

# **GPR WTS Wall Thickness System**

## **General Information**



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**GP Resources, LLC**

**Cumming, GA**

**[www.gprllc.us](http://www.gprllc.us)**

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## • Introduction

The Wall Thickness System (WTS) by GP Resources, LLC (GPR) is a new real-time wall thickness measuring system designed specifically for plastic bottles and containers. The system is installed on an existing conveyor downstream of a blow molding machine for 100% product inspection. The WTS reads thicknesses of each container in desired locations and stores the results in database. The results are displayed instantly on charts providing immediate feedback information for machine operator to quickly adjust and optimize blow molder settings after changeovers and during daily production. The WTS can also be set to automatically alert operators with stack light and to reject containers that exceed specified thickness limits with an automatic air blast blow-off. The system reduces the need for manual Quality Control checks and ensures that only bottles with acceptable thickness values are included in shipped lots. 100% thickness measurement also allows for lightweighing of bottles and preforms resulting in raw material savings; eliminates potential data entry errors in QC laboratory and makes it easy to generate production and quality reports from the stored data.

## • Applications & Specifications

- Minimum container size: 1.0 x 1.0 x 1.5" (25 x 25 x 38 mm) (l x w x h)
- Maximum container size: 8.5 x 8.5 x 10" (216 x 216 x 254 mm) (l x w x h)
- Container shape: symmetrical, non-symmetrical
- Container material: PET, HDPE, LDPE, PC, PP
- Container transparency: transparent, semitransparent
- Container color: Clear, Green, Blue, Amber, other
- Thickness range: 0.002 – 0.197" (0.05 – 5.0 mm) \*
- Accuracy: (+/- 4 um, (+/- 0.004 millimeters") or +/-0.000157" \*
- Repeatability: (+/- 0.04 mils, or +/- 0.00157") \*
- Throughput: Handle 30K BPH over tabletop conveyor & sensor read up 120K BPH\*
- Optimal working distance: 12.7mm (0.5")\*
- Angular working range: +/- 5 degrees\*

\* Depending on container handling.

## • Principle of Operation

An integrated trigger installed immediately before the WTS' probes tells the system that a bottle is approaching the measurement station on the conveyor. The bottle position is tracked by the trigger and an encoder that continuously senses the speed of the conveyor. The probes are aimed to desired measurement locations, independently on each side, and each of them scan every bottle at a high rate resulting often in hundreds of readings from each measurement area, depending on the conveyor speed and bottle diameter. As the bottle moves through the station and the measurement is completed by all the probes, the WTS software then instantly calculates,

stores and displays minimum, maximum and average thickness values from each measurement area. The values are compared to pre-set limits and when needed, the machine operator is alerted by the stack light. As the bottle position is still being tracked by the system, a bad bottle can be rejected by an air blast blow-off nozzle located typically immediately downstream of the WTS system. The blow-off can also be activated manually to collect product samples for Quality Control and other purposes.

The WTS system can be programmed by trained plant personnel for virtually unlimited number of different container types. The pre-set “recipe” for the desired container type is selected from the list, probes are positioned and the system is then ready for production. The stored recipes include container specific parameters for thickness specifications, alarm and reject limits, measurement location and mode for linear test area, and probe positioning. The machine operator may also select active blow mold cavities and container package type for each production run separately.

All the pertinent measurement data is stored in the SQL database. Measurement date and time, cavity number, probe number, minimum, maximum and average thicknesses, rejection status, conveyor speed, etc. for each measurement location in every container are recorded and stored. The data is used for instant real-time and run charting on WATS’ integrated touch screen monitor. The measurement data is also available for other reporting purposes whenever required at a later stage.

- **System & Components**

The WTS system features an all-inclusive design with small footprint. The probes, brackets and their positioning assemblies, touch screen monitor, trigger, encoder and stack light are all mounted to the main frame that is installed on the conveyor. The PC and other electronic parts are inside the electronics cabinet under the conveyor.



