

# Hydraulic Motor Testing using the DaqBook

## Application Note #83

### Application Summary

Hydraulic motors are widely used in many types of heavy-duty, agricultural and construction mobile equipment, such as skid-steer loaders, street sweepers, rock-boring equipment, and golf-course maintenance vehicles. The motors usually occupy less space than electric motors and reciprocating engines with the same torque and speed ratings, and for certain applications, they can provide even more torque and speed.

To ensure that all hydraulic motors that leave the Eaton-Shawnee Hydraulics Division production line meet their intended operating requirements, they undergo a short run-in test and a number of functional tests before shipment. In addition, a few motors are audited to ensure that they meet the full range of performance specifications including maximum reliability and efficiency. This performance testing validates their original design goals — to withstand the real-world rigors of off-road use and abuse. Robert Gear, Reliability Test Technician at the facility, has the responsibility to perform these audits and make sure the equipment and instruments used to test the

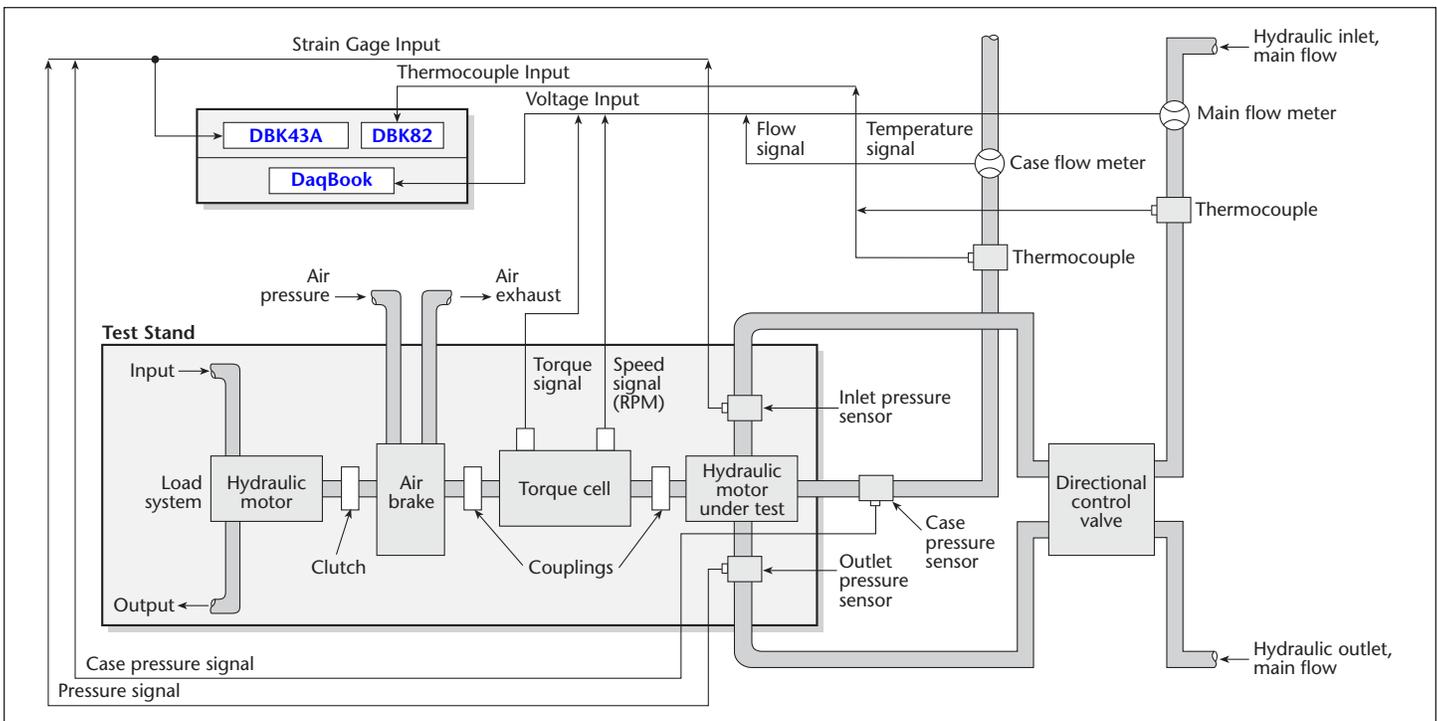
hydraulic motors are properly calibrated and maintained at all times. In addition, Gear operates the equipment and runs the tests.

### Potential Solution

Until recently, the test equipment and data acquisition system that Gear used had a limited number of inputs and other serious drawbacks. Although the acquisition system consisted of a variety of well known, instrumentation-type black boxes, computer-based plug-in cards, signal conditioners, customized interfaces, and strip-chart recorders, much of the equipment was slow, out-dated, and infrequently updated including the DOS-based computer. The data were translated to meaningful information manually, which was extremely tedious and often susceptible to errors. And with an increase in production, it became necessary to purchase more automated and functional test equipment.

