT FILTRATION

Effective melt filtration for the removal of impurities, unmelted or cross-linked particles is most important. Usually SML installs manual or hydraulic single filters in its cast film lines.

Disk filters or candle filters are used for applications such as surface protection or medical films, which require the strictest melt quality.





feedblock and die

4 FEEDBLOCK AND FLAT DIE

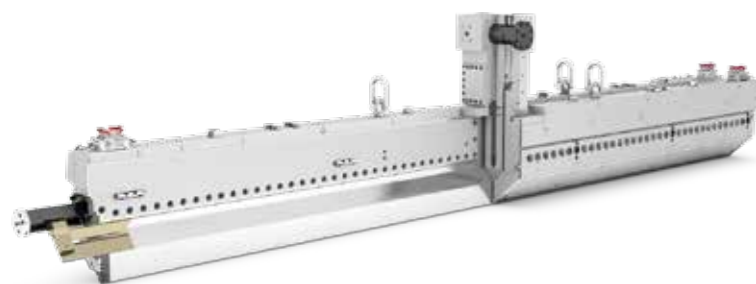
As a leading supplier of cast film lines, SML relies exclusively on respected partners for its feedblocks and flat dies.

Sophisticated MicroLayer or NanoLayer™ feedblocks are integrated on demand.

Multilayer structures require great flexibility with regard to feedblock adjustability. Therefore, SML generally utilizes variable geometry feedblocks and inserts that can be profiled to optimize the thickness variations of the single layers.

Co-extrusion flat dies with a T-channel shape are able to incorporate fixed or variable internal deckling systems, which allows efficient variations of the net film width. Depending on the manufacturer, dies are either chrome- or nickel-plated, but in both cases automatic die control via thermal heated bolts is standard.

In order to achieve better performance in terms of the individual layer distribution, multi-manifold dies are sometimes recommended for the structures using polymers with large differences in melt viscosity or processing temperature.



3-layer, multi manifold die (Cloeren Inc.)

A 3-layer feedblock with three extruders is standard for the production of CPP film, but there is also market demand for structures with five layers and four respectively five extruders.

For barrier films there are no limits in terms of the number of layers. For example, 3-layer structures with three extruders are used for the minimum requirement, while eleven layers with ten extruders are employed for special high-barrier structures.



SML die splitting system

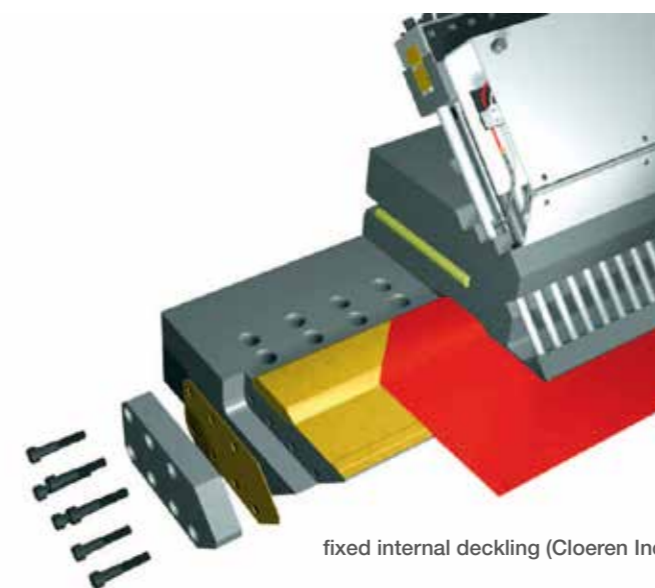
EDGE ENCAPSULATION SYSTEM FOR BARRIER FILM

Using the edge encapsulation system, it becomes possible to re-feed the primary edge trim to one of the extruders, because this trim consists entirely of clean encapsulation material (PE or PP) and is not contaminated with any barrier material. Encapsulation makes the production of barrier films more economical and reduces the scrap rate significantly.

The two encapsulation channels are fed from a separate small extruder directly to the edges of the die.

DIE SPLITTING SYSTEM

The die splitting system enables quick and safe die opening for cleaning purposes. The die remains in its original position in the machine and continues to be heated.



fixed internal deckling (Cloeren Inc.)



edge pinning system

EDGE PINNING

A combined electrostatic and pneumatic pinning system fixes the film to the chill roll surface and reduces the neck-in. Adjustable static power and air pressure, as well as easy positioning allow precise pinning and therefore solid contact between the film edges and the chill roll.

