You Can Avoid Yield and Productivity Losses... by Installing LineMaster on Your Existing Extrusion Lines

The Maguire LineMaster system is simple to operate and cost effective. It works perfectly with all types of extrusion processes to ensure a uniform, quality product. From mono-layer, single extruder lines to multi-layer co-extrusion lines LineMaster provides a solution that is both simple and cost effective.

Benefits of LineMaster™
- Improved product quality through permanent and consistent control.
- Reduced material costs through improved yield.
- Automatic regulation of extruder output.
- Increased line productivity with fast start-up and reduce scrap.
- Quick product changeover.
- Alarms and user security.

Control Options

Production is effectively controlled by any 1 of 3 methods:

Method 1 - Throughput (lb/hr or Kg/h) – XC-1
Method 2 - Weight per Length (lb/ft, g/ft, g/m, kg/m) – XC-2
Method 3 - Weight per Length, Dual Control (lb/ft, g/ft, g/m, kg/m) – XC-3

Throughput (lb/hr or Kg/h) – MODEL XC-1

XC-1 is ideal for simply controlling the throughput of an Extruder or Starve Feeder. Applications include simple lb/h or kg/h extruder control where other downstream equipment is already automating the Take-Off control, for example online gauging or IBC (Internal Bubble Cooling) control.

Weight per Length (lb/ft, g/ft, g/m, kg/m) – MODEL XC-2X, XC-2T

XC-2X Weight per Length control via extruder drive
XC-2X is ideal to control the output of an Extruder or Starve Feeder. Typical application is to control Weight per Length (lb/ft, g/ft, g/m, kg/m) where other downstream equipment may already be automating the Take-Off control, for example, online gauging or IBC (Internal Bubble Cooling) control.

XC-2T Weight per Length Control via Take-Off drive
XC-2T is most commonly selected for mono layer lines. The line speed is determined by the digital encoder mounted on any rotating shaft or roll of the Take-Off. Using the throughput information (lb/h or kg/h) from the extruder, the actual weight per length of the film product is calculated in grams/m. The control of the Take-Off drive, which often has a much finer resolution than that of an extrusion drive, is then maintained automatically, adjusting the speed of the line up or down in relation to extrusion output.

Dual Control (lb/ft, g/ft, g/m, kg/m) – MODEL XC-3

XC-3 Weight per Length Control (lb/ft, g/ft, g/m, Kg/m), or Calculated Gauge Control (mil., micron) of both Extruder and Take-Off Drives

XC-3 can be used on mono layer lines where a user wishes to automatically control both the extruder output and the Take-Off line speed. XC-3 is ideal for use on multi layer, co-extrusion lines. XC-3 operates on the Main layer – the Master layer of the co-extrusion line, and controls both the speed of the extruder drive and speed of the Take-Off. The Side layers, or Slave layers, are controlled by an XC-1 Throughput Control on each layer. To co-ordinate the layers and total line output a Touch Screen Panel PC is used with the XC software to accurately co-ordinate the throughputs to each layer accurately and maintain correct line speed. Control can be managed by either Weight per Length (lb/ft, g/ft, g/m, kg/m) or Calculated Gauge Control (Micron or Mil.).
The design of LineMaster is modular to allow easy selection of the components required for either a mono or co-extrusion film line.

Core Components  LineMaster is comprised of two key components:

LIW Loss-in-Weight Hopper

The LIW Loss in Weight hopper is sized to suit the maximum possible output of a mono or co-extruder layer of a line. The range of LineMaster Loss in Weight hoppers cater to every application of free flowing material, pellets, granules or powder, and incorporates a controller for the LineMaster. Key information is summarized on the display.

Each LineMaster hopper monitors the loss in weight of material as it flows into the extrusion line. The hopper is suspended on a pair of highly accurate load cells, which are sized according to throughput. The control on the LineMaster hopper monitors weight, reading and updating the throughput calculation every second in lb/h or kg/h. This basic information is provided to the system so actual product throughput or weight per length can be calculated and controlled.

XC Drive Control Package

The XC Drive Control Package provides the interface between the LineMaster Controller and either Extruder Drive, Take-Off Drive, or both. There are 4 different ways the LineMaster can automate the control of a line, and these choices are fully defined in Control Selection.

