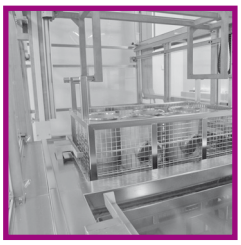
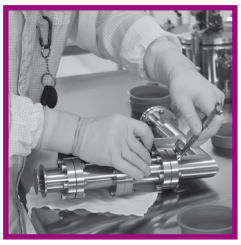
Service

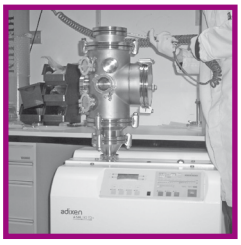
Cleaning and Surface Finishing in the Cleanroom



Assembly and Packing in the Cleanroom

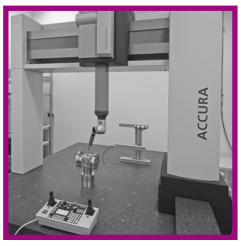


Vacuum Specific Measurements

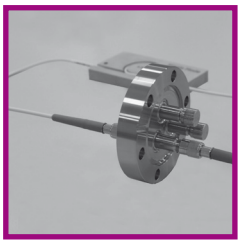


Material Testing

Geometric Measurement



Optical Measurement



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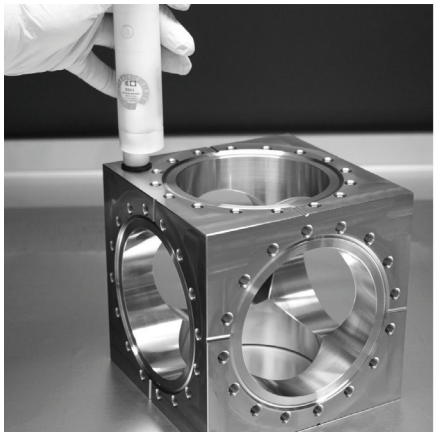
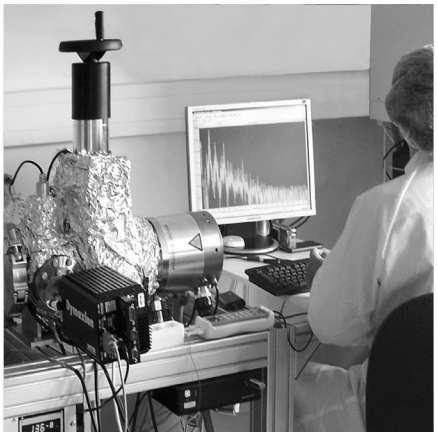
Introduction

To meet the demanding requirements in the manufacture of vacuum components for high-tech sectors we have developed special technologies, made investments in high-precision measuring instrumentation and created an in-house infrastructure which guarantees processes completely free of heavy metals.

Optimized processes, ultra-modern logistics, qualified staff and a professional quality assurance system enable us to make service and measuring stations available for the market independently of our manufacturing process.
Our intention is to give the individual user the opportunity to benefit from our know-how and our machinery at an optimal cost-performance ratio.





Our processes are continuously developing to meet the steadily growing challenges and you can benefit from that progress. We will also be pleased to hear of any unresolved problems you may have and offer the services of our R&D team in finding a solution.

We invite you to visit our technology and production center and to discuss your issues on-site. We can also use videoconferencing to communicate with you efficiently globally to ensure mutual understanding.

Electropolishing

Electropolishing in the cleanroom

- Material: stainless steel
- Machinable dimensions: L = 510 mm, B = 435 mm, H = 350 mm, tubes up to diameter 50 mm and L = 600 mm, other dimensions on request
- Max. surface: 26 dm^2, larger surfaces on request

Results:
- Deburred
- Sealing surfaces protected
- H_2 reduced surfaces
- Corrosion resistant surfaces
- Minimized microroughness
- Particle reduced
- Operational residues removed

