Technical Data Index

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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						
PA	PA-T	PP	POM	PC	PBT	TPE
Glass-fibre reinforced polyamide, with glass filler or glass micro-spheres or polyamidebased SUPER technopolymers	Special transparent polyamide	Glass-fibre reinforced polypropylene or with mineral fillers	Acetal resin	Special polycarbonate	Special polyester	Thermoplastic elastomer

1.1 Mechanical Strength

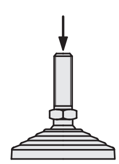
Duroplasts: the addition of mineral fillers, natural textile fibres and the optimum selection of the basic resin give this material an excellent mechanical strength, a high superficial hardness and a good impact strength.
Technopolymers: the rich selection of basic polymers available and the possibility 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 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.

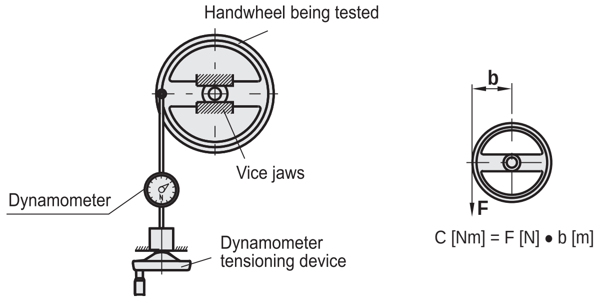
In these cases, the "maximum working load" will be used as maximum design data to guarantee the correct performance, while the "load at breakage" will be used for safety tests.
Obviously, in both cases suitable safety coefficients must be applied.

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 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.

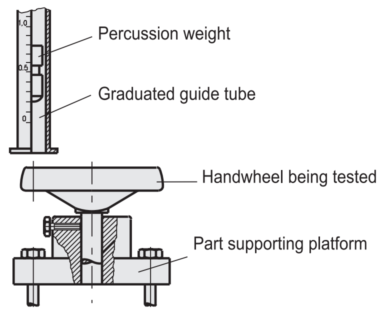


• **Resistance to transmission of torque** (working stress)
Use is made of an electronic dynamometer that applies increasing torque values as shown in the chart hereunder. The dynamometric system in the torque is shown in a traditional way to make the comprehension easier. The mean values of the torque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

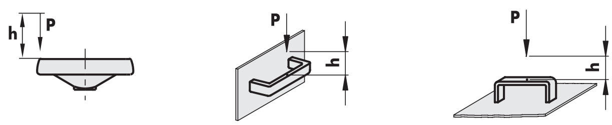


C [Nm] = F [N] • b [m]

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



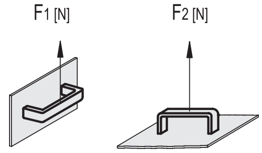
The mean values obtained in the breaking test, shown in the tables for the various models and expressed in [J], correspond to the breaking work L of the element subjected to repeated impacts, with the falling height (h) of the percussion weight (P) being increased by 0.1 m each time. Percussion weight (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.

F_1 [N] F_2 [N]



1.2 Thermal resistance

The use of thermosetting materials and reinforced thermoplastic polymers with a high thermal resistance enables ELESA 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.

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 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-resilience 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 (pages A24 and A25) describe the resistance of the plastic materials used for ELESA 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 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 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.
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 fi lter 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 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 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 V (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 fi ve 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 reaches the further mark from the point of application of the flame.			
UL-94 V		V2	V1	V0
	Time required to extinguish each individual sample after each flame application.	≤ 30 s	≤ 30 s	≤ 10 s
	Sum of times required to extinguish 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.	SI	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.

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 products for which no specific indication is given in this regard belong to the UL94-HB category.
There are groups of ELESA Standards with UL-94 V0 classification, identified as AE-V0 by the symbol shown in the title.
ELESA 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
$10^{-1}\Omega$	$10^{5}\Omega$	$10^{9}\Omega$	$10^{12}\Omega$	$>10^{12}\Omega$

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 thermoplasticm products which may satisfy the requirements of standard conductivity for the ESD (Electro Static Discharge) applications.
The ESD product line developed by ELESA 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, are:

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

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 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.