Every XC Drive Control Package includes an XCD-X (X= Extruder) or an XCD-T (T= Take Off) Interface Box. The packages also include interfacing cables and encoder where relevant.

The XCD Interface can be mounted inside the control cabinet or externally on the control cabinet, depending on how the existing controls are mounted on an individual film line.

Four key functions the Interface Box performs.

1. Provides the Interface Card that terminates all wiring from the drive, the encoder and the LineMaster controller.
2. Communicates and displays the voltage from the LineMaster Controller to the drive being controlled.
3. Includes a toggle switch to change from ‘Manual’ control of the line to ‘Lock’ (Automatic) control by the LineMaster controller.
4. Incorporates a digital potentiometer which replaces the existing rotary drive speed control on the extruder drive panel and communicates with the XCD Drive Speed Control to control the line.

For lines with PLC Controls there is a Follow or Trim mode in the LIW Controller that allows the existing controls to be utilized as before.

Digital Encoder

A Digital Encoder with a 12” / 300mm Wheel is also supplied with XC-2X, XC-2T and XC-3 Drive Control Packages where Line Speed needs to be determined.

The encoder is mounted either direct to a drive shaft on the nip roller or mounted with the wheel on a roller. This accurately monitors the Line Speed to calculate then the weight per length and or gauge of films being produced. The encoder is supplied with a pre-prepared 100ft / 30.4m cable to connect the encoder to the XCD Interface Card.
LineMaster™ Control Selection

LineMaster offers three basic control packages for mono or co-extrusion lines. Each one is simple to operate and designed for easy installation.

**Throughput Control of Extruder or Starve Feeder (lb/h or kg/h) MODEL XC-1**

- The LIW mounted on the throat of the extruder monitors the actual throughput (lb/h or kg/h) of the line.
- Target throughput is set on the LIW Controller and the operator then switches to ‘Automatic’ mode.
- LineMaster varies speed of the extruder or starve feeder to maintain the target throughput per hour when in ‘Automatic’ mode.
- The system maintains constant output of an extruder or starve feeder.
- The LIW controller communicates with the XCD-X Extruder Drive Speed Control, which adjusts the voltage or reference signal to the extruder drive. This controls the speed of the extruder drive and adjusts automatically to maintain desired throughput.

**Where to use XC-1 Throughput Control:**

XC-1 is ideal for simply controlling the throughput of an Extruder or Starve Feeder. Applications include simple lb/h or kg/h extruder control, where other downstream equipment is already automating the Take-Off control, for example online gauging or IBC (Internal Bubble Cooling) control.

**XC-1**
The LIW mounted on the throat of the extruder provides throughput data in lb/h or Kg/h.

Line speed is monitored in meters/minute via the digital encoder mounted on the nip rollers of the Take-Off drive.

These two pieces of data are used to automatically calculate the actual product “yield” in lb/ft, g/ft, g/m, or Kg/m.

The Actual yield is compared to the Target set upon start up of the LIW Control.

The LIW controller communicates to the XCD-X Extruder Drive Speed Control which adjusts the voltage or reference signal to the extruder drive.

Product weight per length (yield) is maintained automatically, adjusting the speed of the line up or down in relation to Extruder Drive.

If the speed of the Take-Off Drive is manually increased or decreased, the LineMaster control will automatically adjust the extruder speed to maintain constant weight per length.

The Take-Off Drive is manually controlled when using the XC-2X.

If the speed of the Take-Off Drive is manually increased or decreased, the LineMaster control will automatically adjust the extruder speed to maintain constant weight per length.

XC-2X Where to use?

XC-2X is ideal to control the output of an Extruder or Starve Feeder. Typical application is to control Weight per Length (lb/ft, g/ft, g/m, kg/m) where other equipment, downstream, may already be automating the

Take-Off control, for example, online gauging or IBC (Internal Bubble Cooling) control. Most mono extruders are run at, or near, maximum output so control of the Take-Off is often preferable (see XC-2T)....
**XC-2T Weight per Length Control Via Take-Off Drive (lb/ft, g/ft, g/m, Kg/m)**

