

GPR WTS Wall Thickness System

General Information

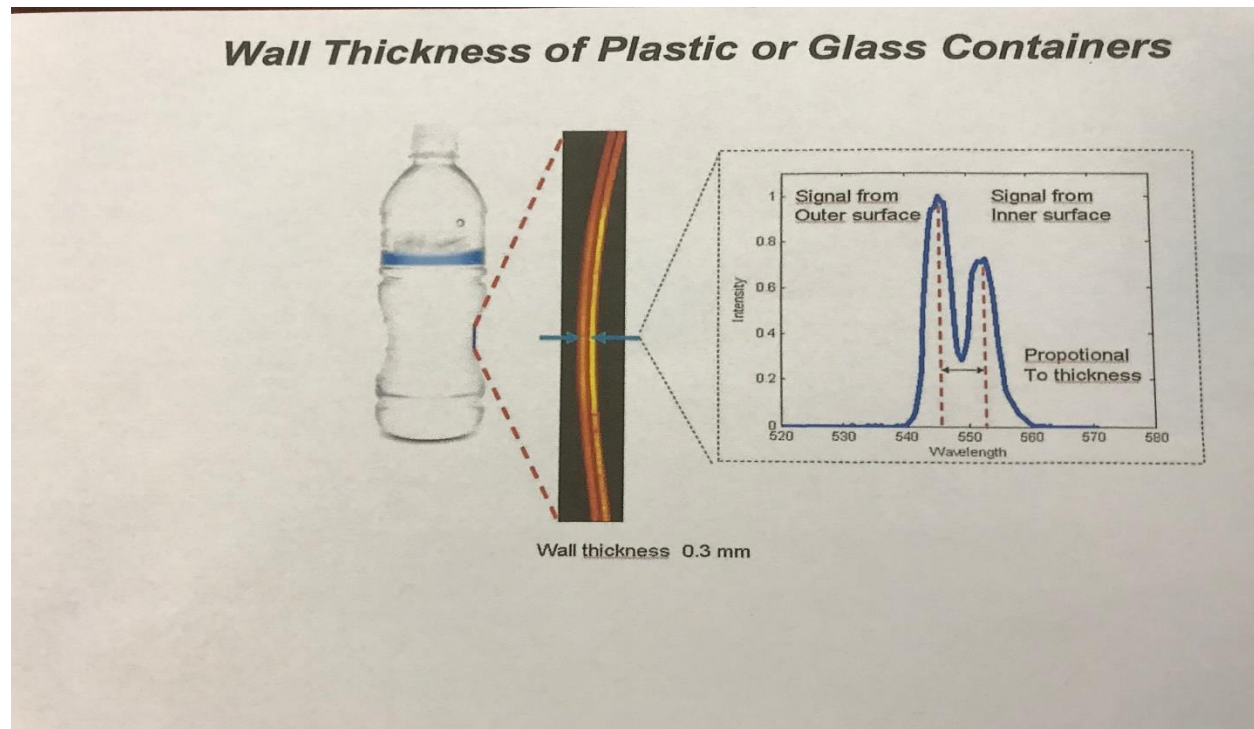


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Container Automation Systems, LLC