BI-VACUUM BOX

The box, which is mounted directly on the die body, consists of two chambers. The pre-chamber extracts the air stream generated by the rotating chill roll, while the main chamber maintains



bi-vacuum box

low air pressure between the extruded film and the chill roll and prevents air entrapment. In addition, the length of the melt curtain can be adjusted before it touches the chill roll. Both chambers are equipped with separate, speed-controlled suction fans.

The vacuum box is slidable mounted on the die splitter so it is not necessary to disassemble the vacuum box during die cleaning.



chill roll unit

5 CASTING STATION

In combination with the bi-vacuum box, the air knife or the soft-box, the casting station has a significant influence on final product quality. Parameters such as the position relative to the flat die, chill roll temperatures and vacuum box or air knife settings have a direct effect on optical and mechanical properties of the film such as haze, transparency, tensile strength or shrinkage.

The first chill roll has an electro-chemically matted and roughened surface that reduces air entrapment and allows an easy release of the film upon exit. The second and the third (optional) chill rolls have polished and chromium-plated surfaces.

Two chill rolls are sufficient for standard CPP film production, while the third chill roll is needed for the elimination of the curling effect when producing asymmetric barrier films. All the chill rolls are equipped with separate water temperature control systems and accurate speed control drives. Optional heating systems can be installed in the water circuit for polymers such as PA or PET.

A cleaning roll unit is installed to stop monomers and other deposits from contaminating the first chill roll. The cleaning roll with a smooth rubber surface and the crowning to compensate deflection presses the film constantly against the first chill roll, thus preventing deposits on the entire surface.

The complete chill roll unit is adjustable in horizontal and vertical direction in order to ensure the correct casting position for each product. Electrical drives actuate the movements and the actual position is shown on the control screen unit and stored in the recipe.

SML places the thickness-gauge unit directly on the chill roll frame behind the last chill roll to achieve the shortest possible distance from the extrusion die to the measuring point. This results in minimum space requirements and most accurate film thickness regulation. In answer to the differing regulations in customer countries and specific product needs, SML supplies automatic gauging systems either with infrared, X-ray or beta-ray sensors.

All the guiding rolls in the production line have a cut-resistant surface for high film grip and long service life.



air knife

6 AIR KNIFE / SOFTBOX

For the production of thicker film, it is necessary to fix the film additionally onto the chill roll using either an air knife or a softbox. This also enhances film cooling, which results in better haze and transparency values.

The SML air knife has a specially designed, internal air distribution system, which guarantees a constant airflow over the whole width of the air knife, and an adjustable lip gap.

The air for the air knife is filtered to ensure that no particles are blown onto the film and the blower of the air knife is speed-controlled.

The softbox represents an alternative to the air knife and offers the advantages of a larger area in which the film is attached to the chill roll and a gentler airflow. Moreover, as compared to the air knife, softbox handling and adjustment are easier.

SML patented its softbox with small fans over the entire width and an internal air-distribution system. All the fans are speed-controlled. Both the air knife and the softbox can be equipped with air-cooling or air-heating systems as an option.

The softbox and the airknife are slidably mounted on the die splitter. If these units are not necessary during production they can be moved to a parking position which is outside of the operation area.



softbox



corona treatment

7 CORONA TREATER

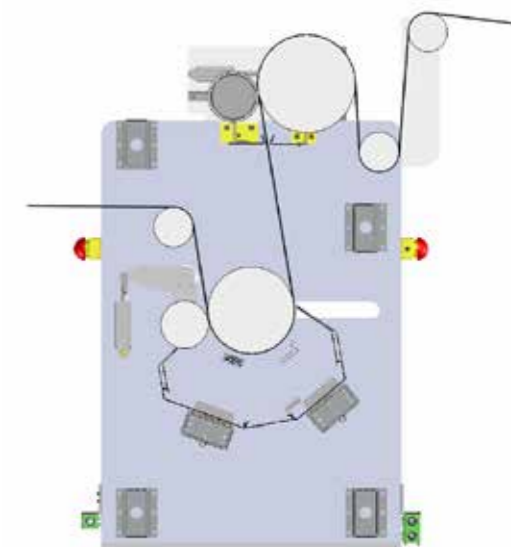
A corona treatment unit must be installed in order to prepare the films for subsequent offline printing or metallizing processes.

Depending on customer requirements, one-side reversible or double-side treatment stations are employed. The corona unit is equipped with electrically driven, water-cooled treatment rolls and with a nip roll to prevent backside treatment of the film. For a gentle but effective treatment to the required surface tension, it is important to select the correct number, shape and material of the electrodes in combination with a well-dimensioned generator.

