



Overview

Profile360™ is an in-line, real-time measurement system for continuously monitoring OD, OOR, and circumference for round pipe and profiles. Profile360 can be installed in two locations, *in-line before cutting, and in final inspection.*

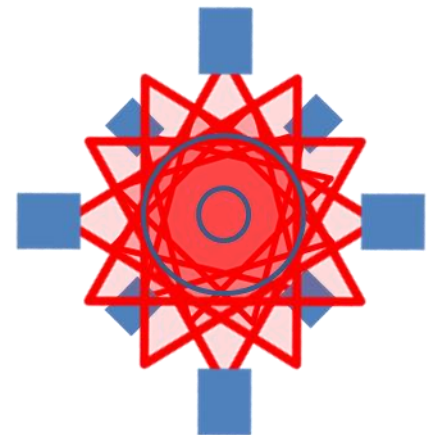
When installed in final inspection the system measures the OD, OOR, and circumference of the pipe ends and body to assure compliance with API and other standards. This includes a pipe length measurement system that measures the pipe length, and also associates each measurement to its position along the length of the pipe.

When installed prior to cutting, the system measures OD, OOR, and circumference continuously. These measurements can be used to fine-tune the tooling during a set up change, and then alarm whenever the values approach the allowable limits so that an operator can intervene before a quality fault occurs.

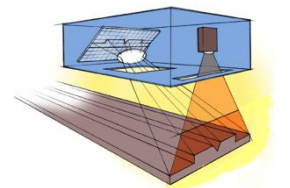


Measurement Principle

Profile360 utilizes CrossCheck™ Line-Laser Sensors, developed and optimized by Starrett-Bytewise to achieve the range and accuracy required for pipe mills. The sensors are mounted at eight positions 90 degrees apart digitize the surface of the pipe as it is conveyed through the measurement head. These multi-sensor systems acquire thousands of data points simultaneously around the profile and extract the measurement values. Measurement values are compared to allowable control limits and displayed on the operator's terminal with a pass/fail indicator. A non-contact laser-Doppler sensor detects the leading edge and trailing edge of the pipe so that each measurement can be associated to a position along the length of the pipe.



The sensor projects a laser line across the pipe diameter. A camera in the sensor takes a snapshot of the laser line at 45 degree angle. This exposes the laser line as an arc. The CCD array in the camera digitizes the arc into 1,600 columns of pixels. Each column has 1,200 pixels. Our software converts the pixel data into spatial x-y coordinates using a patented calibration transform. The coordinates from 8 sensors are combined, or stitched, into a single data set using a patented registration algorithm. The data set, or point cloud, is analyzed using mathematical tools that calculate various measurement parameters for each cross section measured.





Measurement Accuracy

Accuracy is 0.2mm diameter and is verified by checking a metrology-lab certified gauge block with a known OOR. Accuracy is calculated as Error-of-Measure equal to the average bias plus 3 standard deviations for a test series at multiple locations in the field-of-view (FOV).

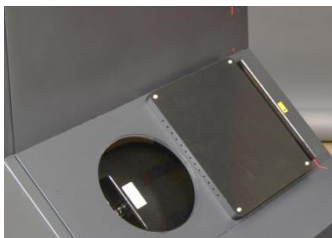
Length measurement accuracy is 0.05% of the pipe length.

Measurement Range

The measurement work envelope is from a minimum diameter of 600mm (24") to a maximum diameter of 1600mm (63").

Environmental Packaging

Unlike oscillating measurement systems, Profile360 has no moving parts – no slides, motors, controllers, or encoders that require maintenance and calibration and will eventually fail. Profile360 is inherently reliable due to its simple design. The system is sealed and temperature controlled to assure a constant internal temperature. This results in a greatly reduced thermal drift for the system and assures a long laser diode life, even in tough environments.

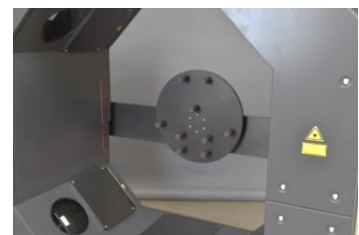


Profile360 has sealed laser apertures and sealed sensor windows so that no dirt gets inside. Air circulation fans assure uniform temperature inside. The air blow-off manifold delivers air pulses to keep the glass surfaces clean, although periodic cleaning is required and can be done with a soft optical cloth.



Registration

Registration is the process of sensor alignment that uses a patented software algorithm. No mechanical adjustment is required; all alignment is done in software via a three-axis offset. The Registration Fixture is positioned in the FOV and a checking routine is run automatically from the software. The whole process takes about 5 minutes.





The software includes a routine that controls the laser source, collects the profile image, extracts the reference points, and corrects their positions based on registration standards. Registration verification cannot be done while the line is running, and should be done at the operating temperature.

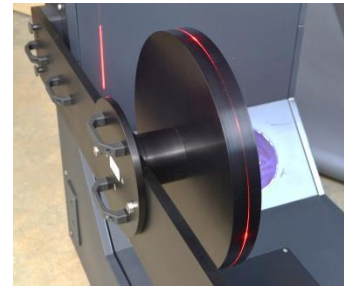


Positioning

This system requires the measurement head to be re-positioned for diameter changes. It includes an electrically powered vertical stage for adjustment.

