AUREX
The next dimension of ultrasonic wall thickness measurement
The production of plastic pipes is significantly influenced by the high demands on quality assurance, economic efficiency and profitability which can only be met by intelligent automation technology. AUREX is the leading system in extrusion due to its innovative high-end measuring and control technology.

AUREX is the answer to almost every measuring, control or documentation task for mono or multilayer pipes or tubes. Specific demands by the customer or specific product and process features are all covered by this automation technology.

Based on the digital multi-channel ultrasonic technology, a variable measuring system for wall thickness and diameter measurement has been created. It features static and rotating sensors which are suitable for a broad product spectrum. Measuring mechanics adapted to the extrusion process combined with gravimetric systems, thermal centering and other modules grant precise measuring results. AUREX is an inexpensive complete solution for geometry measurement of 0.5 - 2.700 mm (0.02" - 106.29") diameter respectively 100 % wall thickness measurement or flaw detection for diameters up to 630 mm (24.80”). The system ECCO is used for fast pipe centering, particularly for large pipes. ECCO supports a fast production start of the extrusion line and thus a significant reduction of start-up scrap. Further, thin points or thick points are recognized at an early stage so that corrections can be carried out on the extrusion die.

"AUREX is the most flexible and economic ultrasonic measuring system for the production of plastic pipes. It is able to significantly reduce production costs and to increase productivity to the benefit of your economic success."

Marius Thiel
Product Management Technology

MODULAR AUTOMATION TECHNOLOGY FOR PIPE EXTRUSION.
THE NEXT DIMENSION OF ULTRASONIC WALL THICKNESS MEASUREMENT

AUREX MK
Measuring chambers are perfectly adapted to the extrusion process. They supply highly accurate measuring values, offer minimum conversion time and represent an inexpensive complete solution for geometry measurement of 0.5 - 400 mm (0.0197" - 15.75").

Reliable and proven, 1000 times over!

AUREX AFM
Die AUREX AFM measuring mechanics has been developed for more complex tasks. Within a broad working range the output is increased to a maximum level. The same applies to material savings.

Perfect measuring technique, full documentation included!

AUREX M-LINE / X-LINE
AUREX M-line and x-line use very little water during operation. Sensors are pneumatically adjusted to the pipe. Thus, the equipment does not need to be converted when pipe dimensions are changed.

Reliable and maintenance-free, also for large diameters!

AUREX ERS
AUREX ERS - used for a 100 % high-quality production. The system is based on the patented iNOEX measuring principle featuring an Electronically Rotating Scanner. Full measurement in lengthwise and circumferential direction.

100 % high-quality production guaranteed by AUREX ERS!

AUREX OBF
AUREX OBF is an easy-to-operate optical 360° surface inspection system for the production of plastic pipes (dots, dents, scratches, foreign bodies, glossy stripes). Perfect addition to AUREX ERS.

360° surface inspection!

ECCO
ECCO - efficient system solution to ensure the fast pipe centering. Very early during the process thin points or thick points are identified and corrected through adaptation of the die setting.

Fast centering for pipes with large diameters!
Only an evenly running, continuous and thoroughly stable extrusion process ensures that the production process is cost-efficient and competitive in the plastics market. This requires a technology which is able to master the interaction of "Measurement & Control", to provide the related real documentation and to convert this data into automated processes. Modular components, flexibility and self-optimization are needed to be able to automate also existing extrusion lines or to respond to new market demands.

The important task is the consistent leveling off of all components involved in the extrusion process. AUREX technology is based on "Measurement & Control", which means that in a classic extrusion process the system recognizes variations from set values without delay and compensates them through control loops. This provides the manufacturer with an option for full automation, including the analysis of the extrusion process, its continued performance and finally the documentation of all production data.

Measuring accuracy and reproducibility are at the base of all further functionalities. In order to be able to regulate the process, measuring values must be recorded continuously and directly during the extrusion process. Consequently, calibration of the measuring devices must be operational also during production changes. Extensive automatic functions such as the self-optimizing measuring value recording, the automatic ultrasonic calibration, integrated compensation of shrinkage and temperatures as well as the reciprocal sensor control ensure a maximum measuring accuracy.

