Accredited laboratory

Services by the physical-technological testing laboratory

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The physical-technological testing laboratory

With modern equipment and professional laboratory staff mechanical-technological, physical, chemical and metallographic tests can be done in the field of

- quality assurance
- customer specific tests
- product development
- first sample inspections
- cause analysis of damages
- complaints
- orders from external customers
Overview of the testing services

Mechanical – technical tests

- tensile and pressure test up to 400 kN
  - tensile test of screws
  - tensile test of wires
  - tensile test of construction parts / inserts / turned tensile samples
  - tensile test of wires at higher temperatures
  - wedge tensile test of screws
  - proof load test of nuts

- hardness test
  Sample preparation for hardness test
  - Vickers hardness test (HV 10, HV 30)
  - micro hardness test (Vickers HV 0.2, HV 0.3)
  - surface hardness test, case depth measurement

- Screwing test
  - torques, rotation angles, pre tensions / single measurement, 15 cycle - screwing, overtorque, torque until fracture

- coefficients of friction *
  - determination of friction coefficient $\mu_{\text{total}}$, $\mu_{\text{head}}$ and $\mu_{\text{thread}}$

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Overview of the testing services

Metallographical and technological test

- Metallographical
  Mikroskopical investigation, crossection (microstructure, purity grade, decarburization), appointment of the Decarburization via hardness test

- Test the surface of defects
  Describing of the surface status (defects, overlapping, dimensional test)

- Leak test *

- Cleanliness test *

- Fatigue-testing
  up to 150 kN ± 75kN *
  Woehler curve, dynamical strength (fatigue)

- Damage examination *
  Selection of fracture surface examination, clarification of the cause of damage

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Overview the testing services of

Physical tests

- Coating thickness measurement – X-ray fluorescence method
  Non-destructive test to measure the state of surface

- Optical issuance-spectrographic analysis (OES)
  spectrographic analysis Fe, Al, Cu-Zn, Cu-Sn, Ni

- Dimensional check and trueness
  Thread test, length measurement, geometric and visual examination

- Corrosion test
  Salt spray test with Sodiumchloridesolution (DIN EN ISO 9227)

- Climate changing test *
  (-70 …. 180 °C, 10….98 % relative wet)

- Check of the coating for Cr(VI) free
  (DIN 50993) *

Mechanical sample preparation/
preparation/ Machine and prototyping
Sawing, turning, milling, drilling, grinding

Sampling of joints *
Choice of joining parameters, installation attempts, cut production and evaluation, tensile tests on riveted plates

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Performance of the testing laboratory and the advantages of the cooperation:

- The Böllhoff-Know-how in mechanical technique for joining parts
- To ensure and improve constantly the quality of the fastener
- Certainty by the cooperation with the accredited Böllhoff testing laboratory
- Cooperation with special departments of several universities of applied sciences at complex failure analysis
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Performance of the testing laboratory and the advantages of the cooperation:

Comprehensive consultation for technological applications:

- Detection of the task
- Concept for the interconnecting technical solution
- Manufacturing of prototypes or using existing fasteners
- Inspecting the suitability by determining mechanical and physical values
- Inspection in consideration of the requirements related to practice
- Summary of the results in a report
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accredited by the German Accreditation Council (DAkkS) under D-PL-18304-01-00

Tests accredited according to DIN EN ISO 17025:

- mechanical-technological tests
- metallographic tests
- Surface tests and measurements at fasteners of metallic materials
- Analysis of low and high-alloyed steels with sparks-emission-spectrometry
- salt-spray-test
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Your laboratory team:

from left to right

Iwona Panek (Team leader measuring equipment), Birgit Porps (laboratory employee), Dr. Cornelia Heermant (laboratory manager), Bastian Hartmann (Team leader joining technology), Oliver Reins (metal cutting technician), Daniel Zimmermann (laboratory employee), Volker Figge (laboratory employee), Christian Jakob (laboratory employee), Viktor Triebus (Team leader testing technology), Peter Buschmann (laboratory employee), Heinrich Fast (laboratory employee), Andreas Jakobsche (laboratory employee), Jörg Hohlbein (laboratory employee)
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Measuring systems and testing facilities

Tensile- and pressure-testing machine 5 kN (0,5 t)

Online-registration of the measured values and evaluation of the tests with the software „TestXpert“

Examples:

