TECHNICAL DATA INDEX

TECHNICAL DATA

The technical data presented here refer mainly to the ELESA+GANTER Standard elements, made of engineering plastics and metal material.
The main technologies used for the manufacture of plastic products are:
– compression/transfer moulding for Duroplasts;
– injection moulding for Technopolymers.
This primary process may be followed by secondary operations such as machining, finishing, assembly, decoration to customize the product (tampoprinting), packaging to guardantee adequate protection during transportation and identification of the product.

1. Plastic materials

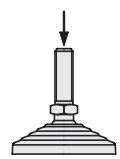
DUROPLASTS: phenolic based (PF) thermosetting plastics that harden during moulding due to irreversible polymerization.
TECHNOPOLYMERS: thermoplastic polymer materials for technical use in which the chemical composition of the molecular chain provides a wide range of mechanical, thermal, and technological properties. The transformation process is based on the melting and subsequent hardening by solidification of the material in the mould. The material itself has a low environmental impact because it can be recycled (reversible solidification).

The main technopolymers used by ELESA+GANTER						
PA Glass-fibre reinforced polyamide, with glass filler or glass micro-spheres or polyamidebased SUPER technopolymers	**PA-T** Special transparent polyamide	**PP** Glass-fibre reinforced polypropylene or with mineral fillers	**POM** Acetal resin	**PC** Special polycarbonate	**PBT** Special polyester	**TPE** Thermo-plastic elastomer

1.1 Mechanical strength

DUROPLASTS: the addition of mineral fillers, natural textile fibres and the optimum selection of the basic resin give this material an excellent mechanical strength, a high superficial hardness and a good impact strength.
TECHNOPOLYMERS: the rich selection of basic polymers available and the possibility of combining these with reinforcing fillers or additives of various kinds make a wide range of performance levels possible in terms of mechanical strength, impact strength, creep and fatigue.
The mechanical properties of a moulded plastic component may vary significantly according to its shape and the technological level of the manufacturing process. For this reason, instead of providing tables containing specific data on the mechanical strength of test pieces of various types of material, ELESA+GANTER has decided to inform designers of the forces which, in the most significant cases, may cause the component breakage. For most products, the mechanical strength values indicated in the catalogue are therefore loads at breakage.
The deformation under a load is not negligible for some products and may therefore jeopardise their performance, even before their breakage. Thus for these products, two load values are provided:
– **maximum working load** below which deformation DOES NOT jeopardise the component performance;
– **load at breakage** in accordance with the concepts outlined above.
In these cases, the "maximum working load" will be used as maximum design data to guarantee the correct performance, while the "load at breakage" will be used for safety tests.
Obviously, in both cases suitable safety coefficients must be applied.
Working stress has been taken into account (e.g. the transmission of torque in the case of a handwheel, the tensile strength in the case of a handle) as well as accidental stress (e.g. an impact with the component), in order to provide designers with a reference for determining suitable safety coefficients, according to the type and importance of the application.
All the strength values supplied were obtained from tests carried out in ELESA+GANTER Laboratories, under controlled temperature and humidity (23 °C – Relative Humidity of 50 %), under specific working conditions, and by applying a static load for a necessarily limited period of time.
The designer must therefore take into account adequate safety coefficients according to the application and specific operating conditions (vibrations, dynamic loads, working temperatures at the limits of the allowed temperature range). In the end, however, the designer is responsible for checking that the product is suitable for its intended purpose.
For some thermoplastics, for which the mechanical properties vary significantly in relation to the percentage of moisture absorbed (see chapter 1.5), the resistance tests on the component are carried out in compliance with ASTM D570, so that the moisture absorbed is in equilibrium with respect to ambient conditions of 23 °C and a RH of 50 %.

• **Compressive strength for levelling elements** (working stress)
The levelling element is assembled on its threaded metal stud and placed on special testing equipment. The element is then subjected to compressive stress with repeated and incremental loads until it breaks or undergoes a permanent plastic deformation of the plastic element.



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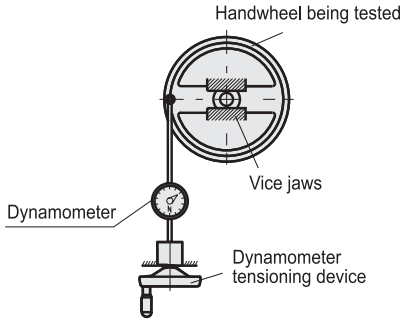
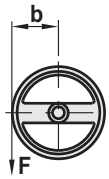
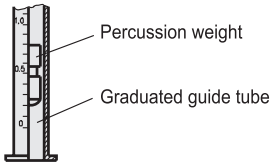
• **Resistance to transmission of torque** (working stress)
Use is made of an electronic dynamometer that applies increasing torque values as shown in the chart hereunder. The dynamometric system in the torque is shown in a traditional way to make the comprehension easier. The mean values of the torque C, obtained in the breaking tests, are shown in the tables for the various components and expressed in [Nm].

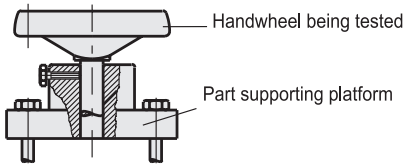




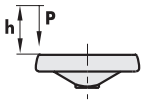
C [Nm] = F [N] • b [m]

• **Impact strength** (accidental stress)
The special equipment is used as shown in the chart.

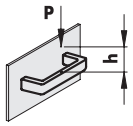




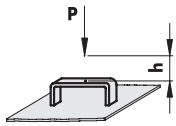
The mean values obtained in the breaking test, shown in the tables for the various models and expressed in [J], correspond to the breaking work L of the element subjected to repeated impacts, with the falling height (h) of the percussion weight (P) being increased by 0.1 m each time. Percussion weight (P): metal cylinder with a rounded ogival shaped end and weighing 0.680 kg (6.7N).



L [J] = P [N] • h [m]

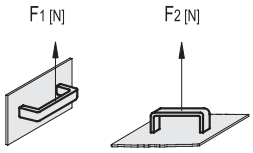


L_1 [J] = P [N] • h [m]



L_2 [J] = P [N] • h [m]

• **Tensile strength of U-shaped handles** (working stress)
This test entails fitting the handle to be tested on an electronic dynamometer, with two types of stress:
– perpendicular to the mounting screws (F1): here the stress on the handle is a mixed combination;
– parallel to the mounting screws (F2).
The load applied by the electronic dynamometer increases gradually in order to obtain a deformation of the tested element within a limit of 20 mm/min.



1.2 Thermal resistance

The use of thermosetting materials and reinforced thermoplastic polymers with a high Thermal resistance enables ELESA+GANTER to obtain products with great thermal stability and a limited variation in their mechanical properties at both high and low temperatures. The recommended operating temperature range for each plastic product in this catalogue is indicated by the symbol, which is shown here on the left. Within this temperature range:
– the material is stable and no significant degradation takes place:
– the user does not normally encounter any problem with the basic performance of the product.

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The mechanical strength, impact strength, maximum torque and maximum working pressure values indicated in the catalogue were obtained from tests carried out under laboratory conditions (23 °C – Relative Humidity of 50 %). These values may vary over the working temperature range indicated. Customers are therefore responsible for checking the product's actual performance in their specific thermal working conditions. A very general indication, as to the working temperature range for the various types of plastics, is given in the table below.

Material	Working temperature range
Duroplasts (PF)	from -20 °C to 100°/ 110 °C
Special, high-resistence polypropylene based (PP) technopolymers	from 0 °C to 80°/ 90 °C
Glass-fibre reinforced polypropylene based (PP) technopolymers	from 0 °C to 100 °C
Polyamide based (PA) technopolymers	from -20 °C to 90 °C
Glass-fibre reinforced polyamide based (PA) technopolymers	from -30 °C to 130°/ 150 °C
Glass-fibre reinforced polyamide based (PA) technopolymers for high temperatures	from -30 °C to 200 °C

1.3 Strength and surface hardness

DUROPLASTS: the high surface hardness of the material and its glossy finish, obtained by the mould, enable the surfaces to be kept in perfect condition, even after prolonged use in the presence of metal machining residues or in abrasive environments, as for example, in metal machining applications with machine tools.
TECHNOPOLYMERS: the surface hardness values are lower than those of Duroplast, but are still within the 60 – 98 Rockwell range, M scale. Technopolymers are however tougher and have a greater impact strength than Duroplasts.

1.4 Resistance to chemical agents

The tables in Chapter 10 (see page A15) describe the resistance of the plastic materials used for ELESA+GANTER products, at an ambient temperature of 23 °C, in the presence of the various chemical agents they may come into contact with, in an industrial environment (acids, bases, solvents, lubricants, fuels, and aqueous solutions) and indicate 3 classes of resistance:
– good resistance = the product functional and aesthetic properties remain unchanged;
– fair resistance = effects on the functional and/or aesthetic properties, depending on the type of product and the working conditions with some limitations of use according to the specific application;
– poor resistance = product susceptible to chemical aggression. Not recommended for use.
As a general rule, chemical resistance decreases as the working temperature and mechanical stresses, to which the product is subjected, increase. The presence of high temperatures and high levels of mechanical stress together require to the product resistance to chemical agents be tested.

1.5 Resistance to atmospheric agents and UV rays

In most cases, ELESA+GANTER plastic Standards are used for "indoor" applications. In any case, due to the properties of the materials and the measures taken during the design stage, these products may also be used for "outdoor applications", where they are exposed to particular atmospheric conditions:
• **rapid changes in temperature:** within the working temperature range recommended for each product, rapid changes in temperature do not create problems due to the impact strength of the materials used;
• **the presence of water or moisture:** may result in processes of hydrolysis and the absorption of a certain percentage of the water/moisture until a state of equilibrium is reached. This may alter some of the material's mechanical properties.
Examples of materials that absorb water include polyamides (PA), transparent polyamides (PA-T, and PA-T AR) and duroplasts (PF).
Products made of these materials may undergo slight changes in size due to the absorption of water, which may affect dimensional tolerances. During the design stage, ELESA+GANTER normally takes these possible variations into account in order to minimise their effects and to guarantee compliance with the technical specifications.
The absorption of water results in a significant increase in impact strength. The following polymers do not absorb water: polypropylene (PP), thermoplastic elastomers (TPE), and acetal resin (POM). Occasional contact with rainwater followed by "drying" does not generally pose any problems in terms of the strength of the product. When used in "outdoor" applications, it is advisable to prevent water accumulating on the product by adopting suitable assembly conditions.
• **Exposure to the sunlight and UV rays** in particular.
Specific resistance tests have been carried out using specific equipment for accelerated ageing testing, in accordance with the ISO 4892-2 standard, and setting the following parameters:
– radiation power: 550 [W]/[m]2;
– internal temperature (Black Standard Temperature, BST): 65°C;
– OUTDOOR filter that simulates exposure to the open air, with low shielding against UV rays;
– relative humidity: 50 % U.R.

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The relation between the hours of testing and the hours of actual exposure to an outdoor environment ("Equivalent Hours") obviously depends on the weather conditions of each geographic area. Taking the Average Radiant Exposure per Day (ARED) as a basis for comparison, the reference values adopted on an international scale include:
– Miami Equivalent Hours = high intensity exposure, typical of countries with a tropical or equatorial climate (ARED = 9.2 MJ/m^2);
– Central Europe Equivalent Hours = mean intensity of exposure, typical of continental climates (ERMG = 2 MJ/m^2).
At the end of prolonged tests carried out at the ELESA+GANTER laboratories, the variation in mechanical strength was measured (tensile/compression breaking, and impact breaking) was measured. In general, the results show that the mechanical strength of polyamide (PA), polypropylene (PP) and Duroplast (PF) products is not significantly reduced by exposure to UV rays.
As to the aesthetic appearance of samples exposed to the action of the UV rays, in some cases a slight variation in the surface appearance of the product was found, on completion of the tests.
For further details on UV ageing tests on specific products, contact the ELESA+GANTER Technical Department.

1.6 Flame resistance

The universally recognised classification used to describe the reaction of plastics to flames is obtained from two tests defined by UL (Underwriters Laboratories, USA). These tests are called: UL-94 HB and UL-94 V.
They define four main types of reaction to flames: HB, V2, V1 and V0 with progressively increasing levels of flame resistance.
• UL-94 HB (Horizontal Burning)
The test consists of putting a set of three standardized samples of the plastic (in a horizontal position set at an angle of 45° with respect to their own axis) each one in contact for 30 seconds with a flame applied at their bottom free edge.
Two marks are present on the samples at standardized distances from the free end.
A material may be classified HB if, for each of the three samples, the following conditions are applicable:
– the speed of burning between the two marks does not exceed a given standardized value that depends on the thickness of the samples being tested;
– the flame is extinguished before the fire reaches the furthest mark from the free edge (that is, from the point of application of the flame).
• UL-94 VB (Vertical Burning)
The test entails putting a set of five standardised samples of the plastic (in a vertical position) into contact each one twice for 10 seconds with a flame applied at their bottom free edge. A sheet of cotton wool is placed underneath the samples.
The following parameters are measured:
– the time required to extinguish each individual sample each time the flame is applied;
– the sum of times required to extinguish the five samples (considering both flame applications specified);
– the post-incandescence time of each individual sample after the second flame application;
– whether any material drips from the sample onto the cotton wool set underneath it with a risk of igniting it.

UL Classification of plastic materials				
UL-94 HB	For each of the three samples, the speed of combustion between the two marks does not exceed the standardized speed that depends on the thickness of the samples. For each of the three samples, the flame is extinguished before it reached the further mark from the point of application of the flame.			
UL-94 V		V2	V1	V0
	Time required to extinghuish each individual sample after each flame application.	≤ 30 s	≤ 30 s	≤ 10 s
	Sum of times required to extinghuish the five samples (considering both flame applications specified).	≤ 250 s	≤ 250 s	≤ 50 s
	Post-incandescence time of each individual sample after the second flame application.	≤ 60 s	≤ 60 s	≤ 30 s
	Presence of any material dripping from the sample onto the cotton wool beneath it with the risk of igniting it.	YES	NO	NO

The variables that determine the reaction to the flame include the thickness of the samples and the colouring of the material, in fact, there may be differences between materials with their natural colour and those with an artificial colour and differences depending on the variation in thickness of the sample with the same colour.

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Yellow Card: this is a document issued by the Underwriters Laboratories that certifies the reaction of a plastic to flames, following laboratory testing. This constitutes an official recognition of the product's flame resistance.
The "Yellow Card" indicates the trade name of the product, the manufacturer and related ID number, known as a UL File Number. The flame resistance is certified for specific material thickness and colour.
Some material manufacturers carry out flame resistance tests in independent laboratories, using the same test methods as the Underwriters Laboratories.
In such cases, a declaration of conformity but no "Yellow Card" is issued by the manufacturer.
Most of the other ELESA+GANTER products for which no specific indication is given in this regard belong to the UL94-HB category.
There are groups of ELESA+GANTER Standards with UL-94 V0 classification, identified as AE-V0 by the symbol shown in the title.
ELESA+GANTER products identified as AE-V0 are made of environment-friendly plastics and are free of PBB (Polybromine Biphenyl), PBDE (Polybrominediphenyl Ether) and in particular of Penta-BDE (Pentabromodiphenyl Ether) and of Octa-BDE (Octabromodiphenyl Ether).

1.7 Electrical properties

Plastics are generally good electrical insulators. This is particularly useful in certain applications in the electromechanical field, making plastic products preferable to similar metal products.
The extent of a material insulating properties is determined by:
- **its surface resistivity**
- **its volume resistivity.**

The table below classifies the materials on the basis of their surface resistivity [Ω]:

Conductive material	Semi-conductive material	Dissipative material	Anti-static material	Insulating material
10^{-1} Ω	10^{5} Ω	10^{9} Ω	10^{12} Ω	> 10^{12} Ω

Due to an increase in the performance of the electronic products and the diffusion of their use in different applications, there has been a rise in the market demand for thermoplastic products which may satisfy the requirements of standard conductivity for the ESD (Electro Static Discharge) applications.
The ESD product line developed by ELESA+GANTER uses materials with a reduced surface resistivity (conductive), marked with the symbol of ESD-C protection indicated in the title.
Typical values, for a few of the plastics used by ELESA+GANTER, are:

Material	Property	Measuring Method	State of material	Value
PA 30 % glassfibre	Surface Resistivity	IEC93, 23 °C	Dry	10^{13} Ω
			Conditioned (50 % RH equil.)	10^{11} Ω
	Volume Resistivity		Dry	10^{15} Ω •cm
			Conditioned (50 % RH equil.)	10^{11} Ω •cm
PP 20 % mineral filler	Surface Resistivity	ASTM D257	Conditioned (50 % RH equil.)	10^{13} Ω
PA ESD	Surface Resistivity		Dry	10^{3} Ω
			Conditioned (50 % RH equil.)	10^{3} Ω
	Volume Resistivity		Dry	10^{3} Ω •cm
			Conditioned (50 % RH equil.)	10^{3} Ω •cm

1.8 Surface finish and cleanability

In moulding technopolymers, it is technically easier to make products with a rough matte surface finish, which hides any aesthetic defect such as shrinkage cavities, flow marks, or joining marks caused by non-optimum moulding processes.
However, a rough matte finish makes it more difficult to clean the component, especially if made out in light colours, and its handling for a long use.
ELESA+GANTER technopolymer Standards have a very fine matte finish so that the product remains easy to clean in time, and it is easier for the user to handle it.
Some groups of technopolymer products have recently been developed with a completely glossy finish, so that they remain clean for a long time.

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1.9 Compliance with international standards

Over the past few years, the national and international regulatory authorities have laid down a series of regulations for the control of substances that are harmful to man or the environment and for the environment safety management in the industrial field.

- **European Directive 2002/95/CE RoHS (Restriction of Hazardous Substances)** applicable to the field of electrical and electronic equipment. This provides for a gradual reduction in the heavy metals (Pb, Cd, Hg, and Cr6) and halogens (PBB and PBDE) present in the components used in the electrical and electronic industries.
  In the data sheet of each product the "RoHS compliance" is indicated by the green symbol. The presence of this symbol means that all the technical problems related to the materials used for the chosen product have been solved out in compliance with the European irective 2002/95/CE. In practice, it could happen that the stock rotation process has not been completed yet: anyway, on ELESA+GANTER website www.elesa-ganter.com it is possible to make a check.
  ELESA+GANTER Technical Department is always at the customer's disposal for any kind of assistance.
- **European Regulation n.1907/2006 - REACH (Registration, Evaluation, Authorisation and restriction of Chemicals)**, applicable to all the chemical substances circulating in the European Community, aiming at improving the knowledge of the dangers and risks arising from the existing chemical substances and from the new ones.
- **European Directive 2000/53/CE - ELV (End Life of Vehicles)**, applicable to the automotive field. This provides for a gradual reduction in the heavy metals Pb, Cd, Hg, and Cr6, resent in vehicles.
- **RAEE (WEEE) Directive**, Waste of Electrical and Electronic Equipment.
- **ATEX Directive 94/9/CE - ATEX**, effective since the 1st of July 2003, refers to work environments with explosion risks and classifies the zones where a potentially explosive atmosphere may occur. ATEX marking (together with the declaration of conformity) certifies that the item, on which it is applied, was manufactured in compliance with all the requirements and provisions of the European Union Directive 94/9/EC (mandatory since 1st of July 2003) and that it was submitted to the procedures for conformity assessment. In accordance with this directive, certification is compulsory for all the equipment and protection systems, for the components (which are necessary for operating in safe conditions) that will be used in potentially explosive atmospheres (either pneumatic, hydraulic, electrical, mechanical) and for all safety, control and adjustment devices needed for the safe operation of the equipment and the protection systems, installed out of the potentially explosive atmosphere, but having the function of protection against explosion risks.

Hazardous zones (are classified according to the frequency and duration of the occurrence of a potentially explosive atmosphere):
- **zone 0** area in which a potentially explosive atmosphere, consisting of a mixture of air and flammable substances in the form of gas, vapour or mist, is present always, for long periods or often (at least 1000 hours/year);
- **zone 1** area in which, during normal operations*, a potentially explosive atmosphere, consisting of a mixture of air and flammable substances in the form of gas, vapour or mist, is occasionally present or with a small frequency (more than 10 hours and less than 1000 hours/year);
- **zone 2** area in which, during normal operations*, a potentially explosive atmosphere, consisting of a mixture of air and flammable substances in the form of gas, vapour or mist, is present only for a short time or seldom (less than 10 hours/year);
- **zone 20** area in which a potentially explosive atmosphere in the form of a cloud of combustible dust in air is present always, often or for long periods (at least 1000 hours per year);
- **zone 21** area in which, during normal operations*, a potentially explosive atmosphere, in the form of a cloud of combustible dust in air is occasionally present or with a small frequency (more than 10 hours and less than 1000 hours/year);
- **zone 22** area in which, during normal operations*, a potentially explosive atmosphere, in the form of a cloud of combustible dust in air is present only for a short time or seldom (less than 10 hours/year).

* normal operations means the situation in which installations are used within their design parameters.

The directive identifies two groups of equipment (I and II), in accordance with the environment in which it is used:
- **group I** comprises equipment intended for use in the underground parts of mines, and/or in the surface parts of such mines;
- **group II** comprises equipment intended for use in environments other than those specified for group I.

Within group II, the devices subject to the provisions of ATEX directive are subdivided into categories according to the combination of explosion hazard zones and equipment groups:
- **category 1** comprises equipment and protection systems in this category are intended for use in areas in which explosive atmospheres are present for long periods or often (1000 hours or more/year), ensuring a very high level of protection;
- **category 2** comprises equipment and protection systems in this category are intended for use in areas in which, during normal operations, explosive atmospheres are present, with a small frequency or occasionally (10 – 1000 hours/year), ensuring a high level of protection;

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- **category 3** comprises equipment and protection systems in this category are intended for use in areas in which, during normal operations, explosive atmospheres are present only for a short period or seldom (less than 10 hours/year), ensuring a normal level of protection.

ZONE	0 G (gas)	20 D (dust)	1 G (gas)	21 D (dust)	2 G (gas)	22 D (dust)
Explosive atmosphere	High probability, continuously or frequently		Average probability, sometimes, occasionally		Low probability, seldom, almost never	
CATEGORY in accordance to ATEX 94/9/EC Directive	**1**		**2**		**3**	

The directive also specifies the Groups of substances, classifying the substances that create potentially explosive atmospheres with air based on their hazardousness.
The hazardousness depends on the gas ignition temperature.
The table below shows some examples of gases with their related classification.