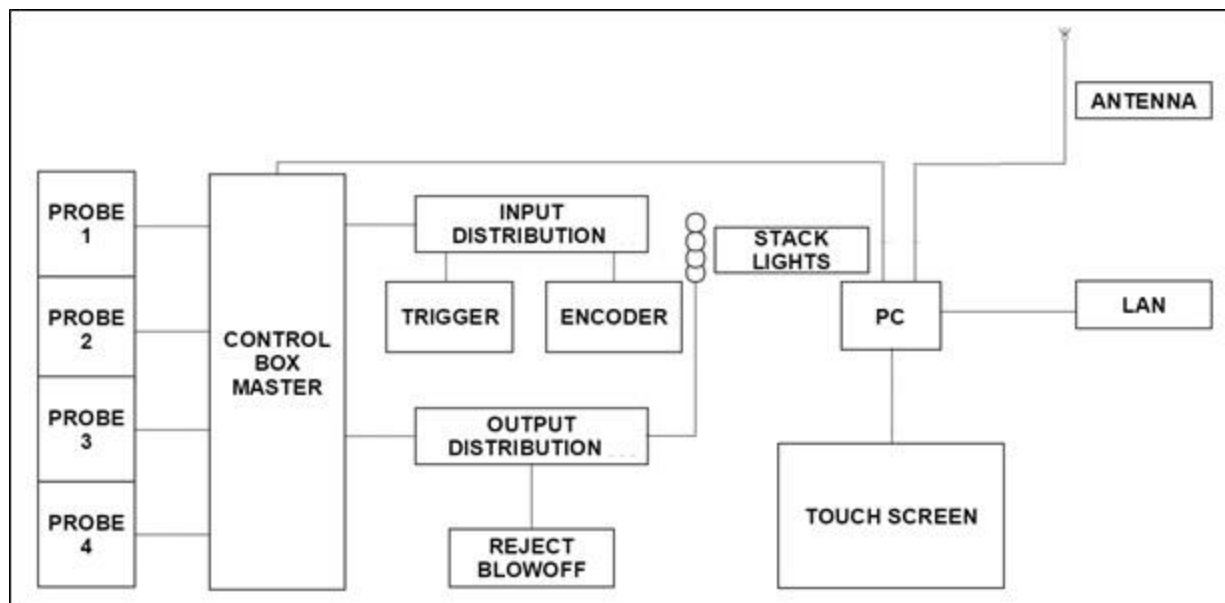
Cumming, GA

www.office@cas-ctg.com



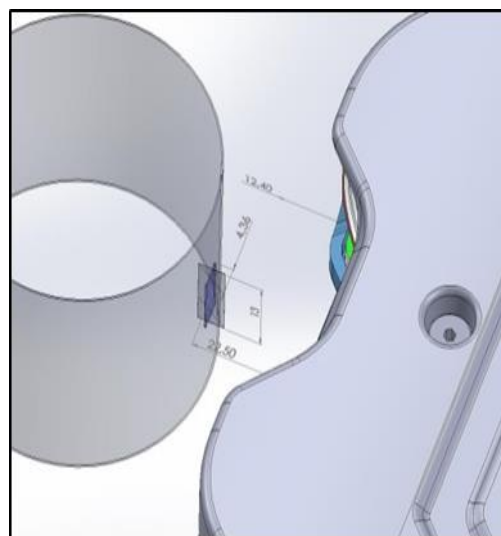
WTS PRINCIPLE OF OPERATION:

- (1) An integrated trigger installed immediately before the WTS probes tells the system that a bottle is approaching the measurement station on the conveyor in position to Sensor Focal Point. Trigger counts bottles for cavity tracking to control charts.
- (2) The bottle position is tracked by encoder for bottle reject blowoff and flat surface read area.
- (3) The probes are aimed to desired measurement locations, independently on each side
- (4) As the bottle moves in front of the sensor, WTS uses the above signal wavelength intensity while tracking and adjusting the thickness reading for impact of tilt of bottle from nominal to provide the final calculation of thickness of bottle by each probe
- (5) The WTS software calculates thickness, displays values on control charts and stores in SQL file all relevant data to the test, including bottle cavity and number in run, tilt, intensity, conveyor speed, min, max and average bottle thickness as well as number of thickness readings taken by each probe on each bottle.
- (6) The thickness values are compared to pre-set limits and when needed, the machine operator is alerted by the stack light or bottle can be automatically rejected off line.
- (7) The WTS system can be programmed by trained plant personnel for virtually unlimited number of different container types/recipes. The pre-set "recipe" for the desired container type is selected from the list, probes are positioned with setup gauges and the system is then ready for production.
- (8) The bottle data is viewed in real-time run charting on WTS integrated touch screen monitor display.



