

*Measure & Save!*



**POLON-IZOT**



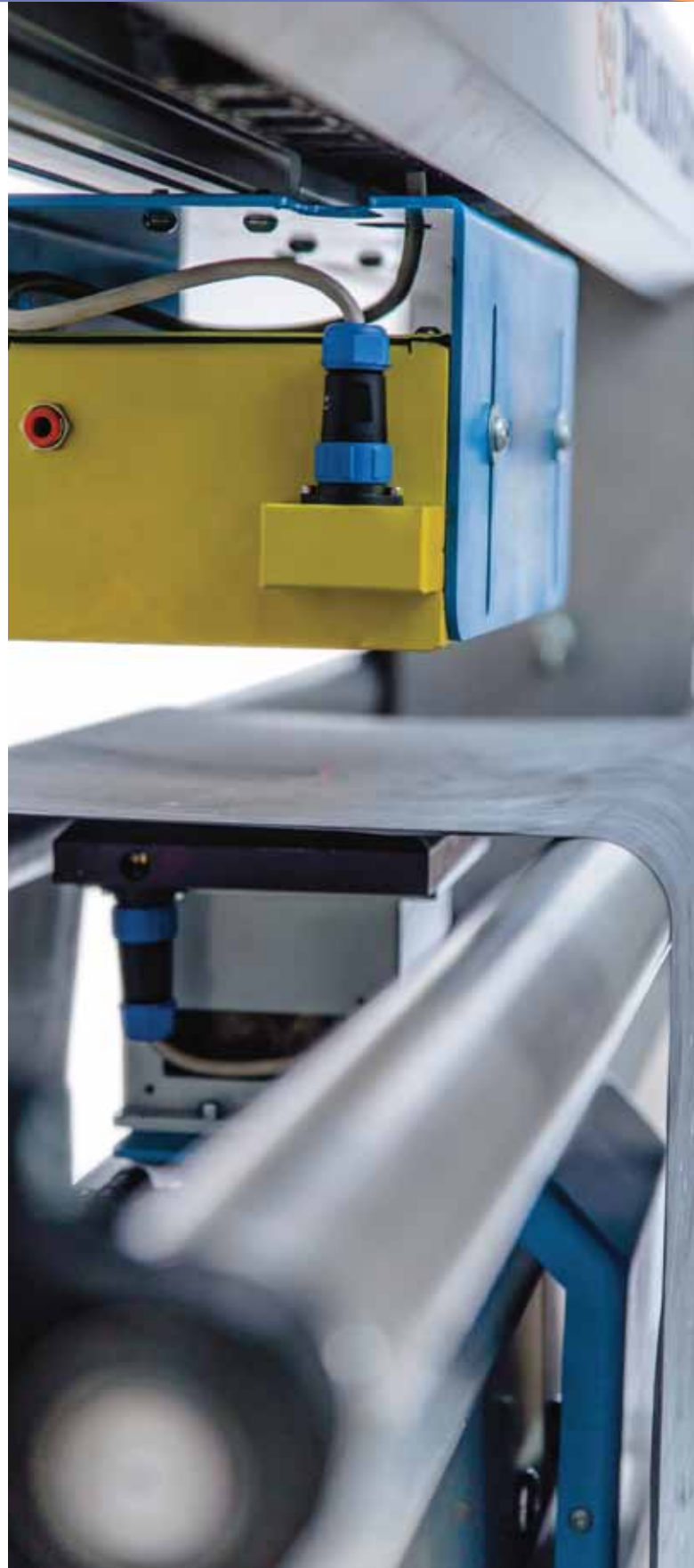
PI-SCANPRO

ON-LINE SYSTEM



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## PI-SCANPRO On-line System

### What is the PI-SCANPRO?

The PI-SCANPRO system is an automatic on-line / in-line system for measuring of thickness, weight, moisture, color and chemical composition, width and other parameters, which enables a non-destructive non-contact measurement of materials / products, in the form of a ribbon in real time. The modular system allows to configure a specific technological solution for a given product. Thanks to the application of innovative technology and precision of workmanship in the PI-SCANPRO, we are able to overcome the most difficult measurement challenges.

We can use the following measuring probe heads with the PI-SCANPRO:



- isotope head
- laser head
- x-ray head
- NIR head
- XRF head
- spectrometric head
- capacitive head
- eddy current head
- optical head

Due to the universality of the measuring heads used in the PI-SCANPRO we can measure the entire spectrum of parameters in most plastics and their composites. Thanks to the use of

PI-SCANPRO, you can save on raw materials, avoid possible customer complaints, improve the team work, as well as control the production process through constant monitoring.

In the PI-SCANPRO measurement system you can see our philosophy:

***To be a supplier of the latest control and measurement technology in the field of on-line measurements of thickness, grammage, defect analysis, width and moisture, and other parameters.***

***To solve technical problems of our clients through the motto:***

***You save by measuring! So Measure and SAVE Technology!***

In our approach, we try to listen to the needs of our customers by offering technology that leads to savings, and is environmentally sustainable.



### Added value of POLON-IZOT products:

Our guiding principle is **"Measuring - you save"**. Guided by it, we create practical solutions for our customers, enabling the real reduction of production costs and quality control. It is very important to us to understand the business needs of our customers and to learn about their daily work, so our products are adapted to individual customer needs thanks to constant communication and cooperation.





We believe devices should be simple and friendly to use by end users. The software that controls the operation of the devices is in Polish or English (we are also able to provide other language versions). Operators of our devices can focus on the merits that matter in their work by applying our straight-forward systems.

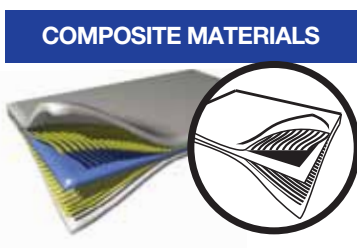
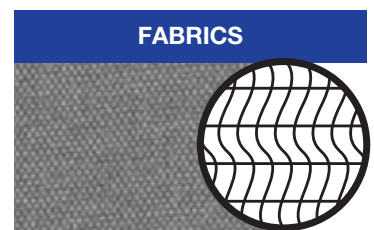
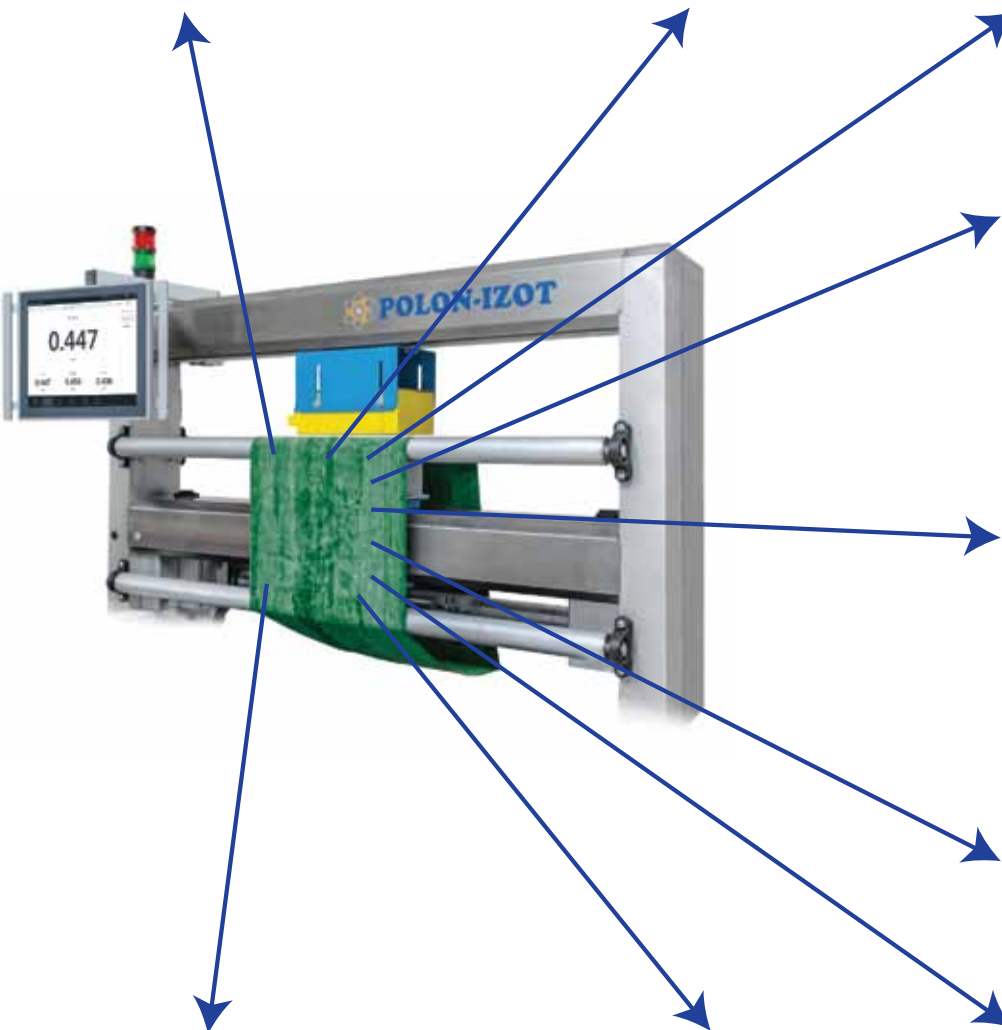
"Measuring - you save" is our guiding principle, therefore the reliability of the offered devices is very important to us. We guarantee the quality and functionality of products as well as quick and effective assistance in case of problems, as well as provide application support for the solutions offered.