DIGITALIZATION FOR AN OPTIMUM DATA BASE.

iNOEX uses a high-precision ultrasonic evaluation electronics for its market-leading AUREX system. Signal evaluation provides reliable measuring results for layer thickness sizes down to 0.02 mm (0.0008”).

Based on this technology, AUREX records and evaluates digital ultrasonic signals on the wall thickness progression and analyses the entire information content of the measurement. The higher measuring accuracy, the comprehensive signal information and an intelligent mathematical analysis grant a reliable determination of individual signals or layer thicknesses in the progression of the total wall thickness of the pipe. Typical signal distortion or overlapping signals which may occur during the measurement of very small wall thickness ranges will be detected by this technology and are suppressed when signals are further processed.

LATEST HARDWARE FOR MAXIMUM PERFORMANCE.

As the system accuracy needs to be adapted to the measured wall thickness, the high computing performance required to master the involved algorithms call for specific processors and memory units. Accordingly, AUREX is equipped with the latest high-capacity electronics.

The ultrasonic system is specifically designed to generate, receive and process ultrasonic echoes at the required accuracy.

Result: The combination of high-end electronics and innovative AUREX measuring technology is able to evaluate up to 7 layers, starting at 0.02 mm (0.0008”) wall thickness.

STATE-OF-THE-ART MEASUREMENT FOR HIGHLY PRECISE CONTROL!

MEASURE:
- Wall thickness
- Layer thickness
- Diameter
- Eccentricity
- Ovality
- Flaws
- Mass throughput
- Haul-off speed
- Temperature
- Pressure (vacuum)

CONTROL:
- Speed / haul-off
- Weight per length (haul-off / extruder)
- Thin points (wall thickness / haul-off)
- Wall thickness profile (thermal centering)
- Diameter (vacuum)
- Working point (extruder / haul-off)
- Component dosing
- Co-extrusion
AUREX MK guarantees with its process-adapted measuring chambers highly precise measuring values, minimum conversion time and an inexpensive complete solution for the measurement of geometries from 0.5 to 400 mm (0.0197" - 15.75").

The required measuring accuracy and functioning are provided by a proven measuring mechanics. Water is supplied through an existing cooling system. An integrated water filter keeps the system clean. For the best possible performance, measuring chambers for diameters up to 125 mm (4.92") are designed with guide shells (for each produced dimension) which guide the pipe through the chamber. The ability of these two-part shells to self trigger is needed for a continuous production process in order to prevent any product tear-off. Measuring chambers of more than Ø 125 mm (4.92") are centered by an easily adjustable double cone guidance.

**MEASUREMENT / CONTROL / EVALUATION MODULES OF AUREX MK:**

- Wall thickness and diameter measurement
- COEX measurement
- Thin layer measurement
- Ethernet interface
- Alarm handling
- Wall thickening
- Option: Documentation and iTREND
- In combination with gravimetric systems:
  - Thin point control
  - Automatic ultrasonic calibration
  - Mass throughput control
  - Weight per length control by extruder
  - Guide parameter control
  - Bleeding function

**BENEFITS:**

- Comprehensive product information (wall thickness, diameter, eccentricity, ovality)
- Control of wall thickness, thin points, weight per length, mass throughput
- Production process is on a continuous and reproducible level based on a constant wall thickness and accurate centering
- Material savings of 5% or more through better centering and systematic start-up
- Optimum support for the user
- Documentation available for customer
- Measurement of up to 7 layers, smallest wall thickness is 0.02 mm (0.0008")
- Option: hinged version
- Profbus DP, Profinet, Ethernet, CANopen etc.