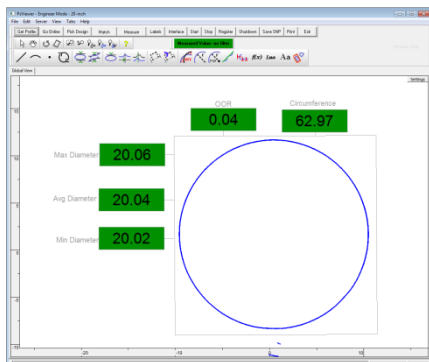
Master Gauges

A set of two master gauges are provided for measurement system verification. Each gauge is built with known OD and OOR characteristics that are certified by a metrology lab.



Software

Profile360 software provides for real-time data acquisition, display, and data logging. Snapshots are taken in a time-series at a user-set rate up to of 18 per second as the pipe is moving through the measurement head. Each snapshot produces a data record that is stored along with its timestamp on the hard drive in a data log file. For continuous pipe (before cutting) each snapshot produces a diameter measurement consisting of the maximum OD, minimum OD, average OD, OOR, and circumference. For cut pipe, these values are separated into three regions along the length of the pipe – the two ends (100mm [4 inches] in length) and the body.



Real-time measurement display for continuous pipe (before cutting)

Tabulated results display for pipe after cutting includes values for the pipe ends and body. The table below shows the data extracted from the screenshot.

Overall Measurements		Specification	LCL	UCL	Measured	Units
Weight	1975	500	2000	500	kg	
Length	16.0	15.2	16.8	15.8	m	
Flange Thickness	8.20	8.00	8.50	8.15	mm	
T-rod Thickness	8.20	8.00	8.50	8.15	mm	

Diameter Specification	Location	Specifications			Measured			Allowable Tolerance	Measured	Measured	Units
		LCL	UCL	Min	Max	Overall					
25 mm	F-rod	322.22	325.48	324.04	324.04	325.28	4.85	4.85	48.25	mm	
		322.22	325.48	324.04	324.04	325.28	4.85	4.85	48.25	mm	
500 mm	Body	321.41	326.29	324.09	324.09	325.15	0.48	0.50	48.25	mm	
		321.41	326.29	324.09	324.09	325.15	0.48	0.50	48.25	mm	
925 mm	Body	321.41	326.29	324.09	324.09	325.15	0.48	0.50	48.25	mm	
		321.41	326.29	324.09	324.09	325.15	0.48	0.50	48.25	mm	
25 mm	T-rod	322.22	325.48	324.04	324.04	325.12	4.85	4.85	48.25	mm	
		322.22	325.48	324.04	324.04	325.12	4.85	4.85	48.25	mm	

Tabulated results display for pipe after cutting includes values for the pipe ends and body



Electrical Cabinet

The electrical cabinet is an IP64 (NEMA 4) cabinet with keyboard tray and monitor window. The package includes a UPS, 19" monitor, and alarm tower. The main processor is an HP desktop PC with 3-year warranty handled directly by HP service locations worldwide. The Operating System is Win7. An Industrial PC and touch-screen monitor can be substituted at an additional cost.

Operation Specifications

Data Output – Data can be output by two methods. For continuous measurements of pipe before cutting, the measurement values can be output in real-time over Ethernet via Modbus TCP. Other PLC communication protocols are supported via an optional protocol converter. Data can also be output over Ethernet via OPC Server.

Pipe ID Code Selection – The pipe ID Code is selected via the keyboard.

Start/Stop Modes – Start and Stop are selected at the keyboard.

Software Password Permission Modes – Select from Operator, Engineer, and Observer modes.

Standards Compliance – Profile360 complies with the following standards:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- Machinery Directive 2006/42/EC

Environmental Operating Conditions - The operating temperature is from 0 to 55 degrees C, 32 to 131 degrees F.

Laser Safety Class – Line Laser Sensors are IEC 60825-1 Class 3R, and the Length Measurement Sensor is 3B.

Maintenance Requirements

- Glass – The glass windows must be cleaned periodically depending on conditions.
- Filter – The filter media in the temperature control unit must be cleaned monthly.
- PC – The PC should be maintained with anti-virus and hard disk management software.

Utility Requirements

- Electric Power – 230V 20A or 115V 40A
- Compressed Air for blow-off system - TBA



Remote Support Utility

Remote technical support is provided by WebEx, a Cisco remote access product. This requires the PC to be connected to the internet via an Ethernet port or wireless network. The Remote Support Utility enables our Service Team to troubleshoot your system and update your software without the need for an on-site service visit.

Total Service Package

The Total Service Package provides a flexible way to assure the top performance of your Profile360. This package provides for 10 days on on-site service over 3 separate visits. You can schedule the visits as needed, assuming sufficient advance notice. We suggest visits be arranged as follows:

Commissioning and Training Visit

- 5 days on site
- Interconnection wiring
- Power-up and checkout of all operations
- Verification of measurement performance and system operation
- Operation and software training
- Maintenance training
- The system should be unboxed, set in place, and leveled prior to the service visit.

Follow-Up Visit

- 3 days on site
- Verification of measurement performance and system operation
- Verification of operator training
- Software update
- Checklist items

Warranty Pre-Expiration Visit

- 2 days on site
- Verification of measurement performance and system operation
- Verification of operator training
- Software update
- Adjustment for any warranty items

Boxing/Palletizing

All goods are packed in a wooden box with the proper wood certification for international shipment. International shipments are exclusively air freight.



Integration Services

The Installation and Training Package does not include services for integration of the system to PLC controllers or host IT Systems, however this work can be quoted based a specified scope of work. Integration may require additional hardware such a PLC bus protocol converter.