- The XC-2T and XC-2X Extrusion Yield Control Package have similar features.
- Primary difference is that the XC-2T controls the speed of the Take-Off Drive.
- Throughput of the LIW on the throat of the extruder is monitored in lb/h or Kg/h.
- Line speed is monitored in meters/minute via the digital encoder mounted on the nip rollers of the Take-Off.
- These two pieces of data are used to automatically calculate the actual product "yield" in lb/ft, g/ft, g/m, or Kg/m.
- The Actual yield is compared to the Target set upon start up of the LIW Control.
- The LIW controller communicates to the XCD-T Take-Off Drive Speed Control, which adjusts the voltage or reference signal to the Take-Off Drive.
- Product’s weight per length (yield) is maintained automatically, adjusting the speed of the line up or down in relation to Take-Off Drive.
- The Extrusion Drive is manually controlled when using the XC-2T.
- If the speed of the Extrusion Drive is manually increased or decreased, the LineMaster control will automatically adjust the Take-Off speed to maintain constant weight per length.

**XC-2T Where to use?**

XC-2T is most commonly selected for mono film extrusion lines. The line speed is determined by the digital encoder mounted on the nip rollers. Using the throughput information (lb/h or kg/h) from the extruder, the actual weight per length of the product is determined. For example Kg/h + m/min = g/m. The control of the Take-Off drive, which often has a much finer resolution than that of an extrusion drive, is then maintained automatically, adjusting the speed of the line up or down in relation to extrusion output.
The XC-3 Package allows both the extruder and takeoff drives to be controlled.

The system includes a LIW Hopper, a controller with operator interface, extruder drive speed control packages for each extruder and a Take-Off / Line Speed control package with digital encoder.

The LineMaster XC-LMC computer with touch screen (Maguire Option) is required for simultaneous control of both extruder drive speed and line speed.

Two or more Extruder drive controllers communicate to each other to synchronize the ramp up and down of all drives as directed by the LineMaster XC-LMC computer.

The XC-3 is designed to maintain product weight per length (yield) or Calculated Gauge.

Material throughput of the LIW hoppers, mounted on the throat of each extruder, is monitored in Lb/h or Kg/h.

This data is combined with the line speed, provided by the encoder mounted on a rotating shaft of the Take-Off.

Actual product yield or gauge is calculated.

The actual yield is compared to the desired target yield of the product entered on the LIW controller.

The LIW controller communicates to the XCD-X Extruder Drive and XCD-T Take-off Drive Speed Controllers to adjust the voltage or reference signal to each extruder drive, controlling increase or decrease of speed in relation to the line speed to maintain the desired target yield.

**XC-3 Weight per Length Dual Control (lb/ft, g/ft, g/m, Kg/m), or Calculated Gauge Control (mil., micron) of both Extruder and Take-Off Drives**

- Where to use?

XC-3 can be used on mono extrusion lines where a user wishes to automatically control both the extruder output and the Take-Off line speed. For multi-layer, co-extrusion lines XC-3 operates on the Main layer, the Master layer of the co-extrusion line, and controls both the speed of the extruder drive and speed of the Take-Off. The Side layers, or Slave layers, are controlled by an XC-1 on each layer. To co-ordinate the layers and total line output a Touch Screen Panel PC is used with the XC software to coordinate the throughputs to each layer accurately and maintain correct line speed. Control can be managed by either Weight per Length (lb/ft, g/ft, g/m, kg/m) or Calculated Gauge Control (Micron or Mil.).
**Line Start-up**

On a first time start-up of the process, the control system is placed into ‘Manual’ mode. The operator starts the line as normal. During this time the LIW Controller learns the rate of the material flow through the Loss in Weight hopper within 45 seconds. The line can then be switched to ‘Automatic’ control.

Throughout the whole production process, from ramping up the film line, reaching target production and then ramp down, the Loss in Weight hopper is monitoring consumption of material. In ‘Automatic’ mode the system constantly compares Actual versus Target, and then adjusts the speed of the drive to maintain target set point.

It does this by monitoring throughput into the extruder every second. The system compares this actual data to target data. If there is a deviation, the system accumulates a weight error until it hits a trip point to make an adjustment to the voltage of the drive under control. The LineMaster system does this continuously, trimming the drive up or down to stay on target.

Control throughout the refill period is constantly maintained by intelligent dynamic algorithms in the software of the LineMaster control, maintaining the control before and after loading, to ensure line stability and consistency.

The accuracy of LineMaster is extremely consistent to within +/- 0.5 % of the required target set point.

**Line Corrections**

During a production run there are many factors that cause a line to deviate from the Target output required. All of these make the process less consistent, harder to regulate automatically and use more energy.

