

Increase reliability and ensure quality



ZEISS Chemistry Service

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Seeing beyond

Foreword

On the fifth edition

The guidelines for the success of our daily work but also for far-reaching decisions for the future are laid down for ZEISS, in particular for our Chemistry & Materials Department, in the cornerstones of the ZEISS Agenda 2020. We measure ourselves against this standard every day and try to live up to it.

Customer

Our department provides highly specialised products and services, which are to a large extent tailored to your requirements, the requirements of other departments and business units. This is reflected in a rich and broad portfolio and well-equipped machine park. Come to us, we will surely find a solution for your problems!

Competitive

In an increasingly difficult market environment with ever broader and more specialized solutions that can be purchased outside the ZEISS Group, the Chemistry & Materials department within the ZEISS Group is also faced with demanding tasks for economic operation. Here we can convince you with our many years of experience in the field of optical and precision mechanical systems and support you in the best possible way through short distances and mostly

fast, uncomplicated help. Embedding the chemical laboratory in your processes increases your added value with stable and guaranteed supply security. Our fully documented quality assurance and qualification measurements of incoming goods to the tube make a decisive contribution.

Digital

Digitization has become an important pillar of our work: We have successfully transferred our paper documentation of our products into an EDP system (LIMS). For you, the safety of your bonding, lubrication and processes has again been significantly improved, as our quality measures are now reliably reproducible, fail-safe and verifiable. As a result, it has become much easier for us to download and process data from old, non-networked measuring device computers. Further digital measures are under construction and should significantly accelerate your inquiries in the field of optical adhesives and cements in the future.

Team

For us TEAM ZEISS is not only an empty phrase: In order to be successful it is essential for us that we try to understand your plans and projects, and do not leave you alone with your concerns and needs. We maintain a good cooperation among the business units and try to solve your situation as

good and as fast as possible with you. Through a network of contacts in almost all areas, there are always new connecting factors that offer added value for all those involved. Our annual auxiliary material working group, which always takes place towards the end of the year (usually in mid-November/early December), plays a major role in this network building. You would like to be a part of it? Get in touch with us; we are happy to welcome everyone.

Building networks

The new #agenda25 supports the auxiliary materials catalog especially in the demand for network building by providing a compendium of our chemical auxiliaries and operating supplies which can be used throughout the entire organisation in order to quickly realise desired results in terms of customer success.

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Introduction

1.0 Introduction

1.1 General information

The production of precision-mechanical, optical instruments – from manufacture of single components to assembly – requires a variety of auxiliary materials in different classes.

In addition to chemical, mechanical, electrical, adhesive and grease-specific features, special optical criteria must be taken into consideration in particular. Depending on its function and application, an auxiliary material must meet many parameters and features simultaneously.

Carl Zeiss Oberkochen has invested decades of development and application experience in this part of its product range in order to present a catalog that enables users in the Carl Zeiss Group to select qualified products from a standard range and use them successfully.

It is possible to individually match the auxiliary materials to the production conditions and the relevant application and

to develop auxiliary materials according to the customer's specifications.

In the development of new auxiliary materials, we made sure, on the one hand, to use only high-quality raw materials and, on the other hand, to prefer standard materials to be able to ensure sufficient availability also in the future. Of course, we favor less harmful products.



All changes to an auxiliary material after its sale and the correct processing in accordance with the instructions are the responsibility of the user. In the interest of ongoing improvement of our product line, usage properties, the chemical composition and the container provision are subject to change. For reasons of product liability and quality assurance, auxiliary materials approved by the responsible departments only may be used at ZEISS. The currently valid processing instructions must be observed when processing auxiliary materials. For general notes on the correct bonding and cementing technologies, please see the CZ Bonding and Cementing standard (NM2004-01).

1.0 Introduction

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1.0 Introduction

How to find us

No matter if you use our service for daily mixing of adhesives or for a quick order of auxiliary and operating materials and want to pick up your goods or if you want to come to us with your request, we will be pleased to assist you. We look forward to welcoming you.

Chemistry and Materials Department, Building 11
Carl-Zeiss-Strasse 22
73447 Oberkochen, Germany

Coming from gate 1 or gate 2, walk around the canteen until you are directly behind the building, i.e. you are standing directly in front of Building 11, which is the location of our department. Then it is best to go to the adhesive distribution which you will find on the 1st floor (Building 11/2), after the stairs on the right behind the heavy, grey fire door. During our opening hours (7:30-9:00 a.m., 9:30-12:45 a.m., 12:45-3:00 p.m.) you can simply open this door, and wait in the entrance area. Our employees will take care of you immediately.

If you are visiting us for the first time, we would be happy to pick you up at the main entrance. If it is necessary to transport material to our building, we will gladly pick you up at the access road near gate 2.
Of course you can also contact us by telephone or e-mail.

Please feel free to address your concerns to one of the listed contacts. For orders or picking up adhesives, please contact adhesive distribution directly.

You are also welcome to browse our website and familiarize yourself with other services offered by our department.
https://zeiss.sharepoint.com/sites/EP_Germany/DE/kands/KSC_ChemieundWerkstoffe/Seiten/Unser-Angebot.aspx

How you can use our service

If you would like to use our wide range of services, there are various ways to contact us.

Request and order based on an offer

We are looking forward to receiving your inquiries for our products and services. Please send them electronically for products in the field of auxiliary materials for optics (3.4 and 3.5, as well as 6.2) to Mrs. Karin Rettenmaier (karin1.rettentmaier@zeiss.com) and for all other products to Mrs. Birgit Fried (birgit.fried@zeiss.com). Then our employees will quickly take care of the preparation of an offer. After we have received your order, we will quickly send you an order confirmation with delivery date(s). Please note our delivery times of 4-5 weeks from receipt of order! In addition, minimum quantity surcharges for orders < 500 EUR are charged for administrative reasons. The goods will then be

sent to you through our shipping department; collection is not possible.

Orders through our online order form

For our colleagues locally in Oberkochen we offer the special service of ordering through our online order form. This form can be downloaded in its current version from our website (see above). The colleagues of Hensoldt Company are kindly asked to send the current version of the order form to the adhesive distribution.

When using the online order form, please note that adhesives of the category "mixed_adhesives" (i.e. fresh adhesives) must be ordered by 8.30 a.m. at the latest to be ready for collection (from 11 a.m.) on the same day. These adhesives are produced daily by our adhesive distribution department and are deep-frozen directly after production. In this state, the adhesives can be processed for 3-5 days depending on the adhesive system (provided the cold chain is not interrupted). To ensure long shelf life, it is important that you pick up the adhesives at around 11 a.m. on the day of order and follow the instructions in the respective processing instructions during defrosting and processing at your workplace.

When ordering auxiliary and operating materials of all other categories, we will get in touch and inform you about the availability of your goods. Usually the goods are available

1.0 Introduction

How to find us

within 1-2 days, rarely in 3-4 days. However, it may also happen that your material must be produced first of all. In this case we will contact you because the delivery will be delayed. We would like to ask you to organize the collection of your goods yourself.

How do my goods get to me now?

As already indicated, goods ordered are sent through our shipping department. Your order is packed according to the guidelines of the German Hazardous Goods Act, so that you receive your goods safely and without problems.

Orders that are kept ready at the adhesive distribution department can be picked up directly. A visit of the Main Factory would be a welcome idea. For the pickup of the material for the South Factory, the in-company transport, such as "SMT Sprinter tour" should be used. Since ordered material very often falls under the transport guidelines for dangerous goods (ADR), the corresponding regulations must be observed when leaving the factory premises (e.g. between the Main and South Factory). Transportation in a company bus is not recommended; transportation in a rental car/company car should be discussed with us in advance.

How do I obtain processing instructions and safety data sheets?

Goods ordered based on an offer or directly (SAP dispatch) are sent with safety data sheets and processing instructions for external customers.

For colleagues of Hensoldt Company, current processing instructions and safety data sheets are handed over by ZEISS at regular intervals and should then be available to employees from the company's own SAP system.

For ZEISS colleagues, all necessary data is provided in SAP and can be accessed there. Material safety data sheets can be found in the module "CG54" (EHS/Hazardous Substances, Report Information System). In the "Configuration" tab of the work area you can switch from "Specification" to "Material master". In the lower area you can save the selection "Material master" by clicking the button depicting a disk. By entering the material number and displaying the report tree (F8 or button top left) the safety data sheet can now be called up in different languages. Processing instructions and the RoHS conformity declaration can be called up using the "MM03" (Show material) module. After entering the material number ("Basic data" view is sufficient), both the processing specification (type "FKT") and the RoHS declaration of conformity (type "QND") can be called up and displayed under the menu item "Extras" - "Document

data" and, if necessary, the selection restricted to "Current version". Depending on the material number, other generally accessible documents such as adhesion curves are available for display.

1.0 Introduction

1.2 Product information

Physical properties such as tensile shear strength, modulus of elasticity, volume shrinkage, viscosity, etc., determine the respective areas of application of auxiliary materials. These characteristic data are shown for each auxiliary material. Thus, an auxiliary material can be selected individually according to its physical properties.

Sampling and measurement of the characteristic data are carried out according to standardized procedures. Some of these specified values (e.g. the strengths) can be maximum values, which are only reached under certain boundary conditions.

The pre-treatment (cleaning) and surface quality of the workpieces, the cleanliness of the workplace, as well as the design of the parts to be treated play a decisive role in the application of the auxiliary materials, which must be taken into account in each individual case.

Further information on bonding is contained in the CZ notification on standards about bonding and cementing. Before using auxiliary materials in instruments, you should check the functionality of the selected system with original components under comparable conditions of use. For example, bonded joints which are subject to frequent changes in temperature and humidity, must undergo a climate check before their final use.



All parameters are orientation data and were determined according to DIN-EN (or based on DIN-EN) or internal test specifications based on our current knowledge and experience. This does not imply the availability of the product properties in application-specific applications. Precise, application-specific test data must be verified by the users themselves, or a test procedure must be initiated. Carl Zeiss cannot accept any liability for such applications.

The values were determined on typical manufacturing batches. They are provided for technical information only and do not constitute product specifications. Some terms which are important when using auxiliary materials are explained and commented below.

1.0 Introduction

1.2.1 Important terms and notes

Single and multi-component systems

Auxiliary materials can be divided into single and multi-component systems. Single-component auxiliary materials (e.g. cements) can be used immediately without any big preparation, while multi-component systems must be mixed not until directly before they are used. The hallmarks of such multi-component systems are a high shelf life, high mechanical strength and flexibility of use (e.g. through filler quantity regulation). The curing properties of multi-component systems are more versatile than those of single-component systems.

The advantage of single-component systems is that they are more easy to use (no need for mixing prior to use). However, their texture (viscosity) changes during their shelf life.

Pot life

The pot life or processing life is the period during which a multi-component system remains usable after mixing. At first, a slow crosslinking reaction starts during the mixing procedure. This continuously increases the viscosity.

The processability of an auxiliary material with increasing viscosity depends on the method of applying, the type of application and the conditions of use (e.g. temperature). Therefore, the specified pot lives must be considered as guidelines only (make sure to observe the processing instructions). The pot life is specified for a 10 g mixture and room temperature.

Curing

The curing process is controlled by a combination of curing temperature and curing time. Several temperature/time combinations can be selected for an auxiliary material to ensure optimum crosslinking of the material in the relevant application. Depending on the curing mechanism, different degrees of curing and crosslinking will result, and the polymer will therefore have different usage properties.

High curing temperatures (short times) result in almost 100 % crosslinking and therefore in high strength and stability. However, cements also become more brittle at high curing

temperatures, leading to optical strain in glass/metal bonds. Therefore, the specified curing conditions are guidelines only. Optimal curing conditions depend on the design and the application. In this context, it is worth remembering the optimization of cementing processes. A specified curing period does not necessarily mean that a load is admitted after this period. For load times, please see the processing instructions.

The curing instructions in the processing instructions must be observed.

According to QS requirements, the curing conditions and times must be verifiably documented.

Any changes are possible after consultation with SPU-EC or MKri or Ed; these must be verifiably checked and documented by the user before series release.

1.0 Introduction

1.2.1 Important terms and notes

Fillers

The addition of fillers such as quartz or aluminum nitride results in the following changes to the usage properties of the cured system:

Volume shrinkage	Vs	drops
Thermal conductivity	λ	rises
Expansion coefficient	α	drops
Modulus of elasticity	E	rises

If the fillers are electrically conductive (aluminum, copper or silver powder), the electrical conductivity of the system increases.

UV-activated auxiliary material

The physical properties of UV-activated auxiliary materials (UV cements WE 57 UV, MHK-01, OK 2274, OK 2272, DK 2282, HK 2260) depend on the following parameters:

- Emission spectrum (excitation wavelength) of the lamp
- Lamp intensity
- Thickness of components to be bonded
- Absorption and reflectance behavior of components to be bonded
- Layer thickness of the cemented joint
- Shadow zones (areas inaccessible to light)
- Exposure time
- Tempering process

For example, radiation using two lamps with a different emission spectrum, but identical radiation intensity, can cause two different strength values.

The absorption spectrum of the photo initiator and the emission spectrum of the radiation source should correspond as much as possible.

If this is not the case, curing will be more difficult or incomplete.

Dissolving adhesive joints

There are several methods of dissolving cemented joints, e.g.

MECHANICAL FORCE

HEAT

SOLVENTS

However, all three methods entail the risk of affecting optical components or other sensitive modules.

For example, solvents for epoxy-based adhesives contain acids that can also attack the cemented components. In general, suitable information is provided in the relevant processing instructions.

1.0 Introduction

1.2.2 Ageing of auxiliary materials

In addition to the geometry and the pre-treatment of the workpiece, ageing of the auxiliary material is a major influencing parameter. All values specified in the catalog are momentary values which change depending on the age of the auxiliary material. Aging is defined as the entirety of all physical and chemical processes in a material that cannot be reversed. In most cases, such ageing phenomena result in deterioration of the mechanical properties. Ageing of polymer materials may be attributable to the following causes:

1 Radiation

Radiation of the sun or artificial light sources cause ageing of the auxiliary materials used. UV radiation has the biggest influence (<400 nm). This type of radiation is able to split molecules or to produce reactive radicals.

2 Temperature

Temperature plays a major role in ageing processes. The rule of thumb here is that a rise in temperature by 10° C doubles the reaction speed. Furthermore, the diffusion of oxygen and water vapor increases. These two substances trigger certain degradation reactions and thus accelerate ageing of the auxiliary material.

3 Humidity

Depending on the reaction system (polyaddition, polymerization, polycondensation, photopolymerization and ventilation), humidity leads to swelling processes of various magnitudes. The absorbed water can facilitate the diffusion of gases and lead to reactions with polymer modules, fillers, etc.

4 Chemicals

In addition to oxygen and water vapor, other chemicals (e.g. lubricants, solvents, cleaning agents, etc.) can also react with polymers. It is therefore strongly recommended to keep auxiliary materials away from other chemicals and to ensure that the workplace is both clean and hygienic. Auxiliary materials may be brought into contact with other chemicals only in accordance with the current processing instructions or after agreement with SPU-EC.

Caution! This can lead to dangerous reactions!

In practice, several causes of ageing occur simultaneously in most cases, so that their effects on the materials are in a complex relationship.

Mechanical (e.g. tensile test after weathering), optical (microscopy) or structural analysis methods (e.g. IR spectroscopy, thermal analysis) are used to detect ageing processes in polymer materials.

1.0 Introduction

1.2.3 Physical parameters and units

Subs:

The **glass point** (or **glass transition temperature**) describes the transition from the rubber-elastic to the hard-elastic or glass state. This is caused by "freezing" or "unfreezing" the molecular movement of long chain segments of the polymers. The glass point is determined by dynamic-mechanical thermoanalysis. It is generally indicated for a heating rate of 2 K/min. and a measuring frequency of 1 Hz. **Unit: °C**

E:

The **modulus of elasticity** is a measure for the elastic deformation of solid materials. It is determined in the stretching or bending mode by dynamic-mechanical thermoanalysis. The modulus of elasticity is generally indicated at 20° c, a heating rate of 2 K/min. and a measuring frequency of 1 Hz.

Unit: [N/mm²]



Note:

The glass transition temperature and the modulus of elasticity are dependent on the following factors:

- Curing conditions (temperature, time, humidity, etc.)
- Type of mechanical stress (dynamic and static forces, tension, pressure, shearing, peeling and torsion)
- Ageing of cemented joint

P:

Penetration is understood to mean the depth at which a test piece sinks into the lubricant to be tested. It is a measure for the deformability of a lubricant. Penetration is tested in accordance with DIN 51804. The values are measured at 25 °C.

Unit: [0.1 mm] tenths of a millimeter

NP:

Needle penetration is a measure for the deformability of auxiliary cements. It is measured in accordance with DIN 52010. This test technique determines the temperature required to achieve a penetration depth of 1 mm within 5 seconds and with a needle load of 250 g.

Unit: °C

VI:

The VI **viscosity index** indicates the change of the viscosity of a petroleum product with temperature. The viscosity index is calculated from kinematic viscosity. A high viscosity index indicates a minor change of viscosity with temperature, and vice versa.

Unit: dimensionless

1.0 Introduction

1.2.3 Physical parameters and units

Sp:

Spreading is understood to mean the oil bleeding tendency of lubricants. The spreading behavior is measured at 40 °C in accordance with DIN 58397/2.

The following evaluation is made as follows:

+++	Sp	< 10	low spreading
++	Sp	10-50	
+	Sp	50-100	
0	Sp	100-200	
+++	Sp	> 200	pronounced spreading

EP RuK:

The **softening point** describes the softening temperature of auxiliary cements and blocking waxes, measured using the "ring-and-ball method" according to DIN 52011.

Unit: °C

α :

The **mean coefficient of linear expansion** is usually specified here for approx. 20 °C, based on the initial length of the sample at 20 °C

Unit: [1/K*10⁻⁶]

τ_B :

The **tensile lap shear strength** (Al-Al) describes the strength of metal bonds when tractive forces act parallel to the contact surface (see Fig. 1)

Unit: [N/mm²]

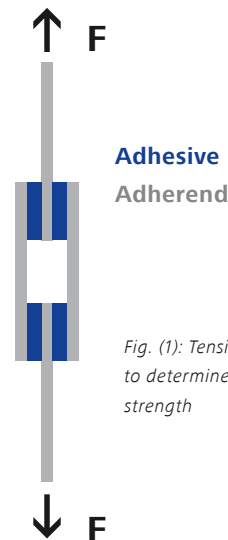


Fig. (1): Tensile shear test to determine the lap shear strength

σ_B :

The **tensile strength** describes the bond strength when tractive forces act vertical to the contact surface. This test is used for optical cements and UV-curing adhesives when

glass must be used instead of metal (see Fig. (2)).

Unit: [N/mm²]



Fig. (2): Tensile test to determine the tensile strength



Note:

The specified tensile strengths and lap shear strengths are achieved after approx. one week of storage at room temperature and standard atmosphere. This enables the cements to be compared with each other.

Values achievable in practice depend on:

- Material type
- Pre-treatment of the surface
- Geometry of the contact surface
- Curing conditions
- Type of mechanical stress
- Ageing of cemented joint

1.0 Introduction

1.2.3 Physical parameters and units

Vs:

Volume shrinkage is a measure for the volume contraction of a cementing system occurring during the curing reaction.

Unit: [%]



Note:

Volume shrinkage is difficult to determine for (highly viscous) auxiliary materials and substances which outgas and give off decomposition products. Volume shrinkage is not specified for these materials.

n_e^{20} , n_D^{20} :

The refractive index is a measure for the change in direction (refraction of light) experienced by a ray of light striking the border between two optically different media at an angle. In practice, it is decisive to match optical cements and edge lacquers to the refractive indexes of the relevant glass types in order to prevent dispersion and reflection.

These values are measured at 546.1 nm (E line) and 589.3 nm (D line) at 20 °C in accordance with DIN 58753/Part 2 and DIN 53491. For immersion oils, the reference temperature is fixed at 23 °C (DIN 58 884 or ISO 8036).

Unit: dimensionless

Shore-A:

Shore A hardness is determined for soft auxiliary materials (sealing agents, silicone cements). Shore hardness is the resistance of a substance to penetration by an object of an undefined shape at a defined spring force.

Shore hardness is specified in a range between 10 (soft) and 90 (hard).

Unit: dimensionless



Note:

Here, Shore A hardness is specified only for elastomers.

η :

Dynamic viscosity is the ratio of shear stress to velocity gradient at a vertical flow direction. Here, dynamic viscosity of ready-to-use, unhardened preparations measured using a rotation viscosimeter is specified at 25° C.

Dynamic viscosity is usually specified at 25 °C. Dynamic viscosity can be applied to both Newtonian and non-Newtonian substances.

Unit: [mPas],

old unit [1 cP], conversion 1 cP = 1 mPas



Note:

Viscosity and tenacity are identical terms. High intermolecular friction forces in a liquid or gas increase the flow resistance and therefore the viscosity.

1.0 Introduction

1.2.3 Physical parameters and units

τ:

Kinematic viscosity is defined as the quotient of dynamic viscosity and fluid density. Kinematic viscosity of ready-to-use, unhardened preparations is determined by using a capillary viscosimeter in accordance with DIN 51562 mostly at 20 °C or 25 °C. For immersion oils, the reference temperature is fixed at 23° C (DIN 58 884, ISO 8036).

Kinematic viscosity can be used for Newtonian fluids only.

Unit: [mm²/s],

old unit [cSt], conversion 1 cSt = 1 mm²/s



Note:

The measured starting viscosity strongly depends on the mixing temperature and the time elapsed between mixing and measurement. Deviations can occur mainly with auxiliary materials containing solvents. Therefore, the specified viscosities are only approximate values.

A:

Flow time describes the time the lacquer needs to flow from a DIN cup with a 4 mm nozzle. The purpose of the test is to obtain a reference value with which lacquer flow can be assessed easily and adequately for operational purposes. The test is made in conformity with DIN 53211.

Unit: [s], seconds

TOC:

The **Total Organic Contamination value** characterizes the outgassing behavior of auxiliary materials.

For this purpose, the sample to be analyzed, e.g. a cured cement, is heated in a gas stream (e.g. 80 °C for 120 s or 120 °C for 120 s). The substances released during heating are captured and characterized by gas chromatography / mass spectrography. The higher the value, the more disadvantageous the outgassing behavior.

The captured quantity of outgassable substances is related to the initial sample weight.

Unit: [ng/mg], [mg/kg] or [ppm]

TML:

The **Total Mass Loss** value indicates the amount of organic components and moisture of auxiliary materials that outgass at a constant temperature at normal pressure or vacuum over a certain time.

For this purpose, the sample to be examined must be conditioned at a relative humidity of 55 % before measurement. The TML value is usually determined at 125 °C over 24 hours and normal pressure.

The higher the value, the more disadvantageous the outgassing behavior. The outgassing substances (organic components and moisture) are determined by weight using simultaneous thermal analysis and related to the sample weight.

Unit: % by weight

1.0 Introduction

1.2.3 Physical parameters and units

RML:

The **Recovered Mass Loss** value indicates the amount of organic components that an auxiliary material outgases at constant temperature, normal pressure or vacuum over a certain time. For this purpose, the sample to be examined must be conditioned and/or dried in the desiccator before measurement. The RML value is usually measured at 125 °C for 24 hours and normal pressure.

The higher the value, the more disadvantageous the outgassing behavior. The outgassing substances (organic components) are determined by weight using simultaneous thermal analysis and related to the sample weight.

Unit: % by weight

1.2.4 Note

Additional physical parameters on request (if no values are available in the tables).

It is possible to individually match the auxiliary materials to the production conditions and the relevant application and to develop auxiliary materials according to the customer's specifications.

1.0 Introduction

1.2.5 Classes of plastics

Elastomers

At low temperatures ($T < T_g$), elastomers are hard-elastic, while they are soft-elastic (rubber elastic) at the useful temperature range.

The plastic chains are available in an entangled form. Under tension or pressure, the entangled chain components can slide away from each other between the contact points and stretch. All in all, however, the chains are retained by the cross-linking main bonds and cannot slide away. When the outside force decreases, the chain components return to their original, entangled position.

Below the glass conversion temperature T_g , widely crosslinked elastomers are in a glass state. Above the glass transition temperature, the transition to the rubber-elastic state occurs with an abrupt increase in ductility and decrease in tensile strength. The useful temperature range of elastomers is above the glass conversion temperature. Auxiliary materials based on silicone (ADM 5, CI 35), nitrile rubber, polychloroprene, polyurethane (DK 2014 B) and alkylene polysulfide (ADM 9) are classified as elastomers.

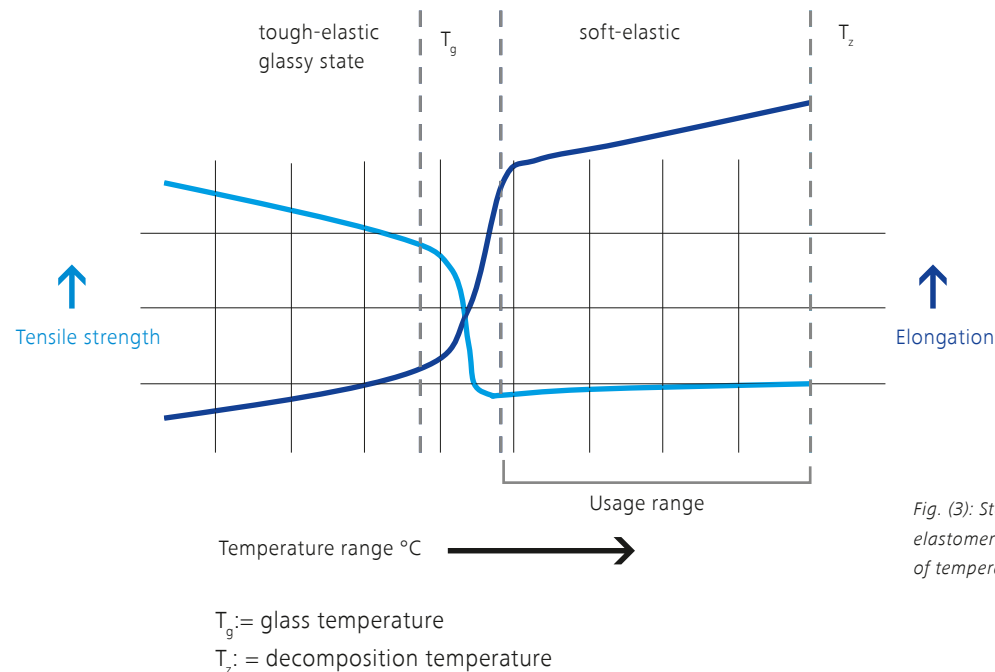


Fig. (3): State of elastomers as a function of temperature range

1.0 Introduction

1.2.5 Classes of plastics

Duromers

At room temperature, duromers are very hard and brittle in most cases. They are temperature-resistant, not plastically deformable, not meltable or weldable, insoluble, and swellable only to a limited extent. The molecules in duromers are firmly anchored to each other.

