



Hazel

Hazel is an optical monitoring system measuring the haze of TCO-coated transparent substrates. It is designed to fit into production lines either for the control of the haze directly after TCO deposition or for quality inspection of incoming TCO/glass sheets for PV production.

Hazel features

in-line measurement of the haze (the ratio of diffusely transmitted light to the totally transmitted light) for coated transparent substrates, typically TCO coated glasses and polymer foils in production lines. The measurements are carried out with a repetition rate of 20 Hz on moving substrates.

The optical monitoring is done with probe light of 635 nm. Other wavelengths are available on request. A second wavelength can be added on request as well.

Communication / integration

Hazel is designed to be compatible with typical state of the art in-line and roll-to-roll processes. It is suitable for all layers on transparent substrates.

The system can interface to production machines using a variety of interface protocols: TCP/IP, Profibus, DeviceNet, RS232, RS 485, SECS II / GEM and others on request.

Customer specific adaptations are possible. Specific software / hardware interfaces can be implemented based on 5V TTL or 24V voltage/current on request.

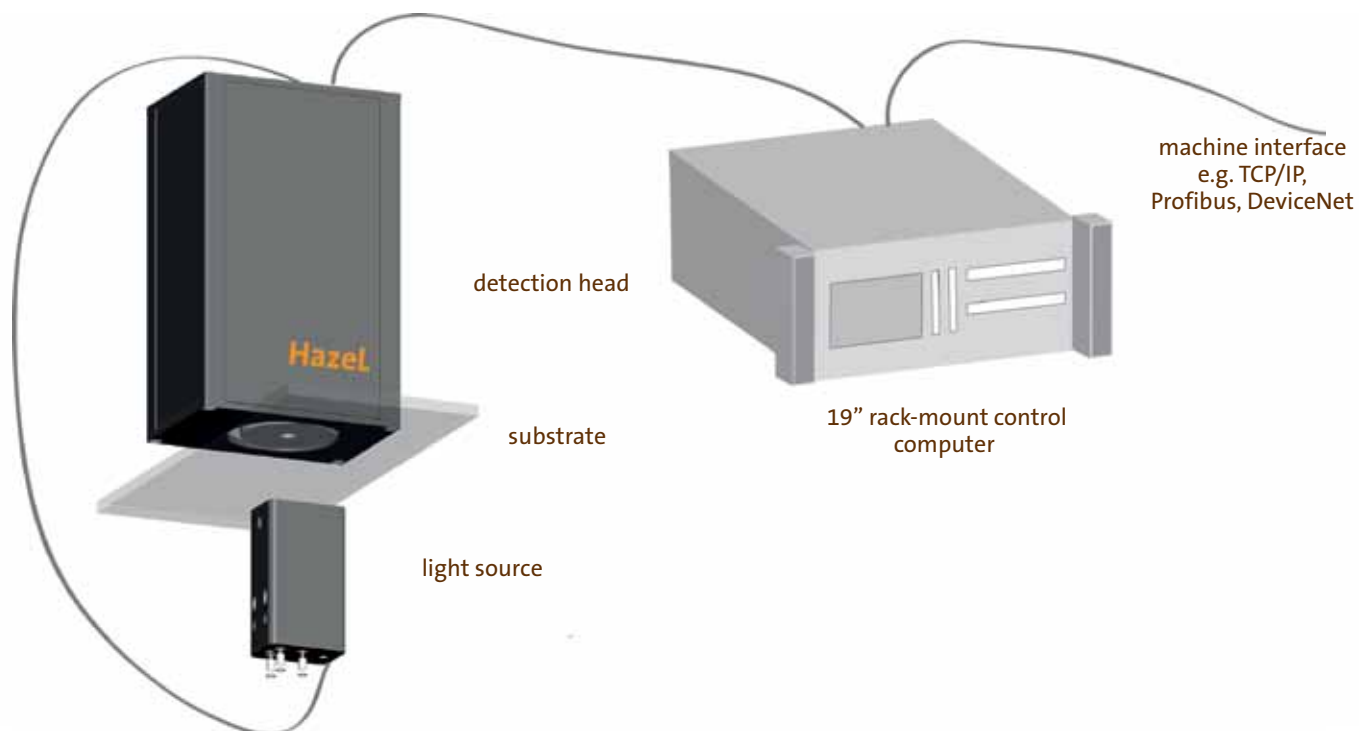
Typical accuracy of haze measurements

- $\pm 1\%$ for typical haze of 10% to 30%.

