

# Hole Gauging Testing using the DaqBoard/2000

## Application Summary

Die-cast parts intended for the automotive industry must meet a wide variety of specifications imposed by the automaker based on fit and function. It also must comply with the Society of Automotive Engineers' (SAE) standards for strength of materials, and the federal government when it involves certain safety standards based on its application. In all cases, size tolerance is critical in order for all parts to fit a specific component, and the automotive industry now requires 100% inspection and size verification of many dimensional characteristics to guarantee tolerances.

## Potential Solution

Traditional methods of inspection include coordinate measuring machines (CMMs), optical comparator gages, gage blocks, height gages, gage pins, micrometers, and bore gages. CMMs and optical comparators are the most accurate and expensive measurement instruments typically used in a machine center and can resolve dimensions to within  $\pm 2$  micro inches. With low profit margins to be made, however, small companies are

hard pressed to justify such an expensive instrument, which often costs more than several tens of thousands of dollars. Fortunately, less expensive and sufficiently accurate production-line test instruments now can be assembled from several widely available components to satisfy the stringent tolerance requirements.

## IOtech's Solution

One automotive parts supplier, Skrl Diecasting, Inc., Eastlake, Ohio, makes small engine mounting brackets for a leading automaker, and recently faced the tight-tolerance requirement. An optical comparator was too expensive, so Roland Graham, Engineering Manager, purchased an IOtech DaqBoard/2000 data acquisition system board, inserted it in the PCI slot of an inexpensive desktop computer, and connected the input to LVDT-based measurement probes.

Intended to be a production line measuring instrument, the DaqBoard had to be easy to set up and quick to get results. Graham included an air cylinder to move the LVDT probe assembly into position to make the measurements and a signal conditioner to convert the LVDT output to a dc signal to drive the DaqBoard. A weight holds the engine-mounting bracket in position while the measurement is being made.

The measurement system uses a master engine-mounting bracket containing steel sleeves to establish the baseline and hold the sizes. The hole is first cast into the production part then placed on an NC machine and reamed through. Graham uses a fine boring tool to machine the hole and make certain it is within 0.10 mm or 0.002 in. of its specified location. The LVDT assembly contains three probes that cycle in and out of the hole and the instrument takes about two hundred continuous readings. The instrument analyzes the acquired numbers, determines where the center of the hole is located and its precise diameter, and then presents the results on the computer screen. Another LVDT is built into the cylinder to report where it is each time it takes a reading. "Enough information is gathered to calculate the taper and angle of the hole if needed," says Graham. The measurement equipment typically runs about 1500 parts per month, but it is capable of running through one bracket every ten seconds or 360 per hour. At that rate, the production run of 1500 parts could actually be handled in less than 4.5 hours.



*The Skrl Diecasting production line measurement system incorporates an IOtech DaqBoard located in the PCI slot of the desktop computer on the right. The die cast bracket under test is shown on the left side of the platform with the LVDT-based probe measuring the hole size and location. Two air cylinder control valves regulate the speed of the air cylinder that positions the three-pronged probe.*

In addition to measuring the hole, an air-operated ink stamp mounted on the gaging fixture automatically prints a small green dot on the acceptable part, which is triggered from one DaqBoard digital I/O output port. Two digital inputs on the DaqBoard also connect to two limit switches located under the bracket to ensure it is seated and positioned properly.

Two more digital I/O ports on the DaqBoard establish a communication path between the computer and a PLC that controls the stamp and gage cylinders. In total, four analog channels and five digital channels are used. "I'm using a software trigger on this one," says Graham. "I watch the digital inputs and the proximity switches — the two switches located below the casting — and when they detect a part, they set a software trigger to start the motion of the gage and monitor the LVDTs."

Graham also recommends that anyone using a plug-in board system pay attention to using proper shielding and grounding techniques. With such a wide assortment of sensors and components connected

externally to the computer chassis, it is possible to have two or more terminals in a circuit at different ground potentials, which create a current flow between or among them. This additional voltage drop can cause an error in the measurement and can appear as transients, periodic signals, or erratic counts in a digital signal output. "For example, the 15-bit board has a full range of 63,000 counts, and although it is possible to get steady readings within 2 to 3 counts, a little noise can typically contribute 50 extra counts," says Graham.

## Conclusion

Skril Diecasting, Inc., an automotive small parts supplier is using an IOtech DaqBoard/2000 data acquisition system, LVDT-based micrometer probes, and an inexpensive desktop computer to measure hole size and location parameters in die cast engine mounting brackets. The measurement system costs much less than traditional CMM and optical instruments and is easy to set up. In addition, it delivers more than adequate accuracy to meet automakers' and government requirements.

## DaqBoard/2000 Series

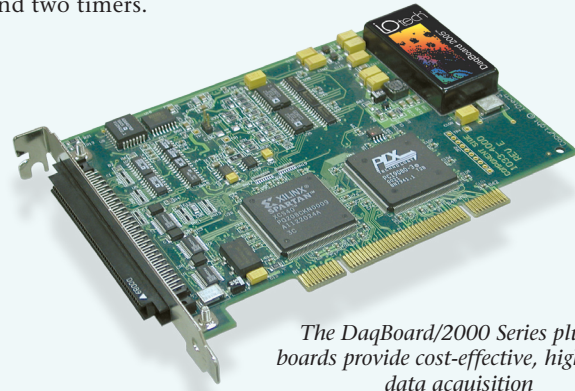
The DaqBoard/2000 Series sets the price/performance benchmark for high-speed, multifunction plug-and-play data acquisition for PCI bus computers. The DaqBoard/2000 Series hardware design offers all of the features normally found on

significantly more expensive boards, including 16-bit, 200-kHz A/D, 100% digital calibration, bus mastering, two or four 16-bit, 100-kHz D/A converters, 40 digital I/O lines, four counters, and two timers.

### Features

- 16-bit, 200-kHz A/D converter
- 8 differential or 16 single-ended analog inputs (software selectable per channel)
- Expandable up to 256 analog input channels, while maintaining 200 kHz (5  $\mu$ s per channel) scan rate
- Up to four boards can be installed into one PC for up to 1024 analog input channels
- 100% digital calibration
- 512 location channel/gain FIFO, capable of scanning all channels, including 256 analog expansion channels and digital/counter channels, at 5  $\mu$ s per channel
- DMA bus mastering for synchronous analog I/O, digital I/O, and counter inputs
- Trigger modes include analog, digital, and software, with <5  $\mu$ s latency
- Virtually infinite pre-trigger buffer\*
- Up to four 16-bit, 100-kHz analog outputs with infinite continuous waveform output capability\*
- 40 digital I/O lines, can be scanned synchronously or asynchronously with analog inputs
- Digital I/O is expandable up to 272 lines, including optional isolation and relay closure
- Four counter/pulse input channels can be scanned synchronously or asynchronously with analog inputs
- Two timer/pulse output channels

\* Limited only by available PC RAM and hard disk space



*The DaqBoard/2000 Series plug-in boards provide cost-effective, high-speed data acquisition*

### Signal Conditioning Options

- Signal conditioning and expansion options for thermocouples, strain gages, accelerometers, isolation, RTDs, etc. — over 40 options in all

### Software

- Includes DaqView *Out-of-the-Box* software application for effortless data logging and analysis
- Comprehensive drivers for DASYLab®, LabVIEW®, MATLAB®, Visual C++®, Visual C#®, Visual Basic®, and Visual Basic® .NET
- DaqCal software application for easy user calibration

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