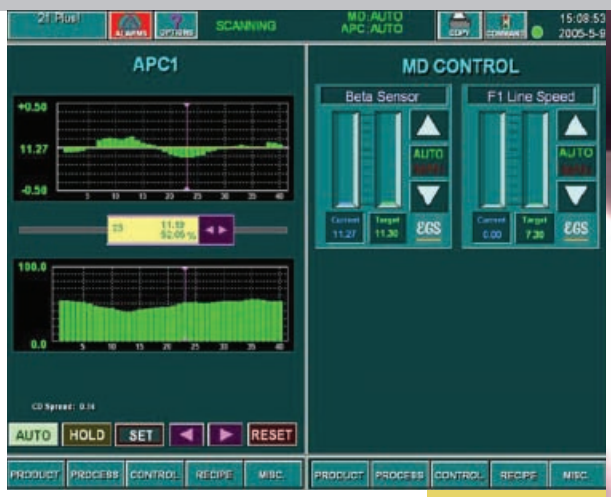
Product Specifications

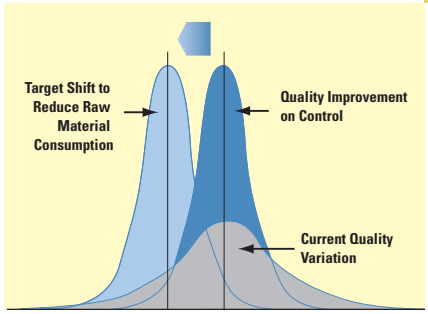
The Thermo Scientific 21Plus! web gauging system provides a suite of advanced machine-direction and cross-direction controls covering a wide range of processes with complex requirements. These advanced application controls significantly improve both quality and productivity delivering consistent results and an impressive return on investment.

Thermo Scientific 21Plus! Advanced Application Controls

Automatic Profile Control (APC)
Machine Direction Control (MD)
Zone Control (ZC)



MD & APC Human Machine Interface (HMI)



Quality Improvement and Material Savings Potential

The Thermo Scientific 21Plus! Advanced Application Controls minimize product quality variations in both the cross direction (CD) and machine direction (MD).

The reduction in quality variation allows raw material savings through down-gauging, increased line speeds from process stability and improved production efficiency by minimizing start-up and product change times. These 21Plus! controls provide a consistent return on investment throughout the life of the system.

Applications

- Cast film
- Biax film and sheet
- Extruded sheet
- Non-wovens
- Insulating materials
- Coaters
- Calenders

Thermo Scientific Automatic Profile Control (APC)

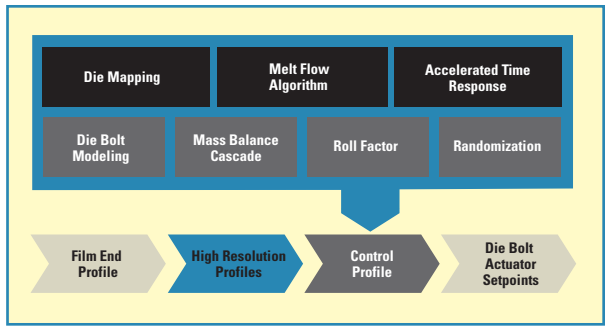
The Auto Profile Control (APC) is a complete hardware and software solution for automatic extrusion dies that delivers flat quality profiles for extruded film, sheet or coatings. APC captures high-resolution profile measurements from the 21Plus! scanning sensors to supervise the extruder die bolt positions. A die-mapping algorithm continuously aligns each measurement zone to its respective die bolt.

Precise die mapping is achieved with a Melt Flow algorithm that models both the linear and non-linear shrinkage of the polymer in the neck-in region. This die mapping function operates at the end of every scan to deliver consistent control performance. The final control output arrays are corrected with a convolution algorithm that decouples the crossflow interactions between the adjacent die bolts.

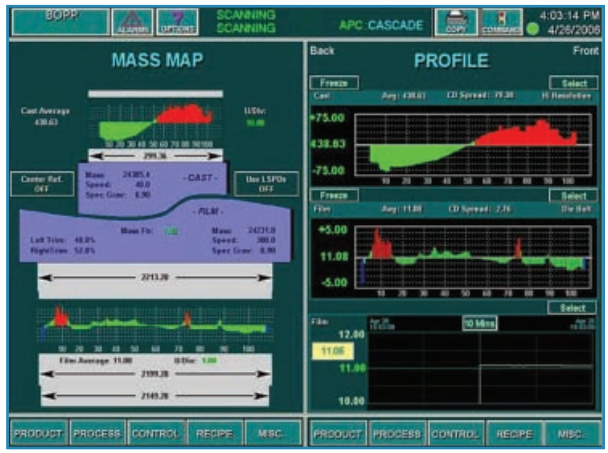
For biax processes, APC employs a Mass Balance Cascade control algorithm that accurately maps and controls the film profile after the tenter oven to supervise the primary die profile at the cast end. This measurement and control strategy provides faster start-up and greater overall economic benefits.

