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Vision for V-rods

DVT & Harley-Davidson

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V-rods, snap rings and innovation

The convergence of the 100th anniversaries of two renowned American companies – Rockwell Automation and Harley-Davidson – has come about at Harley-Davidson's Vehicle and Powertrain Operations in Kansas City in a machine vision inspection application for their popular V-Rod motorcycle.

The V-Rod features the impressive 115-hp, 1130cc Revolution engine, developed by Harley-Davidson in a joint venture with Porsche. Some of the V-Rods are limited editions that include special 100th Anniversary emblems. All V-Rod assembly is performed at the 330,000 square-foot Kansas City plant, which employs some 930 people on four lines. Two of the lines are dedicated to V-Rod assembly: one for engine assembly and the other to complete production of the unit. All four of the lines use SLC 5/03 Allen-Bradley PLCs as controllers.

The inspection, which has been running since February, looks at bearing and balance shaft presence and proper snap ring seating in the engine transmission block. The Allen-Bradley PLC has been used as a controller for the engine assembly line since it began producing V-Rod engines in 2001. DVT Corporation's 530 SmartImage Camera, tied in to the Allen-Bradley PLC, verifies the high quality that is required.

When system integrator Chris Davison of Bachelor Controls, an authorized Rockwell Solutions Provider, got a call from Terry Carson of the DVT distributor company Power Motion Sales, he knew this application would be more challenging than the existing snap ring inspection in place on the V-Rod line. For that inspection, the engine part was positioned on the line in a manner which allowed easy access by the

DVT camera. The new inspection, however, involved an engine block in a different position on the line. The working area was too tight for the small 112mm x 60mm x 30mm form size of the camera.

"When I first learned of this project, I knew it would require more creativity and resourcefulness than a standard application," Davison said. "This kind of challenge is exciting to me because it can potentially open doors for other applications."

Bachelor Controls worked with Harley-Davidson Manufacturing Engineer Dan Bruyn to come up with

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-Chris Davison

an innovative solution. The camera was attached to a linear actuator which is servo-controlled. The actuator is then connected to a pneumatic slide with the whole unit able to extend to three different positions to inspect three identical snap rings in different locations on the transmission block. The inspection procedure involves the camera extending from the home position to the first inspection point, moving back to the home position, and then back to inspection point number two and then point three, each time returning to the home position. This inspection procedure is performed simultaneously with the assembly of 20 internal engine parts that occurs at that place on the line. (A required criterion for the application was that no time would be lost on the line.)

Since the camera could not get close enough to the inspection area, a mirror was affixed at a static position on the pneumatic

can you picture yourself on a HOT HARLEY V-ROD?

When you sell DVT SmartImage cameras, it pays off in more ways than one. Sales professionals with DVT Automated Service Providers (ASPs) are treated to exceptional sales incentives every year. This year, you just might see one of them styling down the highway on a brand new Harley-Davidson.

For 2003, sales professionals who hit top sales levels qualify to earn awards that include a Swiss Army package (watch, binoculars, and tote bag), a 5-day cruise for two, a one-year lease for a Corvette, and a free Harley-Davidson V-Rod motorcycle.

Are YOU born to sell?

slide between the press and the engine block to allow the camera to capture images. The position of the mirror had to be situated at an exact angle for the camera to take precise measurements.

Once the pneumatic slide, camera and mirror assembly were complete, another challenge presented itself: the bearing and balance shaft inspections and one of the snap ring inspections were routine, but the position of the other two snap rings created lighting issues. The camera could not verify seating of the snap rings.

After extensive use of the DVT Framework "blob" tool and associated software filters, Bachelor Controls and Bruyn devised an inspection process with total repeatability that sufficiently addressed all lighting and image issues. The use of the software filters compensated for the lighting conditions and other issues to a degree where the images captured were high enough quality to reliably provide all needed data.

Another challenge for the application was identifying a location to be used as a reference point for camera measurements. The snap ring is in the shape of an incomplete circle, similar to a round horseshoe, with two holes in the ring near the part where the gap begins. The first thought was to use the two holes to establish a fixed location. Instead, Bruyn and Bachelor Controls decided to use the gap in the ring as a reference point, measuring two edges on either side of the ring where the gap begins. After the gap was located, a heavy amount of scripting was required to move the location of multiple line gauges. This involved transferring a spherical coordinate system to a Cartesian coordinate system to offset the lines to ensure they would hit the snap ring edges in the correct locations.

Using the DVT Emulator tool, which permits users to work on applications offline, the two engineers viewed hundreds of logged images of the application without having to wait for images to come up in the actual process.

"The emulator tool helped immensely because it meant we didn't have to babysit the line as it cycled through. This sped up the process dramatically," Davison said.