**FREE STANDING WTS UNIT -- DUAL  
SIDE OF BOTTLES WALL TEST  
WITH FULL CONTROL SYSTEM**



**WTS SENSOR PEDESTAL MOUNTS SINGLE SIDE - WITHOUT CONTROLS**

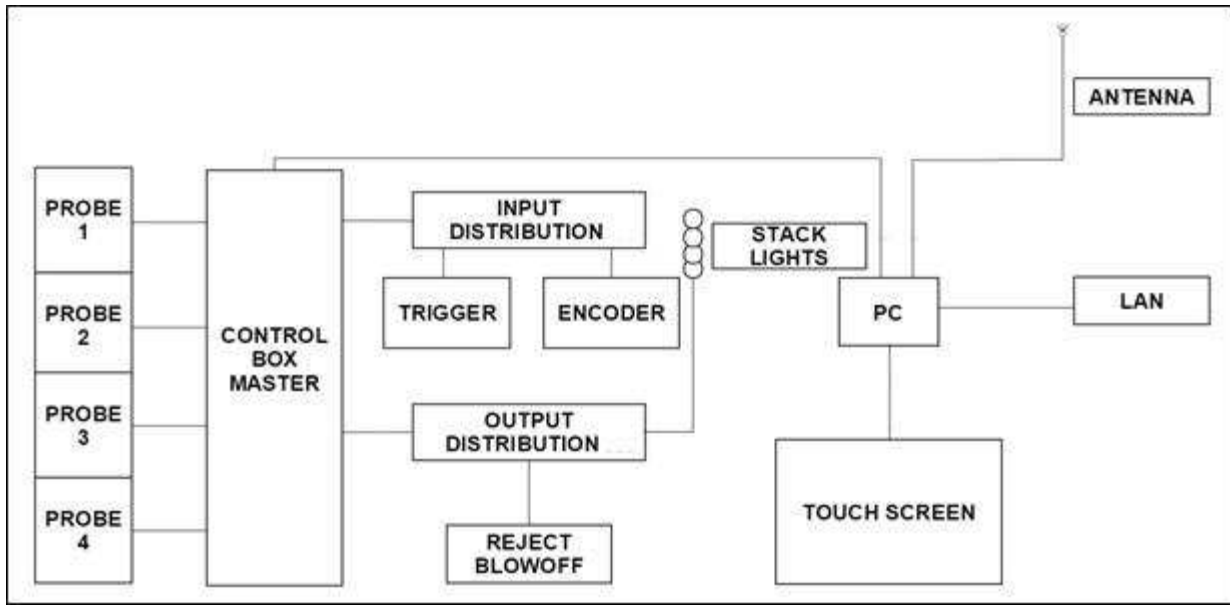


SINGLE SIDE SENSOR PEDESTAL MOUNT UNIT --  
PROCESS MONITOR ONLY UNIT

The WTS probes (shown in light blue) along with probe mount brackets and sensor positioning mounts/operator interface screen and control panel housing with internal PC/WTS controls on the free standing WTS main frame. Free Standing WTS fits over customer existing conveyor line.

The WTS pedestal/sensors unit is integrated into customer specific line application with custom pedestal sensor mounts/adjustments and control panel with controls plus operator interface screen fitment.

The block diagram below shows the main electronic parts of a WTS system. A typical single-line configuration features four probes (for measuring two locations on both sides of the container), with a trigger, encoder, reject blow-off and stack lights that are connected to a PC via a control box. Optional cellular support with antenna enables a secure wireless remote access to WTS as needed for technical support and software upgrades. Connection to LAN/factory network can be hardwired or by wireless via a router if this option desired by plant.