Gas	Group
Propane	IIA
Ethylene	IIB
Acetylene	IIC

Equipment with IIB marking are suitable also for applications that require equipment of explosion group IIA, those marked with IIC are suitable also for applications that require equipment of explosion groups IIA and IIB.
The table below shows the temperature classes, that indicate the max surface temperature (detected on the surface of the piece into contact with air), that must not be exceeded, to prevent ignition.

Max surface temperature	Temperature class
450 °C	T1
300 °C	T2
200 °C	T3
135 °C	T4
100 °C	T5
85 °C	T6

ELESA+GANTER products are components necessary for the safe operating of equipment and protection systems included in Group II (environments other than mines).
The following table shows the related categories:

Zone	2 (20)	1 (21)	2 (22)
Group II environments other than mines	**Category 1** presence of explosive atmosphere > 1000 h/year	**Category 2** presence of explosive atmosphere > 10 and < 1000 h/year	**Category 3** presence of explosive atmosphere > 10 and < 10 h/year

The following example shows the ATEX classification of an ELESA+GANTER product, (a breather cap of the SFP series): CE II 2GD IIB T6 where:
CE – marking CE
Ex – protection against explosion symbol
II – indicates the equipment group
2 – indicates the category it belongs to (and therefore the protection level ensured)
G e D – indicate the type of potentially explosive atmosphere where the component can operate (G = gas, D = dust). They can be present alternatively or simultaneously (like in this case)
IIB – indicates the substance group type (gas, vapours or mists)
T6 – indicates the temperature class

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'k' protection factor: most of ELESA+GANTER products included in the line of accessories for hydraulic systems are also certified according to EN 13463-8 standard (Protection by liquid immersion 'k'): the equipment protection is based on the presence of a liquid that prevents the formation of sparks and other causes of ignition.
The following example shows the ATEX classification of a certified ELESA+GANTER product, e.g. a plug of the TN series, according to EN 13463-8 standard, in which "k" is evidently present: CE Ex II 2GD k T5.

Code	Description	Classification ATEX	See page
58296-EX	TN-3/8-EX	CE ex II 2GD kT5 1146	1665
58297-EX	TN-1/2-EX	CE ex II 2GD kT5 1146	1665
58298-EX	TN-3/4-EX	CE ex II 2GD kT5X 1146	1665
54001-EX	SFP.30-3/8-EX	CE ex II 2GD IIB T6 1170	1706
54011-EX	SFP.30-3/8+a-EX	CE ex II 2GD IIB T6 1171	1706
54022-EX	SFP.30-3/8+F FOAM-EX	CE ex II 2GD IIB T6 1170	1706
54101-EX	SFP.30-1/2-EX	CE ex II 2GD IIB T6 1170	1706
54111-EX	SFP.30-1/2+a-EX	CE ex II 2GD IIB T6 1171	1706
54122-EX	SFP.30-1/2+F FOAM-EX	CE ex II 2GD IIB T6 1170	1706
54201-EX	SFP.40-3/4-EX	CE ex II 2GD IIB T6 1170	1706
54211-EX	SFP.40-3/4+a-EX	CE ex II 2GD IIB T6 1171	1706
54222-EX	SFP.40-3/4+F FOAM-EX	CE ex II 2GD IIB T6 1170	1706
14441-EX	HGFT.10-3/8-EX	CE ex II 2GD kT6X 1188	1725
14461-EX	HGFT.13-1/2-EX	CE ex II 2GD kT6X 1188	1725
14481-EX	HGFT.16-3/4-EX	CE ex II 2GD k IIBT6X 1188	1725
10851-EX	HCFE.12-3/8-EX	CE ex II 2GD kT6 1204	1746
10901-EX	HCFE.15-1/2-EX	CE ex II 2GD kT6 1204	1746
11001-EX	HCFE.20-3/4-EX	CE ex II 2GD k IIBT6 1204	1746
–	GN 743.6-11-M16x1.5	CE ex II 2GD TX 1194	1732
–	GN 743.6-14-M20x1.5	CE ex II 2GD TX 1194	1732
–	GN 743.6-18-M26x1.5	CE ex II 2GD TX 1194	1732
–	GN 743.6-18-M27x1.5	CE ex II 2GD TX 1194	1732
–	GN 743.6-18-M27x2	CE ex II 2GD TX 1194	1732
–	GN 743.6-11-G3/8	CE ex II 2GD TX 1194	1732
–	GN 743.6-14-G1/2	CE ex II 2GD TX 1194	1732
–	GN 743.6-18-G3/4	CE ex II 2GD TX 1194	1732

In an industrial environment, i.e. where ATEX Group II products are used, it is the user's responsibility to classify the zones in relation to the "potential" presence of gases, vapours and explosive dusts, identifying the relevant work places and working activities where explosion risks are present or could trigger, according to his/her risks assessment.
The manufacturer provides all the necessary information related to the Groups and Categories of the product, in order to allow the user to decide in which zone the ATEX product can safely operate, even if he/she is not able to foresee where and how it will actually operate.

1.10 Competence of ELESA+GANTER Technical Department

Ongoing research and experimentation with new materials that offer increasingly high levels of performance are parts of the principles of continuous improvement on which ELESA+GANTER Quality System is based. Our partnership with the leading plastics manufacturers in the world and the use of mechanical and process simulation programs allow us to offer the material that best suits the Client's specific application.

2. Metal materials

Most of ELESA+GANTER plastic elements contain inserts or functional components made of metal. The tables (Stainless steel – Carbon steels, Zinc alloys, Aluminium and Brass – Duroplasts) describe the chemical composition and mechanical strength values as per the reference standards for the metals used.
Surface treatments for metal inserts and parts: the surface of metal inserts or functional parts is generally treated to ensure the maximum protection against environmental agents, in order to maintain the product's aesthetic and functional qualities.
The protective treatments normally used include:
– burnishing of steel bosses and hubs;
– zinc-plating of threaded studs (Fe/Zn 8 in compliance with the UNI ISO 2081 standard);
– matte chromium plating of lever arms and revolving handles shanks.
Metal parts made of brass or stainless steel do not normally require surface treatment.
On request and for sufficient quantities, inserts subjected to other types of protective surface treatment may be supplied: black zinc-plating, nickel-plating, Niploy-Kanigen process, chromium plating, anodising and other, heat treatments like nitriding, hardening and case-hardening.

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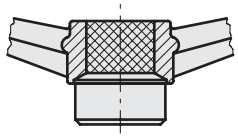
2.1 Properties of metal inserts

The diamond knurling, of a shape, pitch and depth suited to the stress to be applied, is normally adopted, aiming at ensuring the most effective anchoring of the metal inserts to the plastic material and the best mechanical operation of the element. This type of knurling ensures both axial anchoring (that contrasts axial tensile stress) and radial anchoring (to avoid rotation during the transmission of torque).



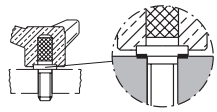
For threaded studs, instead of using a common screw available on the market, they use specially shaped threaded insert which protrudes a few tenths of mm from the plastic body so as to form a metal face on the screwing plane, thus freeing the plastic material of all stresses.

2.2 Clamping knobs with threaded inserts (Types of assembly)

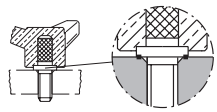
Types of assembly that create optimum clamping conditions

The plastic base on the clamping knob should never rest on the clamping surface. In this way the metal inserts (threaded stud or tapped boss) are never subjected to abnormal twisting ("corkscrew" effect) when axial tensile stress is applied. Thus, the anchoring of the metal insert to the plastic material is stressed in the correct way, that's to say it is only subject to the torque applied to the knob for tightening it.

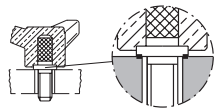
1. Threaded hole, without any chamfer or countersinking.



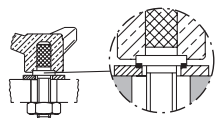
2. Threaded hole with chamfered edge or countersinking of a smaller diameter than that of the face on the stud, in order to ensure an adequate overlap between the metal insert and the clamping surface.



3. Plain cylindrical hole of a smaller diameter than that of the face on the stud, in order to ensure an adequate overlap between the metal insert and the clamping surface.



4. Plain cylindrical hole of a larger diameter than that of the face on the stud, setting in between a steel washer whose hole has a smaller diameter than that of the face of the stud. This guarantees an adequate overlap between the metal insert and the clamping surface, thanks to the washer.

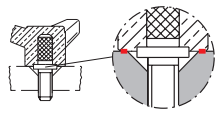


Incorrect types of assembly

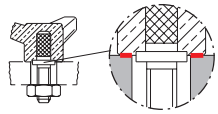
When the plastic base of the clamping knob rests directly on the clamping surface, the threaded stud or tapped boss are also subject to an axial load ("corkscrew" effect), which could jeopardize its anchoring to the plastic material.

The values of this force are always higher, with a broad safety margin, than those that may be applied by normal operations performed by hand, but designers who wish to take into account cases of improper use should avoid the situations illustrated in cases 5-6-7.

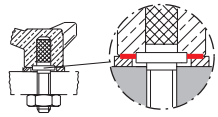
5. Threaded hole and champfer or countersinking with a larger diameter than that of the face on the stud.



6. Cylindrical through hole with a larger diameter than that of the face on the stud.



7. Threaded hole without any chamfer or countersinking, setting in between a steel washer whose hole has a diameter larger than that of the face on the stud.



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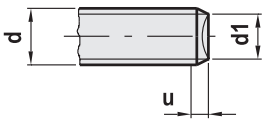
2.3 Pass-through holes

For knobs in which pass-through holes (FP type) have to be made, the insert is set in such a way that the machining of the hole or the broaching of a keyway only affects the metal part, without the plastic material having to be machined in any way.

2.4 End of threaded studs

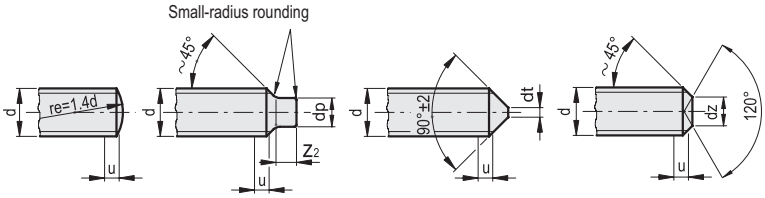
All threaded studs of the ELESA+GANTER elements have a chamfered flat end in compliance with ISO 4753.



Chamfered (rolled) end

d1 = Ø thread minor diam.
P = pitch
u = 2P incomplete threads

On request and for sufficient quantity, studs with different kinds of ends may be provided. These ends may be of the types shown hereunder, as indicated in the ISO 4753 table for "Fixing elements: ends of elements with ISO metric outside threading".



Convex end — Long cylindrical end — Truncated conic end — Cup end

P = pitch
u = 2P incompleted threads

d	dp h14	dt h16	dz h14	Z2 +IT 14* 0
4	2.5	0.4	2	2
5	3.5	0.5	2.5	2.5
6	4	1.5	3	3
8	5.5	2	5	4
10	7	2.5	6	5
12	8.5	3	7	6
14	10	4	8.5	7
16	12	4	10	8

* IT = International Tolerance

2.5 Seizure risk with stainless steel threaded couplings

The stainless steels generally used for fasteners are:
– A2 (similar to AISI.304 steel)
– A4 (similar to AISI.316 steel)
An indelible marking always identifies the steel type and the mechanical strength class.
The tightening torque is dependent upon:
– The nominal diameter of the threading
– The mechanical strength class of stainless steel (50-70-90)
– The friction coefficient.
A high friction leads to the dissipation of a large amount of energy. The stainless steel thermal conductivity is about half that of carbon steels, therefore the tightening of the screw and nut, both made out of stainless steel, increases the heat generated towards the plastic deformation of the material thus creating a potential locking condition (seizure) of the coupling. In the case of disassembly and reassembly of the coupling, the seizure risk increases considerably. In practice, to avoid this risk, it is recommended to lightly lubricate both the threading and the nut under head with MoS2 paste or simply use some anti-corrosive grease.

3. Other materials

GASKETS
ELESA+GANTER normally uses gaskets made of synthetic nitrile butadiene rubber (NBR) or acrylonitrile butadiene rubber (BUNA N) for its products, with hardness values ranging from 70 to 90 SHORE A depending on the type of product considered.
The working temperature range for continuous use is -30 °C to +120 °C. Where a higher chemical and thermal resistance is required, that is, for products in the HCX-SST, HCX-SST-BW and HGFT-HT-PR series, gaskets made of FKM fluorinated rubber are used.
For chemical resistance values, see the table in chapter 10 (on pages A30, A31 and A32).
The working temperature range is from -25 °C to +210 °C.
On request and for sufficient quantity, flat washers and O-rings made of special materials such as EPDM, silicone rubber, or others may be supplied.

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AIR FILTERS for filler breather caps (SFC., SFN., SFP., SFV., SFW., SMN. and SMW. series):
– TECH-FOAM type filters polyester-based polyurethane foam mesh, degree of filtration 40 microns, recommended for temperatures of between -40 °C and +100 °C for continuous use, and brief peak temperatures of +130 °C. This material does not swell in contact with water, petrol, soap, detergents, mineral oils or grease. Some solvents may cause slight swelling of the foam (benzene, ethanol, and chloroform);
– TECH-FIL type filters made of zinc-plated iron wire (quality as per DIN 17140-D9-W.N.R 10312, zinc-plated as per DIN 1548), degree of filtration 50 – 60 microns.

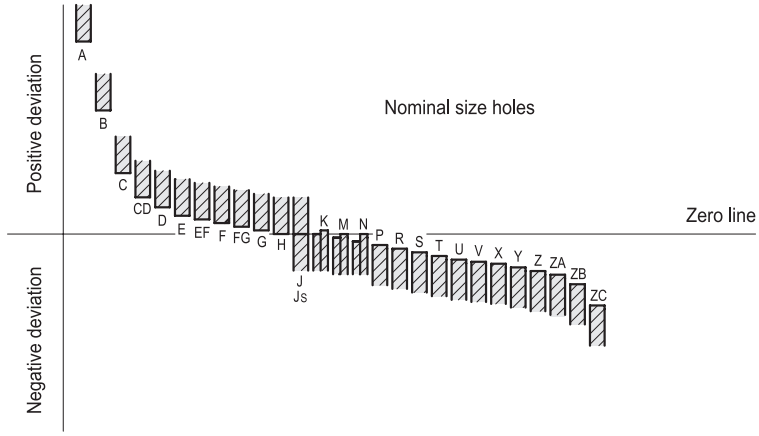
4. Machine tolerance

The reference tolerance system is the: ISO System - Basic hole

TOLERANCES OF THE METAL INSERTS

Plain holes in the bosses and hubs of knobs and handwheels

For the most widely used models, there are various kinds of standardized holes available so the user has a wide selection and is saved the costly task of remachining the hole on assembly. The tolerance of these holes is normally grade H7, but in a few cases it is grade H9. The degree of tolerance is always indicated in the tables of each article, in the hole size column. For cases in which it is more difficult to propose a standardization of the holes that satisfies the broadest range of assembly needs, either a pre-drilled hole with a simple roughing tolerance (hole with a smaller diameter than that of the shaft on which it is expected to be assembled), or a hub with no hole (not drilled) is used.



Holes diameter mm	H7	H9
over 3 to 6	+0.012 0	+0.030 0
over 6 to 10	+0.015 0	+0.036 0
over 10 to 18	+0.018 0	+0.043 0
over 18 to 30	+0.021 0	+0.052 0

• Threaded holes in the bosses and threads of the studs

Machining in accordance with the ISO metric threads for a normal screwing length (see table in chapter 10, page A24).
– Tapped holes of built-in metal bosses = tolerance 6H.
– Metal studs or ends of shanks for revolving handles = tolerance 6g.

TOLERANCES OF HOLES AND THREADS IN THE PLASTIC MATERIAL

• Plain holes (for handles with a through hole for assembly in an idle condition on pins). Despite the considerable difficulties encountered in maintaining the tolerances in a machining process in which numerous factors influence the end result, the size of the diameter of the axial hole is normally respected with a tolerance of C11. The handles may therefore also be assembled on pins made from normal drawn parts. If the pin is obtained by turning from a bar with a greater diameter, a machining process with a tolerance of h11 is recommended, as this gives a suitable free coupling, with the advantage of a quick, simple and inexpensive machining process.
• Inside threads (for handles with no metal bushing to be screwed in and fixed to threaded pins). They are normally kept undersized so that assembly is slightly forced at ambient temperature.
• Outside threads (for filler breather caps or level indicators with a threaded connector). In this case, for reasons related to the process technology and the type of plastic, which may absorb small amounts of moisture from the outside environment, the tolerances must be interpreted taking this into account though the tightening of the component assembled is never actually jeopardized in practice.

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5. Fixed handles
(Types of assembly)

Various kinds of couplings are used for securing fixed handles to the shaft:
– handles with brass boss or nutscrew moulded into the plastic material for screwed assembly on a threaded shaft;
– handles with built-in self-locking boss made of special technopolymer (ELESA Original design) for push-fit assembly on a plain shaft (unthreaded) made from a normal drawn rod (ISO tolerance h9). This solution prevents spontaneous unscrewing in time due to the vibrations to which the lever is subjected or the rotary forces exerted inadvertently by the operator's hand while handling the lever itself;
– handles with threaded hole obtained from moulded plastic material.

For executions with threaded holes obtained from moulded plastic material, the measure of keeping the thread undersized with respect to the specifications laid down in the standards has been taken. This enables the threads of the nut screw to adapt slightly to the screw, when tightening at ambient temperature, thus creating a coupling with an elastic reaction that gives an effective locking effect. Even better results may be obtained by hot assembly: the handle is heated to 80÷90 °C before being screwed onto the threaded pin. This method of assembly initially facilitates the screwing operation in that the thread of the nut screw is expanded when screwed in and subsequently enables an extremely efficient locking effect to be obtained from shrinkage on cooling, due to the slight roughness of the surface of the thread on the shaft.
The solution with a self-locking bushing made of special technopolymer (Fig.1) is, in any case the most effective against spontaneous unscrewing in that the elastic coupling is not susceptible to any vibrations or rotary forces exerted by the operator's hand.

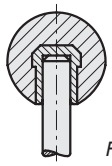

Fig.1

The lock is also such as to ensure that the handle does not come out even when subjected to a normal pulling action along its axis. In relation to this, the results of the research work and tests carried out at the ELESA+GANTER laboratories are provided and they confirm the technical validity of the coupling with self-locking bushings made of special technopolymer (Fig. 2 and 3).
The graph in Fig. 2 shows the variations in axial translation effort expressed in [N] as a function of the variations in diameter of the shaft (mm), dry and degreased with trichloroethylene. The two curves represent the minimum and maximum values in hundreds of tests conducted on a type of self-locking handle with a hole having a Ø 12 mm. The area A contains the values that refer to shaft with a commercial diameter of 12 mm (tol. h9).
The graph in Fig. 3 shows the variations in axial translation effort (mean values) as a function of the surface area of the shaft. As may well be imagined, the presence of lubricating or emulsifying oil on the surface of the shaft lowers the handle removal effort. It may however be readily noted that, even in this unfavourable condition, the axial effort required to slide the handle out is always such as to ensure that this cannot actually happen in practice.
The use of this kind of handle ensures a considerable saving in that it does not entail machining thread on the end of the shaft. The self-locking bushing made of special technopolymer enables an elastic coupling to be obtained and the handle itself maintains all its surface hardness and wear resistance typical of thermosetting materials.
Assembly instructions: fit the handle onto slight chamfered shaft end and push as far as possible by hand or by means of a small press. Alternatively it is possible to tap the handle with a plastic or wooden mallet until firmly in place. In this case we strongly recommend to use a cloth or other suitable soft material over the product to avoid any surface damage.

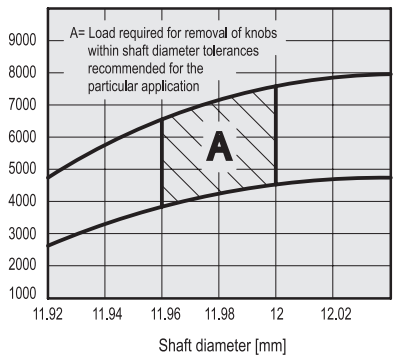

Fig.2

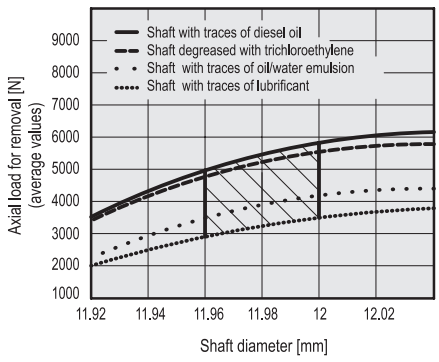

Fig.3

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6. Assembly measures

Plastic is a poor conductor of heat and has a different thermal expansion coefficient from that of the metal inserts so measures must be taken, while remachining the hole, to stop the hubs and bosses from overheating: in fact, the heat produced is not dissipated and the metal parts expand and create stress inside the body of the plastic which has a damaging effect on the strength of the assembly (Duroplasts).
In addition, for thermoplastics (Technopolymers), temperatures close to their softening point could be reached with the risk of the metal insert coming loose.
It is therefore always necessary to adopt cutting and feed rates that do not produce marked localized heating and to cool intensively when the holes have a large diameter and depth with respect to the size of the bushing.
To conserve maximum gloss of the surfaces, we recommend, once machining has been completed, to avoid leaving the plastic wet for a long time, by removing all residual emulsified water from the surfaces; use oil only, if possible.
The machining processes commonly required for the assembly of handwheels or knobs are:

– **remachining of axial hole in the bosses (blind hole)**
When remachining the hole of a built-in metal boss, always avoid operating as shown in Fig.4, because both during the drilling operation and during the insertion of the small shaft, an area of the plastic covering may be subjected to stress, with the risk of cracking or detaching the part indicated with cross shading. The operation shown in Fig. 5 is the most rational.

Note that in the ELESA+GANTER parts, remachining of the axial hole may be performed under the correct conditions indicated above in that the length of the built-in bosses is always indicated in the table of each article so, for the depth of the hole, reference should simply be made to the basic plan.

