Gamma Scientific

Inline Reflectance

Measurement System for Len AR Production line

Statement of Work

GS-191FA-10-Inline-9XY

December 11th, 2017

GAMMA SCIENTIFIC

9925 Carroll Canyon Road

San Diego, CA 92131

Toll Free: (800) 637-2758 Phone: (858) 279-8034 Fax: (858) 576-9286

1. Document Change History

Rev	Description	Date	By
1.0	Document Created	12/11/2017	Kong Loh

2. Supporting Documents and ECN's

Document	Description	Date	Originator
N/A			

3. DEFINITIONS

DUT	Device under Test
QC	Quality Control
N/A	Not Applicable
TBD	To Be Defined
AR	Anti-Reflection

4. Introduction

This document is intended to describe the statement of work following the proposal for an inline Automatic AR Reflectance measurement system with 9 simultaneous measurement points.

5. Development Overview

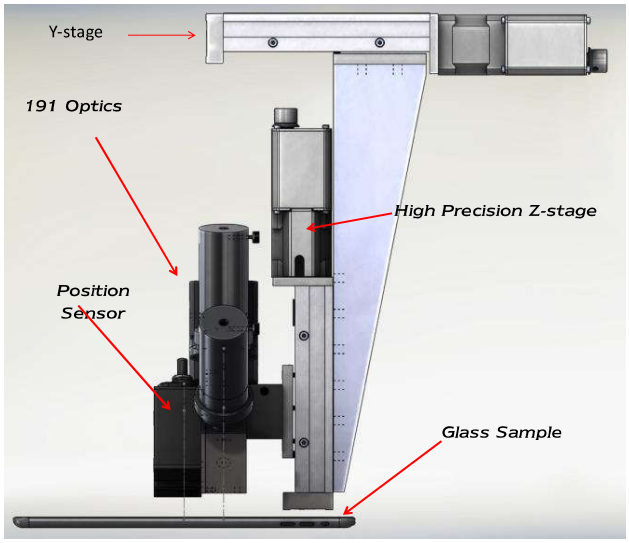
Basic requirements

- The system will allow automated measurement of specular reflection at 10 degrees at 9 different locations on each Device Under Test (DUT).
- Total cycle time to be 5 seconds or less.
- Measurement point locations must be adjustable for 3 different size glass:
  - A: 570mm x 770mm x 1.3 mm thick
  - B: 680mm x 895mm x 1.3 mm thick
  - C" 760mm x 895mm x 1.0mm thick
  -
- The reflectance system will be mounted over a horizontal glass transport system.
- Integration with Production line PLC system is required.
- Data output to include pass/fail, spectral data, reflectance and color data.
- System must be designed for continuous use

System Overview

The proposed custom designed system will consist of 9 Gamma 191 Spectral reflectance measurements systems, distance sensors and moving stages, all controlled by a custom written software.