We believe that the key to savings in a company is ensuring the possibility of obtaining an accurate result for key processes and by using our devices we obtain the most accurate results. When the production process can be optimized on an ongoing basis, we provide on-line solutions that enable constant process control and shorten the time required for production optimization. By using the most effective solutions and making the quickest decisions based on accurate results, our clients achieve real savings.



The penetrating radiation has always been a source of concern to humans. Our products meet the strictest safety standards, guaranteeing radiation levels below the threshold of 0.1uSv / hour - that is, comparable to the radiation that occurs naturally in the environment. Most of the offered spectrometers do not require notification of the STATE AGENCY OF ATOMISTICS or implementation of radiological supervision.

System application



# Table of parameters and options

| MEASURED PARAMETER  | Grammage  |         |       | Thickness |         |       |     |       |     |        |            | Width, Length, Height |       | Chemical composition, heavy metal content, substance identification |     | Colour |         | Humidity | Surface damage |
|---|-----------|---------|-------|-----------|---------|-------|-----|-------|-----|--------|------------|-----------------------|-------|---|-----|--------|---------|----------|----------------|
|   | HEAD TYPE | Isotope | X-ray | NIR       | Isotope | Laser | NIR | X-ray | XRF | UV/VIS | Capacitive | Eddy current          | Laser | Optical   | NIR | XRF    | Optical | UV/VIS   | NIR            |
| Nonwovens   | +         | +       | ✓     | ✓         | i       | i     | ✓   | i     | ✓   | i      | i          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Foil  | +         | +       | +     | +         | +       | +     | +   | i     | ✓   | ✓      | i          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Paper   | +         | +       | +     | +         | +       | +     | +   | i     | ✗   | ✓      | i          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Gum   | +         | +       | ✗     | +         | +       | ✗     | +   | i     | ✗   | ✓      | i          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Fabrics   | +         | +       | +     | i         | +       | +     | i   | i     | ✗   | i      | i          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Metal products  |           |         |       |           |         |       |     |       |     |        |            |                       |       |   |     |        |         |          |                |
| Roof panels   | +         | +       | ✗     | +         | +       | ✗     | +   | ✓     | ✗   | +      | +          | +                     | +     | +   | ✗   | +      | ✓       | +        | ✗              |
| Sheets  | +         | +       | ✗     | +         | +       | ✗     | +   | ✓     | ✗   | +      | +          | +                     | +     | +   | ✗   | +      | ✓       | +        | ✗              |
| Plates  | +         | +       | ✗     | +         | +       | ✗     | +   | ✓     | ✗   | +      | +          | +                     | +     | +   | ✗   | +      | ✓       | +        | ✗              |
| Battery linings   | +         | +       | ✗     | +         | +       | ✗     | +   | ✓     | ✗   | +      | +          | +                     | +     | +   | ✗   | +      | ✓       | +        | ✗              |
| Building materials  |           |         |       |           |         |       |     |       |     |        |            |                       |       |   |     |        |         |          |                |
| Roofing felt & bituminous shingles                        | +         | +       | ✗     | +         | +       | ✗     | +   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Glass wool  | +         | +       | ✗     | +         | +       | ✗     | +   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Mineral wool  | +         | +       | ✗     | +         | +       | ✗     | +   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Insulating foams  | +         | +       | ✗     | +         | +       | ✗     | +   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Styrofoam   | +         | +       | ✗     | +         | +       | ✗     | +   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Carbon fiberglass mats                                    | +         | +       | ✗     | +         | +       | ✗     | +   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Building plates   | +         | +       | ✗     | ✓         | +       | ✗     | ✓   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Building ceramics   | +         | +       | ✗     | ✓         | +       | ✗     | ✓   | ✗     | ✗   | i      | i          | +                     | +     | ✓   | +   | ✓      | +       | ✓        | +              |
| Wooden products   |           |         |       |           |         |       |     |       |     |        |            |                       |       |   |     |        |         |          |                |
| Furniture boards  | +         | +       | ✗     | ✓         | +       | ✗     | ✓   | ✗     | ✗   | ✓      | ✓          | +                     | +     | i   | +   | ✓      | +       | ✓        | +              |
| Plywood   | +         | +       | ✗     | ✓         | +       | ✗     | ✓   | ✗     | ✗   | ✓      | ✓          | +                     | +     | i   | +   | ✓      | +       | ✓        | +              |
| Construction plates                                       | +         | +       | ✗     | ✓         | +       | ✗     | ✓   | ✗     | ✗   | ✓      | ✓          | +                     | +     | i   | +   | ✓      | +       | ✓        | +              |
| Floor panels  | +         | +       | ✗     | ✓         | +       | ✗     | ✓   | ✗     | ✗   | ✓      | ✓          | +                     | +     | i   | +   | ✓      | +       | ✓        | +              |
| Plastics  |           |         |       |           |         |       |     |       |     |        |            |                       |       |   |     |        |         |          |                |
| Composite materials                                       | +         | +       | ✗     | ✓         | +       | ✓     | ✓   | i     | i   | ✓      | ✓          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Single-layer  | +         | +       | ✗     | ✓         | +       | ✓     | ✓   | i     | i   | ✓      | ✓          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Multi-layered   | +         | +       | ✗     | ✓         | +       | ✓     | ✓   | i     | i   | ✓      | ✓          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Sheets  | +         | +       | ✗     | ✓         | +       | ✓     | ✓   | i     | i   | ✓      | ✓          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Foams   | +         | +       | ✗     | ✓         | +       | ✓     | ✓   | ✗     | ✗   | ✓      | ✓          | +                     | +     | +   | +   | ✓      | +       | ✓        | +              |
| Coatings  |           |         |       |           |         |       |     |       |     |        |            |                       |       |   |     |        |         |          |                |
| Extrusion coatings on metal                               | ✓         | ✓       | +     | ✓         | ✓       | ✓     | ✓   | ✗     | ✗   | +      | +          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Metal coatings on plastic                                 | ✓         | ✓       | ✗     | ✓         | ✓       | ✗     | ✓   | +     | ✗   | i      | +          | +                     | +     | ✗   | +   | ✓      | +       | i        | +              |
| Metal coverings on metal                                  | ✓         | ✓       | ✗     | ✓         | ✓       | ✗     | ✓   | +     | ✗   | ✗      | ✗          | +                     | +     | ✗   | +   | ✓      | +       | i        | +              |
| Water-based adhesives and varnishes on paper / plastics   | ✓         | ✓       | +     | ✓         | ✓       | +     | ✓   | ✗     | ✗   | ✗      | ✗          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Solvent-based adhesives and varnishes on paper / plastics | ✓         | ✓       | +     | ✓         | ✓       | +     | ✓   | ✗     | ✗   | ✗      | ✗          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Solvent-based adhesives and varnishes on plastics         | ✓         | ✓       | +     | ✓         | ✓       | +     | ✓   | ✗     | ✗   | ✗      | ✗          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Silicones on polymers                                     | ✓         | ✓       | +     | ✓         | ✓       | +     | ✓   | ✗     | ✗   | ✗      | ✗          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Silicones on paper  | ✓         | ✓       | +     | ✓         | ✓       | +     | ✓   | ✗     | ✗   | ✗      | ✗          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Extrusion coatings on plastics                            | ✓         | ✓       | +     | ✓         | ✓       | +     | ✓   | ✗     | ✗   | ✗      | ✗          | +                     | +     | +   | +   | ✓      | +       | i        | +              |
| Other applications  | i         | i       | i     | i         | i       | i     | i   | i     | i   | i      | i          | i                     | i     | i   | i   | i      | i       | i        | i              |

✗ - not recommended solution

+

✓ - recommended solution

i - application depends on the specific requirements of the application - please contact us