### IOtech's Solution

A cross-functional team located at the Eaton Hydraulics design and development facility, Eden Prairie, Minn., investigated and evaluated several data acquisition



Hydraulic motors off the production line are 100% final tested and a statistical sample are audited at the Eaton-Shawnee Hydraulics Div., Shawnee, Okla., plant using an IOtech DaqBook connected to various temperature sensors, pressure sensors, and turbine-type flow transducers. Multiple points are measured and recorded for hydraulic case pressure, inlet and outlet pressures, and flow. The pressures range from 250 to 3500 psi, while the flow typically measures 0.5 to 30 gpm.



systems that were available. After a thorough analysis, the team decided upon the IOtech test equipment and recommended a **DaqBook**® for the Eaton-Shawnee performance-testing operation.

Gear now has two **DaqBook** systems that routinely measure several temperatures as well as pressure and flow in hydraulic motors ranging from 250 to 5500 psi. and 0.5 to 50 gpm. The test stands are basically dynamometers, using hydraulics or pneumatics to load the motors during dynamic testing. The hardware connects to three pressure transducers, and two flow meters. Strain-gage pressure transducers measure the input, output, and case pressure, thermocouples measure temperature, and turbine transducers measure flow. The turbines output a dc voltage that is fed directly to the **DaqBook**. The strain gages connect to **DBK43A**™ signal conditioners, and the thermocouples use **DBK82**™ signal conditioners. The software interprets flow from turbine rpm measurements, converts the strain-gage outputs to torque in lb-ft at the load, and records pressure in psi in the motor's case. Differential pressure also is measured between the input and output ports. For example, the input pressure may operate at 5300 psi while the output is 300 psi. Therefore, the software automatically interprets the differential pressure to be 5000 psi.

The **DaqBook** is handled as a fine instrument. It is located some distance away from the test stand and mounted in a protected instrument cabinet with the test system's control panel. For most signals, shielded pairs of wires run to single-ended inputs on the **DaqBook** and the signal conditioners located at the test stand. One exception is the differential measurement for the pressure signal between the input and output ports. No noise or other signal deterioration can be detected during any of the testing programs.

Gear appreciates the **DASYLab**® software and Windows-based operating environment, particularly in contrast to the previous DOS-based system. It was difficult to translate the DOS information to the more

widely used Windows®-based computers. The **DASYLab** software also lets Gear record, in real time, mechanical units of measure and volumetric efficiency. He does not have to manually calculate the values, a huge advantage in saving time and reducing errors compared to the previous equipment.

Gear also wrote a timer program that lets him set up a test and take critical measurement points 30 sec apart — unattended for up to two hours. “The **DASYLab** software contains a list option that lets me return to the beginning of the test and re-examine every point that I had taken,” says Gear. “That’s an extremely handy and user-friendly feature that the previous data acquisition didn’t have. When you see our Web site and look at our catalogs, you will notice the “bingo” charts

for numerous performance points from 0.5 to more than 30 gpm over a pressure range of 250 to 3500 psi. The point list is saved so we can return to the test and examine every point that was recorded when we need to run a trend analysis.”

## Conclusion

Numerous **DaqBooks** collect data from test stands used on the hydraulic motor production line for final performance and durability tests at the Eaton-Shawnee Hydraulics Div., Shawnee, Okla. The combination of **DASYLab** software and the **DaqBook** flexibility lets engineers and test technicians run a wide variety of pressure and flow tests on a production line that otherwise would have taken much longer because of the large number of data points needed for final testing.

## DaqBook/2000 Series

The **DaqBook/2000**® series of portable data acquisition devices can synchronously measure analog inputs, frequency inputs, and digital inputs. The 16-bit/200-kHz **DaqBooks** come equipped with built-in signal I/O capability, which can be further expanded and enhanced with over 40 **DBK** series expansion and signal conditioning options.

The **DaqBook/2000** series includes a built-in 10/100BaseT Ethernet interface capable of transferring acquired data back to the PC at the full 200 Kreading/s measurement rate of the **DaqBook**.



### Features

- Analog input, analog output, frequency input, timer output, and digital I/O; all in one compact and portable enclosure
- Built-in Ethernet connection provides continuous streaming to the PC with no data loss
- 16-bit, 200-kHz A/D converter
- Operates from -30° to +70°C
- Powerable from 10 to 30 VDC, or with included AC adapter
- Synchronous analog, digital, and frequency measurements
- Trigger modes include analog, digital, frequency, and software
- Virtually infinite pre-trigger buffer
- 4 channels of 16-bit, 100-kHz analog output (models /2001 and /2020)
- **DaqBook/2020** offers convenient front panel connectors for thermocouple, voltage and frequency measurements all in one box
- **DaqBooks** attach to over 40 **DBK** signal conditioning options to assemble a low-cost system, customized to your particular application
- Signal conditioning and expansion options for thermocouples, strain gages, accelerometers, isolation, RTDs, etc. — over 40 **DBK** I/O expansion options are available
- **DaqView**™ software included for effortless data logging
- Includes support for Visual Basic®, C/C++, ActiveX/COM, LabVIEW®, MATLAB®, and **DASYLab**®

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