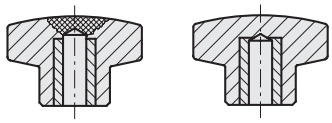

Fig.4 *Fig.5*

– **remachining of the axial hole in the bosses (case of a pass-through hole)** If the drilling operation affects not only the metal boss but also a layer of the covering material, the handwheel must be centred carefully and drilling should be started from the plastic side otherwise, chipping may occur when the tool is removed.
– **transversal threading in the boss for grub-screw** To be performed in accordance with the instructions given above. Avoid threading both the metal and the plastic: it is better to drill the hole in the plastic part and thread the metal part only.

Drilling or threading operations to be performed entirely in the plastic are exceptional. Bear in mind that the difficulty with which the heat produced locally is dissipated, also through the abrasive action of the plastic on the tool, worsens considerably the latter's working conditions, resulting in a rapid wear of the cutting edges (use hard metal tools).

7. Special executions

The range of ELESA+GANTER elements is extremely broad and offers designers valid alternatives as regards designs, properties and performance of materials, sizes..., to satisfy the most different applicational needs. The customer may however need to ask for changes to the standard part or have it made in different colours to adapt it to particular applications. In these cases, ELESA+GANTER engineers are at the customer's full disposal to satisfy these requests for special executions which must be required in sufficient quantities for the modifications they may entail to the moulds.

8. Colours

In addition to black, which represents the most commonly used colour for plastic components, a large number of standard elements are available in the following colours:

Colours in RAL					
	7021		3000		7030
	2004		6001		7040
	7035		9006		7042
	1021		9005		3002
	5024		7031		9002

As the RAL tables refer to the colour of paints and are therefore colours with a glossy surface, the RAL code is indicated indicatively because the tone of the colour of the moulded part may differ slightly, depending on various factors such as the colouring of the polymer pigments (polyamide or polypropylene), the glossy or matte finish, the thickness and the shape of the product.

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9. Test values

All the information about the test values are based on our experience and on laboratory tests conducted under specific standard conditions and in a necessarily limited time.
Any indicated value must therefore be taken only as a reference for the designer who will apply adequate safety coefficients to them according to the product application. The designer and the purchaser are responsible for checking the suitability of our products for their final use under the actual operating conditions.

10. Technical tables

The units contained in the present catalogue, are those of the International System (S). Conveniently, here under there is a list of the parameters converted into the units currently used or into the British ones.

10.1 Conversion tables

Conversion table of the major parameters

Parameter	To convert	in to	multiply by
Force	N	kg	0.1
Couple	Nm	kg-m	0.1
Work	J	kg-m	0.1
Parameter	**To convert**	**in to**	**multiply by**
Length	mm	inches	0.039
Force	N	lbf	0.224
Couple	Nm	lb ft	0.737
Work	J	ft lb	0.737
Weight	g	lb	0.002
Temperature	°C	°F	(°C 9/5) + 32

Conversion table of some temperature values from °C to °F
°C = (°F -32) 5/9 °F = (°C 9/5) +32

°C	°F	°C	°F	°C	°F
-50	-58	+50	+122	+150	+302
-45	-49	+55	+131	+155	+311
-40	-40	+60	+140	+160	+320
-35	-31	+65	+149	+165	+329
-30	-22	+70	+158	+170	+338
-25	-13	+75	+167	+175	+347
-20	-4	+80	+176	+180	+356
-15	+5	+85	+185	+185	+365
-10	+14	+90	+194	+190	+374
-5	+23	+95	+203	+195	+383
0	+32	+100	+212	+200	+392
+5	+41	+105	+221	+205	+401
+10	+50	+110	+230	+210	+410
+15	+59	+115	+239	+215	+419
+20	+68	+120	+248	+220	+428
+25	+77	+125	+257	+225	+437
+30	+86	+130	+266	+230	+446
+35	+95	+135	+275	+235	+455
+40	+104	+140	+284	+240	+464
+45	+113	+145	+293	+245	+473
+50	+122	+150	+302	+250	+482

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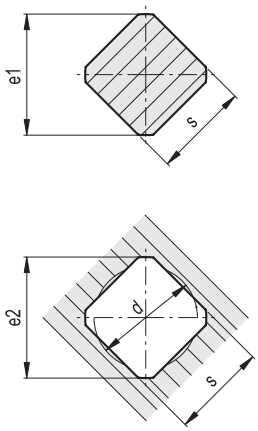
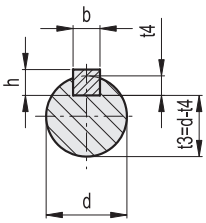
10.2 DIN 79 Square holes and shafts



DIN 79 Square holes and shafts

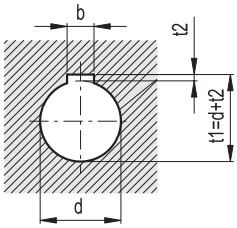
s H11/h11	d max.	e1 max.	e1 min.	e2 min.
4	4.2	5	4.8	5.3
5	5.3	6.5	6	6.6
5.5	5.8	7	6.6	7.2
6	6.3	8	7.2	8.1
7	7.3	9	8.4	9.1
8	8.4	10	9.6	10.1
9	9.5	12	10.8	12.1
10	10.5	13	12	13.1
11	11.6	14	13.2	14.1
12	12.6	16	14.4	16.1
13	13.7	17	15.6	17.1
14	14.7	18	16.8	18.1
16	16.8	21	19.2	21.2
17	17.9	22	20.4	22.2
19	20	25	22.8	25.2
22	23.1	28	26.4	28.2
24	25.3	32	28.8	32.2
27	28.4	36	32.4	36.2
30	31.7	40	36	40.2
32	33.7	42	38.4	42.2
36	38	48	43.3	48.2
41	43.2	54	49.3	54.2
46	48.5	60	55.2	60.2
50	52.7	65	60	65.2
55	57.9	72	66	72.2

10.3 DIN 6885/ UNI 6604 Keyways



DIN 6885/1 Keyways

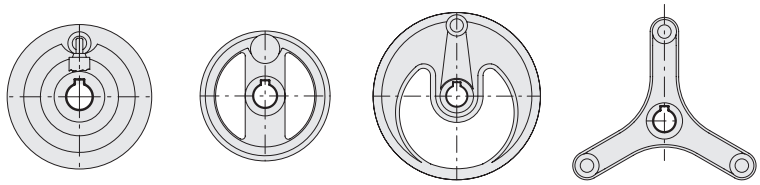
d	b P9/JS9 hole	b P9/N9 shafts	h	t2	t4
from 6 to 8	2	2	2	1 +0.1	1.2 +0.1
over 8 to 10	3	3	3	1.4 +0.1	1.8 +0.1
over 10 to 12	4	4	4	1.8 +0.1	2.5 +0.1
over 12 to 17	5	5	5	2.3 +0.1	3 +0.1
over 17 to 22	6	6	6	2.8 +0.1	3.5 +0.1
over 22 to 30	8	8	7	3.3 +0.2	4 +0.2
over 30 to 38	10	10	8	3.3 +0.2	5 +0.2
over 38 to 44	12	12	8	3.3 +0.2	5 +0.2
over 44 to 50	14	14	9	3.8 +0.2	5.5 +0.2



DIN 6885/2 Keyways

d	b P9/JS9 hole	b P9/N9 shafts	h	t2	t4
from 10 to 12	4	4	4	1.1 +0.1	3 +0.1
over 12 to 17	5	5	5	1.3 +0.1	3.8 +0.1
over 17 to 22	6	6	6	1.7 +0.1	4.4 +0.1
over 22 to 30	8	8	7	1.7 +0.2	5.4 +0.2
over 30 to 38	10	10	8	2.1 +0.2	6 +0.2
over 38 to 44	12	12	8	2.1 +0.2	6 +0.2
over 44 to 50	14	14	9	2.6 +0.2	6.5 +0.2

Standard positioning of the keyways



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UNI 6604/ Keyways					
d	**b D10 hole**	**b H9 shafts**	**h**	**t2**	**t4**
from 6 to 8	2	2	2	1 +0.10	1.2 +0.10
over 8 to 10	3	3	3	1.4 +0.10	1.8 +0.10
over 10 to 12	4	4	4	1.8 +0.10	2.5 +0.10
over 12 to 17	5	5	5	2.3 +0.10	3 +0.10
over 17 to 22	6	6	4	1.8 +0.10	2.5 +0.10
over 17 to 22	6	6	5	2.3 +0.10	3 +0.10
over 17 to 22	6	6	6	3.5 +0.10	3.5 +0.10
over 22 to 30	8	8	5	2.3 +0.10	3 +0.10
over 22 to 30	8	8	6	2.8 +0.10	3.5 +0.10
over 22 to 30	8	8	7	3.3 +0.20	4 +0.20
over 22 to 30	8	8	8	3.3 +0.20	5 +0.20

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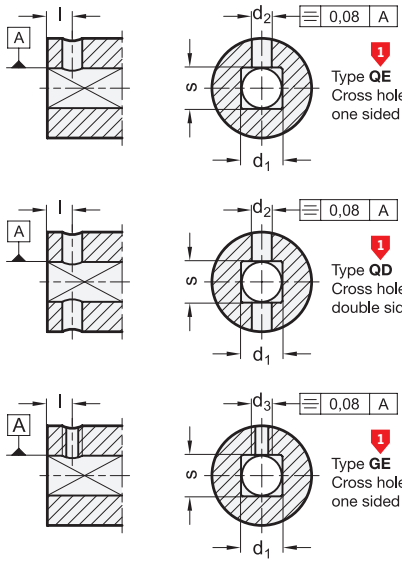
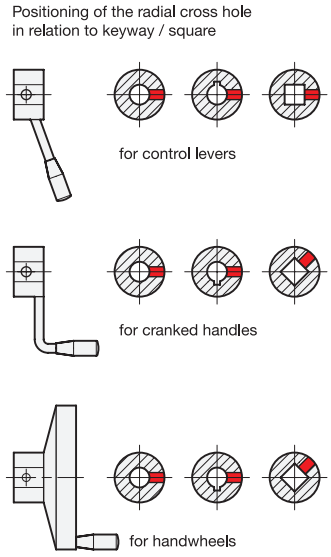
10.4 GN 110 and GN 110.1 Transversal holes

GN 110 – Cross holes for mounting of operating elements on shafts





d1 H7 / **s** H11		**d2** H11	**d3**	Length **l** –0.1 Standard version	Length **l** –0.1 Handwheels DIN 950 / GN 949 to Ø 250
6	7	2.5	M 3	4.5	–
8	9	3	M 5	5.5	4.5
10	11	3	M 5	5.5	4.5
12	13	4	M 6	6.5	5.5
14	15	4	M 6	6.5	5.5
16	17	5	M 6	8	7
18	19	5	M 6	8	7
20	21	5	M 6	8	7
22	23	6	M 6	10	9
24	25	6	M 6	10	9
26	27	6	M 6	10	9

Information

The connection between the operating element and the shaft consists very often of a cross pin or a grub screw.

As a result the user is faced with relatively high costs since cross holes on operating elements are in general not readily available.

Components with cross holes to GN 110 are not only offered at very competitive prices but they also save the manufacturer unnecessary drawing work. The geometrical form of some of the operating elements, however, does not lend itself to modification to this particular GN standard.

The pin hole d2 H11 is drilled to suit drive spring pins.

How to order

Handwheel DIN 950-GG-160-B14-A with cross drilled hole

GN 110-QE

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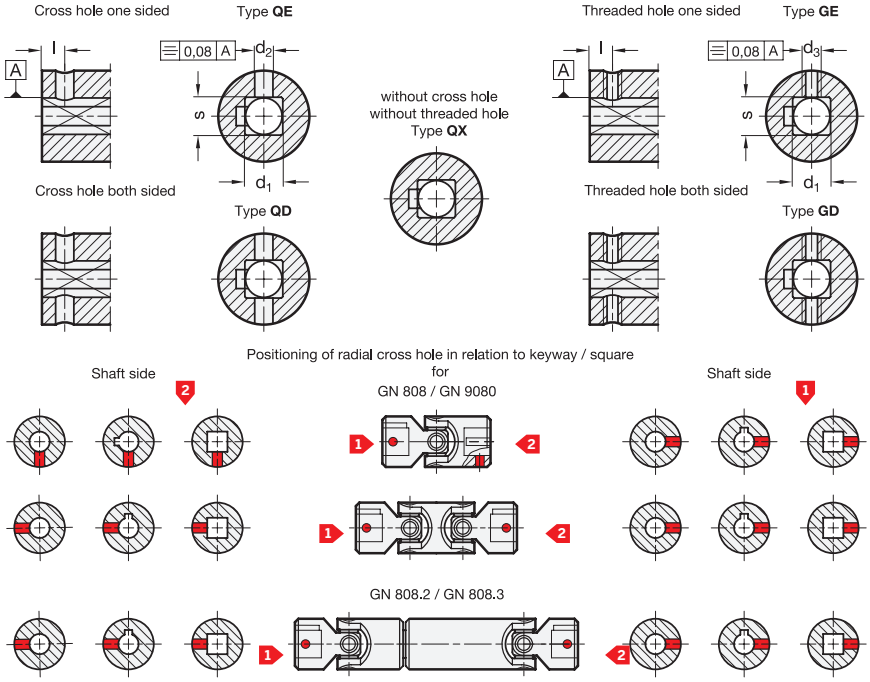
GN 110.1 – Cross holes for mounting of universal joint shafts and universal joints on shafts



d1 H7 / **s** H11		**d2** H11 for bore code		**d3**	Length **l** for bore code	
		K / V	B		K / V	B
6	–	2	2	M 3	4	4
8	–	3	3	M 5	5.5	5.5
10	–	3	4	M 5	5.5	6
12	14	4	5	M 6	6.5	7
16	18	5	6	M 6	8	9
20	–	5	8	M 6	8	10
22	–	6	8	M 6	10	10
25	–	6	10	M 8	10	14
30	32	6	12	M 8	14	16
35	–	6	12	M 8	16	16

Information

Cross holes in universal joint shafts and in universal shafts are ideal for the production of shaft-hub links using a pin or a thrust screw. For bore holes with a feather key groove or square, they serve to secure the axial position of universal joint and shaft.

The d2 pin bore with H11 tolerance is intended for use with coiled spring pins.

The position of the cross holes / the threaded hole with reference to the hub key slot / the square or of the universal joints is shown in the overview.

Should one of the joint sides be delivered without **transversal holes** / **threaded holes**, this is indicated with **QX** on the desired location of the article number.

How to order

Handwheel DIN 950-GG-160-B14-A with cross drilled hole

GN 110.1-QX-GE

Code No.	Shaft side 1	Shaft side 2

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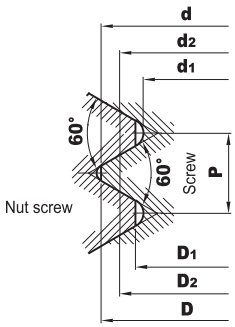
10.5 DIN 13 ISO Metric threads



ISO Metric fine threads – DIN 13 (Thread limits)

Nominal thread-Ø	Gradient P	Screw with tolerance of 6g						Nut screw with tolerance of 6H					
		Ø major d		Ø pitch d2		Ø minor d1		Ø major D		Ø pitch D2		Ø minor D1	
		max.	min.	max.	min.	max.	min.	min.	max.	min.	max.	min.	max.
M5	0.5	4.980	4.874	4.655	4.580	4.367	4.273	5.000	Not specified	4.675	4.775	4.459	4.599
M6	0.5	5.980	5.874	5.655	5.570	5.367	5.263	6.000		5.675	5.787	5.459	5.599
M8	0.5	7.980	7.874	7.655	7.570	7.367	7.263	8.000		7.675	7.787	7.459	7.599
M10	0.5	9.980	9.874	9.655	9.570	11.367	9.263	10.000		9.675	9.787	9.459	9.599
M12	0.5	11.980	11.874	11.655	11.565		11.258	12.000		11.675	11.793	11.459	11.599
M6	0.75	5.978	5.838	5.491	5.391	5.058	4.929	6.000		5.513	5.645	5.188	5.378
M8	0.75	7.978	7.838	7.491	7.391	7.058	6.929	8.000		7.513	7.645	7.188	7.378
M10	0.75	9.798	9.838	9.491	9.391	9.057	8.929	10.000		9.513	8.645	9.188	9.378
M16	0.75	11.978	11.838	11.491	11.385	11.058	10.923	12.000		11.513	15.653	11.188	11.378
M20	0.75	15.978	15.838	15.491	15.385	15.508	14.923	16.000		15.513	11.653	15.188	15.378
M8	1	7.974	7.974	7.324	7.212	6.747	6.596	8.000		7.350	7.500	6.917	7.153
M10	1	9.974	9.974	9.324	9.212	8.747	8.596	10.000		9.350	9.500	8.917	9.153
M12	1	11.974	11.974	11.324	11.206	10.747	10.590	12.000		11.350	11.510	10.917	11.153
M16	1	15.974	15.974	15.324	15.206	14.747	14.590	16.000		15.350	15.510	14.917	15.153
M20	1	19.974	19.974	19.324	19.206	18.747	18.590	20.000		19.350	19.510	18.917	19.153
M12	1.5	11.698	11.732	10.994	10.854	10.128	9.930	12.000		11.026	11.216	10.376	10.676
M14	1.5	13.968	13.732	12.994	12.854	12.128	11.930	14.000		13.026	13.216	12.376	12.676
M16	1.5	15.968	15.732	14.994	14.854	14.128	13.930	16.000		15.026	15.216	14.376	14.676
M18	1.5	17.968	17.732	16.994	16.854	16.128	15.930	18.000		17.026	17.216	16.376	16.676
M20	1.5	19.968	19.732	18.994	18.854	18.128	17.930	20.000		19.026	19.216	18.376	18.676
M22	1.5	21.968	21.732	20.994	20.854	20.128	19.930	22.000		21.026	21.216	20.376	20.676
M26	1.5	25.968	25.732	24.994	24.844	24.128	23.920	26.000		25.026	25.226	24.376	24.676
M27	1.5	26.968	26.732	25.994	25.844	25.128	24.920	27.000		25.026	26.226	25.376	25.676
M30	1.5	26.968	39.732	28.994	28.844	28.128	27.920	30.000		29.026	29.226	28.376	28.676
M35	1.5	34.968	34.732	33.994	33.844	33.128	32.920	35.000		34.026	34.226	33.376	33.676
M40	1.5	34.968	39.732	38.994	38.844	38.128	37.920	40.000		39.026	39.226	38.376	38.676
M20	2	19.962	16.682	18.663	18.503	17.508	17.271	20.000		18.701	18.913	17.835	18.210
M24	2	23.962	23.682	22.663	22.493	24.508	21261	24.000		22.701	22.925	21.835	22.210
M30	2	29.962	29.682	28.663	28.493	27.508	27.261	30.000		28.701	28.925	27.835	28.210
M36	2	35.965	35.682	34.663	34.493	33.508	33.261	36.000		34.701	34.925	33.835	34.210
M42	2	41.962	41.682	40.663	40.493	39.508	39.261	42.000		40.701	40.925	39.835	40.210

ISO Metric threads – DIN 13 (Thread limits for standard engagement lengths to UNI 5545-65)

Nominal thread-Ø	Gradient P	Screw with tolerance of 6g						Nut screw with tolerance of 6H					
		Ø major d		Ø pitch d2		Ø minor d1		Ø major D		Ø pitch D2		Ø minor D1	
		max.	min.	max.	min.	max.	min.	min.	max.	min.	max.	min.	max.
M4	0.7	3.978	3.838	3.523	3.433	3.220	2.979	4.000	Not specified	3.545	3.663	3.242	3.422
M5	0.8	4.976	4.826	4.456	4.361	4.110	3.842	5.000		4.480	4.605	4.134	4.334
M6	1	5.974	5.794	5.324	5.212	4.891	4.563	6.000		5.350	5.500	4.917	5.153
M8	1.25	7.972	7.760	7.160	7.042	6.619	6.230	8.000		7.188	7.348	6.647	6.912
M10	1.5	9.968	9.732	8.994	8.862	8.344	7.888	10.000		9.026	9.206	8.376	8.676
M12	1.75	11.966	11.701	10.829	10.679	10.072	9.543	12.000		10.863	11.063	10.106	10.441
M14	2	13.962	13.682	12.663	12.503	11.797	11.204	14.000		12.701	12.913	11.835	12.210
M16	2	15.962	15.682	14.663	14.503	13.797	13.204	16.000		14.701	14.913	13.835	14.210
M18	2.5	17.958	17.623	16.334	16.164	15.252	14.541	18.000		16.376	16.600	15.294	15.744
M20	2.5	19.958	19.623	18.344	18.164	17.252	16.541	20.000		18.376	18.600	17.294	17.744
M24	3	23.952	23.577	22.003	21.803	20.704	19.855	24.000		22.051	22.316	20.752	21.252
M30	3.5	29.947	29.522	27.674	27.462	26.158	25.189	30.000		27.727	28.007	26.211	26.771

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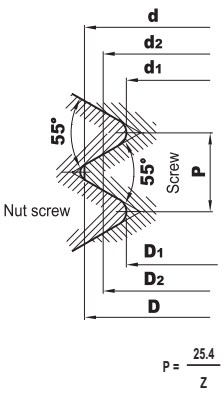
10.6 DIN 228 Cylindrical GAS-BSP threads



Cylindrical GAS-BSP threads DIN 228 (Thread limits)

*	Z threads x1"	Screw with tolerance Classe B						Nut screw					
		Ø major d		Ø pitch d2		Ø minor d1		Ø major D		Ø pitch D2		Ø minor D1	
		max.	min.	max.	min.	max.	min.	min.	max.	min.	max.	min.	max.
G1/8"	28	9.728	9.514	9.147	8.933	8.566	8.298	9.728	Not specified	9.147	9.254	8.566	8.848
G 1/4"	19	13.157	12.907	12.301	12.051	11.445	11.133	13.157		12.301	12.426	11.445	11.890
G 3/8"	19	16.662	16.408	15.806	15.552	14.950	14.632	16.662		15.806	15.933	14.950	15.395
G 1/2"	14	20.955	20.671	19.793	19.509	18.631	18.276	20.955		19.793	19.935	18.631	19.172
G 5/8"	14	22.911	22.627	21.749	21.465	20.587	20.232	22.911		21.749	21.891	20.587	21.128
G 3/4"	14	26.441	26.157	25.279	24.995	24.117	23.762	26.441		25.279	25.421	24.117	24.658
G 7/8"	14	30.201	29.917	29.039	28.755	27.877	27.522	30.201		29.039	29.181	27.877	28.418
G 1"	11	33.249	32.889	31.770	31.410	30.291	29.841	33.249		31.770	31.950	30.291	30.931
G 11/8"	11	37.897	37.537	36.418	36.058	34.939	34.489	37.897		36.418	36.598	34.939	35.579
G 11/4"	11	41.910	41.550	40.431	40.071	38.952	38.502	41.910		40.431	40.611	38.952	39.592
G 3/8"	11	44.323	43.963	42.844	42.484	41.365	40.915	44.323		42.844	43.024	41.365	42.005
G 11/2"	11	47.803	47.443	46.324	45.964	44.845	44.395	47.803		46.324	46.504	44.845	45.485
G 13/4"	11	53.746	53.386	52.267	51.907	50.788	50.338	53.746		52.267	52.447	50.788	51.428
G 2"	11	59.614	59.254	58.135	57.775	56.656	56.206	59.614		58.135	58.315	56.656	57.296

* G in accordance with UNI-ISO 228/1

10.7 DIN EN ISO 898-1 | DIN EN 20898-2 Strength values

Strength values of bolts/nuts EN ISO 898-1 EN 20 898-2

	Strength classes of bolts						
Nominal tensile strength Rm, Nenn N/mm²	4.6	5.6	5.8	6.8	8.8	10.9	12.9
Lower yield point ReL N/mm²	400	500	500	600	800	1000	1200
0.2 % yield limit Rp 0.2 N/mm²	240	300	400	480	–	–	–
Tension under test force Sp N/mm²	225	280	380	440	580	830	970
Elongation A %	22	20	–	–	12	9	8

The strength class identification consists of two numerals:
– the first number corresponds to 1/100 of the nominal tensile strength in N/mm² (see table)
– the second number shows ten times the ratio of lower yield point ReL (or 0.2 % yield limit Rp 0.2) and nominal tensile strength Rm, nom (yield point radio).
Example; Strength class 5.8 means
Minimum tensile strength Rm = 500 N/mm²
Minimum yield point ReL = 400 N/mm²

Strength classes of nuts

Nominal tension Sp N/mm² for thread	5	6	8	10	12
Below M 4	250	600	800	1040	1150
Above M 4 below M 7	580	670	855	1040	1150
Above M 7 below M 10	590	680	870	1040	1160
Above M 10 below M 16	610	700	880	1050	1190
Above M 16 below M 39	630	720	920	1060	1200

The designation of a strength class consists of a distinctive number which provides information of the test tension of the material used:
– distinctive number x 100 = test tension Sp
– the test tension is equal to the minimum tensile strength in N/mm² of a bolt which, if paired with the appropriate nut, can be loaded up to the minimum yield of the bolt.
Example: Bolt 8.8 – nut 8, connection can be loaded up to the minimum yield point of the bolt.