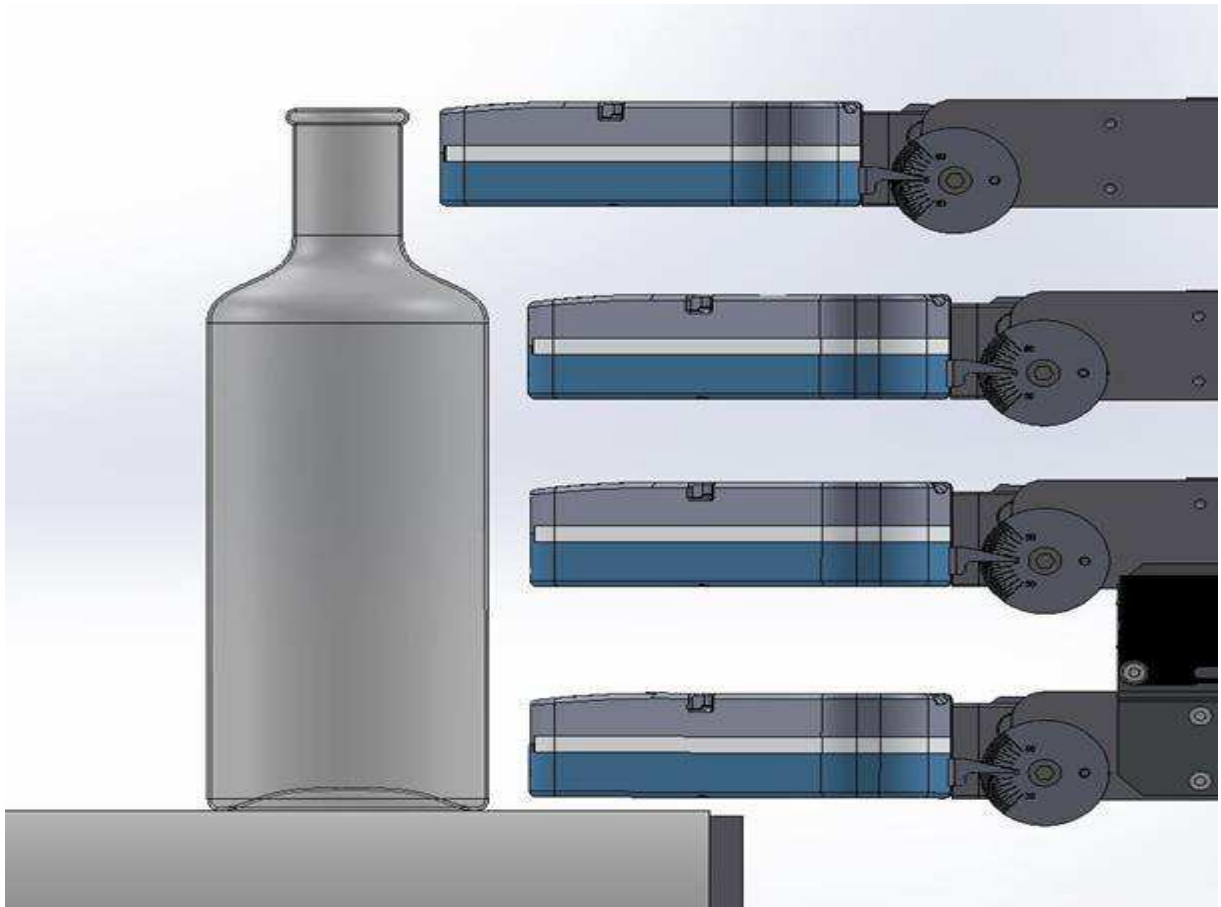
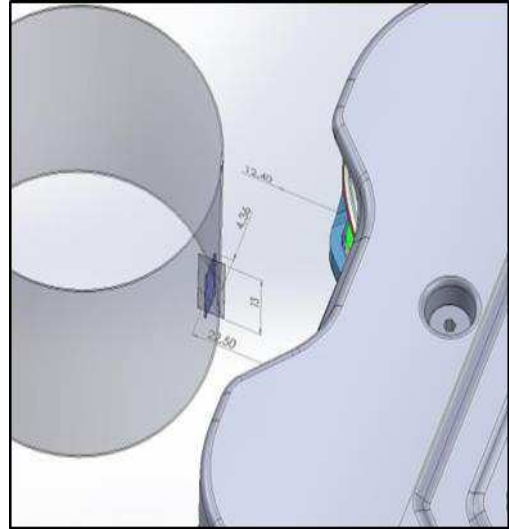
- **Probes**

The WATS thickness measuring method is based on a new patented non-contact imaging technology. Each probe contains an integrated light transmitter and receiver enabling single-sided thickness measurement of individual walls, rather than combining or averaging two walls in a single result. The transmitter focuses a light beam to a bottle's sidewall. The beam reflects from the outer and inner wall surfaces back to the probe's receiver. Depending of the location of the reflective surfaces the receiver detects their positions. The distance between them is proportional to the thickness of the wall that is then automatically calculated to display on operator interface screen and into CSV file for later retrieval as plant QA needs require.

In order for the probe to work reliably at least some light must reflect from the inner wall surface to the receiver. The less transparent the container is the lower is the intensity of the reflected light from the inner wall surface. Hence, best results are achieved by measuring transparent and semi-transparent containers.



A WTS probe scans the container at the rate of up to 8K to 9K readings (measurement lines) per second. The actual number of lines in a measurement area depends on the container diameter and conveyor speed. Flat wall and slow conveyor speed yield the highest number of readings. The height of the measurement line is approx. 0.4" (10 mm) or 3/8" and the viewing field length of reading area is approx. 0.187" or 3/16" (4.7 mm) on a 2" (50mm) dia. round bottle.