Cleaning in the Ultrasonic Cleaning Line

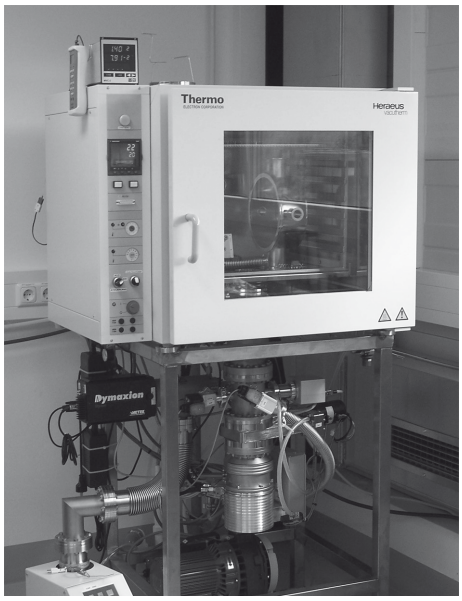
Wet cleaning in the cleanroom

The cleaning process and the cleaning agents used are optimized for the processed materials and geometries of the components.

- Cleanroom class ISO 7 and better
- Manually to fully automated
- Automated process documentation possible
- Miscellaneous ultrasonic frequencies available
- Use of material-specific proven and biodegradable cleaners
- Cleaning line with conductance and pH value control
- Contamination with zinc, tin, indium and lead is debarred
- Fully automated cleaning of components with dimensions from 1 to 1100 mm, other dimensions on request
- Cleaning to a gross weight of 250 kg
- Comprehensive process documentation and filing
- Subsequent to the cleaning items are forwarded directly to the adjacent cleanrooms or to packaging and the automated small-parts warehouse according to specification.
- Adjusted cleaning processes are available for the following materials:
  – stainless steel
  – aluminum
  – copper
  – ceramics
  – glass
- Testing of the cleaning results according to quality control plan

We are pleased to advise you in order to achieve optimal cleaning in accordance with your specification.

Bakeout in the Vacuum Oven



Vacuum components can be baked out to achieve a further reduction of the outgassing rate. The desorption and diffusion rates of all materials are highly temperature dependent. Therefore, the material surfaces are freed from adsorbed particles at high temperatures (e. g. 300 °C) while the diffusion of molecules in the material will be accelerated. Thus the bakeout reduces the outgassing rate during the future operation under low pressures.

Baked stainless steel achieves the following outgassing rates:

2×10^{-10} mbar l / s*cm^{-2}	for water
2×10^{-12} mbar l / s*cm^{-2}	for highly volatile organic compounds
1.5×10^{-13} mbar l / s*cm^{-2}	for low-volatile organic compounds

Process parameters during bakeout of components in the vacuum oven:

- Vacuum to 10^{-5} mbar
- Temperature to 300 °C
- Capacity to component size 420 x 480 x 500 mm

The molecular constituents of the outgassing can be determined by mass spectrometry during bakeout.

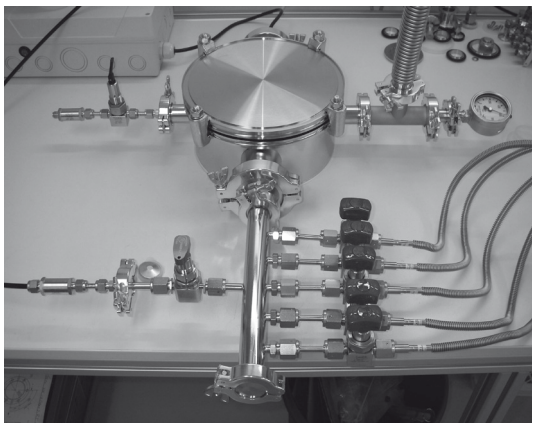
Bakeout of Vacuum Chambers with Residual Gas Spectra

You want to know how your vacuum chamber / assembly behaves in operation and determine the outgassing behavior? We provide you with the opportunity to bakeout complete vacuum chambers and to determine the outgassing and the outgassing rate by means of mass spectrometry.

- Vacuum UCV
- Temperature to 250 °C
- Components / assemblies with a diameter to 900 mm and a height to 1400 mm
- The vacuum chamber / assembly will be evacuated and heated according to the instructions with the outside of the chamber at atmopheric pressure.
- The whole bakeout and outgassing process is documented and recorded to mass number 200 amu.

We gladly advice you in order to provide an optimal evaluation of your components with matched parameters.

Ozone Cleaning



The removal of hydrocarbons (HC) for tubes with a ratio of diameter to length greater than 1:50 by bakeout is only possible to a limited extent. The gaseous hydrocarbons are difficult to remove from a long tube due to physical reasons.