Unlike elastomers and thermoplasts, cured duromers are not subject to erratic changes of properties after a rise in temperature. This is due to general molecule linking. Only after the link breaks up at T_z , the mechanical strength collapses..

Duromers include auxiliary materials based on epoxy resin (KI 10, KI 50, KI 56).

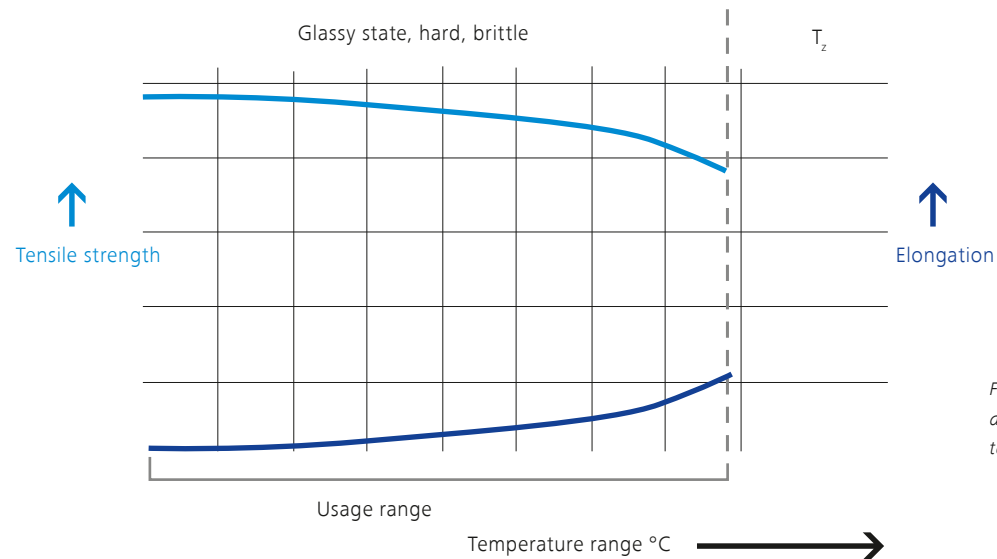


Fig. 4: State of duromers as a function of temperature range.

T_z : = decomposition temperature

1.0 Introduction

1.2.5 Classes of plastics

Thermoplasts

At room temperature, thermoplasts are brittle or tenacious and hard which can be repeatedly heated to ductile state, but are slightly decomposed during the process. In most cases thermoplasts are meltable, weldable, swellable and soluble.

A distinction is made between amorphous and semi-crystalline thermoplasts. If the listed auxiliary materials belong to the group of thermoplastics, they are usually amorphous thermoplastics.

The tensile strength is relatively high below the softening range and slowly decreases with increasing temperature. However, the tensile strength strongly decreases at T_g due to sudden molecular motion. Elongation at break is low in the glass state, but increases strongly at T_g and decreases in the soft-elastic state after reaching a maximum due to the growing portion of ductile flow. The useful temperature lies below the glass transition temperature.

Auxiliary materials based on acrylate, polyvinyl acetate, polyester and PVC belong to the thermoplastics.

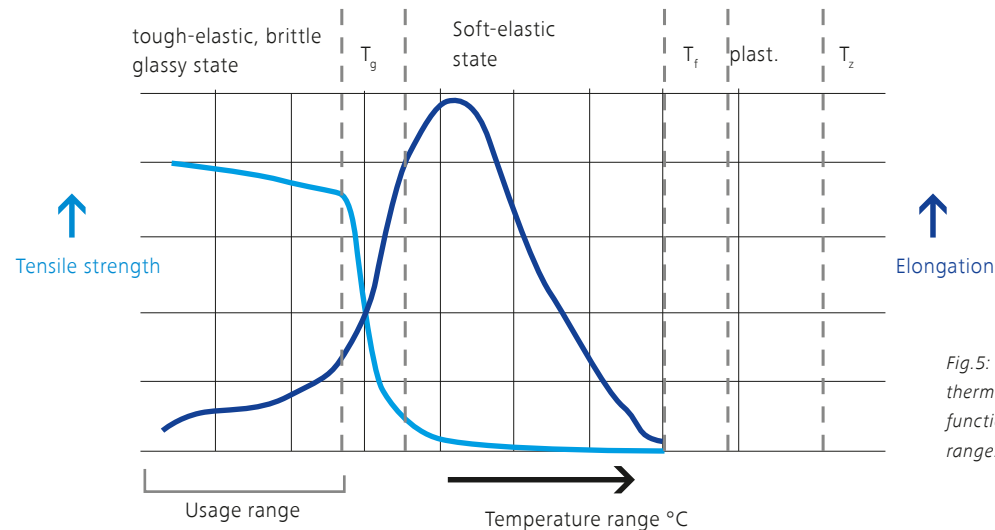


Fig.5: State of thermoplasts as a function of temperature range.

T_g := glass temperature
 T_f := flow temperature
 T_z := decomposition temperature

1.0 Introduction

1.3 Services of the Chemistry and Materials Department

Services of the Chemistry and Materials Department in the following areas are possible.

Dilatometry (DIL)

Dilatometry is a thermoanalytical measuring method for determining dimensional changes of a material while it is exposed to a controlled temperature program. A dilatometer is used to determine the thermal expansion and the coefficient of thermal expansion.

In detail, the following specifications are possible:

- Linear thermal expansion
- Thermal expansion coefficients
- Softening point
- Shrinkage of plastics and (solid) adhesives through the temporal effect of heat (tempering)
- Change of the linear thermal expansion of adhesives by tempering

Materials:

Plastics or adhesives, metals, glass and ceramics
Temperature measuring range: -180 °C to 500 °C

DSC (differential scanning calorimetry)

In dynamic heat flow differential calorimetry, the sample is subjected to a controlled temperature/time program. The heat flow is measured from and to the sample. All physical and chemical processes associated with a thermal effect can be characterized by DSC.

For plastics, rubber, adhesives, holding cements, lacquers, raw materials, the following specifications are possible in detail:

- Glass transition temperatures
- Melting and crystallization temperatures
- Melting and solidification behavior
- Degree of crystallinity
- Reaction temperatures
- Degree of crosslinking
- Thermal and oxidative stability
- Influence of the thermomechanical history (process parameters, aging, storage, etc.)
- Influence of additives (plasticizers, antioxidants, fillers, etc.)
- Crosslinking reactions e.g. of adhesives
- Temperature measuring range: -170 °C to 500 °C

Dynamic-mechanical thermoanalysis (DMTA)

The influence of temperature causes changes in the mechanical properties of polymers. Softening of polymers results in a loss of strength, which is of great importance in practice. The reasons for the loss of strength can be determined with the help of the physical parameters of the polymer that change with temperature (e.g. glass transition temperature). Dynamic Mechanical Thermal Analysis (DMTA) is a method to determine the mechanical properties of elastic and viscoelastic materials as a function of temperature and/or frequency.

Measuring geometry:

- Tension mode
- Bending mode
- Compression mode
- Shear mode

The following materials can be characterized:

- Polymers and polymer mixtures
- Elastomers, duroplastics, thermoplastics
- Adhesives, sealing compounds, optical fine cements
- UV adhesives

1.0 Introduction

1.3 Services of the Chemistry and and Materials Department

The following information can be obtained using the DMTA method depending on temperature and/or frequency:

- Determination of the glass transition or the glass transition temperature
- Storage and loss modulus (modulus of elasticity)
- Change of the modulus of elasticity due to tempering
- Change of the modulus of elasticity due to aging
- Change in the modulus of elasticity due to migrated media (e.g. moisture)
- Change of the modulus of elasticity due to additives (fillers, plasticizers, etc.)
- Determination/tracking of curing curves for adhesives (curing behavior over time at a given temperature)
- Determination of post-curing
- Temperature measuring range: -150 °C to 500 °C
- Measurement frequency: 0.01 to 1,000 Hz

Simultaneous thermal analysis (STA)

Simultaneous thermal analysis refers to the simultaneous application of thermogravimetry (TG) and differential scanning calorimetry (DSC) to one and the same sample in one instrument. The measuring conditions are identical for the TG and DSC signals (identical atmosphere, gas flow rate, vapor pressure over the sample, heating rate, thermal contact to sample crucible and sensor, radiation influences, etc.)

DSC analytical possibilities

- Melting/crystallization behavior
- Solid-state transitions
- Degree of crystallinity
- Glass transitions
- Crosslinking reactions
- Oxidation stability
- Determination of purity

TG analytical possibilities

- Changes of mass
- Temperature resistance
- Oxidation/reduction behavior
- Decomposition

Temperature measuring range: -120 °C to 500 °C

Suntester

Suntester XLS+ is used to simulate solar radiation. Xenon lamps are used to simulate the spectral distribution of solar radiation in the UV and visible light range. Suntester is used for realistic natural outdoor aging through solar radiation. Paints, plastics, coatings, etc. can be checked for ageing/changes due to solar radiation.

Wavelength of irradiation approx. 300-800 nm

Irradiation approx. 250-765 W/m²

Climate test chamber

Climate test chamber VCS 7034-5 is used to test the influence of temperature and humidity on the properties, function and service life of products (devices, assemblies, bondings, etc.).

- Temperature range - -70 °C to 180 °C.
- Relative humidity: approx. 10 % to 95 %.
- Test room volume: approx. 335 liters

We can provide details of the exact technical data if required.

Cold-active plasma system

The cold-active plasma system Piezobrush® PZ2 hand-held device from Reylon Plasma enables gentle cleaning and activation of temperature-sensitive surfaces, e.g. before bonding, with a low temperature load (up to approx. 50 °C).

Ambient air serves as process gas.

It is used preferably for small areas.

1.0 Introduction

1.3 Services of the Chemistry and and Materials Department

Hot atmospheric pressure plasma

The hot atmospheric pressure plasma system Plasmabeam from Diener Elektronik enables cleaning and activation of surfaces e.g. before bonding. The plasma jet has a temperature of approx. 200-300 °C. Ambient air serves as process gas. The process parameters must be well adapted to the surface to avoid burning (thin materials). This technique is preferably used for temperature insensitive materials.

CO₂ snow blasting

CO₂ snow blasting is a cleaning and pretreatment process for solid surfaces. The supply media are liquid CO₂ and compressed air. The blasting medium, so-called CO₂ snow particles made of dry ice, are first produced in the CO₂ snow blasting machines from liquid CO₂. CO₂ snow blasting is often referred to as dry ice blasting or CO₂ particle blasting. The process is not suitable for thin-walled, temperature-sensitive parts or glass.

Moisture condensation, mechanical distortion due to strong cooling (approx. -78 °C) or mechanical action of the CO₂ snow jet (flow velocities in the range of 50 to 300 m/s; steel pressure 2 -10 bar) occur during this process.

Sita CleanoSpector fluorimeter

The handheld SITA CleanoSpector is used for cleanliness control of components (mostly metals) to ensure product quality and subsequent processes such as bonding, coating, welding, hardening and bonding.

Interfering filmic contaminants such as oils, greases, cooling lubricants and release agents are detected by measuring the fluorescence intensity.

Fluorescence is a special form of luminescence. Fluorescence is stimulated by radiation in the ultraviolet range. Electrons of fluorescent molecules absorb photons and reach a higher energy level. This excited state is energetically unstable.

The electrons immediately return to the ground state, releasing the absorbed energy. This causes the emission of fluorescent light. Since part of the energy is converted into heat, the emitted radiation is lower in energy and thus has a longer wavelength. The excitation is performed at 365 nm wavelength and the fluorescence measurement at 460 nm.

(Source: SITA Messtechnik GmbH)

Refractive index and dispersion measurements by refractometer

The refractive index n of a medium is the ratio of the phase velocity of light in a vacuum to that in the medium under consideration. The refractive index depends on both the sample temperature and the wavelength used; its specification is therefore in most cases in the form n_X^Y , where X denotes the wavelength (specification of the wavelength in nm or the letter of a corresponding line, e.g. D for the sodium D line at 589.3 nm) and Y represents a temperature specification in °C (very common: n_D^{20}).

Our automatic refractometers allow refractive index measurements (range n 1.30-1.72) on liquids and solids at wavelengths of 404.9, 436.6, 480.9, 532.9, 546.05 (e), 546.5, 589.3 (D), 634.8, 643.6, and 656.8 nm; samples can be tempered to 10-70 °C (ne to 110 °C). Special fitting software also allows the Sellmeier coefficients to be determined, which makes it possible to calculate Abbe numbers as well as refractive indexes at unlisted wavelengths by interpolation or extrapolation.

1.0 Introduction

1.3 Services of the Chemistry and and Materials Department

Surface tension measurements by tensiometer

The surface tension σ of a liquid is the interfacial tension between the liquid and the surrounding atmosphere, which counteracts an increase in the surface area of the liquid. As a rule, it is understood as a force required to increase the surface area, which is also suggested by the unit N/m.

Using our temperature-controlled tensiometer, it is possible to determine surface tensions and, under certain circumstances, interfacial tensions and densities. Both the ring method (for unfavorable wetting behavior and/or low surface tension) and the plate method (for higher viscosities and unknown density of the liquid) can be used as methods for surface tension measurement.

Contact angle measurements using Mobile-Drop

Contact angle measurements are used to determine the surface energy of solids.

For an adhesive bond or coating, the aim is to achieve the highest possible surface energy in order to improve wetting of the adhesive or paint.

The pre-treatment of the surfaces e.g. plasma cleaning/ plasma activation, are to increase the surface energy. Among other things, contact angle measurement can be used to check the effectiveness of surface pretreatment.

Surface energy is a measure of the energy required to break chemical bonds when a new surface of a solid or liquid is created. It is defined as the energy that must be expended to create the surface per unit area.

For liquids, the surface energy is equal to the surface tension and easily accessible to measurement. In contrast, the surface energy of solids can hardly be measured directly because it is not possible to create a new surface without also expending energy for other processes (e.g. deformation of the body).

For indirect measurement of the surface energy of solids, the contact angle formed between the solid and one or more liquids with known surface tension at the phase boundary is determined.

Young's equation describes the relationship between the contact angle, the surface tension of the liquid, the interfacial tension between the two phases and the surface energy of the solid. Different models for calculating the surface energy from contact angle data differ in their description of the interactions responsible for the respective stress components at the phase boundaries.

(Source: Wikipedia)

Viscosity

Viscosity is also commonly understood to mean the viscosity of a substance. Depending on the measurement method, either the dynamic viscosity η_{dyn} or the kinematic viscosity η_{kin} are determined, which are linked by the density.

Dynamic viscosity η_{dyn} is determined, for example, by rotational rheometers, which determine the viscosity from shear stress and shear rate. Here, the specimen is located between two plates or between a plate and a truncated cone, and the force required for a linear increase in shear rate is determined. Rotational rheometers can also be used to measure non-Newtonian fluids. The kinematic viscosity η_{kin} , on the other hand, is determined by the run-out time of a standardized capillary. The viscosity can be easily calculated by the corresponding capillary parameters. A determination of non-Newtonian fluids is not possible. Since viscosity is strongly temperature-dependent, both methods can only be measured reproducibly ensuring thermal stabilization (Peltier element or water bath). It is measurable within a temperature range of -40 °C to 200 °C; almost all liquid substances can be measured (even at higher temperatures).

1.0 Introduction

1.3 Services of the Chemistry and and Materials Department

Tribology

Tribology describes the interaction of surfaces in relative motion. This includes the areas of friction, wear and lubrication. A tribological system includes all material components involved in a tribological stress and their properties, as well as the processes and variables characteristic of the stress. This means that both the base and mating body, the lubricant and the ambient medium are part of the tribological system and must be taken into account.

How surfaces interact in relative motion depends on the stress spectrum. The stress spectrum includes, among other things, the course and duration of the stress, temperature, speed, type and form of movement.

Determination of friction variables (Rheometer MCR 320/ Tribometer attachment T-PTD 200)

With the tribometer attachment, different measuring modes can be used to determine friction quantities. Measurement programs and modes are individually configurable so that not only continuous loads but also, for example, start/stop loads can be performed.

- Speed ramps (Stribeck curve)
(speed: 10-6 rpm - 3,000 rpm / sliding speed 10-8 m/s - 3.3 m/s)
analysis of the transition from static to dynamic friction (Stribeck curve).
 - » Determination of the friction coefficient f (ratio of frictional force to normal force) as a function of the sliding speed v

Application:

- Overview of the friction conditions of the system
- Comparative measurements (lubricants, measuring conditions, test specimens)
- Lubricant aging tests

- Force ramp
(normal force 0.1 N - 40 N)
Analysis of the lubricant or system behavior under different force influences.
 - » Determination of the friction coefficient f (ratio of friction force to normal force) as a function of the normal force NF
- Long-term measurements
(no time limits are available)
analysis of the lubricant or system behavior under continuous load
 - » Determination of the coefficient of friction f (ratio of frictional force to normal force) as a function of the sliding distance s
- Temperature ramp
Temperature range: -40 °C - 200 °C
analysis of lubricant or system behavior under different temperatures

1.0 Introduction

1.3 Services of the Chemistry and and Materials Department

» Determination of the coefficient of friction f (ratio of frictional force to normal force) as a function of temperature T

In addition, the following parameters are automatically determined for each measurement:

- Sliding speed [m/s]
- Time [s]
- Standard force [N]
- Temperature [°C]
- Coefficient of friction
- Frictional force [N]
- Speed [1/min.]
- Sliding distance [m]

The following model systems can be analysed in dry and lubricated state:

- Roller bearings (sphere / sphere)
- Plain bearing (sphere / plate), (sphere / cylinder)
- Materials of the test specimens:
 - Aluminum
 - Steel (100Cr6 / 1.3505), Steel (1.4401), Steel (1.4034)
 - PTFE, POM

Determination of wear parameters (surface analysis):

Wear can be caused by a number of different mechanisms such as adhesion, abrasion, surface disruption or tribochemical reaction. These are mainly analysed and evaluated by imaging using microscopy. When using a scanning electron microscope with elemental analysis (SEM-EDX), additional information about elemental composition of the surface can be obtained, which provides information about material transfers.

2

Adhesives

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 9	KI 10	KI 10 A	KI 14	KI 15
Material number	66.908	50.484	103.391	82.274	68.399
Chemical basis	Epoxy resin	Epoxy resin, amine hardener	Epoxy resin containing filler	Epoxy resin, amine hardener, filler	Epoxy resin, amine hardener
Tensile strength (lap shear strength) [N/mm ²]	12 – 20	20 – 25 (26 – 32)	8 – 9	24 (25)	12 – (25)
Modulus of elasticity (20 °C), [N/mm ²]	3,100	2,600	2,400	5,000	2,300
Glass transition temperature [°C]	46	58	70	69	55
Volume shrinkage [%]	4.3	-	-	-	4.0
Initial viscosity (25 °C), [mPas]	900	45,000 – 55,000	very paste-like	-	8,000-14,000
Outgas behavior TOC [mg/kg]	/	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	/	97	59	-	-
Operating temperature range [°C]	-55 / 80	-55/80	-55/80	-55/120	-40/80
Pot life [min.]	60	60	60	60	60
Curing conditions	24 h / RT	(a) 24 h / RT (b) 15 h / 50 °C clarify with SPU-EC	(a) 24 h / RT (b) 15 h / 50 °C clarify with SPU-EC	(a) 24 h / RT (b) 8h / 60 °C (c) 4h / 70 °C	(a) 24 h / RT (b) 24h / RT + 12-15 h 50 °C
Application features	2-comp., low-viscosity construction adhesive for metal-to-metal bonding with small bonding gaps	2-comp., viscous standard construction adhesive for metal-metal, metal-ceramic bonding	3-comp., highly pasty construction adhesive for metal-to-metal bonding	2-comp., high-viscosity construction adhesive for metal-to-metal, metal-to-ceramic bonding for higher temperature loads, bridging of larger bonding gaps	2-comp. medium viscosity structural adhesive for metals and bondable plastics
Order details	Resin adhesive 9: Mat. No. 105.337 Hardener H 993 Mat. No. 105.337	Cartridge set 6X50ml adhesive 10 Mat. No. 420.695 Resin adhesive 10 Mat. No. 105.338 Hardener H 960 Mat. No. 103.732	Resin adhesive 10 Mat. No. 105.338 Filler Z 50 Mat. No. 104.193 Hardener H 960 Mat. No. 103.732	Resin adhesive 14 Mat. No. 105.340 Hardener H 967 Mat. No. 623.664	Resin adhesive 15 Mat. No. 105.341 Hardener H 962 Mat. No. 103.742

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 19	KI 20-2	KI 21	KI 21/B	KI 26
Material number	86.376	586.662	66.657	524.945	104.905
Chemical basis	Epoxy resin containing filler	Polyurethane, solvent-containing	Epoxy resin, filled with silver powder, amine hardener	Epoxy resin, filled with silver powder, amine hardener, 100 µm spacer	Styrene butadiene rubber, solvent-containing
Tensile strength (lap shear strength) [N/mm ²]	12 – 24	-	10	-	-
Modulus of elasticity (20 °C), [N/mm ²]	4,600	-	4,300	-	-
Glass transition temperature [°C]	50	-	44	44	-
Volume shrinkage [%]	3.1	-	3.3	-	-
Initial viscosity (25 °C), [mPas]	4,800	1,200	paste-like	paste-like	viscous
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	72 (at 20 °C)	-	-
Operating temperature range [°C]	-55/100	-40/80	-55/80	-55/80	-40/60
Pot life [min.]	60	not applicable	60	60	not applicable
Curing conditions	(a) 5 days/RT, (b) Heat curing possible, consultation with SPU-EC required	flash off for 1-3 min., join parts, press on for approx. 15-25 min. with high pressure	24h /RT + 4h / 65 °C	24h / RT + 4h / 65 °C circulating air (SMT regulation)	flash off for 10-15 min., fit the parts together accurately, press on
Application features	2-comp., medium viscosity, thermally structural adhesive, for metal-metal, metal-ceramic bonding	Versatile contact adhesive with long contact bonding time Especially for surface bonding of plastic sheets (adhesive plastics), rubber with metals and wood materials Not suitable for: PE, PP, PTFE, POM, silicone, EPDM, PVC-soft, PS-rigid foams, plasticized plastics	2-comp., electrically conductive adhesive for metal-to-metal bonding with low strength Extract more data from VV	3-comp., electrically conductive adhesive for metal-to-metal bonding with low strength Is adhesive 21 (66.657) with 100 µm spacer for SMT applications	1-comp. viscous, fast-acting contact adhesive, especially for bonding polystyrene rigid foam (Styropor)
Order details	Resin adhesive 19 Mat. No. 105.342 Filler Z 10 Mat. No. 104.194 Hardener H 993 Mat. No. 105.337	Adhesive 20-2 Mat. No. 586.662	Resin adhesive 21 Mat. No. 105.343 Hardener H 982 Mat. No. 103.731	Resin adhesive 21 Mat. No. 105.343 Spacer 100 µm Mat. No. 475.706 Hardener H 982 Mat. No. 103.731	Adhesive 26 Mat. No. 104.905

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 27	KI 28	KI 29	KI 29 A	KI 32 M
Material number	101.648	66.907	66.867	105.533	97.099
Chemical basis	Sodium silicate, aluminium oxide, boron nitride	Epoxy resin, amine hardener, filler-containing	Cyanacrylate	Cyanacrylate	Polyester/polyether, solution in monomer, peroxide hardener
Tensile strength (lap shear strength) [N/mm ²]	-	12	16 – 20	-	20
Modulus of elasticity (20 °C), [N/mm ²]	-	1,200	-	-	1,300
Glass transition temperature [°C]	-	46	-	-	110
Volume shrinkage [%]	-	(2)	-	-	-
Initial viscosity (25 °C), [mPas]	paste-like	32,000 – 36,000	30	1,100	viscous
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	-	-
Operating temperature range [°C]	1,000	-55/80	-40/100	-40/100	-25/80
Pot life [min.]	30	90	not applicable	not applicable	(5)
Curing conditions	24h / RT	(a) 24h / RT (b) 2.5h / 60 °C	A few seconds at min. 50 % relative humidity	A few seconds at min. 50 % relative humidity	1h / RT
Application features	Metal-ceramic adhesive for high temperature resistant bonding	Red-brown, viscous, 2-comp. casting compound for electronic components, bondable plastics and metal bonding	Fast-setting adhesive, 1-comp. metal-elastic adherends and bondable plastics	Fast-setting adhesive, 1-comp. metal-elastic adherends and bondable plastics Adhesive 29 A is more viscous than adhesive 29	2-comp., assembly aid adhesive, fast curing, universal for metal, bondable plastics, glass
Order details	Binder of adhesive 27 Mat. No. 105.364 Filler adhesive 27 Mat. No. 106.659	Resin adhesive 28 Mat. No. 105.344 Hardener H 963 Mat. No. 103.743	Adhesive 29 Mat. No. 66.867	Adhesive 29 A Mat. No. 105.533	80 g blister (Resin adhesive 32 mechanical Mat. No. 105.363 Hardener H 672 Mat. No. 105.362)

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 32 O	KI 34 A	KI 34 C	KI 34 D	KI 34 G
Material number	105.357	54.830	69.430	87.688	101.650
Chemical basis	Polyester/polyether dissolved in methyl methacrylate Peroxide hardener	1-comp. silicone rubber, non-corrosive (does not release acetic acid), alkoxysilane cross-linking agent	1-comp. silicone rubber, acetic acid releasing, acetoxysilane cross-linking agent	1-comp. silicone rubber, non-corrosive (does not release acetic acid), aminosilane cross-linking agent	1-comp. silicone rubber, solvent-based (toluene), acetoxysilane cross-linking agent
Tensile strength (lap shear strength) [N/mm ²]	13	1 – 2	1 – 2	1 – 2	1 – 2
Modulus of elasticity (20 °C), [N/mm ²]	800	<5	<5	<5	<5
Glass transition temperature [°C]	100 – 130	-40	-44	-34	-44
Volume shrinkage [%]	-	-	-	(4)	-
Initial viscosity (25 °C), [mPas]	3,000 – 6,000	highly viscous	highly viscous, thixotropic	paste-like	9,000 – 10,000
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	-	-
Operating temperature range [°C]	-25/80	-55/200	-55/200	-55/200	-55/200
Pot life [min.]	15	15	15	15	(5)
Curing conditions	4h / RT	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days, depending on the layer thickness	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days
Application features	2-comp., assembly aid for fixing optical components during processing	White, rubber-elastic, highly viscous thixotropic adhesive and sealing compound for glass-metal, glass-adhesive plastics and silicone materials, cross-linking takes place with atmospheric humidity Shore A hardness: 35	Black, rubber-elastic, highly viscous, thixotropic adhesive and sealing compound for glass-metal, glass-adhesive plastics and silicone materials Cross-linking takes place with humidity Shore A hardness: 30	Black, rubber-elastic, paste-like adhesive and sealing compound for glass-metal, glass-adhesive plastics and silicone materials Cross-linking takes place with humidity Must not be used in electronics. Shore A hardness: 25	Transparent, rubber-elastic, low-viscosity adhesive and sealing compound, for glass-metal bonds and silicone materials, releases acetic acid Shore A hardness: 20
Order details	Resin adhesive 32 optical Mat. No. 105.359 Hardener H 671 Mat. No. 105.358	Adhesive 34 A Mat. No. 54.830	Adhesive 26 C Mat. No. 69.430	Adhesive 34 D Mat. No. 87.688	Adhesive 36 G Mat. No. 101.650