During corona treatment, the film is heated, whereby the amount of heating energy required is contingent upon the speed, raw material and treatment level. Depending upon the design of the treatment station, a driven post-cooling roll with a nip roll for additional film cooling can be installed either directly at the corona station, or at the winder inlet.



corona unit





8 TRIM HANDLING SYSTEM

The edges of the film need to be trimmed in front of the corona treater, in order to prevent backside treatment. A final trim is cut directly at the winder and depending upon the winding system, bleed trims are also removed.

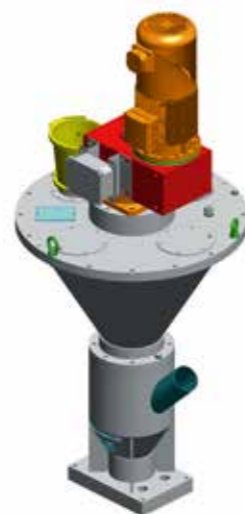
bleed trim cutting



fluff re-feeding unit

The trims are sucked through the grinder of the fluff re-feeding system and then transported to a vertical scraptruder. This feeds the fluff together with virgin material directly to the extruder for the core layer.

Fluff re-feeding is a very energy-efficient and material-compatible method, as no additional melting is involved, which results in less thermal stress of the material.



vertical scraptruder

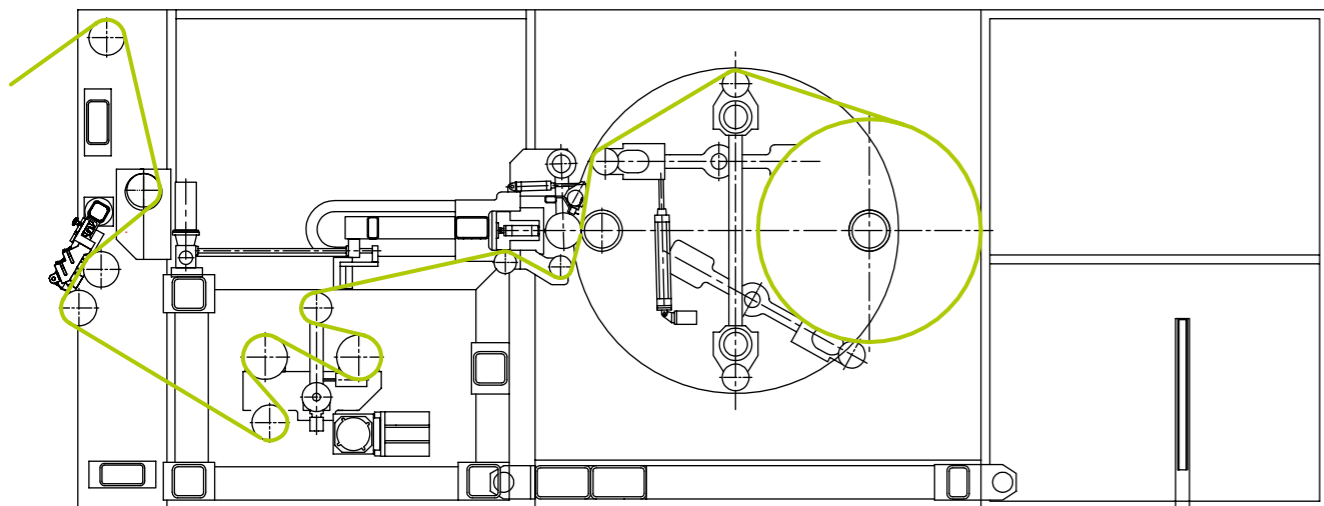


9 WINDING SYSTEMS

For many years, SML has been making major efforts to build its own peak performance winders. Every new product, idea or requirement, which is spotted in the market, or is the object of a customer inquiry, is passed on to the R&D department. Following a detailed evaluation, SML then upgrades its winders with corresponding new features.

SML has created different winding systems focused entirely on the demands of film producers and their customers. All these winders have a solid, vibration-dampening steel frame construction, which is able to resist the dynamic forces generated at high production speeds.

Each winder is equipped with a large, 17-inch touch screen for winding parameter adjustment and maintenance work.



WINDER W1050

The winder W1050 is the basic turret winder for the production of thin cast film mother rolls on 6-inch shafts with a maximum winding diameter of 1,000mm.