This problem can be resolved by purging with ozone, also referred to as ozone cleaning. The components are connected to an ozone generator after the conventional cleaning. The ozone causes scission and conversion of the unwanted HC contamination into easily removable gases such as water vapor and CO_2, making it possible to prepare ultraclean, long tube assemblies.

This procedure is appropriate for tube assemblies in pure gas technology which are applied e. g. in CVD or semiconductor processes: labyrinthine constructed components with rough edges, gaps and sophisticated geometries. The assemblies are delivered closed and filled with ultrapure nitrogen.

Assembly of Components

We assemble components and groups of components with high demands on low particle emission under cleanroom conditions. Therefore, cleanrooms and work stations of cleanroom class ISO 7 to ISO 1 are available. Assemblies up to 250 kg can be mounted in an ISO 7 to ISO 5 area, components groups to 25 kg can be assembled under ISO 1 conditions.

The cleanliness of the work stations is preserved by a permanent flow of ultra clean air ensuring an ultrapure environment at all times. Trained staff takes care of professional handling of susceptible components and assemblies. Work stations and cleanrooms are continuously tested for particle class, test readings are documented and filed.

With the help of latest particle measurement and detection techniques we are able to test single components prior to assembly as well as the finally assembled group of components for their compliance with specified particle limit values.
We can execute cleanroom compatible packaging and assembly of groups of components according to your specifications, also for components that you provide. Supplied cleanroom products are only opened and unpacked in the cleanroom where the assembly is mounted after being tested for cleanroom applicability and where leak testing is standard practice. Special quality inspections and relevant certificates are available on agreement.

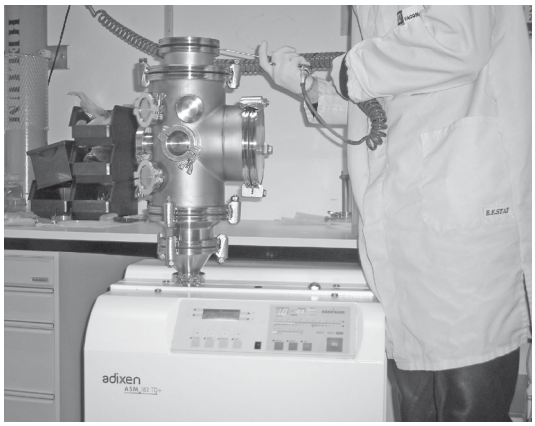
Cleanroom Packaging

All products are packed in such a way that the cleanliness achieved during the ultrasonic cleaning process including freedom of oil and grease will be preserved. In addition, we can provide cleanroom packaging (ISO class 7).

Products can also be packed under inert gas if required. These options can also be agreed upon for custom products.

We provide this service also for your products. We clean your products for you and pack them cleanroom suitable after being tested for the agreed requirements.

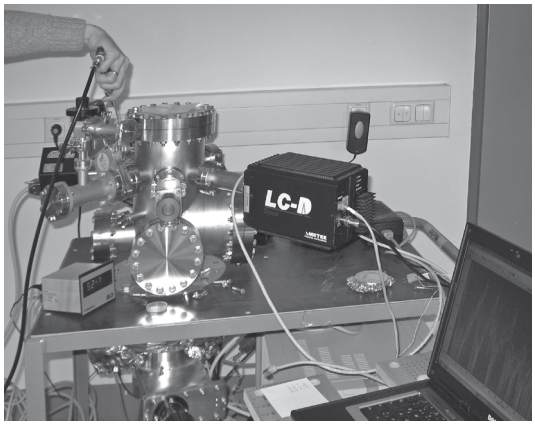
Leak Test for Vacuum



We carry out helium leak tests of all common designs and assemblies. We detect and document leak rates to 1×10^{-9} mbar l/s, 1×10^{-10} mbar l/s and 5×10^{-11} mbar l/s.
The lower the leak rate the higher the effort. A leak test printout is part of the service agreement.

The leak test of cleanroom compatible, cleaned components is executed in a cleanroom environment. Inspection stations are available for cleanroom class ISO 7 and ISO 5 according to the specification of the components. Following the leak test we carry out a black light inspection as standard practice in order to verify the sufficient absence of particles of the components' surface and finally pack your components cleanroom compatibly.

Leak Detection On-site



Leaks as defined by vacuum technology can be gas, liquid or virtual leaks.