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 35	KI 36	KI 36 A	KI 41	KI 42
Material number	54.831	82.732	102.521	86.576	94.961
Chemical basis	1-comp. silicone rubber, acetic acid releasing, acetoxysilane cross-linking agent	1-comp. silicone rubber, non-corrosive (does not release acetic acid), alkoxysilane cross-linking agent	1-comp. silicone rubber, non-corrosive (does not release acetic acid), alkoxysilane cross-linking agent	Urethane methacrylate, anaerobically curing	Methacrylate ester, anaerobically curing
Tensile strength (lap shear strength) [N/mm ²]	1 – 2	1 – 2	1 – 2	> KI 42	< KI 41
Modulus of elasticity (20 °C), [N/mm ²]	<5	<5	<5	-	-
Glass transition temperature [°C]	-46	-44	-44	-	-
Volume shrinkage [%]	-	-	-	-	-
Initial viscosity (25 °C), [mPas]	medium viscosity	thixotropic	thixotropic	low-viscosity	100 – 200
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 -6/K]	-	-	-	-	80
Operating temperature range [°C]	-55/200	-50/200	-50/200	-55/150	-55/150
Pot life [min.]	(5)	15	15	not applicable	not applicable
Curing conditions	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days	min. 24h/RT and min. 50 % rel. humidity, final hardness after 3-5 days	depending on the material combination 2-72h / RT	depending on the material combination 24-72h / RT
Application features	Transparent, rubber-elastic, medium viscosity, slightly levelling adhesive and sealing compound, for glass-metal, glass-adhesive plastics and silicone materials, cross-linking takes place with atmospheric humidity Shore A hardness: 30	Grey, rubber-elastic, thixotropic adhesive and sealing compound, for glass-metal, glass-adhesive plastics, silicone rubber and e.g. for fixing electronic components on printed circuit boards, cross-linking takes place with atmospheric humidity	Transparent, rubber-elastic, thixotropic adhesive and sealing compound, for glass-metal, glass-adhesive plastics, silicone rubber and e.g. for fixing electronic components on printed circuit boards, cross-linking takes place with air humidity	1-comp., green low-viscosity structural adhesive for metal-metal joints with active surface (rust-prone steel or Cu or Cu alloys), anaerobic curing	1-comp., yellow low-viscosity construction adhesive, for low-strength metal-to-metal joints with active surface (rust-prone steel or Cu or Cu alloys), anaerobic curing
Order details	Adhesive 35 Mat. No. 54.831	Adhesive 36 Mat. No. 82.732	Adhesive 36 A Mat. No. 102.521	Adhesive 41 Mat. No. 86.576	Adhesive 42 Mat. No. 94.961

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 43	KI 44	KI 44 colorless	KI 45	KI 49
Material number	67.429	69.820	360.004	67.153	69.360
Chemical basis	Dimethacrylate ester, anaerobic curing	Polymethacrylate solvent-containing	Polymethacrylate solvent-containing	Dimethacrylate ester, anaerobic curing	Nitrile rubber, synthetic resin, solvent-containing
Tensile strength (lap shear strength) [N/mm ²]	-	-	-	-	-
Modulus of elasticity (20 °C), [N/mm ²]	-	-	-	-	-
Glass transition temperature [°C]	-	-	-	-	-
Volume shrinkage [%]	-	-	-	-	-
Initial viscosity (25 °C), [mPas]	100 – 150	low-viscosity	low-viscosity	low-viscosity	viscous
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	100	-	-	-	-
Operating temperature range [°C]	-55/150	-55/80	-55/80	-55/150	-40/120
Pot life [min.]	not applicable	not applicable	not applicable	not applicable	not applicable
Curing conditions	depending on the material combination 6-72h / RT	1-2h / RT	1-2h / RT	depending on the material combination 1-24h; Cu or Cu alloys harden faster, stainless steels and galvanic surfaces slower	flash off for 10 min., join parts, press on with high pressure
Application features	1-component, green, low-viscosity structural adhesive, for high-strength metal-to-metal joints with active surfaces (rust-prone steel or Cu or Cu alloys), anaerobic curing, breakaway torque 15-40 Nm	1-comp., red, low-viscosity, solvent-based screw locking adhesive, for threads ≤ M 2.5; pre-screw rings and screws ≥ M3 that cannot be secured with KI. 45 because the required conditions are not present All types of nuts used in the precision-mechanical optical industry.	1-comp., red, low-viscosity, solvent-based screw locking adhesive, for threads ≤ M 2.5; pre-screw rings and screws ≥ M3 that cannot be secured with KI. 45 because the required conditions are not given All types of nuts used in the precision-mechanical optical industry.	1-comp., red, low-viscosity screw locking adhesive; for threads ≥ M3 with blind holes or a minimum screw-in depth of 5 mm and active surface (rust-sensitive steel, Cu or Cu-Leg.), anaerobic curing	1-comp. oil-resistant contact adhesive for elastic joint connections, elastomers, bondable plastic, hard PVC, leather, textiles, metal, for high temperatures
Order details	Adhesive 43 Mat.-Nr. 67.429	Adhesive 44 Mat. No. 69.820	Adhesive 44 colorless Mat. No. 360-004	Adhesive 45 Mat. No. 67.153	Adhesive 49 Mat. No. 69.360

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 50	KI 50 A	KI 50 B	KI 50 B1	KI 50 B2
Material number	86.919	104.315	105.215	401.582	401.583
Chemical basis	Epoxy resin Amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener
Tensile strength (lap shear strength) [N/mm ²]	19 – 30 (46)	28 – 32	28 – 32	-	-
Modulus of elasticity (20 °C), [N/mm ²]	2,500 – 2,800	4,800	6,400	-	-
Glass transition temperature [°C]	47-53	53	53	-	-
Volume shrinkage [%]	4-4.4	2.7	3.2	-	-
Initial viscosity (25 °C), [mPas]	1,000 – 6,000	medium viscosity	highly viscous	viscous	very highly viscous
Outgas behavior TOC [mg/kg]	11	< 1 % (TML)	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	80	70	55	-	-
Operating temperature range [°C]	-55/100	-55/100	-55/100	-55/100	-55/100
Pot life [min.]	60	60	60	60	60
Curing conditions	(a) 24h / RT (b) 4h / 60 °C	(a) 24h / RT (b) 4h / 60 °C	(a) 24h / RT (b) 4h / 60 °C	(a) 24h / RT (b) 4h / 60 °C	(a) 24h / RT (b) 4h / 60 °C
Application features	Low viscosity structural adhesive, high strength metal to metal, Metal-ceramic combinations Ad- hesive 50 was used in outer space projects, among others	Structural adhesive for metal-metal, glass-metal ceramics Metal-metal compounds with reduced coefficient of expansion, suitable for outer space, outgassing-resistant	3-comp. structural adhesive for metal-metal, metal-CFK (adhesive plastic) and metal-ceramic bonding with reduced coefficient of thermal expansion	3-comp. structural adhesive for metal-metal, metal-CFK (adhesive plastic) and metal-ceramic bond- ing with reduced coefficient of thermal expansion	3-comp. structural adhesive for metal-metal, metal-CFK (adhesive plastic) and met- al-ceramic bonding with re- duced coefficient of thermal expansion
Order details	Resin adhesive 50 Mat. No. 105.346 Hardener H 952 Mat. No. 105.273	Resin adhesive 50 Mat. No. 105.346 Filler Z 80 Mat. No. 105.279 Hardener H 952 Mat. No. 105.273	Resin adhesive 50 Mat. No. 105.346 Filler Z 81 X Mat. No. 105.280 Hardener H 952 Mat. No. 105.273	Resin adhesive 50 Mat. No. 105.346 Filler Z 81 X Mat. No. 105.280 Hardener H 952 Mat. No. 105.273	Resin adhesive 50 Mat. No. 105.346 Filler Z 81 X Mat. No. 105.280 Hardener H 952 Mat. No. 105.273

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 50 C	KI 50 D	KI 50 E	KI 50 F
Material number	401.581	405.359	472.862	519.329
Chemical basis	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener
Tensile strength (lap shear strength) [N/mm ²]	-	27	-	-
Modulus of elasticity (20 °C), [N/mm ²]	-	5,100	-	-
Glass transition temperature [°C]	-	67	-	-
Volume shrinkage [%]	-	3.1	-	-
Initial viscosity (25 °C), [mPas]	highly viscous	medium viscosity	medium viscosity	medium viscosity
Outgas behavior TOC [mg/kg]	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	70	-	-
Operating temperature range [°C]	-55/101	-55/100	-55/100	-55/100
Pot life [min.]	60	60	60	60
Curing conditions	(a) 24h / RT (b) 4h / 60 °C	(a) 7d / RT incl. 48h / 40 °C (c) 24h / RT (c) 4h / 60 °C	(a) 7d / RT incl. 48h / 40 °C (c) 24h / RT (c) 4h / 60 °C	(a) 7d / RT incl. 48h / 40 °C (c) 24h / RT (c) 4h / 60 °C
Application features	3-comp., black structural adhesive for metal-metal and metal-ceramic bonding	2-comp., structural adhesive for glass-metal, metal-metal and metal-ceramic bonding with defined spacing (100 µm) and reduced coefficient of thermal expansion	2-comp., structural adhesive for glass-metal, metal-metal and metal-ceramic bonding with defined spacing (200 µm) and reduced coefficient of thermal expansion	4-comp. structural adhesive for glass-metal, metal-metal and metal-ceramic bonding with defined spacing (50 µm) and reduced coefficient of thermal expansion (gg. adhesive 50) Corresponds to adhesive 50 D (Mat. No. 405.359), only spacers 100 µm have been replaced by spacers 50 µm
Order details	Resin adhesive 50 Mat. No. 105.346 Filler Z 85 X Mat. No. 401.580 Hardener H 952 Mat. No. 105.273	Resin adhesive 50 D Mat. No. 405.351 Hardener H 952 Mat. No. 105.273 Spacer 100 µm Mat. No. 475.706	Resin adhesive 50 E Mat. No. 472.864 Hardener H 952 Mat. No. 105.273 Spacer 200 µm Mat. No. 578.755	Resin adhesive 50 Mat. No. 105.346 Filler Z80 Mat. No. 105.279 Spacer 50 µm Mat. No. 510.560 Hardener H 952 Mat. No. 105.273

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 52 A	K 52 A colorless	KI 52 K	KI 52 C
Material number	95.381	457.091	513.830	405.362
Chemical basis	Epoxy resins, amine hardener	Epoxy resins, amine hardener	Epoxy resins, amine hardener	Epoxy resins, inorganic filler, amine hardener
Tensile strength (lap shear strength) [N/mm ²]	15 – 22	15 – 18	15 – 22	21
Modulus of elasticity (20 °C), [N/mm ²]	200-500	500	300 – 600	390
Glass transition temperature [°C]	60	64	64	81
Volume shrinkage [%]	2.8-3.0	3.6	2.6 – 3.0	2.1
Initial viscosity (25 °C), [mPas]	60,000 – 90,000	60,000 – 90,000	60,000 – 90,000	60,000 – 90,000
Outgas behavior TOC [mg/kg]	2.8 % (TML)	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	130-140	-	120 – 140 (at 0 – 30 °C)	126
Operating temperature range [°C]	-65/100	-65/100	approx. (-65)* -55/100 <small>*conditionally suitable for use at -65°C</small>	-65/100
Pot life [min.]	45	45	45	45
Curing conditions	(a) 24h / RT (b) 24h / RT + 12-15h / 50 °C	24h / RT	(a) 24h / RT (b) 12 – 15h / 50 °C	(a) 7 days / RT + 48h 40 °C (b) 24h / RT (c) 4h / 60 °C
Application features	2-comp., black, highly viscous, elastified structural adhesive, for metal-metal, metal bondable plastic, glass with bondable plastic, and glass with metal (especially glass with aluminum), metal with ceramic material, low gas emissions. For better adhesive strength, the bondable surfaces can be pre-treated with glymo primer (Mat. No. 104.216)	2-comp., colorless, highly viscous, elastified structural adhesive, for metal-metal, metal bondable plastic, glass with bondable plastic, and glass with metal (especially glass with aluminum), metal with ceramic material, low gas emissions. For better adhesive strength, the bondable surfaces can be pre-treated with glymo primer (Mat. No. 104.216)	2-comp., black, highly viscous, elastified structural adhesive, for metal-metal, metal bondable plastic, glass with bondable plastic, and glass with metal (especially glass with aluminum), metal with ceramic material, low gas emissions. For better adhesive strength, the bondable surfaces can be pre-treated with glymo primer (Mat. No. 104.216)	2-comp., black, highly viscous, elastified structural adhesive for glass-to-metal bonding, metal-to-metal bonding, with defined spacing approx. 100 µm, metal-to-ceramic, metal-adhesive plastic, low outgassing
Order details	Cartridge with 50 g adhesive 52 A Mat. No. 420.698 Resin adhesive 52 A Mat. No. 105.350 Hardener H 960 Mat. No. 103.732	Cartridge à 50g adhesive 52 A colorless Mat. No. 472.066 Resin adhesive 52 A colorless Mat. No. 457.092 Hardener H 960 Mat. No. 103.732	Cartridge with 50 g adhesive 52 K Mat. No. 513.832 Resin adhesive 52 A Mat. No. 105.350 Hardener H 969 Mat. No. 513.831	Resin adhesive 52 C Mat. No. 405.354 Hardener H 960 Mat. No. 103.732 Spacer 100 µm Mat. No. 475.706

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 52 D	KI 56	KI 56 A	KI 56 A2
Material number	488.867	102.534	105.726	496.235
Chemical basis	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener
Tensile strength (lap shear strength) [N/mm ²]	21	23 (25)	-	21
Modulus of elasticity (20 °C), [N/mm ²]	390	2,900	6,000 – 10,000	6,000 – 7,000
Glass transition temperature [°C]	81	73	75	75
Volume shrinkage [%]	2.1	4.3	2.3	3.1
Initial viscosity (25 °C), [mPas]	60,000 – 90,000	1,500 – 2,500	very paste-like	3,500 – 5,500
Outgas behavior TOC [mg/kg]	-	0.1 – 2 (80 °C)	-	< 0.5 (80 °C)
Expansion coefficient [10 ⁻⁶ /K]	126	73	25 – 29	37
Operating temperature range [°C]	-65/100	-55/120	-55/120	-55/120
Pot life [min.]	45	60	60	60
Curing conditions	(a) 7 days / RT + 48h 40 °C (b) 24h / RT (c) 4h / 60 °C	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/metal bonds	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/metal bonds	(a) 24h / RT + 4h / 60 °C (b) 24h / RT + 24h / 60 °C
Application features	2-comp., black, highly viscous, elastified structural adhesive for glass-to-metal bonding, metal-to-metal bonding, with defined spacing approx. 200 µm, metal-to-ceramic, metal-adhesive plastic, low outgassing	Low viscosity structural adhesive for metal-metal, metal-glass and metal-ceramic bonding, low gas emissions Standard adhesive SMT	Paste-like structural adhesive with reduced coefficient of expansion for metal-metal and metal-ceramic bonding, outgassing resistant	Structural adhesive with reduced coefficient of expansion for metal-metal and metal-ceramic bonding, outgassing resistant For SMT, e.g. EUVL bonding ULE-Invar and Zerodur-Invar bonding
Order details	Resin adhesive 52 D Mat. No. 488.865 Hardener H 960 Mat. No. 103.732 Spacer 200 µm Mat. No. 578.755	Resin adhesive 56 Mat. No. 105.353 Hardener H 995 Mat. No. 105.747	Resin adhesive 56 Mat. No. 105.353 Filler Z 70 Mat. No. 105.282 Hardener H 995 Mat. No. 105.747	Resin adhesive 56 Mat. No. 105.353 Filler Z 70 Mat. No. 105.282 Hardener H 995 Mat. No. 105.747

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 56 B	KI 56 C	KI 56 D	KI 56 FL620
Material number	105.616	463.341	475.707	466.182
Chemical basis	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, inorganic filler, amine hardener	Epoxy resin, amine hardener, fluorescent pigment
Tensile strength (lap shear strength) [N/mm ²]	25 – 27	-	-	-
Modulus of elasticity (20 °C), [N/mm ²]	5,000	-	-	-
Glass transition temperature [°C]	60	-	-	-
Volume shrinkage [%]	3.1	-	-	-
Initial viscosity (25 °C), [mPas]	highly viscous	very paste-like / paste-like	very paste-like / paste-like	paste-like, still fluent
Outgas behavior TOC [mg/kg]	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	58	-	-	-
Operating temperature range [°C]	-55/120	-55/120	-55/120	-40/70
Pot life [min.]	60	60	60	60
Curing conditions	(a) 24h / RT + 2h / 60 °C (b) 4h / 60°C, not for glass/metal bonds	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/metal bonds (c) 24h / RT + 72h / 60 °C	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/metal bonds (c) 24h / RT + 72h / 60 °C	24h / RT + 2h / 60 °C
Application features	3-component, highly viscous structural adhesive for metal/metal, metal/ceramic bonds with reduced heat expansion coefficient, outgas-resistant	Paste-like structural adhesive with reduced coefficient of expansion for metal-to-metal and metal-to-ceramic bonding, outgassing resistant, especially for EUVL with defined spacing	Paste-like structural adhesive with reduced coefficient of expansion for metal-to-metal and metal-to-ceramic bonding, outgassing resistant, especially for EUVL with defined spacing	High viscosity adhesive with red to orange fluorescence, excitation by light ≤ 400 nm. Use for ALA phantoms
Order details	Resin adhesive 56 Mat. No. 105.353 Filler Z 80 Mat. No. 105.279 Hardener H 995 Mat. No. 105.747	Resin adhesive 56 Mat. No. 105.353 Spacer 20 µm Mat. No. 463.735 Hardener H 995 Mat. No. 105.747 Filler Z 70 Mat. No. 105.282	Resin adhesive 56 Mat. No. 105.353 Spacer 100 µm Mat. No. 475.706 Hardener H 995 Mat. No. 105.747 Filler Z 70 Mat. No. 105.282	Resin adhesive 56 Mat. No. 105.353 Hardener H 995 Mat. No. 105.747 Filler ZF 05 Mat. No. 466.183

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 56 FL-NIR	KI 56 HL1	KI 56 HL1.5	KI 56 HL2	KI 56 T
Material number	473.509	411.930	484.630	411.935	106.827
Chemical basis	Epoxy resin, amine hardener, fluorescent pigment	Epoxy resins, inorganic filler, amine hardener	Epoxy resins, inorganic filler, amine hardener	Epoxy resins, inorganic filler, amine hardener	Epoxy resins, inorganic filler, amine hardener
Tensile strength (lap shear strength) [N/mm ²]	-	23 (38)	-	23 (34)	25 (40)
Modulus of elasticity (20 °C), [N/mm ²]	-	2,900	-	3,300	2,900
Glass transition temperature [°C]	-	70	-	69	68
Volume shrinkage [%]	-	(4)	-	(4)	(4)
Initial viscosity (25 °C), [mPas]	paste-like	-	-	-	-
Outgas behavior TOC [mg/kg]	-	-	-	0.2 – 2	-
Expansion coefficient [10 ⁻⁶ /K]	-	68	-	68	69 (at 20 °C)
Operating temperature range [°C]	-40/70	-55/120	-55/120	-55/120	-55/120
Pot life [min.]	60	60	60	60	60
Curing conditions	24h / RT + 2h / 60 °C	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C	24h / RT + 2h / 60 °C	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/ metal bonds
Application features	High viscosity adhesive with near infrared fluorescence Use for IR 800 phantoms	Glass-to-metal bonding, metal-to-metal bonding, here especially for SMT bonding of the Z-sensor	Metal-to-metal bonding, metal-to-glass bonding, adhesive base for adhesive 56 FL-NIR	Metal-to-metal seals, here especially for SMT/LIT exclusively for sealing lenses	Thixotropic structural adhesive, metal-metal, metal-glass, metal ceramic, glass-glass bonding (no fine cementing)
Order details	Resin adhesive 56 HL 1.5 Mat. No. 484.628 Hardener H 995 Mat. No. 105.747 Filler ZF 06 Mat. No. 473.510	Resin adhesive 56 HL 1 Mat. No. 411.932 Hardener H 995 Mat. No. 105.747	Resin adhesive 56 HL 1.5 Mat. No. 484.628 Hardener H 995 Mat. No. 105.747	Resin adhesive 56 HL 2 Mat. No. 411.937 Hardener H 995 Mat. No. 105.747	Resin adhesive 56 T Mat. No. 360-255 Hardener H 995 Mat. No. 105.747

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	KI 56 T red	KI 56 W60-2	KI 60 T	KI 61	KI 61 A
Material number	630.259	587.316	106.287	360.123	463.340
Chemical basis	Epoxy resin, inorganic filler, red amine hardener	Epoxy resins, ceramic filler, amine hardener	Epoxy resin, aluminum oxide ceramic, amine hardener	Epoxy resin, amine hardener	Epoxy resin, amine hardener, filler
Tensile strength (lap shear strength) [N/mm ²]	-	18 – 24	-	> 13	16
Modulus of elasticity (20 °C), [N/mm ²]	-	6,090	4,800	3,670	4,000
Glass transition temperature [°C]	-	72	147	142	150
Volume shrinkage [%]	-	2.8	3.2	3.8 – 4.2	3.2
Initial viscosity (25 °C), [mPas]	-	10,000 – 15,000		5,300	5,000
Outgas behavior TOC [mg/kg]	-	0.1 – 2 (80 °C, RT-curing)	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	33	38	51 (20 °C)	42
Operating temperature range [°C]	-55/120	-55/120	-55/130	-55/240	-55/160
Pot life [min.]	60	60	60	180	240
Curing conditions	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/metal bonds	(a) 24h / RT + 2h / 60 °C (b) 4h / 60 °C, not for glass/metal bonds	(a) 24h / RT, consultation with SPU-EC (b) 24h / RT + post-curing	(a) 4h RT -> 100 °C, 4h 100 °C, 4 h 100 °C -> RT (b) 30 min. / 80 °C (c) 1h / 150 °C	1h / 100 °C
Application features	Thixotropic structural adhesive, metal-metal, metal-glass, metal-ceramic, glass-glass bonding (no fine cements), adhesive 56 T Red is the red colored adhesive 56 T to increase the visibility of the bond	Heat conducting structural adhesive for metal-metal, metal-glass and metal-ceramic bonding, low gas emissions	White, thixotropic special adhesive, bonding of ceramic housings for electronic assemblies (helium-tight hybrid circuits) Metal-metal, metal-ceramic bonding, residual chlorine content < 0.1 % (resin content, more elaborate, etc.)	Low viscosity, thermosetting structural adhesive for metal-metal, metal-ceramic, metal-fibreglass bonding USP Class VI certified, s. TDS Epo-Tek 353 ND (Rev XXVII)	Filler-containing, thermosetting structural adhesive, for metal-to-metal, metal-to-ceramic bonding Especially for EUVL mirror connector bonding, Invar-Zerodur bonding
Order details	Resin adhesive 56 T Mat. No. 360.255 Hardener H 997 Mat. No. 429.866	Resin adhesive 56 Mat. No. 103.353 Hardener H 995 Mat. No. 105.747 Filler Z 21 Mat. No. 587.315	Resin adhesive 60 T Mat. No. 106.341 Hardener H 980 Mat. No. 103.729	Resin adhesive 61 Mat. No. 360.203 Hardener H 974 Mat. No. 360.204	Resin adhesive 61 A Mat. No. 463.339 Hardener H 974 Mat. No. 360.204

2.0 Adhesives

2.1 Structural adhesive, KI

UV
HARDENING ↓↓↓

Product designation	KI 63	Crossbeam blend	KI 66	KI 66 / Fu	KI UV-MKH 01
Material number	458.000	87.964	622.267	627.613	103.539
Chemical basis	Cyanacrylate	Epoxy resin containing filler Amine hardener	Epoxy resin, amine hardener	Epoxy resin, amine hardener, fungicide	Methyl methyl acrylate
Tensile strength (lap shear strength) [N/mm ²]	-	-	23 – 25	-	-
Modulus of elasticity (20 °C), [N/mm ²]	-	-	-	-	-
Glass transition temperature [°C]	-	-	67	-	80
Volume shrinkage [%]	-	-	-	-	6.4
Initial viscosity (25 °C), [mPas]	gel-like	paste-like/highly viscous	4,160	-	-
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	-	-
Operating temperature range [°C]	-40/100	-55/80	-55/80	-55/70	-40/120
Pot life [min.]	not applicable	45	30 min.	30 min.	not applicable
Curing conditions	A few seconds at min. 50 % relative humidity	(a) 24h / RT (b) 24h / RT + 15h / 50 °C	(a) 24h / RT (b) 24h / RT + 4h / 90 °C	(a) 24h / RT (b) 24h / RT + heat curing < 70 °C	UVA (365 nm) 10-30 sec.
Application features	"Fast-setting adhesive" gel; 1-comp. adhesive for metal- elastic joining parts and bondable plastics	Gray casting compound for cross- beams, slide bearings and spindle ball bearings	2-comp., low-viscosity epoxy adhesive, for metal-to-metal bonding	2-comp., low-viscosity epoxy resin adhesive, for metal-to-metal bonding, fungistatic finish	Viscous, UV-curable 1-comp. auxiliary adhesive, used as an assembly aid adhesive for fixing glass, ceramics, metal and adhesive plastics
Order details	Adhesive 63 Mat. No. 458.000	Mixture for traverses - resin Mat. No. 105.356 Hardener H 993 Mat. No. 103.727	Resin adhesive 66 Mat. No. 105.3556 Hardener H 998 Mat. No. 622.259	Resin adhesive 66 / Fu Mat. No. 627.614 Hardener H 998 Mat. No. 622.259	UV MH Adhesive 01 Mat. No. 103.539

2.0 Adhesives

2.1 Structural adhesive, KI

Product designation	Sturgeon glue
Material number	34.659
Chemical basis	-
Tensile strength (lap shear strength) [N/mm ²]	-
Modulus of elasticity (20 °C), [N/mm ²]	-
Glass transition temperature [°C]	-
Volume shrinkage [%]	-
Initial viscosity (25 °C), [mPas]	-
Outgas behavior TOC [mg/kg]	-
Expansion coefficient [10 ⁻⁶ /K]	-
Operating temperature range [°C]	-
Pot life [min.]	-
Curing conditions	
Application features	
Order details	Fish glue Mat. No. 34.659