APC incorporates Roll Factor and Randomization options to prevent gauge build-up on thin film products. The Roll Factor algorithm derives a control profile by exponentially weighting the last scan average versus the entire roll profile to help eliminate stubborn profile deviations. Randomization control superimposes a sine wave flow pattern through the die bolt heaters over the control profile for flatter rolls. Together these contribute to better winding performance and help avoid the need to oscillate the winder, thereby saving subsequent trim losses.

An Accelerated Time Response control operates in a coarse control mode at startup to attenuate the profile quickly. Once the process has stabilized, a PI loop control takes over. APC automatically switches between these two control modes based on an enterable profile spread value. This strategy delivers quality production faster by minimizing scrap at startup, product change and during process disturbances.

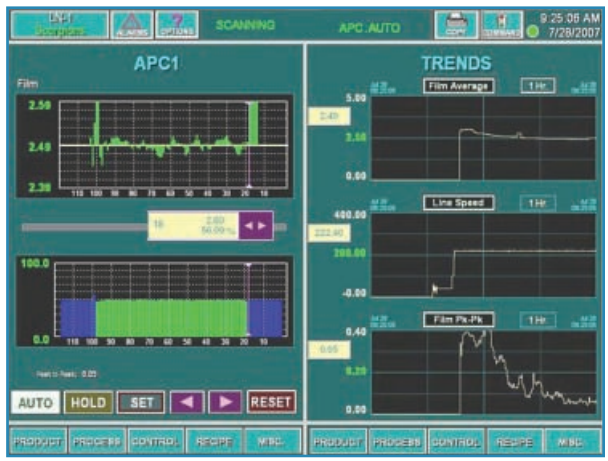


Biaxially Oriented Film Functional Block Control Diagram



Mapping Non-Linear Biaxially-Orientated Stretch Film

Mapping Non-Linear Cast Film



APC Control Display

Features

- Accelerated Time Response and PI strategies ensure flat profiles are achieved quickly
- Randomization and Roll Factor algorithms eliminate gauge band buildups
- Melt Flow algorithm provides precise die mapping in the non-linear profile region
- Biax Cascade controls provide fast, stable control response
- Convolution modeling between die bolts eliminates cross-flow streaks
- Tunable die bolt heating and cooling gains ensure optimum actuator positioning
- Skip and duplicate positioning locks actuators outside the sheet width to a fixed value for stable edges
- Shape sub-recipe archive ensures repeatable profile shape control for each product
- Die bolt shuffle option reallocates final control outputs to operational hardware in the event of failure
- Heater burnout detection alarm option alerts operators to malfunctioning actuators

Thermo Scientific Machine Direction Control

Machine Direction (MD) Nominal Control supervises either line speed or screw/pump speed in order to maintain uniform product basis weight or thickness. At the end of each scan the thickness or basis weight setpoint is compared to the last scan average. The difference is used to calculate a new setpoint for either the line speed or screw/pump inner control loop. The control output signals can either be sent directly to a process actuator or to a Programmable Logic Controller (PLC).

All the supervisory control loops include Transport Lag Compensation (TLC) to account for the delay between the control actuator and the final measurement. An advanced "Smith Predictor" algorithm models this time delay between the scanner and the process actuator device to prevent potential control oscillation.

Target Management Control

Raw material savings through 'down-gauging' can be realized with Target Management Control (TMC). This control ensures that no part of the final product is outside either an upper or lower quality control limit. TMC takes advantage of flat profiles and straight quality trends to reduce the nominal control target, thus automating the process of down-gauging. This provides substantial raw material savings while also eliminating scrap. In cases where products are sold by area, TMC produces increased yield per unit weight of raw material consumed.

Adaptive Throughput Control

Adaptive Throughput Control (ATC) optimizes the throughput rate of a process based on a matrix of process and quality constraints to deliver maximum productivity at the highest quality.