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10.8 DIN ISO 286 ISO-Fundamental tolerances

This ISO Standard represents the basic for a system of nominal dimensions and sizes whereby the table mirrors the calculated values of basic tolerances relating to basic dimensions.
The use of this table is limited to smooth circular cylindrical workpieces or such with two parallel fitting planes or contact areas.
The values attributed to an ISO tolerance grade (IT) specify the tolerance value and hence the tolerance area. With ascending numbers, the size of the tolerance increases.
For identification purpose of the position of the tolerance area in relation to the nominal dimension (zero), the number chosen as tolerance grade IT is preceeded by a letter.
Tolerance area H is the most common value for bores. It specifies that the minimum dimension of the bore corresponds to the nominal dimension.
The permissible maximum dimension corresponds to the nominal dimension plus the IT tolerance.

Examples:
bore 20 H7 = 20 + 0.021/0 **bore 8 H11 = 8 + 0.090/0**
min. dimension: 20.000 **min. dimension: 8.000**
max. dimension: 20.021 **max. dimension: 8.090**

ISO-Fundamental tolerance series DIN ISO 286

Tol. (µm)	Nominal sizes												
Grades IT	**– ... 3**	**> 3 ... 6**	**> 6 ... 10**	**> 10 ... 18**	**> 18 ... 30**	**> 30 ... 50**	**> 50 ... 80**	**> 80 ... 120**	**> 120 ... 180**	**> 180 ... 250**	**> 250 ... 315**	**> 315 ... 400**	**> 400 ... 500**
01	0.3	0.4	0.4	0.5	0.6	0.6	0.8	1	1.2	2	2.5	3	4
0	0.5	0.6	0.6	0.8	1	1	1.2	1.5	2	3	4	5	6
1	0.8	1	1	1.2	1.5	1.5	2	2.5	3.5	4.5	6	7	8
2	1.2	1.5	1.5	2	2.5	2.5	3	4	5	7	8	9	10
3	2	2.5	2.5	3	4	4	5	6	8	10	12	13	15
4	3	4	4	5	6	7	8	10	12	14	16	18	20
5	4	5	6	8	9	11	13	15	18	20	23	25	27
6	6	8	9	11	13	16	19	22	25	29	32	36	40
7	10	12	15	18	21	25	30	35	40	46	52	57	63
8	14	18	22	27	33	39	46	54	63	72	81	89	97
9	25	30	36	43	52	62	74	87	100	115	130	140	155
10	40	48	58	70	84	100	120	140	160	185	210	230	250
11	60	75	90	110	130	160	190	220	250	290	320	360	400
12	100	120	150	180	210	250	300	350	400	460	520	570	630
13	140	180	220	270	330	390	460	540	630	720	810	890	970
14	250	300	360	430	520	620	740	870	1000	1150	1300	1400	1550
15	400	480	580	700	840	900	1200	1400	1600	1850	2100	2300	2500
16	600	750	900	1100	1300	1600	1900	2200	2500	2900	3200	3600	4000
17	1000	1200	1500	1800	2100	2500	3000	3500	4000	4600	5200	5700	6300
18	1400	1800	2200	2700	3300	3900	4600	5400	6300	7200	8100	8900	9700

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Tol. (µm)	Nominal sizes									
Classes for bore	**... ... 3**	**> 3 ... 6**	**> 6 ... 10**	**> 10 ... 18**	**> 18 ... 30**	**> 30 ... 50**	**> 50 ... 80**	**> 80 ... 120**	**> 120 ... 180**	**> 180 ... 250**
D9	+45	+60	+76	+93	+117	+142	+174	+207	+245	+285
	+20	+30	+40	+50	+65	+80	+100	+120	+145	+170
D12	+120	+150	+190	+230	+275	+330	+400	+470	+545	+630
	+20	+30	+40	+50	+65	+80	+100	+120	+145	+170
E8	+28	+38	+47	+59	+73	+89	+106	+126	+148	+172
	+14	+20	+25	+32	+40	+50	+60	+72	+85	+100
G6	+8	+12	+14	+17	+20	+25	+29	+34	+39	+44
	+2	+4	+5	+6	+7	+9	+10	+12	+14	+15
G7	+12	+16	+20	+24	+28	+34	+40	+47	+54	+61
	+2	+4	+5	+6	+7	+9	+10	+12	+14	+15
H7	+10	+12	+15	+18	+21	+25	+30	+35	+40	+46
	0	0	0	0	0	0	0	0	0	0
H8	+14	+18	+22	+27	+33	+39	+46	+54	+63	+72
	0	0	0	0	0	0	0	0	0	0
H9	+25	+30	+36	+43	+52	+62	+74	+87	+100	+115
	0	0	0	0	0	0	0	0	0	0
H11	+60	+75	+90	+110	+130	+160	+190	+220	+250	+290
	0	0	0	0	0	0	0	0	0	0
H12	+100	+120	+150	+180	+210	+250	+300	+350	+400	+460
	0	0	0	0	0	0	0	0	0	0
H13	+140	+180	+220	+270	+330	+390	+460	+540	+630	+720
	0	0	0	0	0	0	0	0	0	0
H14	+250	+300	+360	+430	+520	+620	+740	+870	+1000	+1150
	0	0	0	0	0	0	0	0	0	0
JS9	±12.5	±15	±18	±21.5	±26	±31	±37	±43.5	±50	±57.5
N9	-4	0	0	0	0	0	0	0	0	0
	-29	-30	-36	-43	-52	-62	-74	87	-100	-115
P9	-6	-12	-15	-18	-22	--26	-32	-37	-43	-50
	-31	-42	-51	-61	-74	-88	-106	-124	-143	-165
for shaft f7	-6	-10	-13	-16	-20	-25	-30	-36	-43	-50
	-16	-22	-28	-34	-41	-50	-60	-71	-83	-96
h6	0	0	0	0	0	0	0	0	0	0
	-6	-8	-9	-11	-13	-16	-19	-22	-25	-29
h7	0	0	0	0	0	0	0	0	0	0
	-10	-12	-15	-18	-21	-25	-30	-35	-40	-46
h8	0	0	0	0	0	0	0	0	0	0
	-14	-18	-22	-27	-33	-39	-46	-54	-63	-72
h9	0	0	0	0	0	0	0	0	0	0
	-25	-30	-36	-43	-52	-62	-74	-87	-100	-115
h11	0	0	0	0	0	0	0	0	0	0
	-60	-75	-90	-110	-130	-160	-190	-220	-250	-290
h13	0	0	0	0	0	0	0	0	0	0
	-140	-180	-220	-270	-330	-390	-460	-540	-630	-720
h14	0	0	0	0	0	0	0	0	0	0
	-250	-300	-360	-430	-520	-620	-740	-870	-1000	-1150
js14	±125	±150	±180	±215	±260	±310	±370	±435	±500	±575
n6	+10	+16	+19	+23	+28	+33	+39	+45	+52	+60
	+4	+8	+10	+12	+15	+17	+20	+23	+27	+31
p6	+12	+20	+24	+29	+35	+42	+51	+59	+68	+79
	+6	+12	+15	+18	+22	+26	+32	+37	+43	+50

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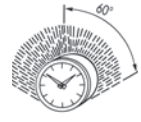
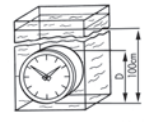
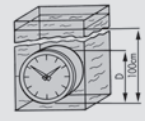
10.9 IP Protection Classification

IP Protection Classification for Cases according to international Standard EN 60529					
1st digit Protection against intrusion of solid foreign bodies.			2nd digit Protection against pentration of liquids.		
0		No protection.	0		No protection.
1		Protection against intrusion of solid foreign bodies, Ø larger than 50 mm (hands).	1		Protectionagainst drops of condensed water falling vertically.
2		Protection against intrusion of solid foreign bodies, Ø larger than 12 mm (fingers).	2		Protection against drops of liquid falling at an angle equal to or smaller than 15° with respect to the vertical.
3		Protection against intrusion of solid foreign bodies, Ø larger than 2.5 mm (tools, wires).	3		Protection against drops of liquid falling at an angle euqal to or smaller than 60° with respect to the vertical.
4		Protection against intrusion of solid foreign bodies, Ø larger than 1 mm (wires).	4		Protection against liquid splashed from any direction.
5		Protection against harmful deposits of dust, which damage the correct operation.	5		Protection against water jets projected by a nozzle from any direction.
6		Complete protection against instrusion of durst.	6		Protection against water from heavy sea on ship's decks.
As a specification for cases of rotary controls does not exist, we refer to International Standard EN 60529 for protection classification of cases for electrical machines, devices of materials.			7		Protection against immersion in water under stated conditions of pressure and time.
			8		Protection against indefinite immersion in water under stated conditions of pressure.

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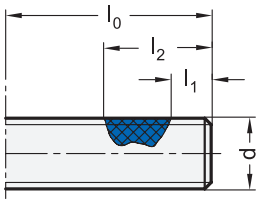
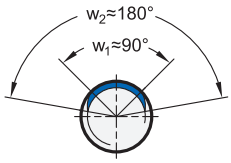
10.10 Thread Lockings (PFB, PRB, MVK, GPC)

PFB | PRB Thread locking with jamming action Polyamide patch coating / Polyamide complete coating

PFB

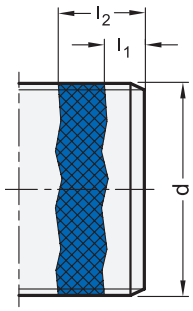


l_0 ≈ Threaded length
l_1 ≈ 2 to 3 x Thread pitch
l_2 ≈ 1.5 x d



w_1: Coating core zone
w_2: Coating including edge zone

PRB



Polyamide patch coating PFB					
			Values acc. to DIN 267 Part 28		Values for spring plungers GN 611 / GN 615.3
d	**l_1 ≈**	**l_2 ≈**	**$M_{max.}$** in Nm 1st Screw in	**$M_{min.}$** in Nm 1st Screw out	**M ≈** in Nm 1st Screw in / Screw out
M 3	1 ... 1.5	4.5	0.43	0.1	0.3
M 4	1.5 ... 2	6	0.9	0.12	0.5
M 5	1.5 ... 2.5	7.5	1.6	0.18	0.6
M 6	2 ... 3	9	3	0.35	1.2
M 8	2.5 ... 4	12	6	0.85	2
M 10	3 ... 4.5	15	10.5	1.5	3.5
M 12	3.5 ... 5	18	15.5	2.3	5
M 16	4 ... 6	24	32	4	7
M 20	5 ... 7.5	30	60	5.4	10
M 24	9 ... 9	36	85	6.9	12

Polyamide complete coating PRB				
d	**l_1 ≈**	**l_2 ≈**	**$M_{max.}$** in Nm 1st Screw in	**$M_{min.}$** in Nm 1st Screw out
M 12 x 1.5	2.5	5.5	15.5	2.3
M 16 x 1.5	2.5	5.5	32	4
M 20 x 1.5	2.5	7.5	54	7.5
M 24 x 1.5	2.5	7.5	80	11.5
M 27 x 1.5	2.5	7.5	94	13.5
M 30 x 1.5	2.5	7.5	108	16
M 33 x 1.5	2.5	7.5	122	18

The torque values are based on a test of a thread without preload with a nut thread 6H at room temperature. For PFB and thread lenghts $l_0 < l_2$, l_2 is reduced in such a way that one to two thread turns are not coated at the end of the thread.

Description

The polyamide patch coating PFB is a process whereby an elastic plastic material (Polyamide) is applied to a part of thread which creates a jamming action during the tightening of a nut. The coating can be produced either as a patch or complete coating. The axial play between the bolts and nut thread is taken up by the polyamide thus ensuring maximum surface pressure between the opposite uncoated thread flanks. This process counteracts the loosening and unscrewing on their own. There is no cure time required, the thread contact is instantaneous resilient. The typical spray edge zone of the polyamide deposit prevents shear blasting.

Features

– High thread locking action, shakeproof. Excellent convenient for adjusting bolts.
– The locking system is a captive component of the standard part, which eliminates the fitting of additional belay.
– Temperature resistant from – 60 °C up to 120 °C
– Approval for food areas
– High chemical stability
– Use is also possible, for instance, in oil-contaminated threaded holes
– Multi use is possible whereby the jamming effect after the 5th removal is around 50 % of its original strength.

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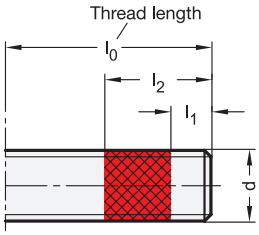
Information
Polyamide patch coating is offered for GN 615.3 (see page 840) spring plungers. A blue coating indicates type K or KN, green indicates type KS or KSN (high spring load). Polyamide complete coating is available for GN 252 and GN 252.5 blanking plugs (see page 1685) as a type.

MVK Thread locking gluing Micro encapsulation precote 80 (red)



$l_1 \approx$ 2 to 3 x Thread pitch
$l_2 \approx$ 1.5 x d

d	l_1	$l_2 \approx$	**MIN** in Nm max. insertion torque	**MLB** in Nm min. breakaway torque	**MOUT** in Nm max. loosening torque
M 5	1.5 ... 2.5	7.5	0.5	1	6.5
M 6	2 ... 3	9	0.8	1.8	10
M 8	2.5 ... 4	12	1.5	4	26
M 10	3 ... 4.5	15	3	10	55
M 12	3.5 ... 5	18	5	16	95
M 16	4 ... 6	24	11	35	250
M 20	5 ... 7.5	30	14	45	500

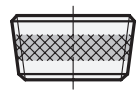
The torque value comply with DIN 267 Part 27. They are based on a test of a thread without preload with a nut thread of 6H at room temperature. For thread lengths $l_0 < l_2$, l_2 is reduced in such a way that one to two thread turns are not coated at the end of the thread.

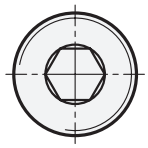
Description
The principle of micro encapsulation MVK (gluing) consists of a liquid plastic material and hardener encapsulated in a thin polymer film which is embedded in a lacquer like carrier deposited in patch form an a thread. This patch dries and the component can be stored and handled in a normal manner.
When fitting a bolt with this patch the two capsules will burst under the pressure and friction between the two threads. The liquid plastic material and hardener will mix leading to a chemical reaction which will harden the glue, thus giving the required thread locking.
The setting of the mixture will start after 10 – 15 minutes. Sufficient hardness is achieved after about 30 minutes but complete setting is reached after 24 hours.
Adjustment and setting process must be completed within about 5 minutes.
The thread locking can be cracked by applying the MOUT torque on the thread or alternatively by heating the component over +170 °C. It is not recommended to re-use the thread.
Threads, free from oil and grease give increased strength of locking action.
Components treated with this process can be stored for up to 4 years.

Features
– Thread locking to the highest order to prevent the self loosening and component loss even under vibration. Not suitable for adjustable bolts or screws.
– This security aspect may be essential for certain applications of standard parts. Stockholding of liquid glue is eliminated.
– Low insertion torque
– Temperature resistant from – 40 °C up to 170 °C
– Excellent chemical stability

GPC Tightening with thread coating Precote 5 (white)

Threaded plugs DIN 906





Description
Precote 5 is a non-reactive, film-forming emulsion with mineral solids for coating threaded parts.
The coating generates a seal against gases and liquids in threaded parts, both in cylindrical / cylindrical and in cylindrical / conical pairs. Corrosion in the threaded connection is prevented.
The coating is solvent-free, dry and non-sticky. It is non-hazardous for health.
The minimum storage stability in unmounted state is 4 years.

Features
– The sealing coat is a captive element of the locking screw. It saves storing and mounting locking materials.
– The sealing effect sets in after mounting, no curing time is required.
– The friction rating of the thread remains virtually constant, the working-loose torque is low, max. reusable once.
– Sealing effect of thread: cylindrical / cylindrical < 15 bar cylindrical / conical > 50 bar
– Temperature resistance: from – 50 °C to 180 °C
– Good chemical resistance, e.g. against oils, water, petrol and solvents

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10.11 Stainless Steel characteristics

AISI Standard	**431 (A4)**	**304**	**303**	**CF-8 Precison casting**
German Material No.	1.4057 (A4)	1.4301	1.4305	1.4308
DIN / EN-Number	EN 10088-3	EN 10088-3	EN 10088-3	EN 10213-4
Symbol	X 17 CrNi 16-2	X 5 CrNi 18-10	X 8 CrNiS 18-9	GX 5CrNi 19-10
Alloying components %	C ≤ 0.12 ... 0.22 Cr 15.0 ... 17.0 Ni 1.5 ... 2.5	C ≤ 0.07 Cr 17.5 ... 19.5 Ni 8.0 ... 10.5	C ≤ 0.10 S ≤ 0.15 ... 0.35 Cr 17.0 ... 19.0 Ni 8.0 ... 10.0	C ≤ 0.07 Cr 18.0 ... 20.0 Ni 8.0 ... 11.0
Minimum tensile strength Rm in N/mm^2	800 ... 950	500 ... 700	500 ... 700	440 ... 640
Yield strength Rp0.2 in N/mm^2	≥ 600	≥ 190	≥ 190	≥ 175
Machinability	poor	medium	very good	medium
Forgeability	medium	good	poor	–
Weldability	good	excellent	poor	good
Special characteristics	magnetic, martensitic structure for elements with high stability, can be used up to 400 °C	antimagnetic, austenitic structure suitable for low temperatures, can be used up to 700 °C	antimagnetic, austenitic structure	antimagnetic, austenitic structure
Corrosion resistance	good however, sensitive to intercrystalline corrosion	good resistant to corrosion, in the natural environment: water, rural and urban atmospheres without significant chloride or acid concentrations, in food areas and in agricultural food areas	medium due to the sulphur content reservations in environments which contain acids and chlorides	good resistant to corrosion, Material is largely comparable with AISI 304
Main areas of application	– Vehicle construction – Chemical industry – Aviation – Machine construction – Food industry	– Food industry – Agriculture – Chemical industry – Vehicle construction – Construction industry – Machine construction – Decorative purposes (Kitchen equipment)	– Vehicle construction – Electronics – Decorative purposes (Kitchen equipment) – Machine construction	– Food industry – Beverage industry – Packaging industry – Fittings – Pumps – Agitators