**PROVEN A 1000 TIMES OVER!**

**INNOVATIVE MEASURING MECHANICS.**

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of</th>
<th>Pipe dimensions</th>
<th>Pipe dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sensors</td>
<td>(mm)</td>
<td>(inch)</td>
</tr>
<tr>
<td>MK 20</td>
<td>4 / 8</td>
<td>0.5 - 20</td>
<td>0.0197 - 0.79</td>
</tr>
<tr>
<td>MK 32</td>
<td>4 / 6 / 8</td>
<td>0.5 - 32</td>
<td>0.0197 - 1.26</td>
</tr>
<tr>
<td>MK 63</td>
<td>4 / 6 / 8</td>
<td>10 - 63</td>
<td>0.39 - 2.48</td>
</tr>
<tr>
<td>MK 125</td>
<td>4 / 6 / 8</td>
<td>10 - 125</td>
<td>0.39 - 4.92</td>
</tr>
<tr>
<td>MK 160</td>
<td>8</td>
<td>16 - 160</td>
<td>0.63 - 6.29</td>
</tr>
<tr>
<td>MK 250</td>
<td>8</td>
<td>32 - 250</td>
<td>1.26 - 9.84</td>
</tr>
<tr>
<td>MK 400</td>
<td>8</td>
<td>32 - 400</td>
<td>1.26 - 15.75</td>
</tr>
</tbody>
</table>

AUREX MK is available in the following sizes:

**AUREX MK 21" Terminal with circle graphics:**

Measuring chamber MK 160 with pipe guidance
Measuring chamber MK 32, hinged
Measuring chamber MK 400

MEASUREMENT / CONTROL / EVALUATION MODULES OF AUREX MK:
AUREX AFM AUREX AFM

PERFECT MEASURING MECHANICS, FULL DOCUMENTATION!

32 TO 800 MM – MEASUREMENT WITHOUT LIMITS.

AFM measuring chambers are flanged directly to the outlet of the vacuum tank. Its sensors perform a dependable ultrasonic measurement and center the pipe.

For the diameter range of 32 : 800 mm (1.26” - 31.45”) AUREX AFM measures on 8 – 24 spots around the pipe circumference. Wall thickness and diameter are simultaneously measured. Minimum wall thickness tolerances are obtained through subsequent control loops for weight per length and thin points and the thermal die centering. All measurements can be automatically documented and evaluated. Product settings are managed and stored under recipe or product numbers to make parameters available very quickly and reliably when pipe dimensions are changed.

This measuring and control system was designed to fulfill the specific tasks of standard pipe extrusion:

- Maximum increase in output, maximum material savings
- Modular product conception for gradual retrofitting
- Very simple handling and usage
- Process logging

AUREX AFM 21” Terminal with circle graphics

BENEFITS:

- Large measuring range, extended range retrofittable
- Proven measuring and control loops
- Comprehensive production data
- Regular and reproducible production process due to constant wall thickness and good centering
- Material savings of 5 % or more due to improved centering and systematic start-up process

AUREX AFM is available for the following working ranges:

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of sensors</th>
<th>Pipe dimensions [mm]</th>
<th>Extended measuring range [mm]</th>
<th>Pipe dimensions [inch]</th>
<th>Extended measuring range [inch]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFM 400</td>
<td>8 / 16 / 24</td>
<td>160 - 400</td>
<td>32 - 160</td>
<td>6.29 - 15.75</td>
<td>1.26 - 6.29</td>
</tr>
<tr>
<td>AFM 500</td>
<td>8 / 16 / 24</td>
<td>250 - 500</td>
<td>63 - 250</td>
<td>9.84 - 19.69</td>
<td>2.48 - 9.84</td>
</tr>
<tr>
<td>AFM 630</td>
<td>8 / 16 / 24</td>
<td>315 - 630</td>
<td>75 - 315</td>
<td>12.40 - 24.80</td>
<td>2.95 - 12.40</td>
</tr>
<tr>
<td>AFM 800</td>
<td>8 / 16 / 24</td>
<td>315 - 800</td>
<td>90 - 315</td>
<td>12.40 - 31.50</td>
<td>3.54 - 5.70</td>
</tr>
</tbody>
</table>

MEASUREMENT / CONTROL / EVALUATION MODULES OF AUREX AFM:

- Wall thickness and diameter measurement
- COEX measurement
- Alarm handling
- Wall thickening
- In combination with gravimetric systems:
  - Automatic ultrasonic calibration
  - Thin point control
  - Mass throughput control
  - Weight per length control by extruder
  - Guide parameter control
  - Bleeding function
  - Option: Diameter control
  - Option: Documentation and iTREND
EASY, RELIABLE AND MAINTENANCE-FREE!