In case of tightness problems of facilities or in processes we can also execute leak tests in the pressure range from atmosphere to UHV on-site at your location if required.

With our mobile leak tester and mass spectrometer we are able:
- to determine the type of leak,
- to determine where the leak is situated,
- discuss with you the best way to remedy the leak effectively.

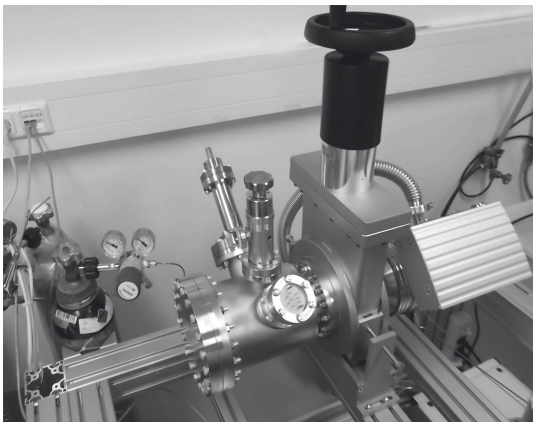
Furthermore, we can provide you a mobile leak tester as a loan unit on request. This device is immediately applicable after delivery and a manual is included. If you need helium and a spray pistol, we can provide these as well.

Process and Residual Gas Analysis On-site (GAPAS®)

We can give you the benefit of our experience in the different fields of vacuum technology and also provide assistance in the partial pressure analysis with our on-site service. We can directly trace different important process parameters in the range from 1...300 amu to atmospheric pressure with our mobile quadrupole mass spectrometer system (GAPAS®).

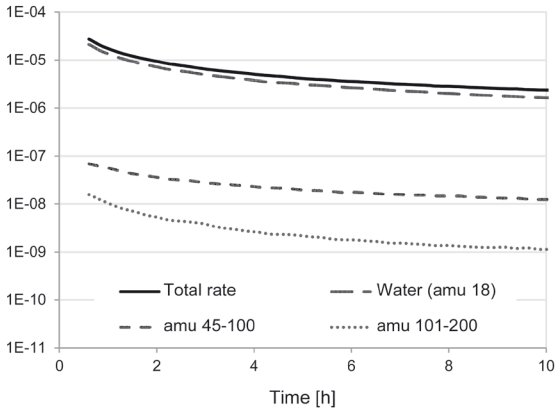
The device is also ideally suited for measurements with high demands on detection sensitivity such as the characterization of the outgassing behavior of vacuum components by means of residual gas analysis. These tests can be performed in test chambers of different size and at specified throughput. The measurements are independent of the sample size and reach their detection limit not less than 5×10^{-14} mbar. Additionally, the residual gas analysis can be carried out with controlled sample heating.

Qualitative and Quantitative Outgassing Measurement of Materials and Assemblies



The evaluation of the outgassing behavior of materials, components and assemblies is most important for many modern technology processes. This includes on the one hand the basic classification of materials regarding their vacuum compatibility that depends both on the operating pressure and the prevailing temperatures.

On the other hand, measurements of the outgassing behavior are a method of quality inspection for the performance of the cleaning of materials and components. Our measuring procedures are so sensitive that we can detect e. g. the contamination of a mounting glove with slight traces of skin oil on the mounted assembly.



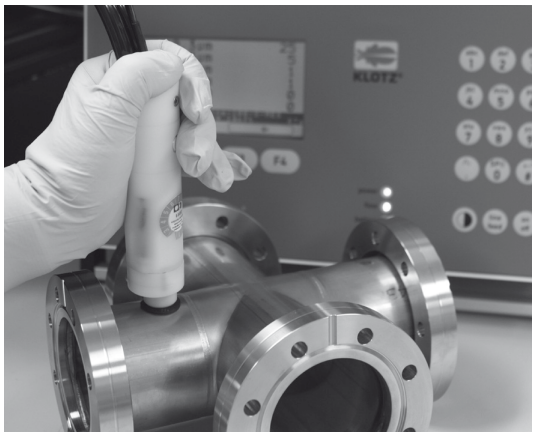
We provide you with outgassing measurements by qualitative and quantitative residual gas analysis (RGA). The measurement of outgassing rates [mbar l/s] covers the mass number range to 200 m/z (mass/load). Our highly sensitive measuring stations enable the detection of slightest contamination e. g. by highly volatile and low-volatile organic compounds (45...100 m/z and 101...200 m/z) in order to provide the requisite cleanliness of vacuum components and chambers for our customers. The lowest detection limit for the partial pressure is 5×10^{-14} mbar.