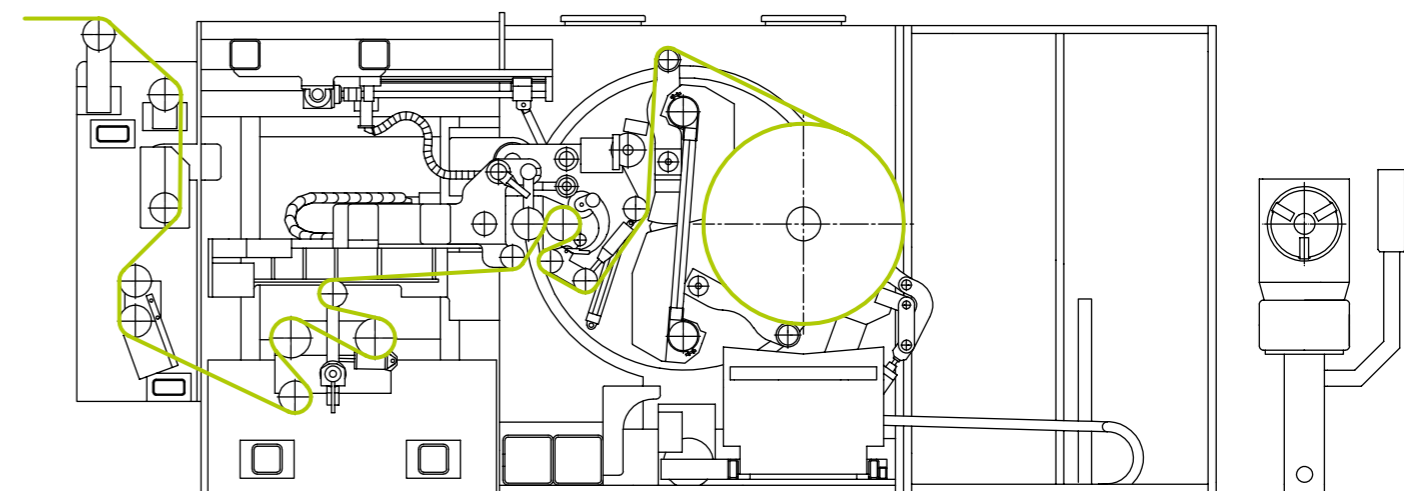
An ultra lightweight dancer roll controls film tension, while the shaft is center-driven and the film is wound onto the roll in either a gap or contact mode.

Film cross-cutting is performed by a twisting knife and in standard configuration, the new winding core is prepared with double-sided adhesive tape.

As an option, the film can be fixed onto the new winding core by means of electrostatic charging, thus making core preparation unnecessary.

During indexing, the incoming film is attached to the surface of the finishing roll by an auxiliary contact roll. The finished roll is removed by a semi-automatic trolley.

As an option, this winder W1050 is also available in shaftless version.

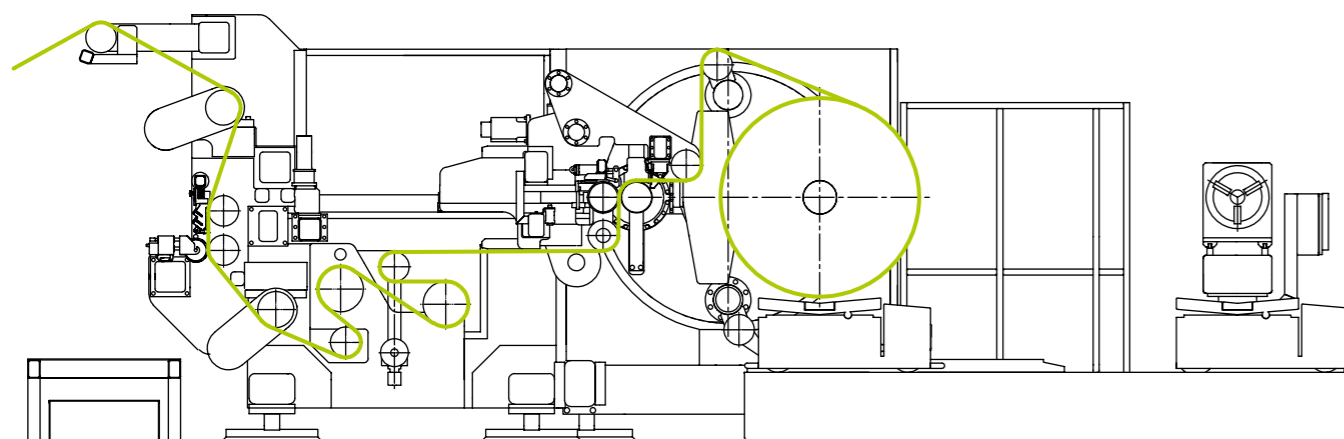


WINDER W1100

Based on the model W1050 the winder W1100 is equipped with a strong guillotine cross-cutting knife for thick cast film. It is able to produce mother rolls on 6-inch shafts with a maximum winding diameter of 1,000mm.