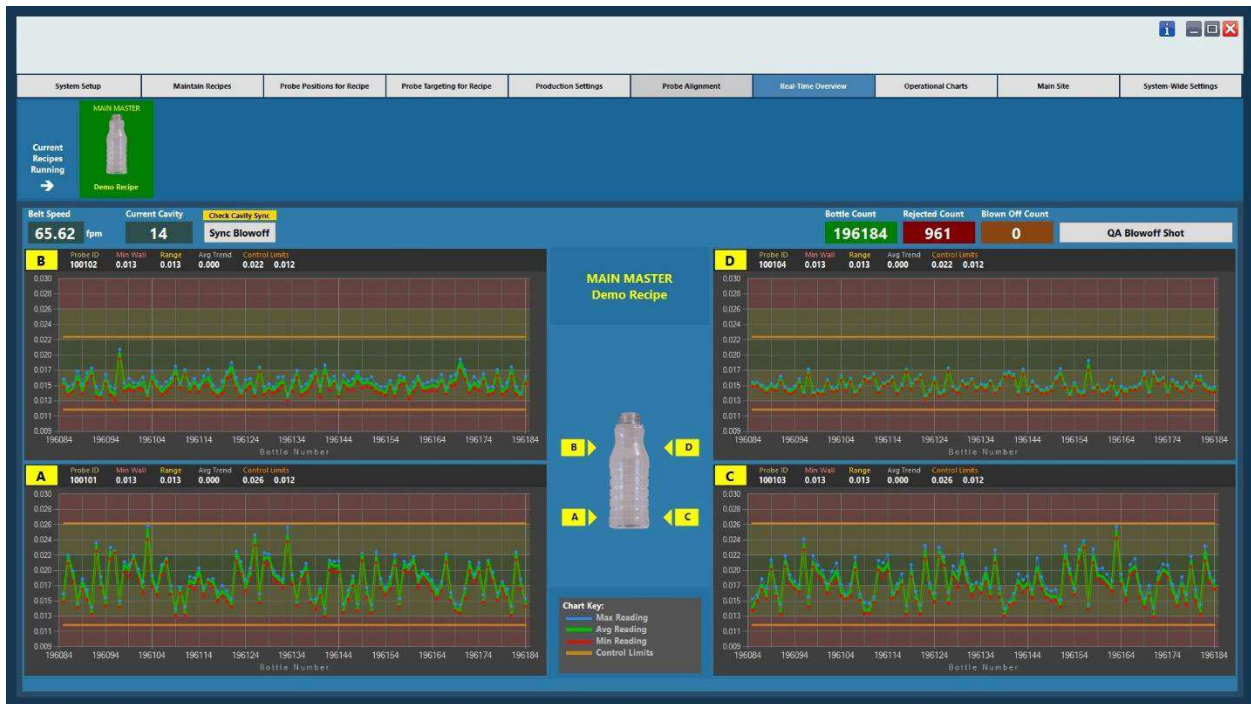


**TYPICAL FOUR WTS SENSORS SETUP ON ONE SIDE OF BOTTLE**



- **User Interface**

The two main screens used in the system’s everyday operation are Real-Time Overview and Operational Charts. The Real-Time Overview contains a thickness X-chart for each probe/measurement location. These charts are updated in real time when each container is measured and analyzed. Each dot in the chart shows minimum (red), maximum (blue) and average (green) readings from the measurement area in each container. Average trend and control limits for each probe are displayed as well. In addition, the screen shows probe locations, bottle count, reject count, last cavity number and conveyor speed.

