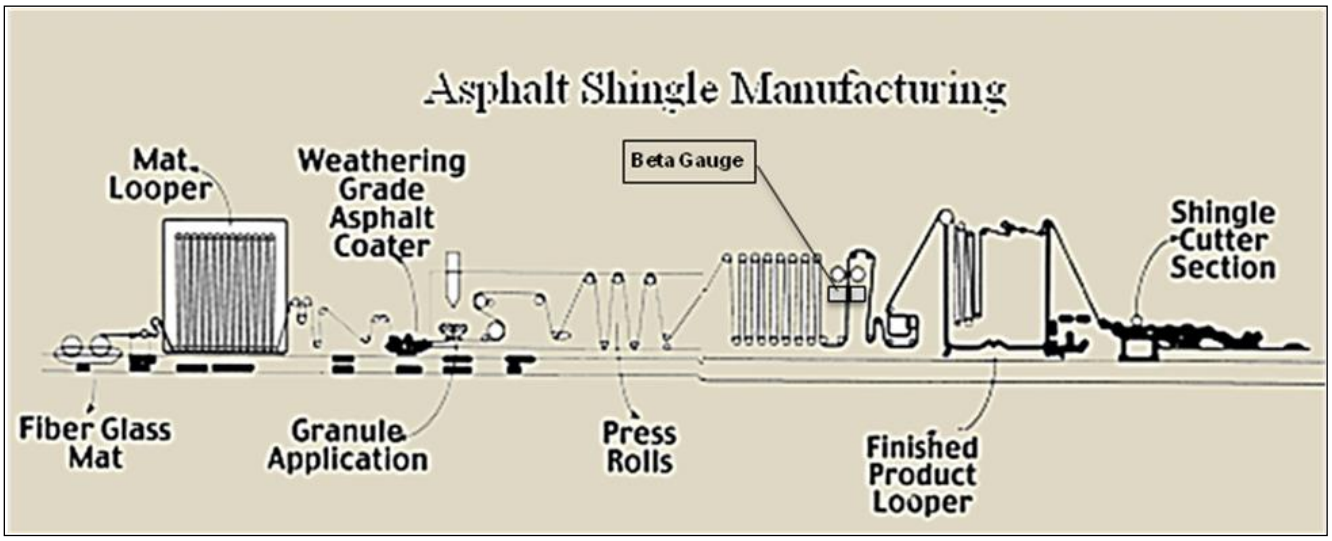
BUILDING PRODUCTS APPLICATION REPORT

The diverse Building Products market requires a flexible Quality Control System that is both industrially sealed and rugged. In addition, these industries have become increasingly more competitive resulting in tighter product specifications and more challenging profit margins. For 70 years, Mahlo has been responding to these market pressures by providing measurement and control solutions.

Mahlo's experience and understanding within the building products industry has allowed us to tailor web gauging systems for the following processes:

- **Roofing Shingles**
- **Fiberglass Batt, Roll & Pipe Insulation / Mineral Wool**
- **Fiberglass Mat**
- **TPO/PVC/EPDM Roofing**
- **Polyisocyanurate and Polystyrene Foam Board**
- **Drywall / Gypsum Board, etc.**