2.0 Adhesives

2.2 Mounting adhesives DK

Product designation	Adhesive DK 2013	Adhesive DK 2013 A	Adhesive DK 2013 Z	Adhesive DK 2013 Z / FU	Adhesive DK 2013 black
Material number	69.143	106.571	104.372	405.744	106.978
Chemical basis	Epoxy resin, polysulfide, amine hardener	Epoxy resin, polysulfide, amine hardener	Epoxy resin, polysulfide, amine hardener	Epoxy resin, polysulfide, amine hardener	Epoxy resin, polysulfide Amine hardener
Tensile strength (lap shear strength) [N/mm ²]	10 – 12	6 – 8	4 – 5	4 – 5	10 – 12
Modulus of elasticity (20 °C), [N/mm ²]	500	400	-	-	500
Glass transition temperature [°C]	60	52	-	-	60
Volume shrinkage [%]	6.2	4.8	-	-	6.2
Initial viscosity (25 °C), [mPas]	600-740	600	-	-	600 – 740
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	145 (at 19 °C)	-	-	-	145 (at 19 °C)
Operating temperature range [°C]	-55/70	-55/70	-55/70	-55/70	-55/70
Pot life [min.]	60	150	150	150	60
Curing conditions	(a) 48h / RT + storage at RT (b) 48h / RT + 15h / 50 °C	(a) 72h / RT + storage at RT (b) 72h / RT + 15h / 50 °C	(a) 72h / RT + storage at RT (b) 72h / RT + 15h / 50 °C	(a) 72h / RT + storage at RT (b) 72h / RT + 15h / 50 °C	(a) 48h / RT + storage at RT (b) 48h / RT + 15h / 50 °C
Application features	3-comp., yellowish transparent, low-viscosity, elastified structural adhesive for glass/metal bonds (lens or mirror in metal mount) Lens diameter up to 20 mm	3-comp. colorless, low-viscosity, elasticised structural adhesive, for glass-metal (lens or mirror in metal mount) bonds, cures slower than DK 2013, lens diameter up to approx. 20 mm	3-comp. colorless, low viscosity, elasticised structural adhesive, for glass-metal (lens or mirror in metal frame) bonding, embedding compound, cures slower than DK 2013	3-comp., low viscosity, elastified structural adhesive for glass-metal (lens or mirror in metal frame) bonding, embedding compound, cures slower than DK 2013, fungistatic properties	3-comp., yellowish transparent, low-viscosity, elastified structural adhesive for glass/metal bonds (lens or mirror in metal mount) Lens diameter up to 20 mm
Order details	Resin DK 2013 Mat. No. 105.318 Cross-linking agent B 20 Mat. No. 104.196 Hardener H 993 Mat. No. 105.337	Resin DK 2013 Mat. No. 105.318 Cross-linking agent B 20 Mat. No. 104.196 Hardener H 980 Mat. No. 103.729	Resin DK 2013 Z Mat. No. 105.319 Cross-linking agent B 20 Mat. No. 104.196 Hardener H 980 Mat. No. 103.729	Resin DK 2013 Z / Fu Mat. No. 405.745 Cross-linking agent B 20 Mat. No. 104.196 Hardener H 980 Mat. No. 103.729	Resin DK 2013, black Mat. No. 106.996 Cross-linking agent B 20 Mat. No. 104.196 Hardener H 993 Mat. No. 105.337

2.0 Adhesives

2.2 Mounting adhesives DK

UV
UV HARDENING ↓↓↓

Product designation	Adhesive DK 2014 B	Adhesive DK2014 C-HL	DK 2282	DK 2282 / G/H	DK 2283
Material number	105.895	421.578	360.738	452.662	405.553
Chemical basis	Polyurethane	Polyurethane	Epoxy resin, UV-hardening at 365 nm	Epoxy resin, filler UV-hardening at 365 nm	Epoxy resin, filler UV-hardening at 365 nm
Tensile strength (lap shear strength) [N/mm ²]	0.7 – 1.3	0.7 – 1.3	-	-	-
Modulus of elasticity (20 °C), [N/mm ²]	<5	<5	50	50	-
Glass transition temperature [°C]	-5	(2)	20	20	80
Volume shrinkage [%]	2.7	2.7	(4)	-	-
Initial viscosity (25 °C), [mPas]	2,000-3,500	-	very paste-like	-	highly viscous
Outgas behavior TOC [mg/kg]	1 – 2	1 – 2	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	240 (at 20 °C)	-	-	-	-
Operating temperature range [°C]	-40/100	-40/100	-40/120	-40/120	-
Pot life [min.]	60	60	not applicable	not applicable	not applicable
Curing conditions	(a) 24h / RT (< 40 % rel. humidity) (b) 20h / RT + 24h / 60 °C (c) 24h / RT + 15h / 80 °C	(a) 24h / RT (< 40 % rel. humidity) (b) 20h / RT + 24h / 60 °C (c) 24h / RT + 15h / 80 °C	UV-A (365 nm) partial curing: 50-60 mW/cm ² 60 s; post-curing: (a) 12h / 50 °C (b) 24h / 40 °C (c) 2-3d / RT	UV-A (365 nm) partial curing: 50-60 mW/cm ² 60 s; post-curing: (a) 12h / 50 °C (b) 24h / 40 °C (c) 2-3d / RT	UV-A (365 nm) partial curing: 50-60 mW/cm ² 60 s; post- curing: (a) 12h / 50 °C (b) 24h / 40 °C (c) 2-3d / RT
Application features	2-comp., black, low viscosity, low outgassing, elastic potting and embedding compound and low-stress, lens-setting adhesive, Shore hardness A 58-65 For better adhesive strength, the bondable surfaces can be pre-treated with glymo primer (Mat. no. 104.216)	2-comp., black, highly viscous, low-outgas, elastic casting and embedding compound and low-tension lens mounting adhesive For better adhesive the bondable surfaces can be pre-treated with glymo primer (Mat. No. 104.216)	Directional bonding technology, e.g. for cameralenses or lens mount bonding (metal-bond- able plastics), highly paste-like UV-reactive, 1-comp. adhesive, fungistatic properties	Glass-to-metal bonding, micro lenses for 193 nm, 248 nm, UV-reactive one-component adhesive	UV-reactive 1-comp. adhesive
Order details	Resin DK 2014 B Mat. No. 106.304 Hardener H 771 Mat. No. 105.276	Resin DK 2014 C-HL Mat. No. 421.577 Hardener H 771 Mat. No. 105.276	DK 2282 Mat. No. 360.738	DK 2282 / G/H Mat. No. 452.662	DK 2283 Mat. No. 405.553

2.0 Adhesives

2.2 Mounting adhesives DK

UV
HARDENING ↓↓↓

Product designation	DK 2283 /Q	DK 2296 /Fu	DK 2297 /Fu	SKSL black	SKSL red
Material number	405.554	360.200	535.199	50.483	233.917
Chemical basis	Epoxy resin, fillers, UV-hardening at 365 nm	Modified polythiol/polyene system, UV-hardening at 365 nm	Modified polythiol/polyene system, UV-hardening at 365 nm	Nitrocellulose basis, solvent-containing	Nitrocellulose basis, solvent-containing
Tensile strength (lap shear strength) [N/mm ²]	-	-	-	-	-
Modulus of elasticity (20 °C), [N/mm ²]	-	-	-	-	-
Glass transition temperature [°C]	-	-	-	-	-
Volume shrinkage [%]	-	-	-	-	-
Initial viscosity (25 °C), [mPas]	highly viscous	-	15 – 22	-	-
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	-	-
Operating temperature range [°C]	-40/120	-40/70	-55/70	-55/80	-55/80
Pot life [min.]	not applicable	min. 7 days	5-7 days	not applicable	not applicable
Curing conditions	UV-A (365 nm) partial curing: 50-60 mW/cm ² 60 s; post-curing: (a) 12h / 50 °C (b) 24h / 40 °C (c) 2-3d / RT	UV-A (365 nm) partial curing: 20-25 mW/cm ² 120 s; through-curing UV-A 5 - 10 mW/cm ² , 12-15h	UV-A (365 nm) partial curing: 20-25 mW/cm ² 120 s; through-curing UV-A 5 - 10 mW/cm ² , 12-15h	0.5h	0.5h
Application features	UV-reactive 1-comp. adhesive	2-comp., black, highly viscous, low-outgas, elastic casting and embedding compound and low-tension lens mounting adhesive For better adhesive the bondable surfaces can be pre-treated with glymo primer (Mat. No. 104.216)	Directional bonding technology, e.g. for cameralenses or lens mount bonding (metal-bondable plastics), highly paste-like UV-reactive, 2-comp. adhesive, fungistatic properties	1-comp., black, low-viscosity, solvent-based screw head securing lacquer; it is used exclusively for the colored, externally visible marking (securing) of screw heads, threaded pins and slots of threaded rings	1-comp., red, low-viscosity, solvent-based screw head securing lacquer; it is used exclusively for the colored, externally visible marking (securing) of screw heads, threaded pins and slots of threaded rings
Order details	DK 2283 /Q Mat. No. 405.554	DK 2296 Part A Mat. No. 405.895 DK 2296 Part B Mat. No. 405.896	DK 2297 Part A Mat. No. 535.198 DK 2296 Part B Mat. No. 405.896	Screw sealant, black Mat. No. 50.483	Screw sealant, red Mat. No. 233.917

2.0 Adhesives

2.2 Mounting adhesives DK

Product designation	SKSL blue	SKSK colorless
Material number	360.167	360.168
Chemical basis	Nitrocellulose basis, solvent-containing	Nitrocellulose basis, solvent-containing
Tensile strength (lap shear strength) [N/mm ²]	-	-
Modulus of elasticity (20 °C), [N/mm ²]	-	-
Glass transition temperature [°C]	-	-
Volume shrinkage [%]	-	-
Initial viscosity (25 °C), [mPas]	-	-
Outgas behavior TOC [mg/kg]	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-
Operating temperature range [°C]	-55/80	-55/80
Pot life [min.]	not applicable	not applicable
Curing conditions	0.5h	0.5h
Application features	1-comp., colorless, low-viscosity, solvent-based screw head securing lacquer; it is used exclusively for the colored, externally visible marking (securing) of screw heads, threaded pins and slots of threaded rings	1-comp., colorless, low-viscosity, solvent-based screw head securing lacquer; it is used exclusively for the colored, externally visible marking (securing) of screw heads, threaded pins and slots of threaded rings
Order details	Screw sealant, blue Mat. No. 360.167	Screw sealant, colorless Mat. No. 360.168

3

Sealing agents and cements

3.0 Sealing agents and cements

3.1 Sealing agents ADM

Product designation	ADM 4/9 A	ADM 5	ADM 5 A	ADM 5 A/1	ADM 5 A/2
Material number	482.115	86.447	87.896	94.404	523.818
Chemical basis	Polysulphide, fillers, manganese dioxide hardener, solvent-based	Silicone rubber, filler Hardener contains organo-tin compounds	Silicone rubber, filler Hardener contains organo-tin compounds	Silicone rubber, filler Hardener contains organo-tin compounds	Silicone rubber, containing fillers, hardener contains organo-tin compounds
Tensile strength (lap shear strength) [N/mm ²]	0.6 – 1.2	1 – 2	1 – 2	1 – 2	-
Modulus of elasticity (20 °C), [N/mm ²]	<5	<5	<5	<5	-
Glass transition temperature [°C]	-38	-43	-44	-48	-
Volume shrinkage [%]	-	0.7	1.7	0.6	-
Initial viscosity (25 °C), [mPas]	60,000 – 80,000	15,000 – 25,000	15,000 – 20,000	5,000 – 15,000	10,000
Outgas behavior TOC [mg/kg]	-	30 – 40	50	60	-
Expansion coefficient [10 ⁻⁶ /K]	-	180 (at 19 °C)	-	150 °C (at 0-150 °C)	-
Operating temperature range [°C]	-65/70	-55/200	-55/200	-55/200	-55/200
Pot life [min.]	2-6h/RT	45	45	60	60
Curing conditions	(a) 5d / RT (60-90 % rel. humidity) (b) 48h / RT (60-90 % rel. humidity)+16h / 50 °C (c) 48h / RT (60-90 % rel. humidity)+8h / 80 °C	Without base coat 24h / RT (> 50 % rel. humidity); with base coat 8h / 50 °C (> 50 % rel. humidity)	Without base coat 24h / RT (> 50 % rel. humidity); with base coat 8h / 50 °C (> 50 % rel. humidity)	Without base coat 24h / RT (> 50 % rel. humidity); with base coat 8h / 50 °C (> 50 % rel. humidity)	24h / RT (50 % rel. humidity)
Application features	2-comp., black, elastic, solvent-based, easy-flowing sealing and casting compound, suitable for low-stress metal, glass bonds (with large Δα), metal, glass, plastic (adhesive) bonds, lens barrel bonding (Ø > 20 mm)	2-comp., condensation-crosslinking, whitish grey, viscous casting and molding compound; sealing compound can also be used as an adhesive for glass-metal and glass-adhesive plastics in combination with ADM primer (Mat. No. 88.136).	2-comp., condensation-crosslinking, red, viscous casting and molding compound; sealing compound can also be used as an adhesive for glass-metal and glass-adhesive plastics in combination with ADM primer (Mat. No. 88.136).	2-comp., condensation-crosslinking, red, low-viscous casting and molding compound; sealing compound can also be used as an adhesive for glass-metal and glass-adhesive plastics in combination with ADM primer (Mat. No. 88.136).	black 2-comp., condensation-crosslinking flowable sealing compound, can also be used as an adhesive for glass-metal in conjunction with ADM primer (Mat.-No. 88.136)
Order details	Compound ADM 4/9 Mat. No. 106.008 Hardener H 643 Mat. No. 478.678	Compound ADM 5 Mat. No. 105.333 Hardener H 512 Mat. No. 105.126	Compound ADM 5 A Mat. No. 105.329 Hardener H 512 Mat. No. 105.126	Compound ADM 5 A/1 Mat. No. 105.330 Hardener H 512 Mat. No. 105.126	Compound ADM 5 A/2 Mat. No. 523.819 Hardener H 512 Mat. No. 105.126

3.0 Sealing agents and cements

3.1 Sealing agents ADM

Product designation	ADM 5 B	ADM 5 C	ADM 5 W	ADM 5 W/1
Material number	89.116	93.815	105.854	105.989
Chemical basis	Silicone rubber, filler-containing	Silicone rubber, filler-containing	Silicone rubber, containing fillers, hardener contains organo-tin compounds	Silicone rubber, fillers (cross-linking by addition), hardener
Tensile strength (lap shear strength) [N/mm ²]	1 – 2	1 – 2	-	-
Modulus of elasticity (20 °C), [N/mm ²]	-	-	-	<5
Glass transition temperature [°C]	-	-	-	-44
Volume shrinkage [%]	-	-	-	0.2
Initial viscosity (25 °C), [mPas]	-	-	650 – 900	medium viscosity
Outgas behavior TOC [mg/kg]	40	40	-	50 – 60
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	320 (at 19 °C)
Operating temperature range [°C]	-55/200	-55/200	-55/200	-55/180
Pot life [min.]	45	45	30	1 – 3h
Curing conditions	Without base coat 24h / RT (> 50 % rel. humidity); with base coat 8h / 50 °C (> 50 % rel. humidity)	Without base coat 24h / RT (> 50 % rel. humidity); with base coat 8h / 50 °C (> 50 % rel. humidity)	Without base coat 24h / RT (> 50 % rel. humidity); with base coat 8h / 50 °C (> 50 % rel. humidity)	(a) 24h / RT (b) 12-15h / RT + 6-8h / 50 °C
Application features	2-comp., condensation-crosslinking, grey, heat-conducting highly viscous casting and molding compound; sealing compound can also be used as an adhesive for glass-metal and glass-adhesive plastics in combination with ADM primer (Mat. No. 88.136).	2-comp., condensation-crosslinking, black, highly viscous casting and molding compound; sealing compound can also be used as an adhesive for glass-metal and glass-adhesive plastics in combination with ADM primer (Mat. No. 88.136).	2-comp., condensation-crosslinking, grey, heat-conducting highly viscous casting and molding compound in combination with ADM primer (Mat. No. 88.136)	2 comp. grey, medium viscosity casting compound; good thermal conductivity, insulating
Order details	Compound ADM 5 B Mat. No. 105.339 Hardener H 512 Mat. No. 105.126	Compound ADM 5 C Mat. No. 105.332 Hardener H 512 Mat. No. 105.126	Compound ADM 5 W Mat. No. 106.274 Hardener H 512 Mat. No. 105.126	Compound ADM 5 W/1 Mat. No. 106.273 Hardener ADM 5 W/1 Mat. No. 106.900

3.0 Sealing agents and cements

3.1 Sealing agents ADM

Product designation	ADM 9 B	ADM 13	ADM 15	Silicone gel MZ
Material number	479.519	68.993	403.065	469.881
Chemical basis	Polysulphide, fillers, manganese dioxide hardener, solvent-based	Polyurethane	Silicone rubber	Silicone rubber
Tensile strength (lap shear strength) [N/mm ²]	1.3 – 1.9	-	-	-
Modulus of elasticity (20 °C), [N/mm ²]	<5	-	-	-
Glass transition temperature [°C]	-38	-	-	-
Volume shrinkage [%]	3.3	-	-	-
Initial viscosity (25 °C), [mPas]	14,000 – 18,000	-	gel-like	gel-like
Outgas behavior TOC [mg/kg]	40-50	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	-
Operating temperature range [°C]	-65/70	-50/200	-55/200	-55/200
Pot life [min.]	1-6h	not applicable	2h	2h
Curing conditions	(a) 5d / RT (60-90 % rel. humidity) (b) 48h / RT (60-90 % rel. humidity) + 16h / 50 °C (c) 48h / RT (60-90 % rel. humidity) + 8h / 80 °C	Apply thinly, join, screw together	24h / RT	24h / RT
Application features	Alternative to ADM 9: 2-comp., black, elastic, solvent-based, easy-flowing sealing and casting compound, suitable for low-stress metal, glass bonds (with large Δα), metal, glass, plastic (adhesive) bonds, lens barrel bonding (Ø > 20 mm)	Permanently elastic, non-hardening sealant or no cohesive forces, based on polyurethane, with good flow behavior, good media resistance (petrol fuels), in detail a check may be necessary. ADM 13 is not suitable for use as an adhesive or fixing aid of any kind. ADM 13 is used as a sealing compound between 2 sealing surfaces which are fixed together via the screw connections of the components.	2-comp., transparent sealing agent, cross-linking by addition, of gel-like texture when cured, suitable for sealing of glass/metal, glass/bondable plastic, metal/bondable plastic and plastic/plastic bonds; no primer required, cannot be used as an adhesive !	Use as expansion compound for temperature compensation in zoom slide group + 2-comp., addition-crosslinking transparent silicone compound of gel-like consistency in the cured state
Order details	Compound ADM 9 Mat. No. 105.335 Hardener H 643 Mat. No. 478.678	ADM 13 Mat. No. 68.993	Compound ADM 15 Mat. No. 403.070 Cross-linking agent ADM 15 Mat. No. 403.071	Compound ADM 15 Mat. No. 403.070 Cross-linking agent ADM 15 Mat. No. 403.071

3.0 Sealing agents and cements

3.2 Optical cements OK

Product designation	OK 2007	OK 2008	OK 2009	OK 2030	OK 2036
Material number	105.377	103.284	104.141	103.392	527.056
Chemical basis	Epoxy resin, ketone resin, amine hardener	Epoxy resins, amine hardener	Epoxy resin, ketone resin, amine hardener	Epoxy resin, ketone resin, amine hardener	Epoxy resin, polythiol hardener amine catalysed
Refraction index n_D (20 °C) / n_e (20 °C)	1.580	1.559 / 1.563	1.567 / 1.571	1.621	1.634 / 1.639
Modulus of elasticity (20 °C), [N/mm ²]	-	2,900	2,700	2,000	-
Glass transition temperature [°C]	50	65	103	57	-
Volume shrinkage [%]	3.8	5.2	4.4	4.2	-
Initial viscosity (25 °C), [mPas]	1,500	800	1,400	1,150	-
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	55 (at 18° to 28°C)	31 (at 21 °C)	48 (at 19 °C)	-
Operating temperature range [°C]	-55/80	-55/120	-40/80	-40/80	-40/80
Pot life [min.]	60	90	60	60	120
Curing conditions	24h / RT	(a) 24h / RT (b) 24h / RT +1 5h / 50 °C	(a) 24h / RT (b) 24h / RT + 15h / 50 °C	24h / RT	15h / RT
Application features	Optical cement for high-precision low-stress prism cementing (zenith prisms), transmitting from 300 nm, climate-resistant	Standard optical cement, glass-glass, good climate resistance Optical transmission (20 µm cement layer): min. 90 % T in the range 310 - 2,700 nm, for circular and plano optics	Optical cement with matched n_D (N-BaK4), transmitting from 300 nm, climate-resistant, mainly for plane optical systems,	Optical cement with matched n_D (F2) for the cementing of higher-refractive optics, transmitting from 320 nm, good climate-resistance	Highly refractive fine cement, low fluorescence, transmittance (20 µm cement layer) from approx. 310 nm ($T \geq 90$ %)
Order details	Resin OK 2007 Mat. No. 105.567 Hardener H 980 Mat. No. 103.729	Resin OK 2008 Mat. No. 105.300 Hardener H 980 Mat. No. 103.729	Resin OK 2009 Mat. No. 105.301 Hardener H 980 Mat. No. 103.729	Resin OK 2030 Mat. No. 105.314 Hardener H 950 Mat. No. 103.734	Resin OK 2036 Mat. No. 527.057 Hardener OK 2036 Mat. No. 527.058 Amine catalyst APP Mat. No. 552.797

3.0 Sealing agents and cements

3.2 Optical cements OK

Product designation	OK 2055 A	OK 2061	OK 2066 F	OK 2067 A	OK 2067 B
Material number	423.449	103.393	458.188	464.718	480.060
Chemical basis	Epoxy resins, amine hardener	Epoxy resin, ketone resin, amine hardener	Epoxy resins, polymer captans, amine hardener	Epoxy resins, UV absorber, polymer captans, amine hardener	Epoxy resins, UV absorber, polymer captans, amine hardener
Refraction index n_D (20 °C) / n_e (20 °C)	1.522	1.536	1.529 / 1.530	1.535 / 1.538	-
Modulus of elasticity (20 °C), [N/mm ²]	-	2,500	1,700	1,300	-
Glass transition temperature [°C]	-	69	42	35	-
Volume shrinkage [%]	-	6.1	4.8	4.9	-
Initial viscosity (25 °C), [mPas]	600	485	500	820	-
Outgas behavior TOC [mg/kg]	-	-	-	.	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	.	-
Operating temperature range [°C]	-40/70	-40/80	-40/80	-40/80	-40/80
Pot life [min.]	90		2 – 3h	2 – 3h	2 – 3h
Curing conditions	24h / RT	24h / RT	Pre-curing: 30-60 min./50 °C Curing: 2d / RT post-curing: 15h / 50 °C	Pre-curing: 30-60 min. / 50 °C curing: 2d / RT post-cure: 15h / 50 °C	Pre-curing: 30-60 min./50 °C Curing: 3d / RT post-curing: 15h / 50 °C
Application features	Optical cement for optical functional films, pol. films in particular, with large filter diameter	Fine cement with matched nD, for cementing PVA film, transmitting from 300 nm, good climate resistance	Fine cement for large lens diameters, optical transmission (20 µm cement layer): min. 90 % T in the range 260-2,700 nm, suitable for fluorescence applications	Elastic fine cement for large lens diameters, absorption edge at approx. 399 nm (20 µm cement layer)	Elastic fine cement for large lens diameters Variable absorption edge of approx. 403 nm (20µm cement layer)
Order details	Resin OK 2055 A Mat. No. 423.041 Hardener H 980 Mat. No. 103.729	Resin OK 2061 Mat. No. 105.307 Hardener H 980 Mat. No. 103.729	Resin OK 2066 F Mat. No. 458.190 Cross-linking agent B 30/F Mat. No. 458.193 Hardener H 996 F Mat. No. 458.191	Resin OK 2067 A Mat. No. 464.720 Cross-linking agent B 30 Mat. No. 104.192 Hardener H 980 Mat. No. 103.729	Resin OK 2067 A Mat. No. 464.720 Resin OK 2066 F Mat. No. 458.190 Cross-linking agent B 30 Mat. No. 104.192 Hardener H 980 Mat. No. 103.729

3.0 Sealing agents and cements

3.2 Optical cements OK

Product designation	OK 2096 A	OK 2096 B2	OK 2096 C	OK 2096 D	OK 2096 E
Material number	412.019	558.944	411.332	411.328	444.192
Chemical basis	Epoxy resins, UV absorber, amine hardener	Epoxy resin, UV absorber, amine hardener	Epoxy resins, UV absorber, amine hardener	Epoxy resins, UV absorber, amine hardener	Epoxy resins, UV absorber, amine hardener
Refraction index n_D (20 °C) / n_e (20 °C)	1.556 / 1.560	-	1.554 / 1.558	1.553 / 1.556	1.588 / 1.593
Modulus of elasticity (20 °C), [N/mm ²]	-	-	-	-	3,200
Glass transition temperature [°C]	-	-	-	-	80
Volume shrinkage [%]	-	-	-	-	4.3
Initial viscosity (25 °C), [mPas]	-	-	-	-	3,000
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	-	-
Operating temperature range [°C]	-40/80	-40/80	-40/80	-40/80	-40/80
Pot life [min.]	90	90	90	90	45
Curing conditions	24h / RT + 15h / 50 °C	24h / RT + 15h / 50 °C	24h / RT + 15h / 50 °C	24h / RT + 15h / 50 °C	24h / RT + 4h / 50 °C
Application features	Optical cement with absorption edge at approx. 400 nm 10 µm cement layer)	Optical cement with absorption edge at approx. 396 nm 10 µm cement layer) Replace- ment for OK 2096 B (Mat. No. 411.793)	Optical cement with absorption edge at approx. 393 nm (10 µm cement layer)	Optical cement with absorption edge at approx. 382 nm (10 µm cement layer)	Optical cement with absorption edge: 10 µm cement layer approx. 403 nm (T=50 %) 20 µm cement layer approx. 407 nm (T=50 %)
Order details	Resin OK 2096 A Mat. No. 412.020 Hardener H 980 Mat. No. 103.729	Resin OK 2096 / B2 Mat. No. 558.943 Hardener H 980 Mat. No. 103.729	Resin OK 2096 C Mat. No. 411.330 Hardener H 980 Mat. No. 103.729	Resin OK 2096 D Mat. No. 411.331 Hardener H 980 Mat. No. 103.729	Resin OK 2096 E Mat. No. 444.195 Hardener H 980 Mat. No. 103.729

