CETA® Newsletter

Dear readers,

Here is our CETA newsletter no. 11, issued for the MOTEK 2008 fair trade. Our practical tip will deal this time with a model describing the relationship between hole size and leak rate.

Wishing you a pleasant reading,
Yours faithfully

Günter Groß
Managing Director

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CETA in-house: Jubilees

This year, we will celebrate the 20th anniversary of the foundation of the company CETA. Our managing director, Mr. Günter Groß, laid the cornerstone in February 2008 by establishing CETA as a joint partnership for sale and servicing of leak detectors. Due to the good business development, it was possible to convert the undertaking to a limited liability company (GmbH) at the turn of the year 1988/89. In 1996 began the development of our own leak detectors and flow testing devices. At the same time, the company changed its name to CETA Testsysteme GmbH. At this occasion, we would like to thank our customers for their patronage and trust in our company.

We are also pleased to celebrate further jubilees: Mr. **Till Blomtrath** (Director of Production) has been working 10 years with our company. And **Dr. Joachim Lapsien** (Director of Sales and Marketing), Mr. **José Pereira** (Sales Representative) and Mr. **Carsten Bradtke** (Technical Customer Service) have each been 5 years in the company.

Our new series of leak detectors CETATEST 815

We just introduced in the market our new differential pressure leak detector CETATEST 815 as the follow-up model of our successful CETATEST 810. The first devices of this series will be available in the first quarter of 2009. The pneumatic system of our CETATEST 815 will be individually equipped with the components best suited to the customer application. A further optimization regarding the reproducibility of measuring results takes into account the demanding requirements for measurement system capability. The 24 bit AD-converter with its high frequency allows short total test times.
The CETATEST 815 will also be available as two-channel device. In addition to the pressure decay test mode, all other test modes available in the CETATEST 810 (e.g. closed component, dynamic pressure, pressure steps) will be available as option. A new feature is the filling curve analysis, which analyses the behaviour of pressure build-up during the filling phase. With this, problems with the adaption, closed measuring lines as well as gross leaks in test parts can already be detected during the filling phase. The 64 test programs can be given alphanumerical designations. In addition to the standard interfaces (digital I/O, RS-232), we can provide upon request Profibus, Ethernet and CANopen interfaces. The settings can be stored on a USB stick. This allows an easy parameter exchange between identical devices. Besides, this also allows to store test results and measuring curves. The revised graphical user interface provides the operator with important information. A substantial automatic self-diagnosis integrated into the CETATEST 815 detects and reports internal defects.

All CETATEST 815 devices are delivered with DKD calibration for a pressure range of -1 bar to +10 bar (according to DIN ISO 17025). With several thousand test devices in use worldwide, CETA's success story now continues with the new CETATEST 815.

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Parameter-Tool

The device settings for each test mode allow reliable detection of good and reject parts in the production line. Consequently, these settings can be considered as sensitive data. We were asked by our customers what would be the best way to safeguard these data. We looked into the matter and developed a parameter tool. This tool provides a simple means to read out and input data via the RS-232 interface for all devices from year of manufacture 2004 on, i. e. CETATEST 510 (from firmware E 5.14), CETATEST 710 (from firmware R 6.02 b) and CETATEST 810 (from firmware E 5.14). The parameter file can be saved as a backup copy and if needed passed back to the test device. We can supply this tool upon request, you only need to give us the serial-no. of the test device. For this purpose, please contact our sales department. Tel.: +49 (0) 2103/ 2471-75, e-mail: sales@cetatest.com.

CETA practical tip: Relationship between hole size and leak rate

In practice, we are often faced with the question whether specially prepared test parts with defined hole sizes can be provided for adjustment of the permissible leak rate. A simplified model is used for a rough estimate: In an evacuated container at a relative pressure of -1 bar is a hole. When this hole is suddenly opened, the air column above the hole cross section (atmospheric pressure of 1013 hPa) penetrates the container at the speed of sound. We have:

$$Q_L = \Delta p \cdot \frac{\pi \cdot d^2}{4} \cdot c_0 \cdot \sqrt{\frac{273{,}15\ \mathrm{K} + \Delta T}{273{,}15\ \mathrm{K}}}$$

whereby

Q_L air-leak rate [Pa*m³/s]
Δp pressure difference [Pa]
d hole diameter [m]
c_0 speed of sound [m/s] (air: c_0 = 331,2 m/s at 0°C)
ΔT temperature difference [K] from 0°C

At absolute pressures above 1 mbar (low vacuum range), air behaves in good approximation as an ideal gas, and the speed of sound depends on the temperature and not on the pressure.

As an example, for a pressure difference of Δp = 1013 hPa and a temperature of ΔT = 20°C, we obtain the following computed leak rates in relation with the hole diameter.

Hole diameter	Air leak rate		
d [mm]	Q_L [Pa*m³/s]	Q_L [mbar*l/s]	Q_L [ml/min]
1	$2{,}73 \cdot 10^{1}$	$2{,}73 \cdot 10^{2}$	$1{,}64 \cdot 10^{4}$
10^{-1} (= 100 µm)	$2{,}73 \cdot 10^{-1}$	2,73	$1{,}64 \cdot 10^{2}$
10^{-2} (= 10 µm)	$2{,}73 \cdot 10^{-3}$	$2{,}73 \cdot 10^{-2}$	1,64
10^{-3} (= 1 µm)	$2{,}73 \cdot 10^{-5}$	$2{,}73 \cdot 10^{-4}$	$1{,}64 \cdot 10^{-2}$
10^{-5} (= 0,01 µm)	$2{,}73 \cdot 10^{-9}$	$2{,}73 \cdot 10^{-8}$	$1{,}64 \cdot 10^{-6}$

(1 Pa*m³/s = 10 mbar*l/s = 600 ml/min)

With compressed air as test medium, leak rates can be detected from approximately 10^{-3} mbar*l/s on, according to the application. Water tightness is usually set at 10^{-2} mbar*l/s.

With this model and the size of viruses and bacteria, we can also attribute leak rate limit values to the terms „bacteria-tight“ and „virus-tight“:
Diameter of bacteria approx. 0,5 µm
=> $Q_L < 10^{-4}$ mbar*l/s <=> bacteria-tight
Diameter of small viruses approx. 0,01 µm
=> $Q_L < 10^{-8}$ mbar*l/s <=> virus-tight.

The direct comparison between model and practice is complicated or hindered by many effects:

- We seldom have a single hole as leak, but more often micro-holes.
- The test medium is subject to temperature effects during filling or evacuating the test part.
- The shape of the test part can be modified by pressure.
- There can be undercuts in the flow channel, hindering the formation of an ideal leakage flow.
- Due to blowholes, through which the air creeps very slowly, it takes a long time to reach stable testing conditions.
- The evaporation of gas from inner cavities can lead to additional volume effects.
- Due to short cycle times, it is not possible to reach an ideal testing condition.

In practice, the real leak rates are established in trials with test parts and calibrated test leaks (the flow of which is known). This method also determines the process stable recognizability of the permissible leak rate.