Successful extrusion operations demands running at the highest possible line efficiency. This means maximum process uptime, minimum raw material consumption, low rejects plus quality that meets today’s stringent requirements. It is vital to squeeze as much yield as possible out of today’s high cost resins and produce a flat, uniform, quality product that exceeds the performance expectations from the downstream processes.

Meeting the extrusion measurement challenge: By definition, extrusion products are a diverse family, as are their measurement requirements. This includes thickness, weight and coextrusion layer measurements, as well as speciality measurements such as density of cavitated films or pre-extraction oil content in porous battery separators. NDC’s investment in gauging technology provides the exact system solution for these diverse extrusion application requirements. In fact NDC, offers the widest range of web gauging measurements and controls available today.
Infrared Film and Sheet Measurement

Innovative measurements for the extrusion processes

NDC’s infrared gauges are designed to measure and control the thickness or basis weight of a wide range of film and sheet products. In addition, these gauges can simultaneously measure the thickness of up to six components of coextruded multilayer polymers plus other unique product characteristics.

**FG710S:** Applications for this gauge include single or multi-layer composition for most polymeric film and sheet products ranging from 10 microns to 5mm.

The FG710S is able to measure the thickness of structures such as clear, voided, cavitated, porous and translucent films. Thickness measurement of voided films has proven difficult due to density variation through the product. Now NDC’s patented FG710S combines discrete near infrared filters and powerful gauge algorithms that enables direct thickness measurement of these voided films.

In addition the FG710S can measure the oil content in PE battery film across the entire process, beginning with the wet cast film, after the biax stretch and the final film itself.

**TFG710ER:** Is engineered to measure thin biaxially-oriented films, cast films and CPE stretch films. The TFG710ER film gauge incorporates a unique patented optical engine that negates the effect of thin film optical interference. The TFG710ER can accurately measure across a wide range of film thicknesses from less than 2 microns up to 100 microns. This unique non-nuclear gauge provides high accuracy and overall performance without compromising its measurement range.

Both the FG710S and TFG710ER gauges help the film and sheet producers to meet their sustainability goals and downgauge their products with NDC’s advanced controls, such as Automatic Profile Control (APC) and machine direction controls.
Accurate, Reliable Measurements
A complete choice of sensors
for the sheet and film extrusion processes

► Beta
NDC’s Beta transmission gauges feature an ultra high-efficiency detection system and a minimized source activity for safety and performance.

Beta gauges are used to measure extruded sheet, packaging foam and at the cast end of the biax process.

► Gamma Backscatter
NDC’s Gamma BackScatter (GBS) gauge family provides a cost-effective thickness measurement. This compact sensor can provide valuable measurements from difficult process locations.

Applications for this gauge typically include blown film, cast film and sheet products.

► OptiMike
The OptiMike OM190 optical micrometer provides direct, single-sided thickness measurement.

The sensor is suitable for measuring extruded sheet and non-metallic thick film products.

► Laser Transmission
NDC’s laser gauges measure thickness via a distance triangulation computation of a laser beam.

Laser gauges are typically designed to measure thick extruded sheet products. The thickness measurement range for NDC’s single-sided sensor is 50 mm, while the dual-sided range extends to 15 mm.

► X-Ray Transmission
NDC’s X-ray transmission sensor’s energy source is tuned for optimum product measurement sensitivity to provide precise measurement of basis weight or thickness for nonwoven products.

X-ray transmission gauges typically measure extruded film and sheet products up to 8,000 microns.

► X-Ray Backscatter
The X-ray backscatter sensor’s compact footprint permits it to be installed in difficult measurement locations on the process.

The X-ray backscatter sensor is able to operate over a wide thickness range for extruded products up to 25,000 microns.
Proven, Capable Solutions

NDC extrusion industry expertise
...a measurement solution for each application

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrared TFG710ER</td>
<td>2 microns -100 microns</td>
<td>Biax film, Cast film, Capacitor film, Coextrusion components</td>
</tr>
<tr>
<td>Infrared FG710S</td>
<td>10 microns-5 mm</td>
<td>Biax film, Cast film, Blown film, Clear, cavitated, porous and translucent films, Coextrusion components, Oil content, (Battery separator)</td>
</tr>
</tbody>
</table>