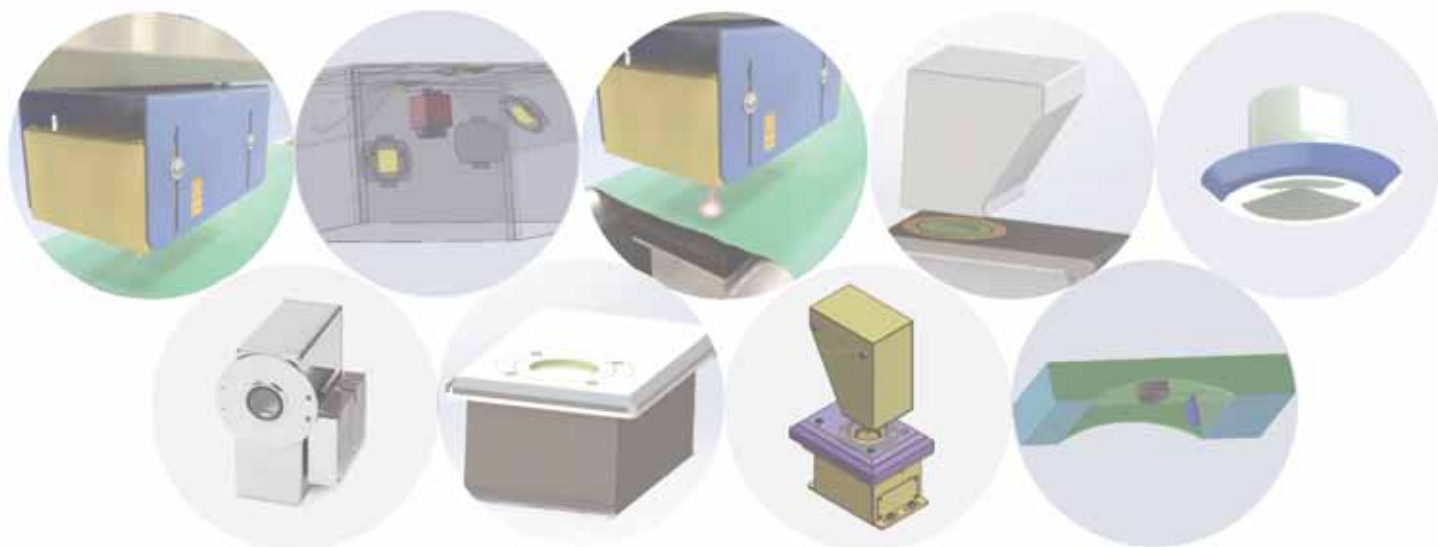


## Technical specifications of the measuring heads

| HEAD TYPE  |                              | Isotope   | Laser   | NIR  | X-ray  | XRF   | UV/VIS  | Capacitive                             | Eddy current                           | Optical   |
|--|------------------------------|---|---|--|--|---|---|--|--|---|
| Principle of measurement   |                              | Absorption radiation $\beta$ or $\gamma$  | Angle measurement reflections   | Absorption radiation NIR   | Absorption radiation X                             | Secondary radiation X, dispersion radiation   | Absorption radiation out of scope UV-VIS  | Change capacity sensor                 | Change currents vortex                 | Computer image analysis   |
| Emitter  |                              | Sources isotopic<br>Krypton (Kr-85)<br>Strontium (Sr-90)<br>Promet (Pm-147)<br>Americas (Am-241)<br>Cesium (Cs-137) | Diode laser   | Lamp halogen -tungsten   | Lamp X-ray   | Lamp X-ray  | Lamp halogen -tungsten;<br>Lamp deuterium;<br>Lamp Xenon                        | Sensor capacitive                      | Sensor eddy current                    | LED lights with color appropriate for use                             |
| Type of radiation  |                              | Beta<br>Gamma   | VIS   | NIR  | X  | X   | UV-VIS  | Electro-magnetic                       | Electro-magnetic                       | VIS   |
| Measured parameters  |                              | Grammage;<br>Thickness;<br>Density  | Thickness;<br>Width;<br>Length;<br>Height;<br>Weight *;<br>Density <sup>1</sup> | Grammage;<br>Density;<br>Thickness;<br>Humidity;<br>Composition chemical;<br>Identification material | Grammage;<br>Thickness;<br>Density                 | Grammage;<br>Thickness;<br>Density;<br>Composition chemical;<br>Identification material | Grammage *;<br>Thickness;<br>Density*;<br>Colour;<br>Absorbance / Transmittance | Grammage *;<br>Thickness;<br>Density * | Grammage *;<br>Thickness;<br>Density * | Width;<br>Length;<br>Height;<br>Detection defects material;<br>Colour |
| Range measuring  | grammage [g/m <sup>2</sup> ] | 2 - 10 <sup>7</sup>   | From conversion <sup>*</sup>  | 1 - 300  | 1 - 10 <sup>7</sup>                                | From conversion <sup>*</sup>  | From conversion <sup>*</sup>  | From conversion <sup>*</sup>           | From conversion <sup>*</sup>           | ---   |
|  | thickness [mm]               | It results from the measured grammage <sup>*</sup>  | 0,001 - 100   | It results from the measured grammage <sup>*</sup>   | It results from the measured grammage <sup>*</sup> | 1x10 <sup>-7</sup> - 3x10 <sup>-5</sup>   | 1x10 <sup>-7</sup> - 1  | 0,01 - 15                              | 0,04 - 10                              | ---   |
| Resolution   | grammage [g/m <sup>2</sup> ] | 0,0005  | 0,00001   | 0,001  | 0,0005   | 0,0005  | 0,001   | 0,01                                   | 0,01                                   | ---   |
|  | thickness [mm]               | 0,0001  | 0,00001   | 0,001  | 0,000001   | 0,0000001   | 0,000001  | 0,000001                               | 0,00001                                | ---   |
| Temperature range of operation head (without additional cooling) |                              | 5 - 70°C  |   |  |  |   |   |  |  |   |

**COMMENTS**

1. The given data in the table is typical, others are possible on request
2. \* parameter from conversion, see page 11

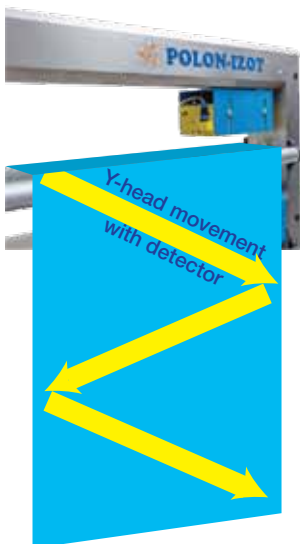


## Measurement types and their features

We make adjustments to the PI-SCANPRO system in accordance with individual customer requirements in order to ensure the best possible results and meet all expectations. For this reason, the PI-SCANPRO systems can perform scanning, line and point measurements.

### CROSS-SCAN MEASUREMENT

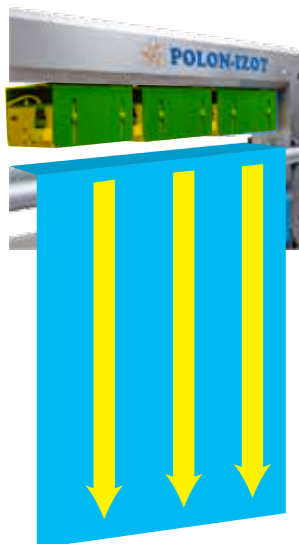
The measuring head moves perpendicular to the direction of movement of the analyzed product, the measurement takes into account the entire width of the analyzed product.



Measured quantities in a diagonal line.

### LONGITUDINAL SCAN MEASUREMENT

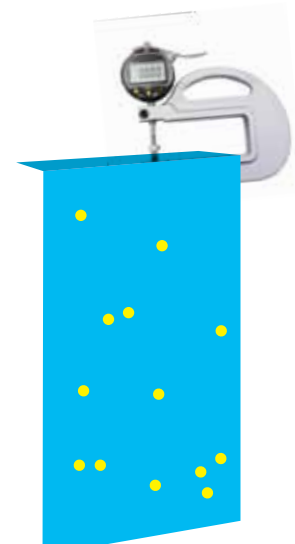
The measuring head is suspended in a defined position, the measurement takes place directly below it - at one set height (1 line per head).



Measured values along the vertical longitudinal line.

### LABORATORY-POINT MEASUREMENT

The measurement is performed for selected points - it is a typical method of laboratory measurements when we analyze only a fragment of production.



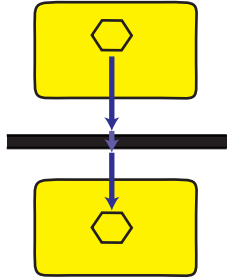
Measured values at various points on the sample surface.





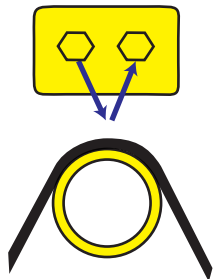
## Types of measurements

### Measurement in transmission



In this type of measurements, radiation penetrates the product, we analyze its absorption by the material. The radiation detector faces the emitter, maintaining the same relative position to each other during the measurement. This type of measurements allows for the analysis of the entire cross-section of the product, regardless of its layering. This is the most common type of measurements with the use of isotope or X-ray probes. The penetration of radiation through the material allows you to measure its thickness, grammage or humidity or the degree of radiation absorption (e.g. UV). Another advantage of measurements in the transmission mode is the ability to detect inclusions or blemishes invisible from the outside. The limitation of this method is the technical possibility of installation split head (emitter and detector) on both sides of the product and the degree of absorption of specific radiation by the material.

### Reflective measurement

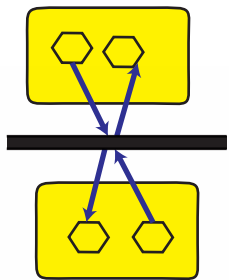


The measuring head is only on one side of the product. The radiation emitted from the head reflects or scatters from the product and goes to the detector.

This measurement mode is most often used for thickness measurements with laser heads, then the product it is based on a cylinder stabilizing its position and the laser measures the distance from the head to the top edge of the product. Reflection measurements are also used in the case of NIR, XRF, X-ray probes and spectrometric heads. In this case, the radiation emitted by the head interacts with the product and the analyzer receives diffuse reflection. This allows for the analysis of only the outer layer for multi-layer products, e.g. determining the thickness

of the adhesive coating applied to the base without taking into account the fluctuations of such primer or colors, or moisture of the outer layer. Such a system of the meter also allows for measurements in a situation where the product absorbs the used radiation range too strongly or it is physically impossible to place the detector in front of the radiation source.

### Differential measurement



It is a measurement mode in which we use two sets of emitters and detectors (two full measuring heads) placed on both sides of the analyzed material. This type of measurement allows you to test materials impervious to the applied radiation, or to measure parameters that differ for the upper and lower surfaces. These types of measurements are also routinely used in laser thickness gauges in cases where the product cannot come into contact with a stationary gauge element. The limitation of this method is the technical possibility of installing the measuring heads on both sides of the product and the degree of absorption of specific radiation by the material.