Once the machine vision unit was set up, Bachelor Controls added a remote I/O module to the Allen-Bradley PLC to

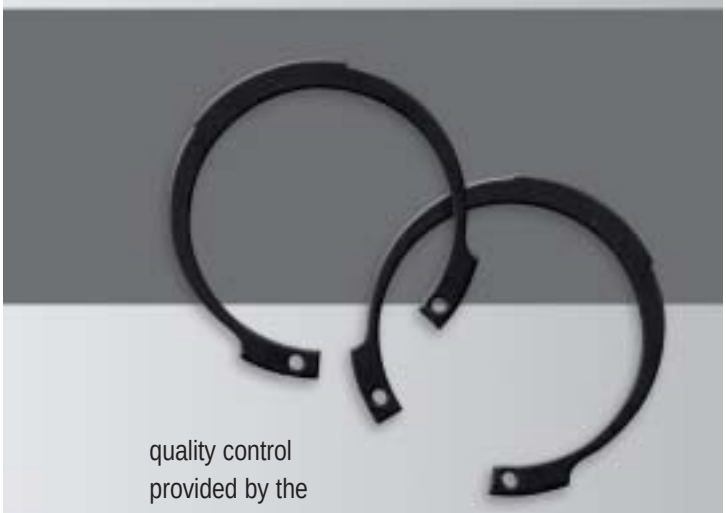
A DVT Legend SmartImage 530 camera, tied in to an Allen-Bradley PLC, provides a 100 percent inspection rate for bearing and balance shaft presence and proper snap ring seating in Harley-Davidson V-Rod engine transmission blocks.

communicate to a new remote I/O flex rack. They added two power supplies-one for the flex I/O and the other for the DVT equipment. All digital I/Os were connected to the DVT breakout board. The DVT breakout board I/O was connected to the new flex I/O for station sequencing.

This PLC expansion was a straightforward integration with no major challenges and it has worked flawlessly, Bruyn said.

"Bachelor Controls built a new panel with the DVT I/O Board connected to new Flex I/O and provided the programming for the linear actuator, pneumatic slide, DVT communications and miscellaneous I/O through this Flex I/O," Bruyn noted.

Now that the machine vision system is performing this inspection, operators save line time and are thus have more time to successfully complete other duties. But while this benefit is notable, the no-fail



quality control provided by the system is the top benefit. With a combined two centuries worth of corporate excellence, Allen-Bradley and Harley-Davidson – united by DVT Corporation – are showing that "old pros" can use the language of quality control to speak to a new generation through the power and style of the V-Rod motorcycle.

By Richard Daigle
Editor, Vision In Action

ask photonics phil

By **Dr. Phil Heil**

What's the best way to exchange data between cameras?

I'm installing five DVT systems in a workcell and I'd like to reduce my wiring to a minimum. What's the best way to send the inspection results from four systems to the fifth and only wire the fifth to my PLC?

Normally this configuration would require separate I/O lines to monitor PASS and FAIL conditions from your PLC to each of the DVT systems. We can take advantage of the Modbus communications feature of FrameWork to send the inspection results to a single camera using Ethernet. If the inspection is relatively slow (500ms or more between inspections), then the polled Modbus protocol can be employed. The inspection result can be saved to a register on the slave camera and the master camera will query the slave every 50ms or so. This only requires a couple of lines of script on each slave and setting up a Modbus Master transfer on one camera.

Once the data is received by the master camera, it can evaluate the inspection results and set the necessary output lines for the PLC.

Should I use a SpectroCam or a 542C?

I work for a large plastic injection molding company and we're trying to ensure we get the correct color parts to the right customers. When should I use a SpectroCam and when is a 542C best suited for the job?

The 542C is an excellent choice when you're sorting colors or inspecting multiple colors in the field of view. If your inspection involves plastic parts with a significant difference in color, then the color monitoring SoftSensor will be able to handle the application.

The SpectroCam uses special optics to direct different colors of light to different locations on the CCD. The result is that you have a much finer color resolution. The tradeoff is that the inspection requires a lot more light to be used and the field of view is limited to a short line on the part surface. For inspections where the shades of color are difficult to discern with a human eye or a tight tolerance must be held with a certain color, the Spectrocam is the best choice.

What are the options for an operator interface?

My operators need a simple to use interface to see the inspections, part counts, and change products. What are my options for a low cost user interface?

There are a couple of easy options to explore. The most flexible UI choice is to write a Visual Basic program that incorporates the DVT ActiveX control. You will be able to view inspection images, save failed images, change inspection products and monitor inspection counts. This option does require some knowledge of Visual Basic and the presence of a computer on the factory floor.

If you have a question for Photonics Phil, email him at **askphil@dvtsensors.com**