By repetition of the measurement we can ascertain if the outgassing behavior of the materials is reversible or if the outgassing caused sustained modification of the material's characteristics. A printout can be delivered for each measurement which contains the time-dependent outgassing rate of your assembly. We can then process the evaluation of the measuring results and interpret the data in consultation with you.

Mass specific outgassing rates to 1×10^{-14} mbar l/s/cm^2 can be detected by our residual gas analysis measuring stations. The detectability/analysability of the residual gas composition is decisively affected by the surface relation between test objects and measuring instrument.
The calibration of the mass spectrometer is as essential as the appropriate selection and dimensioning of the pump und the correct adjustment of conductance values.

Our experience enables us to predict whether the measurements let expect an evaluable result by comparing the lowest detection limit of our measuring station with the expected outgassing behavior of your samples. If necessary, we are able to design and manufacture a measuring chamber specially adapted to your testing process with appropriate low detection limit.
Our RGA measuring stations are regularly maintained and calibrated according to strict guidelines in order to guarantee their high quality und measuring accuracy.

Particle Measurement



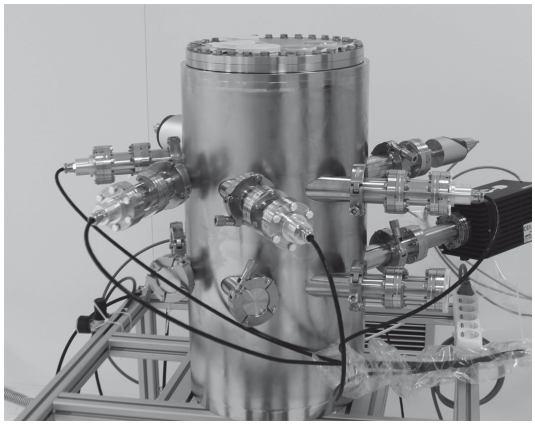
We help you to answer the following questions:
- Are the materials / assemblies cleanroom compatible?
- Can the materials / assemblies be cleaned with low particle emission?
- Is the achieved cleanliness reversible or non-reversible?

We apply the folllowing methods for the measurement of residual particles:
- Surface measurement at plane or slightly curved surfaces
- Through-flow measurement of tubular components
- Blow-down measurement at complex structures
- Measurement with ionized nitrogen as medium to achieve an additional cleaning effect

Ultrapure air and nitrogen are available as media for particle measurement. The counting and classification into 6 size classes from 0.3 µm to 10 µm by the particle measuring device is based on stray light originating from the particles. The measurements on the basis of ISO 14644 and the VDI instruction 2083 are executed in cleanroom environment (ISO class 7 to ISO class 5) or under a cleanroom flow box (ISO class 1). The results are recorded in a standardized log.

We provide you the following measurements as a service:
- Which cleaning process generates a minimum particle load?
- The mechanical application (bending, screwing, rubbing) generates particles. Which particle load is to be expected after usage?
- Particle determination on a defined surface (considering particle class)
- Particle load of cleanroom cleaned components

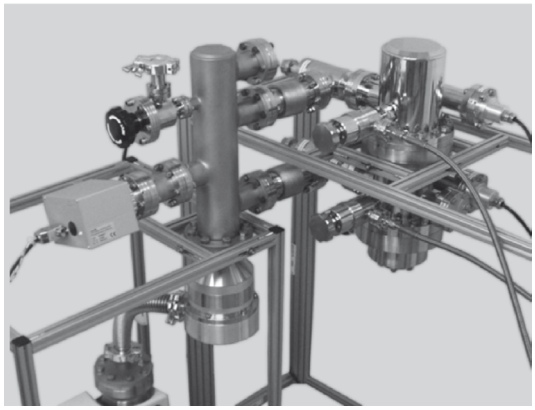
Vacuum Comparison Measurement – Calibration Service for Vacuum Gauges



Vacuum gauges are instruments which have to be controlled regularly according to DIN EN ISO 9001-2000.
We provide vacuum comparison measurements with DKD calibrated reference devices according to ISO 3567 independent of the instrument manufacturer. Our comparison measurement comprises the sensor calibration of your device at our factory calibration unit in addition to the functional test. The test report includes the traceability of the DKD calibrated reference measuring devices.