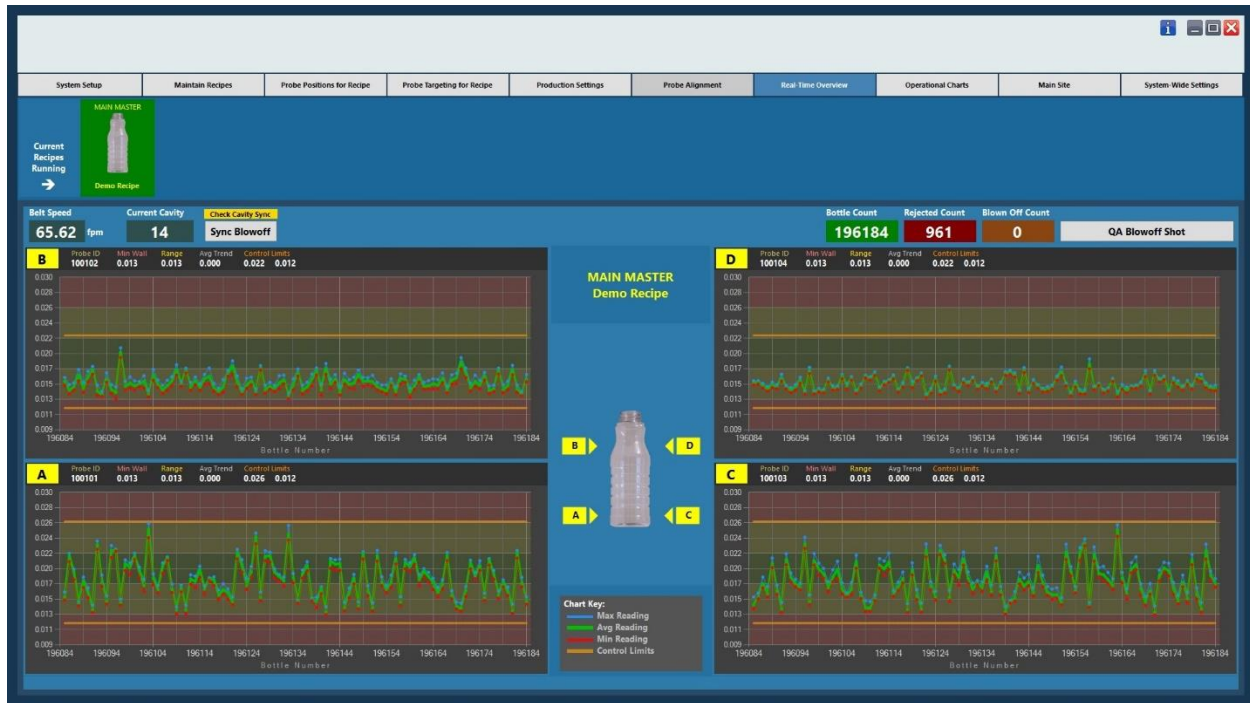
A WTS probe scans the container at the rate of up to 8K to 10K readings (measurements per second). The actual number of lines in a measurement area depends on the container diameter and conveyor speed. On 2" dia. Round bottle at 33 fpm expect 30 – 150 readings per bottle sensor to be reported in SQL file.

US Patent 9476,707 B2 issued October 25, 2016



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. Both charts are updated in real time when each container is measured and analyzed. Each dot in the chart shows by sensor the bottle thickness reading average (green). Real Time Chart also shows Average trend and control limits for each probe are displayed. In addition, the CRT Real Time Overview Chart shows the current recipe denoting probe locations and critical setup parameters bottle being run, 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 chart as in Real-Time Overview is shown for each probe/measurement location with an additional Thickness Range Variance. A horizontal histogram for both charts is displayed too. Bottle Recipe run and reject counts, average thickness results from the selected run are shown as well.



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

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 base WTS unit provides this data via USB Export File transfer. Data format is available in CSV or in Microsoft Excel via USB transfer.

For those plants desiring a complete plant-wide statistical process control system GPR can team with customer to provide data to their optional plant network.

b. Cellular Support

The WTS system features optional support for vendor cellular connection. The connection can be used for secure wireless remote access to the system for software update, analysis, troubleshooting and maintenance purposes.

GPR WTS CAPABILITY FOR BOTTLE THICKNESS

The GPR WTS Sensor system is a new proprietary IR LED Optics based (not laser) test system that employs line camera and optics where beams define the outer and inner wall of bottles. This reflected light is analyzed with a high resolution proprietary imaging and proprietary software system. The distance to a surface is measured by defining for each imaged point on the exterior and interior walls the respective bottle wall thickness and automatically adjusting this data for bottle distance/tilt change from nominal to optimize accuracy of bottle readings on conveyor.