- Testing of screws up to M3 class 8.8
  - DIN EN ISO 898-1
- Loading test with screw nuts up to M3
  - DIN EN 20898-2
  - DIN EN ISO 898-6
- HeliCoil® wire (round and profile wire) from 0,35 up to 1,12 mm

AMTEC® Thread insert for plastics

- Determining of move-out values in plastics
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Measuring systems and testing facilities

Tensile- and pressure-testing machine
100 kN (10 t)
Tensile test according to DIN EN 10002-1, DIN EN ISO 6892-1

Online-registration of the measured values and evaluation of the tests with the software „TestXpert“

- finestrain measurement
- hot tensile test up to 900°C

Examples:
- Testing of screws up to M12 class 8.8
  - DIN EN ISO 898-1
- Special test, e.g. to screws with a short leg
- Loading test with screw nuts up to M12 class 10
  - DIN EN 20898-2
  - DIN EN ISO 898-6
- Nut expansion test
  - DIN EN ISO 6157-2 Kap 4.3
  - DIN EN ISO 10484
- HELICOIL® wire (round- und profiled)
- Flat samples, samples from pressing technique and rivet technique

Tensile- and pressure-testing machine
100 kN (10 t)
Tensile test according to DIN EN 10002-1, DIN EN ISO 6892-1

Online-registration of the measured values and evaluation of the tests with the software „TestXpert“

- finestrain measurement
- hot tensile test up to 900°C

Examples:
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  - DIN EN ISO 898-1
- Special test, e.g. to screws with a short leg
- Loading test with screw nuts up to M12 class 10
  - DIN EN 20898-2
  - DIN EN ISO 898-6
- Nut expansion test
  - DIN EN ISO 6157-2 Kap 4.3
  - DIN EN ISO 10484
- HELICOIL® wire (round- und profiled)
- Flat samples, samples from pressing technique and rivet technique

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Measuring systems and testing facilities

**Tensile- and pressure-testing machine**

400 kN (40 t)
Tensile test according to
DIN EN 10002-1, DIN EN ISO 6892-1

Online-registration of the measured values and evaluation of the tests with the software „TestXpert“

**Examples:**

- Testing of screws up to M24
class 10.9
wedge tensile tests
  - DIN EN ISO 898-1

- Loading test with screw nuts up to M24
class 10
  - DIN EN 20898-2
  - DIN EN ISO 898-6 (class 6)
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Measuring systems and testing facilities

Universal hardness testing device for hardness testing according to Vickers HV 0,1 - HV 30

Computer-controlled test:
Automatically loading, holding period to keep the force, reloading, indentation measurement, calculating the hardness, generating the report, export of results

Hardness curves:
Automatic testable with programmable X-Y-table

Indentation measurement:
Automatically testable with analysis of the camera picture or manually on the display

Possible tests:
Core hardness, surface hardness, case depth DIN EN ISO 2639, edge hardness
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Measuring systems and testing facilities

**Screwing test benches 200 Nm / 1000 Nm**

for the measurement of torques, rotation angles, pre-tensions *) and frictional values of thread and head, for instance friction test according to DIN EN ISO 16047, customer specifications *)

**Measurement range:**
0 up 1000 Nm (M4 - M22), 20 to 200 U/min,
Minimum length of the testing screws: 30 mm

**Sensors:**
Torque: 5 Nm, 20 Nm, 50 Nm, 200 Nm, 1000 Nm
Force: 100 kN/150 Nm, 300 kN / 350 Nm

**Application:**
- Tests of locked-, over-turn- and breaking torques
- Practice-oriented tests of large components, flexible arm allows different screwing directions
- Computer-aided data collection, graphical output, report, analysis and data export possible

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Measuring systems and testing facilities

Junkertest (Vibration test) *

Application:
To determine the locking behavior against loosening of the screw connection (loss of preload force)

Test range: M6 - M16

The vibration test bench operates at room temperature, with a defined clamping length and a uniform frequency. Only the amplitude is varied or determined from the preliminary tests with not locking elements and then applied to the locking elements.