For the reason that film will be fixed on the new core electrostatically it is not necessary to prepare the core with double adhesive tape. During indexing, the film is attached to the surface of the roll by an auxiliary contact roll.

The finished rolls are removed by a semi-automatic trolley or, as an option, by a fully automatic overhead robot system. The winder W1100 is available with steel winding tubes for shaftless operation as an option.



WINDER W1200

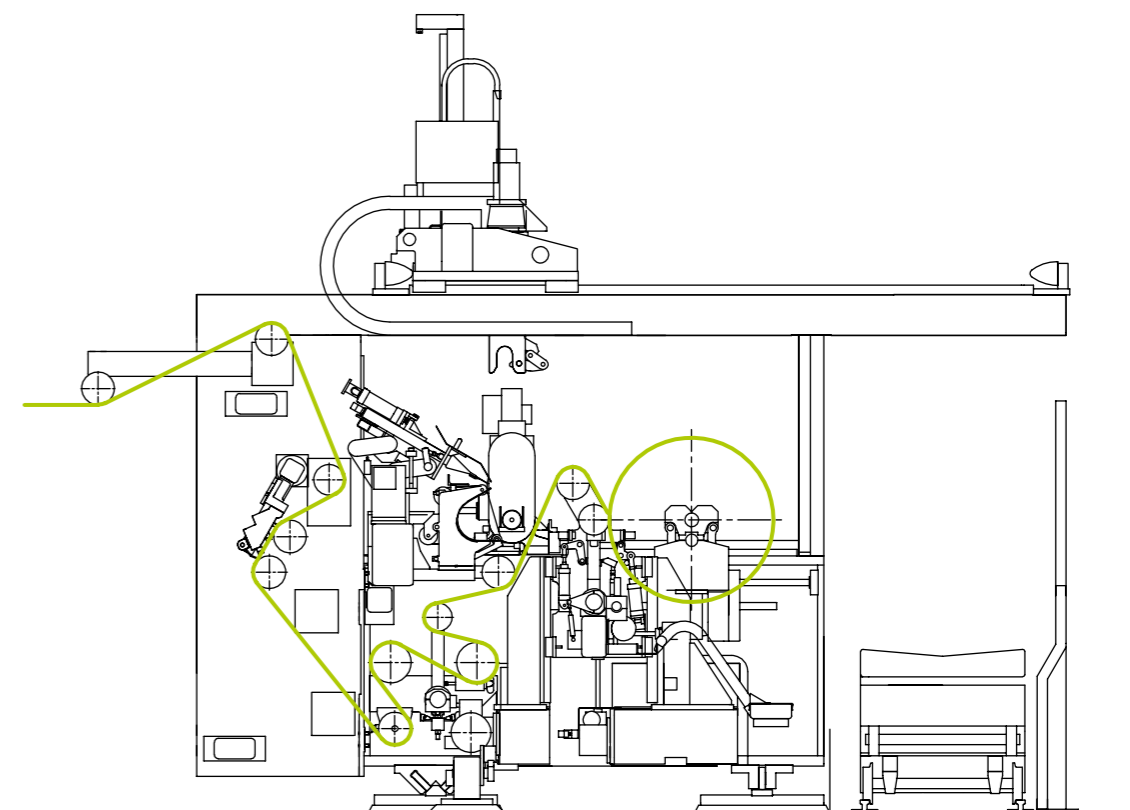
The winder W1200 is the thin film turret winder for large widths of up to 5.2m and maximum roll diameters of 1,200mm.

An ultra lightweight dancer roll controls film tension, while the shaft is center-driven and the film is wound onto the roll in either a gap or contact mode.

Film cross-cutting is performed by a twisting knife and as the film is fixed onto the new winding core by means of electrostatic charging, no core preparation is necessary.

During indexing, the incoming film is attached to the surface of the finishing roll by an auxiliary contact roll. This winder with steel winding tubes can either be operated with winding shafts or shaftless.

A semi-automatic trolley together with a shaft pulling device is available as an option for the handling of heavy rolls or shafts.