ADVANTAGES OF THE GPR WTS IMAGING TECHNIQUE

- Excellent performance versus other conventional techniques for on line wall thickness
 - Repeatability Same Bottle Same Spot = +/- .6 mils
 - Accuracy – calibrated to reflective index and calibration fixture --+/- .8 mils
 - Measures individual walls versus averaging opposite walls together
 - Measurements per Sensor per Second = up to 8,000 to 10,000
 - Wall Thickness Range = 2 – 160mils (.002” to .160”)
 - Optimal working distance of sensor = 12mm (1/2”)
 - Sensor capture read distance range = 3 – 5mm (1/8 - 3/16”)
 - Height of area measure about 7 to 8mm on flat bottle surface
 - Length of area test on 2 to 3” diameter bottle about 5 to 6mm (3/16” to 1/4”)
 - Angular working range = +/- 5 degrees
 - 24V Power to master box and 3 Watts per sensor (.53 amps for 4 sensors)
- High sampling speed – up to potential 36,000 BPH rate per sensor
(contingent on container size/conveyor speed and container handling at sensors)
- Non Contact measurement applicable to transparent PET (except white/bottles with Titanium Oxide colorant or bottles not transparent to light beam) and clear PP/PC, PVC and some clear HDPE transparent bottles
- Run up to 4 sensors per master box
- 50 TO 100 readings per Bottle Sensor at 150 FPM conveyor speed on 3” diameter bottle
- WTS provides, via Microsoft Server and SQL software, the data with date/time run on recipe, min/max and average wall, Intensity, plus tilt of bottle by sensor & speed of conveyor.
- WTS provides several blow molder cavity tracking options independent of blow molder
- Data retrieval provided by USB and ethernet from our PC “W” drive or optional customer purchased Data Hub with WTS via our OPC UA to customers OI PI historical data system.

SENSOR US PATENT 9476,707 B2 issued October 25, 2016

REPEATABILITY TEST SAME SPOT ON SAME BOTTLE USING 1.0 FACTOR FOR PET MONOLAYER												
Test Date	Test Time	Bottle #	CavityIndex	QABlowOff	Is Rejected	ProbeID	ThicknessAvg	Distance	MeasuredTilt	Intensity	Samples	FPM
11/27/2019	28:44.8	1	1	0	0	100104	0.01662351	0.011007	-0.1885102	97.22607	115	40.968
11/27/2019	28:44.8	1	1	0	0	100106	0.02430805	0.0207127	0.2897145	142.0446	202	40.968
11/27/2019	28:44.8	1	1	0	0	100111	0.022576837	-0.002748	1.40294	159.0163	246	40.968
11/27/2019	28:44.8	1	1	0	0	100112	0.0192158	0.0059712	0.9829825	152.8405	257	40.968
11/27/2019	28:48.3	2	2	0	0	100104	0.017321119	0.0238061	-0.312488	117.6146	192	41.616
11/27/2019	28:48.3	2	2	0	0	100106	0.024110306	0.0196252	0.17897	145.2327	202	41.616
11/27/2019	28:48.3	2	2	0	0	100111	0.022678821	0.0009841	1.349378	211.4981	271	41.616
11/27/2019	28:48.3	2	2	0	0	100112	0.019241446	-0.003006	0.8570725	187.5445	180	41.616
11/27/2019	28:55.0	3	3	0	0	100104	0.016965726	0.0165919	-0.2811767	107.3533	150	41.88
11/27/2019	28:55.0	3	3	0	0	100106	0.023985027	0.0171686	0.2688202	151.4555	180	41.88
11/27/2019	28:55.0	3	3	0	0	100111	0.022587518	0.0040702	1.470969	239.3934	244	41.88
11/27/2019	28:55.0	3	3	0	0	100112	0.020065094	0.0045951	1.174005	232.3066	150	41.88
11/27/2019	28:59.7	4	4	0	0	100104	0.016284176	-0.002408	-0.2786186	119.8276	174	41.064
11/27/2019	28:59.7	4	4	0	0	100106	0.024102633	-0.00028	-0.07387894	197.8528	231	41.064
11/27/2019	28:59.7	4	4	0	0	100111	0.022859332	0.0153497	1.412406	134.053	264	41.064
11/27/2019	28:59.7	4	4	0	0	100112	0.019304977	0.018392	1.026667	137.1966	234	41.064
11/27/2019	29:04.3	5	5	0	0	100104	0.01679273	0.0171634	-0.4167999	106.3541	161	41.928
11/27/2019	29:04.3	5	5	0	0	100106	0.023859586	0.0105094	0.08290499	171.8379	216	41.928
11/27/2019	29:04.3	5	5	0	0	100111	0.023700945	0.0113711	2.042027	214.2654	260	41.928
11/27/2019	29:04.3	5	5	0	0	100112	0.019142887	0.0061683	1.050876	313.6226	106	41.928
AVERAGE OVER 5 BOTTLES RAN ABOVE						5 BOTTLE RANGE						
Bottom 23mm Bead Rear Side			Sensor 1	.0168"		.0001"		.0171" TO .0195"				
Top 15mm Rear Side Bead			Sensor	.0240"		.0004"		.0204" TO .0269"				
Top 15mm Operator Side Bead			Sensor	.0228"		.0011"		.0215" TO .0235"				
Bottom 23mm Bead Operator Side			Sensor	.0193"		.0009"		.0168" TO .0197"				

