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moehwald inside

INFORMATION FOR THE CUSTOMERS, SUPPLIERS AND STAFF OF MOEHWALD GMBH

This issue comes with thanks for our excellent cooperation in 2006

We wish all our customers, suppliers and staff a Happy Christmas and Health and Happiness in the New Year 2007.

H.BOLLE **H.-J. BURGARDT** **W. GEENEN**

LEAKAGE TESTING FOR GASOLINE INJECTION VALVES

Due to the constantly stricter specifications imposed on car manufacturers regarding liquid tightness, the detection of leaks in gasoline injection systems is assuming ever greater importance.
Conventional processes like the capillary tube method are reaching their physical limitations when it comes to delivering accurate assessments in a reasonable time. With high-pressure injection valves in particular, future permissible leakage rates will make the use of new methods essential.

Test bench FLR 1000

To address this problem Moehwald has cooperated with Bosch Valve Development in Schwieberdingen to develop the FLR 1000 leakage test stand (FLR = FID Leakage Rate) based on FID measuring technology. These test stands are employed in Bosch development departments and for series related tasks.

In these test stands the leakage rates of low and high-pressure valves are measured at the nozzle tip using a flame ionisation detector (FID). Widely used in exhaust emissions measuring technology, this method delivers test results into the range of fractions of ppm ($<10^{-6}$).
In technical execution the test stand is configured so that it need not be installed in an explosion proof room. In this way it is flexible and avoids high investments in new workrooms for the user. The test-piece valves are delivered to the stand ready-filled with n-heptane and equipped with a special protective sealing cap. A maximum of 8 valves can be tested in the device and subject to an automated test procedure, in which the nozzle tip is blown off, they are tested for coarse leaks and the rate of leakage determined. In this process a variety of test conditions can be set. (e.g. testing pressure, waiting times, acceptable leakage rates etc.)

Exchangeable component sets and a range of different electrical contacts allow adaptation to different types of valves and their geometries. Via suitable pressure control circuit configurations, the test stand can be laid out for straightforward low and high-pressure applications or for combined testing requirements.
The FLR 100 test stand should be particularly popular with development departments, who gain a device which has multiple uses in the area of leakage examinations and sets new standards in testing accuracy.

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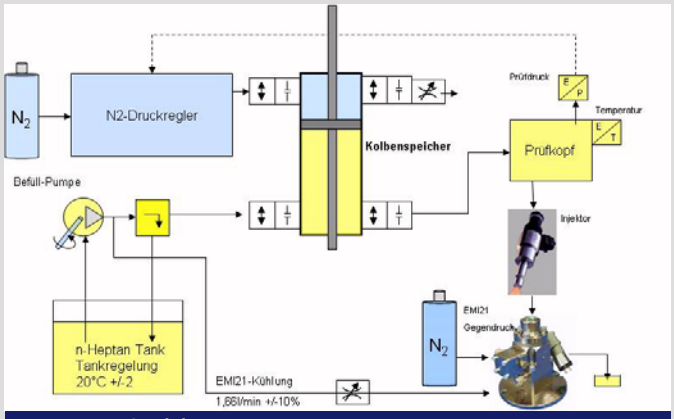
INJECTED QUANTITY INDICATOR EMI 21 FOR HIGH PRESSURE GASOLINE INJECTION

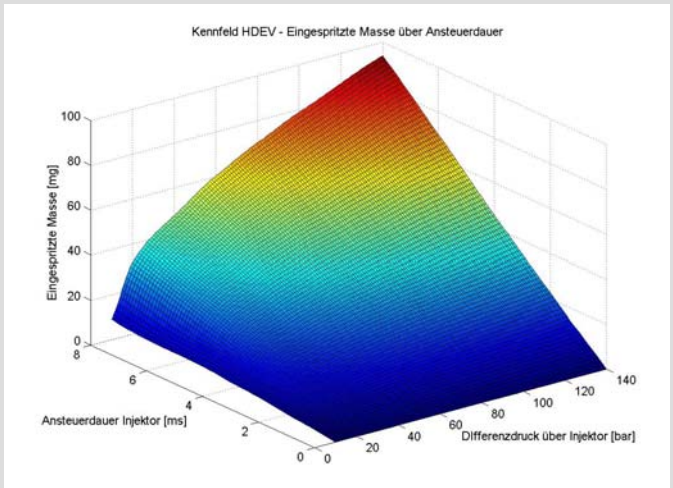
The further development of the EMI21 measuring device for the testing of high-pressure gasoline injectors is now concluded. The test programme carried out in cooperation with the Bosch GS (Gasoline Systems) business area have shown that the EMI21 can be directly applied to the measurement of injectors for high pressure gasoline injection equipment (HDEV).

