

Thermo Scientific 21Plus! Advanced Application Controls

Process measurement solutions

The Thermo Scientific™ 21Plus! measurement and control system for continuous web processes 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.

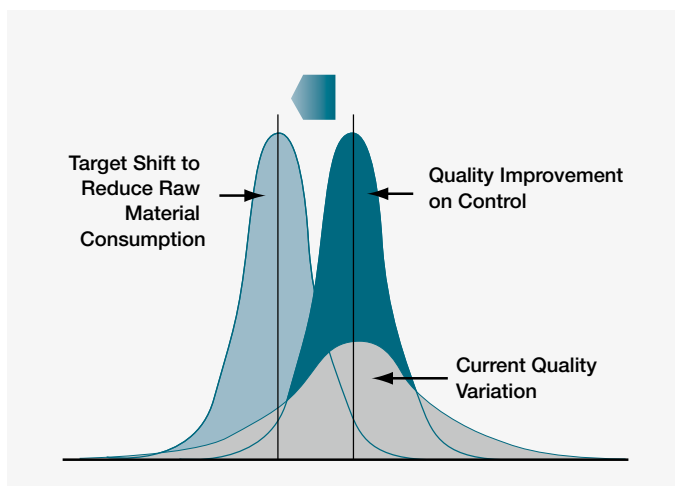
Applications

- Cast film
- Biax film and sheet
- Extruded sheet
- Nonwovens
- Insulating materials
- Coaters
- Calenders



The 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 controls provide a consistent return on investment throughout the life of the system.



Quality improvement and material savings potential

Automatic profile control

Thermo Scientific™ Automatic Profile Control (APC) is a complete hardware and software solution for automatic extrusion dies that delivers flat 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.

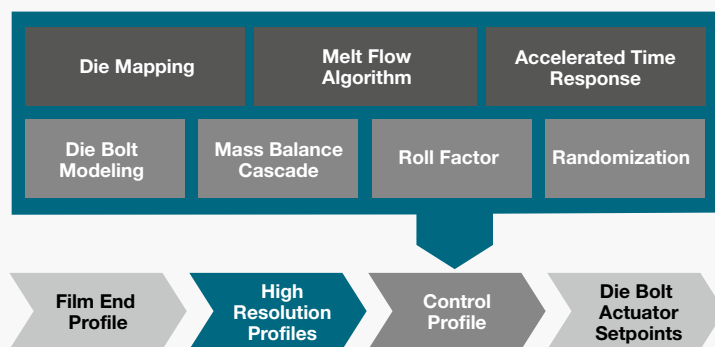
APC incorporates roll factor and randomization options to prevent gauge build-up on thin film products. The roll factor algorithm derives a control profile by exponentially weighting the last scan average versus the entire roll profile to help eliminate stubborn profile deviations. Randomization control 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 start-up to attenuate the profile quickly. Once the process has stabilized, a loop control takes over. APC automatically switches between these two control modes based on an enterable profile spread value. This strategy delivers a quality production faster by minimizing scrap at start-up, product change and during process disturbances.

Features and benefits

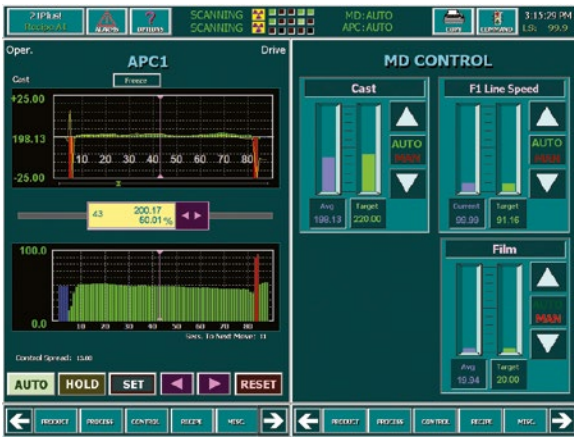
- Accelerated time response and PI strategies ensure flat profiles are achieved quickly
- Randomization and roll factor algorithms eliminate gauge band build-ups
- Melt flow algorithm provides precise die-mapping in the non-linear profile region
- Biax cascade controls provide fast, stable control response
- 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
- Heater burnout detection alarm option alerts operators to malfunctioning actuators