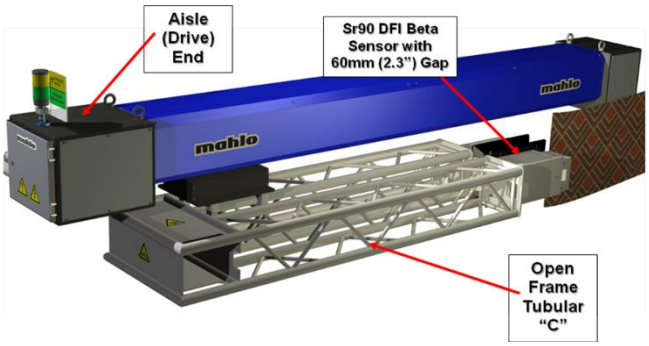
➢ Roofing Shingles

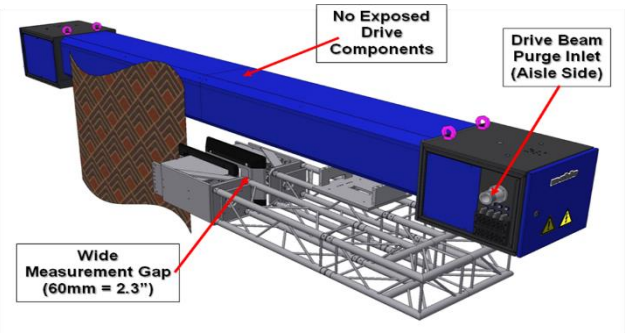


Typical Shingle Manufacturing Line Schematic

For the measurement of final shingle weight, the gauging system must withstand a rain of granules, moisture, fiberglass and asphalt! A special Scanning Frame is required that is quite well sealed with no openings to the drive components in the path of contamination. Additionally, the moving measurement assembly must be extremely rugged, but reject a build-up of heavy granules. Finally, the measurement gap must be very wide so that the shingle does not come into contact with the sensor, but in so doing, the sensor cannot be affected by ripples or flutter of the moving shingle web. **The Mahlo WebPro-CR:**

All maintenance is performed outside of the shingle path from one end of the scanner drive beam. The moving "C" itself is a strong tubular construction (like a race car frame) and the granules pass right through with minimal build-up. A sealed 4" drive belt moves the "C" beneath the drive beam, out of the way of raining contaminants.





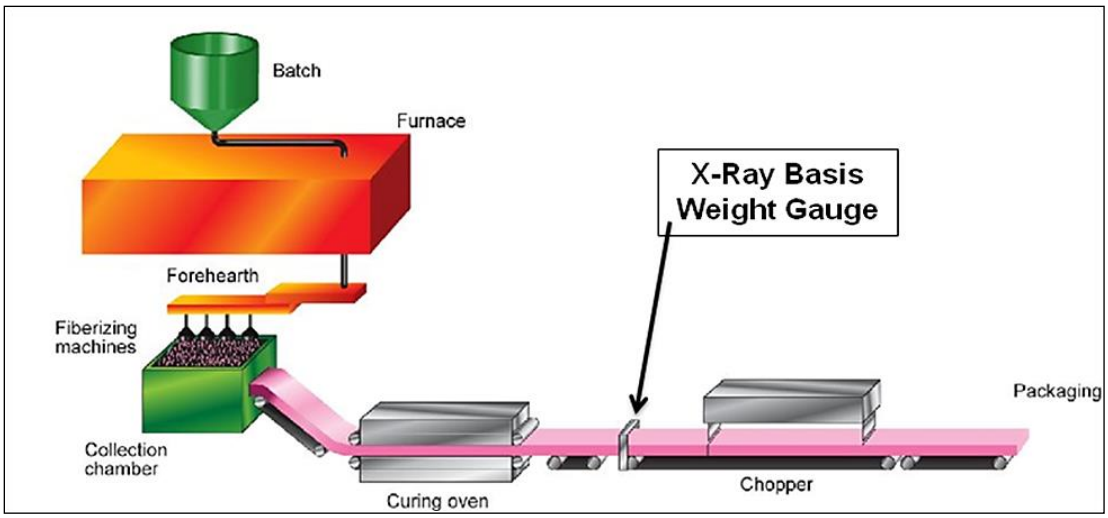
The DFI Strontium-90 Beta Transmission Sensor has a very wide 60mm ($2^3/_8$") measurement gap. The patented Mahlo Dynamic Flutter Independent (DFI) Beta Technology is completely unaffected by the position of the shingle in the gap! *Finally, the correct solution for shingles.*

Typical Mahlo System Build for Roofing Shingles:

