

Independent applications technology laboratory tests screw connections



Picture 1: The mainstay of the Fastener Testing Center is application analysis.
(Picture: ARNOLD UMFORMTECHNIK)

In industrial manufacturing, the focus lies on the quality, safety and efficiency of the manufactured product. And the same applies to screw fastenings. Screw technology investigative tests help to ensure that the required quality standards are met and to optimise processes and procedures.

Manufacturers using screw fastenings in their products need to react to different market requirements, including increasingly pressured development and testing times. But it often takes a while to do the practical checks of the calculation and simulation data, and then validate the acceptance and quality criteria. The necessary measuring instrumentation

also has to be available, along with qualified staff with the relevant experience and necessary expertise in fastening technology. ARNOLD UMFORMTECHNIK meets these challenges with its Fastener Testing Center – an independent applications technology laboratory that investigates issues concerning screw technology for all industrial applications.



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**Moritz Stahl, Director Fastener Testing Center,
ARNOLD UMFORMTECHNIK**

Moritz Stahl became Director of the Fastener Testing Center at ARNOLD UMFORMTECHNIK in Forchtenberg in January 2017. His role is to head a laboratory that completely fits this description. “We are an independent laboratory, where of course we carry out tests on fastening solutions containing ARNOLD fasteners. But we also test components containing fasteners from other manufacturers”, explained Stahl. “The ARNOLD UMFORMTECHNIK Fastener Testing Center offers a full service programme wherever checks, tests, measurements or qualifications on metal components are required.”

Within the company, the laboratory carries out all tests during the production process in cases where the tests fall outside the standards. Additionally, the laboratory offers support to the Quality Management and Research & Development departments and is also responsible for investigating any complaints, as well as every new development prior to launching on the market.

Comprehensive equipment for application analyses and standardised tests

A comprehensive range of equipment is on hand at the Fastener Testing Center – several torque test benches, friction test benches, and ultrasound measurement technology to measure clamp loads. The laboratory also has various options for photographic documentation as well as servo-presses which, for example, can test thread pull-out resistance.

Working with other specialist departments at ARNOLD UMFORMTECHNIK, the laboratory can also carry out further investigative tests. The mechanical testing section can carry out pulling tests on screws and wire sections to DIN EN 10002-1 and DIN EN ISO 898-1 at room temperature. It also tests torques and breaking torques to DIN EN 20898-7, carries out compressive hardness tests to DIN EN ISO 6507, effective hardness tests (EHT) measurements, and investigative tests into hardness processes. Join assessment technology can carry out macro and micro-analyses of heat-treated and case-hardened steels, the joint itself, its state of carburisation and the degree of cleanliness to DIN

50602. The laboratory can also be asked to ascertain grain size as per ASTM E112, and also to ascertain coat thickness and carry out measurements. When it comes to measuring components, the Fastener Testing Center offers 3D measurement, profile measurement, as well as measurements for length, diameter, radius, and angles. It is also possible to determine a component’s corrosion resistance – for example, using a DIN EN ISO 9227 saltwater spray test and a DIN 50018 industrial atmosphere test.

The mainstay of the Fastener Testing Center is application analysis. This involves the connection between two components by means of a fastener. The analysis determines the assembly parameters. Customers often approach us with a calculation ready for a specific fastening solution. We then test it out. Here, we can determine the friction coefficient to DIN EN ISO 16047, the tapping torque to DIN 7500 and DIN 267-30, the clamp load and the heat release behaviour as per VDA 235-203. Customers can also commission a long-term measurement of the clamp load, in alternating atmospheres, as well as an application analysis.