3.0 Sealing agents and cements

3.2 Optical cements OK

UV
HARDENING ↓↓↓

Product designation	OK 2097	OK 2097 A	OK 2272	OK 2274	OK 2282/14
Material number	446.064	480.065	89.698	102.339	469.759
Chemical basis	Epoxy resin, dyes, amine hardener	Epoxy resin, dyes, amine hardener	Polyene /polythiol system UV reactive at 365 nm	Polyene /polythiol system UV reactive at 365 nm	Epoxy resin UV-hardening at 365 nm
Refraction index n_D (20 °C) / n_e (20 °C)	-	-	1.557	1.54	1.509 / 1.511
Modulus of elasticity (20 °C), [N/mm ²]	-	-	2,200	2,000	260
Glass transition temperature [°C]	-	-	54	41	23
Volume shrinkage [%]	-	-	7.5	5.8	(3)
Initial viscosity (25 °C), [mPas]	-	-	240 – 380	4,000 – 5,000	-
Outgas behavior TOC [mg/kg]	-	-	-	-	-
Expansion coefficient [10 ⁻⁶ /K]	-	-	-	148 (at 19 °C)	-
Operating temperature range [°C]	-40/70	-40/70	-55/80 °C	-55/80 °C	-40/80
Pot life [min.]	45	60	not applicable	not applicable	not applicable
Curing conditions	24h / RT + 4h / 50 °C	24h / RT + 4h / 50 °C	Curing: UVA 365 nm, 20-30 mW/cm ² , 60 s set hardening: UVA 365 nm, 2-5 mW/cm ² , 60 min. Post-curing: 15h / 50 °C	Curing: UVA 365 nm, 20-30 mW/cm ² , 60 s set hardening: UVA 365 nm, 2-5 mW/cm ² , 60 min. Post-curing: 15h / 50 °C	2x 60 s with 30-40 mW/cm ² ; UVA (365 nm) post-annealing 15h / 40 °C
Application features	Optical cement, absorption edge at approx. 400 nm and absorption in the range from 500 to -580 nm, used for color correction in Photo lenses	Optical cement, absorption edge in the range of approx. 500 to 680 nm, used for color correction in Photo lenses	low viscosity, 1-comp. standard UV cement, also suitable for glass-metal joints (under certain conditions), climate resistant, transmittance (20 µm cement layer) from 350 nm (T > 90 %), from 312 nm (T > 75 %)	Viscous 1-comp. UV fine cement, mainly for lens-setting bonding, climate-resistant, glass-glass, glass-metal bonding	Elastic fine cement, 1-comp., transmittance (20 µm cement layer) from approx. 380 nm (T ≥ 90 %)
Order details	Resin OK 2097 Mat. No. 446.052 Hardener OK 2097 Mat. No. 450.494	Resin OK 2097 A/red Mat. No. 480.061 Resin OK 2067 A/blue Mat. No. 480.062 Resin OK 2097 A/colorless Mat. No. 480.063 Hardener H 995/D Mat. No. 480.064	OK 2272 Mat. No. 89.698	OK 2274 Mat. No. 102.339	OK 2282/14 Mat. No. 469.759

3.0 Sealing agents and cements

3.2 Optical cements OK

UV
HARDENING ↓↓↓

Product designation	OK 2403	OK 2405	OK 2405 HL	OK 4009	OK 4066
Material number	95.380	105.911	635.359	588.693	595.160
Chemical basis	Epoxy resins, amine hardener	Addition crosslinking 2K silicone rubber	Addition crosslinking 2K silicone rubber	Epoxy-thiol system	Epoxy-thiol system, photoactivatable with LED 365 nm
Refraction index n_d (20 °C) / n_e (20 °C)	1.511	1.406 / 1.408	1.406 / 1.408	1,568 / 1,571 (21 °C)	1.590 / 1.594
Modulus of elasticity (20 °C), [N/mm ²]	2,500	<5	<5	1,000	800
Glass transition temperature [°C]	64	-52	-52	30	30
Volume shrinkage [%]	7.3	0.3	0.3	-	-
Initial viscosity (25 °C), [mPas]	90	800 – 1,000	800 – 1,000	2,000	1,200
Outgas behavior TOC [mg/kg]	-	24 – 30	24 – 30	-	-
Expansion coefficient [10 ⁻⁶ /K]	69 (at 19 °C)	350 (-30° bis 70 °C)	350 (-30° bis 70 °C)	-	-
Operating temperature range [°C]	-55/80	-70/180	-70/180	-40/80	-40/80
Pot life [min.]	180	60	60	90	90
Curing conditions	78h / RT	24h / RT	24h / RT	24h / RT	(1) UV LED 365 nm, 200 mW/cm ² , 60 s, then 3-5 min. (2) Dark curing 20h / RT
Application features	Very low viscosity 2-comp. fine cement for UV optics, low stress with long residence time at RT, transmitting from 250 nm, climate resistant, 20 µm cement layer T ≥ 90 %: 330-800 nm	Optical cement for UV optics (high radiation load), low fluorescence, extremely low tension, climate-resistant, transmitting from 210 nm (20 µm cement layer), siliconization risk, requiring separate cementing room For further data, refer to VV	Fine cement with special quality for Carl Zeiss SMT GmbH cement elements, transmittance (20 µm cement layer) 220-2200 nm T ≥ 95 % or 210-3000 nm T ≥ 90 % ; low-stress optics, low-fluorescence optics (e.g. lenses); sufficient climate resistance	Low-tension optical cement with matched nd (N-BaK4) (n_e at 21 °C), transmitting from 300 nm, climate-resistant, mainly for plane optical systems	Low-tension cement, transmitting in the range 330-2000 nm (20 µm cement layer)
Order details	Resin OK 2403 Mat. No. 105.311 Hardener H 980 Mat. No. 103.729	Resin OK 2405 Mat. No. 105.277 Hardener OK 2405 Mat. No. 106.072	Resin OK 2405 HL Mat. No. 635.360 Hardener OK 2405 HL Mat. No. 635.361	Resin OK 4009 Mat. No. 588.690 Hardener OK 4009 Mat. No. 588.691	Resin OK 4066 Mat. No. 595.158 Hardener OK 4066 Mat. No. 595.159

3.0 Sealing agents and cements

3.3 Auxiliary cements HK

Explanations on the auxiliary cements

(1) Type of cement

SK Melt cement

RK Reactive cement

AW Blocking wax

UV UV-A light-curing, 365 nm center of gravity wavelength (Hg lamp, UV LED)

(2) Water swelling at 40 °C (storage) after 1 and 7 days

(3) Cold flow limit: limit temperature in °C at which a cement sample flows off a slope (45°) by 1 mm after 24 hours without exposure to mechanical stress

Limited solubility

The letters A, B and W at the end of the designation indicate the solubility in solvents:

(A) Soluble in polar solvents like acetone, ethyl acetate, butyl diglycol

Resistant to unpolar media

(e.g. glass polishing oil, white spirit)

(B) Soluble in unpolar solvents such as benzine hydrocarbon

Resistant to polar media (e.g. alcohol)

(W) Soluble in warm water

3.0 Sealing agents and cements

3.3 Auxiliary cements HK

Product designation	HK 0251	HK 0251 A	HK 0351	HK 0351 black	HK 0551
Material number	104.314	504.623	105.909	429.968	509.264
Chemical basis	Epoxy resin, ketone formaldehyde resin, amine hardener	Epoxy resin, ketone formaldehyde resin, amine hardener, fillers	Epoxy resin, ketone formaldehyde resin, amine hardener	Epoxy resin, ketone formaldehyde resin, amine hardener, dye	Epoxy resin, ketone formaldehyde resin, amine hardener
Type of cement	RK	HK	RK	RK	RK
Softening point [°C]	-	-	-	-	-
Needle penetration [°C]	-	-	-	-	-
Water swelling (2) [% by weight]	-	-	-	-	-
Cold flow limit (3) [°C]	-	-	-	-	-
Viscosity (20 °C) [mm²/s]	900	50,000	-	-	1,000
Cleaning agent	Acetone	Acetone	Acetone	Acetone	Acetone
Operating temperature range [°C]	60	60	40	40	60
Pot life [min.]	120	120	150	150	120
Curing conditions	24h / RT	24h / RT	24h / RT	24h / RT	24h / RT
Application features	Low-tension, room-temperature curing 2-comp. reaction cement for temporary fixation of plano and special optics, from approx. 80 °C thermoplastic behavior	Low-tension, room-temperature curing, viscous 2-comp. reactive adhesive for temporary fixation of plano and special optics, thermoplastic behavior above 80 °C This is the thickened version of HK 0251	Low-tension, room-temperature curing, viscous 2-comp. reaction cement for special and plano optics, from approx. 70 °C thermoplastic behavior	Low-tension, room-temperature curing, viscous 2-comp. reaction cement for special and plano optics, from approx. 70 °C thermoplastic behavior Dyed black for easier inspection	Low-tension, room-temperature curing, 2-comp. reactive cement for large-area auxiliary cement of plano and special optics, e.g. instead of auxiliary cement HK 0251, auxiliary cement HK 0551 is used for boiler plates from approx. 30 cm size, redissolvable, thermoplastic behavior from approx. 80 °C onwards
Order details	Resin HK 0251 Mat. No. 105.315 Hardener H 953 Mat. No. 105.274	Resin HK 0251 Mat. No. 105.315 Hardener H 953 Mat. No. 105.274 Filler Z 82 Mat. No. 105.281	Resin HK 0351 Mat. No. 105.985 Hardener H 971 Mat. No. 106.431	Resin HK 0351 black Mat. No. 419,971 Hardener H 971 Mat. No. 106.431	Resin HK 0551 Mat. No. 509.263 Hardener H 953 Mat. No. 105.274

3.0 Sealing agents and cements

3.3 Auxiliary cements HK

UV
UV HARDENING ↓↓↓

Product designation	HK 2250 /12	HK 2261	HK 2262	HK 2264	HK 2264 A
Material number	405.969	442.588	446.049	502.385	517.614
Chemical basis	Polyene /polythiol system (1K)	Epoxy resin, ketone formaldehyde resin UV initiator	Epoxy resin, ketone formaldehyde resin UV initiator	Epoxy resin, ketone formaldehyde resin, alcohols, special plasticizer, UV initiator	Epoxy resin, ketone formaldehyde resin, alcohols, special plasticizer, UV initiator
Type of cement	UV	UV	UV	UV	UV
Softening point [°C]	-	-	-	-	-
Needle penetration [°C]	-	-	-	-	-
Water swelling (2) [% by weight]	-	-	-	-	-
Cold flow limit (3) [°C]	-	-	-	-	-
Viscosity (20 °C) [mm²/s]	viscous, thixotropic	9.000, structurally viscous	3,000 – 4,000	viscous	paste-like
Cleaning agent	Acetone	Acetone	Acetone	Acetone	Acetone
Operating temperature range [°C]	40	45	40	50	40
Pot life [min.]	not applicable	not applicable	not applicable	not applicable	not applicable
Curing conditions	UVA, 25 – 30 mW/cm², 60 s	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)
Application features	UVA-reactive, elastic auxiliary adhesive for auxiliary cements in processing of optics Depth curing up to approx. 1 mm. Cements can be dissolved again by swelling in acetone.	UV reactive auxiliary cement for optical component processing, contains a red curing indicator, softens at approx. 45 °C Depth curing up to approx. 2 mm, softens at approx. 45 °C and above The cured cement is entirely soluble in acetone	UV-reactive auxiliary cement for auxiliary bonding in processing of optical components Contains a blue dye that changes from blue to beige during UV curing (curing indicator) The cured auxiliary cement softens above approx. 40 °C (reversible process) and is completely soluble in acetone	UV-reactive auxiliary cement for extensive auxiliary bonding in processing of optical components Contains a blue dye that changes from blue to light red during UV curing (curing indicator) The cured auxiliary cement softens above approx. 50 °C (reversible process) and is light and completely soluble in acetone Depth curing up to approx. 3 mm, good water stability	UV-reactive auxiliary cement for auxiliary bonding in processing of optical components Contains a blue dye that changes from blue to light red during UV curing (curing indicator) The cured auxiliary cement softens above approx. 40 °C (reversible process) and is light and completely soluble in acetone Depth curing up to approx. 2 mm, good water stability
Order details	Optical auxiliary cement HK 2250/12 Mat. No. 405.969	Optical auxiliary cement HK 2261 Mat. No. 442.588	Optical auxiliary cement HK 2262 Mat. No. 446.049	HK 2264 Mat. No. 502.385	HK 2264 A Mat. No. 517.614

3.0 Sealing agents and cements

3.3 Auxiliary cements HK

UV
HARDENING ↓↓↓

Product designation	HK 2264 B	HK 2265	HK 2265 A	HK 2265 B	HK 2266 A
Material number	522.491	475.193	483.352	486.904	484.189
Chemical basis	Epoxy resin, ketone formaldehyde resin, alcohols, special plasticizer, UV initiator	Epoxy resin, ketone formaldehyde resin, alcohols, UV initiator	Epoxy resin, ketone formaldehyde resin, alcohols, UV initiator	Epoxy resin, ketone formaldehyde resin, alcohols, UV initiator	Epoxy resin, ketone formaldehyde resin, alcohols, UV initiator
Type of cement	UV	UV	UV	UV	UV
Softening point [°C]	-	-	-	-	-
Needle penetration [°C]	-	-	-	-	-
Water swelling (2) [% by weight]	-	-	-	-	-
Cold flow limit (3) [°C]	-	-	-	-	-
Viscosity (20 °C) [mm²/s]	very paste-like	5,000 – 6,000	-	1,700	highly viscous
Cleaning agent	Acetone	Acetone	Acetone	Acetone	Acetone
Operating temperature range [°C]	40	60	45	40	40
Pot life [min.]	not applicable	not applicable	not applicable	not applicable	not applicable
Curing conditions	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s (b) 20-30 mW/cm², 2x60 s (2 mm)	UVA (a) 50-60 mW/cm² 60 s
Application features	UV-reactive auxiliary cement for auxiliary bonding in processing of optical components Contains a blue dye that changes from blue to light red during UV curing (curing indicator) The cured auxiliary cement softens above approx. 40 °C (reversible process) and is light and completely soluble in acetone Depth curing up to approx. 2 mm, good water stability HK 2264 B is the very paste-like version of HK 2264 A	Low-viscous, UV-reactive reaction cement for extensive auxiliary bonding in processing of optical components Contains a blue dye that changes from blue to yellow during UV curing (curing indicator) The cured cement softens from approx. 65 °C and is completely soluble in acetone Depth curing up to approx. 5 mm, good water stability	Low-viscous, UV-reactive auxiliary cement for extensive auxiliary bonding in processing of optical components, especially for bonding supporting yokes in processing of mirror blocks (LIT) Contains a blue dye that changes from blue to light red during UV curing (curing indicator) The cured auxiliary cement softens above approx. 45 °C (reversible process) and is light and completely soluble in acetone Depth curing up to approx. 5 mm, good water stability	Low-viscous, UV-reactive auxiliary cement for extensive auxiliary bonding in processing of optical components, especially for processing of thin crystal quartz disks Contains a blue dye that changes from blue to light red during UV curing (curing indicator) The cured auxiliary cement softens above approx. 40 °C (reversible process) and is light and completely soluble in acetone Depth curing up to approx. 5 mm, good water stability	Highly paste-like, low-tension auxiliary assembly adhesive, UV-curing, for support and alignment auxiliary bonding of bonded mechanical components (e.g. waferstages), during curing of 2-comp. structural adhesives. Contains a blue dye that changes from blue to pink during UV curing (curing indicator) The cured cement softens above 50 °C and is completely soluble in acetone
Order details	HK 2264 B Mat. No. 522.491	HK 2265 Mat. No. 475.193	HK 2265 A Mat. No. 493.352	HK 2265 B Mat. No. 486.904	HK 2266 A Mat. No. 484.189

3.0 Sealing agents and cements

3.3 Auxiliary cements HK

UV
UV HARDENING ↓↓↓

Product designation	HK 2267
Material number	527.587
Chemical basis	Epoxy resin, ketone formaldehyde resin, alcohols, UV initiator, fillers
Type of cement	UV
Softening point [°C]	70
Needle penetration [°C]	-
Water swelling (2) [% by weight]	-
Cold flow limit (3) [°C]	-
Viscosity (20 °C) [mm ² /s]	highly viscous
Cleaning agent	Acetone
Operating temperature range [°C]	60
Pot life [min.]	not applicable
Curing conditions	UVA (a) 50-60 mW/cm ² 60 s (b) 20-30 mW/cm ² , 2x60 s (2 mm)
Application features	Low tension auxiliary adhesive, UV curing, for light rod production SMT Contains a blue dye that changes from blue to pink during UV curing (curing indicator) The cured cement softens above approx. 70 °C and is completely soluble in acetone
Order details	HK 2267 Mat. No. 527.587

3.0 Sealing agents and cements

3.4 Auxiliary cements OHM

Product designation	Blocking wax 52 A	Blocking wax 60 A	Blocking wax 62 A	A cement 73	A cement 110
Material number	360.352	105.856	360.107	599.749	618.616
Chemical basis	Polywax, ketone formaldehyde resin	Polyglycol wax, ketone formaldehyde resin	Polyglycol wax, ketone formaldehyde resin	Pitch, wax	Pitch, wax
Type of cement	AW	AW	AW	SK	SK
Softening point [°C]	56 – 59	59 – 61	60 – 63	71 – 75	108 – 112
Needle penetration [°C]	-	-	-	-	-
Water swelling (2) [% by weight]	-	-	-	-	-
Cold flow limit (3) [°C]	-	-	-	-	-
Viscosity (20 °C) [mm²/s]	88 (90 °C)	257 (90 °C)	112 (90 °C)	-	-
Cleaning agent	Methylated spirit, warm butyl diglycol; hand wash: ethyl acetate	Methylated spirit, warm butyl diglycol; hand wash: ethyl acetate	Methylated spirit, warm butyl diglycol; hand wash: ethyl acetate	Xylene; acetone, butyl diglycol (with some exceptions)	Xylene
Operating temperature range [°C]	-	-	-	-	-
Pot life [min.]	-	-	-	-	-
Curing conditions	-	-	-	-	-
Application features	For longer exposure times, the cement joint must be protected against aqueous processing media by using OKS Protective Lacquer KW green.	For longer exposure times, the cement joint must be protected against aqueous processing media by using OKS Protective Lacquer KW green.	For longer exposure times, the cement joint must be protected against aqueous processing media by using OKS Protective Lacquer KW green.	Extensive use as a carrier material on polishing machines	Cement point method in polishing large lenses SMT
Order details	Blocking wax 52 A Mat. no. 360.352	Blocking wax 60 A Mat. No. 105.856	Blocking wax 62 A Mat. no. 360.107	A cement 73 Mat. No. 599.749	A cement 110 Mat. No. 618.616

3.0 Sealing agents and cements

3.4 Auxiliary cements OHM

Product designation	HK 5510 A	HK 6011 A/blue	HK 6205 A	HK 6212 AB	HK 6220 A
Material number	105.790	102.537	102.536	106.967	408.395
Chemical basis	Ketone formaldehyde resin Monomer softener	Ketone formaldehyde resin Monomer softener	Ketone formaldehyde resin Softener	Polymer softener	Ketone formaldehyde resin Softener
Type of cement	SK	SK	SK	SK	SK
Softening point [°C]	53 – 55	59 – 61	61 – 63	61 – 63	61 – 63
Needle penetration [°C]	14	24	24	-	-
Water swelling (2) [% by weight]	0.6 / 1.0	0.9 / 1.3	-	-	-
Cold flow limit (3) [°C]	36	40	-	-	-
Viscosity (20 °C) [mm²/s]	-	-	-	-	-
Cleaning agent	Butyl diglycol, acetone, ethyl acetate, butyl acetate	Butyl diglycol, acetone, ethyl acetate, butyl acetate	Butyl diglycol, acetone, ethyl acetate, butyl acetate	Acetone	Butyl diglycol, acetone, ethyl acetate, butyl acetate
Operating temperature range [°C]	-	-	-	-	-
Pot life [min.]	-	-	-	-	-
Curing conditions	-	-	-	-	-
Application features	Auxiliary cement with particularly low softening point	Low melting auxiliary cement with low melting viscosity for special applications		Auxiliary cement for internal-hole saw	Yellowish appearance
Order details	HK 5510 A Mat. No. 105.790	HK 6011 A/blue Mat. No. 102.537	HK 6205 A Mat. No. 102.536	HK 6212 AB Mat. No. 106.967	HK 6220 A Mat. No. 408.395

3.0 Sealing agents and cements

3.4 Auxiliary cements OHM

Product designation	HK 6508 A	HK 7003 A	HK 7003 A black	HK 7009 A	HK 7504 A
Material number	105.459	105.469	102.540	105.460	102.539
Chemical basis	Ketone formaldehyde resin Polyglycol wax	Ketone formaldehyde resin Polymer softener	Ketone formaldehyde resin Polymer softener Black filler	Ketone formaldehyde resin Polyglycol wax	Ketone formaldehyde resin Polymer softener
Type of cement	SK	SK	SK	SK	SK
Softening point [°C]	64 – 66	69 – 71	69 – 71	69 – 71	73 – 75
Needle penetration [°C]	24.5	33	33	34.5	40
Water swelling (2) [% by weight]	1.1 / 2.5	0.3 / 0.8	0.3 / 0.8	2.9 / 6.4	0.3 / 0.7
Cold flow limit (3) [°C]	42	46	46	42	52
Viscosity (20 °C) [mm²/s]	-	-	-	-	-
Cleaning agent	Acetone (methylated spirit, hot butyl diglycol)*	Butyl diglycol, acetone Ethyl acetate, butyl acetate	Butyl diglycol, acetone Ethyl acetate, butyl acetate	Acetone (methylated spirit, hot butyl diglycol)*	Butyl diglycol, acetone Ethyl acetate, butyl acetate
Operating temperature range [°C]	-	-	-	-	-
Pot life [min.]	-	-	-	-	-
Curing conditions	-	-	-	-	-
Application features	Slow-hardening auxiliary cement for particularly low-tension cements	Standard auxiliary cement for round and plane optics, can also be used as cementing carrier	Standard auxiliary cement dyed black for round and plane optics	Slow-hardening auxiliary cement for aligning chuck techniques	Auxiliary cement
Order details	HK 6508 A Mat. No. 105.459	HK 7003 A Mat. No. 105.469	HK 7003 A black Mat. No. 102.540	HK 7009 A Mat. No. 105.460	HK 7504 A Mat. No. 102.539

3.0 Sealing agents and cements

3.4 Auxiliary cements OHM

Product designation	HK 7504 A black	HK 7506 A/Q	HK 7506 A/Q black	HK 8822 A/Q red	HK 10012 A/Q
Material number	102.541	105.892	106.146	408.397	411.836
Chemical basis	Ketone formaldehyde resin Polymer softener Black dye	Ketone formaldehyde resin Polymer softener, filler-containing (quartz)	Ketone formaldehyde resin Polymer softener, filler-containing (quartz) Black dye	Ketone formaldehyde resin Softener, filler	Polywax, ketone formaldehyde Filler
Type of cement	SK	SK	SK	SK	SK
Softening point [°C]	73 – 75	75 – 78	75 – 78	86 – 89	97 – 103
Needle penetration [°C]	40	37	37	-	-
Water swelling (2) [% by weight]	0.3 / 0.7	0.4 / 0.6	0.4 / 0.6	insoluble	insoluble
Cold flow limit (3) [°C]	52	46	46	-	-
Viscosity (20 °C) [mm²/s]	-	-	-	-	-
Cleaning agent	Butyl diglycol, acetone Ethyl acetate, butyl acetate	Butyl diglycol, acetone Ethyl acetate, butyl acetate	Butyl diglycol, acetone Ethyl acetate, butyl acetate	Butyl diglycol, acetone Ethyl acetate, butyl acetate	Butyl diglycol, acetone, ethyl acetate, butyl acetate
Operating temperature range [°C]	-	-	-	-	-
Pot life [min.]	-	-	-	-	-
Curing conditions	-	-	-	-	-
Application features	Auxiliary cement dyed black	Block cement with reduced coef- ficient of expansion (sealing bed cement) for plane optics, round optics and special optics.	Block cement with reduced coef- ficient of expansion (sealing bed cement) for plane optics, round optics and special optics. Dyed black	High softening point	High softening point, contains quartz flour, white
Order details	HK 7504 A black Mat. No. 102.541	HK 7506 A/Q Mat. No. 105.892	HK 7506 A/Q black Mat. No. 106.146	HK 8822 A/Q red Mat. No. 408.397	HK 10012 A/Q Mat. No. 411.836

3.0 Sealing agents and cements

3.5- Polish pitches

Product designation	Polish pitch P 55 B	Polish pitch P 58 B	Polish pitch P 60 B	Polish pitch N 57	Polish pitch P 61 GZ
Material number	105.866	472.064	422.108	639.636	522.685
Chemical basis	Balsamic resin, softener	Balsamic resin, softener	Balsamic resin, softener	Pitches, softener	Pitches
Type of cement	SK	SK	SK	SK	SK
Softening point [°C]	54 – 56	57 – 59	59 – 61	56 – 59	60 – 62
Needle penetration [°C]	-	-	-	-	-
Water swelling (2) [% by weight]	-	-	-	-	-
Cold flow limit (3) [°C]	-	-	-	-	-
Viscosity (20 °C) [mm²/s]	-	-	-	-	-
Cleaning agent	Butyl diglycol, acetone	Butyl diglycol, acetone	Butyl diglycol, acetone	Butyl diglycol, acetone	Butyl diglycol, acetone
Operating temperature range [°C]	-	-	-	-	-
Pot life [min.]	-	-	-	-	-
Curing conditions	-	-	-	-	-
Application features	Replacement product for polish pitch N 20/45	-	-	Polish pitch of SMT optics Replaces polish pitch P 56 GZ Mat. No. 456.611	Polish pitch of SMT optics
Order details	Polish pitch P 55 B Mat. No. 105.866	Polish pitch P 58 B Mat. No. 472.064	Polish pitch P 60 B Mat. No. 422.108	Polish pitch N 57 Mat. No. 639.636	Polish pitch P 61 GZ Mat. No. 522.685