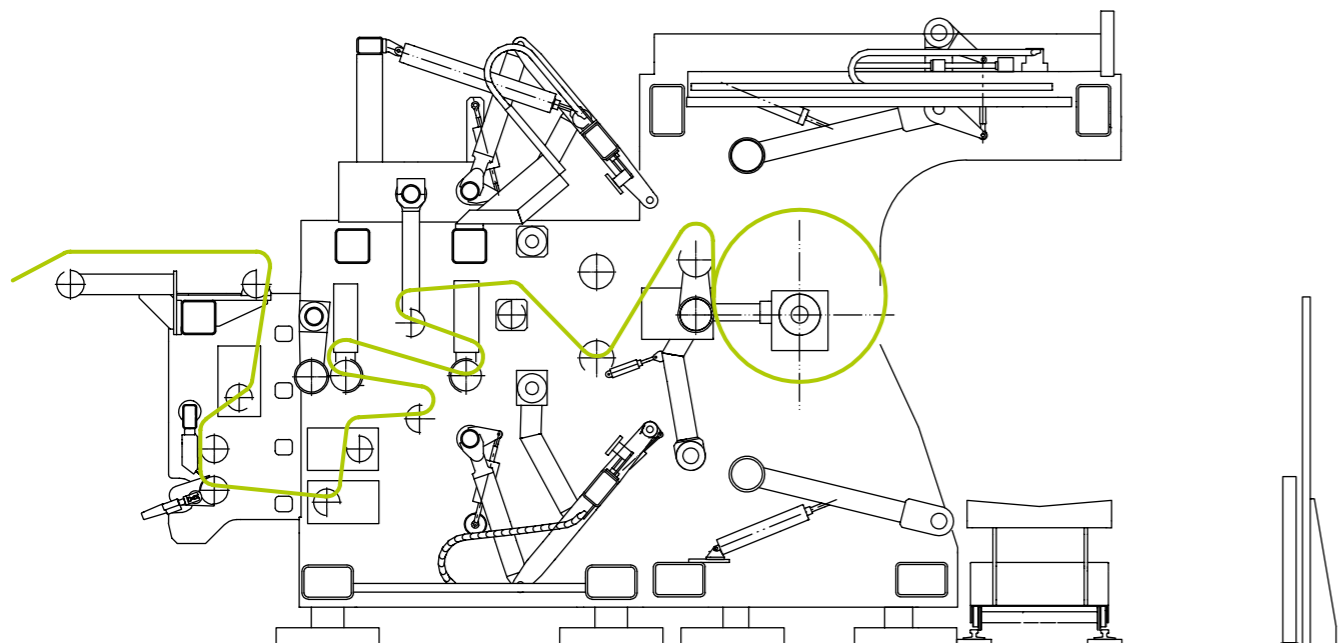
WINDER W2000

The winder W2000 robotic is a horizontal sliding winder for the inline-slitting of part rolls to narrow widths. With over seventy units running in the field the winder W2000 is the most popular and proven winder for cast film.

Owing to the principle of horizontal shaft movement, the roll remains in an optimum winding position until the very last moment before cross-cutting, thus guaranteeing perfect winding quality up to the last layer on the roll. This winder is designed for the winding of films in a wide thickness range, is equipped with an ultra lightweight dancer roll for sensitive tension control and can be operated in gap or contact mode. A satellite roll optimizes the entrance angle of the film to the roll, which minimizes air entrapment between the layers. Optional a XL-version of the winder W2000 is available, maximal diameter 1,300mm. Different

cross cutting units and film fixing systems are possible, depending on the film and requirements. The inline-slitting process can be carried out either with or without bleed trims. Depending on the product, slitting stations with razorblades or with circular knives are integrated at the winder entrance.

The finished rolls and the winding shaft are transported onto a moveable lifting table by an overhead robot, while a trolley pulls the rolls from the clamped shaft. The complete roll and shaft handling process is fully integrated into the automatic mode of the winder.



WINDER W5000

The winder W5000 is a linear turret winder (LTW), which combines the advantages of a horizontal sliding winder and a turret winder and sets new winding standards for cast film.

It is a turret winder, which prior to cross-cutting reduces the free length of the web to a minimum by means of individually moveable winding stations, which guarantees perfect winding quality up to the last layer on the roll.