This adaptive control reacts to process conditions and product changes in real-time. Process parameters such as line speed, screw speed, melt pressure and melt temperature are continually monitored along with product variations; both sets of data are fed forward to a Process Variance Analyzer (PVA). ATC then ramps the process variables to optimum production conditions in a coordinated fashion.

Thermo Scientific Zone Controls (Calender Control)

The 21Plus! calendar controls deliver significant economic savings through raw material savings, faster start-ups, more rapid product change and scrap minimization. They incorporate knowledge from hundreds of applications and many patents, including rubber, vinyl and adhesive calendering processes. These control strategies provide fast, stable performance over a broad range of products.

First, a quadratic curve-fit algorithm determines the shape of the thickness profile to be used for supervisory roll gap control. Then three control loops operate simultaneously to reduce the offset, crown and thickness tilt errors to zero at the end of each scan. Finally, to prevent control oscillation, a Variscan feature coordinates the scanner speed with the web width and speed to eliminate the roll run-out from zone average calculations.

Additional control options such as absolute or delta preset, mid-range, feed forward, growth compensation, and width control are available.

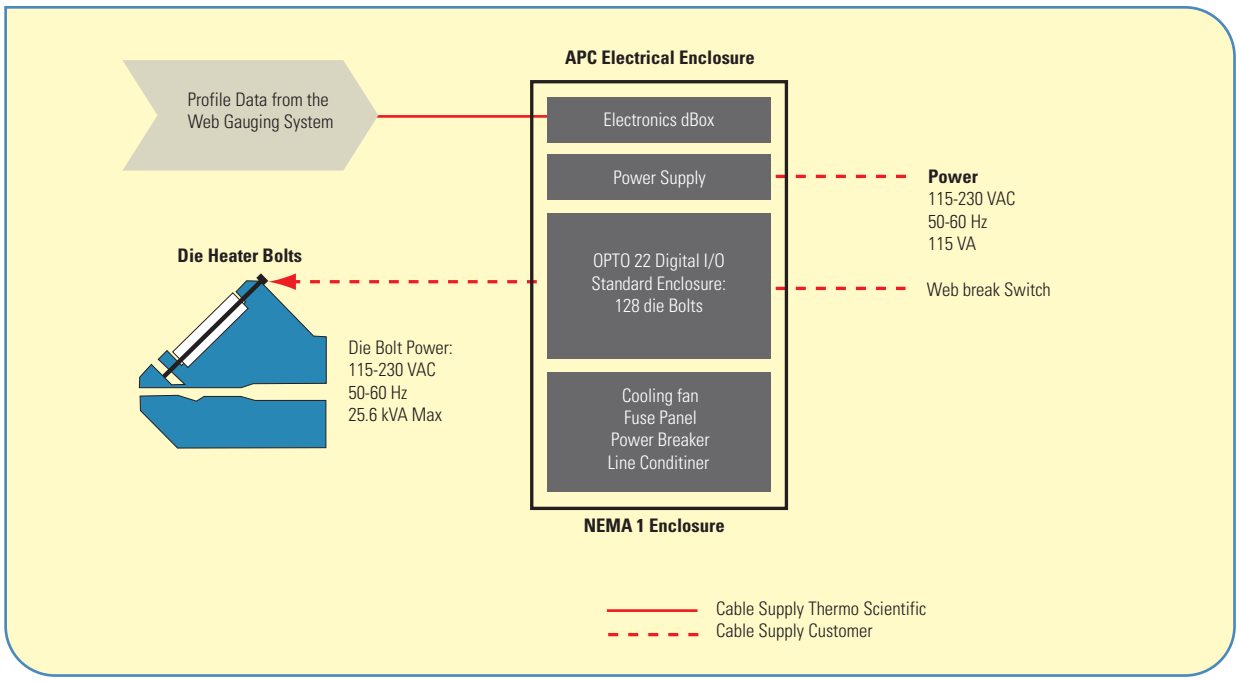
Features

- Unique curve-fit algorithm accurately models the process for optimum control
- Variscan eliminates the effect of roll runout on control
- Absolute or Delta Preset feature provides fast control setup at startup and product change
- Feed forward control decouples line speed change effects
- Motor start compensation models control motor response delay
- Screw control backlash compensates correctly for turn-around control outputs
- Automatic gain algorithm compensates for stock hardness or thin products

Calender Profile Zone Control

Thermo Scientific 21Plus!

Automatic Profile Control Installation Details and Specifications



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