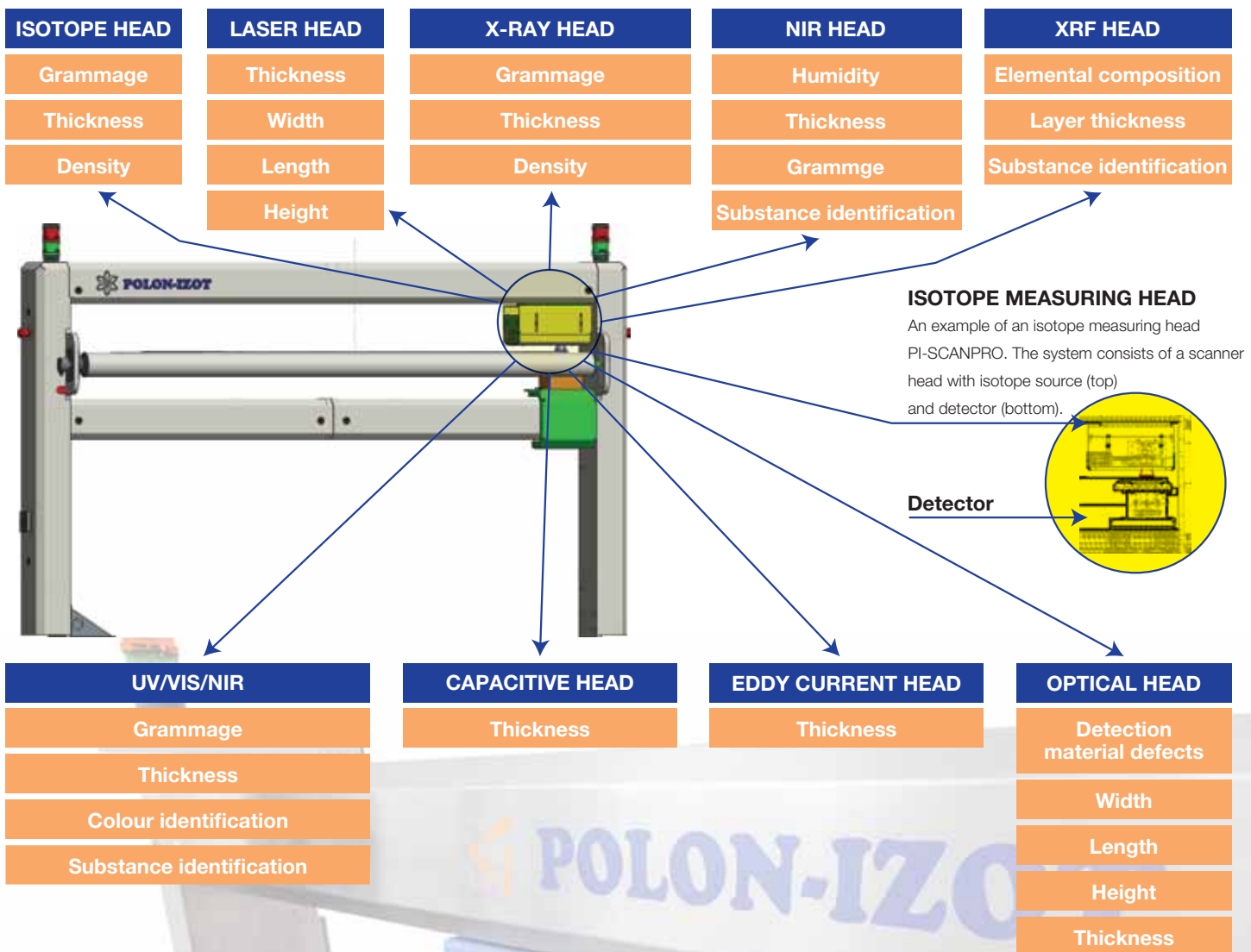


## Measuring heads

The PI-SCANPRO system enables on-line / in-line measurements of many parameters in real time.

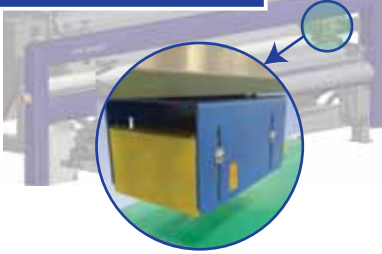
Our idea, which we followed when designing the PI-SCANPRO system, was versatility and the ability to measure various product parameters. Through an individual approach to each product and production process, we are able to select the appropriate measuring head.

Thanks to our many years of experience, we can offer both a single-head device and a multi-head device (combining various measurement technologies).



## Isotope head

### ISOTOPE head



The **isotope probe** is commonly used to measure thickness and grammage in plastics. Depending on the isotope source used, the isotope head is characterized by a wide measuring range, e.g. for a grammage of 10-10,000 g / m<sup>2</sup>.

The most commonly used Radioisotopes (synthetically produced sources) in industry are:

- Pm-147 (Prometium), Beta radiation
- Am-241 (Americas), Gamma radiation
- Kr-85 (Krypton), Beta radiation
- Cs-137 (Cesium), Gamma radiation
- Sr-90 (Stront), Beta radiation
- Co-60 (Cobalt), Gamma radiation

The isotopes used in industry, due to their low activity and the use of certified containers, are safe and constitute an alternative to other measuring sources.

The isotope head is perfect for measurements in harsh industrial conditions, e.g. high temperatures or high dustiness. The most popular radiation used in the industry is Beta (β) radiation, the measurement is non-invasive, non-contact, which does not leave any traces on the material and, importantly, does not change any physico-chemical properties of the measured Material. The measurement method uses the phenomenon of **radiation absorption**, e.g. β is a transmission method, through which we can measure products with different surface structures, e.g. nonwovens, mineral wool, glass fiber, carbon, etc. The main advantage of this head is the large measuring diameter (Ø 48 mm) long trouble-free service life (approx. 30-40 years) and the possibility of product analysis regardless of the surface structure and color.

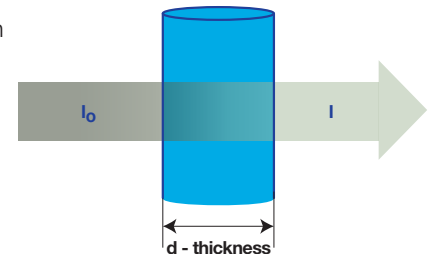
The use of the isotope head in control and measurement devices (in accordance with the Polish Atomic Law) requires a permit for use with PAA \* and supervision IOR-01 \*\*.

The isotope head in our PI-SCANPRO system can be used to measure:

- **In the scanning (traversing) system** - scanning material across the product or web
- **In the point system** - point measurement in a given place of the material (by multiplication we can obtain a multi-point measuring system, e.g. 3 point isotope heads)

$$I = I_0 \cdot e^{-\mu \cdot d}$$

$$F = 10^3 \cdot \rho \cdot d$$



In the absorption method, the type and activity of the isotope or the type of X-ray tube is selected depending on the type of the measured layer, where:

**I** - radiation intensity after passing through a layer of thickness **d**

**F** - layer with a specific grammage

**I<sub>0</sub>** - primary radiation intensity

**μ** - radiation absorption coefficient

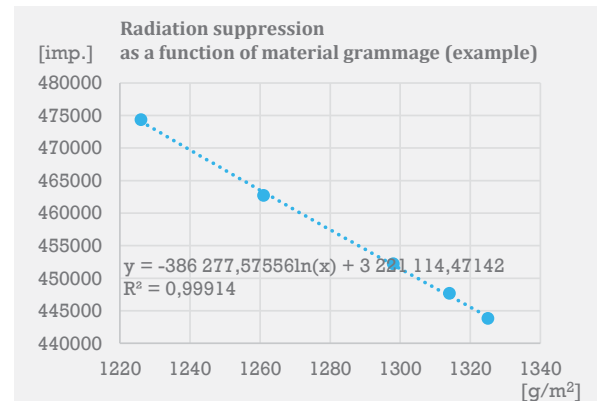
F - grammage of the measured layer in g/m<sup>2</sup>

d - thickness in mm

ρ - density in g/cm<sup>3</sup>

**By measuring the absorption of radiation, we can determine:**

- grammage at a constant chemical composition of the material [g / m<sup>2</sup>]
- thickness with the constant material density
- density at the constant thickness



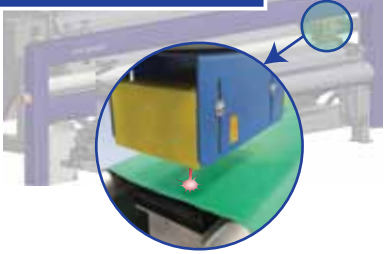
\* PAA - National Atomic Energy Agency

\*\* IOR - Radiological Protection Inspector according to Polish Atomic Law

*Isotope probe specifications (comparison of the different probe types on page 7)*

## Laser head

### LASER head



**The laser head** can be an effective alternative to the use of the isotopic head (we avoid the use of an isotopic source, permits from PAA \* and IOR-01 supervision \*\*).

The use of industrial lasers enables the measurement of thickness, width and height of entire products as well as individual parts. In particular, the laser measurement is commonly used in the plastics industry, e.g. production of **rubber products and all kinds of sheets**. The precise use of lasers in industrial and laboratory conditions allows the measurement of

a homogeneous layer of material or the entire structure. The use of lasers ensures a non-contact and non-invasive measurement for both products and operators on the production line.



The principle of measurement with a laser head is to measure the path of the laser beam sent from the receiver and its return (the reflection method).

