Online/Robotic Integrated Thickness And Color Measurement

In industries where the parts or products being coated are large and/or the volumes are high, measurement of process output with manual gauges can be labor and time intensive. Here, read about how automated robotic measurement technology provides opportunities for changing the manner in which paint processes can be managed and controlled.

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Control of the paint application process and assessment of paint quality requires sampling and monitoring key process output parameters such as coating thickness, color and appearance. Traditionally, measurements of thickness and color have been obtained using hand-held measurement gauges. Manual thickness and color measurement devices provide a means of conveniently making measurements virtually anywhere in a paint facility or even in the field. However, in industries where the parts or products being coated are large and/or the volumes are high, measurement of process output with manual gauges can be labor and time intensive.

In an automotive assembly plant, it is necessary to obtain measurements of the process output for a number of colors, body styles and paint application booths. With manual measurement gauges, it may only be feasible to measure the process output for a few color and body style combinations per operating shift. Therefore, it may take a number of days before every combination of color, body style and booth can be sampled.

An online automated measurement system can make it possible to significantly increase the rate at which samples of the paint process output can be obtained, especially for different combinations of colors, parts or body styles, and paint application booths. This dramatic increase in sample size along with a corresponding reduction in measurement time lag can lead to a significant improvement in control and optimization of the paint application process and facilitate troubleshooting of process problems. In turn, improved control over the process will provide benefits such as enhanced paint quality and reductions in both material usage and environmental emissions.

A small sample of the production output can be inspected with manual equipment such as a hand-held spectrophotometer color measurement device.

In addition to reducing time lag in obtaining paint process measurement feedback, there are other advantages to utilizing an automatic online measurement system. As an example, obtaining accurate and repeatable measurements from curved surfaces can sometimes be challenging when using a contacting hand held spectrophotometer.

A robotic non-contact spectrophotometer can eliminate many issues with color measurement on curved surfaces because of the superior placement accuracy and repeatability that is achievable when utiliz-

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ing both the robot and color instrument positioning systems. It is thus possible to obtain accurate and repeatable color measurements at multiple angles of view from both flat and curved surfaces.

A robotic measurement system also provides a significant labor savings. It will no longer be necessary to allocate labor for the operation and collection of measurement data from hand held gauges. Furthermore, robotic measurements will be more repeatable because the robotically manipulated measurement gauge sensors are placed in precisely the same locations part after part.

Robotic versions of film thickness and color measurement gauges are commercially available and have been in use at several automotive paint facilities in both Europe and North America. In addition, a robotic version of a paint appearance measurement device will also soon be available. When designed with lightweight and compact packaging, all three types of devices can be mounted together on the same robots. This makes it possible to obtain data from each of these measurement devices within a single robotic cell.

In an automotive paint facility application, a typical cell will contain two robots, one on each side of the vehicle. When each robot has both an ultrasonic multi-layer thickness gauge and a multi-angle spectrophotometer, the cell will be able to obtain 50 multi-layer thickness measurements at various locations along with a color measurement in the center of each body panel in approximately 6 minutes. With this cycle time, multi-layer film thickness and color measurements can be obtained from approximately seven jobs per hour.

With conventional hand held equipment, multi-layer film thickness measurements are typically obtained for only two to five jobs per shift. Hand held spectrophotometer color measurements can be obtained from a somewhat higher quantity of jobs than for film build as significantly fewer locations per job are inspected for color as opposed to film build. However in both cases, only a small sample of the production output can be inspected with manual equipment.

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With the availability of automated online film thickness, color and even appearance measurement technology, the time lag required for obtaining a representative sample of the paint process output for all color, booth and part or body style combinations can be reduced.

active non-contact positioning is used, the programmed angle and distance to the body surface are not critical and there is an allowance for some angular and positional variability from part to part or job to job. The contacting ultrasonic thickness gauging sensor will obtain multi-layer measurements on virtually any substrate material — steel, aluminum, SMC, and plastics.

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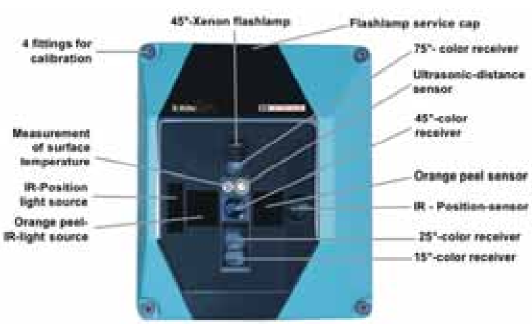
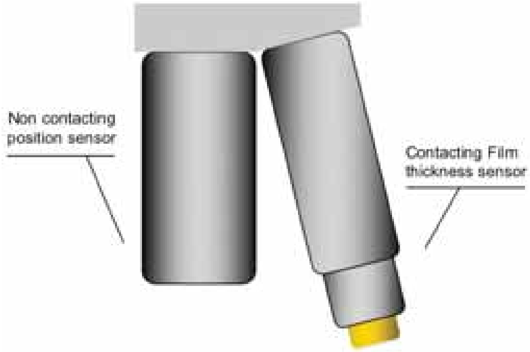
For each point that is measured, the robot moves to its rough programmed position 100 to 200 mm from the body surface. Once in the rough programmed position, the position sensors will precisely determine the distance and angle that the robot will use for placing the multi-layer film thickness sensor normal to the surface. As the thickness sensor approaches the panel, a mist of deionized water acoustic couplant is sprayed onto the measurement location surface. Once the sensor has contacted the panel, the multi-layer thickness measurements are obtained and the ultrasonic sensor is lifted off the surface. An optional air blow-off can be used to scatter the remaining ultrasonic couplant water droplets across the surface. Color and appearance measurements usually are made first, followed by thickness measurements. This ensures that any water couplant remaining on the body surface does not interfere with the other measurement devices.



A robotic non-contact spectrophotometer can eliminate many issues with color measurement on curved surfaces because of the placement accuracy and repeatability that is achievable when utilizing both the robot and color instrument positioning systems.



The contacting ultrasonic thickness gauging sensor will obtain multi-layer measurements on virtually any substrate material—steel, aluminum, SMC, and plastics.

For robotic multi-angle spectrophotometer measurements, the robot is once again moved to a rough programmed position approximately 100 mm above the painted surface. A combination of ultrasonic and infrared positioning sensors provide the robot with the information required to move to a final measurement position 35 mm from the body surface. Once in final position, the spectrophotometer obtains color measurements at four different angles, and it can also obtain surface temperature and orange peel data.

With the availability of automated online film thickness, color and even appearance measurement technology, the time lag required for obtaining a representative sample of the paint process output for all color, booth and part or body style combinations is dramatically reduced. Robotic placement of the measurement devices ensures that inspections are obtained at precisely the same locations for each job or part that is measured. Automatic positioning systems for the measurement instruments provide a higher degree of measurement repeatability and reliability, across a variety of surface contours and geometries. The advent of automated robotic measurement technology provides opportunities for dramatically changing the manner in which paint processes can be managed and controlled.

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