How it works

Two detectors inside the Hazel head measure simultaneously light that is transmitted directly and diffusely through the substrate. Out of the relative intensities the haze value is calculated and displayed on-line.

HazeL standard package



Details of the set-up:

The figure above shows the set-up of the HazeL-System in a production line. The light source is mounted under the conveyor system of the production line that transports the coated substrates. The sensor head is installed in the same place above the substrate. Sensor head and light source are connected by an electric cable, the sensor head is connected to a control computer. The control computer visualizes the measured quantities and is responsible for the communication with the production line control system.

Mounting and adjustment units are customized to fit to the requirements of the production line.

The device needs to be calibrated only once. This will be done during the installation.

Components

light source	laser (laser class 2)
typical life-time according to manufacturer	15.000 h
standard wavelength	635 nm (others on request)
second wavelength	405, 680 or other on request
measurement interval	0.05 s

Hazel standard package

- Control computer**
(subject to technical changes)
- 19" rack mount control computer
 - CPU: Pentium Core 2 Duo, min 1.66 GHz, RAM min. 1 GB
 - HDD min. 160 GB, RAID 1
 - DVD-writer, card reader, mouse, keyboard
 - 100 Mbit/s LAN interface or better
 - operating system: Windows XP pro MUI (multi language version)
 - 19" TFT flat screen (monitor resolution of 1280 x 1024 or higher)

- Cables**
- ethernet Cat5 + TP cable
 - electrical link cable between light source and detection head
 - multi-plug and power cables

- Miscellaneous items**
- customized mounting and adjustment unit
 - manual and software CD
 - trigger units for detecting incoming glass substrates (available on request)

Interfacing Option

LayTec can offer the following options:

- ProfiBus
- DeviceNet
- OPC
- Straight Wiring: connecting analog or digital signals via wire pairs as the simplest way of interfacing. Available are 24 V current loops (4-20mA) or voltages (0-10V) (only very limited information transport is possible)
- other options on request, e.g. LightBus, EtherCat, CANBus, ModBus, InterBus.

Sizes and weights of the parts

Parts	Size X x Y x Z mm	Weight, kg
detection head	154 x 108 x 152.5	2.0
light source	60 x 40 x 60	0.5
rack mount control computer (4 HE)	450 x 600 x 180	17.0
19" LCD display	410 x 20 x 420	5,5
additional: customized adjustable mounts		

Hazel requirements

Requirements to the production line

- free optical access to the substrate at the measurement position
- distance between detection head and substrate: 5 to 15 mm
- distance between light source and substrate: 20 mm to 1000 mm
- Laser light beam must be shielded according to local regulations

Operating conditions

Component	Allowed temperature range	
	operation	storage
light source	10°C – 40°C	10°C – 60°C
electronic control unit	10°C – 40°C	10°C – 60°C
control computer	10°C – 35°C	10°C – 60°C

Please note:

- optical head is fragile, avoid shock-treatment
- device contains a class 2 laser source

Electrical connections / power consumption

- the mains connection (100-240 V) including extension cables has to be provided by the customer
- input voltage: 100 - 240V AC wide range
- the power supply must be equipped with grounding wire
- power consumption (typical values for 230 V operation):

Component	current / A	power /W
	typical	typical
control computer	0.5	115
monitor	0.3	60
detection head and light source	0.1	25
sum	0.9	200