Reference measuring devices and pressure ranges:
- Hot cathode ionization gauge (Bayard-Alpert): 1×10^{-7}...1×10^{-3} mbar (abs.)
- Temperature compensated capacitance gauges: 1×10^{-4}...0.1 mbar (abs.)
- Temperature controlled capacitance gauges: 1...1000 mbar (abs.)

Determination of Pumping Speed According to DIN 28429



The determination of the pumping speed of new or used ion getter pumps with a nominal pumping speed greater than 10 l / s can be executed on a pumping speed station according to DIN 28429 at our premises. The service includes the complete characterization of the ion pump according to DIN 28429 and the record of the measured results. The process includes e. g. the determination of the pumping speed in the respective pressure range, of the magnetic stray field and the max. power consumption. Nitrogen is used as standard test gas, other test gases can be used on request.

Analysis of Material Composition

The material composition is an essential parameter for processing of metallic materials and a significant criterion for quality and durability in the application. The analysis of metallic materials is part of our range of services.

By means of a metal analyzer based on arc and spark excitation it is possible to determine all necessary elements of metallic materials incl. traces of carbon, phosphor, sulphur and nitrogen. Predefined calibration modules are available for alloys of Fe, Al, Cu, Ni, Co, Ti, Mg, Zn, Sn and Pb. They comprise the relevant range of elements and are individually adjustable. Currently, we use calibration modules for austenitic steel, aluminium, copper and their alloys.

Measurement of Hardness

The knowledge of the hardness of a material is often of crucial importance. The hardness, strength and the yield strength of high-alloy stainless steels e. g. are especially low in quenched condition. The manufacturing process can also have significant impact on the hardness at other materials such as copper. In order that the components fulfill their task in your application it is important to check the hardness of the material.

With our mobile hardness test device we can also measure and immediately analyze the Vickers hardness on-site at your premises. The hardness measurement according to Vickers specifies the ingression of an equilateral diamond pyramid with an aperture angle of 136° with a defined test load into the work piece. The indentation surface is calculated from the diagonal length of the remaining indentation determined by a measuring microscope. The Vickers hardness number (VHN) is the result of the ratio between the test load (unit newton = N) and the indentation surface (d in mm) multiplied by the factor 0.1891.
Being independent of material and geometry, the examination of metal, plastics and ceramics as well as thick- and thin-walled components is possible.

Determination of Permeability of Paramagnetic Materials

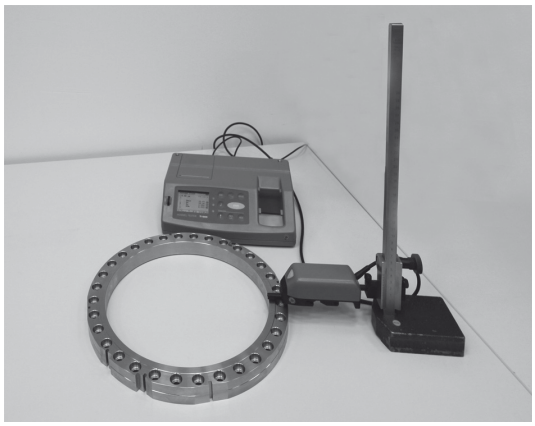
The magnetic permeability μ characterizes the permeability or magnetic conductivity of materials. It is the product of the magnetic field strength μ_0 and the relative permeability μ_r, which we can determine for paramagnetic materials (μ_r = 1...2).

The relative permeability of vacuum is 1.
Materials can be classified into 3 groups with regard to their relative permeability:

- Diamagnetic materials $0 \leq \mu_r < 1$
- Paramagnetic materials $\mu_r > 1$
- Ferromagnetic materials $\mu_r >> 1$

The flux-gate magnetometer covers the measuring range from μ_r = 1.001 to 1.999. The results are displayed with a resolution of 0.001. The measurements can be determined in-house or on-site at your premises.

Measurement of Surface Roughness



Roughness is a term from surface physics that describes the unevenness of the surface. There are several measuring and calculation procedures for roughness characterization which are adjusted to different surface properties. The surface roughness can be affected e. g. by surface processing and characteristic.