The product thickness can be determined using two measuring techniques:

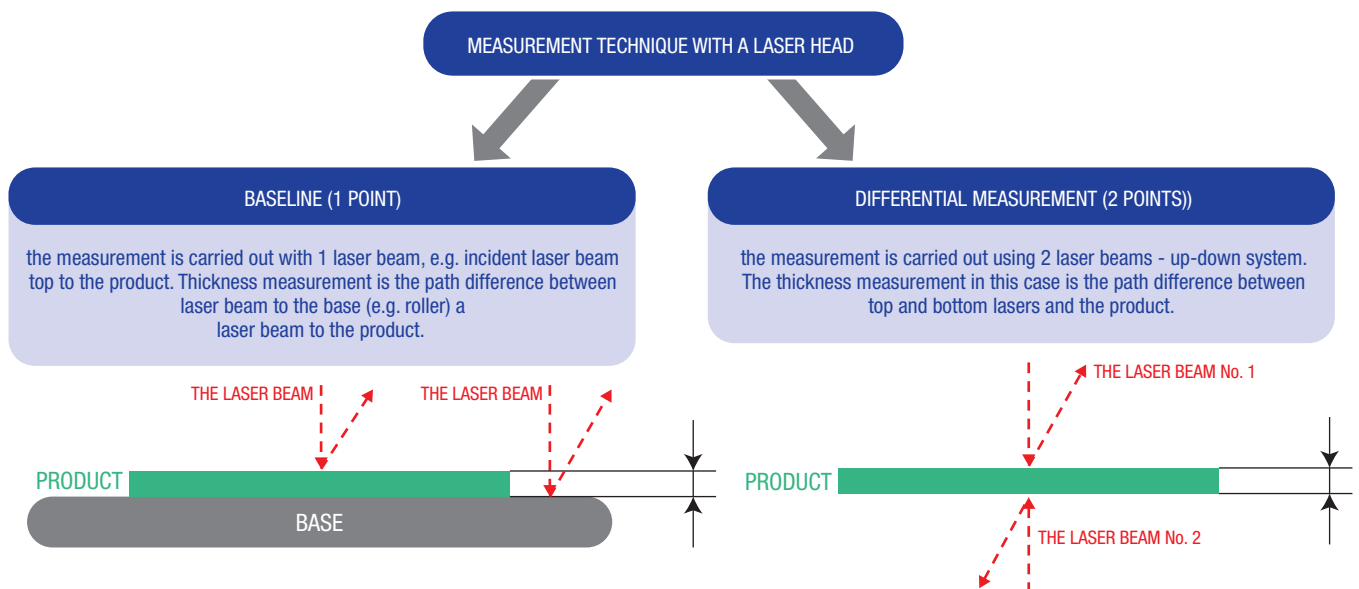
**Measurement to the base** - it is the difference of the distance between the laser beam and the base (e.g. shaft, roll) and the laser beam and the product placed on this base. See the diagram below.

**Differential measurement** - it can be the measurement of 2 or more lasers placed simultaneously in the top-down system. The thickness determined by this measurement is the difference in the path length between the upper laser beam and the product and the lower laser beam and the product. Depending on the type of product and its size, this measuring system can be multiplied, e.g. a system of 4 differential lasers for measuring industrial rubber bands. See the diagram below.

The laser head in our PI-SCANPRO system can be used to make a measurement:

- **In the scanning (traversing) system** - scanning a material across the product or web
- **In the point system** – making a point measurement in a given place of the material (by multiplication we can obtain a multi-point measuring system, e.g. 3 point laser heads)

Depending on the laser head measurement technique used, the measurement is either the base measurement or differential measurement (see also page 9 Measurement types and their features).

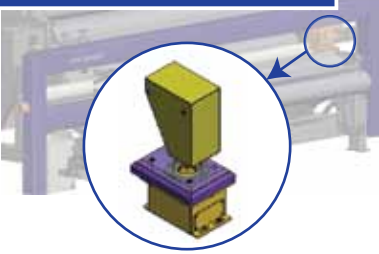


*Isotope probe specifications (comparison of the different probe types on page 7)*



## X-ray head

### X-RAY head



**The X-ray tube** is used as the radiation source in the X-ray head. A job performed with the meter using the X-ray with a voltage of up to 30keV allows the use of the meter without the need for a permanent fixture supervision by a radiological protection inspector, excluded according to PAA.

This head is available in 2 versions:

### X-RAY-T

Operating in the mode of transmitting radiation through the sample. Just like in the isotope head it consists of 2 elements moving in relation to the analyzed material, but immobile in relation to each other. The X-ray radiation emitted by the lamp is partially absorbed by the tested material, so only a part of it reaches the detector. The amount of radiation absorbed depends on the type of material, its density, thickness and basis weight. The developed calibration curve, depending on the type of material, allows to measure the thickness or basis weight of the analyzed product.

### X-RAY-O

It works in the reflection mode. Such a probe is suitable for specialized thickness and grammage measurements. The measurement of this head uses the backscattering of X-rays coming from the lamp. The back radiation caused by the Compton effect depends on the type of material (its atomic number), density and thickness (grammage), which allows the measurement and identification of the analyzed product. The Compton phenomenon consists in knocking out an electron from the outer shell of an atom at the expense of the photon energy from the primary beam. As a result of such a collision, the energy of the photon decreases. The Compton radiation has an energy lower than the energy of the excitation beam and propagates in different directions, partly also towards the signal source. This head is used in cases where it is not possible to position the detector-source unit on both sides, especially in the case of analysis of light materials (consisting of elements with a low atomic number).

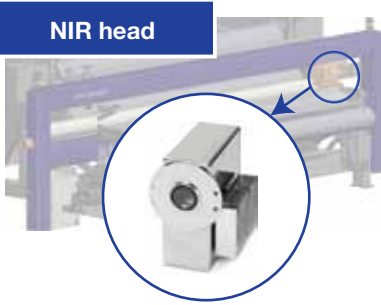


*Isotope probe specifications (comparison of the different probe types on page 7)*





## NIR head



**The NIR technique**, i.e. the Near InfraRed Spectroscopy it is a quick and non-destructive research technique.

The NIR spectrum is defined by ASTM as the electromagnetic spectrum in the range 780 - 2526 nm, which corresponds to wave numbers 12820 - 3959 cm<sup>-1</sup>.

The absorption of the radiation quantum in this range causes the vibration of chemical bonds to be excited in the analyzed substance. The vibrations occur around the equilibrium point, corresponding to the asynchronous, expiring vibration situation, as described in the asynchronous oscillator model.

The combination of vibrations in the range 1900 - 2500 nm is the superimposition of fundamental vibrations and their harmonic derivatives.

The absorption of such radiation causes vibrations of chemical bonds in compounds. These vibrations modify our output signal, so that the signal reaching the detector carries information about all chemical compounds in our sample. As each type of bond has a different characteristic point, thanks to specialized software, we can associate the spectrum of a given substance with its concentration or use it for identification during the calibration process. From this fact, comes also the limitation of these techniques also follows. In order for them to be useful for operation, the devices require calibration. In the case of NIR, such calibration is a mathematical model describing the relationship between the collected spectrum and the analyzed properties.

### Technical data of the NIR head

The PI-SCANPRO system is a universal measuring system dedicated to be installed directly in the measuring line, enabling the measurement of many parameters thanks to the possibility of using multiple measuring heads.

The size measurements are based on the absorption of radiation with specific characteristics by the analyzed material (product). This relationship is then converted into the determined parameter. The exception is the laser head, which uses the phenomenon of light reflection and measurement of the reflection angle. PI-SCANPRO systems use different radiation ranges thanks to the modular structure and different measuring heads.

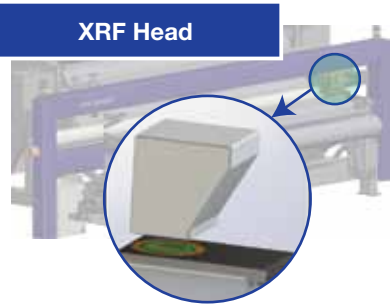


*Isotope probe specifications (comparison of the different probe types on page 7)*





## XRF Head

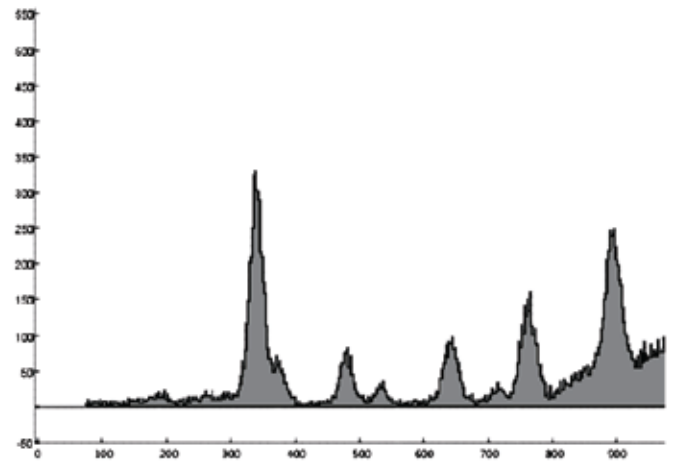
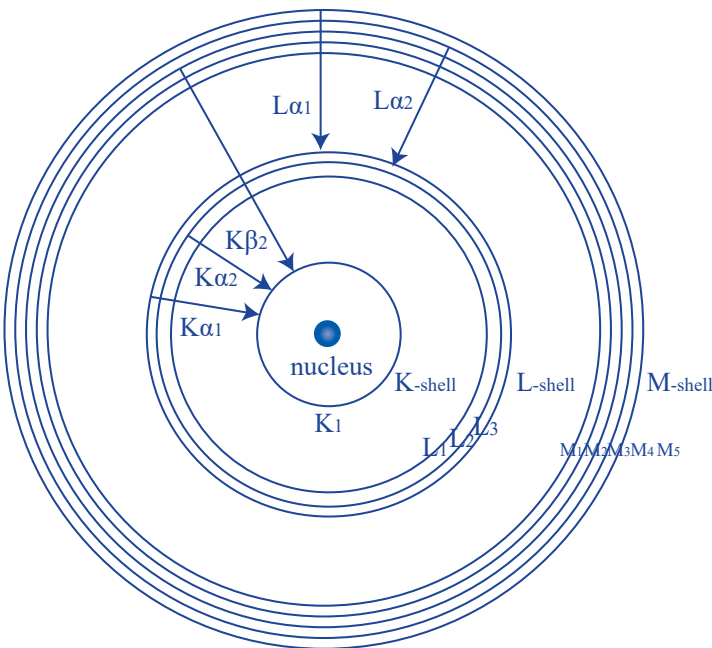
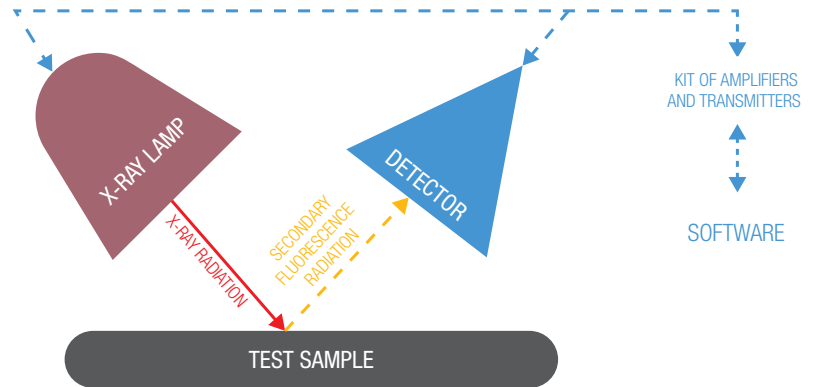