Picture 2: Clamp loads in the original application are determined using ultrasound measurement technology. (Picture: ARNOLD UMFORMTECHNIK)

Using ultrasound to measure clamp load in the original application

Ultrasound measuring technology takes on a special prominence here. This is based on a pulse-echo process, used to determine the clamp load on screw connections. The benefit: There is no need to use any additional ring sensors and the clamp load measurement is made within the original application. A piezo element and a measuring instrument induce an ultrasound pulse at one end of the screw. The pulse courses through the fastener and is reflected at the other end in the form of an echo. When it courses through the screw a second time, this echo is recorded on the measuring instrument and the run-time of the ultrasound pulse is measured. The run-time is specific to each screw and increases as the screw is tightened in the elastic area due to its expansion and the

acousto-elastic effect that occurs. By comparing run-times under no load (reference run-time measurement) and after the screw has been tightened, it is possible – taking further factors into account – to conclude the clamp load. Ultrasound measurement technology has been in successful use at ARNOLD UMFORMTECHNIK for close on ten years. The range of applications extends to metric threads and screw fastenings made directly into metal with a nominal diameter of ≥ 4.0 mm and a clamping length of ≥ 1.0 mm. Moritz Stahl who also heads the Fastening Solutions R&D section at ARNOLD UMFORMTECHNIK stresses an important point: “Investigative tests using ultrasound measurement technology basically require more detailed coordination than standard tests. In order to obtain meaningful results, it is necessary to be aware of the system’s technical limitation and the range of applications.”

Highly accurate tests and a detailed test report

“Customers are always needing to cut development and innovation cycle times. Few can really afford an extra loop on the development chain. Tests and trials are required to be absolutely certain that, despite these short development times, the fastening is secure and safe. And there is a growing understanding of this,” said Stahl.

However, customers do not always automatically involve ARNOLD’s test lab, although according to Stahl, it would be desirable in many cases. When introducing any new design or material innovation it is important, and indeed necessary, to examine the fastening position. “The laboratory’s aim is to be brought on board at the latest by the prototype stage, and not just before the pre-series production run,” said Stahl.

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Where necessary, ARNOLD UMFORMTECHNIK advises customers about the recommended services and investigative tests – in other words some initial advice. However, many customers are very experienced, and know exactly what they need. In general, investigative tests carried out at the Fastener Testing Center are made for a fee. Customers receive a firm quotation in advance, detailing the tests to be made. On completion, they receive a test report in PDF form. Depending on the job in question, the report contains all the measured values, the screw curves, torques, rotation angles and press-in forces. Everything is illustrated in graphic form. Also included in the documentation are photographic records of the component and the measurement

structure, a description of the tasks carried out and the results, along with recommendations for improvements and implementation – for example rotation speeds and switch-over points – to act as a guide to help the customer to implement the fastening. If necessary, following the analysis, we can discuss implementation over the phone, or even at an on-site meeting. And occasionally customers come to the laboratory to attend the trials.

Along with the services offered by the Fastener Testing Center, ARNOLD UMFORMTECHNIK also provides additional services such as investigative tests into materials in the specialist lab or, in the Cleancon[®] laboratory, to check technical cleanliness. According to Stahl these services can all interconnect.

Hiring an independent laboratory yields positive benefits

“Technical investigative tests are becoming more complex and components and fasteners are increasingly reaching their limit zones. Moreover, customers are more open to trying out new materials. And the pressure on time is increasing. There’s often little time to make corrections,” said Moritz Stahl. Hiring a neutral laboratory delivers positive technical, economical and time advantages. “Customers do not need to set up their own laboratory or train their own staff to carry out tests, so they save a great deal of time. They can obtain the complete package from a single source.” Another point is that each and every sensor deployed in the measuring instruments has to be calibrated every year. That is expensive, as is the initial investment in the test instrumentation. The target group of customers to use the Fastener Testing Center – which currently employs six members of staff, and is equipped with the latest testing equipment – includes all of ARNOLD UMFORMTECHNIK’s customers, as well as non-customers – in the automotive, white goods, electronic, and trailer and crane construction sectors. Any company needing to conduct standard or specially adapted investigative tests with screw fastenings is a potential user of these services.

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