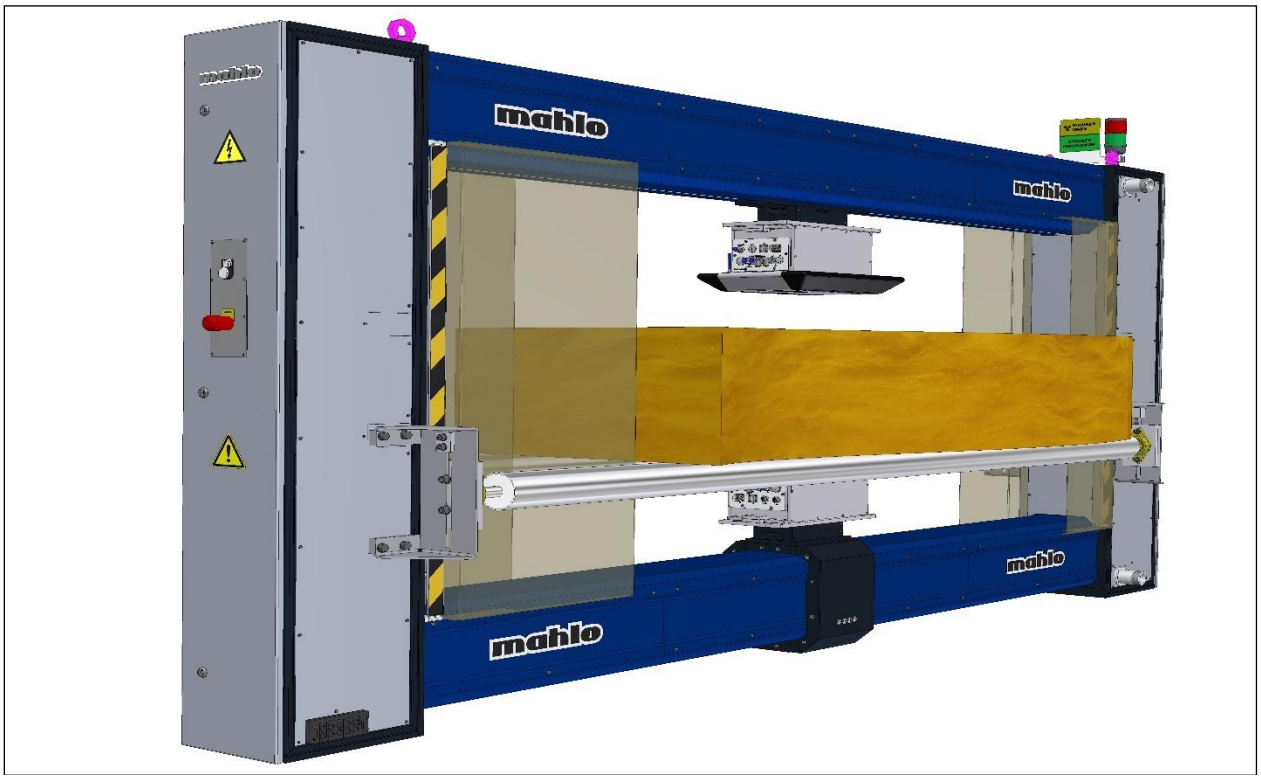
- QMS-12 Control & Display Station with all Control and Display Features
- WebPro-CR C-Frame Scanner for Vertical Web
- DFI Sr90 Beta Transmission Sensor
- Ethernet Communications to Plant Control & Data Acquisition System

➢ Fiberglass Batt, Roll & Pipe Insulation / Mineral Wool

As greater energy efficiency is required, fiberglass batt and roll insulation is in increasing demand. Thicknesses in excess of 16" are commonplace, and accurate measurement of the fiberglass weight to guarantee R-value, while minimizing raw material usage, is mandatory.



The Mahlo WebPro-MH Wide Gap O-Frame Scanner with FMX-TW X-Ray Transmission Sensor is the preferred solution for fiberglass batt and roll:



•Rugged steel frame construction •Wide steel-reinforced drive belts seal the drive components •Linear-profile bearings and rails •No-maintenance brushless high-torque AC motor •Automatic safeguarding and interlocks. All guarantee the industry's highest measurement availability with the lowest long-term cost of ownership.