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Recipe Name = 0															
Measurement	MeasurementTime	BottleNumber	CavityIndex	ISQABlowOff	IsRejected	IsOK	ThicknessMin	ThicknessAvg	ThicknessMax	Distance	MeasuredTilt	MeasuredIntensity	SampleCount	BeltSpeed	
2/28/2020	24:30.3	1	1	0	0	100106	0.01974424	0.020799384	0.021854838	-0.00102	-0.1971053	264.8412	170	65.52	
2/28/2020	24:30.3	1	1	0	0	100110	0.018107208	0.018682593	0.019379449	-0.00807	0.2402469	235.2727	176	65.52	
2/28/2020	24:30.3	1	1	0	0	100111	0.020318192	0.021732161	0.022510738	0.024466	0.9164618	173.5732	164	65.52	
2/28/2020	24:30.3	1	1	0	0	100112	0.023121332	0.025621496	0.027212079	0.003274	-0.8009198	186.1953	174	65.52	
2/28/2020	24:30.5	2	2	0	0	100106	0.018017759	0.018773266	0.019525099	-0.00636	-0.4527705	158.373	185	65.52	
2/28/2020	24:30.5	2	2	0	0	100110	0.020976505	0.022014586	0.023108414	-0.00312	-1.272921	171.9655	145	65.52	
2/28/2020	24:30.5	2	2	0	0	100111	0.019040635	0.020311255	0.021637996	0.023706	1.838226	135.75	152	65.52	
2/28/2020	24:30.5	2	2	0	0	100112	0.018265271	0.01899295	0.019955803	0.009144	-0.5537564	195.2216	176	65.52	
2/28/2020	24:30.8	3	3	0	0	100106	0.016938529	0.017308674	0.017772319	-0.01507	-0.2224367	189.1875	176	64.536	
2/28/2020	24:30.8	3	3	0	0	100110	0.019510158	0.020007845	0.020638053	-0.00484	0.923628	182.8919	148	64.536	
2/28/2020	24:30.8	3	3	0	0	100111	0.024440849	0.025538039	0.027789728	0.029806	1.056282	202.8219	174	64.536	
2/28/2020	24:30.8	3	3	0	0	100112	0.01687021	0.01805583	0.019491965	0.011927	-1.19424	132.3167	161	64.536	
2/28/2020	24:31.1	4	4	0	0	100106	0.019757268	0.020367861	0.020862954	-0.02286	-0.2345754	171.8756	201	64.536	
2/28/2020	24:31.1	4	4	0	0	100110	0.024003917	0.025011072	0.026012428	-0.00292	-1.84034	197.931	145	64.536	
2/28/2020	24:31.1	4	4	0	0	100111	0.016929946	0.017935185	0.019188032	0.021453	0.1516732	163.4372	183	64.536	
2/28/2020	24:31.1	4	4	0	0	100112	0.01854525	0.019894228	0.021109785	0.008305	-0.3974477	125.5693	202	64.536	
2/28/2020	24:31.4	5	5	0	0	100106	0.014328271	0.015382662	0.016411719	-0.0157	-0.03190899	182.27	200	65.376	

SAMPLE CSV FILE DATA FOR RETRIEVAL BY CUSTOMER FROM “D” WTS DRIVE SENT IN TIME/MAX BOTTLE QUANTITY FILE SIZES THAT ARE NUMBERED SEQUENTIAL FILES SENT TO GPR EXPORT MAPPED “W” DRIVE ON WTS TO BE RETRIEVED (MOVED FROM “W” DRIVE) BY USTOMER AT THEIR SELECTED TIME INTERVALS OR FREQUENCY USING A CUSTOMER PROVIDED STATIC IP ADDRESS SET UP ON WTS DURING INSTALL