Machine direction control

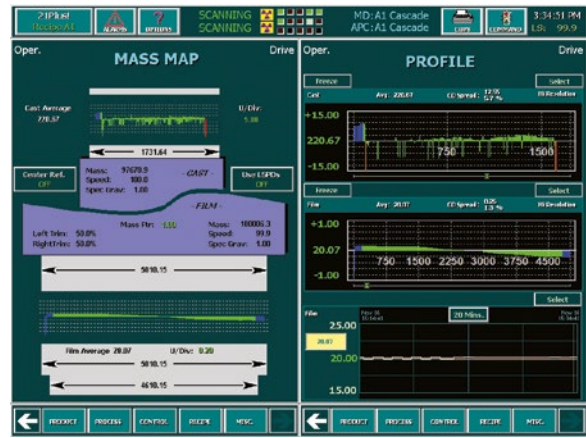
Thermo Scientific™ Machine Direction (MD) nominal control supervises either line speed or screw/pump speed in order to maintain uniform product basis weight or thickness. At the end of each scan the thickness or basis weight set-point is compared to the last scan average. The difference is used to calculate a new set-point 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).



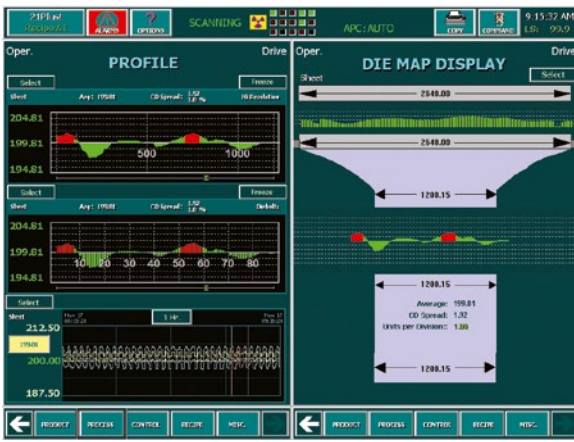
Biaxially orientated film functional block control diagram



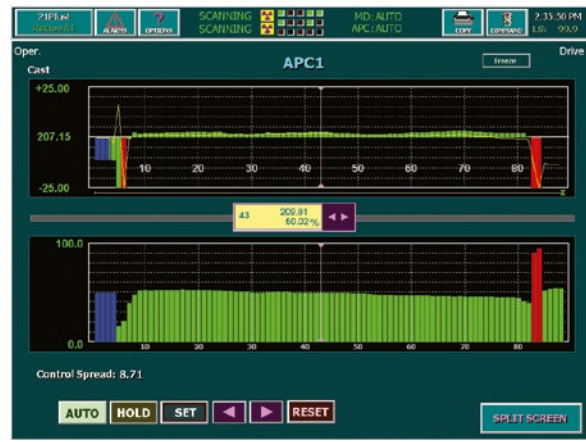
MD & APC Human Machine Interface (HMI)



Mapping non-linear cast film



Mapping non-linear biaxially-orientated stretch film



APC control display

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 Thermo Scientific™ 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.