The LineMaster system helps to regulate fluctuations and stabilize end product to give a more consistent output.

**Examples requiring line correction include:**

**Screen Packing** – As contaminants build up on the screen of the extruder this slows output and increases melt pressure. Conversely, as screw packs are changed, melt pressure and output can change again, all of which cause film to vary from the target weight per length required.

**Voltage Fluctuations** – Over a given 24-hour period, power supplies can fluctuate to a plant effecting all drives and outputs, causing variable outputs on extrusion lines.

**Melt Flow Temperature Fluctuations** – Heat and Cooling of screws and barrels can vary significantly due to many factors, including worn drives, which can cause sheer on materials leading to variations in output.

**Worn Screws and Barrels** – Over time, and depending on materials used and maintenance, screws and barrels can become worn - leading to variable outputs from an extruder.

**Material Mix, Geometry and Density Changes** – Changes in densities or blends of materials impact output consistency.

### XC Drive Control Packages

<table>
<thead>
<tr>
<th>Model</th>
<th>Drive Controlled</th>
<th>Units of Control</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Extruder Drive</td>
<td>Take-Off Drive</td>
</tr>
<tr>
<td></td>
<td>lb/h</td>
<td>Kg/h</td>
</tr>
<tr>
<td></td>
<td>lb/ft</td>
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<tr>
<td></td>
<td>g/m</td>
<td>Mil.</td>
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<tr>
<td></td>
<td>Micron</td>
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<td>Mono Layer Extrusion Lines</td>
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<td>XC-3X</td>
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<tr>
<td>Co-Extrusion Lines</td>
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<td>XC-3</td>
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<tr>
<td>Side/Slave Layers</td>
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<tr>
<td>XC-1 - per layer</td>
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### LineMaster Options

<table>
<thead>
<tr>
<th>Model</th>
<th>Surge Hoppers</th>
<th>Stub Tube Adapters</th>
<th>Flow Moderator Cones</th>
<th>Drain Ports</th>
<th>Controller Cable Kit</th>
<th>MXF Starve Feeders</th>
<th>XC Software</th>
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<tr>
<td>For All LIW Models</td>
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</table>
Optional G2 software offers multiple advantages for the control and monitoring of extrusion lines.

For XC-1 and XC-2
Maguire G2 software can be connected to LineMaster to generate reports on material consumption, control performance and control production lines remotely for XC-1 and XC-2 applications.

- G2 Software is sold as 1 license per each LIW hopper for Multi Layer Co-Extrusion applications. The program is typically installed and run from computer, with a touch screen, that is mounted in or around the central control panel of the extrusion line. Maguire can supply the touch screen computer or it can be sourced locally.
- The G2 software can also integrate and control Maguire WSB Gravimetric Blenders, which are often utilized to dose and mix blends of materials to LineMaster.
- The software is fully networkable, allowing access to reports and controls remotely from any other PC on the same network.

For XC-3
The G2 software program is an integral part of the XC-3 Extrusion Multi-layer line.

- Control Throughput and Yield
- Monitor and control up to 7 layers; each layer is graphically depicted (screen shot). All lines visually merge where the Total Throughput is displayed. Take-off and downstream controls are displayed at the right showing line speed, weight per length and/or gauge. A more detailed examination of each blender’s settings and output can be accessed through the Line Blender Screen by clicking on the individual extruder.
- The software also allows reporting on average throughput, total throughput, and the percentage of total uptime of an individual blender or all blenders on the line. Reports are based on start/stop date and time, weight units and percentage of run time.

G2 Software
- G2 Software is sold as 1 license per each LIW hopper for Multi Layer Co-Extrusion applications. The program is typically installed and run from touchscreen computer that is mounted in or near the central control panel of the extrusion line. Maguire can supply the touch screen computer or it can be sourced locally.
- The G2 software can also integrate and control Maguire Blenders.
- The software is fully networkable, allowing remote access to reports and controls from any other PC on the same network.

Maguire Products offers one of the most comprehensive warranties in the plastics industry. We warrant each Maguire blender to be free from defects in material and workmanship for 5 years from the date of delivery. In addition, we are committed to satisfying our customers in whatever manner is deemed most expedient to overcome any problems they may have in connection with Maguire equipment.

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5-Year Warranty
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