Add a non-contact DML Thickness Sensor to the measurement head to provide real-time Density (correlates to R-value):

Weight/Area (from FMX) divided by Thickness (from DML) = Weight/Volume = Density

Air purging of the scanner, air wipes of the sensor faces and closed-circuit liquid cooling of the measurement heads are included as standard.

Typical Mahlo System Build for Fiberglass Batt & Roll:

- QMS-12 Control & Display Station with all Control and Display Features
- WebPro-MH Wide Gap O-Frame Scanner
- FMX-TW X-Ray Transmission Sensor
- *Optional* – DML Non-Contact Thickness Sensor including Real-Time Density
- Ethernet Communications to Plant Control & Data Acquisition System

➢ Fiberglass Mat

The accurate on-line measurement of glass and binder weights is necessary for the manufacture of fiberglass mat. Mahlo offers a wide range of measurement solutions that include Transmission Basis Weight sensors for final mat weight, and Infrared, Gamma Transmission and X-Ray Transmission measurements for the determination of binder weight. In addition, our non-contact DML Caliper Sensor can be added to the measurement head to provide real-time precise mat thickness.

The industry's most durable all-steel O-Frame scanners, the Mahlo WebPro-M and WebPro-L, carry multiple sensor payloads tailored to the specific measurement needs and mat widths.

The Mahlo QMS-12 System for fiberglass Mat measurement meets the stringent correlation to TAPPI T-211 for Ash and TAPPI T-1013 for Loss on Ignition (LOI).

Typical Mahlo System Build for Fiberglass Mat:

- QMS-12 Control & Display Station with all Control and Display Features
- WebPro-M or WebPro-L O-Frame Scanner
- DFI Kr85 Beta Transmission Sensor for Total Weight
- IMF IR, FMA Fe-55 Gamma or FMX X-Ray Transmission Sensor for Binder Weight
- *Optional* – DML Non-Contact Thickness Sensor including Real-Time Density
- Ethernet Communications to Plant Control & Data Acquisition System

➢ TPO/PVC/EPDM Roofing & Signage

TPO and PVC sheet for flat roofing and signage require precise basis weight and thickness measurement as well as continuous cross-machine direction (CD) profile control. The wide, rugged WebPro series of O-Frame Scanners and patented DFI Basis Weight and DML Laser Caliper Sensors provide the fast, high-resolution CD measurements required for flat profile control. The Mahlo APC Pro Autodie Profile Control System integrates seamlessly with the QMS-12 measurement console with its easy-to-use operator interface, Fast Start and Kick modes for rapid control on startup and changeovers, Self-Tuning utility and standard automatic diebolt heater checking.

Rapid Flatness Control

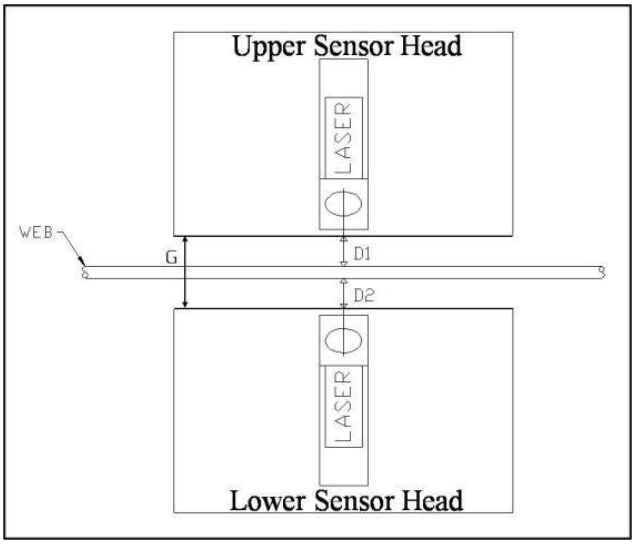
Wide Rugged Scanners

From single extruder, single scanner systems, to dual extruder, multiple scanner systems operating in precise same-spot measurement mode, both basis weight and thickness of each layer and the final composite web can be measured and controlled.