RELIABLE AND MAINTENANCE-FREE.
AUREX m-line, the ultrasonic measuring mechanics, sets high standards. AUREX m-line is maintenance-free and needs only small water quantities for ultrasonic coupling. This is due to the flexible and interlocking connection between the sensor holder and the measured pipe. The correct pipe/sensor coupling is supported by spring tension. The specific combination of the sensor/sensor holder provides a unique flexibility.

THE SOLUTION FOR ALL LARGE PIPES.
AUREX x-line reliably measures large pipes with diameters of up to 2700 mm (106.29”). For both AUREX x-line and AUREX m-line the ultrasonic sensors are mounted on pneumatically operated carrier arms which are attached to a support frame. When dimensional changes are required, the sensors can be pneumatically adjusted to the required pipe diameter.

WALL THICKNESS, OPTIONALLY DIAMETER MEASUREMENT.
AUREX m-line and AUREX x-line measure the wall thickness and optionally the diameter of a pipe. Subsequent control loops for weight per length and thin points reduce wall thickness tolerances to a minimum and optimize the production process. The improved centering of the pipe results in substantial material savings, especially for large pipes. Measuring accuracy is ± 0.1 mm (0.0039”).

BENEFITS AUREX m-line:
- Excellent cost-performance ratio
- Pneumatic pipe adjustment
- Fast readiness for measurement during line start or dimensional changes
- Stainless steel housings such as they are used in full bath scanners are not required
- Dimensional accessories, e.g. reducing rings, guide or sealing rings are not required
- Low water consumption
- Automatic sensor coupling supported by spring tension
- Very easy operation
- User-friendly and self-optimizing software based on digitized evaluation electronics
- Profinet, Ethernet, CANopen etc.
- Automated sensor opening

BENEFITS AUREX x-line:
- Large measuring range
- Proven measuring and control techniques
- Comprehensive production data
- Production process runs evenly and is reproducible due to constant pipe wall thickness and an optimum centering
- Material savings of 5 % or more due to a better centering and a systematic start-up process
- Increased production capacity due to reduced weight per length based on thin point control
- Very simple sensor change
- Integration into extruder control
- Individual data evaluation on demand
- Profinet, Prognet, Ethernet, CANopen etc.

MEASUREMENT / CONTROL / EVALUATION MODULES OF AUREX M-LINE AND AUREX X-LINE:
- Wall thickness measurement
- Coex measurement
- Alarm handling
- Wall thickening
- In combination with gravimetric systems:
  - Automatic ultrasonic calibration
  - Thin point control
  - Mass throughput control
  - Weight per length control either by haul-off or by extruder
  - Guide parameter control
  - Bleeding function
- Option: Diameter measurement
- Option: Documentation and iTREND

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of sensors</th>
<th>Pipe dimensions (mm)</th>
<th>Pipe dimensions (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>m-line 500</td>
<td>8</td>
<td>125 - 500</td>
<td>4.92 - 19.69</td>
</tr>
<tr>
<td>m-line 630</td>
<td>8</td>
<td>250 - 630</td>
<td>9.84 - 24.80</td>
</tr>
<tr>
<td>x-line 800</td>
<td>8</td>
<td>200 - 800</td>
<td>7.87 - 31.50</td>
</tr>
<tr>
<td>x-line 1000</td>
<td>8</td>
<td>220 - 1000</td>
<td>7.87 - 39.37</td>
</tr>
<tr>
<td>x-line 1200</td>
<td>8</td>
<td>250 - 1200</td>
<td>9.84 - 47.24</td>
</tr>
<tr>
<td>x-line 1600</td>
<td>8</td>
<td>630 - 1600</td>
<td>24.80 - 62.99</td>
</tr>
<tr>
<td>x-line 2000</td>
<td>8</td>
<td>1000 - 2000</td>
<td>39.37 - 78.74</td>
</tr>
<tr>
<td>x-line 2500</td>
<td>8</td>
<td>1600 - 2500</td>
<td>62.99 - 98.42</td>
</tr>
<tr>
<td>x-line 2700</td>
<td>8</td>
<td>1800 - 2700</td>
<td>70.87 - 106.29</td>
</tr>
</tbody>
</table>
AUREX ERS guarantees a 100 % quality production. Process variations which normally occur during the production process are identified and compensated so that it becomes possible to run a controlled flow production which will in turn generate a plus in quality and efficiency. This exactly where iNOEX comes into the picture!