NDC has specialized in infrared measurement technologies. These non-nuclear gauges provide exceptional performance and are ideal for biax and cast film processes.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBS 101</td>
<td>6,350-26,000 microns</td>
<td>Sheet</td>
</tr>
<tr>
<td>GBS 102</td>
<td>1,500-8510 microns</td>
<td>Sheet, Cast end biax</td>
</tr>
<tr>
<td>GBS103</td>
<td>0-2,000 microns</td>
<td>Sheet, Biax, Cast Film, Blown Film</td>
</tr>
</tbody>
</table>

The GBS Backscatter Gauge is ideally suited for sheet and thick film on narrow processes.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta 301</td>
<td>100-5,500 microns</td>
<td>Sheet, Cast end biax</td>
</tr>
<tr>
<td>Beta 302</td>
<td>15-1,200 microns</td>
<td>Film end biax, Cast film, Thin sheet</td>
</tr>
</tbody>
</table>

The measurement performance of beta gauges is largely unaffected by product composition, hence their wide acceptance on sheet, cast and biax applications.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>OptMike OM190</td>
<td>150-5,000 microns</td>
<td>Sheet, Non-metallic films</td>
</tr>
</tbody>
</table>

OptMike provides non-nuclear direct thickness measurement and is ideal for sheet applications.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser 172, 1 Sided</td>
<td>0-15 mm</td>
<td>Sheet</td>
</tr>
<tr>
<td>Laser 170, 2 Sided</td>
<td>0-50 mm</td>
<td>Sheet</td>
</tr>
</tbody>
</table>

Laser gauges are intended for use on thick sheet applications.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>XRT 312A</td>
<td>5-8,000 microns</td>
<td>Sheet, Biax, Cast film</td>
</tr>
<tr>
<td>XRB 318</td>
<td>5-25,000 microns</td>
<td>Sheet, Biax, Cast film</td>
</tr>
</tbody>
</table>

X-Ray sensors offer a non-nuclear alternative with minimal licensing issues and provide measurement across a wide range of extrusion applications.

Machine Direction Control

Machine direction (MD) controls compare the current scan average thickness against the target. The difference is used to supervise either the extruder or line speed (user-selectable) in order to drive the average thickness to the target.

Automatic Target Optimization Control (ATO):

Automatic Target Optimization supervises the average film or sheet thickness to run to the lowest acceptable specification. If the thickness variation is high, the average target will be increased to protect against making under-spec product at any point across the profile. If the sheet is flat, then ATO will ensure that no product is manufactured below the minimum quality limit. The combination of APC and MD control will supervise the thickness target downward to the lowest acceptable limit, resulting in significant raw materials savings while avoiding scrap.

Ratio Control

On coextrusion processes ratio control will insure that all extruders maintain the same relative output to maintain layer ratio balance. This is especially valuable during line speed changes.

Automatic Profile Control (APC)

APC works with extrusion dies to supervise the die bolt heaters and control the lip opening across the web width to create a flat profile. This technology can be applied to blown film, sheet, cast film and biax processes. For the biax application, our Asynchronous Integrated Mass (AIM) algorithm insures that the film and cast scanners are appropriately mapped to provide fast, responsive control to film thickness upset.

Other System Options

► FFT (Fast Fourier Transform) analysis
► SPC quality reporting
► 3D profile analysis displays

The Measure of Quality
Company overview

Combining industry-best performance and reliability with a global support structure

NDC, based in Irwindale California, develops and manufactures gauging and analyzer systems for a wide range of process industries. The company also manufactures in Essex, UK and Aulier, Belgium with direct sales and support operations in China, Japan, Germany, France, Italy and Brazil.

Our global client base consists of some of the world’s most successful companies who rely on NDC to ensure that their product performance, process yield and quality meet the stringent standards demanded by their customers.

**NDC comprises three divisions:**

**NDC Systems** service the converting, extrusion, calendering and nonwovens industries, providing real-time measurement of key product parameters such as product thickness, coating thickness & basis weight.

**NDC Sensors** service the food, chemical, pharmaceutical, mineral, bulk materials and tobacco industries with on-line and at-line measurements system for constituents such as moisture, fat and protein content.

**IRM Metals Gauging Systems** service the steel and non-ferrous metals industry, delivering rugged measurements systems for key parameters such as thickness, width, flatness, edge shape and metals coatings.

NDC is part of Spectris plc, the leading supplier of productivity-enhancing instrumentation and controls.