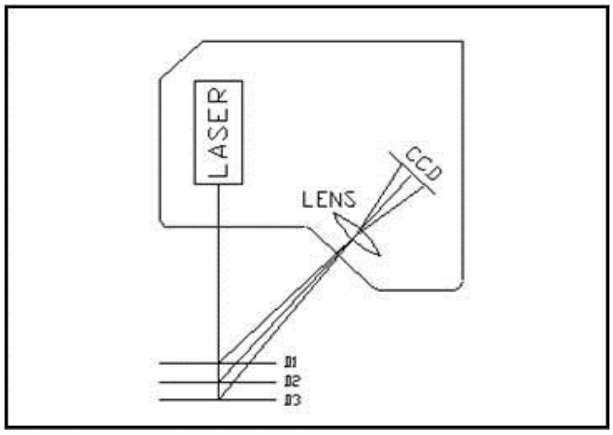
Typical Mahlo System Build for TPO / PVC Roofing and Signage:

- QMS-12 Control & Display Station with all Control and Display Features
- WebPro-M or WebPro-L O-Frame Scanner
- DFI Kr85 Beta Transmission Sensor for Total Weight
- *Optional* – DML Non-Contact Thickness Sensor
- APC Pro Autodie Profile Control System
- Ethernet Communications to Plant Control & Data Acquisition System

➢ Polyisocyanurate and Polystyrene Foam Board



The measurement of insulation board thickness in order to produce consistent quality material while reducing raw material usage is providing manufacturers with a significant competitive edge. The Mahlo DML Laser Caliper Sensor employs laser distance sensors above and below the foam board. The thickness is calculated as G – D1 – D2. In addition, a measurement of the total received laser beam intensity is made. This information is used to closed-loop modulate the intensity of the laser beams so that sufficient light is reflected to the CCD. This maintains a low-noise measurement in cases of changes in color or surface reflectivity of the target. This utility significantly reduces any sensitivity to foam color, facer color or surface reflectivity.



Insuring True Peak-to-Peak Thickness

The laser beam footprint is small (elliptical, 70 x 1000 microns [3 x 40 mils]) compared to some surface texture in foam. In order to obtain good correlation to TAPPI T 411 and ASTM D 645/D 645M Thickness Test Methods, a sophisticated peak-picking algorithm is used in the gauging console to provide true peak-to-peak thickness over the desired integration distance. Reporting the data in Peak mode has been shown to provide a very repeatable correlation to T411, which is inherently a peak-picking laboratory caliper measurement technique. The Mahlo DML Caliper Sensor incorporates all necessary tools for temperature compensation, systematic scanner profile and automatic standardization for long-term accurate thickness measurements.

In addition to thickness, many manufacturers have found that a real-time measurement of foam density is the best choice to control R-value. The Mahlo MS-12 can incorporate a Basis Weight Sensor on the same scanner with the DML Caliper Sensor to provide real-time Density:

Weight/Area (from FMX) divided by Thickness (from DML) = Weight/Volume = Density

Both Faced and Un-Faced Foam Board is Measured Accurately

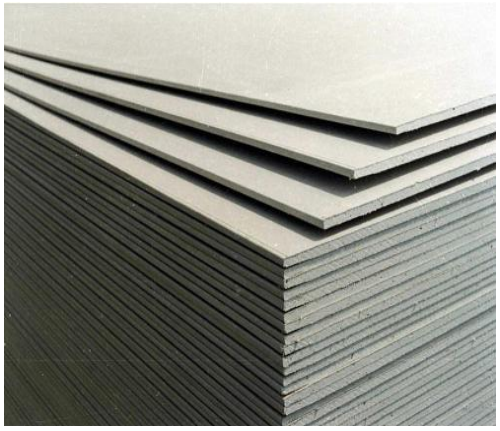
The Mahlo WebPro-MH is used for foam board applications, which allows the measurement of six inch and thicker boards. In addition, the scanner beams are positioned quite far from the board to keep them protected in case of board buckling. Facer weight and thickness can be subtracted out of the foam measurements to provide a very accurate foam density calculation. Special Display Screens include Bow. Width, Temperature, etc.