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TECHNICAL DATA

Material characteristics of Stainless Steel continued

AISI Standard	301	302	316	316 LHC Sintered Material	316 L (A4, bar steel)
German Material No.	1.4310	1.4325	1.4401 (A4)	1.4404	1.4404 (A4)
DIN / EN-Number	EN 10088-3	EN 10088-1	EN 10088-3	Sint C40	EN 10088-3
Symbol	X 10 CrNi 18-8	X9CrNi 18-9	X 5 CrNiMo 17-12-2	X 2 CrNiMo 17-13-2	X 2 CrNiMo 17-12-2
Alloying components %	C ≤ 0.05 ... 0.15 Mo ≤ 0.8 Cr 16.0 ... 19.0 Ni 6.0 ... 9.5	C ≤ 0.08 Si ≤ 0.6 Mn ≤ 1.2 Cr 18.0 Ni9.0	C ≤ 0.07 Cr 16.5 ... 18.5 Ni 10.0 ... 13.0 Mo 2.0 ... 2.5	C ≤ 0.08 Mo 2.0 ... 4.0 Cr 16.0 ... 19.0 Ni 10.0 ... 14.0	C ≤ 0.03 Cr 16.5 ... 18.5 Ni 10.5 ... 13.0 Mo 2.0 ... 2.5
Minimum tensile strength Rm in N/mm²	500 ... 750	600 ... 800	500 ... 700	330	500 ... 700
Yield strength Rp0.2 in N/mm²	≥ 195	≥ 210	≥ 200	≥ 250	≥ 200
Machinability	poor	good	medium	–	medium
Forgeability	good	poor	good	–	good
Weldability	excellent	poor	good	–	excellent
Special characteristics	antimagnetic, austenitic structure usable as spring steel up to 300 °C	Non-magnetic structure. Suitable for low temperatures	antimagnetic, austenitic structure suitable forlow temperatures, can be used up to 600 °C	antimagnetic structure	antimagnetic, austenitic structure suitable for low temperatures, can be used up to 700 °C
Corrosion resistance	good however, sensitive to intercrystalline corrosion	fair	very good significantly higher than AISI 304 in natural environmental mediums and moderate chlorine and salt concentrations, however not resistant to ocean water	medium by virtue of its coarser porosity the corrosion resistance is in general reduced as compared with Stainless Steel, reservations especially in acid and salty environment	very good significantly higher than AISI 304 in natural environmental mediums and moderate chlorine and salt concentrations, however not resistant to ocean water
Main areas of application	– Springs for temperatures up to 300 °C – Tools (knives) – Plates for vehicle construction – Chemical and food industry	Used for the manufacture of springs in various fields of application	– Chemical industry – Food industry – Machine construction – Building industry	– Paint, oil, soap and textile industry – Electronics – Decorative purposes (Kitchen equipment)	– Vehicle construction – Chemical industry – Food industry – Medical / Pharmaceutical industry – Building industry

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Material characteristics of Stainless Steel continued

AISI Standard	**316**	**630**	**304 Cu**	**316 Ti (A4)**
German Material No.	1.4408	1.4542	1.4567	1.4571 (A4)
DIN / EN-Number	EN 10213-4	EN 10088-3	EN 10088-3	EN 10088-3
Symbol	GX 5 CrNiMo 19-11-2	X 5 CrNiCuNb 16-4	X 3 CrNiCu 18-9-4	X 6 CrNiMoTi 17-12-2
Alloying components %	C ≤ 0.07 Cr 18.0 ... 20.0 Ni 9.0 ... 12.0 Mo 2.0 ... 2.5	C ≤ 0.07 Cr 15.0 ... 17.0 Ni 3.0 ... 5.0 Cu 3.0 ... 5.0 Nb min. 5xC ... 0.45	C ≤ 0.04 Cr 17.0 ... 19.0 Ni 8.5 ... 10.5 Cu 3.0 ... 4.0	C ≤ 0.08 Mn ≤ 2.0 Cr 16.5 ... 18.5 Ni 10.5 ... 13.5 Mo 2.0 ... 2.5 Ti ≤ 5xC max. 0.7
Minimum tensile strength Rm in N/mm^2	440 ... 650	800 ... 1200	450 ... 650	500 ... 700
Yield strength Rp0.2 in N/mm^2	≥ 185	500 ... 1000	≥ 175	≥ 175
Machinability	medium	poor ... medium	medium ... good	medium ... poor
Forgeability	–	good	good	medium
Weldability	good	good	good	good
Special characteristics	antimagnetic, austenitic structure	antimagnetic, austenitic structure hardenable (precipitation hardening) suitable for low temperatures, can be used up to 450 °C	antimagnetic, austenitic structure suitable for cold forming	antimagnetic, austenitic structure suitable for low temperatures can be used up to 700 °C, high stability even at high temperatures
Corrosion resistance	very good acid-resistant	good Corrosion resistance comparable with AISI 304. insensitive to intergranular corrosion	good resistant to corrosion in the natural environment: water, rural and urban atmospheres without significant acid concentrations, in food areas and in agricultural food areas	very good comparable with 316 L
Main areas of application	– Food industry – Chemical industry – Fittings – Pumps – Machine construction	– Shipbuilding – Food industry – Construction engineering – Automotive industry – Chemical industry – Plant construction	– Food industry – Agriculture – Chemical industry – Machine construction – Shipbuilding – Electronics – Screw industry	– Equipment and pipeline construction – Chemical industry – Food industry – Medical / Pharmaceutical industry – Shipbuilding

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10.12 Surface treatments
in alphabetical order

Anodizing
Anodizing is one of the most widely used methods for treating the surface of aluminum workpieces. In this surface treatment, an anodizing process is used in which the surface of the component is specifically oxidized electrolytically – the top layer converts into a stable oxide compound Al_2O_3. Changing the process parameters allows the layer thickness to be varied between 5 and 25 µm and allows organic, inorganic, or electrolytic coloration.
The surface treatment takes place in an electrolytic tank, whereby the workpiece acts as the anode and the sulfur or oxalic acid filing is the cathode. Usually direct current is used, which creates a weak flow of current between the two electrodes. The hydrogen ions created in this process stimulate electrochemical corrosion on the aluminum surface, during which released atomic oxygen reacts with the metallic aluminum to form a hard oxide layer.
Anodizing is mainly used to give aluminum workpieces better corrosion resistance. Introduction of dyes in the Al_2O_3 layer also allows anodizing to permanently color code components or visually enhance them – for example, by means of a red color.

Black oxide coating
Black-bronzed parts are only minimally protected against corrosion. The process is therefore, usually used to improve storage stability or for decorative reasons.
When the workpieces are placed in the hot black oxide solution, a chemical reaction creates a mixed oxide layer consisting of FeO and Fe_2O_3 with a maximum thickness of 1.5 µm. The dimensional accuracy is preserved. The conversion layer is heat resistant up to about 300 °C and is resistant to abrasion and bending, although it is too porous to provide adequate protection against corrosion. This protection can be achieved through additional coatings for which the black-oxide layeracts as a primer. The process is standardized according to DIN 50938.

Chrome-plating
Chromium layers with thicknesses between 8 and 10 µm are used for decorative purposes and are available as glossy or matte chrome-plating from ELESA+GANTER. The process is a galvanic process. Chromium ions are supplied from an aqueous solution with a chromic acid base.
Usually a combination of layers are necessary, whereby which the chromium always forms the top layer. For example, ELESA+GANTER uses two-layer chrome-plating with nickel as the first layer and chromium as the top layer. The three-layer process is also used. Here the first layer is copper, the second nickel, and the final layer is chromium.
Chrome-plating is a comparably cost-intensive process that places high demands on occupational safety and environ-mental protection due to the use of chromium(VI)-based electrolytes. Alternative electrolytes based on non-toxic chromium(III) are still in the testing phase.

Electropolishing
This electrochemical process reduces surface roughness and removes impurities, microfissures, and microstructural defects in stainless steel parts. The workpiece is placed into an immersion bath containing material-specific electrolytes and forms the anode from which a thin metallic layer is removed after direct current is applied.
Electropolishing operates on the micro-scale and removes rough peaks, while generating increased abrasion at the edges, which also makes electropolishing ideal for fine deburring. The process is gentle on the structure since there is neither thermal nor mechanical stress.In addition to decorative applications, electropolished elements are used, for example, in the chemistry and food industry, in container construction, or in medical technology.

Galvanizing
This general term stands for various processes for the application of pure zinc layers to steel. In all cases, the objective is to protect the substrate against corrosion for as long as possible. The galvanic zinc-coating most commonly used by ELESA+GANTER uses a bath in which an electrolyte connects the workpiece which acts as the cathode to an anode made of pure zinc.
Depending on process parameters, the layer thicknesses which are deposited in this way range from 2.5 to a maximumof 25 µm. The process, which is standardized according to DIN 50979, is mainly suitable for corrosion protection of small parts.
The zinc which is present on the surface may also be exposed to corrosion depending on ambient conditions and is therefore subsequently protected by additional passivation to prevent zinc corrosion (white rust). In addition, treatment with suitable chromium(VI)-free solutions creates a chromate layer, which considerably improves the corrosion resistance of the zinc coating. Dyes can also be introduced in this process step.

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Nano-passivation
This process provides exceptionally good corrosion protection with minimal layer thicknesses for die-cast zinc parts. The passivation layer is only 0.3 to 0.5 µm thick and does not affect dimensional accuracy. ELESA+GANTER, usually uses an anthracite-colored layer.
The passivation consists of a chromium(III) layer and an overlying layer consisting of nanoscale SiO_2 particles which have self-healing properties. If the surface becomes damaged down to the metallic substrate, the SiO_2 particles migrate through the potential differences in a mobilized way to the unprotected area to reclose the layer.
Nano-passivation can be performed quickly and economi-cally as a spray or immersion process – and is also a good primer for subsequent, further coatings, such as powder coating.

Nickel-plating
This term is a collective term for different processes that are used to apply nickel to metallic substrates. Nickel-plating is divided mainly into galvanic and chemical nickel-plating.
With galvanic nickel-plating according to DIN EN ISO 1456, nickel ions are deposited from an electrolyte by the application of an electrical voltage. The layer created in this way appears silvery with a light yellow shade and is resistant to water and diluted acids and bases, but does not protect against tarnishing. Corrosion protection is also only provided to a limited extent, as the layers, which are less than 25 µm thick, are usually porous and are therefore susceptible to pitting. Multi-layer systems with chromium as the top layer are more resistant in this respect.
Chemical nickel-plating, on the other hand, is not an electrochemical process. It is a reduction reaction of the surface of the part in the electrolyte bath, in which a uniform, non-porous nickel layer is formed. The end result provides very good protection against corrosive media, good abrasion resistance, and high hardness – including for parts with complex geometries with interior surfaces. The nickel layer created in this way can be soldered and is non-ferromagnetic.

Powder coating
Powder coating, also known as plastic coating, usually refers to the electrostatic process variant. The powder, consisting of pigmented thermoplastic polymer or reactive binding agents made of epoxy resin, polyester resin, or acrylic resin, is applied to the workpiece.
Inside the spray nozzle, the powder accumulates a negative electrostatic charge, flows along the field lines to the grounded workpiece, and also reaches the rear of the workpiece. The electrostatic charge reduces overspray and ensures adhesion of the powder up to its thermal fusion.
The actual closed and homogeneous layer, with a thickness in the range from 100 to 200 µm, is not created until this step in the process. Depending on powder type, the layers are highly resilient, weatherproof, and corrosion-resistant. They also can be produced in a wide variety of colors. Powder coating is very popular due to the ease of automation of the process and its economic feasibility.

Steam oxide coating
This process is used for the post-treatment of hardened sintered parts for which black oxide coating using a saline solution cannot be used.
With steam oxidation, the sintered part is treated with water vapor at temperatures in excess of 350 °C. The result is a thin, almost black homogeneous oxide layer of about 1 µm. Steam oxide coating only increases corrosion resistance to a small extent.

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10.13 Carbon steel, zinc alloys, aluminium, brass characteristics

Carbon steel, zinc alloys, aluminium and brass							
Description		**Steel for threaded studs**	**Steel for threaded studs**	**Zinc alloy for pressure diecasting**	**Aluminium for handles tubes**	**Brass for bosses with threaded or plain hole**	**Brass for reinforcing square holes**
Material description	Symbol	11SMnPb37	C10C	ZnA14Cu1	AlMgSi	CuZn39Pb3	CuZn37
	Number	1.0737	1.0214	ZL0410 (ZL5)	EN AW-6060	CW614N	CW508L
UNI standard		UNI EN 10277-4	UNI EN 10263-2	UNI EN 1774	UNI EN 573-3	UNI EN 12164	UNI EN 12449
% components of alloy		C < = 0.14 Pb ≤ 0.20-0.35 Si ≤ 0.05 Mn 1.00 ÷ 1.50 P ≤ 0.11 S 0.340.40 Fe rest	C 0.08-0.12 Si ≤ 0.10 Mn 0.30-0.50 P ≤ 0.025 S ≤ 0.025 Al 0.02-0.06 Fe rest	Cu 0.7-1.1 Pb ≤ 0.003 Fe ≤ 0.020 Al 3.8-4.2 Sn ≤ 0.001 Si ≤ 0.02 Ni ≤ 0.001 Mg 0.035-0.06 Cd ≤ 0.003 Zn rest	Si 0.03-0.6 Fe 0.1-0.3 Cu ≤ 0.10 Mn ≤ 0.10 Mg 0.035-0.06 Cr ≤ 0.05 Zn ≤ 0.15 Ti ≤ 0.10 Total impurities ≤ 0.15	Cu 57-59 Pb 2.5-3.5 Fe ≤ 0.30 Al ≤ 0.05 Sn ≤ 0.30 Si ≤ 0.90 Ni ≤ 0.30 Total impurities ≤ 0.20 Zn rest	Cu 62-64 Pb ≤ 0.10 Fe ≤ 0.10 Al ≤ 0.05 Sn ≤ 0.10 Ni ≤ 0.30 Total impurities ≤ 0.10 Zn rest
Tensile breaking load Rm [MPa]		400 – 650	510 – 520	280 – 350	120 – 190	490 – 530	340 – 360
Yield point Rp 0.2 [MPa]		≤ 305	–	220 – 250	60 – 150	–	–
Modulus of elasticity E [MPa]		–	–	100000	67000	100000	103400
Ultimate elongation %		9	58	2 – 5	16	12 – 16	45
Special features		Steel for high-speed machining. Used for parts obtained by turning.	Steel for moulding.	–	–	Brass for high-speed machining. Used for parts obtained by turning.	Brass for machining with good plastic deformability.

Duroplasts – Resistance to chemical agents at 23 °C temperature		
Chemical agent resistance	**Duroplast (PF)**	**Painted Duroplast**
Alcohol (methanol, ethanol, isopropanol...)	●	●
Boiling water	❒	❒
Edible oils	●	●
Esters (methyl acetate, ethyl acetate, ...)	●	
Ether (ethyl eter, oil ether, ...)	●	
Fat	●	
Ketons (acetone)	●	●
Mineral oils	●	●
Petrol, gas oil, benzene	●	●
Strong acids (hydrocloric, nitric, sulphuric, ...)	▲	▲
Strong alkali	▲	▲
Toluene	●	❒ (milk effect)
Water	●	●
Weak acids (butyric, oleic, lactic, ...)	❒	
Weak alkali	❒	
Xylene	●	❒ (milk effect)

● = good resistance ❒ = fair resistance (limited use according to working conditions) ▲ = poor resistance (should not be used) Blank stand for data not available

The characteristics described should be treated as guidelines only. No guarantee is made.
The user is responsible for checking the exact operating conditions.

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10.14 Duroplast, elastomer, technopolymer and rubber characteristics

Elastomer (Rubber)						
International symbol	**NR**	**NBR**	**CR**	**FKM - FPM**	**TPE**	**PUR**
Brand name (es.)		Perbunan®	Neoprene®	Viton®	SANTOPRENE®	Bayflex®
Chemical name	Polisoprene	Acrylonitrile-butadiene Rubber	Chloroprene Rubber	Fluorine Rubber	Thermoplastic Rubber	Polyurethane
Hardness (shore A)	from 30 to 95	from 25 to 95	from 30 to 90	from 65 to 90	from 55 to 87	from 65 to 90
Temperature resistance						
Short-term	from -55° to +100 °C	from -40° to +150 °C	from -30° to +150 °C	from -30° to +280 °C	from -40° to +150 °C	from -40° to +130 °C
Long-term	from -50° to +80 °C	from -30° to +120 °C	from -20° to +120 °C	from -20° to +230 °C	from -30° to +125 °C	from -25° to +100 °C
Tensile strength [N/mm^2]	27	25	25	20	8.5	20
Wear / Abrasion resistance	excellent	good	good	good	good	excellent
Resistance to						
Oil, grease	not suitable	outstanding	good	good	good	very good
Solvents	low	good in part	good in part	very good	outstanding	satisfactory
Acids	low	restricted	good	very good	outstanding	not suitable
Caustic solutions	low	good	very good	very good	outstanding	not suitable
Fuels	not suitable	good	slight	outstanding	good	good
General		NBR Synthetic rubber resistance to swelling when in contact with oils and fuels. Standard material for O-rings.	CR Synthetic rubber excellent resistance to ageing, atmospheric and environmental influences.	FPM Resistance to contact with fuels, oils, solvents, acids, caustic solutions and to atmospheric and environmental influences. High price, to be used for applications under severe conditions.	SANTOPRENE® Thermoplastic rubber, its performances are comparable to those of many customary vulcanised special rubbers. Outstanding dynamic fatigue life, excellent resistance to ozone and to atmospheric and environmental influences.	PUR Excellent mechanical characteristics, resistance to atmospheric and environmental influences. Extreme resistance to wear and tear.

Perbunan® and Bayflex® are registered trade-marks by Bayer.
Viton® is registered trade-mark by DuPont Dow Elastomer.
Neoprene® is registered trade-mark by DuPont SBR.
SANTOPRENE® is registered trade-mark by Advanced Elastomer Systems.

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TECHNICAL DATA

Technopolymer and Rubber
Resistance to chemical agents at 23 °C temperature

Chemical agents and solvents	Polyamide (PA)	Trans-parent polyamide (PA-T)	Alcohol-Resistant transparent polyamide (PA-T AR)	Poly-propylene (PP)	Acetal resin (POM)	Poly-carbonate (PC)	Soft-Touch thermoplastic elastomer (TPE)	Rubber NBR	Flourated Rubber FKM	Natural rubber NR
	Notes %	Notes %	Notes %	Notes %	Notes %	Notes %	Notes	Notes %	Notes %	Notes %
Acetic acid	Sol. 10 ▲	Sol. 10 ▲	Sol. 10 ❒	40 ●	Sol. 20 ▲	Sol. 10 ●	●	▲	▲	❒
Acetone	100 ●	❒	●	●	●	▲	●	▲	▲	▲
Acrylonitrile	100 ●	▲	▲	●			❒	▲	▲	▲
Aluminium chloride	Sol. 10 ●	●	●	●		●	●	Sol. ●	Sol. ●	●
Aluminium sulphate	Sol. 10 ●	Sol. 10 ▲	Sol. 10 ●	Sol. 50 ●		●	●	Sol. ●	Sol. ●	●
Ammonia gas	❒	●	●	●			❒	●	▲	▲
Ammonia	Sol. 10 ●	Sol. 10 ●	10 ●	Conc. ●		▲	❒	Sol. ❒	Sol. ▲	▲
Ammonium chloride	Sol. 10 ●	Sol. 10 ●	Sol. 10 ●	●	Sol. 10 ▲	●	●	Sol. ●	Sol. ●	●
Amyl alcohol	100 ●	▲	●	●	●	❒	●	●	●	●
Aniline	100 ❒	▲	▲	●	●		▲	Swell. ▲	●	●
Beer	●	●	●	●	●	●	●	●	●	▲
Benzoic acid	Sol. Sat. ❒	Sol. 10 ▲	Sol. 10 ❒	Sat. ●			up to 60°C ●	Sol. ❒	Sol. ●	●
Benzol/benzene	100 ●	●	●	▲	●	▲	▲	▲	●	▲
Boiling water	Swell. ❒	Swell. ❒	Swell. ❒	●		●	❒	❒	❒	▲
Boric acid	Sol. 10 ●	❒	❒	Sat. ●			●	Sol. ●	Sol. ●	▲
Butter	●	●	●	●	●	●	●	●	●	▲
Butyl acetate	100 ●	100 ●	100 ●	●			❒			▲
Butyl alcohol	100 ●	▲	●	●	●	●	●	●	●	●
Butylene glycol	100 ●	▲	❒				❒	●	●	
Calcium chloride	Sol. 10 ●	●	●	Sol. 50 ●		●	●	Sol. ●	Sol. ●	●
Carbon disulphide	100 ●	❒	●	▲			▲	▲	●	▲
Carbon tetrachloride	●	❒	●	▲	●	▲	▲	▲	●	▲
Caustic potash	Sol. 5 - 10 ●	Sol. 5 - 10 ●	Sol. 5 - 10 ●	Sol. 5 - 10 ●	Sol. 10 ❒		●	Sol. 5 - 10 ❒	Sol. 5 -10 ▲	▲
Caustic potash	Sol. 50 ❒	Sol. 50 ●	Sol. 50 ●	Sol. 50 ●			●	Sol. 50 ▲	Sol. 50 ▲	●
Chloroform	100 ▲	▲	▲	▲		▲	▲	▲	●	●
Citric acid	Sol. 10 ❒	Sol. 10 ❒	Sol. 10 ❒	10 ●	●	Sol. 10 ●	up to 60°C ●	Sol. ●	Sol. ●	●
Copper sulphate	Sol. 10 ●			●	●		●	Sol.	Sol. ●	●
Dichloropropane				❒			▲			●
Distilled water	●	●	●	●	●	●	●	●	●	▲
Edible fats	●	●	●		●		●	●		
Edible oils	●	●	●	●	●	●	up to 60°C ●	●	●	❒
Ethyl acetate	100 ●	100 ●	100 ●	●	●	▲	❒	▲		▲
Ethyl alcohol (ethanol)	96 ●	▲	●	96 ●	●	●	●	❒	❒	▲
Ethyl chloride	100 ●	▲	▲	▲				●	●	
Ethylene glycol	●	▲	❒	●		●	❒	●	●	▲
Ethyl ether	●	●	●	●		▲	▲	❒	▲	●
Ferric chloride	Sol. 10 ●	●	●	●	●	●	●	Sol. ●	Sol. ●	▲
Formaldehyde (formalin)	Sol. ●	Sol. 40 ❒	Sol. 40 ●	Sol. 40 ●		Sol. 10 ●	▲	Sol. 40 ❒	Sol. 40 ●	
Formic acid	Sol. 10 ▲	Sol. ▲	Sol. ▲	Sol. 10 ●	100 ▲	Sol. 30 ❒	up to 60°C ●	Sat. ▲	Sat. ▲	
Freon 11				❒	●			●	❒	▲
Freon 12	Liq. ●	●	●	❒	●			●	❒	▲
Freon 13				❒	●			●	●	●
Gas oil	●	●	●	●	●	●	▲	●	●	●
Gasoline vapor	●	●	●	Swell. ❒	●		▲	❒	●	●
Glycerin	●	●	●	●		❒	▲	●	●	❒
Green gasoline	●	●	●	Swell. ❒	●	▲	▲	❒	●	●
Hydrochloric acid	Sol. 10 ▲	Sol. 10 ❒	Sol. 10 ❒	Sol. 30 ●	Sol. 10 ▲	Sol. 10 ●	up to 60°C ●	Sol. 10 ❒	Sol. 10 ●	●
Hydrofluoric acid	Sol. 40 ▲	Sol. 10 ▲	Sol. 10 ▲	Sol. 40 ●	▲	Sol. 20 ●	❒	50 ▲	50 ●	▲
Hydrogen peroxide	Sol. 3 ▲	Sol. 3 ▲	Sol. 3 ▲	30 ●	Sol. 90 ▲	Sol. 30 ●	❒	Sol. 80 ▲	Sol. 80 ❒	▲
Iodine	▲	▲	▲	●		❒	●			●