ERS MEASURING TECHNOLOGY.

This iNOEX measuring technology uses the principle of the Electronically Rotating Scanner (ERS) for touch-free measurement and a full scan of the pipe. The technology is based on active/passive measurement. The patented measurement of electronically rotating ultrasonic signals does not leave a single spot of the pipe unchecked. Full measurement in lengthwise direction and around the circumference identifies hidden product defects.

THE OPERATING PRINCIPLE.

Sensor B (active) transmits and receives ultrasonic signals whereas sensors A and C are in passive mode and only receive ultrasonic signals. This is followed by a rotation to the next measuring cycle. In this measuring cycle sensor C is switched to active mode. It transmits and receives ultrasonic signals. Sensors B and D are now passive and only receive signals. The rotation then continues to the next measuring cycle.

Measuring cycles rotate electronically around the measuring object for a 100 % scan.

Complementary to the wall thickness check of AUREX ERS, there is optionally the "Quality Check" which recognizes discrepancies on the exterior pipe surface, inside the material and on the interior pipe surface compared to wall thickness tolerances.

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of sensors</th>
<th>Pipe dimensions [mm]</th>
<th>Measuring range extension [mm]</th>
<th>Pipe dimensions [inch]</th>
<th>Measuring range extension [inch]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERS 32</td>
<td>18</td>
<td>1 - 32</td>
<td>0.039 - 1.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERS 63</td>
<td>24</td>
<td>10 - 63</td>
<td>0.39 - 2.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERS 125</td>
<td>36</td>
<td>10 - 125</td>
<td>0.39 - 4.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERS 160</td>
<td>30</td>
<td>32 - 160</td>
<td>1.26 - 6.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERS 250</td>
<td>36</td>
<td>40 - 250</td>
<td>1.57 - 9.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERS 400</td>
<td>36</td>
<td>225 - 400</td>
<td>8.66 - 15.75</td>
<td>3.54 - 8.86</td>
<td></td>
</tr>
<tr>
<td>ERS 630</td>
<td>72</td>
<td>400 - 630</td>
<td>15.75 - 24.80</td>
<td>6.29 - 9.75</td>
<td></td>
</tr>
</tbody>
</table>

BENEFITS:

- Sensors scan 100 % of the pipe wall
- Evaluation of vertical and angular signals reflected by the pipe based on the activation of adjacent sensors
- Parallel sensor communication for the highest measuring resolution and the identification of even the smallest variations in production
- Integrated self-diagnosis of the sensors
- Optimum adaptation of the sensors (frequency, diameter) to the variety of measuring tasks
- Electronic rotation of up to 6000 r.p.m. achieves a 100 % scan in lengthwise direction, given a line speed of up to 100 m/min (328.08 ft/min)
- 100 % wall thickness measurement for pipe dimensions of up to 630 mm (24.80”) diameter
- Integration into extruder control
- Profibus DP, Profinet, Ethernet, CANopen etc.

MEASUREMENT / CONTROL / EVALUATION MODULES OF AUREX ERS:

- Wall thickness and diameter measurement
- Diameter control
- COEX measurement
- Alarm handling
- Wall thickening
- In combination with gravimetric systems:
  - Automatic ultrasonic calibration
  - Thin point control
  - Mass throughput control
  - Weight per length control either by haul-off or by extruder
  - Guide parameter control
  - Bleeding function
- Option: Documentation and iTREND
- 100 % wall thickness measurement
- Flaw detection
- Surface scan when combined with AUREX OBF

100 % HIGH-QUALITY PRODUCTION WITH AUREX ERS!
OPTICAL INSPECTION OF PIPE SURFACES.