Typical Mahlo System Build for Foam Insulation Board:

- QMS-12 Control & Display Station with all Control and Display Features
- WebPro-MH Wide Gap O-Frame Scanner
- DML Non-Contact Thickness Sensor
- *Optional* – Sr90 Beta Transmission Sensor for Total Weight including Real-Time Density
- *Optional* - Facer Scanners
- Ethernet Communications to Plant Control & Data Acquisition System

➢ Drywall / Gypsum Board

Online Gypsum Board basis weight and thickness measurement is key to ensuring proper board dimensions, including taper, and the most efficient raw material usage. Mahlo uses our WebPro-MH Wide Gap O-Frame Scanner to move the scanner beams away from the board in case of buckling and to clear the conveyer on both sides to eliminate or reduce any line modifications. Our DML Non-Contact Laser Caliper Sensor provides a very accurate thickness measurement with high cross-machine direction resolution. The FMX-TW X-Ray Transmission Sensor provides real-time board weight and eliminates the need for contacting on-line weighing devices. In addition, a calculation of board density is automatically provided.



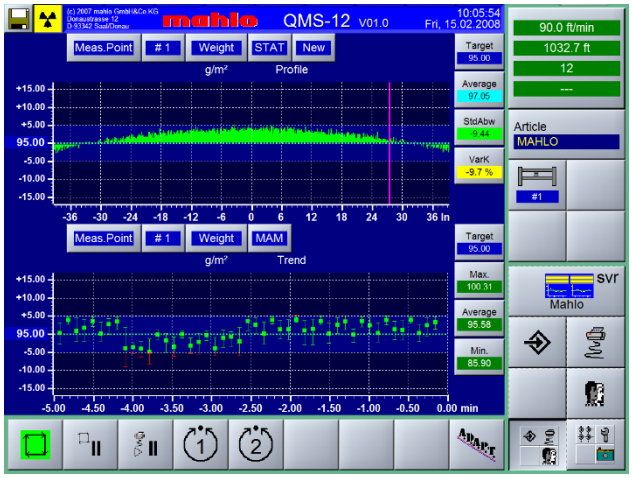
Typical Mahlo System Build for Drywall / Gypsum Board:

- QMS-12 Control & Display Station with all Control and Display Features
- WebPro-MH Wide Gap O-Frame Scanner
- DML Non-Contact Thickness Sensor
- *Optional* – FMX-TW X-Ray Transmission Sensor for Weight includes Real-Time Density
- Ethernet Communications to Plant Control & Data Acquisition System

Other Building Products

Mahlo makes solutions for all types of flat web processes, including:

- ***Ice and Water Shield***
- ***Felt***
- ***Asphalt / Tar Paper***
- ***Ceiling Tiles***
- ***Fiberboard***
- ***House Wrap***
- ***Vinyl Siding***
- ***Any Flat Web less than 20 Inches Thick!***

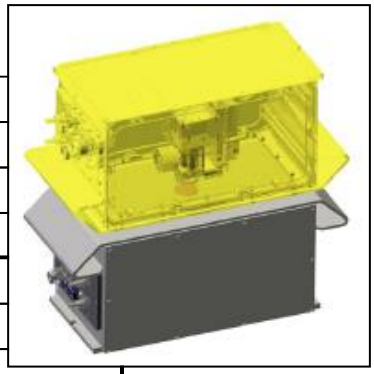


Utilizing intelligent sensor and scanner techniques, the Mahlo QMS systems measure on-line continuously and with extreme precision and speed. The computer interface is Windows Embedded (WES7) based, is fully open and conforms to all industrial communications standards. Ease of use and configurability were built in from the ground up and the menus and functions are very easy to understand with a short learning curve.