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Technopolymer and Rubber
Resistance to chemical agents at 23 °C temperature

Chemical agents and solvents	Polyamide (PA)		Transparent polyamide (PA-T)		Alcohol-Resistant transparent polyamide (PA-T AR)		Poly-propylene (PP)		Acetal resin (POM)		Poly-carbonate (PC)		Soft-Touch thermoplastic elastomer (TPE)	Rubber NBR		Flourated Rubber FKM		Natural rubber NR
	Notes	%	Notes	%	Notes	%	Notes	%	Notes	%	Notes	%	Notes	Notes	%	Notes	%	Notes %
Isopropyl alcohol (isopropanol)		●		▲		●		●		●		❒	●		❒		●	●
Kerosene		●		●		●		❒		●		▲	▲		●		●	▲
Lactic acid	Sol.	10 ●	Sol.	10 ❒	Sol.	10 ❒	Sol.	20 ●		●	Sol.	10 ●	up to 60°C ●	Sol.	●	Sol.	●	▲
Light petroleum		●		▲				●		●		❒	▲					▲
Linseed oil		●		●		●		●		●			up to 60°C ●		●		●	▲
Magnesium chloride	Sol.	10 ●		●		●	Sol.	Sat ●		●		●	●	Sol.	●	Sol.	●	●
Mercuric chloride	Sol.	6 ▲						●					●					●
Mercury		●		●		●		●				●	●		●		●	●
Methyl acetate		100 ●		100 ●		100 ●							❒					❒
Methyl alcohol		100 ●		▲		●		100 ●		●		▲	●		❒		▲	❒
Methylene chloride		100 ●		▲		●		❒				▲	▲		▲		●	●
Methyl ethyl ketone		●		▲		▲		❒		▲		▲	▲		▲		▲	●
Milk		●		●		●		●		●		●	●		●		●	▲
Mineral oil		●		●		●		●		●		●	up to 60°C ●		●			●
Nitric acid		10 ▲	Sol.	2 ❒	Sol.	2 ❒	Sol.	10 ●	Sol.	10 ▲	Sol.	20 ❒	❒	Sol.	10 ❒	Sol.	❒	●
Oleic acid		100 ●		●		●	Sol.	●		●		●	up to 60°C ●		❒			●
Paraffin oil		●		●		●		●				●	up to 60°C ●		●		●	❒
Phenol	Sol.	▲		▲		▲		●		▲		▲	▲		▲		●	●
Phosphoric acid	Sol.	10 ▲		▲		▲	Sol.	85 ●	Sol.	10 ▲	Sol.	10 ●	up to 60°C ●	Sol.	20 ❒	Sol.	●	▲
Potassium nitrate	Sol.	10 ●	Sol.	10 ●	Sol.	10 ●	Sat.	●				●	●		●		●	▲
Sea water, river, drinking		●		●		●		●		●		●	●		●		●	
Silicone oil		●		●		●		●				●			●		●	●
Silver nitrate		●	Sol.	10 ●	Sol.	10 ●	Sol.	20 ●					●	Sol.	❒			
Soap solution	Sol.	●	Sol.	●	Sol.	●	Sol.	●		●			●	Sol.	●	Sol.	●	▲
Sodium carbonate	Sol.	10 ●		●		●	Sol.	Sat. ●		●			●	Sol.	●	Sol.		▲
Sodium chloride	Sol.	●	Sol.	25 ●	Sol.	25 ●	Sol.	Sat. ●		●		●	●	Sol.	●	Sol.	●	●
Sodium hydroxide	Sol.	5 - 10 ●	Sol.	5 - 10 ●	Sol.	5 - 10 ●	Sol.	5 - 10 ●	Sol.	10 ●			●	Sol.	5 - 10 ❒	Sol.	5 - 10 ▲	
Sodium hydroxide	Sol.	50 ❒	Sol.	50 ●	Sol.	50 ●	Sol.	50 ●					●	Sol.	50 ▲	Sol.	50 ▲	●
Sodium hypochlorite	Sol.	●		▲		▲	Sol.	20 ●	Sol.	5 ▲	Sol.	5 ●	●	Sol.	10 ▲	Sol.	10 ▲	●
Sodium nitrate	Sol.	10 ●	Sol.	10 ●	Sol.	10 ●		●				▲	●		●		●	
Sodium silicate		●						●					●					●
Sodium sulphate	Sol.	10 ●	Sol.	10 ●	Sol.	10 ●		●		●		●	●	Sol.	●	Sol.	●	❒
Sulfuric acid	Sol.	10 ▲	Sol.	2 ●	Sol.	2 ●		98 ●	Sol.	10 ▲	Sol.	50 ●	up to 60°C ●	Sol.	20 ❒	Sol.	20 ●	●
Tartaric acid		●	Sol.	❒	Sol.	❒	Sol.	10 ●		●			up to 60°C ●	Sol.	●	Sol.	●	▲
Tetralin		●		●		●		▲				▲	▲		▲		●	❒
Toluol/toluene		●		●		●		❒		●		▲	▲		▲		❒	▲
Transformer oil		●		●		●		❒		●			up to 60°C ❒		●		●	▲
Trichlorethylene (Trichloroethylene)		❒		●		●		▲				▲	▲		▲		❒	▲
Vaseline		●		●		●		●				●	❒		●		●	▲
Vinegar								●				●	●		❒		❒	▲
Water vapor		●		●		●		●					●		❒		●	❒
Whisky		●		❒		●		●		●		●	●		●		●	❒
Wine		●		●		●		●		●		●	●		●		●	❒
Xylene		●		●		●		▲		●		▲	▲		▲		●	❒
Zinc chloride		❒	Sol.	50 ●	Sol.	50 ●	Sol.	20 ●		●		●	●	Sol.	●	Sol.	●	▲

● = good resistance
❒ = fair resistance (limited use according to working conditions)
▲ = poor resistance (should not be used)
Blanks stand for data not available

Conc. = concentration
Sol. = solution
Liq. = liquid
Sat. = saturated
Rigonf. = swelling

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TECHNICAL DATA

10.15 Load ratings U-Handles

Load capacity F1 in N

Load capacity F2 in N

Load rating of cabinet U-Handles / Tubular handles in metal in ascending order of the standard numbers

An extensive series of tests were carried out with the cabinet "U" handles / Tubular handles listed below.

The handles were slowly loaded and relieved at room temperature with incrementally increasing force. After load relieve, a deTypeation irrelevant in terms of function and appearance remained at the listed values for F1 and F2 respectively. The breaking loads were in most cases multiples above the specified value.

Note:
The details given on load rating are non-binding guide values without any liability. In general, they do not constitute a warranty of quality.

The user must determine from case to case if a product is suitable for the envisaged use. Ambient factors and ageing may influence the specified values.

Cabinet U-Handles GN 225 (see page 427)

Size	18	20	22	25
F1	2250	2250	3000	3500
F2	5500	7500	9750	9750

Tubular handles GN 331 (see page 496)

Size	30–200	30–300
F1	3000	2400
F2	4000	3700

Tubular handles GN 332 (see page 492)

Size	30–200	30–300
F1	2500	2250
F2	3500	3400

Tubular handles GN 333 (see page 498)

Size	20–200	20–250	20–300	20–350	20–400		
F1	1700	1500	1200	800	500		
F2	2800	2500	2000	1500	500		
Size	**28–200**	**28–250**	**28–300**	**28–350**	**28–400**	**28–500**	**28–600**
F1	2500	2250	2000	1750	1650	1575	1500
F2	4750	4250	3750	3250	2750	2250	1500
Size	**30–200**	**30–300**	**30–350**	**30–400**	**30–500**	**30–600**	**30–1000**
F1	2500	2250	2200	2200	2000	1800	750
F2	3500	3400	3200	2850	2250	1900	800

Tubular handles GN 333.1 (see page 496)

Size	20–180	20–200	20–250	20–300	20–350	20–400	
F1	1600	1500	1400	1250	750	700	
F2	2500	2000	1900	1600	1550	1250	
Size	**28–200**	**28–250**	**28–300**	**28–350**	**28–400**	**28–500**	**28–600**
F1	1700	1500	1500	1350	1000	1000	1000
F2	4800	3500	2800	2400	1800	1700	1500
Size	**30–200**	**30–300**	**30–350**	**30–400**	**30–500**	**30–600**	**30–1000**
F1	3000	2400	2400	2350	2350	1750	1250
F2	4000	3700	3000	2700	2300	2000	1000

Tubular handles GN 333.2 (see page 500)

Size	242	292	392	492	592
F1	2400	2200	2000	1900	1600
F2	3700	3200	2400	2200	1650

Tubular handles GN 333.3 (see page 489)

Size	242	292	392	492	592
F1	1800	1700	1650	1600	1500
F2	3500	3000	2500	2000	1500

Stainless Steel-Tubular handles GN 333.5 (see page 506)

Size	200	250	300	400	500	600
F1	3000	2500	2000	1750	1500	1450
F2	7500	6000	5000	4250	3500	2500

Oval tubular handles GN 334 (see page 532)

Size	200	250	300	350	400	500	600	800
F1	1750	1650	1500	1500	1250	1200	1100	700
F2	3000	2400	1750	1750	1500	1350	1000	700

Oval tubular handles GN 334.1 (see page 523)

Size	200	250	300	350	400	500	600	800
F1	1700	1650	1500	1450	1400	1200	1000	750
F2	3000	2700	2500	2000	1500	1250	1000	750

Oval tubular handles GN 366 (see page 524)

Size	200	250	300	400	500	600
F1	2000	2000	2000	1500	1300	900
F2	3500	2800	2250	1600	1450	1150

Cabinet "U" handles GN 423 – Type A (see page 444)

Size	55	88	100	120	180	235
F1	270	250	220	200	180	150
F2	1700	1500	1000	600	500	250

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Load rating of cabinet U-Handles / tubular handles in metal continued – F_1 / F_2

Cabinet "U" handles GN 423 – Type B (see page 444)						
Size	**55**	**88**	**100**	**120**	**180**	**235**
F1	270	250	220	200	180	150
F2	1600	1250	800	400	300	200

Arch handles GN 424.1 (see page 449)					
Size	**64**	**96**	**128**	**160**	**192**
F1	1300	800	800	700	525
F2	6500	5250	2700	2000	1550

Stainless Steel-Arch handles GN 424.5 (see page 449)					
Size	**64**	**96**	**128**	**160**	**192**
F1	1500	900	900	800	600
F2	7500	5750	3000	2250	1750

Cabinet U-Handles, Steel GN 425 (see page 454)							
Size	**8–55**	**8–64**	**8–88**	**8–96**	**8–100**	**8–120**	**8–128**
F1	475	550	500	500	500	450	500
F2	5000	4300	3300	3000	2800	1750	1250
Size	**10–88**	**10–100**	**10–120**	**10–180**	**10–200**	**10–235**	
F1	1300	900	900	700	500	400	
F2	4000	3750	3000	2000	1200	1150	
Size	**12–125**	**12–160**	**12–200**	**12–250**			
F1	1200	1000	400	200			
F2	6000	4000	3000	3400			
Size	**16–160**	**16–200**	**16–250**	**16–300**			
F1	1900	1300	1100	800			
F2	5000	4000	3500	5750			

Cabinet U-Handles, Aluminum GN 425 (see page 454)							
Size	**8–55**	**8–64**	**8–88**	**8–96**	**8–100**	**8–120**	**8–128**
F1	300	300	300	200	200	200	200
F2	1400	1200	825	750	700	575	450
Size	**10–88**	**10–100**	**10–120**	**10–180**	**10–200**	**10–235**	
F1	500	450	400	350	250	250	
F2	2000	1500	1000	700	600	500	
Size	**12–125**	**12–160**	**12–200**	**12–250**			
F1	400	300	250	200			
F2	2000	1000	800	800			
Size	**16–160**	**16–200**	**16–250**	**16–300**			
F1	800	750	500	250			
F2	2300	2000	1500	1000			

Stainless Steel-Cabinet U-Handles GN 425 (see page 454)							
Size	**8–55**	**8–64**	**8–88**	**8–96**	**8–100**	**8–120**	**8–128**
F1	–	600	850	700	700	700	700
F2	–	4000	3000	2500	2000	1500	1300

Stainless Steel-Cabinet U-Handles GN 425 *continued*						
Size	**10–88**	**10–100**	**10–120**	**10–180**	**10–200**	**10–235**
F1	1400	1000	1000	700	600	500
F2	4000	3800	3000	2250	1500	1400
Size	**12–125**	**12–160**	**12–200**	**12–250**		
F1	1200	1000	700	500		
F2	7000	4500	3000	2500		
Size	**16–160**	**16–200**	**16–250**	**16–300**		
F1	1900	1300	1100	800		
F2	8500	7000	5000	4000		

Cabinet U-Handles, Steel GN 425.1 (see page 458)					
Size	**8–55**	**8–64**	**8–88**	**8–96**	**8–100**
F1	500	425	450	375	325
F2	700	600	500	600	400
Size	**10–88**	**10–100**	**10–120**	**10–180**	**10–200**
F1	1000	900	900	500	500
F2	2000	1500	1500	750	700

Cabinet U-Handles, Steel GN 425.1 (see page 458)				
Size	**12–125**	**12–160**	**12–200**	**12–250**
F1	1150	1250	1425	875
F2	1925	1500	1425	1250

Cabinet U-Handles, Aluminum GN 425.1 (see page 458)					
Size	**8–55**	**8–64**	**8–88**	**8–96**	**8–100**
F1	400	350	300	250	250
F2	400	400	350	350	350
Size	**10–88**	**10–100**	**10–120**	**10–180**	**10–200**
F1	400	450	400	350	250
F2	500	500	500	450	400
Size	**12–125**	**12–160**	**12–200**	**12–250**	
F_1	600	600	500	650	
F2	725	1050	1000	900	

Stainless Steel-Cabinet U-Handles, GN 425.1 (see page 458)					
Size	**8–55**	**8–64**	**8–88**	**8–96**	**8–100**
F1	450	500	500	500	500
F2	500	1000	1000	1000	1000
Size	**10–88**	**10–100**	**10–120**	**10–180**	**10–200**
F1	1500	1450	1450	500	500
F2	2150	2000	2000	1000	1000
Size	**12–125**	**12–160**	**12–200**	**12–250**	
F_1	700	1250	1350	1350	
F2	1650	1700	2250	1750	

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TECHNICAL DATA

Load rating of cabinet U-Handles / tubular handles in metal continued – F_1 / F_2

Folding handles, Steel GN 425.2 (see page 466)

Size	100	120	180
F1	1750	1600	1250
F2	2600	2600	2500

Stainless Steel-Folding handles GN 425.2 (see page 466)

Size	100	120	180
F1	2000	2000	1750
F2	5000	3500	2250

Folding handles, Steel GN 425.5 (see page 467)

Size	100	120	180
F1	500	500	500
F2	–	–	–

Stainless Steel-Folding handles GN 425.5 (see page 467)

Size	100	120	180
F1	500	500	500
F2	–	–	–

Folding handles with recessed tray GN 425.8 (see page 468)

Size	100	120
F1	1000	1000
F2	5000	5000

Cabinet U-Handles GN 426 (see page 462)

Size	20–200	20–250	20–300	20–350	28–250	28–300	28–350	28–400
F1	1400	1100	1100	1000	2000	1900	1800	1500
F2	3300	3000	2300	2200	4500	3500	3500	3500

Cabinet U-Handles GN 426.1 (see page 464)

Size	20–200	20–300	28–250	28–350	28–500
F1	1500	1450	3000	2500	2300
F2	1600	1400	2000	2000	2000

Stainless Steel-Cabinet U-Handles GN 426.5 – Type A (see page 463)

Size	20–200	20–250	20–300	20–350	28–250	28–300	28–350	28–400
F1	4000	6000	5500	3500	4000	3500	2800	2750
F2	9000	10000	8000	6500	8000	7250	6750	6500

Stainless Steel-Cabinet U-Handles GN 426.5 – Type B (see page 463)

Size	20–200	20–250	20–300	20–350	28–250	28–300	28–350	28–400
F1	1000	1600	1400	1400	2700	2700	2700	2700
F2	4000	9000	6500	7500	10000	7000	6000	5000

Stainless Steel-Cabinet U-Handles GN 426.6 – Type A (see page 465)

Size	20–200	20–300	28–250	28–350	28–500
F1	4200	4000	2000	1500	2700
F2	7500	7000	5000	3500	2250

Stainless Steel-Cabinet U-Handles GN 426.6 – Type B (see page 465)

Size	20–250	20–300	28–250	28–350	28–500
F1	1000	500	1000	1250	1750
F2	1200	1200	1250	1750	1750

Cabinet U-Handles GN 427 (see page 461)

Size	55	88	100	120	180	200	235
F1	650	600	500	450	300	250	200
F2	1600	1150	1100	1000	550	500	400

Stainless Steel-Cabinet U-Handles GN 427.5 (see page 461)

Size	55	88	100	120	180	200	235
F1	2400	2100	2000	1800	1250	850	800
F2	6000	5000	3750	3000	1700	1500	1200

Cabinet U-Handles GN 428 – Type A (see page 445)

Size	28–250	28–300	28–400		
F1	1250	2250	1500		
F2	4250	2750	2200		
Size	**36–300**	**36–400**	**36–500**	**36–600**	**36–800**
F1	5750	6250	3750	2500	1750
F2	7500	6750	5750	4000	1000

Cabinet U-Handles GN 428 – Type B (see page 445)

Size	28–250	28–300	28–400		
F1	1500	1250	1250		
F2	3500	2750	1750		
Size	**36–300**	**36–400**	**36–500**	**36–600**	**36–800**
F1	4500	7000	3750	2250	1750
F2	7500	6500	4500	3500	1000

Cabinet U-Handles GN 559 – Type A (see page 448)

Size	162
F1	5000
F2	8000

Cabinet U-Handles GN 559 – Type B / Type C (see page 448)

Size	162
F1	1000
F2	2500

Cabinet U-Handles GN 564 (see page 419)

Size	112	128	160	192
F1	900	900	900	–
F2	1200	1200	1200	–

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Cabinet U-Handles GN 565 (see page 414)

Size	20–100	20–112	20–117	20–120	20–128	20–160	20–180	20–200
F1	1250	1250	1250	1250	1250	1200	1250	1250
F2	2100	2200	2200	2200	2200	2000	1750	2000

Size	20–235
F1	1000
F2	1250

Size	26–112	26–117	26–120	26–125	26–128	26–160	26–179	26–192
F1	3000	2900	2900	2800	2800	2800	2400	2300
F2	7000	6000	5500	5000	4500	3500	3250	3000

Size	26–300	26–400	26–500
F1	1700	1600	1200
F2	2250	1750	1500

Cabinet U-Handles GN 565.1 (see page 416)

Size	20–100	20–112	20–120	20–128	20–160
F1	1250	1200	1100	1000	1000
F2	2500	2400	2400	2300	2000

Cabinet U-Handles GN 565.1 (see page 416)

Size	26–116	26–120	26–132	26–164	26–179	26–196
F1	2000	2000	2000	2000	1800	1750
F2	6500	6250	4000	3600	3400	3000

Inclined cabinet U-Handles GN 565.2 – Type A (see page 417)

Size	20–112	20–128	26–128	26–160
F1	1900	1900	2400	2000
F2	2400	2000	5200	4800

Inclined cabinet U-Handles GN 565.2 – Type B (see page 417)

Size	26–128	26–160
F1	1750	1500
F2	1850	2500

Cabinet U-Handles GN 565.3 (see page 443)

Size	20–120	20–160
F1	1400	1500
F2	1900	2750

Arch handles GN 565.4 (see page 450)

Size	20–160	20–192	26–160	26–192
F1	1300	1000	2000	2000
F2	3500	2500	5000	5000

Stainless Steel-Cabinet U-Handles GN 565.5 – Type A (see page 415)

Size	20–112	20–128	20–160	20–200	20–250	20–300	20–350	20–400
F1	4000	3200	3100	3000	2800	2500	2000	1500
F2	7000	6000	4000	3800	3000	3000	2300	1500

Stainless Steel-Cabinet U-Handles GN 565.5 – Type B (see page 415)

Size	20–112	20–128	20–160
F1	3000	2000	2500
F2	6850	5800	4250

Stainless Steel-Cabinet U-Handles GN 565.7 (see page 418)

Size	20–112	20–128
F1	5250	5000
F2	7250	3500

Stainless Steel-Arch handles GN 565.9 (see page 451)

Size	20–160	20–192
F1	4500	2500
F2	4500	2500

Arch handles GN 665 (see page 451)

Size	26–350	26–450
F1	1200	1100
F2	2700	1550

Tubular handles GN 666 (Tube, Aluminum) (see page 512)

Size	200	250	300	350	400	500	600
F1	900	850	950	1000	1000	1100	1000
F2	2500	2450	2400	2300	1750	1700	1350

Tubular handles GN 666 (Tube, Stainless Steel) (see page 512)

Size	200	250	300	350	400	500	600
F1	900	850	950	1000	1000	1100	1000
F2	2500	2450	2400	2300	1750	1700	1350

Tubular handles GN 666.1 (Tube, Aluminum) (see page 513)

Size	200	250	300	350	400	500	600
F1	1000	1350	1500	1500	1750	1750	1500
F2	5500	5500	5250	4500	4500	3500	2500

Tubular handles GN 666.1 (Tube, Stainless Steel) (see page 513)

Size	200	250	300	350	400	500	600
F1	1150	1150	1200	1200	1150	1100	1000
F2	3000	3000	2750	2500	2000	1850	1350

Tubular arch handles GN 666.4 (Tube, Aluminum) (see page 525)

Size	400	500	600
F1	750	750	750
F2	1800	1700	1500

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TECHNICAL DATA

Load rating of cabinet U-Handles / tubular handles in metal continued – F_1 / F_2

Tubular arch handles GN 666.4 (Tube, Stainless Steel) (see page 525)			
Size	**400**	**500**	**600**
F1	1350	1700	1750
F2	5000	4500	3750

Cabinet U-Handles GN 728 (see page 441)		
Size	**120**	**180**
F1	2000	2500
F2	2500	2750

Stainless Steel-Tubular handles GN 666.5 (see page 508)						
Size	**200**	**250**	**300**	**400**	**500**	**600**
F1	2300	2200	2100	2000	1800	1700
F2	4500	4300	4000	3700	3500	2000

Cabinet U-Handles GN 728.5 (see page 441)	
Size	**120**
F1	2500
F2	5000

Stainless Steel-Tubular handles GN 666.7 (see page 510)						
Size	200	250	300	400	500	600
F1	2300	2200	2100	2000	1800	1700
F2	4500	4400	4000	3600	3500	2000

Cabinet U-Handles M.1043 (see page 514)							
Size	**20–180**	**20–200**	**20–250**	**20–300**	**20–350**	**20–400**	
F1	750	750	600	600	550	500	
F2	2000	2000	2000	1500	1250	1000	
Size	**30–300**	**30–350**	**30–400**	**30–500**	**30–600**	**30–700**	**30–1000**
F1	1100	1100	750	750	750	625	550
F2	3000	2250	2250	1750	1500	1250	1000

Cabinet U-Handles M.1043 (see page 514)							
Size	**20–180**	**20–200**	**20–250**	**20–300**	**20–350**	**20–400**	
F1	1200	1100	1000	1000	750	700	
F2	4000	3500	3500	2500	2000	1000	
Size	**30–300**	**30–350**	**30–400**	**30–500**	**30–600**	**30–700**	**30–1000**
F1	1250	1250	1200	1200	1200	900	800
F2	5000	5000	4250	4000	2250	2000	1000

Flat cabinet U-Handles GN 668 – Type A (see page 440)				
Size	**20–130**	**20–170**	**20–190**	**20–210**
F1	1600	1600	1500	1350
F2	2100	1900	1800	1650

Flat cabinet U-Handles GN 668 – Type B (see page 440)				
Size	**20–130**	**20–170**	**20–190**	**20–210**
F1	700	650	600	550
F2	2400	2000	1600	1200

System handles GN 669 (see page 507)						
Size	**200**	**250**	**300**	**400**	**500**	**600**
F1	1750	1500	1250	1200	1000	900
F2	3000	2250	2100	2000	1500	1000

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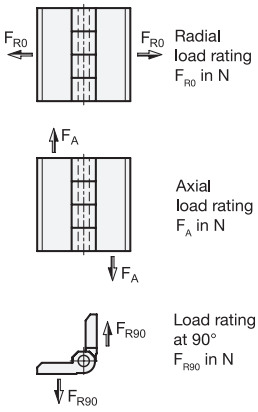
10.16 Load ratings metal hinges



Load rating of metal hinges in ascending order of the standard numbers

An extensive series of tests were carried out with the hinges listed below.