**The XRF head** is in fact a full EDXRF - EnergoDisperse X-Ray Fluorescence spectrometer that allows for identification and quantification (after appropriate calibration) of elemental composition in any sample. This equipment can be widely used in analysis of elementary metal, glass, ceramic and building materials.

Due to the nature of the phenomenon used, XRF spectrometers are used mainly for surface analysis.

The XRF (X-ray fluorescence) uses the phenomenon of secondary emission of X-rays from a sample induced by exposure to high-energy X-rays or gamma rays. It is a non-destructive method of sample testing characterized by high selectivity and a low limit of quantification. This method uses the spectrum that is characteristic for each element, which it emits after the excitation with X-rays.

The spectrum is the basis for the construction of calibration models that allow for qualitative and quantitative analyzes.



*Isotope probe specifications (comparison of the different probe types on page 7)*



## UV-VIS head

UV-VIS head



**In the UV / VIS head** we use absorptions in the visible and ultra-violet ranges. It is used for continuous monitoring of the color of the product or ability to absorb the UV radiation in a specific range. The head is also working in 2 measurement modes – the reflection measurement (mainly color analysis) and the measurement transmission (mainly time absorption).

### SPEK UV/VIS

The color of the product can be assessed subjectively, using the sense of sight and color templates, or using a color analyzer. In the first case, we rely on subjective assessments made by employees. The results then depend on the employee, his current psychophysical state as well as the intensity and color of the light used during the assessment. The color measurement performed by the spectrometric sensor is more reproducible and also produces results in a reproducible unit on a specific color scale. This means that a measurement done in one place can be reliably compared to a measurement done elsewhere at another time, all using standard international terminology. For this purpose, the so-called tristimulus coordinates are used that measure the intensity of light in relation to the values of the three primary colors red, green and blue. The values are considered as X, Y, and Z coordinates in the CIE XYZ color space. This system has been widely used for decades as a common standard for objective color assessment. It was defined by the International Commission on Lighting (CIE) in 1931. The information about the characteristics of the XYZ space, as well as other commonly used color scales, is publicly available from many sources.

### SPEK-UV

The head operating in the range of ultraviolet light and visible light is used when the analyzed product must absorb the UV radiation or visible light. Various ranges of operation of this head are possible, depending on individual requirements. The test consists of assessing the absorption of radiation in a given spectral range. Most often, these heads work in the mode of light transmission through the tested product. Enabling the detection of e.g. sample defects or the assessment of the degree of radiation absorption in various types of materials.

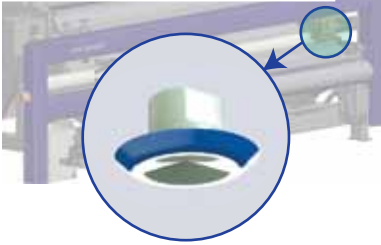
*Isotope probe specifications (comparison of the different probe types on page 7)*





## Capacitive head

### CAPACITIVE head



**The capacitive head** is dedicated to a non-contact material thickness measurement. To determine the distance of the sample to the sensor in addition to light (as is the case with a laser head) we can also use the electromagnetic field. One of the methods of such measurement is the use of capacitive sensors. Their operation is based on changing the capacitance of the capacitor that the sensor creates when another object approaches or goes farther away. The capacity of the capacitor system formed in this way increases as the material moves closer to the sensor. In our measuring head, sensors of this type move on a stable and stationary basis rail that is at a constant

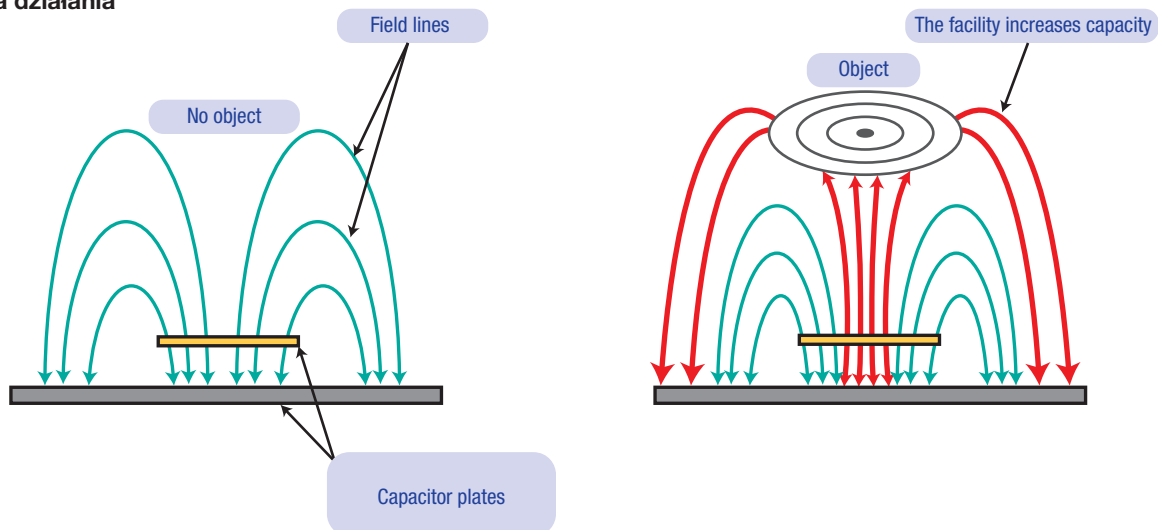
distance from the tested material. A change in material thickness is recognized as the material is approaching the sensor. Unlike laser sensors, capacitive technology is not sensitive to the color or texture of the material or the degree of its transparency. The capacitive sensors are suitable for the analysis of various materials, both conductive and dielectrics. The area between the sensor and the material to be measured should be completely free of dust, oil or water, if necessary this is achieved by blowing air through the gap between the sensor and the material.



The capacitive head in our PI-SCANPRO system can be used to measure:

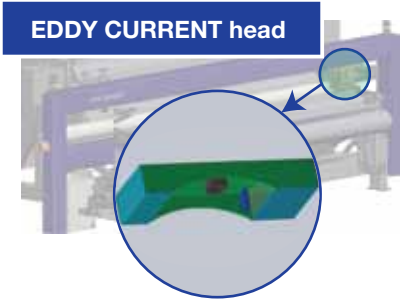
- **In the scanning (traversing) system** - scanning the material across or along
- **In the point system** - point measurement at a given place of the material (by multiplication we can obtain a multi-point measuring system, e.g. 3 heads)

### Zasada działania



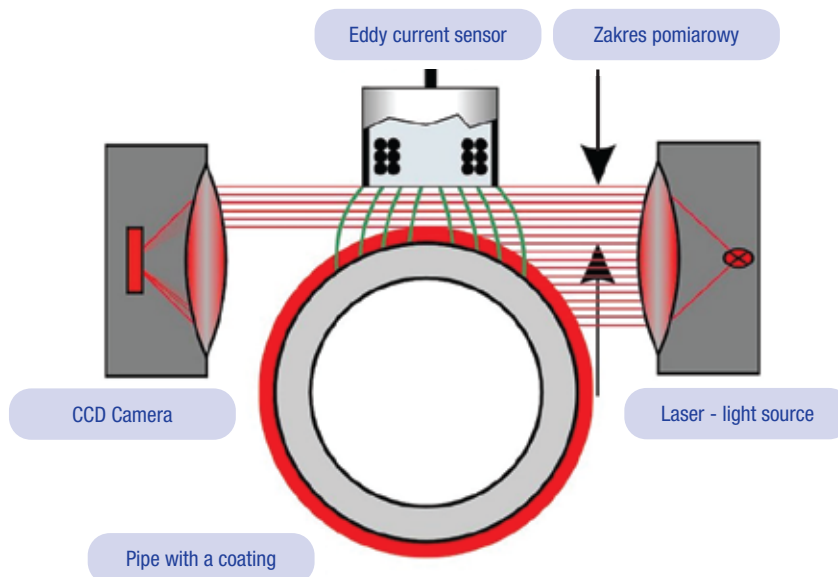
*Isotope probe specifications (comparison of the different probe types on page 7)*

## Eddy current head



**The Eddy current** sensors use the eddy current principle to detect a displacement. The eddy currents arise when a moving or changing field magnetic cuts the conductor or vice versa. The relative motion causes a circulating flow of electrons or currents in a conductor. These swirling currents create electromagnets with magnetic fields, which counteract with the applied magnetic field. The stronger an applied magnetic field or greater electrical conductivity of the conductor or the relative speed of the movement, the greater are the arising eddy currents and the greater is the opposite magnetic field. The Eddy current probes detect the formation of secondary fields to

determine the distance between the probe and the target material. So if we put a test sample between the probe and the target material - the measurement base, the head will indicate the thickness of this sample. The eddy current heads in measurement systems are used for fast, precise displacement measurements. The system most often consists of a compact controller, sensor, and integrated cable, and is factory calibrated for a ferromagnetic or non-ferromagnetic material.



