ValveExpert 8.1

Servovalve Test Equipment
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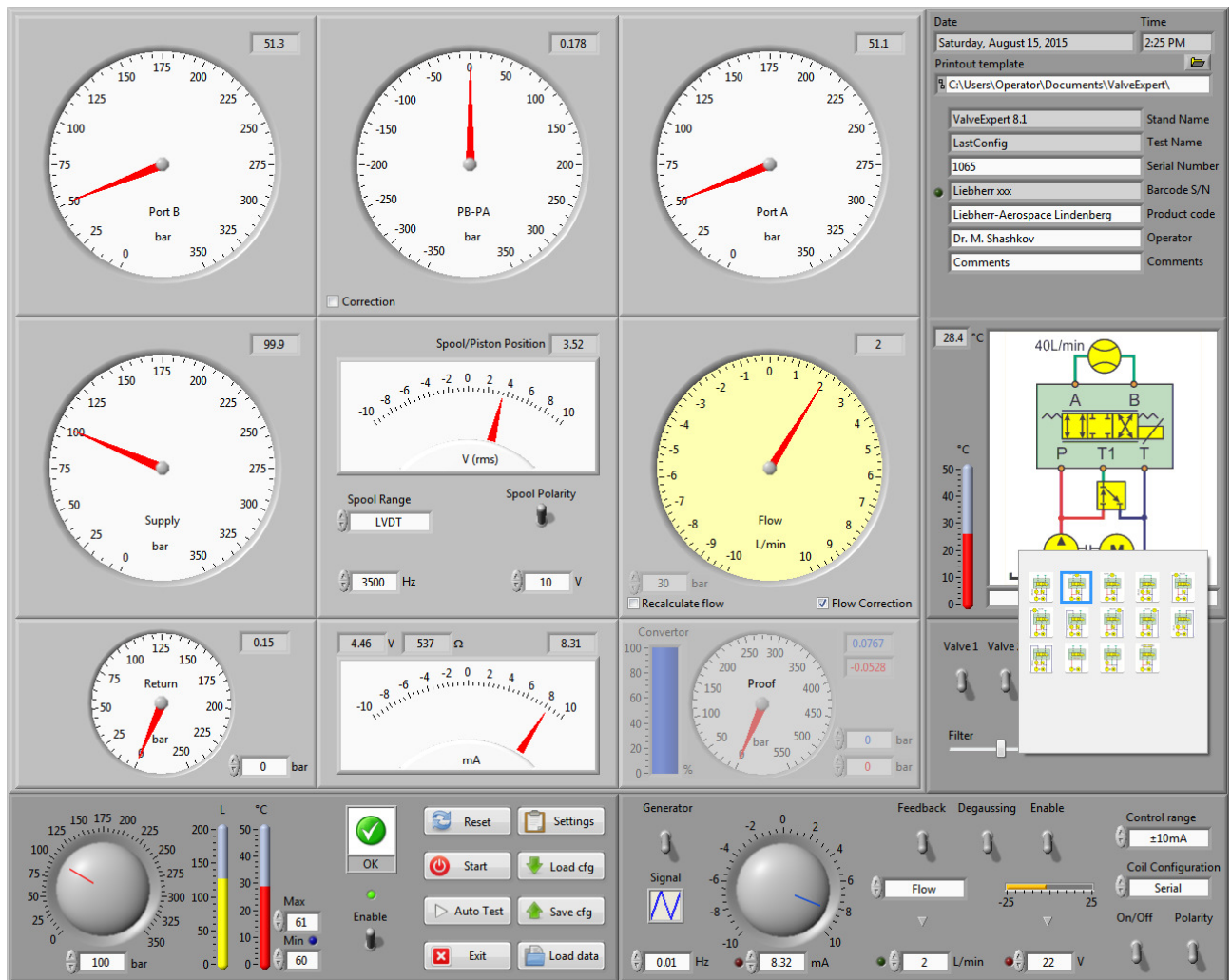
Short Description

Figure 1: Manual mode of the Test Equipment ValveExpert 8.1.

Introduction

ValveExpert 8.1 is an automatic test equipment for checking, maintenance, and adjustment of servo- and proportional valves. The test stand is developed in according to the standards established in SAE ARP 490 and ARP 4493. To satisfy special requirements of Liebherr-Aerospace Lindenberg GmbH, additional test procedures were included. Below are the main features of the stand ValveExpert 8.1.

- Compact high efficient and low noise $30kW$ hydraulic power station is inside.

- Maximal test flow is up to $45L/min$. Maximal working pressure is up to $350bar$.

- An additional hydraulic supply line can be used to regulate pressure on a control port or return line ($0bar\ldots250bar$).

- High pressure line allows to make proof pressure tests ($0bar\ldots525bar$). To smooth the supply pressure, a six liter hydraulic converter is utilized.

- PID controllers are based on multifunction RIO modules from National Instruments with FPGL chip on board. It allows to achieve high precision regulation together with extreme flexibility. Parameters of all PID controllers can be changed with a setup file.

- Wide range of servo- and proportional valves is supported. Fourteen standard hydraulic configurations can be used. Additional external outputs allow to configure valves on sub-manifolds.

- Temperature control system stabilizes the oil temperature in a specified range with tolerance $\pm 2°C$.