The hinges were slowly loaded and relieved at room temperature with incrementally increasing force. After load relieve, a deformation irrelevant in terms of function and appearance remained at the listed values for L_A, L_{R0} and L_{R90}. The breaking loads were in most cases multiples above the specified value.

The details given on load rating are non-binding guide values without any liability. In general, they do not constitute a warranty of quality.

The user must determine from case to case if a product is suitable for the envisaged use. Ambient factors and ageing may influence the specified values.

Article No.		Radial load rating L_{R0} in N	Radial load rating L_{R90} in N	Axial load rating L_A in N
GN 127	-76-60	2000	2000	1150
GN 136	-30-30-ST	–	–	–
	-30-45-ST	–	–	–
	-40-40-ST	1000	700	2000
	-40-60-ST	–	–	–
	-50-50-ST	2000	1000	2500
	-50-75-ST	–	–	–
	-60-60-ST	2500	1200	2800
	-60-90-ST	–	–	–
	-30-30-NI	–	–	–
	-30-45-NI	–	–	–
	-40-40-NI	1000	700	2000
	-40-60-NI	–	–	–
	-50-50-NI	2000	1000	2500
	-50-75-NI	–	–	–
	-60-60-NI	2500	1100	2800
	-60-90-NI	–	–	–
GN 138	-ZD-40-42-A	1500	4000	1000
	-ZD-50-52-A	3500	6000	1750
	-ZD-60-62-A	4000	6500	2000
GN 139.1	-49-101	1000	1000	1500
	-79-101	500	500	750
GN 139.2	-49-101	1000	1000	1500
	-79-101	500	500	750
GN 139.5	-76-126	2000	2000	2000
GN 139.6	-76-126	2000	2000	2000
GN 161	-57	1150	1500	600
	-68	1500	1200	750
	-80	2500	2500	1000
GN 237	-AL-30-30-A-EL	1200	750	550
	-AL-40-40-A-EL	2000	2800	1060
	-AL-50-50-A-EL	3000	4250	2250
	-AL-60-60-A-EL	5000	5150	4050
	-NI-30-30-A-GS	1700	750	750
	-NI-40-40-A-GS	4000	1650	2100
	-NI-50-50-A-GS	6500	2250	2550
	-NI-60-60-A-GS	10000	5000	5000
	-A4-30-30-A-GS	1700	750	750
	-A4-40-40-A-GS	4000	1650	2100
	-A4-50-50-A-GS	6500	2250	2550
	-A4-60-60-A-GS	10000	5000	5000
	-ZD-30-30-A	1200	750	500

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Load rating of metal hinges
continued

Article No.		Radial load rating L_{R0} in N	Radial load rating L_{R90} in N	Axial load rating L_A in N
GN 237	-ZD-40-40-A	2100	2000	1150
	-ZD-50-50-A	3500	2450	2100
	-ZD-60-60-A	6000	4400	3200
	-ZD- 40-40-C	1700	1850	900
	-ZD- 50-50-C	3550	2000	2050
	-ZD- 60-60-C	4050	2550	3050
	-NI- 63-50-A-GS	4000	2000	1500
	-NI- 76-50-A-GS	4000	2000	1200
	-NI- 90-60-A-GS	4500	2000	1500
	-NI-120-60-A-GS	4500	2000	1200
	-ZD- 63-50-A	3000	1250	1500
	-ZD- 76-50-A	3000	1250	1300
	-ZD- 90-60-A	4500	1500	1500
	-ZD-120-60-A	4500	1500	1300
	-ZD- 63-50-C	3000	2000	1500
	-ZD- 76-50-C	3000	2000	1200
	-ZD- 90-60-C	4500	1500	2000
	-ZD-120-60-C	4500	1500	1500
GN 237.3	-NI- 50-50-A-*	6000	3000	3000
	-NI- 50-50-B-*	0000	5000	5000
	-NI- 60-60-A-*	8000	6000	6000
	-NI- 60-60-B-*	15000	8000	10000
	-NI- 63-50-A-*	6000	5000	3000
	-NI- 63-50-B-*	10000	7000	5000
	-NI- 76-50-A-*	7000	5000	4000
	-NI- 76-50-B-*	13000	7000	7000
	-NI- 80-80-A-*	10000	8000	8000
	-NI- 80-80-B-*	22000	10000	13000
	-NI- 90-60-A-*	8000	8000	6000
	-NI- 90-60-B-*	15000	10000	10000
	-NI-120-60-A-*	10000	8000	6000
	-NI-120-60-B-*	21000	10000	13000
	-NI-120-80-A-*	10000	10000	8000
	-NI-120-80-B-*	22000	13000	13000
	-NI-160-80-A-*	13000	10000	10000
	-NI-160-80-B-*	28000	13000	15000
GN 238	-42-42-BJ	1500	2100	1050
	-42-42-EJ	1000	1500	1200
	-42-42-NJ	1250	1350	1500
	-50-50-BJ	1500	2200	1500
	-50-50-EJ	1500	1700	1500
	-50-50-NJ	1800	1900	2000
	-60-60-BJ	2500	3200	1500
	-60-60-EJ	2000	2000	1500
	-60-60-NJ	3700	2600	2550
GN 337	-NI-40-40-A-GS	3000	3500	2000
	-NI-50-50-A-GS	5000	3500	2500
	-NI-60-60-A-GS	6000	6000	5000
	-ZD-40-40-A	2200	1600	1500
	-ZD-50-50-A	3000	2500	2500
	-ZD-60-60-A	4300	3500	3100

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Load rating of metal hinges
continued

Article No.		Radial load rating L_{R0} in N	L_{R90} in N	Axial load rating L_A in N
GN 437	-ZD-40-40-A	2400	1600	1200
	-ZD-50-50-A	3200	2000	1600
	-ZD-60-60-A	4500	2500	2000
GN 437.1	-ZD-60-60-A-*	2800	2300	2000
GN 437.2	-ZD-60-60-A-*	3000	2800	2000
GN 437.3	-ZD-60-60-*	2300	2000	1700
GN 437.4	-ZD-60-60-*	2800	2300	1700
GN 1362	-NI- 60-30-A	1500	1700	2750
	-NI- 60-40-A	1500	1950	3750
	-NI- 60-60-A	1750	1350	4250
	-NI- 80-30-A	1500	1700	2750
	-NI- 80-40-A	1500	1950	3750
	-NI- 80-80-A	3000	1500	6750
	-NI-100-100-A	3500	1750	7250
GN 1364	-NI- 70-50-B	2750	2000	3750
	-NI-105-50-B	2750	2000	3750
	-NI-140-50-B	2750	2000	3750
GN 1366	-ST- 60-30-A	9500	3750	5750
	-ST- 120-30-A	9500	3750	5750
	-ST- 160-30-A	9500	3750	5750
	-ST- 60-40-A	10000	4350	7000
	-ST-120-40-A	10000	4350	7000
	-ST-160-40-A	10000	4350	7000
	-ST- 60-50-A	12000	5000	7750
	-ST-120-50-A	12000	5000	7750
	-ST-160-50-A	12000	5000	7750
	-ST- 60-60-A	17500	5500	11000
	-ST-120-60-A	17500	5500	11000
	-ST-160-60-A	14000	7000	11000
	-ST-160-80-A	19000	7500	13500
	-ST-200-80-A	19000	7500	13500
	-ST-160-100-A	26000	9750	17500
	-ST-200-100-A	26000	9750	17500
	-ST-220-100-A	26000	9750	17500

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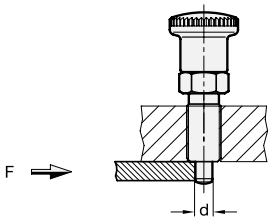
10.17 Strength of indexing plungers



Computing the strenght of indexing plungers for shear loads / flexure loads of the plunger pin

Shear loads

Provided that a miniscule gap remains between the guide of the indexing plunger and the indexing bore hole opposite, the load can be reduced to a clean shear action. As this is normally not the case, the "flexure" load case should preferably be considered on the following page. Approximately 80 % of the bolt's tensile strength is assumed for the shear strength. This approach calculates against the tensile strength R_m, i.e. against the indexing pin shearing off. Any pre-existing and remaining deformation may, however, mean that the indexing plunger can be used no longer.
To ensure the permanent and proper function of the indexing plunger, the yield limit R_e must be considered in place of the tensile strength R_m.

Formulas for computation

Bolt cross-section	Limit tension	Shear force
$S = \frac{d^2 \times \pi}{4}$	$\tau_a = 0.8 \times R_m$	$F = S \times \tau_a = \frac{d^2 \times \pi}{4} \times 0.8 \times R_m$

Material characteristics

The tensile strength shown in the table below (R_m) and the yield or substitute yield limit (R_e / $R_{p\ 0.2}$) have been determine in tension tests involving tension specimen in accordance with DIN 50125-B6-30. These tests constitute the basis for the load bearing details given herein.

Material Description	Material no.	**R_e** in N/mm²	**R_m** in N/mm²
C45Pb	1.0504	560	640
X 10 CrNiS 18 9	AISI 303	580	740

Computing examples, load values

Example:
Indexing plungers with a bolt diameter of 6 mm made of Stainless Steel with a yield limit of R_e = 580 N/mm², computation against permanent deformation, the maximum permissible shear stress is wanted.

$$F_{per} = \frac{(6\ mm)^2 \times \pi}{4} \times 0.8 \times 580\ N/mm^2 = 13120\ N$$

d Bolt diameter	max. force **F** in N, acc. to material and strength value differs			
	C45Pb / 1.0504		X 10 CrNiS 18 9 / 1.4305	
	at R_e	at R_m	at R_e	at R_m
3	3160	3610	3270	4180
4	5620	6430	5830	7430
5	8790	10050	9110	11620
6	12660	14470	13120	16730
8	22510	25730	23320	29750
10	35180	40210	36440	46490
12	50660	57900	52470	66950

Safety informaion

On principle, the design also needs an adequate safety coefficient to be taken into account. The usual safety coefficients under static load 1.2 to 1.5; pulsating 1.8 to 2.4 and alternating 3 to 4.

Disclaimer:

Our information and recommendations are given with non-binding effect and ruling out any liability, unless we have expressly committed ourselves in writing to provide information and recommendations. All products are standard elements for versatile uses and as such are subject to extensive standard tests. You should carry out your own test series to verify whether a certain product is suitable for your specific applications. We cannot be held responsible for this.

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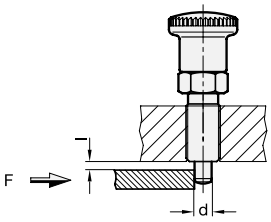

Flexure loads

As soon as a gap l remains between the guide and the indexing bore hole opposite, the load can be reduced to a flexure rod clamped in at one side.
With this approach, the computation is made against the bending of the indexing plunger as a case of failure.

Formulas for computation

Resistance torque	Flexural stress	Flexural strength
$W = \frac{\pi \times d^3}{32}$	$M_b = \sigma_b \times W$	$F = \frac{M_b}{l} = \frac{\sigma_b \times \pi \times d^3}{l \times 32}$

Material characteristics

The yield or substitute yield limit (R_e / $R_{p\,0.2}$) shown in the table below has been determine in tension tests involving tension specimen in accordance with DIN 50125-B6-30. These tests constitute the basis for the load bearing details given herein.

Material Description	Material no.	**R_e** in N/mm² (≈ per. flexural tension σ_b)
C45Pb	1.0504	560
X 10 CrNiS 18 9	AISI 303	580

Computing examples, load values

Example:

Indexing plungers with a bolt diameter of 5 mm made of steel with a yield limit of R_e = 560 N/mm², computation against permanent deformation, the maximum permissible flexural strength is wanted:

$$F_{per} = \frac{560\ N/mm^2 \times \pi \times (5\ mm)^3}{2\ mm \times 32} = 3430\ N$$

d Bolt diameter	max. flexural strength **F** in N, acc. to material and gap **l** differentiated			
	C45Pb / 1.0504		X 10 CrNiS 18 9 / 1.4305	
	l = 2 mm	**l** = 3 mm	**l** = 2 mm	**l** = 3 mm
3	740	490	760	510
4	1750	1170	1820	1210
5	3430	2290	3550	2370
6	5930	3950	6140	4100
8	14070	9380	14570	9710
10	27480	18320	28470	18980
12	47490	31660	49190	32790

Safety information

On principle, the design also needs an adequate safety coefficient to be taken into account. The usual safety coefficients under static load 1.2 to 1.5; pulsating 1.8 to 2.4 and alternating 3 to 4.

Disclaimer:

Our information and recommendations are given with non-binding effect and ruling out any liability, unless we have expressly committed ourselves in writing to provide information and recommendations. All products are standard elements for versatile uses and as such are subject to extensive standard tests. You should carry out your own test series to verify whether a certain product is suitable for your specific applications. We cannot be held responsible for this.

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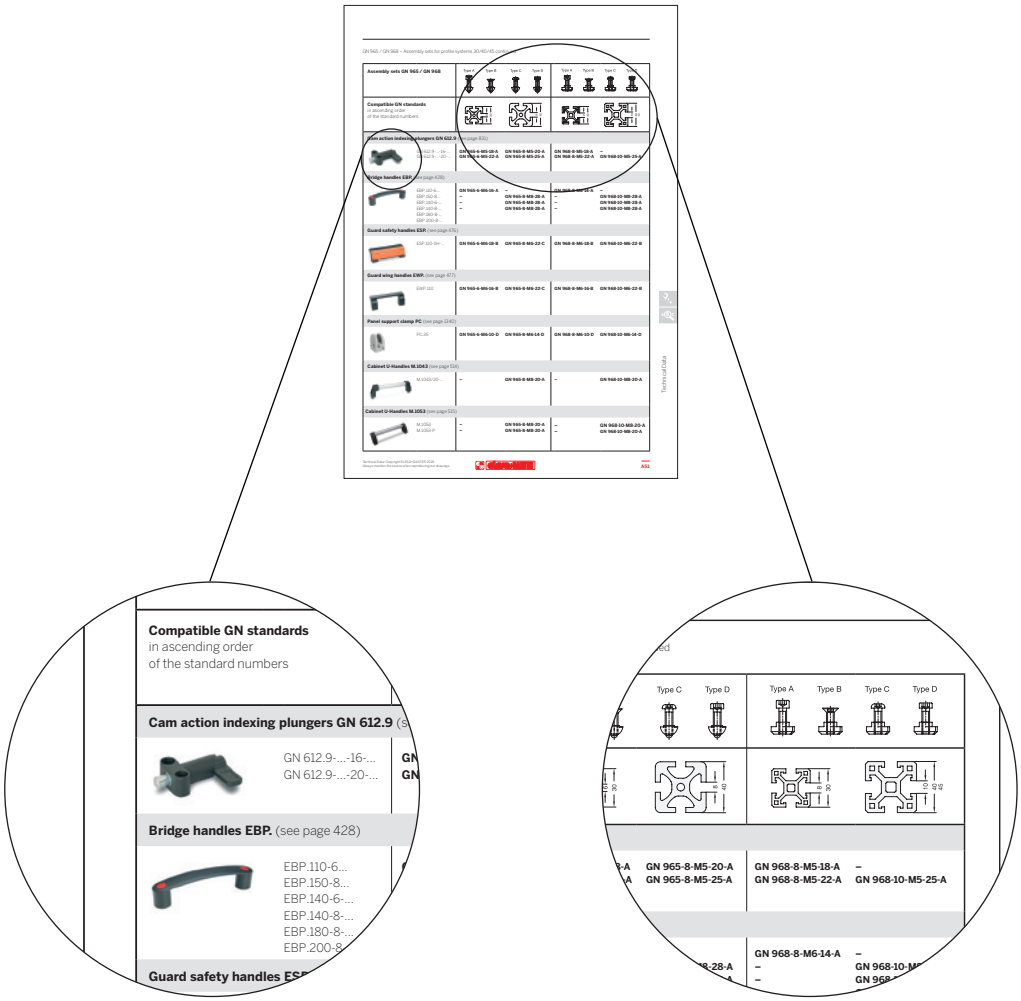
10.18 Assembly sets GN 965 and GN 968

Selection of the appropriate assembly sets
ELESA+GANTER offers many products which are compatible with the most common T-Slot Profile Systems.
Show the tables to select the assembly set you need.



1. Your ELESA+GANTER product
The left hand column of the table shows the compatible ELESA+GANTER products, sorted in ascending standard number. At this point, first select the standard part to be mounted.

2. Your assembly set
The columns on the right hand side show assembly sets matching the selected products.
Depending on the profile shape, select the standard GN 965 or GN 968. The list underneath the profile cross-sections show the order numbers for the matching sets.