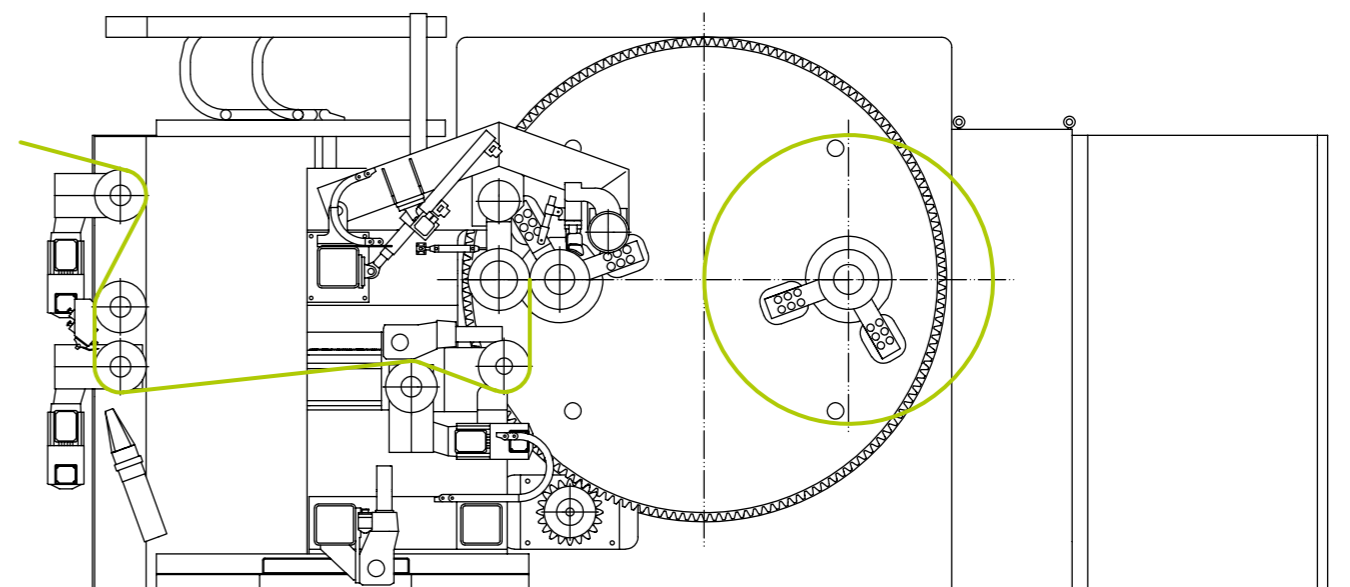
Before roll changes, the active roll moves horizontally into the centre of the turret, which prevents any further movement while the new shaft is turned into the cutting position by the turret. In addition, as soon as the roll leaves the stationary main contact roll, an auxiliary contact roll guides the film.

Depending on the film thickness, the film is cross-cut by a twisting knife, or by a flying knife. After cross-cutting, the finished roll is

again moved horizontally from the central to the outer removal position and is then pulled from the shaft by a lifting trolley. The winding shaft constantly remains fixed on one side of the winder, which allows a higher load and less deflection as compared to conventional winding systems.

Another feature of the winder W5000 is the possibility for the installation of an additional cutting unit, which provides the ability to wind in both directions. If 3-inch shafts are used with a large width, a centre support can be installed that offers adjustable positioning. Inline-slitting can be carried out without bleed trim and depending on the product, slitting stations with razorblades or with circular knives are integrated at the winder entrance.

The complete roll handling process is fully integrated into the automatic mode of the winder.



WINDER W6000

The winder W6000 is a shaftless turret winder for extra-wide, cast film lines with widths of up to 6m. Typical products are thin CPP or CPE film, mother jumbo rolls wound onto 10- or 12-inch steel winding cores. The winder W6000 can carry loads as heavy as 7t and provide a range of rolls with diameters of up to 1,300mm. Moreover, in line with the recent trend towards an increase in the largest possible reel diameters on metallisers and slitters, an optional version with a top mechanical winding diameter of 1,500mm is available, which raises roll length to a maximum.

Before the film enters the winder, the film is oscillated by an oscillation frame, which can be adjusted with regard to speed and oscillation width. The winder is equipped with ultra-light carbon fibre rolls for optimum performance at elevated speeds and an edge trim cutting unit with a spreader roll is installed at the winder inlet. Further downstream, an adjustable satellite roll matches the entrance angle of the film precisely to that of the film roll, thus

minimising air entrapment between the film layers. A spreader roller also keeps the wrinkles on the roll to a minimum. The winder can wind in both a gap and contact mode. The turret unit consists of two massive side frames in which the turning disks with chuck heads and drives are indexed. To avoid vibrations, the disks are guided by strong two-path, ball bearing slewing rings.

Film crosscutting is carried out using an electro-mechanical operated flying knife. The film is attached to the new steel winding core by an electrostatic system, while a hall crane to be supplied by the customer handles the finished rolls.

Like all other SML winders, the winder W6000 is equipped with its own control unit.