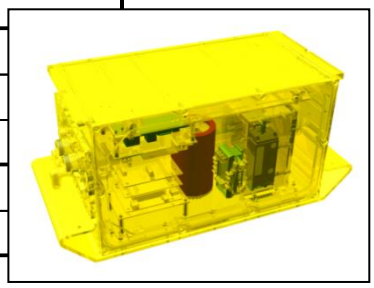
One of the many strengths of the Mahlo system is the family of rugged steel O-Frames. We know that these scanners must traverse back and forth around the clock, 365 days per year for many years. Building tough industrial machinery is a forte of German manufacturing, and Mahlo grew up making large-scale machinery for the textile and carpet industry, and continues to this day. Over-engineered for long, trouble-free life, yet easy to maintain with commercial components, all Mahlo scanners whether single-sided for Infrared or X-Ray sensor applications, COMPACT O-Frames for tight spaces or the WebPro-L O-Frame scanner for spans of up to eight meters and a payload of up to five sensors are built to last.

Mahlo QMS Quality Control System Offerings for Building Products

Measurements



Basis Weight	
5 to 20,000 GSM	*DFI Krypton-85 Beta Transmission*
	DFI Strontium-90 Beta Transmission
	FMX-TW X-Ray Transmission
Binder Weight	
5 to 1500 GSM	*IMF Infrared Absorption*
	FMA Iron-55 Gamma Transmission
	FMX-T LowEnergy X-Ray Transmission Sensor
Thickness	
0.010 - 20 Inches	*DML Single-Sided Laser Caliper Sensor*
250µ - 500mm	*DML Dual-Sided Laser Caliper Sensor*
Moisture	
0.01 - 95%	*IMF Infrared Absorption Sensor*
0.01 - 1000 g/m^2	*HMF Microwave Resonance Sensor*
Selective Coatings	
0.01 - 1000 g/m2	*IMF Infrared Absorption Sensor*



Traversing Platforms

O-Frame Scanners	
Up to 2 meters	*WebPro - XS*
Up to 4 meters	*WebPro - M, - S, - MH*
Up to 8 meters	*WebPro - L*
Single-Beam Scanners	
Up to 3 meters	*Uniscan - S*
Up to 6 meters	*Uniscan - M*
C-Frame Scanners	
Up to 2 meters	*WebPro – C, WebPro-CR*

Operator Stations

Stand-Alone	*Standard Operator Station*
IP Desktop	*QMS Visualization IP Desktop*
Line Control Station	*Integrated into Line Operator Station*

Options

Auto Die Control ~ SPC/QC Packages ~ Hazardous Location Applications

About Mahlo

Since 1945, Mahlo has built its reputation based on the design and manufacture of rugged, innovative, cost effective on-line monitoring and control technologies. It is our focus to provide our customers with tailored solutions that offer a quick return on investment and are supported by our experienced and responsive technical support team.

Mahlo is headquartered in Saal, Germany, in the heart of Bavaria. We are privately owned by the Mahlo family and take great pride in continuing the tradition of quality-built products based upon German engineering and craftsmanship. Mahlo employs over 300 people worldwide with over 100 sales and service centers in 115 countries.

Mahlo America, located in Spartanburg South Carolina, celebrated its 50th anniversary in 2018. Our facility, along with a network of sales and service offices throughout North America, provide unparalleled customer support and a true commitment to helping our customers improve their manufacturing processes and reduce production costs. And 24/7/365 *Lifetime* telephone and Internet support is provided with every Mahlo System at no cost. Ever.

In addition, our U.S. office maintains a comprehensive spare parts inventory and houses a fully operational pilot line with QC laboratory for product testing, sample evaluation, and technical training. The line is capable of processing up to 80” wide webs and is equipped with a full suite of traversing scanners and measurement sensors for detailed evaluation of our on-line web gauging technologies.

Please call us today at (864) 576-6288, or visit us at www.mahloamerica.com