With AUREX OBF, INOEX offers a simple optical 360° surface inspection system for the production of plastic pipes. AUREX OBF is based on IOS (Intelligent Optical Sensor), features a PowerPC and an intelligent line scan camera which are both mounted in one housing. 3 IOS systems are optionally linked to an AUREX OBF terminal or to an AUREX ERS system. Very small surface flaws can be detected:

- 0.27 mm² (0.0004 sq inches) for pipes with OD range 10 - 32 mm (0.39" - 1.26")
- 0.40 mm² (0.0006 sq inches) for pipes with OD range 32 - 63 mm (1.26" - 2.48").

Flaws are automatically recognized by the IOS and the corresponding flaw image is transmitted to the master terminal. 360° surface inspection is guaranteed for line speeds of max. 48 m/min (157 ft/min) for outer diameters up to 32 mm (1.26") and 30 m/min (98.43 ft/min) for outer diameters up to 63 mm (2.48"). Activation of the alarm lamp, the saw or other downstream equipment is carried out by the IOS.

PERFECT COMBINATION WITH AUREX ERS.

AUREX OBF combined with AUREX ERS perform the optical detection of even the smallest surface flaws and the ultrasonic detection of inclusions such as structural flaws in the pipe wall. Both systems combined represent the currently most comprehensive system available for flaw detection in the plastic pipe extrusion industry.

Various options for visualization assist the operator in documenting detected flaws faster and more clearly. In favour of a more easy handling, the control units of both AUREX ERS and AUREX OBF are encased in a single operation terminal.

FLAW DETECTION IN SECTION 1.

Surface flaw detection is based on optical measurement. In such case, the AUREX ERS is additionally equipped with min. 3 intelligent cameras of AUREX OBF.

SYSTEM FUNCTIONS:

- Automatic exposure setting
- Automatic recognition of the surface area to be inspected
- Activation of alarm lamp, saw or other downstream equipment in case a flaw was detected
- Flaw documentation in a log-book including date, time and flaw image
- Easy „teach-in“ based on flawless pipe samples
- „Surface Inspection Value“ (SIV) for quality assessment of the pipe

FLAW TYPE I IN SECTION 2.

This is a process engineering flaw which is controlled through alternative control loops within very narrow limits. Such flaws are:

- Thick and thin points
- Eccentricity
- Ovality

The system checks whether the variation is within tolerances or not, adjusts the process if necessary and sets off an alarm in case values are outside set tolerances. Control parameters are the weight per length and thin points.

FLAW DETECTION IN SECTION 2.

Digitalization of the ultrasonic measurement permits to record the full signal which optimizes signal evaluation and makes fast processing possible. Full recording of the signal shape is required for flaw management and provides complete data on the product.

AUREX ERS flaw management recognizes 2 flaw types:

Based on this recorded data (flaw type I / flaw type II), it automatically decides either for the intervention of adequate control systems or for the release of an alarm message. All activities of the flaw management are automatically documented in an online protocol.

Due to the full signal identification of the digitalization, ultrasonic curves with or without flaws are compared. In case that between the entry and the rear wall echoes there are significant deviations above the tolerance of the compared ultrasonic signals, then a flaw is most probable. At the same time an alarm is released and logged.

FLAW TYPE II IN SECTION 2.

Such a flaw type was caused by coincidence. Flaws which are in the middle of the pipe are recognized. Such flaws are:

- Inclusions in the pipe wall, e.g. air bubbles caused by moist material or by gas inclusions
- Structural flaws in the pipe wall
FAST CENTERING OF LARGE PIPES!

FAST PIPE CENTERING FOR AN ECONOMIC PRODUCTION OF LARGE PIPES.

The start-up process of thick-walled large pipes is difficult and requires time. The centering of the pipe is a special challenge as different temperatures in the extrusion die have an influence on the melt flow which leads to an irregular wall thickness distribution around the pipe circumference.

As line speed is at a low rate and mass throughput is high, it takes plenty of time and raw material until the pipe can be measured and the centering of the extrusion die can be carried out. A centering aid used at a very early stage is worth hard cash as it supplies immediate data on the wall thickness distribution which in turn is required for the fast centering of the extrusion die.