A special feature of the Moehwald EMI21 is that its definition allows up to ten part injections to be detected and measured. Continuous measuring devices - like those using the Coriolis principle or turbine and gear processes - cannot achieve comparable results. When using n-heptane as a testing medium, the deviation in results from the EMI21 from results recorded using weighing scales is below 0,1mg per injection event at all operating points.



Test setup GDI injector measurements

The EMI21 is operated with backpressure in order to evacuate the measuring chamber. Given the low rail pressure in high-pressure gasoline injection (up to 250 bar) compared to diesel fuel injection, backpressure at the injector nozzle is a discernible factor in the mass flow measurements. As a result the injection pressure at the injector is regarded as differential pressure i.e. rail pressure minus backpressure. In the following example "Injection Map Measurement" the EMI21 was operated at a backpressure of 6 bar. The calculated rail pressure minus backpressure gives the actual pressure.



Characteristic diagram of GDI injector with EMI 21

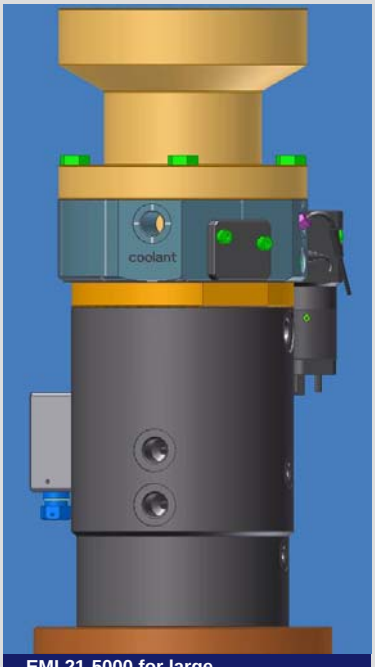
Explosion protection

When using the EMI21 for gasoline applications it should be clarified how safety precautions regarding explosion protection are to be met. The EMI21 is not type tested for explosion protection but there is a series of measures with which an EMI21 can be used in an explosion-protected zone.

- The complete test field is protected by primary explosion protection measures (e.g. technical ventilation, gas warning devices).
- The EMI21 can be built into a pressurised encapsulated housing which is flushed with nitrogen and slightly pressurised (inertisation).
- A replacement medium is used which does not require any special measures (e.g. Exxsol).

EMI 21 INJECTION QUANTITY INDICATOR FOR LARGE DIESEL APPLICATIONS

As a special application EMI21 devices are offered for large quantities. Currently an EMI21 with an enlarged measuring chamber (measuring range up to 1500 mm^3 per injection) is in use by a customer in the large diesel sector. For even larger quantities we are developing an EMI21 with a measuring range up to **5000 mm^3** per injection. Development should be completed by the end of this year. With this measuring range all applications in the large diesel sector can be fulfilled for the foreseeable future. If even this quantity is not enough, please contact us.



EMI 21-5000 for large diesel applications

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HOT LEAKAGE TEST STAND (ENDURANCE TESTING AND FLUSHING STATION)

A CONTRIBUTION TO THE ENVIRONMENTAL FRIENDLINESS OF THE DIESEL ENGINE

The introduction of diesel injectors with fast acting Piezo actuators in common rail systems goes hand in hand with increased injection pressures. Piezo injection systems with system and injection pressures up to 2000 bar are already on the market and pressures over 2000 bar already planned.

A pre-condition to mastering such high pressures is absolute liquid tightness in all areas of the injection system under all operating conditions. For this reason Moehwald has developed a hot liquid leakage test stand using the flexible Moehwald standard frame. It makes possible endurance leakage testing of common rail systems with Piezo injectors at typical system pressures and operating temperatures.

Hot leakage test stand

In the hot leakage test stand the injectors are filled with testing oil, put under high pressure and visually inspected for leaks. The special feature, however, of the new hot leakage test stand is the simulation of real operating conditions. In this way a whole range of injection patterns resembling those of a running engine can be reproduced.

The Moehwald hot liquid leakage test stand is versatile: it is suited both to testing tasks on prototypes in product development contexts and to random sample testing in quality control contexts. In addition, test can be carried out on injectors returning from the field.

As well as all high pressure connections special attention is paid to the injection nozzles of the Piezo injectors. Piezo technology is still relatively new and its operating behaviour in the field must be closely followed. Since a leak in these high precision injection systems can lead to an imprecise injection pattern on one cylinder, as well as the engine running rough the advantages of this technology would be lost in terms of fuel consumption and emissions.

To test Piezo injectors the hot leakage test stand is equipped with a rail with connections for four injectors. The injectors are clamped into holders which channel the injection sprays into a separate container. To remove possible air inclusions from the test-pieces, all tests begin with a purging phase. Before the tests the test-pieces are thoroughly flushed with large quantities of pre-heated test oil. Using compression effects they are brought up to realistic operating temperatures.