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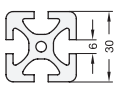
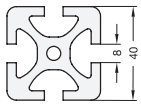
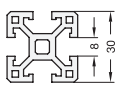
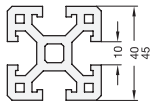
Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Compatible GN standards in ascending order of the standard numbers								
Hinges GN 127 (see page 1397)								
 GN 127-...-B	**–**		**GN 965-8-M6-20-B**		**–**		**GN 968-10-M6-20-B[1)]**	
Mounting plate GN 139.3 (for hinges with / without safety switch GN 139.1 / GN 139.2) (see page 1444)								
 GN 139.3-170	**GN 965-6-M6-12-A**		**GN 965-8-M6-14-A**		**GN 968-8-M6-10-A**		**GN 968-10-M6-14-A**	
Mounting plate GN 139.4 (for hinges with / without safety switch GN 139.1 / GN 139.2) (see page 1444)								
 GN 139.4-101	**GN 965-6-M6-12-A**		**GN 965-8-M6-14-A**		**GN 968-8-M6-10-A**		**GN 968-10-M6-14-A**	
Flanged connector clamps GN 145 (see page 1821)								
 GN 145-...	**–**		**GN 965-8-M5-16-A**		**–**		**GN 968-10-M5-18-A**	
Hinges CFA-SL (see page 1373)								
 CFA.65-SL-...	**–**		**GN 965-8-M6-18-A**		**–**		**GN 968-10-M6-18-A[1)]**	
Hinges CFG. (see page 1406)								
 CFG.30/30 SH-6 CFG.40/40 SH-6 CFG.45/45 SH-6	**GN 965-6-M6-16-B** **–** **–**		**–** **GN 965-8-M6-18-B** **–**		**GN 968-8-M6-16-B** **–** **–**		**–** **GN 968-10-M6-18-B[1)]** **GN 968-10-M6-18-B[2)]**	

[1)] only for profile 40 x 40 [2)] only for profile 45 x 45

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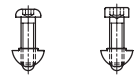
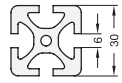
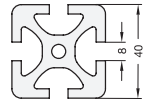
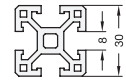
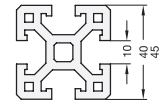
TECHNICAL DATA

GN 965 / GN 968 – Assembly sets for profile systems 30/40/45 continued

Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
								
Compatible GN standards in ascending order of the standard numbers								
Double hinges CFI. (see page 1408)								
 CFI.30-30/30 SH-6 CFI.40-40/40 SH-6 CFI.45-45/45 SH-6	**GN 965-6-M6-16-B** **–** **–**		**–** **GN 965-8-M6-18-B** **–**		**GN 968-8-M6-16-B** **–** **–**		**–** **GN 968-10-M6-18-B**[1] **GN 968-10-M6-18-B**[2]	
Hinges GN 161 (see page 1410)								
 GN 161-57 / 68 / 80	**–**		**GN 965-8-M6-16-B**		**GN 968-8-M6-14-B**		**GN 968-10-M6-18-B**	
Base plate connector clamps GN 162.3 (see page 1828)								
 GN 162.3-...	**GN 965-6-M5-16-A**		**GN 965-8-M5-18-A**		**GN 968-8-M5-14-A**		**GN 968-10-M5-18-A**	
Connecting clamps MSX. (see page 1906)								
 MSX.56-B-8-10 MSX.56-B-10-12 MSX.56-B-12-14	**GN 965-6-M6-12-A** **GN 965-6-M6-12-A** **GN 965-6-M6-12-A**		**GN 965-8-M6-14-A** **GN 965-8-M6-14-A** **GN 965-8-M6-14-A**		**GN 968-8-M6-10-A** **GN 968-8-M6-10-A** **GN 968-8-M6-10-A**		**GN 968-10-M6-14-A** **GN 968-10-M6-14-A** **GN 968-10-M6-14-A**	
Fastening sets GN 181 for cabinet U-Handles (see page 488)								
 GN 181-ZD-8-M4-... GN 181-ZD-10-M5-... GN 181-ZD-...-M6-... GN 181-ZD-...-M8-...	**GN 965-6-M4-10-B** **GN 965-6-M5-12-B** **GN 965-6-M6-12-B** **–**		**–** **GN 965-8-M5-14-B** **GN 965-8-M6-14-B** **GN 965-8-M8-16-B**		**–** **GN 968-8-M5-12-B** **GN 968-8-M6-12-B** **–**		**–** **–** **GN 968-10-M6-16-B** **GN 968-10-M8-16-B**	
Tube supports GN 231 (see page 1844)								
 GN 231-B20 / B25 / B30 GN 231-V20 / V25 / V30	**–** **–**		**GN 965-8-M8-14-A** **GN 965-8-M8-14-A**		**–** **–**		**GN 968-10-M8-14-A** **GN 968-10-M8-14-A**	

[1] only for profile 40 x 40 [2] only for profile 45 x 45

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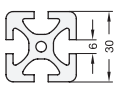
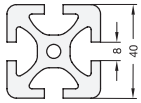
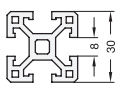
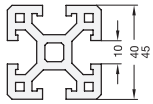
Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Compatible GN standards in ascending order of the standard numbers								
Hinge CFR. (see page 1396)								
 CFR.60 SH-6	–		**GN 965-8-M6-20-B**		–		**GN 968-10-M6-20-B**[1)]	
Hinge CFM. (see page 1382)								
 CFM.60-45-SH-6	–		**GN 965-8-M6-18-B**		–		**GN 968-10-M6-18-B**[1)]	
Hinges with built-in safety switch CFSQ. (see page 1436)								
 CFSQ.60-SH-6-...	–		**GN 965-8-M6-18-B**		–		**GN 968-10-M6-18-B**[1)]	
Hinges with built-in safety multiple switch CFSW. (see page 1428)								
 CFSW.110-6-...	–		**GN 965-8-M6-18-B**		–		**GN 968-10-M6-18-B**[1)]	
Hinges CFMW. (see page 1434)								
 CFMW.70-SH-6 CFMW.110-SH-6	– –		**GN 965-8-M6-18-B** –		– –		**GN 968-10-M6-18-B**[1)] **GN 968-10-M6-18-B**[1)]	
Mounting plates PMW for hinges CFSW. / CFMW. (see page 1433)								
 PMW.110-30 PMW.110-40 PMW.110-45	**GN 965-6-M6-16-B** – –		– **GN 965-8-M6-18-B** –		**GN 968-8-M6-14-B** – –		– **GN 968-10-M6-18-B** **GN 968-10-M6-18-B**	
Swivel clamp connector bases GN 271 (see page 1847)								
 GN 271-25-...	–		**GN 965-8-M5-18-A**		–		**GN 968-10-M5-18-A**	

[1)] only for profile 40 x 40

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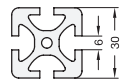
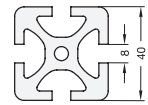
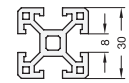
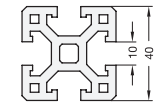
TECHNICAL DATA

GN 965 / GN 968 – Assembly sets for profile systems 30/40/45 continued

Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Compatible GN standards in ascending order of the standard numbers								
Sensor holders GN 271.4 (see page 1872)								
 GN 271.4-B12-... GN 271.4-B18-...			**–** **–**				**–** **–**	
Swivel clamp connector joints GN 281 (see page 1859)								
 GN 281-...			**–**				**–**	
Tubular handles GN 333 (see page 498)								
 GN 333-28-...-B-...			**–**				**–**	
Tubular handles GN 333.1 (see page 496)								
 GN 333.1-28-...-B-...			**–**				**–**	
Oval tubular handles GN 334.1 (see page 523)								
 GN 334.1-36-...			**–**				**–**	
Indexing plungers GN 412 (see page 789)								
 GN 412-5-35-...-1 GN 412-6-35-...-1 GN 412-8-47-...-1 GN 412-10-47-...-1			**–** **–** **GN 965-8-M5-20-A** **GN 965-8-M5-20-A**				**–** **–** **GN 968-8-M5-20-A** **GN 968-8-M5-20-A**	
Mounting blocks GN 412.1 (see page 814)								
 GN 412.1-35-...-1 GN 412.1-47-...-1			**–** **GN 965-8-M5-20-A**				**–** **–**	

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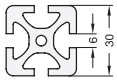
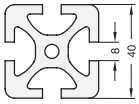
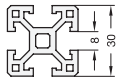
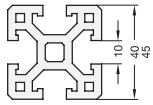
Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
								
Compatible GN standards in ascending order of the standard numbers								
Spring latches GN 416 (see page 790)								
	GN 416-6-38-... GN 416-8-38-... GN 416-8-46-... GN 416-10-38-... GN 416-10-46-... GN 416-12-46-...	**GN 965-6-M5-14-A** **GN 965-6-M5-14-A** **–** **GN 965-6-M5-14-A** **–** **–**	**GN 965-8-M5-16-A** **GN 965-8-M5-16-A** **GN 965-8-M6-16-A** **GN 965-8-M5-16-A** **GN 965-8-M6-16-A** **GN 965-8-M6-16-A**	**GN 968-8-M5-14-A** **GN 968-8-M5-14-A** **–** **GN 968-8-M5-14-A** **–** **–**	**GN 968-10-M5-18-A** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A** **GN 968-10-M6-18-A**
Locators GN 416.1 (see page 791)								
	GN 416.1-6-38 GN 416.1-8-38 GN 416.1-8-46 GN 416.1-10-38 GN 416.1-10-46 GN 416.1-12-46	**GN 965-6-M5-14-A** **GN 965-6-M5-14-A** **–** **GN 965-6-M5-14-A** **–** **–**	**GN 965-8-M5-16-A** **GN 965-8-M5-16-A** **GN 965-8-M6-16-A** **GN 965-8-M5-16-A** **GN 965-8-M6-16-A** **GN 965-8-M6-16-A**	**GN 968-8-M5-14-A** **GN 968-8-M5-14-A** **–** **GN 968-8-M5-14-A** **–** **–**	**GN 968-10-M5-18-A** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A** **GN 968-10-M6-18-A**
Indexing plungers GN 417 (see page 792)								
	GN 417-5-A / -B / -C GN 417-6-A / -B / -C GN 417-8-A / -B GN 417-8-C GN 417-10-A / -B / -C	**GN 965-6-M4-12-A** **GN 965-6-M5-14-A** **GN 965-6-M5-14-A** **–** **–**	**–** **GN 965-8-M5-16-A** **GN 965-8-M5-16-A** **GN 965-8-M5-16-A** **GN 965-8-M6-16-A**	**GN 968-8-M4-12-A** **GN 968-8-M5-14-A** **GN 968-8-M5-14-A** **–** **–**	**–** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A**
Locators GN 417.1 (see page 794)								
	GN 417.1-5 GN 417.1-6 GN 417.1-8 GN 417.1-10	**GN 965-6-M4-12-A** **GN 965-6-M5-14-A** **GN 965-6-M5-14-A** **–**	**–** **GN 965-8-M5-16-A** **GN 965-8-M5-16-A** **GN 965-8-M6-16-A**	**GN 968-8-M4-12-A** **GN 968-8-M5-14-A** **GN 968-8-M5-14-A** **–**	**–** **GN 968-10-M5-18-A** **GN 968-10-M5-18-A** **GN 968-10-M6-18-A**
Base clamp mountings GN 473 (see page 1878)								
	GN 473-B8-... GN 473-B10 / B12-... GN 473-B15 / B16-... GN 473-B20-...	**GN 965-6-M4-10-A** **–** **–** **–**	**GN 965-8-M4-14-A** **GN 965-8-M5-12-A** **GN 965-8-M6-14-A** **GN 965-8-M6-18-A**	**GN 968-8-M4-10-A** **–** **–** **–**	**GN 968-10-M4-14-A** **GN 968-10-M5-14-A** **GN 968-10-M6-14-A** **GN 968-10-M6-18-A**
Clamp mountings GN 477 (see page 1879)								
	GN 477-B8-... GN 477-B10 / B12-... GN 477-B15 / B16 / B20-...	**GN 965-6-M4-16-A** **GN 965-6-M5-18-A** **GN 965-6-M6-20-A**	**GN 965-8-M4-20-A** **GN 965-8-M5-20-A** **GN 965-8-M6-22-A**	**GN 968-8-M4-16-A** **GN 968-8-M5-18-A** **GN 968-8-M6-20-A**	**–** **GN 968-10-M5-20-A** **GN 968-10-M6-22-A**

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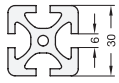
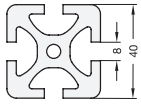
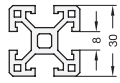
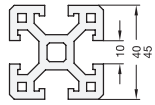
TECHNICAL DATA

GN 965 / GN 968 – Assembly sets for profile systems 30/40/45 continued

Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
								
Compatible GN standards in ascending order of the standard numbers								
Flanged bolts GN 480 (see page 1885)								
	GN 480-8-... GN 480-10 / 12-... GN 480-15 / 16 / 20-...	**GN 965-6-M4-10-A** **GN 965-6-M5-10-A** **GN 965-6-M6-12-A**	**GN 965-8-M4-12-A** **GN 965-8-M5-12-A** **GN 965-8-M6-14-A**		**GN 968-8-M4-10-A** **GN 968-8-M5-10-A** **GN 968-8-M6-12-A**	– **GN 968-10-M5-12-A** **GN 968-10-M6-14-A**		
Bridge handles M.443 CH / M.443 N-CH / M.443 AE-V0 / M.443-ESD (see page 435)								
	M.443/110-... M.443/140-6-... M.443/140-8-... M.443/145-... M.443/150-... M.443/170-... M.443/180-... M.443/190-... M.443/200-... M.443/260-...	**GN 965-6-M6-14-A** **GN 965-6-M6-16-A** – – – – – – – –	**GN 965-8-M6-16-A** **GN 965-8-M6-16-A** **GN 965-8-M8-18-A** – **GN 965-8-M8-18-A** **GN 965-8-M8-18-A** **GN 965-8-M8-20-A** **GN 965-8-M8-20-A** – –	**GN 968-8-M6-14-A** **GN 968-8-M6-16-A** – – – – – – – –	**GN 968-10-M6-16-A** **GN 968-10-M6-20-A** **GN 968-10-M8-16-A** **GN 968-10-M8-16-A** **GN 968-10-M8-18-A** **GN 968-10-M8-18-A** **GN 968-10-M8-20-A** **GN 968-10-M8-20-A** **GN 968-10-M8-20-A** **GN 968-10-M8-20-A**		
Angles SQT. (see page 1899)								
	SQT.40-18-...-8 SQT.40-25-...-8 SQT.43-43-A-8	– – –	**GN 965-8-M8-18-C** **GN 965-8-M8-18-C** –		**GN 968-8-M6-14-C** **GN 968-8-M6-14-C** –	– – **GN 968-10-M8-18-C**		
Cabinet U-Handles GN 565.1 (see page 416)								
	GN 565.1-20-... GN 565.1-26-...	**GN 965-6-M5-22-A** –	– **GN 965-8-M6-22-A**		**GN 968-8-M5-20-A** –	– **GN 968-10-M6-22-A**		
Inclined cabinet U-Handles GN 565.2 (see page 417)								
	GN 565.2-26-128-B-... GN 565.2-26-160-B-...	– –	**GN 965-8-M6-22-C** **GN 965-8-M6-22-C**		– –	**GN 968-10-M6-22-C** **GN 968-10-M6-22-C**		
Cam action indexing plungers GN 612.2 (see page 830)								
	GN 612.2-...-16-... GN 612.2-...-20-...	**GN 965-6-M5-18-A** **GN 965-6-M5-22-A**	**GN 965-8-M5-22-A** **GN 965-8-M5-25-A**		**GN 968-8-M5-18-A** **GN 968-8-M5-22-A**	– **GN 968-10-M5-25-A**		

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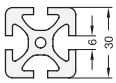
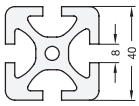
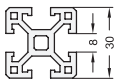
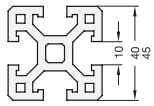
Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Compatible GN standards in ascending order of the standard numbers								
Cam action indexing plungers GN 612.9 (see page 831)								
 GN 612.9-...-16-... GN 612.9-...-20-...	**GN 965-6-M5-18-A** **GN 965-6-M5-22-A**		**GN 965-8-M5-20-A** **GN 965-8-M5-25-A**		**GN 968-8-M5-18-A** **GN 968-8-M5-22-A**		**–** **GN 968-10-M5-25-A**	
Bridge handles EBP. (see page 428)								
 EBP.110-6... EBP.140-6-... EBP.140-8-... EBP.150-8... EBP.180-8-... EBP.200-8-...	**GN 965-6-M6-16-A** **–** **–** **–**		**–** **GN 965-8-M8-28-A** **GN 965-8-M8-28-A** **GN 965-8-M8-28-A**		**GN 968-8-M6-14-A** **–** **–** **–**		**–** **GN 968-10-M8-28-A** **GN 968-10-M8-28-A** **GN 968-10-M8-28-A**	
Guard safety handles ESP. (see page 476)								
 ESP.110-EH-... ESP.110-SH-...	**GN 965-6-M6-16-A** **GN 965-6-M6-18-B**		**GN 965-8-M6-18-A** **GN 965-8-M6-22-B**		**GN 968-8-M6-16-A** **GN 968-8-M6-18-B**		**GN 968-10-M6-20-A** **GN 968-10-M6-22-B**	
Guard wing handles EWP. (see page 477)								
 EWP.110-EH EWP.110-SH	**GN 965-6-M6-16-A** **GN 965-6-M6-18-B**		**GN 965-8-M6-18-A** **GN 965-8-M6-22-B**		**GN 968-8-M6-16-A** **GN 968-8-M6-18-B**		**GN 968-10-M6-20-A** **GN 968-10-M6-22-B**	
Panel support clamp PC (see page 1340)								
 PC.35	**GN 965-6-M6-10-D**		**GN 965-8-M6-14-D**		**GN 968-8-M6-10-D**		**GN 968-10-M6-14-D**	
Cabinet U-Handles M.1043 (see page 514)								
 M.1043/20-...	**–**		**GN 965-8-M8-20-A**		**–**		**GN 968-10-M8-20-A**	
Cabinet U-Handles M.1053 (see page 515)								
 M.1053 M.1053-P	**–** **–**		**GN 965-8-M8-20-A** **GN 965-8-M8-20-A**		**–** **–**		**GN 968-10-M8-20-A** **GN 968-10-M8-20-A**	

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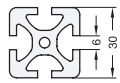
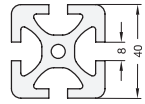
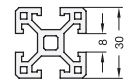
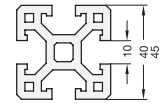
GN 965 / GN 968 – Assembly sets for profile systems 30/40/45 continued

Assembly sets GN 965 / GN 968	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Compatible GN standards in ascending order of the standard numbers								
Spring latches GN 722.3 (see page 832)								
 GN 722.3-8-...	–		**GN 965-8-M6-18-A**		–		**GN 968-10-M6-18-A**	
GN 722.3-10-...	–		**GN 965-8-M6-18-A**		–		**GN 968-10-M6-18-A**	
GN 722.3-12-...	–		**GN 965-8-M6-18-A**		–		**GN 968-10-M6-18-A**	
GN 722.3-14-...	–		**GN 965-8-M6-18-A**		–		**GN 968-10-M6-18-A**	
Cabinet U-Handles GN 728 (see page 441)								
 GN 728-120-B-...	**GN 965-6-M6-14-A**		–		**GN 968-8-M6-14-A**		–	
GN 728-180-B-...	–		**GN 965-8-M8-18-A**		–		**GN 968-10-M8-18-A**	
Stainless Steel – Cabinet U-Handles GN 728.5 (see page 441)								
 GN 728.5-120-B-...	**GN 965-6-M6-14-A**		–		**GN 968-8-M6-14-A**		–	
Angle pieces / Shackles GN 967 (see page 1000)								
 GN 967-...-20-...-1-...	**GN 965-6-M5-12-A**		**GN 965-8-M5-14-A**		**GN 968-8-M5-12-A**		**GN 968-10-M5-14-A**	
GN 967-...-20-...-2-...	**GN 965-6-M5-12-B**		**GN 965-8-M5-14-B**		**GN 968-8-M5-12-B**		**GN 968-10-M5-14-B**	
GN 967-...-30-...-1-...	**GN 965-6-M6-12-A**		**GN 965-8-M6-14-A**		**GN 968-8-M6-12-A**		**GN 968-10-M6-14-A**	
GN 967-...-30-...-2-...	**GN 965-6-M6-12-B**		**GN 965-8-M6-14-B**		**GN 968-8-M6-12-B**		**GN 968-10-M6-14-B**	
GN 967-...-40-...-1-...	–		**GN 965-8-M8-16-A**		–		**GN 968-10-M8-16-A**	
GN 967-...-40-...-2-...	–		**GN 965-8-M8-16-B**		–		**GN 968-10-M8-16-B**	
GN 967-...-45-...-1-...	–		**GN 965-8-M8-16-A**		–		**GN 968-10-M8-16-A**	
GN 967-...-45-...-2-...	–		**GN 965-8-M8-16-B**		–		**GN 968-10-M8-16-B**	
Threaded flanges GN 3490 (see page 1012)								
 GN 3490-45-...	**GN 965-6-M6-14-B**		–		**GN 968-6-M6-14-B**		**GN 968-8-M8-16-B**	
GN 3490-60-...	–		**GN 965-8-M8-16-B**		–		**GN 968-8-M8-16-B**	

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11 Vibration-damping elements - Guidelines for the choosing

Basic data required

- Disturbing frequency: the frequency of the disturbing vibration produced by an on-duty machine. In general, it is obtained by the number of rotations of the engine [Hz=r.p.m./60];
- The load applied to every single vibration-damping element [N];
- The isolation degree required [%];
- The deflection value of the vibration-damping element under a given load [mm];
- The stiffness [N/mm], that is to say the load that applied to the vibration-damping element produces a deflection of 1.0 mm.

How to choose the vibration-damping element

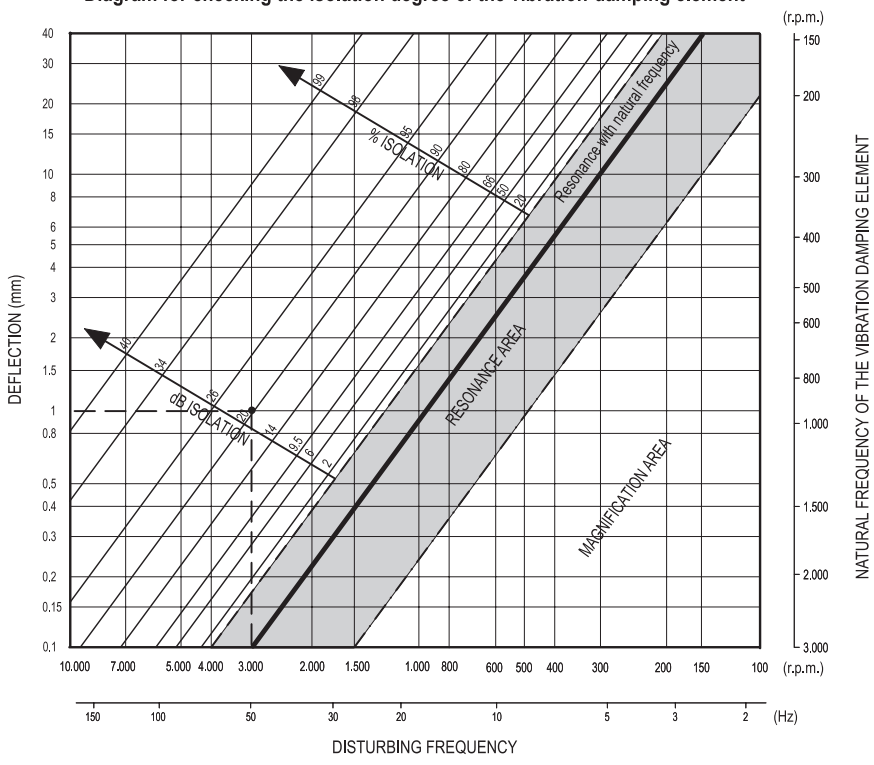
- With reference to the diagram for checking the isolation degree, intersect the disturbing frequency value with the isolation degree required (each isolation degree corresponds to a line in the diagram) and define the deflection [in mm];
- Divide the load applied onto the vibration-damping element by the deflection value to obtain the required stiffness of the vibration-damping element;
- Compare the stiffness obtained with the stiffness shown in the table and choose the vibration-damping element which presents the nearest value (lower) to the calculated one (the stiffness values reported in the table refer to the maximum load values);
- The designer must verify that the article chosen through this selection criterion is suitable for the application required, in any case. For this purpose on request for each article, non-linear graphs of the spread (according to the applied load) are available.

Example

Conditions of use:

- Disturbing frequency= 50 Hz (3,000 r.p.m.);
- Load applied on each vibration-damping element 120 N;
- 90% isolation required;
- Diagram shows that with a 50 Hz disturbing frequency and an isolation degree of 90%, the deflection obtained is 1.0 mm;
- Divide the load applied by the deflection obtained to define the rigidity required, which is 120/1.0 = 120 N/mm;
- Compare the rigidity value obtained (120 N/mm) with the values reported in the table;
- The values reported in table, for type DVA.1, show that the vibration-damping element which should be used is DVA.1-25-20-M6-18-55.

Diagram for checking the isolation degree of the vibration-damping element



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