Figure 1: 191 Reflectance optics module



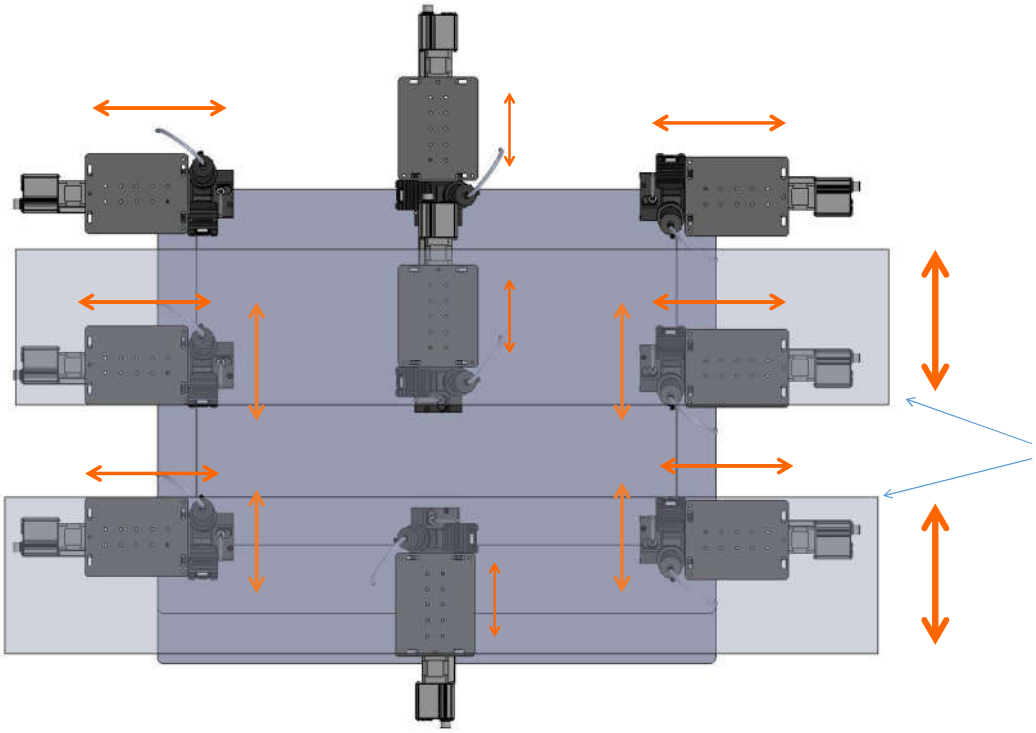


Figure 2: Image shows a concept of 9 Reflectance optics systems. 4 of the Reflectance optics will be movable in 2 directions. 5 of the reflectance optics will be movable in 1 direction.

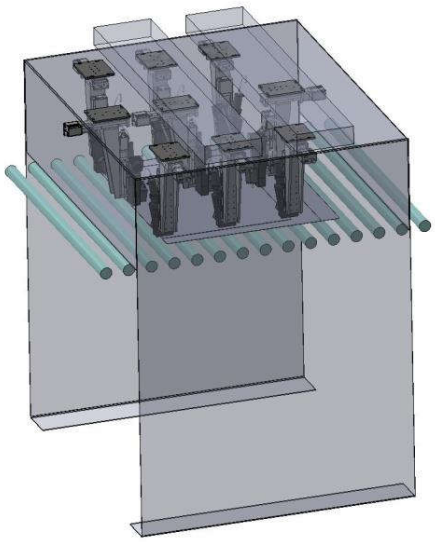


Figure 3: Concept drawing of reflectance equipment over a glass roller system

Hardware Overview

The proposed system will include the following hardware:

- Qty 9 Gamma Scientific Radoma Spectrometer, 380nm to 1000nm measurement range, temperature stabilized back illuminated CCD array
- Qty 9 model 191 10 degree specular optical head with integrated distance sensor, custom configured for transparent samples with AR coating.
- Qty 9 Leveling system to ensure orthogonality between the optics and the sample.
- Custom Illumination light source with integrated monitor system and 9 fiber output.
- Multiple translation stages to move optics to different measurement locations.
- System controller with PLC communication hardware, 1TB SSD storage. HD monitor, keyboard and mouse.
- System housing, optical support platform and stands. Electronics racks.
- UPS power supply
- BK7 calibration samples.
- 1 BK7 standard for calibration

Software Overview

The proposed system will include a custom developed control software to measure specular reflectance for all 3 samples sizes, 9 measurement points per glass.

The GSAARMeas inline software controls 9 optical systems to measure the AR reflectance and color of glass, at the same time. It will be programmable for different glass sizes. Data output will be reflectance, color, spectral data and pass/fail determination.

In addition a custom PLC interface software will be developed to interface the Gamma system with Lens automation PLC.

6. Scope and Deliverables

Gamma Scientific will be responsible for:

- Designing the measurement system
- Process development, testing measurement validity, accuracy and repeatability at Gamma Scientific
- On-site Install and integration
- Training for factory and support personnel regarding basic operation of the system

Lens will be responsible for:

- Selecting a location for the system to be installed.
- Providing uninterrupted access to the automation line so that installation can be done without unnecessary delays.
- Arranging for factory access and necessary system requirements (power, etc.)
- Providing space for Gamma spectrometers and system control electronics.
- Providing access and space to optically adjust the reflectance optics.

- Providing relevant Lens and factory contacts for system overview and training
- Providing adequate glass samples for testing.
- If additional support or data analysis assistance is required, Lens will orchestrate the required experiments and provide necessary data (or access to such data)
- Providing adequate CG samples for system installation, implementation and test.

7. Specifications

7.1 System description:

Illumination Angles: 10 degrees
Viewing Angles: 10 degrees
Minimum sample thickness: 0.8 mm (transparent samples)
Maximum sample thickness: 3 mm
Sample flatness tolerance: +/- 0.5 degrees
Maximum sample size: 760 mm x 895 mm
Spectral range: 380-1000 nm
Illumination spot size: 1 mm x 10 µm
Calibration reference standard: Built-in BK7 polished glass

7.2 System physical dimensions:

TBD

7.3 Measurement accuracy:

Spectral reflectance: ± 0.5%
Tristimulus (CIE 1931 X, Y, Z): ± 0.05 for 10 degrees, ± 0.10 for 45 degrees
Chromaticity (CIE 1931 x, y): ± 0.005
LAB Color (CIE 1976 L* a* b*): L* ± 2.0 a*, b* ± 0.8
Average reflectance: ± 0.2

7.4 Reported parameters:

Spectral data: Reflectance as a function of wavelength
Colorimetric data: Tristimulus 1931 X, Y, Z
CIE 1931 x, y
CIE 1976 L* a* b*
Wavelength data: Dominant Wavelength, Peak Wavelength