OPTICAL (NIR) MEASURING SYSTEM
UR 5500 „LED“
EQUIPMENT INFORMATION
1 GENERAL

This equipment information refers to an optical measuring system based on infrared radiation for the determination of material properties online in the process. A standard design system consists of a measuring head, control unit and of a connection cable. The measuring head must be installed in a manner that the emitted light ray can meet the material to be examined unimpeded and continuously.

The NIR Measuring System is excellently suited for the determination of the moisture in materials, but also of other constituents as for instance fat or proteins in foodstuff and animal food, of layer weight on paper and coating thickness on foil.

Moisture measurement with light from the near-infrared range (NIR) is a method for the determination of constituents in a number of different materials. The basic physical principle of NIR (near infrared) moisture measurement in solid materials is based on the ability to make weakly-bonded water molecules vibrate by means of electro-magnetic waves. Free water absorbs electro-magnetic energy at certain wave lengths (absorption bands). An emitted light beam is partly absorbed and partly reflected at impervious to light, moist surfaces of the material to be examined. The absorbing part of the beam energy contains the information on material moisture.

2 MEASURING PROCEDURE

2.1 EXPLANATION

Moisture measurement with light from the near-infrared range (NIR) is a method for the determination of constituents in a number of different materials.
2.2 ADVANTAGES

The NIR (near-infrared) measuring technology offers many advantages compared with the conventional analysing methods:

1. Speed:
Measured values are displayed immediately and without any delay. With the weighing-drying method, for comparison, it takes 10 – 20 minutes (without microwave drying).

2. Online capability:
Admittedly, there are also some other moisture measurement methods suitable for online measurements (microwave method, dielectric measurement, electrical conductivity measurement, under circumstances even air-moisture equilibrium measurement), but most only at very high system expense.

3. Accuracy:
The NIR method allows to achieve the same degree of accuracy as with the reference method. The water content can be determined with an accuracy of up to 0.1 % (for comparison: With the conductivity moisture measurement of wood the uncertainty is at ± 10 %).

4. Ease of operation:
After installation and production of the calibration curves the sensor is absolutely maintenance-free.

5. Universality:
The NIR technology allows moisture measurement in a wide range of materials. In addition to solid matter also liquids and gasses can be examined for moisture.

6. Versatility:
By means of variation of measuring wavelength also other constituents, in addition to moisture, can be measured.

7. Contactless measurement without destruction of the product:
Because of this, also measurements can be carried out on materials which are hazardous to health or are poisonous.

8. Environmental compatibility:
The NIR moisture sensors do not produce any waste und consume very little energy.

9. Automation friendliness:
By means of a continuous output signal direct processing in a moisture control system is possible.

3 POSSIBLE APPLICATIONS

Foodstuff and semi-luxury food:
Flour, sugar, powdered coffee, rice, chocolate, tobacco, chips and other potato products, gelantine, biscuits and cookies, tea and other products.

Wood and paper industry: Woodchips, paper webs, cardboard, corrugated board, veneers, chipboard and other products.

Glass industry: Plastic film in laminated glass, sand, quartz sand and similar materials.

Chemical and pharmaceutical industry:
Paint, detergents, cellulose, bauxite, lactose, india rubber, fertilizer, soap, explosives, various powders and granulates and similar materials.

Steel and aluminium industry:
Measurement of grease, corrosion protection or liquid films on continuous sheet metal.

Building material and ceramics industry:
Clay, sand, potash, bauxite, gypsum, kaolin and similar materials.

Textile industry: Fleece, fabrics, fibres, cotton wool, wool, layers, etc.

Agricultural industry: Fertilizer, grain, seeds, hop, etc.
4 HARDWARE / SOFTWARE / OPTIONS

4.1 MEASURING HEAD

The measuring head contains the electronics, consisting of the following modules:

- Circuit board LED with the receiver for the installation of the specific LEDs selected for the respective measuring task
- Circuit board Signal processing
- Circuit board Power supply

Novel is the possibility to extend signal processing with a micro controller which permits to process signals immediately in the measuring head which can then be sent via bus directly to a customer-owned control system for further processing.