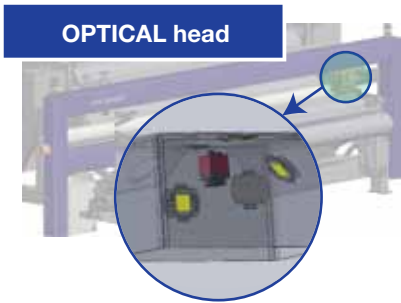
**An example of the use of an eddy current head with a laser head**

The eddy current head in our PI-SCANPRO system can be used to measure:

- **In the scanning (traversing) system** - scanning the material across or along
- **In the point system** - point measurement at a given place of the material (by multiplying we can obtain a multi-point measuring system, e.g. 3 heads)

*Isotope probe specifications (comparison of the different probe types on page 7)*

## OPTICAL head



**The optical head** is used in the PI-SCANPRO system as an independent measuring head or as an additional head to other heads, e.g. laser or isotope head, capacitive or other.

The use of the optical head in industrial conditions makes possible a measurement of width, height, length of whole products as well as individual parts. An additional function of the optical head is the use its capabilities to analyze various types of defects and faults, losses or inclusions of foreign bodies in the produced materials. The precise application of heads in industrial and laboratory

conditions enables the measurement of homogeneous materials or their structures (e.g. composite fibers). The optical measurement is non-contact and non-invasive.

The optical head in our PI-SCANPRO system can be used to measure:

- **In the scanning (traversing) system** - scanning the material across or along
- **In the point system** - point measurement in a given place of the material (by multiplication we can obtain a multi-point measuring system, e.g. 3 optical point heads)
- **In the holistic arrangement** - including 100% of the product, material, e.g. a ribbon



Due to the type of analyzed parameters, optical heads in the PI-SCANPRO system are divided into:

**The optical head -OPTISCAN-01** – which allows you to measure the width, height, length of whole products and individual parts. The drive from the production line (in the X axis direction) brings the products into the working area of the head, the products are scanned, and then exit the machine and continue along the production line. The measurement is carried out automatically, and information, e.g. about width and height, is sent on an ongoing basis to the industrial computer with full archiving.

**The optical head -OPTISCAN-MD** - allows for constant control and monitoring of parameters such as loss, defect, foreign body, inclusion, incorrect material structure. The PI-OPTISCAN-MD head allows you to automatically monitor on-line defects in materials in continuous motion on the production line. The system monitors the entire width of the web and can also be programmed to control any section of the web of material. The measurement is automatic, and information, e.g. about errors, is sent on an ongoing basis to the industrial computer with full archiving. When a fault or fault is detected, the system activates an alert level (operator defined).

### BASIC INFORMATION FROM THE OPTISCAN-MD OPTICAL HEAD:

Distribution of defects (counting) per given batch of material or time

Selection of lower tolerance ranges and upper defect detection

Alarm when detected defect out of tolerance

Possibility of classification / categorization material

Marking the product out of tolerance - all product or piece of material, e.g. web (OPTION)

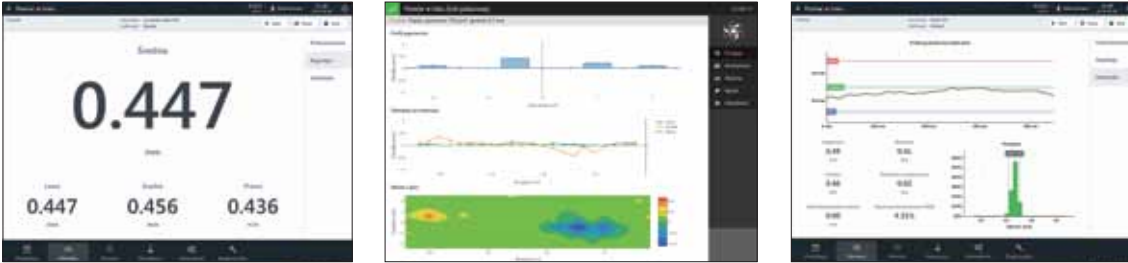
Other possibilities on individual request

*Isotope probe specifications (comparison of the different probe types on page 7)*



## PI-SCANPRO software

The PI-SCANPRO system works under the control of dedicated software that can be tailored to individual needs.



### Data presentation

The software allows you to manage results for products collected in measurement batches as well as unit products. In each case, we get full information about the value of the measured parameter as a function of length and width.

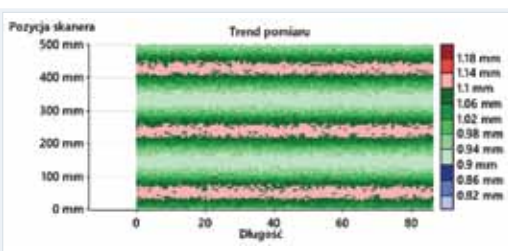
For the operator's convenience, the software allows you to display the results in the form of a graphic cross-section of the product or only numerical values - the average for the entire width and the average for the selected sections.



The cross-sectional plot shows the profile of the material as measured by the scanner. The horizontal axis is scaled from the edge of the material or from a given margin. The software also displays the defined tolerance range values in this view.



Each exceeding of the tolerance ranges is signaled to the operator directly on the screen, optionally external alarm signaling can also be turned on. In this case, we can define the time or the exceedance value that triggers the alarm, force the product to be corrected at a given time by the operator, and register any exceedances in the database product tolerance values.



For quality control departments, the software generates a visualization with a comprehensive view of the product, where the measured values are presented in the form of a color map that enables product evaluation. The user can also display the cross-section for the selected product length.

### System calibration

In PI-SCANPRO systems, the calibration and verification process is fully automated. Each product is different, it may differ in composition, analyzed parameters and tolerance ranges. In order for PI-SCANPRO systems to always meet customer expectations, they enable the creation of an unlimited number of calibrations and product recipes.

The system calibration is performed for each type of head independently, in accordance with its intended use. We divide the calibration into several stages. The factory calibrations performed at the time of production of the installation - which define the characteristics of a given head. The product calibrations - performed depending on the requirements of the measuring head by a user with appropriate access rights. The automatic calibration at a specified time or when working conditions change, performed independently of the operator. For the purposes of quality control, we also have the option of performing system validation - that is, checking the measurement system on a defined validation pattern.

## PI-SCANPRO software

### Data recording

The PI-SCANPRO system automatically saves all the recorded results, creating a current history of the product, these data are available to the user from the device software level, they can be exported to an external medium (connected locally or network) immediately after the end of production and at the user's request.



To ensure the comfort of analysis of the collected data, they are exported in the spreadsheet format. Data export can be configured by the system administrator.

### Reports

The report generation functionality is available as an additional option. The software can generate a product / batch measurement report in line with the customer's expectations. And also generate a label for the product.

### Access levels

Currently, not only pharmacy requires different access rights for users, thanks to such functionality it is possible to eliminate accidental errors in configuration and settings, or to limit access to confidential information for unauthorized persons. The PI-SCANPRO system software already in its basic version offers the possibility to define many roles for groups of users. So as not to impose their own concept of division of duties in the plant, our software allows for full editing of permissions for individual groups. The control covers each of the menu items and for key data it is also possible to define access at the read / write level. The PI-SCANPRO ADV, in addition to the aforementioned functionality, also has a built-in AUDIT TRIAL - creating a full history of activities and events that took place in the searchable system.



### Remote control

Accessing devices from remote locations is no longer a problem. Our software fully enables remote access to data and device control. This functionality is available in two versions - the basic one in the PI-SCANPRO-Basic system. In this version, a remote user is connected directly to the computer system controlling the meter. The user has access to all options as if he was standing directly next to the meter. It is also an essential tool for remote system diagnostics. The activation of this functionality requires only providing the PI-SCANPRO meter with access to the Internet.

For more demanding users, we recommend the PI-SCANPRO-Advanced version of advanced software, where the remote access is realized through a dedicated application operating in the WINDOWS environment. The remote user then receives his own independent control panel of the system, and thanks to optional cameras he has a preview of the meter operation. The defined access levels and direct connection of the client's application with the meter system provides the ability to view the results, generate reports, or modify settings without interrupting the routine work of the line operator.

## Integration of PI-SCANPRO with the production line

### Integration of PI-SCANPRO with the production line

The PI-SCANPRO system enables integration with the customer's production line at several points. At the most basic level, the system automatically detects product edges or stops measuring when the production line is stopped. In the extended version, as an option, the PI-SCANPRO system enables full communication with the production line controller, sending the current results or the value of the required correction in a digital or analog manner. It is also possible to mark the exceedances directly on the analyzed product. Due to the variety of production line control systems, the integration of the PI-SCANPRO system is always based on individual arrangements.

### Supervision over the technological process (calendering, extruding, etc.)

Most often, setting the size of the gaps responsible for the final parameters of the product, such as thickness, grammage, width, shape on lines equipped with calenders or extruders, is done by manually adjusting their size.