Winding	winder W1050	winder W1100	winder W1200	winder W2000	winder W5000	winder W6000
Film thickness range	15 - 100µm	15 - 300µm	15 - 100µm	15 - 300µm	15 - 100µm	15 - 100µm
Maximal mechanical speed	400 m/min	400 m/min	400 m/min	400 m/min	500 m/min	300 m/min
Maximal winding width	2,800mm	2,800mm	5,200mm	3,250mm	4,200mm	6,200mm

Winding shaft/pipe diameter	3-inch ¹ 6-inch	3-inch ¹ 6-inch	6-inch 8-inch	3-inch ¹ 6-inch	3-inch ¹ 6-inch 8-inch 10-inch	10-inch 12-inch
Max. mechanical diameter ³	1,000mm	1,000mm	1,200mm	980mm W2000 XL: 1,300mm	1,600mm	1,300mm
Winding direction	top outside	top outside	top outside	top inside	both	top outside

Winding tension	10 - 100 N/m	10 - 100 N/m	10 - 100 N/m	10 - 100 N/m	10 - 100 N/m	10 - 100 N/m
Contact roll pressure	50 - 500 N	50 - 500 N	50 - 500 N	50 - 500 N	50 - 500 N	50 - 500N

Roll handling	semi-automatic	semi-automatic	semi-automatic	automatic	automatic	manual
Oscillation	frame	frame	winder or frame	winder or frame	winder or frame	frame

¹ Depending on end film width and product



MDO unit

10 MACHINE DIRECTION ORIENTATION (MDO)

For special film applications, SML integrates an inline MDO into cast film lines. SML has accumulated 45 years of experience in film stretching and has created excellent MDO units for a wide range of applications.

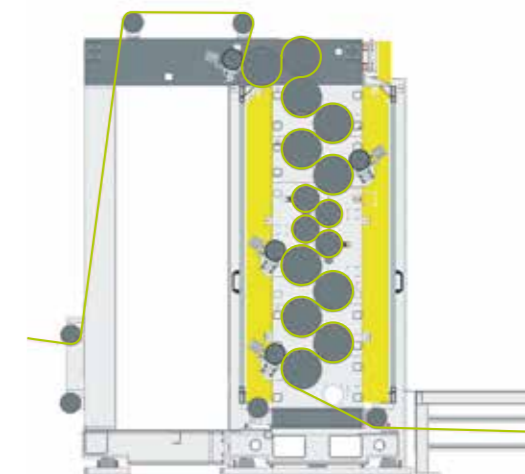
The monoaxial stretching process allows to adjust a variety of film properties such as elongation, tensile strength, shrinkage, stiffness, barrier and optical characteristics. Furthermore, downgauging by stretching represents a growing trend in the film industry.

TYPICAL MDO FILM APPLICATIONS INCLUDE:

- Carrier handles
- Self-adhesive tapes
- Tear tapes
- Label film
- Foamed film
- Aging resistant and shrink-optimized PET-film
- Barrier film

MDO units consist of a stable, modular machine frame, including a preheating section, a stretching section and an annealing and cooling section. All the rolls are separately driven and temperature-controlled. Well dimensioned film preheating and annealing sections are important with regard to mechanical properties and high production speeds.

The modular design of the MDO allows the addition of preheating or annealing rolls. Nip rolls can also be installed on every roll in order to fix the film and to eliminate air entrapment. As an option, the MDO is equipped with an adjustable stretching gap. For comfortable line start-up, the unit is equipped with a film feeding chain. SML MDO's are also available for blownfilm lines or offline stretching processes.



MDO unit for MOPP film



e-container

11 SMILE CONTROL SYSTEM

An innovative, intuitive and operator-friendly human-machine interface (HMI) with two 17-inch touch screens provides all the functions needed by operators and maintenance personnel to handle the complete line. Everything, from the input of the ratio of each raw material to the parameters of the winder can be dealt with from the main terminal, which is located in the casting section. A second touch screen at the winder that is linked to the main terminal allows winding parameter adjustment directly in the field of vision for the process.

Different access levels and features such as alarm management, recipe administration and remote service via ethernet/internet are standard. For extended trend analysis and quality documentation, data can be transferred to a data logging system via a separate PC, or existing data collection systems. The electrical equipment is either installed in an e-container or, depending upon the space requirement, in e-cabinets. Both customised solutions are supplied complete with electrical engineering, wiring and air-conditioning equipment. Only first choice and proven components are used for each device.

ADVANTAGES
<ul style="list-style-type: none"> Centrally operated touch-screen monitor, displaying all relevant data
<ul style="list-style-type: none"> Central control of all production parameters
<ul style="list-style-type: none"> Industrial Ethernet Powerlink connection to decentralised I/O points
<ul style="list-style-type: none"> Process data analyses
<ul style="list-style-type: none"> Integrated OEE (Overall Equipment Effectiveness)



control panel

HIGHEST QUALITY PRODUCTS



NOTES:

SML

EXTRUSION LINES – ENGINEERED TO PERFORM ▶

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