THE WINNING FORMULA: EARLY MEASURING DATA — LOGGED SHORTLY AFTER THE PIPE CALIBRATION UNIT.

ECCO by iNOEX represents an efficient solution for a fast centering of the pipe. For the first time the wall thickness distribution can be measured shortly after the pipe calibration. The ultrasonic sensors of ECCO i-line are mounted on a pneumatically operated carrier arm attached to a frame ring which is located closely after the calibration sleeve. After the line start the ultrasonic sensors are pneumatically adjusted to the pipe. The high-resolution ultrasonic electronics which is part of the system ECCO i-line evaluates measuring data and displays it on a 10” monitor. Data is displayed automatically after the entry of the values for set wall thickness and diameter sizes. Variations in wall thickness distribution are part of a graphic representation. The early product inspection makes it possible to center the pipe after a few meters upon production start. Measuring values on material distribution are available and any variations from set values can be adjusted through modifications on the extrusion die.

RETROFITTING POSSIBLE AT ANY TIME.

The ECCO i-line centering aid including sensor holders can be retrofitted to the vacuum tank. iNOEX offers an engineering package for this purpose which includes detailed technical drawings for assembly, water and compressed air supply.

BENEFITS:

- Fast leveling of the line during the production start
- Optimum pipe centering
- Easy operation
- Significantly reduced start-up scrap
- Regular wall thickness distribution
- System amortization within a few months
- No mechanical sensor conversion required
- Pneumatic adjustment

TECHNICAL DATA:

- Suitable for PE, PVC and PP
- Exterior diameters larger than 200 mm (7.87”)
- Wall thickness range 5 - 140 mm (0.197” - 5.51”)

FAST CENTERING OF LARGE PIPES!

Variable screen display. Receive data on the overall eccentricity or the measuring values of each sensor in %. During the production process and when the system is manually calibrated, wall thickness values are available either in mm or inches.

ECCO is available with 4 or 8 sensors for the following OD ranges:

<table>
<thead>
<tr>
<th>Pipe OD [mm]</th>
<th>Pipe OD [inch]</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 - 800</td>
<td>1000 - 2000</td>
</tr>
<tr>
<td>200 - 1000</td>
<td>1600 - 2500</td>
</tr>
<tr>
<td>250 - 1200</td>
<td>1800 - 2700</td>
</tr>
<tr>
<td>630 - 1600</td>
<td>other ranges available upon request</td>
</tr>
<tr>
<td></td>
<td>other ranges available upon request</td>
</tr>
</tbody>
</table>

ECCO i-line ultrasonic measurement with pneumatic sensor adjustment
IDM - THE INOEX DATA MANAGER!

LOGGING, ANALYSIS AND EVALUATION OF YOUR PRODUCTION DATA.

The INOEX data manager (IDM) features a central data logger for the collection of all process and quality data of all standard INOEX systems along the extrusion line.

The software is installed on a virtual machine on an existing server in your network which means that no additional hardware is required. The analysis and evaluation of your data is carried out by the integrated iTREND function. Data can be downloaded for further processing, e.g. as CSV file.

**BENEFITS:**
- Access to all relevant product data
- Visualization and data evaluation by iTREND
- Older systems can be addressed by an additional gateway
- Supports quality assurance
- Easy access via web browser

**iTREND.**

iTREND visualizes your production and process values in the form of diagrams. Display of process data and time periods can be individually adapted by the user. Besides pre-defined diagrams the user-friendly software offers customized presentations of process values.

Storage as CSV files permits the easy export of protocols for documentation purposes for the customer. Operation of iTREND is intuitive and it is done via web browser on PC, notebook or tablet in your network.

**FAST CUSTOMER SUPPORT VIA TEAMVIEWER:**
- Direct global support via remote control
- Easy configuration, no VPN gateway
- Adherence to the highest safety standards

**VISUALIZATION.**

The future-oriented and platform-independent concept allows visualization as a website by way of an easy integration via browser. As such, the INOEX user interface is displayable on all web-enabled devices. The multi-touch surface allows an intuitive navigation through gestures (zooming, wiping).