By measuring and visualizing on-line parameters obtained after forming the material, we can, using many years of experience, improve or automate the process of controlling the production line. Our systems provide:

#### - Manual adjustment:

The most common traditional manual adjustment is performed in the lines by visualizing the geometry deviations measured by the material scanner: of thickness, weight on the monitor screen and tightening or loosening the adjustment screws, e.g. extruder or calender shafts.

#### - Automatic regulation:

The innovative method developed by us provides an automatic method of adjustment, while it allows the user to use the manual as well as the automated method. The actuators of the system automatically carry out the calendering or extruding process.

Our scanners have built-in feedback using on-line measured values such as thickness, grammage for automatic adjustment.

#### User's benefits:

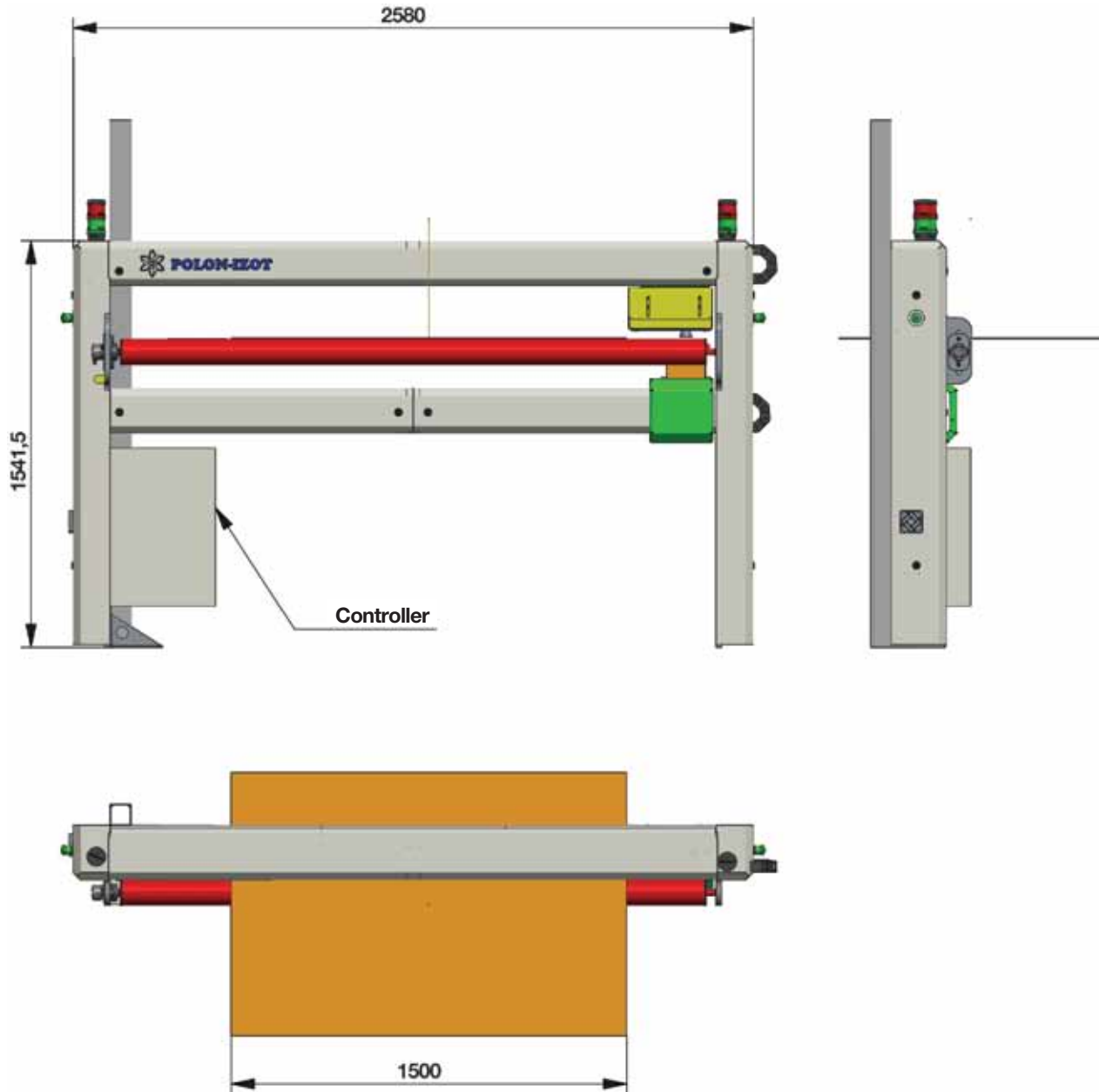
- the work without / with limited supervision by operators
- permanent set of parameters in the time range
- minimization of the start time for a production line
- cutting material costs
- real-time process conditions monitoring
- psychological aspect of work conditions improvement
- becoming a market leader





## Dimensions of the PI-SCANPRO

Example dimensions of the PI-SCANPRO TRAWERS for a 1.5m web



## OUR SERVICE!

### We do offer:

- Comprehensive sales and after-sales service
- Warranty service
- Post-warranty service
- Installation and commissioning of devices
- Training of personnel in operating devices, including maintaining work safety (e.g. working with isotope devices)
- Periodic inspections
- Service contracts
- Modernization of control and measurement devices: on-line, at-line and laboratory
- Modernization of technological lines
- Transport of isotope sources in accordance with ADR and PAA
- Storage of isotope sources
- Comprehensive service of supervision over isotope sources in control and measurement devices (IOR-01)
- Supervision over industrial and laboratory devices using ionizing radiation.



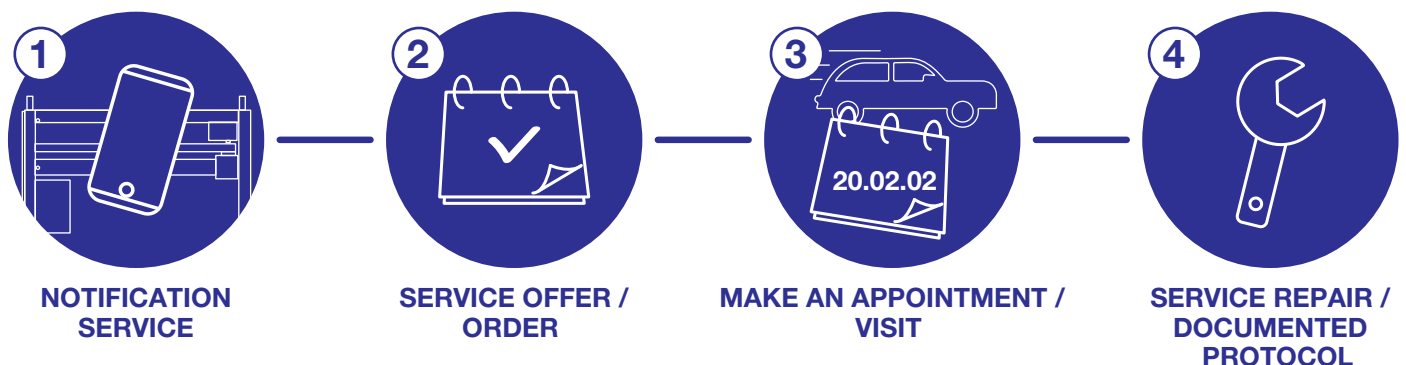
We have a permit from the National Atomic Energy Agency (PAA) to perform activities in accordance with the Atomic Law Act consisting of:

- I. - starting devices generating ionizing radiation - XRF spectrometers
- II. - manufacturing, installing and servicing devices containing radioactive sources

We have UDT f-gas qualifications in accordance with the Act:

REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

Our priority is to provide timely service and an individual approach to each service request.



# Measure & Save!







**Implementation Examples**



**PGAI**

**Jaktorów near Warsaw, POLAND**

**Solution:**

On-line thickness measurement

Product: PS film (Polystyrene)



**Zielona Góra, POLAND**

**Solution:**

On-line basis weight measurement

Product: floor coverings, carpet underlays, plastics

**Successfully completed projects:**





**Our product portfolio examples**



**XRF spectrometers**



**Thickness and grammage gauges  
Laboratory version**



**Optical defect analyzers**

**Density meters**



**Non-contact density measurements through  
the installation pipe**



**Dust concentration meters,  
including explosive dust**

**Contamination metres Surface and dose rate**



**Contamination  
meters surface  
and dose rate**



**MAZAR - radionuclide analyzers in  
environmental samples including  
in building materials**



**Contamination monitoring systems  
wheeled and rail vehicles including  
in pedestrian traffic**



## Contact information



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**e-mail: office@polonizot.pl**

POLON-IZOT is a Polish manufacturer of measuring equipment for laboratories and industry. We are the continuator of the activities of the world-famous company POLON United Works of Nuclear Devices, founded in 1956 and functioning as the Office of Nuclear Technology Devices. Therefore, we can be proud of over 60 years of technical achievements.

Our mission is to create our own advanced technical solutions for both on-line and at-line measuring equipment or typical laboratory products.

We are prepared to manufacture measuring and control equipment on individual orders.

We have a permit from the National Atomic Energy Agency (PAA) to perform activities in accordance with the Atomic Law Act consisting of:

I. - starting devices generating ionizing radiation - XRF spectrometers II. - manufacturing, installing and servicing devices containing radioactive sources

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**Measure & Save!**

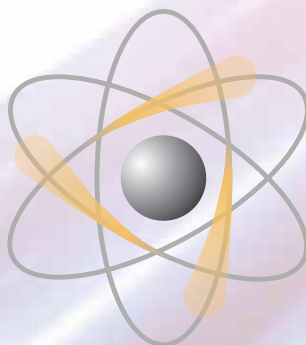
**www.polonizot.pl**



# Measure & Save!



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