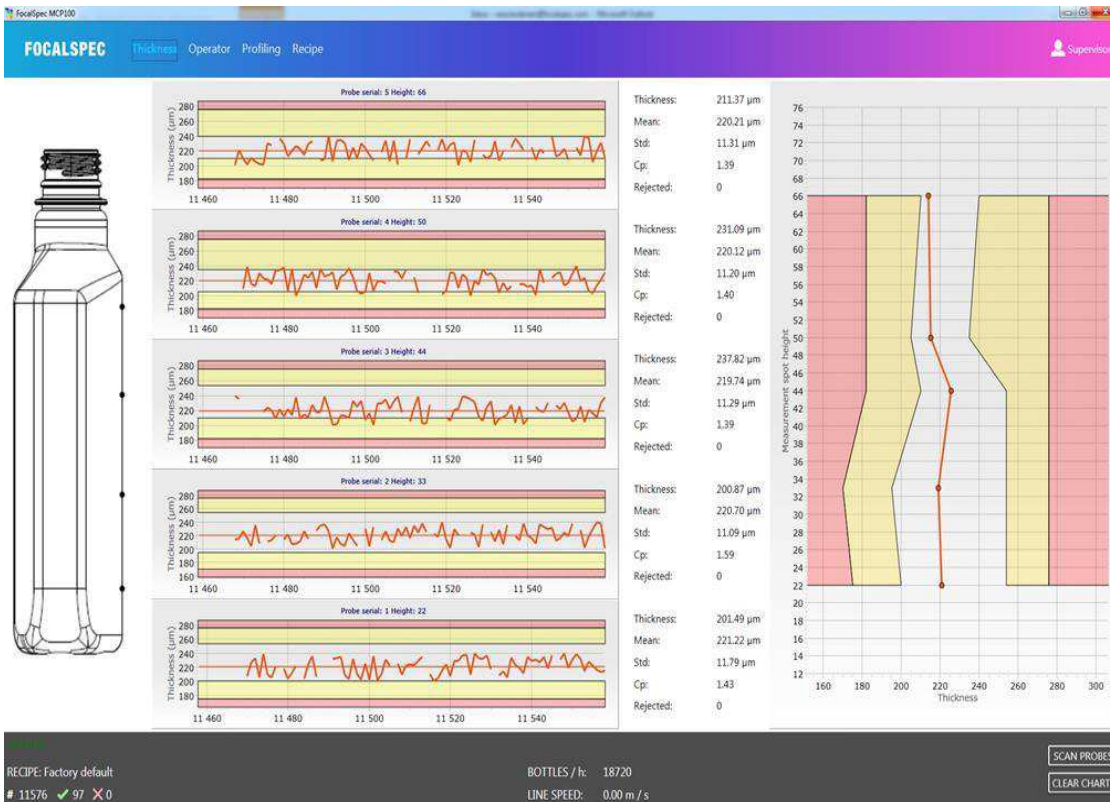


**REAL-TIME OVERVIEW CHART FOR WTS FLAT SURFACE, ROUND AND OVAL BOTTLES**

The Operational Charts enable deeper analysis of current or earlier production runs. The measurement data for each probe/measurement location can be scrolled through based on time or bottle count. A similar thickness X-chart as in Real-Time Overview is shown for each probe/measurement location with an additional Thickness Variance vs. Standard chart. A horizontal histogram for both charts is displayed too. Bottle and reject counts, minimum, maximum and average thickness results from the selected run are shown as well.



OPERATIONAL TREND CHART FOR WTS FLAT SURFACE, ROUND/OVAL BOTTLES



OPTIONAL METRIC INTERFACE SYSTEM SCREEN/CONTROL FOR OVAL/ROUND BOTTLES

The main optional metric interface screen above monitored by line personnel is the Thickness window. It contains a thickness chart for each probe/measurement location. These charts are updated in real time as the container is being measured/analyzed. Each dot in the chart shows the average thickness calculated using the multiple samples from the measurement area of each container. A vertical thickness profile (set in recipe for sample size update) is shown at the right side of the screen with the same warning and out-of-spec areas denoted on the chart for each probe. In addition, numerical values for latest thickness value, mean value, standard deviation, process capability index and number of rejected bottles are shown for each bottle. Overall reject count, line speed and number of measured bottles are also displayed.

- **Optional Features**

- a. Reporting & SPC Software***

The WTS software system features Microsoft SQL Server that manages the database where all the thickness measurement results with a variety of other pertinent data is stored. The data can be imported to Microsoft Excel or other software applications that support a connection to SQL Server tables for reporting purposes.

For those plants desiring a complete plant-wide statistical process control system GPR can team with DataNet Quality Systems to offer their optional plant network WinSPC software package with its sophisticated reporting and statistical charting tools. Below are two examples for WinSPC's reports that are automatically generated from WTS' imported demo thickness data.

- b. Cellular Support***

The WTS system features optional support for bidirectional cellular connection. The connection can be used for secure wireless remote access to the system for software update, analysis, troubleshooting and maintenance purposes by a "master user".

- **Key Features**

- New patented optical sensor technology
  - Single-sided measurement: each wall is measured independently
  - Fast operation
  - High accuracy, precision and repeatability
  - Wide thickness range

- **Benefits**

- Measures all produced bottles with no added labor
  - Single-wall measurement improves process control capabilities significantly

- Modular design with selectable le number of sensors
- Adjustable sensor alignment for wide range of container sizes and designs
- Automatic real-time display
  - Thickness trend display
  - Numeric and key statistics reporting.