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Different torque wrenches and torque sensors *

![Image of torque wrenches]

Torque wrench measurement range: 750 to 2000 Nm

Measurement range: 3 to 60 Nm, 10 to 200 Nm, 20 to 400 Nm

Torque sensor

Measuring range:
0 to 25 Nm, 0 to 50 Nm

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Analytical instrument for optical spectroscopy
Detection of chemical elements in metals

Diagnostic programmes:
- Steel low-alloyed (Cr < 5% and Ni < 5%)
- Steel high-alloyed (Cr > 5% and Ni > 5%)
- Free cutting steel (e.g. 11SMnPb30)
- Al-base
- Ni-base
- Cu-base brass
- Cu-base bronze

Programmable material detection,
also special qualities, e.g. steel according to
- DIN EN ISO 898-1,
- DIN EN ISO 898-2,
- VDA 231 (strength class: 8.8, 10.9, 12.9)
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Coating thickness measurement according to X-ray fluorescence-method DIN EN ISO 3497

e. g. Measurement according to DIN EN ISO 4042 or customer specification:

Applications:
- Zn/ Fe
- Zn/ Ni
- Ni/ Cu/ Fe
- Cr/ Ni/ Cu/ Fe
- Zn/Cu-Cu Alloy
  - Dacromet/ Fe
  - Geomet/ Fe
  - Delta Tone/ Fe
  - Delta Protekt/ Fe
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Measuring systems and testing facilities

Mahr contour graph and roughness measuring device

Device configuration:
Test device with DAkkS certified calibration standard and connected evaluation software

Application:
- Roughness measurement Ra and Rz
- Conturograph for measuring surface profiles
- Creation of test results and documentation
- Determination of diameter, flank diameter, thread pitch, angle measurement and distance measurement
- Stroke of the probe approx. 200 mm

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Measuring systems and testing facilities

Digital microskope type: Zeiss Smartzoom5

Lenses:
34times to 2021times magnification

Device configuration:
Two lenses with PC connection and evaluation software

Anwendung:
- Surface defects of screws DIN EN ISO 26157 Parts 1 and 3
- Surface defects of nuts DIN EN ISO 6157-2 Section 4.2
- Investigations for damage analysis
- Roughness depth measurement
- Microstructure analysis
- Documentation
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Measuring systems and testing facilities

Microscope type: Zeiss, Axio Imager A1m

Objective:
Magnification from 50x up to 1000x

Configuration of the device:
CCD-colour camera with data-link to the computer and evaluation software, connection to DHS-databank

Application:
- Determination of the actual state of carburization of screws
- Investigations for damage analysis
- Length measurement
- Check of the microstructure
- Documentation
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Measuring systems and testing facilities

Stereo microscope with zoom-lens magnification up to 60 x

Objectives:
from 0,75 x up to 6 x (Magnification up to 60 x)

Configuration of the instruments:
CCD-colour camera with data-link to the computer and evaluation software connection to a database for pictures

Application:
- Pictures for over-view
- Assessment of the fracture surfaces
- Direct measurement of length
- Fracture analysis
- Documentation
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Measuring systems and testing facilities

Temperature and climatic chambers *
Temperature: from -70°C to +180°C, Test space: 64 liters / 200 liters

Climate test:
Temperature: from +10°C to +95°C
Humidity range: from 10 to 98% relative humidity

Application:
- Measurement of losing of pre-tensions e.g. at connections with Amtec inserts for thread-amplification of synthetic materials or at synthetic screw joints *
- Alternating climate test (corrosion test)*
- Test according to TL 244 PV 1200, PV 1210, PV 2005 und PV 1209 with test solution according DIN EN ISO 9227 NSS

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Measuring systems and testing facilities

Temperature resistant force washer with measuring amplifier system
for measuring prestressing forces *)

With the KMR sensor (force washer) shown below, the process of the preload force over time can be determined in laboratory tests, e.g. under the influence of the temperature of a screw connection or together with a torque sensor, the relationship between the torque and the preload force in mobile applications.

Measurement range:
up to M6, M8, M10, M20 – heat resistant up to 120 °C

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Measuring systems and testing facilities

Fatigue testing machine for endurance test

To determine dynamic mechanical strength properties like time- and duration-strength (SN curve) of bolts, riveted components under alternating or pulsating axial and pressure loading tension, e.g. DIN 969 *)

- **Working principle:**
  high frequency resonance test

- **Maximum static test load:**
  150 kN

- **Maximum dynamic test load:**
  +/- 75 kN

- **Frequency:**
  45-260 Hz

- **Dimension of the sample:**
  Round-proof and bolts approx M4-M16,
  Flat test samples up to 10 mm thickness

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Measuring systems and testing facilities

**Precision length measuring machine Mahr type „PRECIMAR PLM 600“**

length measuring machine for measuring (inside or outside) on components and measurement equipment for quality inspection and calibration of measurements *)

- **Outside measuring:** 0 - 600 mm (switchable mm/inch)
- **Inside measuring:** 0,5 - 445 mm (switchable mm/inch)
- **Measuring table:** Universal measuring table with 5 axes
- **Measured force:** Adjustable from 1 up to 13,9N
- **Measuring carriage:** Electrically adjustable; automatic probing with selected measuring force
- **Application:** calibration of gauge, or thread rings, length measuring at samples for proof load test

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Measuring systems and testing facilities

Twist tester according to hugging method (String-test)

For determination of spin structures from surfaces *), which can affect the closeness of components.