4

Lacquers

4.0 Lacquers

4.1 Optical edge lacquers ORL

Product designation	ORL 1.6	ORL 56	ORL 56 matte	ORL 56/22
Material number	611.082	104.311	460.679	105.092
Chemical basis	Epoxy resin, fungicide additive, amine hardener, contains solvent	Ketone resin, softener, special carbon black, contains solvent	Ketone resin, softener, special carbon black, contains solvent	Ketone resin, softener, special carbon black, fungicide additive, contains solvent
Intended field of application [°C]	-40/80	-55/70	-55/70	-55/70
Refractive index of the lacquer binder n_D (20 °C) / n_g (20 °C)	1.5411 / 1.5421	1.56	1.56	1.56
Lacquer layer thickness (brush technique) [μm]	-	10-14	-	4-6
Curing conditions	Flash off for min. 30 min. (RT/rel. humidity) < 70 %), then (a) 2h / 60 °C (b) before second coating 24h / RT	24h / RT; 30-70 % rel. humidity	24h / RT; 30-70 % rel. humidity	24h / RT; 30-70 % rel. humidity
Flow time [sec] (4 mm nozzle)	17 – 20	17 – 19	18 – 19	15
Cleaning agent	Acetone, thinner, optical edge lacquer 1.6	Acetone, methoxypropanol	Acetone, methoxypropanol	Acetone, methoxypropanol
Application features	Matte-black, solvent-based 2-comp. epoxy resin lacquer (optical edge coating), blackening of glass up to $n_D > 1.65$ (depending on geometry), good mechanical stability after curing, sufficient edge coverage, open edges can be repainted a second time after a flash-off time Stable at RT against optical cleaner L and acetone Specially suitable for brush painting Can be adjusted with "Thinner Optical Edge Paint 1.6" (Mat. No. 360.344) Replacement for optical edge lacquer 58 (513.343) and optical edge lacquer 58 NT (515.768)	Black standard optical edge lacquer for glasses up to n_D approx. 1.62, lacquer layer thickness approx. 10-14 μm , pronounced fungistatic effect Can be adjusted with "Thinner Optical Edge Paint 56" (Mat. No. 360.344)	Black dull matte optical edge lacquer, use preferably for retouching work, fungistatic effect Can be adjusted with "Thinner Optical Edge Paint 56" (Mat. No. 360.344)	Low-viscous version of black optical edge lacquer 56, for coating glasses up to n_D approx. 1.62, lacquer layer thickness of approx. 4-6 μm , pronounced fungistatic effect Can be adjusted with "Thinner Optical Edge Paint 56" (Mat. No. 360.344)
Order details	Resin - optical edge lacquer 1.6: Mat. No. 611.088 Hardener - optical edge lacquer 1.6 Mat. No. 611.091	Optical edge lacquer 56 Mat. No. 104.311	Optical edge lacquer 56 matte Mat. No. 400.679	Optical edge lacquer 56/22 Mat. No. 105.092

4.0 Lacquers

4.1 Optical edge lacquers ORL

Product designation	ORL 57	ORL 57/22	Black lacquer 57 matte	Black lacquer 57 matte / P
Material number	360.364	360.876	360.884	400.974
Chemical basis	Epoxy resin, fungicide additive, amine hardener, contains solvent	Epoxy resin, fungicide additive, amine hardener	Epoxy resin, fungicide additive, amine hardener	Epoxy resin, fungicide additive, amine hardener
Intended field of application [°C]	-40/70	-40/70	-40/70	-40/70
Refractive index of the lacquer binder n_D (20 °C) / n_g (20 °C)	1.574 / 1.579	1.58	-	-
Lacquer layer thickness (brush technique) [μ m]	-	4-6	-	-
Curing conditions	Flash off for min. 30 min. (RT/rel. humidity) < 70 %), then (a) 2-3 d RT (b) 6h / 60 °C	min. 2h / RT; 30-70 % rel. humidity, then 4h / 60 °C	Flash off for min. 30 min. (RT/rel. humidity 30-70 %), then (a) 2-3 d RT (b) 15h / 60 °C	Flash off for min. 30 min. (RT/rel. humidity 30-70 %), then (a) 2-3 d RT (b) 15h / 60 °C
Flow time [sec] (4 mm nozzle)	17 – 20	13 – 14	15	15
Cleaning agent	Acetone	Acetone, methoxypropanol	Acetone	Acetone
Application features	Black, solvent-based 2-comp. epoxy resin lacquer (optical edge coating), blackening of glasses up to n_D approx. 1.65, fungistatic effect. Can be adjusted with "Thinner Optical Edge Lacquer 57" (Mat. No. 360.344).	Black, 2-comp. epoxy resin lacquer, for edge coating of lens and cement elements, blackening of glasses up to n_D = 1.64. High mechanical strength (depending on glass surface). Lacquer layer thickness approx. 4-6 μ m, fungistatic effect Can be adjusted with "Thinner Optical Edge Lacquer 57" (Mat. No. 360.344).	Dull matte, black 2-comp. epoxy resin lacquer, for painting housings, preferably by spraying or airbrushing Fungistatic effect Can be adjusted with "Thinner Optical Edge Lacquer 57" (Mat. No. 360.344).	Dull matte, black 2-comp. epoxy resin lacquer, for painting housings, preferably by spraying or airbrushing Can be adjusted with "Thinner Optical Edge Lacquer 57" (Mat. No. 360.344).
Order details	Resin - optical edge lacquer 57: Mat. No. 360.343 Hardener - optical edge lacquer 57 B Mat. No. 511.360	Resin - optical edge lacquer 57/22: Mat. No. 360.887 Hardener - optical edge lacquer 57 B Mat. No. 511.360	Resin - black lacquer 57 matte Mat. No. 360.885 Hardener - optical edge lacquer 57 B Mat. No. 511.360	Resin - optical edge lacquer 57 matte Mat. No. 360.885 Hardener - optical edge lacquer 57 matte/P Mat. No. 400.975

4.0 Lacquers

4.1 Optical edge lacquers ORL

Product designation	ORL 58	ORL 5822	ORL 58 NT	ORL 70
Material number	513.343	515.236	515.768	360.354
Chemical basis	Epoxy resin, nanoscaled filler, fungicide additive, amine hardener, contains solvent	Epoxy resin, nanoscaled filler, dye, fungicide additive, amine hardener, contains solvent	Epoxy resin, nanoscaled filler, fungicide additive, amine hardener, contains solvent	Phenolic epoxy resin
Intended field of application [°C]	-40/80	-40/80	-40/80	-40/150
Refractive index of the lacquer binder n_D (20 °C) / n_e (20 °C)	1.56 / 1.57	1.56 / 1.57	1.56 / 1.57	1.69
Lacquer layer thickness (brush technique) [μ m]	-	6-10	-	5-8
Curing conditions	Flash off for min. 30 min. (RT/rel. humidity) < 70 %), then (a) 24h / RT b) 2h / 60 °C	Flash off for min. 30 min. (RT/rel. humidity) < 70 %), then (a) 24h / RT b) 2h / 60 °C	Flash off for min. 30 min. (RT/rel. humidity) < 70 %), then (a) 24h / RT b) 2h / 60 °C	Flash off for min. 2h, 3h / 160 °C (kiln program)
Flow time [sec] (4 mm nozzle)	11 – 12	10 – 12	12 – 15	13 – 15
Cleaning agent	Acetone	Acetone	Acetone	Acetone, methoxypropanol
Application features	Black, solvent-based 2-comp. epoxy resin lacquer (optical edge lacquer), blackening of glasses up to n_D approx. 1.65, fungistatic effect, good mechanical stability after curing, resistant at RT to optical cleaning agents and conditionally to acetone (light wiping with a solvent-damp cleaning cloth), suitable for brush coating and spray coating (airbrush), compatible with epoxy resin adhesives e.g. adhesive 52A. Used in new designs after consultation with SPU-EC only !	Black, solvent-based 2-comp. epoxy resin lacquer (optical edge lacquer), blackening of glasses up to n_D approx. 1.65, fungistatic effect, good mechanical stability after curing, resistant to optical cleaning agents at RT (light wiping with a solvent-damp cleaning cloth), suitable for brush coating and spray coating (airbrush), compatible with epoxy resin adhesives e.g. adhesive 52A, typical lacquer layer thickness approx. 6-10 μ m (depending on the coating technique) Used in new designs after consultation with SPU-EC only !	Matte black, solvent-based 2-comp. epoxy resin lacquer (optical edge lacquer), blackening of glasses up to n_D approx. 1.65, fungistatic effect, good mechanical stability, adequate edge cover, resistant to optical cleaning agents at L and to acetone under certain conditions (light wiping with a solvent-damp cleaning cloth), especially suitable for brush coating and spray coating (airbrush), compatible with epoxy resin adhesives e.g. adhesive 52A Used in new designs after consultation with SPU-EC only !	Black, heat-curing, solvent-resistant optical edge lacquer for blackening of single lenses up to n_D approx. 1.74, typical lacquer edge thickness approx. 5-8 μ m, good mechanical strength (depending on the glass surface). Can be adjusted with "Thinner Optical Edge Lacquer 70" (Mat. No. 360.353)
Order details	Resin - optical edge lacquer 58 Mat. No. 513.341 Hardener - optical edge lacquer 58 Mat. No. 513.342	Resin - optical edge lacquer 5822: Mat. No. 515.235 Hardener - optical edge lacquer 58 Mat. No. 513.342	Resin - optical edge lacquer 58 NT Mat. No. 515.767 Hardener - optical edge lacquer 58 Mat. No. 513.342	Optical edge lacquer 70 Mat. No. 360.354

4.0 Lacquers

4.1 Optical edge lacquers ORL

Product designation	ORL 70/22	ORL 100
Material number	360.842	105.296
Chemical basis	Phenolic epoxy resin	Synthetic resins, dyes, fungicide additive
Intended field of application [°C]	-40/70	-55/70
Refractive index of the lacquer binder n_D (20 °C) / n_g (20 °C)	1.68	1.64
Lacquer layer thickness (brush technique) [μm]	5 – 6	5 – 8
Curing conditions	Flash off for min. 2h, 160 °C (a) 30 min. (b) 4h (kiln program)	24h / RT; 30-70 % rel. humidity
Flow time [sec] (4 mm nozzle)	12 – 13	11 – 12
Cleaning agent	Acetone, methoxypropanol	Acetone, methoxypropanol
Application features	Black, heat-curing, 2-comp., optical edge lacquer for blackening of single lenses up to n_D approx. 1.72, typical lacquer layer thickness approx. 5-6 μm , good mechanical strength (depending on glass surface), fungistatic effect Can be adjusted with "Thinner Optical Edge Lacquer 70" (Mat. No. 360.353)	Blackening of single lenses and cemented components in black mounts (lacquered surfaces are slightly transparent). Typical lacquer layer thickness 5-8 μm , blackening of glasses up to n_D approx. 1.68, coats of lacquer mechanically sensitive, pronounced fungistatic effect. Can be adjusted with "Thinner Optical Edge Lacquer 100" (Mat. No. 106.245)
Order details	Resin - optical edge lacquer 70/22 Mat. No. 360.759 Hardener - optical edge lacquer 70/22 Mat. No. 360.843	Optical edge lacquer 100 Mat. No. 105.296

4.0 Lacquers

4.2 Protective optical lacquer OSL

Product designation	Protective optical lacquer SBN 30 blue	Protective optical lacquer SBN 32 black	Protective optical lacquer SBN 34 black	Protective optical lacquer KW blue	Protective optical lacquer HSN blue
Material number	585.632	527.569	508.363	104.190	442.297
Chemical basis	Ketone formaldehyde resin, softener, nitrocellulose, solvent	Ketone formaldehyde resin, softener, nitrocellulose, solvent	Ketone formaldehyde resin, softener, nitrocellulose, solvent	Aromatic hydrocarbon resins, dye, solvent: ethyl acetate	Ketone resin, nitrocellulose, polymer softener, solvent
Softening point [°C]	-	-	-	83	-
Flash-off time [min.]: Time at RT (20-25 °C) after which a standard lacquer layer is dry to the touch	-	-	-	(2)	-
Lacquering treatment	Spraying	Brushing, dipping, spraying	Brushing, dipping, spraying	Brushing, dipping	Spraying
Intended field of application [°C]	-	-	-	up to 70	-
Flow time [sec] 4 mm nozzle	12 – 13	13 – 14	13 – 14	10 – 12	17 – 19
Application features	Bonding agent content approx. 30 %	Bonding agent content approx. 33 %	Bonding agent content approx. 34 %	Protective lacquer for the phasing of round optics (aqueous sanding suspension)	Pigment-free, standard protective lacquer, preferably spray coating Can be brought to the desired viscosity by using "Thinner for optical protection lacquer HSN blue" (Mat. No. 456.119)
Order details	Protective optical lacquer SBN 30 blue: Mat. No. 585.632	Protective optical lacquer SBN 32 black Mat. No. 527.569	Protective optical lacquer SBN 34 black Mat. No. 508.363	Protective optical lacquer KW blue: Mat. No. 104.190	Protective optical lacquer HSN blue: Mat. No. 442.297

4.0 Lacquers

4.2 Protective optical lacquer OSL

Product designation	Protective optical lacquer SKN red	Protective optical lacquer SN blue	OKS protective lacquer KW green	Protective optical lacquer KW black	Protective optical lacquer TL/D green
Material number	360.122	489.062	106.876	465.914	456.491
Chemical basis	Ketone resin, nitrocellulose, polymer softener, butyl acetate	Ketone formaldehyde resin, softener, nitrocellulose, solvent	Aromatic hydrocarbon resin, xylene, cyclohexane	Aromatic hydrocarbon resin, softener, xylene, methylcyclohexane	Aromatic hydrocarbon resin, xylene, methylcyclohexane
Softening point [°C]	-	-	-	-	-
Flash-off time [min.]: Time at RT (20-25 °C) after which a standard lacquer layer is dry to the touch	-	-	-	-	-
Lacquering treatment	Brushing	-	Brushing	-	Spraying
Intended field of application [°C]	-	-	-	-	-
Flow time [sec] 4 mm nozzle	20 – 23	18 – 22	11 – 13	10 – 12	14 – 15
Application features	Polymer-free protective lacquer, special setting for semiconductor lenses, applied by brush Can be brought to the desired viscosity by using "OKS thinner SKN" (Mat. No. 106.879)	Pigment-free, standard protective lacquer, for cameras preferably spray coating Without adhesive resin content to improve cleanability	Finishing lacquer for OSL SKN red, to improve stability towards aqueous processing media, applied by brush	Use as finishing lacquer for two-lacquer systems	Finishing lacquer for double lacquer systems, spray paintable, pigment-free (base lacquer: OSL HSN blue
Order details	Protective optical lacquer SKN red Mat. No. 360.122	Protective optical lacquer SN blue Mat. No. 489.062	OKS protective lacquer KW green Mat. No. 106.876	Protective optical lacquer KW black Mat. No. 465.914	Protective optical lacquer TL/D green Mat. No. 456.491

4.0 Lacquers

4.2 Protective optical lacquer OSL

UV
HARDENING ↓↓↓

Product designation	Protective optical lacquer UVL 48	UV AL-Photo	Masking lacquer PH	Protective lacquer PVAL 1305	Peelable lacquer UV-AZL-2015
Material number	528.485	516.820	408.384	566.267	582.892
Chemical basis	Epoxy resins, synthetic resin	Polythiol-polyene system, silicone-free, contains a fatty amine-based release agent	Rubber, cyclohexane, octane, etc.	Polyvinyl alcohol, fillers, solvent, dye	Thiol polyene lacquer, fatty amine release agent, dye
Softening point [°C]	-	-	-	-	-
Flash-off time [min.]: Time at RT (20-25 °C) after which a standard lacquer layer is dry to the touch	Allow to flash off for approx. 2-5 min. at RT, anneal at 60 °C for approx. 10 min., UV curing, refer to VV	Partial curing: 10 sec 20-25 mW/cm ² , full curing 60 sec 20-25 mW/cm ²	-	-	Partial curing: 60 sec, 30-40 mW/cm ² , 365 nm LED
Lacquering treatment	Brushing, spraying	Brushing or filling	-	-	Spraying
Intended field of application [°C]	up to 70		-	-	-
Flow time [sec] 4 mm nozzle	12 – 13	-	11	-	-
Application features	Blue colored UV-curable protective coating for processing optical surfaces Hard, scratch-resistant lacquer layer after UV curing, high water resistance at RT. Color change during UV curing Completely removable with polar solvents Not suitable for overcoating other protective layers Solvents: Ketones	Red, solvent-free, peelable protective layer, UV-curing (365 nm), used to protect optical surfaces during airbrush coating, as well as during straightening of mounted optics	Used in camera as a protective coating on certain optical edge lacquers	Used to cover the optical surfaces during the application of edge lacquer of camera optics	Used to protect optical surfaces during the edge lacquering process (airbrushing) of camera lenses, can be easily peeled off
Order details	Protective optical lacquer UVL 48 Mat. No. 528.485	UV AL-Photo Mat. No. 516.820	Masking lacquer PH Mat. No. 408.384	Protective lacquer PVAL 1305 Mat. No. 566.267	Peelable lacquer UV-AZL-2015 Mat. No. 582.892

5

Lubricants
and oils

5.0 Lubricants and oils

5.1 Lubricants

(1) Explanations on the lubricants

Base oils

SK	Synthetic hydrocarbons
Mi	Mineral oils
SE	Synthetic ester oils
PE	Polyether oils
Si	Silicone oils
FSi	Fluorine silicone oils
PFE	Perfluorinated polyether oils

Thickeners

B	Bentonites
S	Silica gel
O	Metal oxides
A	Aluminum powder
R	Special carbon black
T	PTFE powder
Li	Lithium soap
LiK	Lithium complex soap
BaK	Barium complex soap
Al	Aluminum soap
AlN	Aluminum nitride
MoS ₂	Molybdenum disulfide
BN	Boron nitride

(2) Behavior towards plastics and elastomers in the specified temperature range

Category (A): Resistant are ACM, AU, CR, CSM, EPDM, EVA, FKM, IIR, NBR, NR, PVMQ, SBR, Si, VMQ, ABS, CA, CAB, EP, PA, PBTP, PC, PE, PES, PETP, PF, PI, PMMA, PMP, POM, PP, PPO, PPS, PS, PSO, PTFE, PUR, PVC, PVDF, PVF, SAN

Category (B): Resistant are ACM, AU, CR, CSM, FKM, NBR, SBR, ABS, CA, CAB, EP, PA, PBTP, PC, PE, PES, PETP, PF, PI, PMMA, PMP, POM, PP, PPO, PPS, PS, PSO, PTFE, PUR, PVC, PVDF, SAN

Category (C): Resistant are ACM, AU, CR, FKM, NBR, ABS, CA, CAB, PA, PBTP, PC, PE, PES, PETP, PF, PI, PMP, POM, PP, PPS, PTFE, PVC, PVDF, PVF

Category (D): Resistant are EPDM, NR, SBR, VMQ, EP, PBTP, PE, PES, PETP, PF, PI, PMP, POM, PP, PSO, PTFE, PVDF, PVF

Category (E): Resistant are PA, PBTP, PE, PETP, PF, PI, PMP, POM, PP, PPS, PTFE

These are approximate values only. Practical tests are essential for critical operating conditions.

5.0 Lubricants and oils

5.1 Lubricants

(3) Apparent dynamic viscosity

Apparent dynamic viscosity is measured by using a plate-cone rotations viscosimeter at 25 °C and a velocity gradient of $D = 300 \text{ s}^{-1}$.

(4) (Static) penetration at 25 °C

Measured in 1/10 mm.

(5) Spreading behavior

Spreading is understood to mean the oil bleeding tendency of lubricants. The spreading behavior is measured at 40 °C in accordance with DIN 58397/2.

+++ SP < 10 low spreading

++ SP 10 – 50

+ SP 50 – 100

0 SP 100 – 200

+++ Sp < 200 pronounced spreading

(6) Evaporation loss

At 70 °C after 16 hours according to DIN 58397/1.

+++ < 0.1 % by weight

+++ < 0.1 - 0.3 % by weight

+++ < 0.3 - 0.6 % by weight

+++ < 0.6 - 1.2 % by weight

- >1.2 % by weight

(7) Corrosion protection effect on steel

+++ very good

++ good

+ satisfactory

0 moderate

(8) Miscibility of different base oils

Base oils	SK	MI	SE	PE	SI	FSI	PFE
SK		+	+	-	-	-	-
MI	+		+	-	-	-	-
SE	+	+		+	-	-	-
PE	-	-	+		-	-	-
SI	-	-	-	-		-	-
FSI	-	-	-	-	-		-
PFE	-	-	-	-	-	-	

+ miscible

- not miscible

5.0 Lubricants and oils

5.1.1 Lubricants: Instrument grease, F

TRIBOLOGICAL DATA

Product designation	F 5	F 10	F 15	F 30	F 30 MIL
Material number	92.212	101.883	92.213	92.214	92.219
Chemical basis (1)	SK, B	SK, B	SK, B	SK, B	SE
Intended field of application [°C]	-60 / 100	-60 / 100	-50 / 120	-60 / 130	-73 / 125
Resistance to plastics (2)	W	W	W	W	E
Viscosity [mPas] (3)	350 – 500	900 – 1,100	1,500 – 1,700	3,200 – 4,200	2,000 – 3,000
Penetration (4)	440 – 490	360 – 420	340 – 390	240 – 290	250 – 300
Spreading behavior (5)	-	0	+	0	-
Evaporation loss (6)	-	-	+	+	+
Corrosion protection (7)	+	+	+	++	++
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Very soft instrument grease, considerable oil separation after long standing times, suitable to grease very narrow fits, used for very small torques	Very soft instrument grease, considerable oil separation after long standing times, suitable to grease very narrow fits, used for very small torques	Soft instrument grease, suitable for tight fits and for small torques, lubrication of plain bearings and small gears	Instrument grease for roller bearings and high-speed spindle ball bearings, comparable to MIL-G-23827B (G-354).	Low-temperature instrument grease for roller and plain bearings and high-speed spindle ball bearings MIL-G-23827 A
Order details	Instrument grease F 5 Mat. No. 92.212	Instrument grease F 10 Mat. No. 101.883	Instrument grease F 15 Mat. No. 92.213	Instrument grease F 30 Mat. No. 92.214	Instrument grease F 30 MIL Mat. No. 92.219

5.0 Lubricants and oils

5.1.1 Lubricants: Instrument grease, F

Product designation	F 50	F 50 G	F 80	F 100	F 150
Material number	92.215	462.141	92.216	92.217	92.218
Chemical basis (1)	SK, B / T	SK, B / T	SK, B / T	SK, B / T	SK, B / T
Intended field of application [°C]	-50 / 120	-50 / 120	-50 / 120	-40 / 120	-40 / 120
Resistance to plastics (2)	W	W	W	W	W
Viscosity [mPas] (3)	3,500 – 4,500	4,000	6,000 – 7,000	8,500 – 9,500	9,000 – 12,000
Penetration (4)	250 – 290	270	230 – 270	210 – 250	140 – 190
Spreading behavior (5)	++	/	++	++	+++
Evaporation loss (6)	+	/	+	+	+
Corrosion protection (7)	0	0	0	0	0
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Instrument grease for slow sliding and rotary movements, use for lubrication of lens threads, as well as for low-loaded plain bearings for slow relative movement.	Instrument grease, contains graphite for greasing lens threads and plain bearings.	Instrument grease for slow sliding and rotary movements, use for lubrication of lens threads, as well as for low-loaded plain bearings for slow relative movement.	Instrument grease for slow sliding and rotary movements, use for lubrication of lens threads, as well as for low-loaded plain bearings for slow relative movement.	Instrument grease for slow sliding and rotary movements, use for lubrication of lens threads, as well as for low-loaded plain bearings for slow relative movement.
Order details	Instrument grease F 50 Mat. No. 92.215	Instrument grease F 50 G Mat. No. 462.141	Instrument grease F 80 Mat. No. 92.216	Instrument grease F 100 Mat. No. 92.217	Instrument grease F 150 Mat. No. 92.218

5.0 Lubricants and oils

5.1.1 Lubricants: Instrument grease, F

Product designation	F 5 T 20	F 10 T 20	F 15 T 20	F 30 T 20	F 50 G
Material number	101.308	102.347	101.309	101.310	462.141
Chemical basis (1)	SK, B / T	SK, B / T	SK, B / T	SK, B / T	SK, B / T / R
Intended field of application [°C]	-60 / 100	-50 / 120	-50 / 120	-50 / 120	-50 / 120
Resistance to plastics (2)	W	W	W	W	W
Viscosity [mPas] (3)	500 – 700	900 – 1,100	1,300 – 1,500	2,900 – 3,600	3,500 – 4,500
Penetration (4)	420 – 460	360 – 420	320 – 380	270 – 320	250 – 290
Spreading behavior (5)	-	-	+	+	++
Evaporation loss (6)	-	-	+	++	+
Corrosion protection (7)	+	+	+	+	0
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Very soft instrument grease, noticeable oil separation during prolonged standing, bridging of surface roughness by microfine PTFE powder, lubrication of lens threads and plain bearings.	Very soft instrument grease, noticeable oil separation during prolonged standing, bridging of surface roughness by microfine PTFE powder, lubrication of lens threads and plain bearings.	Soft instrument grease, contains microfine PTFE powder for greasing lens threads and plain bearings.	Soft instrument grease, contains microfine PTFE powder for greasing lens threads and plain bearings.	Instrument grease for slow sliding and rotary movements, use for lubrication of lens threads, as well as for low-loaded plain bearings for slow relative movement. Contains graphite to improve lubricating properties.
Order details	Instrument grease F 5 T 20 Mat. No. 101.308	Instrument grease F 10 T 20 Mat. No. 102.347	Instrument grease F 15 T 20 Mat. No. 101.309	Instrument grease F 30 T 20 Mat. No. 101.310	Instrument grease F 50 G Mat. No. 462.141

5.0 Lubricants and oils

5.1 Lubricants: Gear grease, GF

TRIBOLOGICAL DATA

Product designation	GF 15	GF 30	GF 40	GF 40 M	GF 40 EL
Material number	92.223	92.224	101.299	106.772	521.371
Chemical basis (1)	PE, Li	SK, B	Mi / SK, LiK	Mi / SK, LiK, MoS2	Mi / SK, LiK/ R
Intended field of application [°C]	-40 / 120	-40 / 120	-40 / 150	-40 / 150	-40 / 150
Resistance to plastics (2)	D	W	W	W	W
Viscosity [mPas] (3)	1,100	3,500	4,500	4,500	4,500
Penetration (4)	400	330	250	250	250
Spreading behavior (5)	+	++	++	++	++
Evaporation loss (6)	+	0	++	++	++
Corrosion protection (7)	+	+	++	++	++
Cleaning agent	Acetone, IPA, methylated spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Soft, high-performance gear grease with thixotropic properties, to grease capsuled gear components. Caution: Do not mix with other gear lubricants !	Highly adhesive gear grease, especially for open gears as well as for joints and plain bearings.	Highly adhesive, well wetting gear grease, used for roller and plain bearings as well as in joints and sliding guides, especially in case of boundary lubrication and risk of tribocorrosion in case of micro sliding friction, vibration and pendulum motion.	Heavy gear grease with properties comparable to GF 40, contains molybdenum disulfide ("Molykote") for emergency lubrication.	Heavy-duty gear grease with comparable properties to GF 40, containing additionally conductive carbon black
Order details	Gear grease GF 15 Mat. No. 92.223	Gear grease GF 30 Mat. No. 92.224	Gear grease GF 40 Mat. No. 101.299	Gear grease GF 40 M Mat. No. 106.772	Gear grease GF 40 EL Mat. No. 521.371