Operation is carried out by way of installed widgets. On the interface, the user is free to configure, add or remove the widget’s size or information value, just as he wishes. As such, the user has constant access to his most important applications (favorites).
SUCCESS IS MEASURABLE!

Ultrasonic systems by iNOEX provide you with the option to submit a measurable quality to your customers. Moreover, measurable cost savings are available. Your production process runs not only consistently and reproducibly due to constant wall thicknesses and good centering. With AUREX ultrasonic systems, material savings of 5% or more are possible through better centering and a systematic start up. Especially in combination with SAVEOMAT gravimetric systems, payback periods are very short.

### AUREX MK (Ø 63 mm PE-PIPE)

<table>
<thead>
<tr>
<th>Output</th>
<th>Production time</th>
<th>Savings</th>
<th>Material costs</th>
<th>Savings p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>2.0% (Ultrasound)</td>
<td>1.20 €/kg</td>
<td>33,600 €</td>
</tr>
<tr>
<td>250 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>3.0% (Gravimetry)</td>
<td>1.20 €/kg</td>
<td>50,400 €</td>
</tr>
<tr>
<td>5.0% total</td>
<td></td>
<td></td>
<td></td>
<td>84,000 €</td>
</tr>
</tbody>
</table>

### AUREX x-line (Ø 800 mm PE-PIPE)

<table>
<thead>
<tr>
<th>Output</th>
<th>Production time</th>
<th>Savings</th>
<th>Material costs</th>
<th>Savings p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>2.0% (Ultrasound)</td>
<td>1.20 €/kg</td>
<td>188,160 €</td>
</tr>
<tr>
<td>1400 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>3.0% (Gravimetry)</td>
<td>1.20 €/kg</td>
<td>282,240 €</td>
</tr>
<tr>
<td>5.0% total</td>
<td></td>
<td></td>
<td></td>
<td>470,400 €</td>
</tr>
</tbody>
</table>

### AUREX AFM (Ø 630 mm PE-PIPE)

<table>
<thead>
<tr>
<th>Output</th>
<th>Production time</th>
<th>Savings</th>
<th>Material costs</th>
<th>Savings p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>2.0% (Ultrasound)</td>
<td>1.20 €/kg</td>
<td>161,280 €</td>
</tr>
<tr>
<td>1200 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>3.0% (Gravimetry)</td>
<td>1.20 €/kg</td>
<td>241,920 €</td>
</tr>
<tr>
<td>5.0% total</td>
<td></td>
<td></td>
<td></td>
<td>403,200 €</td>
</tr>
</tbody>
</table>

### AUREX ERS (Ø 250 mm PE-PIPE)

<table>
<thead>
<tr>
<th>Output</th>
<th>Production time</th>
<th>Savings</th>
<th>Material costs</th>
<th>Savings p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>2.0% (Ultrasound)</td>
<td>1.20 €/kg</td>
<td>107,520 €</td>
</tr>
<tr>
<td>800 kg/h</td>
<td>16 hrs/day x 350 days/year</td>
<td>3.0% (Gravimetry)</td>
<td>1.20 €/kg</td>
<td>161,280 €</td>
</tr>
<tr>
<td>5.0% total</td>
<td></td>
<td></td>
<td></td>
<td>268,800 €</td>
</tr>
</tbody>
</table>

### AUREX OBF

significantly reduces product complaints and resulting costs.

### ECCO (Ø 1200 mm PE-PIPE (SDR: 17.6); weight per length 243 kg/m; recycling costs 0.46 €/kg)

<table>
<thead>
<tr>
<th>Produced pipe length up to sellable pipe</th>
<th>Scrap</th>
<th>Recycling costs per line start</th>
<th>Cost for energy, personnel, etc.</th>
<th>Cost per line start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without ECCO</td>
<td>36 m 8,748 kg</td>
<td>4,024 €</td>
<td>1,451 €</td>
<td>5,475 €</td>
</tr>
<tr>
<td>With ECCO</td>
<td>2 m 486 kg</td>
<td>224 €</td>
<td>83 €</td>
<td>307 €</td>
</tr>
</tbody>
</table>

Energy consumption: 1,000 kWh with 0.12 €/kWh

+ saved costs for potential product complaints