Three different test sequences can be simulated:

A complete test cycle begins with a simple high-pressure test. The test piece is put under high pressure for a prescribed period and inspected visually for possible leaks

In the next stage the test pieces are tested under pulsating pressure. In this state the injectors can be actuated at regular intervals and for extended periods by means of an automatic control system. This test confirms the liquid tightness of the components under powerful hydraulic and mechanical pulsation

Very realistic testing can be achieved in the endurance mode. Likewise automated, in this procedure the emphasis is on long-term liquid tightness and the stabilisation and bedding-in behaviour of the injector needles. They are pressurised for several hours and assessed according to precisely defined profiles.

Test chamber of hot leakage test stand

These tests are very realistic in their execution. After a short time the Piezo injectors and the test oil reach operating temperatures comparable to those of a running engine under different operating conditions. As in a vehicle operating on the road, the injectors are actuated by control signals, which correspond to signals from a running engine.

As such, the hot leakage test stand has the potential to make a considerable contribution to the environmental friendliness of the diesel engine in the years to come.

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BUSINESS DEVELOPMENT AT MOEHWALD GMBH

The business year 2006 has developed according to our expectations. At 26.3 million Euros, turnover in the part year to 10.06 is significantly down on the exceptional year 2005, but due to the traditionally strong turnover in the months November and December we expect to reach an overall turnover of around 34 million Euros (2 million Euros over plan).

Due in particular to a reduction in the use of bought-in labour we were able to control capacity to ensure good levels of utilisation in development and production over the year.

At around 32 million Euros our expected order intake for 2006 is at the planned level. The forecast order book of 20.5 million Euros at the end of 2006 covers 68% of our planned turnover for 2007.

Due to reduced investments in the diesel area we are making a relatively cautious forecast for the business year 2007 and preparing for a slight reduction in turnover.

MOBILE TEST FACILITY FOR HYDRAULIC FLOW SENSORS

As well as a wide range of test stands for the diesel, gasoline and hydraulics sectors, Moehwald also produces test facilities for use in service and commissioning. The latest example is a mobile device for testing hydraulic flow sensors. With a testing range of 0-10 l/min at pressure levels up to 10 bar, many of the flow sensors used in testing devices can be checked and tested. Among these are both mass-flow measuring devices working on the Coriolis principle (e.g. DI 1,5/ DI 3/ DI 6 from Siemens) and gear, screw and turbine volume meters (e.g. VSE, KRAL, VEM, ...).

On the mobile test facility the flow meter to be tested is connected in series to a calibrated reference measuring system. Using a comparative measurement of the test-piece and the reference appliance, deviations can now be determined and possible faults discovered and suitably analysed. The test piece can be either connected by hoses and remain in the test stand or be mounted in the test device. The latter includes both the necessary supply of hydraulic media and the required control technology. The temperature of the testing medium can be selected in a range from 40-70°C (digital PID regulator) while flow is set manually via a fine throttle. All relevant pressures in the testing circuit are displayed by pressure gauges.

The measuring blocks behind and in front of the test piece allow ready integration of pressure and temperature sensors into the test circuit. This makes possible a modular expansion of the facility to a flexible test stand suitable for basic examinations. Coriolis measuring systems (Siemens DI 3 to 250 kg/h and DI 6 to 1000 kg/h) are used as reference devices. These mass flow meters with integrated electronics and special calibration provide measuring precision of 0.05%.

The mobile test facility is also a popular means of connecting a reference device into the test circuit using hose connections to eliminate mechanical vibrations from the test stand. This allows a rapid assessment of the flow sensors on the test stand and the associated measuring sections. Should problems occur the flow measuring technology can be readily evaluated and downtimes significantly reduced.

The photo shows the compact facility consisting of the removable test appliance, the wheeled undercarriage and the optional Moehwald measuring box for temperature, pressure and flow rate. The undercarriage consists of a closed and lockable tool trolley with enough space to stow the test accessories (hoses, connecting plates, filters, sensors). The test facility is built on strong aluminium profiles and a firmly bolted, oil-tight stainless steel pan supports the tank, pump unit, pressure filter and all other necessary components. The appliance was conceived so that media can be quickly changed and cleaning takes up very little time (short set-up times). On its front side a broad grooved plate offers ample possibilities for installing and fixing the reference device, test pieces and necessary ancillaries.

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HIGHLIGHTS...

Anniversaries 2006:

10 Years

Nicole Grund

25 Years

Ludwig Daniel

Michael Dohle

Dieter Magin

General:

… TEHCM test technology business is progressing well: 8 test stands already delivered, further stands under construction

… contract from DaimlerChrysler for diesel systems test stands

…more intensive collaboration started with Bosch Rexroth

… new explosion protected test stand delivered for measuring pump torque in tank assembly units

… CA 4000 Application Test Stand delivered with new standard MoBa-B test bench

From the development departments:

… test technology for the new Common Rail CP4-Pump to come from Moehwald

… test stand for gasoline direct injection systems (GI 3000) for Bosch USA

Structure of the mobile test facility

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