

Leak Test of Encapsulated Systems

Particularities of non-fillable products | Testing process design

Quality control through routine test during the production process

Usage of encapsulated products

Many products are encapsulated to protect their sensitive internal components from harmful environmental influences and to ensure they function correctly. These include, for example, sensor systems, actuators, microswitches, relays, car keys, cameras, displays and even transmitter and receiver units, used in humid or harsh environments. These products con-

sist of a housing with integrated electronics and an electrical connection panel, and may also contain operation elements, sensor windows or displays. The entire system must be leak-proof. To ensure production quality, a 100% routine test is carried out as part of the end-of-line testing in the manufacturing process. Compressed air is widely used as the test medium.

Leak testing of encapsulated test parts - Detection of gross leaks and leakage measurement

Encapsulated systems can not be filled directly with compressed air. These products are tested in a product-specific test hood that encloses the test part as closely as possible. The test hood is pressurised or evacuated, and the change in pressure over time due to a leakage is analysed.

Here, the following problem arises: If the test part has a gross leak, it is evacuated or filled directly with compressed air during the hood's filling phase. In that case, only the hood's leak-tightness would be tested. Consequently, the first step is to check that the test part does not have a gross leak. The test volume is determined pneumatically during this process. To do



this, a reservoir volume integrated into the test device is filled to a pressure p_1 and disconnected from the pressure regulator. The blocking valve of the internal reservoir volume is opened and the air floods into the test hood connected to the test device. As the air spreads out over a larger volume, a pressure p_2 is measured. By doing this, it can be determined whether the pro-

duct has a gross leak or not. If the part is found not to have a gross leak, a fine leak test is conducted to evaluate the pressure gradient caused by the leakage.

Image: Encapsulated electro-optical sensor systems must be watertight.

Limitations of the method

It is only possible to detect a gross leak if the internal volume of the product (which is filled in the case of a gross leak) is greater than the span of the displacement volume due to manufacturing and component tolerances.

The hood test can only be used if the sensors are not completely potted. For potted products, alternative methods must be used to ensure that the potting is complete.

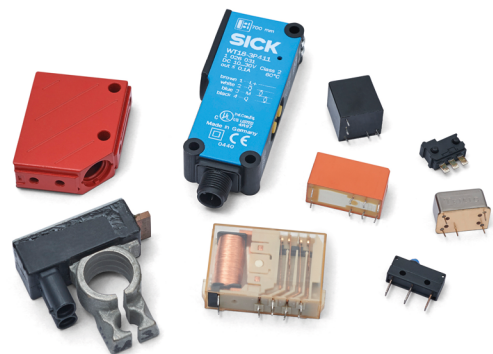
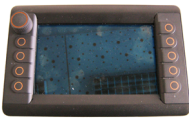


Image: Example of encapsulated test parts

Use cases

Project data relating to leak testing of encapsulated products tested for leaks using CETA test equipment. The requirements regarding the measurement system capability were taken into account and applied. This has a direct impact on the total test time.

	Microswitch	Optical sensor	Display	Thermographic camera
				
Displacement volume	0,54 cm ³	12,0 cm ³	1220 cm ³	986 cm ³
Internal volume	0,05 cm ³	3,0 cm ³	635 cm ³	547 cm ³
Test hood volume	0,60 cm ³	13,8 cm ³	1400 cm ³	1280 cm ³
Test pressure	200 mbar	100 mbar	100 mbar	200 mbar
Leakage rate	10 ⁻² mbar*l/s	10 ⁻² mbar*l/s	10 ⁻² mbar*l/s	10 ⁻² mbar*l/s
Total test time	1,4 s	5,0 s	15 s	36 s

Testing technology - Suitable test device series for leak testing of encapsulated products

Leak testing of small-volume products requires very short test times. Test pressures are generally between 100 mbar and 200 mbar, and the permissible leakage rates range from 10⁻³ mbar*l/s to 10⁻² mbar*l/s. The CETATEST 530 test device series, in the „Sealed Component, High-Resolution“ variant, was developed specifically for leak testing very small-volume products. Electrically actuated internal valves enable very short switching times. In combination with high-resolution measurement technology, very small differences in volume (from 0.03 cm³) can be reliably detected. This corresponds to the volume of an O-ring with a diameter of 12 mm and a line thickness of 1 mm. If the requirements for volume detection or the permissible leakage rate are



not that high, the CETATEST 730 series with a gauge pressure sensor or the CETATEST 830 series with a differential pressure sensor are suitable. These are then equipped with the „sealed component“ as additional feature.

The CETATEST x30 series includes digital I/O interfaces, RS-232, USB (host) and Ethernet as standard. The usual industrial interfaces are available as options. The testers are supplied with an internationally recognised calibration certificate (DIN EN ISO/IEC 17025) and a warranty of up to three years (optionally extendable to 5 years).

Image: CETATEST 530 leak tester

CETA Testsysteme GmbH - Competence and expertise

CETA Testsysteme GmbH has been active for more than 35 years as a solution partner and quality manufacturer of “Made in Germany” leak and flow testers for 100% end-of-line testing. Compressed air is used as the test medium. With a comprehensive ran-

ge of testers and suitable accessories, the right testing technology can be found for nearly any testing task. Several thousand CETA test devices are in use worldwide for quality assurance in production lines. www.cetatest.com.

Images: Elektro-optical sensor system: CETA Testsysteme GmbH / Canva / Generated by AI | Encapsulated test parts: Michael Jaeger, photographer, Düsseldorf | Further product pictures and leak tester CETATEST 530: CETA Testsysteme GmbH