4.2 CONTROL UNIT

As a control unit (evaluation unit) a power panel is used in this system. This control unit contains integrated connection options for I/O signals and visualisation. The unit is characterised by a compact design, particular efficiency and a wide range of functions.

The standard version of the control unit contains 8 digital and 4 analog inputs plus 8 digital and 4 analog outputs. The serial interface can be used optionally for data output for measurement records etc. For visualisation there is an LCD display 9x27 characters provided. By means of buttons all the necessary parameters can be set, respectively displayed.

4.3 SOFTWARE

The following features are implemented in the program:
- Calibration plus calibration help
- Rapid and reliable measured value acquisition
- Adjustable measured value processing
- Presentation of the processed measurement results
- Variable integration time for mean-value generation
- Administration of several different materials (up to 5)
- Analog output of processed measurement results
- Output of measurement results via the serial RS-232 interface

Possible options:
- Connection of several, also differing, sensors
- Administration of additional different materials (up to 20)
- Digital de-coupled output of alarm warnings in case of deviations from set measurement values
4.4 OPTIONS

4.4.1 Stand 500 mm high for using the measuring head also in the laboratory.

4.4.2 PC system for customer-specific data acquisition, evaluation and documentation.

4.4.3 Connection of a light wave conductor in case of difficult operating conditions, for installing the measuring head outside ex-areas or in case of confined installation conditions. Length and type of the optical fibre are determined by the application.

4.4.4 Water cooling for service at higher temperatures from 45 °C for protecting the electronics, consumption at 3 bar approx. 100 l/h, when ambient temperature rises, also temporarily, above 45 °C.

4.4.5 Cleaning air nozzle for keeping the optical system clean with clean compressed air at 2 bar, max. 2³/h when the ambient air contains, also temporarily, dust. A multi-channel nozzle or a tube can be chosen.
### 5. TECHNICAL SPECIFICATIONS UR 5500 “LED“ MEASURING

#### Measuring principle
- Infrared reflection measurement
- Contactless
- Practically simultaneous same-spot scanning by up to four different measuring waves

#### Measured material properties
- Suitable for flat web-type products, bulk material with grain size up to 30 mm, depending on product composition and type of product

#### Measuring range
- 0 % up to 80 % moisture (depending on product)

#### Measuring period
- 0.1 seconds, mean value and integration function from 0.1 to 99 seconds freely adjustable

#### Distance to measured material
- 10 bis 300 mm (depending on reflection)

#### Size of measuring spot
- Up to 200 mm, depending on optics and distance to measured material

#### Dimensions and weight
- 150 x 150 x 160 mm (W x H x L)
- 4 kg without options
- Light alloy RAL 5018 painted

#### Light source
- LED

#### Light receiver
- Photodiode

#### Ambient temperature
- 5 °C to 45 °C without cooling
- Up to 85 °C with cooling (optional)

#### Power supply
- 24 V DC, max. 0.2 A

#### Signal output
- Per wave length 0…10 V or 4…20 mA (Customer request)

#### Level of protection
- IP 65

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**Evaluation electronics (standard)**
- Casing: 400 x 350 x 200 mm
- Paint finish: RAL 5018 / RAL 7035
- Front fitted with Power Panel 153 x 120 mm
- LC Display, backlight, 16 buttons
- Integrated processor
- RS 232 interface
- Analog inputs / analog outputs
- Digital inputs / digital outputs
- Connection voltage 230 V AC
- Internal power 24 V DC

*Example of installation above conveyor*
6 INSTALLATION / MOUNTING

6.1 INSTALLATION / MOUNTING

When mounting the sensor our specifications according to the accompanying documentation must be complied with. For instance use of screened data cables and vibration-free installation of the sensor.

6.2 INSTALLATION DRAWINGS

Mounting example at circular screen feeder - for processing of ceramic mixes
Below follows an example for the installation above a conveyor belt with skimmer for uniform material flow.

1. Positioning of the sensor if possible near or above a conveyor roller for avoiding vibrations of the conveyor belt.  
2. The material to be measured should be distributed on the conveyor belt as even as possible; if necessary, a skimmer will have to be installed.  
3. Optimum distance to the material is 80 - 100 mm.