Swirl is a thread-like structure on rotationally symmetrical parts, which is caused by the grinding of the product and causes an axial conveyance of fluids and there by causes leakage. This can cause leakage.

Results:
Quantitative determination of twist or freedom from twist. Swirl direction right / left.

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Measuring systems and testing facilities

Testing device for paint penetration test

for non-destructive testing of small irregularities, like cracks, pores and overlaps. We are testing with the paint penetration test*) defects, which are open to the surface of the constructional element, for instance according to DIN EN 571-1.

Operator:
qualified and certified according to DIN EN 473 level 2

Sensitivity:
using of calibration block no. K2 according to EN ISO 3452-3

Testing and evaluation:
for instance according DIN EN 571-1, DIN EN ISO 1371-1 or customer requirement
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Chemical laboratory

Applications:

- Preparation of metallographic sections
  - Preparation of samples
    - Binding, embedding
    - Separating
    - Grinding
    - Polishing
  - Microstructure developing
    - Macro etching
    - Micro etching
- Residual dirtiness-tests *)
- Check of coating for Cr(VI) free *)
- Hardening, annealing, queching and tempering (lab-furnace up to 1.000 °C)

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Chemical laboratory

Material test machine for corrosion test of metal material and protective coatings according to DIN EN ISO 9227 (DIN 50 021-SS) and DIN EN 60068-2-11

Tests:
Assessment of the surface of the samples every workday. There are different kinds of criteria:
- Surface corrosion (white corrosion)
- Fe-corrosion (red corrosion)

Functional description:
The corrosion resistance of the test specimens is tested using a continuously sprayed, aqueous sodium chloride solution with a concentration of 45-55 g/litre as an aggressive agent. Spraying is done with compressed air.
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Chemical laboratory

Determination of residual dirt / cleanliness test

Examination of the cleanliness of fasteners and components.

Test procedure:
The component or connecting elements to be tested are cleaned in a residual dirt extraction system using a desired cleaning process (dipping, spraying, ultrasonic cleaning). The cleaning solution is filtered by membrane filters. The filter is dried, weighed and the particle size distribution is measured automatically. The type of particles is determined at the light microscope.

Cleaning solution:
e.g. cold degreaser DE-SOLV-IT 1000

Membrane filter: size 5 µm

Application:
- Determination of dirt measurement
- Determining of particle type and size and distribution
- Assessment of the results after
  - Böllhoff company standard BN 0901.003 or customer specifics

residual dirt particles under the microscope:
Fibers, metallic particles, cardboard

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Chemical laboratory

Check of surfaces to be free from oil and grease

Determination of the surface tension, the cleaner is testing ink*) to test the quality of the surface, for instance to evaluate the process of cleaning or to check the pretreatment of the coating process.

Nuts coated with several testing ink to determine the surface tension.

The higher the surface tension the far cleaner is the surface and the higher is the adhesive strength of the coating.

Cleanliness control of component surfaces using fluorescence measurement *

The measurement is fast, contact-free, mobile and non-destructive. It is a comparative measurement, i.e. a reference surface with a known degree of purification is required.

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Joining technology

Application:

- Sampling of riveted joinings *)
- Choosing of rivet dimensions and montage parameters for special applications
- Consideration of customer requirements
- Montage of samples for tensile shear test, cross tension test, bend test and prototypes

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Joining technology

Application:
- Mechanical properties of the test compounds on*)
  - Tensile test
  - Peel test
  - Tensile shear test

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Testing in the cross section *)

Scherzugversuch

Schälzugversuch
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Prototype construction

**processing machines:**
- CNC-turning machine
- turning machine, conventionally
- milling machine

**general machines:**
- pillar drill press
  - belt-saw
  - belt-sander
  - wet-platesander
  - cutting-machine
  - hole punching machine for RIVKLE® products

Heat Treatment Lab Furnace

**possibilities *):**
- manufacturing prototypes
  - production of samples and pilot samples
  - production of devices, tensioning mediums
  - production of cutting-samples

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