- The integrated 3μ filtration system achieves a cleanliness level 5 of NAS1638 (level 14/11 of ISO4406) or better.

- An additional, the last chance 10μ filter protects the valve from contamination.

- Extremely robust construction of the stand. The most of hydraulic components are mounted on one steel manifold. The only top quality components are used.

- Multi-level alarm system protects the operator from risky conditions. This system informs the operator if service is required.

- Generally designed for aerospace hydraulic fluids like $Skydrol^{©}$, $Hyjet^{©}$ or similar.

- The computer subsystem is based on a high performance Intel processor and a DAQ system from National Instruments.

- The computer interface is intuitively clear and simple. Special education and knowledge are not required. Operator works with a powerful virtual hydraulic laboratory on a 19-inch touchscreen monitor.

- Internal user-defined database keeps all test parameters. This database contains also overlay polylines for automated pass/fail evaluation. The operator can use keyboard, touch screen monitor, trackball, or bar-code scanner for fast access to the database.

- The system supports manual and automatic modes.

- The measurement data includes the most of static and dynamical characteristics. Up to fifty different subtests can be done during one automatic test.

- Complete test process requires a short time. Computer shows the results during the testing process.

- A powerful mathematical analysis of the results is already embedded into the system. ValveExpert 8.1 program saves the data in a standard MS Excel format and Excel tools can be used for an additional analysis. The operator can use template files to prepare required analysis and printout forms.

- ValveExpert can work with any measurement units, i.e. the operator can decide which units he will use for pressure, flow, temperature and so on.

- High precision measurement tools are used. All instruments are individually calibrated and scaled. Nonlinear calibration allows compensate nonlinearity of transducers, and reach extremely high precision.

- Calibration process is very simple and can be made by an operator. The only standard measurement tools are required.

Review of Specifications

Applications

Test stand ValveExpert 8.1 is developed for checking, maintenance and adjustment of two, three and four ways servo- and proportional valves. [1] Working pressure of the stand is up to $350bar$. The maximal test flow is $45L/min$.

Control Signals

A servo- or proportional valve under testing can be controlled by voltage or current command signal. There are five standard ranges for control signal: $\pm10V$, $\pm10mA$, $\pm20mA$, $\pm50mA$, and $4mA\ldots20mA$. The build in relays can change polarity of control signal and the coil configurations (for two coil electric servo- or proportional valves): Series, Parallel, Coil No.1, and Coil No.2.

Spool Position Signals (Feedback)

The most of modern servo- or proportional valves have a build in electronics. These valves are usually equipped by spool position transducers. ValveExpert 8.1 can check the signal from such a transducer. The standard signal ranges $\pm10V$, $\pm10mA$, $\pm20mA$, and $4\ldots20mA$ are supported. In additional, support of LVDT transmitters is included. Work frequency range is $1000Hz\ldots15000Hz$. Amplitude of the excitation signal is up to $10V$. Spool position transducers can be used at static tests as well as for frequency response and step response analysis.

Frequency Response Cylinder

In case of absence of a spool position transducer, a frequency response cylinder should be used for frequency response analysis. This analysis expressed by amplitude ratio and phase angle which are constructed for harmonic signals from a specific frequency range. The cylinder must be equipped by a position and a velocity transducers with linear voltage outputs. Signals of these transducers should not exceed $\pm10V$ range. Optionally, the stand can be equipped by a cylinder with effective piston area about $1850mm^2$ and total stroke about $30mm$ ($\pm15mm$).

Electric Power Supply for Servovalve

Servovalves with build in electronics require external power supplies. In the most cases, it is $\pm15V$ or $+24V$. Such power suppliers are built in the test stand. [2]

Hydraulic Fluid

The test stand ValveExpert 8.1 is designed for aerospace hydraulic fluids like $Skydrol^{©}$, $Hyjet^{©}$ or similar with viscosity about $10cSt$. The integrated filtration system achieves a cleanliness level 5 of NAS1638 (level 14/11 of ISO4406) or better. The capacity of the oil tank is about $200L$.

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[1] adapter manifolds allow to use this test equipment for different purposes.

[2] Maximal current is $2A$ for $\pm15V$ power supply, and $3A$ for $24V$ power supply.

Hydraulic Power Supply

The test stand does not require an external hydraulic power supply. A modern high efficient and low noise $30kW$ hydraulic power station is built in the stand. Maximal working flow of the power station is about $45L/min$. The working pressure is up to $350bar$. ValveExpert 8.1 has got a supply pressure line ($0bar \ldots 350bar$), return pressure line ($0bar \ldots 250bar$), and proof pressure line ($0bar \ldots 525bar$). The all pressure regulators of the hydraulic power pack are based on a high precision pressure transmitters and fast PID controllers which are based on FPGA DAQ cards from National Instruments. This integrated hydraulic power pack requires three-phase $380V \ldots 500V$, $120A$ electric power supply connection, and a water connection for cooling system. Note, the temperature control system allows to stabilize the oil temperature in a specified range with tolerance $\pm 2°C$.

DIETZ automation GmbH
Auf Maien 17
66538 Neunkirchen
Germany
office: +49 6821 8691762
cell: +49 1522 8712097
shashkov@dietzautomation.com
www.dietzautomation.com

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