Our mechanical touch-signal gauge enables us to measure the roughness values on sealing and functional surfaces e. g. according to DIN EN ISO 4287:1998 (mean roughness index). The mobile device measures with the accuracy class 1 for skid measurements, i. e. with a maximal deviation of 1 per cent.

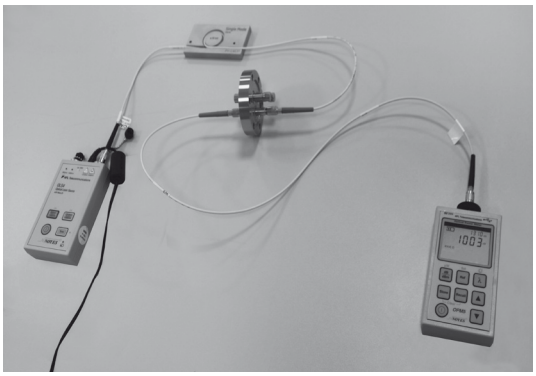
The measurement is performed mechanically at the defined surface of components or materials and is finished within the shortest time. We provide a log with a possible resolution of 0.001 for documentation.

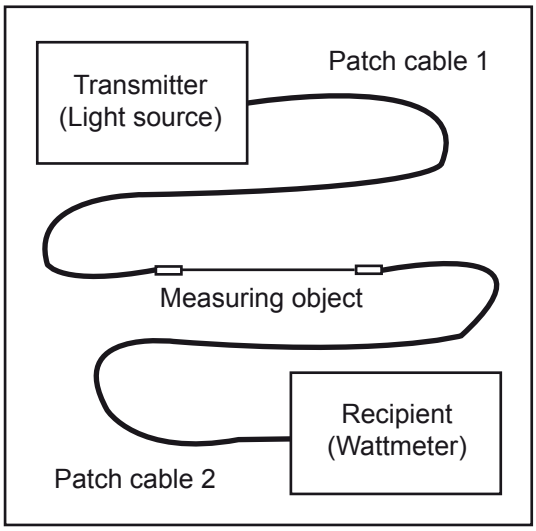
Measurement of Components by the 3D Measuring Machine

We can measure your supplied components including provision of a log. Complex and precise components require measurement instrumentation with the highest accuracy. The 3D measuring machine makes it possible to determine and to log the manufacturing dimensions in addition to shape and position tolerance.
The portal style measuring machine with fixed measuring table is a multi-sensor instrument which allows optical as well as tactile measurements with active and passive scanning sensors. All axes are equipped with air bearings. The measurement range is: X-axis = 900 mm, Y-axis = 1400 mm and Z-axis = 800 mm. CAA (Computer Aided Accuracy) ensures the computer-aided error correction of the dynamic deformation of the instrumentation. The applied sensors guarantee a maximal measurement error of 1.6 µm + measuring length [mm] / 333 and a touch deviation of 1.7 µm. The additional dynamic pivoting and swivelling unit makes it possible to measure areas which are difficult to access.

Your CAD files can be read as a test basis and a log can be provided according to your requirements.

Measurement of Insertion Loss of Optical Fiber Cables





Unavoidable losses appear at all removable plug connections of optical fiber cables due to their functional principle. These losses are determined by the precision of the alignment of the respective fiber end surfaces and the quality of the fiber end polishing. The insertion loss is a measure for the apparent losses at these plug connections and therefore of the quality of the plug assembly (Insertion Loss, IL, see also chapter 7 Vacuum Optics).
We provide the determination of the insertion loss of optical fiber cables for the following optical fibers / plug connections according to the standard (see table):

Fiber	Plug type	Test wavelength	Measurement according to standard
SM635	FC / APC	635 nm	DIN N 61280-4-2
SM780	FC / APC	780 nm	DIN N 61280-4-2
SM850	FC / APC	850 nm	DIN N 61280-4-2
SM1310	FC / PC PC / APC	310 nm	DIN N 61280-4-2
MM50	FC / PC PC / APC	1300 nm	DIN N 61280-4-1
MM400UV **MM400IR** **MMGE400IR**	FC / PC	850 nm	DIN N 61280-4-1

We can also provide this service for special and customer supplied fiber cables on request.
Please see detailed information and technical data of the individual fibers in chapter 7 Vacuum Optics.