5.0 Lubricants and oils

5.1.2 Lubricants: Gear grease, GF

Product designation	GF 50	50% dispersion GF 20	50% dispersion GF 40	50% dispersion GF 50	GF 100
Material number	92.225	360.263	534.522	497.851	92.226
Chemical basis (1)	SK, BaK	SK, BaK, Lösemittel	SK, BaK, Lösemittel	SK, BaK, Lösemittel	Mi, BaK
Intended field of application [°C]	-60 / 160	-60 / 160	-60 / 150	-60 / 160	-35 / 150
Resistance to plastics (2)	W	W	W	W	C
Viscosity [mPas] (3)	5,500	/	/	/	7,000 – 9,000
Penetration (4)	240	/	/	/	230
Spreading behavior (5)	++	/	/	/	++
Evaporation loss (6)	+	/	/	/	+
Corrosion protection (7)	++	/	/	/	+++
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Highly adhesive wide-range gear grease Used to grease roller and plain bearings, for gears, joints and guide slide bearings, identical to MIL-G81322D (G-395)	Highly adhesive wide-range gear grease Used to grease pressure springs Applied by dipping or brushing Lubrication of trailing cables IMT	Highly adhesive wide-range gear grease Used to grease pressure springs Applied by dipping or brushing Lubrication of trailing cables IMT	Highly adhesive wide-range gear grease Used to grease pressure springs Applied by dipping or brushing Lubrication of trailing cables IMT	Highly adhesive lubricant with high corrosion protection, also when subjected to sea water Used to grease plain bearings, gears and joints
Order details	Gear grease GF 50 Mat. No. 92.225	Gear grease GF 50 20% dispersion Mat. No. 360.263	40% dispersion gear grease Mat. No. 534.522	Gear grease GF 50 50% dispersion Mat. No. 497.851	Gear grease GF 100 Mat. No. 92.226

5.0 Lubricants and oils

5.1.2 Lubricants: Gear grease, GF

Product designation	GF 100 AL 30
Material number	92.976
Chemical basis (1)	Mi, BaK/A
Intended field of application [°C]	-35 / 120
Resistance to plastics (2)	C
Viscosity [mPas] (3)	10,000 – 12,000
Penetration (4)	240
Spreading behavior (5)	++
Evaporation loss (6)	+
Corrosion protection (7)	+++
Cleaning agent	Petroleum ether, white spirit
Application features	Highly adhesive electrically conductive lubricant with high corrosion protection, also when subjected to sea water Used to grease plain bearings, gears and joints
Order details	Conductive paste GF 100 AL 30 Mat. No. 92.976

5.0 Lubricants and oils

5.1.3 Lubricants: Adhesive grease, HF

Product designation	HF 200	HF 300	HF 350	HF 500
Material number	92.410	92.411	360.071	92.412
Chemical basis (1)	Mi / SE, Li	SK, B / A	SK, LiK	SK, B / Al
Intended field of application [°C]	-30 / 120	-30 / 120	-30 / 120	-25 / 120
Resistance to plastics (2)	C	-	-	W
Viscosity [mPas] (3)	10,000 – 15,000	32,000	30,000	60,000
Penetration (4)	160	180	-	70
Spreading behavior (5)	++	+++	+++	+++
Evaporation loss (6)	+	+	+	++
Corrosion protection (7)	+	+	+	+
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Viscous adhesive and brake grease, sealing grease for folding bridges and joints	Viscous adhesive and brake grease	Viscous adhesive and brake grease	Very firm adhesive and brake grease
Order details	Adhesive grease HF 200 Mat. No. 92.410	Adhesive grease HF 300 Mat. No. 92411	Adhesive grease HF 350 Mat. No. 360.071	Adhesive grease HF 500 Mat. No. 92.412

5.0 Lubricants and oils

5.1.4 Lubricants: Adhesive camera grease, HF

TRIBOLOGICAL DATA

Product designation	HP 30	HP 30 B	HP 50	HP 80	HP 100
Material number	566.161	566.162	442.086	419.348	419.342
Chemical basis (1)	SK, LiK	SK, LiK/BN	SK, LiK	SK, LiK	SK, LiK
Intended field of application [°C]	/	/	/	/	/
Resistance to plastics (2)	-	-	-	-	-
Viscosity [mPas] (3)	2,400 – 2,900	2,700 – 3,200	4,500	7,500	9,500
Penetration (4)	280 – 310	/	255	255	240
Spreading behavior (5)	+	/	/	++	/
Evaporation loss (6)	/	/	/	/	/
Corrosion protection (7)	/	/	/	/	/
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Soft special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces	Boron nitride-containing long-life special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces	Long-life special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces	Long-life special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces TOC <150 ng/mg and/or ppm (80 °C / 2 min., GC-MS)	Long-life special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces
Order details	Photo adhesive grease HP 30 Mat. No. 566.161	Photo adhesive grease HP 30 B Mat. No. 566.162	Photo adhesive grease HP 50 Mat. No. 442.086	Photo adhesive grease HP 80 Mat. No. 419.348	Photo adhesive grease HP 100 Mat. No. 419.342

5.0 Lubricants and oils

5.1.4 Lubricants: Adhesive camera grease, HF

Product designation	HP 120	HP 150
Material number	419.344	419.347
Chemical basis (1)	SK, LiK	SK, LiK
Intended field of application [°C]	/	/
Resistance to plastics (2)	-	-
Viscosity [mPas] (3)	12,500	15,000
Penetration (4)	230	210
Spreading behavior (5)	+++	++-
Evaporation loss (6)	/	/
Corrosion protection (7)	/	/
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit
Application features	Long-life special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces TOC <100 ng/mg and/or ppm (80 °C / 2 min., GC-MS)	Long-life special lubricating greases with good surface adhesion, viscosity level adjusted for camera lenses (fine screw threads, motion threads) and eyepieces
Order details	Photo adhesive grease HP 120 Mat. No. 419.344	Photo adhesive grease HP 150 Mat. No. 419.347

5.0 Lubricants and oils

5.1.5 Lubricants: HL special greases, SF-HL

Product designation	SF-HL 20	TEM-BN 20	SF-HL 30 / SF-HL 40	TEM-BN 30	SF-HL 60
Material number	522.431	610.293	456.489	484.956	456.490
Chemical basis (1)	PFE, BN	PFE, BN	PFE, BN	PFE, BN	PFE, BN
Intended field of application [°C]	/	/	/	/	/
Resistance to plastics (2)	A		-	A	-
Viscosity [mPas] (3)	1,300 – 1,600	1,700 – 2,300	3,500 / 3,300 – 3700	3,200 – 3,600	5,700
Penetration (4)	/	/	/	/	/
Spreading behavior (5)	/	/	++	/	+
Evaporation loss (6)	/	/	/	/	/
Corrosion protection (7)	0	/	0	/	0
Cleaning agent	Petroleum ether (Pre-cleaning using a fluorinated solvent LM e.g. petroleum ether Galden ZT 130, post-cleaning with a fluorinated solvent)	Petroleum ether (pre-cleaning with a fluorinated solvent LM e.g. H-Galden ZT 130, post-cleaning with petroleum ether)	Petroleum ether (Pre-cleaning using a fluorinated solvent LM e.g. petroleum ether Galden ZT 130, post-cleaning with a fluorinated solvent)	Galden ZT 130 (pre-cleaning), fluorinated solvent 40/60 (post-cleaning)	Petroleum ether (Pre-cleaning using a fluorinated solvent LM e.g. petroleum ether Galden ZT 130, post-cleaning with a fluorinated solvent)
Application features	Lubricating paste containing boron nitride for clean room and high vacuum applications, spindle lubrication of lithography systems	Special grease containing boron nitride for high-vacuum applications in electron microscopes (NTS) TOC <10 ng/mg or ppm (200 °C / 2 min., GC-MS)	Lubricating paste containing boron nitride for clean room and high vacuum applications, spindle lubrication of lithography systems	Special grease containing boron nitride for high-vacuum applications in electron microscopes (NTS) TOC <10 ng/mg or ppm (200 °C / 2 min., GC-MS)	Lubricating paste containing boron nitride for clean room and high vacuum applications, spindle lubrication of lithography systems
Order details	HL special grease SF-HL 20 Mat. No. 522.431	High vacuum special grease TEM - BN 20 Mat. No. 610.293	HL special grease SF-HL 30 Mat. No. 456.489 HL special grease SF-HL 40 Mat. No. 527.439	High vacuum special grease TEM - BN 30 Mat. No. 484.956	HL special grease SF-HL 60 Mat. No. 456.490

5.0 Lubricants and oils

5.1.5 Lubricants: HL special greases, SF-HL

TRIBOLOGICAL DATA

Product designation	SF-HL 100	SF-HL 150
Material number	456.780	599.751
Chemical basis (1)	PFE, BN	PFE, BN
Intended field of application [°C]	/	/
Resistance to plastics (2)	-	-
Viscosity [mPas] (3)	10,000 – 12,000	15,000 – 18,000
Penetration (4)	/	/
Spreading behavior (5)	++	/
Evaporation loss (6)	/	/
Corrosion protection (7)	0	/
Cleaning agent	Petroleum ether (Pre-cleaning using a fluorinated solvent LM e.g. H-Galden ZT 130, post-cleaning with petroleum ether)	Petroleum ether (pre-cleaning with a fluorinated solvent LM e.g. H-Galden ZT 130, post-cleaning with petroleum ether)
Application features	Lubricating paste containing boron nitride for clean room and high vacuum applications	Lubricating paste containing boron nitride for clean room and high vacuum applications Used for sluice lubrication within the project 3 FM VITA
Order details	HL special grease SF-HL 100 Mat. No. 456.780	HL special grease SF-HL 150 Mat. No. 599.751

5.0 Lubricants and oils

5.1.6 Lubricants: Teflon grease, TF

Product designation	TF 6TF 6	TF 10	TF 20	TF 30	TF 50 HV
Material number	569.616	87.607	522.433	92.413	101.311
Chemical basis (1)	PFE, T	FSi, T	PFE, T	PFE, T	PFE, T
Intended field of application [°C]	- 80 / 150	-40 / 180	/	-60 / 280	-30 / 250
Resistance to plastics (2)	A	A	A	A	A
Viscosity [mPas] (3)	520 – 640	1,500	1,400 – 1,600	3,500	5,000
Penetration (4)	/	380	/	260	290
Spreading behavior (5)	/	++	/	+++	+++
Evaporation loss (6)	/	++	/	++	+++
Corrosion protection (7)	/	0	/	0	0
Cleaning agent	Petroleum ether	Petroleum ether	Petroleum ether	Petroleum ether	Petroleum ether
Application features	Highly aging-resistant grease with high chemical resistance and inert behavior towards plastics and elastomersUse in cameras for adjusting and fine pitch threads	Soft, wide-range grease with high chemicals resistance, very high ageing stability for the lubrication of roller and plain bearings, suitable for plastic/ plastic sliding pairs	Use in cameras	Highly aging-resistant grease with high chemical resistance and inert behavior towards plastics and elastomers Lubrication of rolling and plain bearings, especially plastic-plastic pairings Lubrication of silicone O-ring seals and plastic gears, high vacuum capability, good low-temperature behavior	High vacuum-compatible grease (up to 10-10 mbar at 25 °C) with very high ageing stability, high chemicals resistance, inert towards plastics and elastomers Suitable for constantly high temperatures Lubrication of roller and plain bearings as well as small gears
Order details	Teflon grease TF 6 Mat. No. 569.616	Teflon grease TF 10 Mat. No. 87.607	Teflon grease TF 20 Mat. No. 522.433	Teflon grease TF 30 Mat. No. 92.413	High vacuum Teflon grease TF 50 HV Mat. No. 101.311

5.0 Lubricants and oils

5.1.6 Lubricants: Teflon grease, TF

TRIBOLOGICAL DATA

Product designation	TF 60	TF 100 HV	TF 200 HV
Material number	495.001	96.249	101.820
Chemical basis (1)	PFE, T	PFE, T	PFE, T
Intended field of application [°C]	/	-30 / 250	-25 / 280
Resistance to plastics (2)	A	A	A
Viscosity [mPas] (3)	4,800 – 5,500	8,000 – 10,000	12,000 – 16,000
Penetration (4)		230	130
Spreading behavior (5)	+++	+++	+++
Evaporation loss (6)	/	+++	+++
Corrosion protection (7)	/	0	0
Cleaning agent	Petroleum ether	Petroleum ether	Petroleum ether
Application features	Used for long-range instruments e.g. telescopic sights	High vacuum-compatible grease (up to 10 ⁻¹⁰ mbar at 25 °C) with very high ageing stability, high chemicals resistance, inert towards plastics and elastomers Suitable for constantly high temperatures Used as sealing grease as well as adhesive and brake grease	High vacuum-compatible grease (up to 10 ⁻¹⁰ mbar at 25 °C) with very high ageing stability, high chemicals resistance, inert towards plastics and elastomers Suitable for constantly high temperatures Used as sealing grease as well as adhesive and brake grease
Order details	Teflon grease TF 60 Mat. No. 495.001	High vacuum Teflon grease TF 10 HV Mat. No. 96.249	High vacuum Teflon grease TF 200 HV Mat. No. 101.820

5.0 Lubricants and oils

5.1.7 Lubricants: Vacuum paste/silicone paste

Product designation	High-vacuum paste 100-M	SF 60 M	SP 30	Silicone paste SP 100	P 12
Material number	105.479	504.817	66.349	92.235	74.887
Chemical basis (1)	PFE, MoS ₂	PFE, MoS ₂	SK, LiK	Si, S	SK
Intended field of application [°C]	-30 / 180	-30/180	-73/180	-40 / 210	-40/200
Resistance to plastics (2)	A	A	/	W	/
Viscosity [mPas] (3)	10,000	5,000 – 7,000	3,800	12,000	27,000 – 30,000
Penetration (4)	260	/	240	330	300
Spreading behavior (5)	/	/	/	+++	/
Evaporation loss (6)	/	/	-	++	+
Corrosion protection (7)	/	/	/	+	/
Cleaning agent	Petroleum ether	Petroleum ether	Petroleum ether	Petroleum ether	Petroleum ether
Application features	High vacuum-compatible grease (up to 10 ⁻¹⁰ mbar at 25 °C) with very high ageing stability, high chemicals resistance, inert towards plastics and elastomers Suitable for constantly high temperatures Used as sealing grease.	Heavy-duty grease with very high ageing stability, high chemical resistance, inert to plastics and elastomers Suitable for constantly high temperatures	Lubricating grease with high oxidation resistance, compatibility with many plastics as well as water resistance For use on pulleys, control cables, electric clocks, motors, windshield wiper motors, starter motors, photographic and optical equipment, and monitoring equipment	Consistent silicone paste, highly water repellent, good chemical resistance, use as sealing grease for valves, gaskets, O ring seals, lubricating grease for chemical devices	Lubricating paste as a heat-dissipating filler material, especially in semiconductor technology
Order details	High-vacuum paste 100-M Mat. No. 105.479	Special grease SF 60 M Mat. No. 504.817	Silicone paste SP 30 Mat.-Nr. 66.349	Silicone paste SP 100 Mat. No. 92.235	Silicone heat-conducting paste P 12 Mat. No. 74.887

5.0 Lubricants and oils

5.2 Other lubricants

Product designation	Contact grease C 15	Heat-conducting paste HT	WV grease	Rust-protective petroleum jelly	Lubricating lacquer Unimoly C 220
Material number	101.312	149.920	69.265	101.119	92.641
Chemical basis (1)	Mi, R	PFE, AlN			MoS ₂ solvent
Intended field of application [°C]	-10 / 70	-70 / 280	-10 / 40	-10 / 40	-180 / 450
Resistance to plastics (2)	C	A	/	/	C
Viscosity [mPas] (3)	5,900	5,300	/	/	/
Penetration (4)	170	/	/	/	/
Spreading behavior (5)	+	+++	+	+	/
Evaporation loss (6)	+	+++	/	/	+++
Corrosion protection (7)	0	0	+	+	0
Cleaning agent	Petroleum ether, white spirit	Petroleum ether	Petroleum ether	Petroleum ether	Petroleum ether, white spirit
Application features	Contact lubricant for low-ohm electrical contacts, e.g. in probe heads (IMT)	High temperature, heat-conducting paste, high vacuum-compatible, heat dissipation in UHV systems, vapor pressure at 20 °C below 10 ⁻¹⁰ mbar	Lubricant, provisional lubrication of unloaded lubrication points	Lubricant, provisional lubrication of unloaded lubrication points with corrosion protection	Release agents
Order details	Contact grease C 15 Mat. No. 101.312	Heat-conducting paste HT Mat. No. 149.920	WV grease Mat. No. 69.265	Rust-protective petroleum jelly Mat. No. 101.119	Lubricating lacquer Unimoly C 220 Mat. No. 92.641

5.0 Lubricants and oils

5.2 Other lubricants

Product designation	Anticorrosion agent Controxid
Material number	103.961
Chemical basis (1)	Mi, SK
Intended field of application [°C]	-30 / 70
Resistance to plastics (2)	C
Viscosity [mPas] (3)	low-viscosity
Penetration (4)	/
Spreading behavior (5)	/
Evaporation loss (6)	+
Corrosion protection (7)	++
Cleaning agent	Petroleum ether, white spirit
Application features	High temperature, heat- conducting paste, high vacuum- compatible, heat dissipation in UHV systems, vapor pressure at 20 °C below 10 ⁻¹⁰ mbar
Order details	Anticorrosion agent Controxid Mat. No. 103.961

5.0 Lubricants and oils

5.3 Oils

Product designation	Oil 15	Oil 15 20% Petroleum ether	Instrument oil Oil 68	Watch oil 46	Adhesive oil 1.500
Material number	92.232	419.028	92.233	101.313	360.431
Chemical basis (1)	SK	SK, petroleum ether, solvent	SK	PE	SK
Intended field of application [°C]	-60 / 120	-40 / 120	-50 / 120	-30 / 100	-20 / 120
Resistance to plastics (2)	W	W	W	D	W
Kinematic viscosity [mm²/s] (3) at					
-40 °C	500	/	7,200	/	/
-20 °C	130	/	1,350	3,800	/
0 °C	55	/	380	625	/
20 °C	27	~ 15 (oil content)	140	150	4,340
25 °C		/	/	/	/
40 °C	15	/	65	49	1,900
100 °C	4.7	/	14	(7)	/
Viscosity index	270	/	230	100	/
Density [g/cm³] at 20 °C	0.83	/	0.86	0.91	0.85
Flash point [°C]	175	< -20	200	240	/
Corrosion protection effect (7)	+	/	+	0	0
Cleaning agent	Petroleum ether, white spirit	/	Petroleum ether, white spirit		Petroleum ether, white spirit
Application features	Instrument oil for precision metrology with wear protection properties	Instrument oil for precision metrology with wear protection properties In case of very thin oil films	Instrument oil for precision metrology with wear protection properties	Age-resistant synthetic watch oil, minimum volatility, no leaking from bearings, used for very tight-fitting plain bearings	Adhesive lubricant with high-pressure properties, to grease plain bearings, joints, bolts and slide bearings
Order details	Oil 15 Mat. No. 92.232	Oil 15 20% Petroleum ether Mat. No. 419.028	Instrument oil Oil 68 Mat. No. 92.233	Watch oil 46 Mat. No. 101.313	Adhesive oil 1.500 Mat. No. 360.431

5.0 Lubricants and oils

5.3 Oils

Product designation	Adhesive oil 10.000	Contact oil EK Oil 30	Friction gear oil 22	LIT Oil 300 / TEM Oil 300	LIT Oil 500
Material number	102.348	530.393	105.914	456.079 / 484.955	457.522
Chemical basis (1)	SK	PFE	SK, Mi	PFE	PFE
Intended field of application [°C]	-20 / 120	-80 / 150	-30 / 120	/	/
Resistance to plastics (2)	W	A	C	/	/
Kinematic viscosity [mm²/s] (3) at					
-40 °C	/	380	/	/	/
-20 °C	/	130	/	/	/
0 °C	/	56	/	/	/
20 °C	4,340	30	/	280	500
25 °C	/	/	/	/	/
40 °C	1,900	18	20 – 25	165	160
100 °C	/	/	/	/	/
Viscosity index	/	/	/	/	/
Density [g/cm³] at 20 °C	0.85	1.82	/	/	/
Flash point [°C]	/	/	/	/	/
Corrosion protection effect (7)	0	0	+	/	/
Cleaning agent	Petroleum ether, white spirit	Petroleum ether	Petroleum ether, white spirit	/	/
Application features	Adhesive lubricant with high-pressure properties, to grease plain bearings, joints, bolts and slide bearings	Age-resistant contact oil, lubrication of sliding contacts, noble metal contacts in particular Replacement for contact oil EK oil 22 Mat. No. 92.310	Special oil for friction gears (friction drive)	Special grease for use in SMT products, clean room aeras, high vacuum applications, i.a. in electron microscopes TOC max. 20 mg/mg or ppm (200 °C/2 min., GC-MS)	Special grease for use in SMT products, clean room aeras, high vacuum applications, TOC max. 20 mg/mg or ppm (200 °C / 2 min., GC-MS)
Order details	Adhesive oil 10.000 Mat. No. 102.348	Contact oil EK Oil 30 Mat. No. 1530.393	Friction gear oil 22 Mat. No. 105.914	LIT Oil 300 / TEM Oil 300 Mat. No. 456.079 / Mat. No. 484.955	LIT Oil 500 Mat. No. 457.522

5.0 Lubricants and oils

5.3 Oils

Product designation	LIT oil 600	LIT oil 3000	Damping oil E 15.000	Damping oil KW 3.000	Damping oil KW 20.000
Material number	527.440	457.523	424.439	521.803	464.799
Chemical basis (1)	PFE	PFE	SK	SK	SK
Intended field of application [°C]	/	/	/	/	/
Resistance to plastics (2)	/	/	/	/	/
Kinematic viscosity [mm²/s] (3) at					
-40 °C	/	/	/	/	/
-20 °C	/	/	/	/	/
0 °C	/	/	/	/	/
20 °C	600	2,900	15,000 – 16,000	4,100	/
25 °C	/	/	/	3,000	16,500
40 °C	355	740	/	1,300	/
100 °C	/	/	/	/	/
Viscosity index	/	/	/	/	/
Density [g/cm³] at 20 °C	/	/	1.22 (AT 25 °C)	0.85	0.84
Flash point [°C]	/	/	> 150	282	191
Corrosion protection effect (7)	/	/	/	/	/
Cleaning agent	/	/	Acetone	/	/
Application features	Special grease for use in SMT products, clean room areas, high vacuum applications, TOC max. 20 mg/mg or ppm (200 °C / 2 min., GC-MS)	Special grease for use in SMT products, clean room areas, high vacuum applications, TOC max. 20 mg/mg or ppm (200 °C / 2 min., GC-MS)	Silicone-free damping oil for measuring machines (IMT)	Silicone-free damping oil for measuring machines (IMT)	Silicone-free damping oil for measuring machines (IMT) Scale fixation
Order details	LIT oil 600 Mat. No. 527.440	LIT oil 3000 Mat. No. 457.523	Damping oil E 15.000 Mat. No. 424.439	Damping oil KW 3.000 Mat. No. 521.803	Damping oil KW 20.000 Mat. No. 464.799

5.0 Lubricants and oils

5.3 Oils

Product designation	LIT damping oil KW 60.000	Damping oil KW 70.000	Silicone oil AK 50	Silicone oil M 5.000	Silicone oil M 12.500
Material number	527.499	104.917	105.227	98.592	98.593
Chemical basis (1)	SK	SK	Si	Si	Si
Intended field of application [°C]	/	/	-40 / 180	-40 / 180	-40 / 180
Resistance to plastics (2)	/	/	W	W	W
Kinematic viscosity [mm²/s] (3) at					
-40 °C	/	/	/	21,000	60,000
-20 °C	/	/	/	12,500	35,000
0 °C	/	/	/	8,000	22,000
20 °C	/	60,000 – 70,000	/	5,700	14,000
25 °C		/	50	/	/
40 °C	/	/	/	4,000	9,800
100 °C	/	/	/	1,700	3,800
Viscosity index	/	/	/	> 400	> 400
Density [g/cm³] at 20 °C	0.86	0.84 (AT 25 °C)	0.96 (25 °C)	0.98	0.98
Flash point [°C]	> 150	> 140	> 250	> 300	> 300
Corrosion protection effect (7)	/	/	0	0	0
Cleaning agent	Petroleum ether, white spirit	Petroleum ether, white spirit	Petroleum ether	Petroleum ether	Petroleum ether
Application features	Low outgassing damping oil for clean room applications (LIT). TOC <10 ng/mg or. ppm (120 °C / 2 min., GC-MS)	Silicone-free damping oil for measuring machines (IMT)	Silicone oil for microphones	Methyl silicone oil Use as a damping agent	Methyl silicone oil Use as a damping agent
Order details	LIT damping oil KW 60.000 Mat. No. 527.499	Damping oil KW 70.000 Mat. No. 104.917	Silicone oil AK 50 Mat. No. 105.227	Silicone oil M 5.000 Mat. No. 98.592	Silicone oil M 12.000 Mat. No. 98.593

5.0 Lubricants and oils

5.3 Oils

Product designation	Silicone oil M 60.000	Silicone oil M 300.000	Paraffin oil M	Cooling lubricant KM 88/1
Material number	98.597	360.132	648.779	360.559
Chemical basis (1)	Si	SK	/	/
Intended field of application [°C]	-40 / 180	-40 / 180	/	/
Resistance to plastics (2)	W	W	/	/
Kinematic viscosity [mm²/s] (3) at				
-40 °C	350,000	/	/	/
-20 °C	180,000	/	/	/
0 °C	105,000	/	/	/
20 °C	57,000 – 63,000	/	/	/
25 °C	/	/	/	/
40 °C	43,000	270,000 – 330,000	/	/
100 °C	15,000	/	/	/
Viscosity index	> 400	/	/	/
Density [g/cm³] at 20 °C	0.98	* 0.96 – 0.98	/	/
Flash point [°C]	> 300	> 320	/	/
Corrosion protection effect (7)	0	/	/	/
Cleaning agent	Petroleum ether	Petroleum ether	/	/
Application features	Methyl silicone oil use as a damping agent	Methyl silicone oil use as damping oil	Use for special processes in optics and as a model system (lubricant, auxiliary material) in medical devices and processes	Use in laser engraving machines
Order details	Silicone oil M 60.000 Mat. No. 98.957	Silicone oil M 300.000 Mat. No. 360.132	Paraffin oil M Mat. No. 548.779	Cooling lubricant KM 88/1 Mat. No. 360.559