Calender control

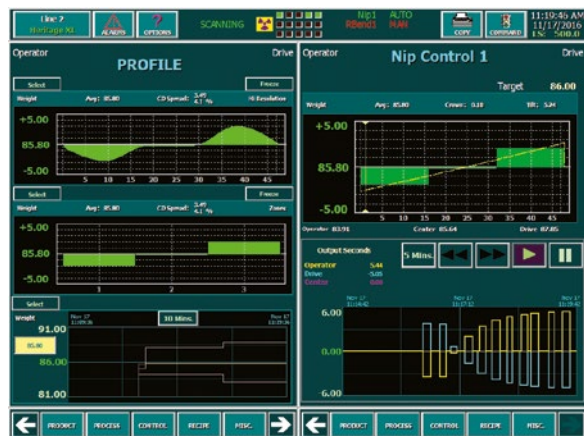
Thermo Scientific™ calender control delivers significant economic savings through raw material savings, faster start-ups, more rapid product change and the minimization of scrap. They incorporate knowledge from hundreds of applications, including rubber, vinyl and adhesive calendaring processes. These 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 pre-set, mid-range, feed forward, growth compensation, and width control are available.

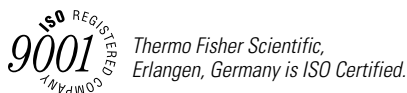
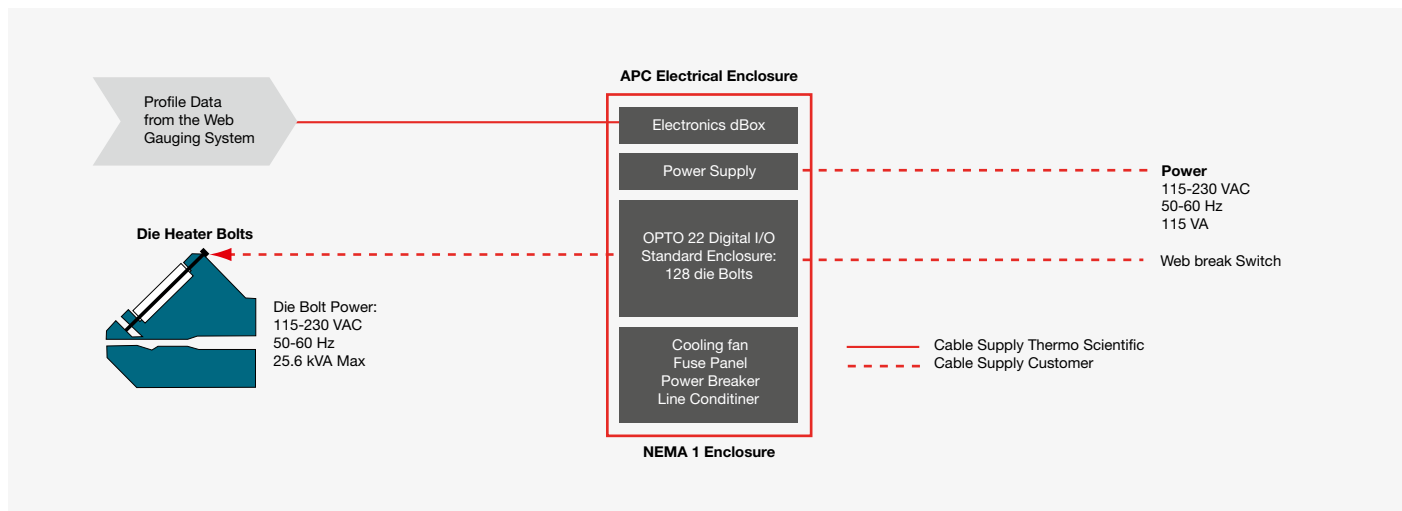
Features and benefits

- Unique cure-fit algorithm accurately models the process for optimum control
- Variscan eliminates the effect of roll run-out on control
- Absolute or delta pre-set feature provides fast control set-up at start-up and product change
- Feed forward control decouples line speed change effects
- Motor start compensation models control motor response delay
- Screw control backlash compensates for turn-around control outputs
- Automatic gain algorithm compensates for stock hardness or thin products



Calendar profile zone control

Automatic profile control installation details and specifications



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Find out more at thermofisher.com/gauging