5.0 Lubricants and oils

5.4 Immersion oils

Product designation	Immersol® 518 N	Immersol® 518 F	Immersol® M	Immersol® HI 661	Immersol® 2010 W	Immersol® G
Material number	424.187	360.890	488.362	616.325	522.046	531.910
Area of application	Standard oil for microscopy, corresponds to ISO 8036. Also suitable for open preparations (without cover slips) with lens Achromplan 100 x / 1,25 oil o.D.	Fluorescence microscopy, optimized dispersion, corresponds to ISO 8036. Also suitable for open preparations (without cover slips) with Achromplan 100 x lens / 1,25 oil o.D.	Immersion oil for metallography, corresponds to with ISO 8036	Highly refractive immersion liquid for high-resolution microscopy. Suitable in combination with coverslips made of NSSK2 Alpha-Plan-Apochromat 100x1,57	Immersion oil for water immersion, not suitable for open preparation (without coverslip), dissolves dye	Immersion glycerine
Chemical basis (1)	Synthetic ester oils Hydrocarbons, non-halogen	Ester oils, non-halogen	Alcohols, glycols, esters, non-halogen	Dithiourethane resin	Urethane-modified alcohol-terminated perfluoropolyether	Alcohol
Refractive indexes (23 °C)						
at 546.1 nm (e)	1.5180	1.5180	1.5180	1.6610	1.3339	1.4560
at 589.3 nm (D)	1.5150	1.5151	1.5151	1.6532	1.3329	1.4541
Dispersion v_e (23 °C)	42.1	45.8	45.8	20.6	82.2	58.5
Transmission (d=10 mm)				d = 1 mm		
450 nm				97		99 (320 nm)
420 nm	95	99		92		90 (300 nm)
400 nm	92	98		62		80 (270 nm)
380 nm	88	96	98	(2)	97	70 (240 nm)
365 nm	82	94	95		95	
350 nm	70	88	90		92	
Intrinsic fluorescence [mg/l] Quinine sulfate – equivalent quantity	max. 0.30 max. 10	max. 0.05 max. 1.0	max. 0.20 max. 5.0		max. 0.20 max. 8.0	max. 0.02 max. 0.5
F (365 nm / 450 nm) F (405 nm / 485 nm) (F excitation / F emission)						
Order details	Immersol® 518 N Mat. No. 424.187	Immersol® 518 F Mat. No. 360.890	Immersol® M Mat. No. 488.362	Immersol® HI 661 Mat. No. 616.325	Immersol® 2010 W Mat. No. 522.046	Immersol® G Mat. No. 531.910

6

Miscellaneous

6.0 Miscellaneous

6.1 Other auxiliary materials

Product designation	Dust binder SBL 2010	Dust binder SBL P	Dust binder SBL 9606 / FU
Material number	519.408	498.139	360.857
Chemical basis (1)	Synthetic hydrocarbons, fillers, petroleum ether (solvent), dye	High vacuum grease P, petroleum ether (solvent)	Synthetic hydrocarbons, fillers, petroleum ether
Temperature range for applications	-25 / 100	-10 / 70	-25 / 100
Application features	Viscous variant of dust binder solution SBL 2010 Solvent-containing adhesive dispersion, leaves a black, sticky film after evaporation of the solvent content, which binds interfering small particles and dust inside housings of optical devices by adhesion, fungicides	Replacement for Hensoldt dust binder solution (Mat. No. 153.661). Use with CZ-Surgical	Solvent-containing adhesive dispersion, leaves a black, sticky film after evaporation of the solvent content, which binds interfering small particles and dust inside housings of optical devices by adhesion, fungicides
Order details	Dust binder SBL 2010 Mat. No. 519.408	Dust binder SBL P Mat. No. 498.139	Dust binder SBL 9606 / FU Mat. No. 360.857

6.0 Miscellaneous

6.1 Other auxiliary materials

Product designation	Optics cleaning mixture L	Optics cleaning mixture HL	Optics cleaning mixture CP	Fungus cleaner (new)	Adhesive coating mixture KBM18
Material number	105.200	360.582	587.293	102.527	470.158
Chemical basis (1)	Special gasoline, 40-60 °C, isopropanol	Diethyl ether, special gasoline, ethyl alcohol	Cycloalkane, isopropanol	Ethanol, water	Acrylic, solvent
Temperature range for applications	RT	RT	RT	RT	RT
Application features	Cleaning of optical surfaces	Cleaning of optical surfaces, extremely low flash point, strongly narcotic vapors	Cleaning of optical surfaces Hexane-free formulation	Cleaning of fungus contaminated optics	Results in pressure-sensitive adhesive coating
Order details	Optics cleaning mixture L Mat. No. 105.200	Optics cleaning mixture HL Mat. No. 360.582	Optics cleaning mixture CP Mat. No. 587.293	Fungus cleaner (new) Mat. No. 102.527	Adhesive coating mixture KBM18 Mat. No. 470.158

6.0 Miscellaneous

6.1 Other auxiliary materials

Product designation	DEGBE (for WELLE)	Glymo primer	ADM primer	Optics lacquer thinner 56	Optics lacquer thinner 1.6
Material number	592.317	104.216	88.136	105.649	613.233
Chemical basis (1)	Polyol	Organosilane solution	Organosilane solution	Alcohol mixture	Mixture of acetates and ketones
Temperature range for applications			-55 / 200		
Application features	Cleaning medium for WELLE	Bonding agent for epoxy adhesives, DK 2014A, DK 2014B, preferably for glass substrates	Bonding agent for condensation-crosslinking sealants, ADM 5, ADM 5A, ADM 5A/1, ADM 5B, ADM 5C and ADM 5W	Thinner for optical edge lacquer 56	Thinner for optical edge lacquer 1.6
Order details	DEGBE (for WELLE) Mat. No. 592.317	Glymo primer Mat. No. 104.216	ADM primer Mat. No. 88.136	Optics lacquer thinner 56 Mat. No. 105.649	Optical edge lacquer thinner 1.6 Mat. No. 613.233

6.0 Miscellaneous

6.1 Other auxiliary materials

Product designation	Optical edge lacquer thinner 57	Optical edge lacquer thinner 70	Optical edge lacquer thinner 100	Protective optical lacquer thinner HSN blue	OKS thinner SKN
Material number	360.344	360.353	106.245	456.119	106.879
Chemical basis (1)	Mixture of acetates and alcohols	Mixture of alcohols and ketones	Mixture of alcohols	Solvent blend, acetone	Solvent blend, acetone
Temperature range for applications					
Application features	Thinner for optical edge lacquer 57	Thinner for optical edge lacquer 70	Thinner for optical edge lacquer 100	Thinner for optical protective lacquer HSN blue	Thinner for OKS protective lacquer SKN red
Order details	Thinner for optical edge lacquer 57 Mat. No. 360.344	Thinner for optical edge lacquer 70 Mat. No. 360.353	Thinner for optical edge lacquer 100 Mat. No. 106.245	Protective optical lacquer thinner HSN blue Mat. No. 456.119	OKS thinner SKN Mat. No. 106.879

6.0 Miscellaneous

6.1 Other auxiliary materials

Product designation	OKS thinner KW
Material number	106.875
Chemical basis (1)	Mixture of alkanes and aromatics
Temperature range for applications	
Application features	Thinner for OKS protective lacquer KW green

Order details	OKS thinner KW Mat. No. 106.875
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6.0 Miscellaneous

6.2 Other products OHM

Product designation	Desmopan polishing pads Desmopan line pattern	Desmopan polishing pads Desmopan cross pattern
Material number	1949-778	1951-896
Basic material	Desmopan, Shore hardness A (ISO 868) approx. 97	Desmopan, Shore hardness A (ISO 868) approx. 97
Diameter of pads	130 mm	130 mm
Thickness of pads	0.5 mm	0.5 mm
Raster depth	200 – 250 µm	200 – 250 µm
Frequency	approx. 200 µm	approx. 450 µm
Order details	Desmopan line pattern Mat. no. 1949-778	Desmopan line pattern Mat. no. 1951-896



Desmopan line pattern



Desmopan cross pattern

Ready-to-use mixed polishing agent suspensions for fine optical polishing

Opaline suspension (basis: cerium dioxide) in the following polishing agent densities, average hydrodynamic grain diameter: approx. 1 µm; ready-mixed as a ready-to-use polishing agent suspension; quality assurance by polishing agent test (pH value, removal behavior, fit, microscopic findings, microroughness, average particle size)

Product designation	Opaline suspension 1.01	Opaline suspension 1.04	Opaline suspension 1.07	Opaline suspension 1.08	Opaline suspension 1.08	Opaline suspension 1.20
Material number	2412-661	1518-230	2175-662	1462-865	2411-201	1518-231
Density [g/cm³]	1.01	1.04	1.07	1.08	1.08	1.20
Polishing time [h]	24	24	24	24	120	24
Container size [liter]	15	15	15	15	15	15
Order details	Opaline suspension 1.01 Mat. no. 2412-661	Opaline suspension 1.04 Mat. no. 1518-230	Opaline suspension 1.07 Mat. no. 2175-662	Opaline suspension 1.08 Mat. no. 1462-865	Opaline suspension 1.08 Mat. no. 2411-201	Opaline suspension 1.20 Mat. no. 1518-231

6.0 Miscellaneous

6.2 Other products OHM

Cleaning of used polishing carrier dishes and new application of polishing foils

Reconditioning of polishing dish with diameters of 100, 300 and 500 mm with the following phases:

- Cleaning of the used polishing film
- Recoating with polyurethane-based polishing films (Shore hardness D 33 - 43 ZrO₂-filled and Shore hardness D 20 - 30: CeO₂-filled)



Reconditioning and production of diamond bonded grinding tools

with the following phases:

-
- Design of the disk density with diamond pellets
- Manufacturing and dressing of the tool



6.0 Miscellaneous

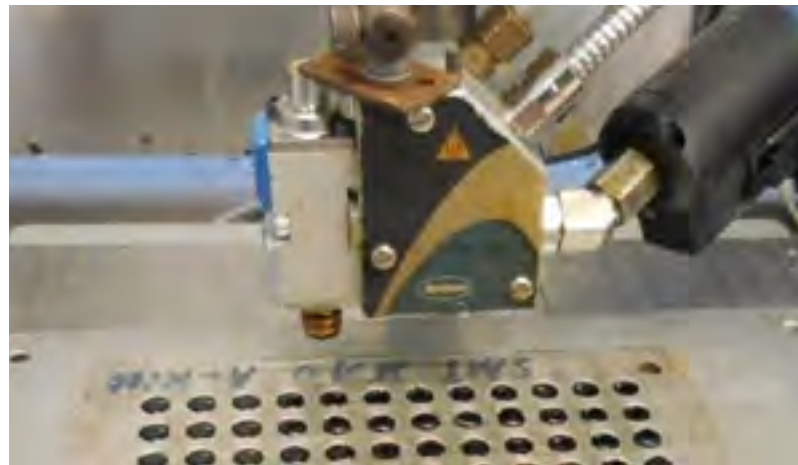
6.2 Other products OHM

Contract filling of polishing agents provided by the customer in containers of 0.1 - 0.5 liters



Production of cement points, cement bars and pitch plates

- Casting of cement points (DM10, DM17) for pinpoint mounting of optical components during machining (picture below)
- Production of cement bars and pitch plates of different dimensions

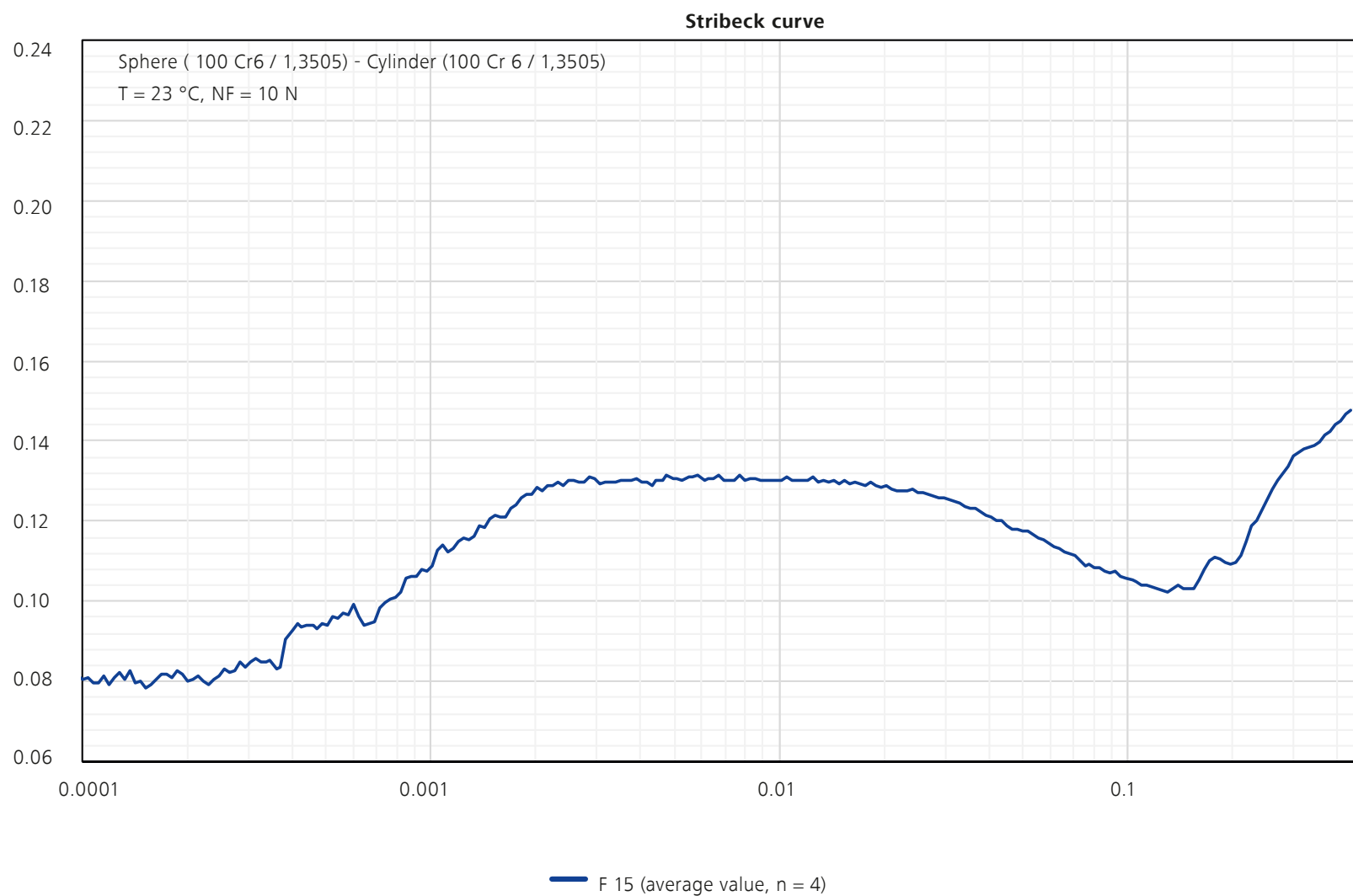


7

Appendix

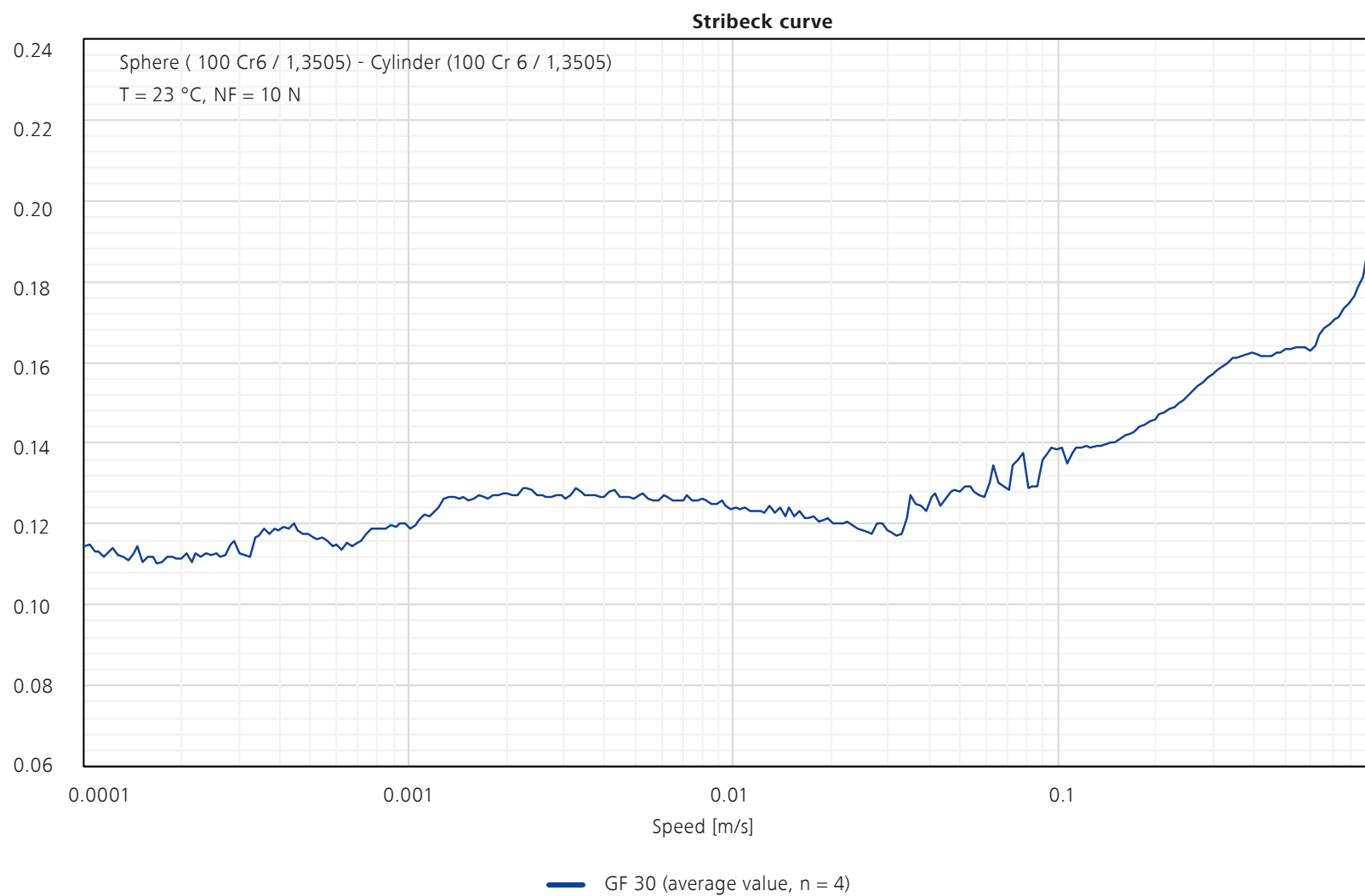
7.1 Tribological data

Instrument grease F 15 (Mat. No. 92.213)



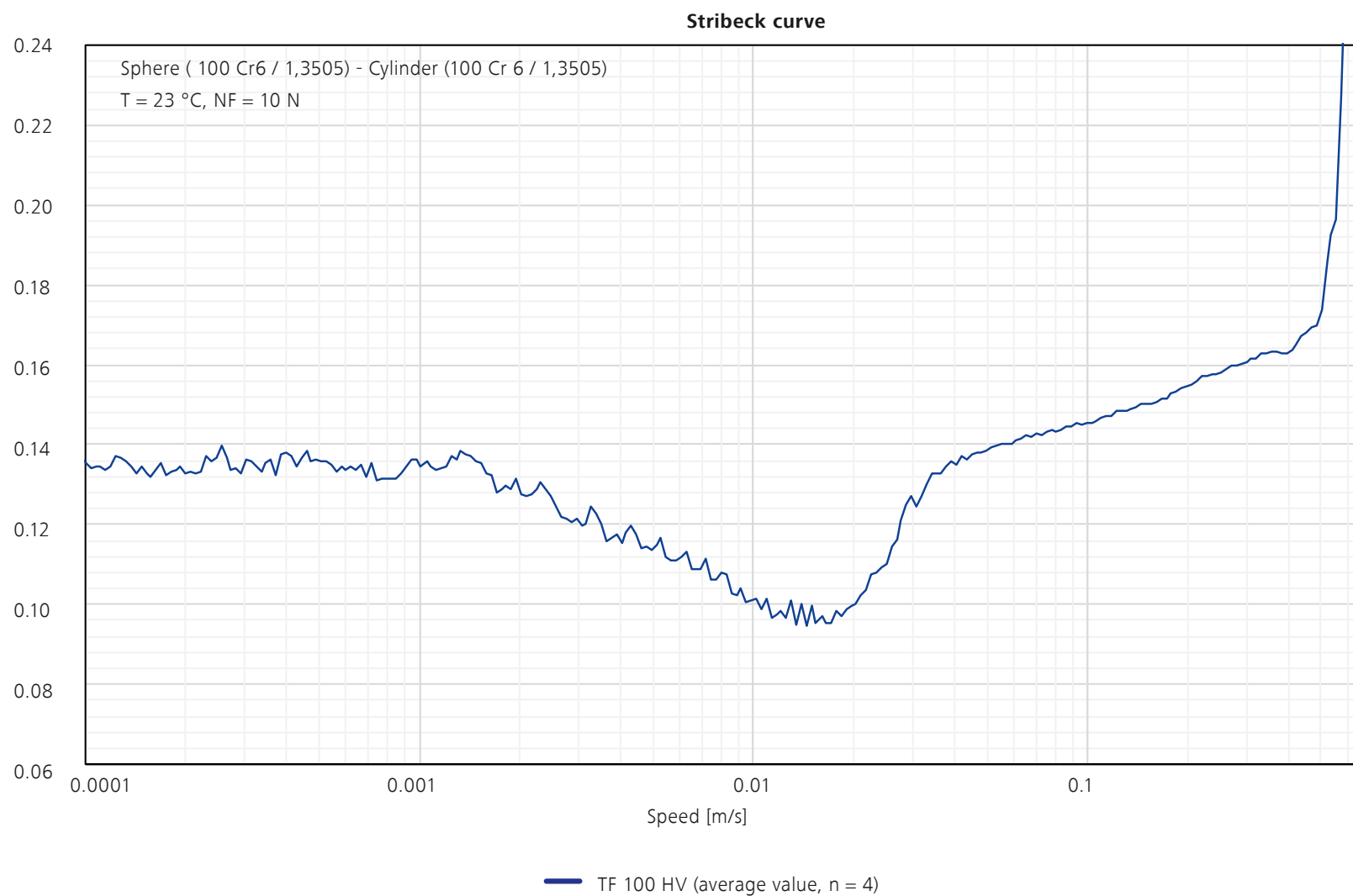
7.1 Tribological data

Gear grease GF 30 (Mat. No. 92,224)



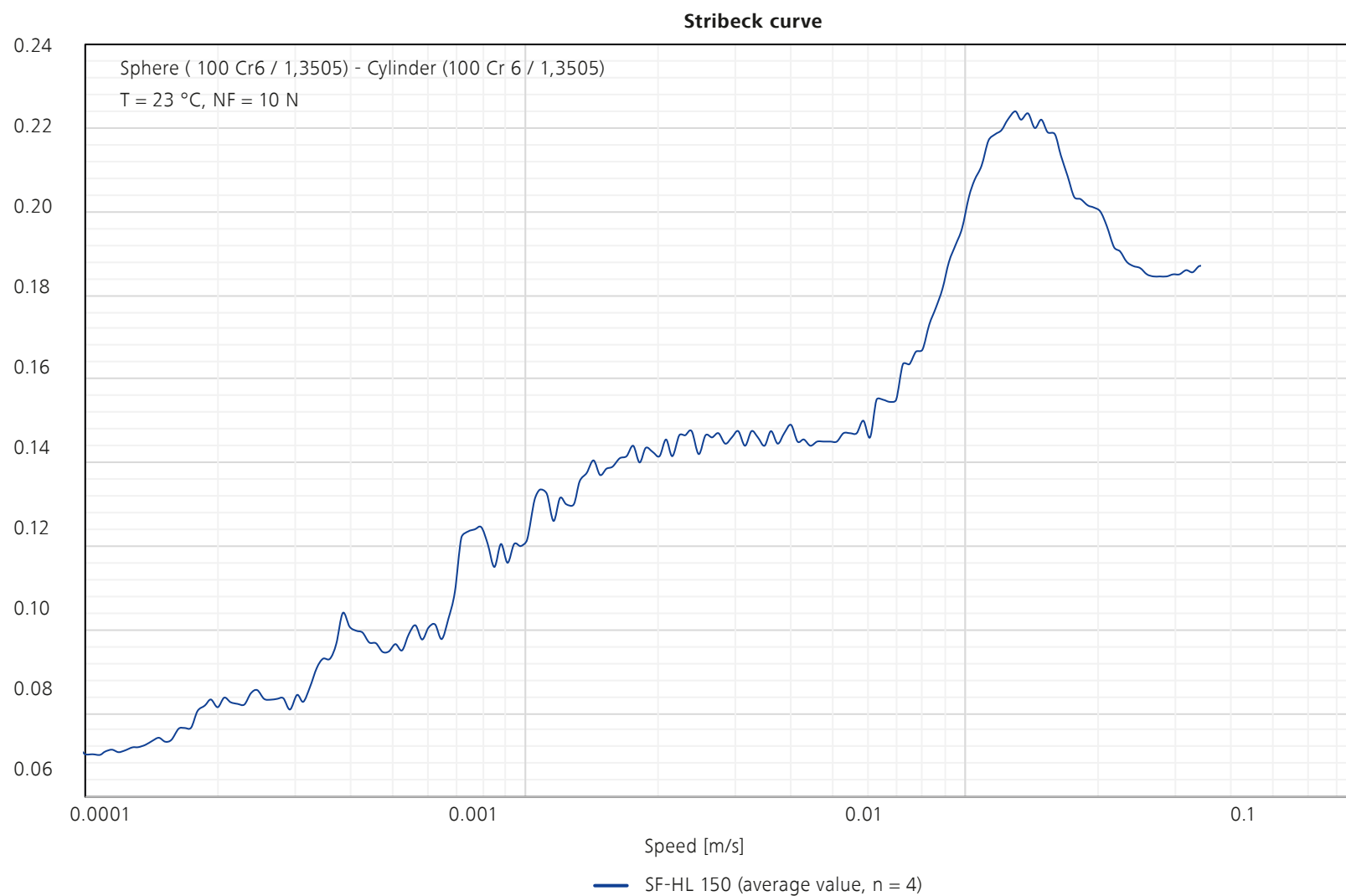
7.1 Tribological data

Teflon grease TF 100 HV (Mat. No. 96.249)



7.1 Tribological data

HL special grease SF-HL 150 Mat. No. 599.751



7.1 Tribological data

Teflon grease TF 100 HV (Mat. No. 96.249)