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 fi eld 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 here on the side. 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 Directive 2002/95/CE. In practice, it could happen that the stock rotation process has not been completed yet: anyway, on elesa website www.elesa.com it is possible to make a check.
  ELESA 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 fi eld. This provides for a gradual reduction in the heavy metals Pb, Cd, Hg, and Cr6, present 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 classifi es the zones where a potentially explosive atmosphere may occur. ATEX marking (together with the declaration of conformity) certifi es 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, certifi cation 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 periodsor 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 fl ammable 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 fl ammable 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;

• **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 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	0 (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 h/year

The following example shows the ATEX classification of an Elesa product, (a breather cap of the SFP series):
CE ex 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 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 product, e.g. a plug of the TN series, according to EN13463-8 standard, in which "k" is evidently present:
CE ex II 2GD k T5.

Code	Description	Classification ATEX	Page
58296-EX	TN-3/8-EX	CE ex II 2GD kT5	1146
58297-EX	TN-1/2-EX	CE ex II 2GD kT5	1146
58298-EX	TN-3/4-EX	CE ex II 2GD kT5X	1146
54001-EX	SFP.30-3/8-EX	CE ex II 2GD IIB T6	1170
54011-EX	SFP.30-3/8+a-EX	CE ex II 2GD IIB T6	1171
54022-EX	SFP.30-3/8+F FOAM-EX	CE ex II 2GD IIB T6	1170
54101-EX	SFP.30-1/2-EX	CE ex II 2GD IIB T6	1170
54111-EX	SFP.30-1/2+a-EX	CE ex II 2GD IIB T6	1171
54122-EX	SFP.30-1/2+F FOAM-EX	CE ex II 2GD IIB T6	1170
54201-EX	SFP.40-3/4-EX	CE ex II 2GD IIB T6	1170
54211-EX	SFP.40-3/4+a-EX	CE ex II 2GD IIB T6	1171
54222-EX	SFP.40-3/4+F FOAM-EX	CE ex II 2GD IIB T6	1170
14441-EX	HGFT.10-3/8-EX	CE ex II 2GD kT6X	1188
14461-EX	HGFT.13-1/2-EX	CE ex II 2GD kT6X	1188
14481-EX	HGFT.16-3/4-EX	CE ex II 2GD k IIBT6X	1188
10851-EX	HCFE.12-3/8-EX	CE ex II 2GD kT6	1204
10901-EX	HCFE.15-1/2-EX	CE ex II 2GD kT6	1204
11001-EX	HCFE.20-3/4-EX	CE ex II 2GD k IIBT6	1204
GN.37762	GN 743.6-11-M16x1.5	CE ex II 2GD TX	1194
GN.37767	GN 743.6-14-M20x1.5	CE ex II 2GD TX	1194
GN.37772	GN 743.6-18-M26x1.5	CE ex II 2GD TX	1194
GN.37773	GN 743.6-18-M27x1.5	CE ex II 2GD TX	1194
GN.37761	GN 743.6-11-G3/8	CE ex II 2GD TX	1194
GN.37766	GN 743.6-11-G1/2	CE ex II 2GD TX	1194
GN.37771	GN 743.6-18-G3/4	CE ex II 2GD TX	1194

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 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 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 plastic elements contain inserts or functional components made of metal.
The tables in chapter 10 (pages A21 and A22) describe the chemical composition and mechanical strength values as per the reference standards for the metals used.

Surface treatments for metal inserts and parts

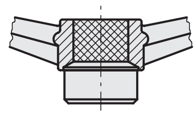
The surface of metal inserts or functional parts is generally treated to ensure the maximum protection against environmental agents, in order to maintain the product's aesthetic and functional qualities.
The protective treatments normally used include:
- burnishing of steel bosses and hubs;
- zinc-plating 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, nitriding and others.

2.1 Properties of metal inserts

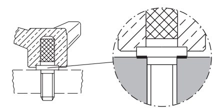
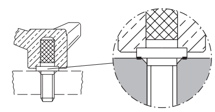
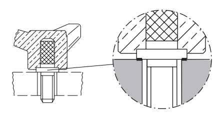
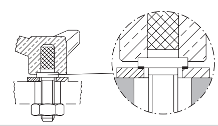
The diamond knurling, of a shape, pitch and depth suited to the stress to be applied, is normally adopted, aiming at ensuring the most effective anchoring of the metal inserts to the plastic material and the best mechanical operation of the element.
This type of knurling ensures both axial anchoring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



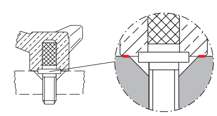
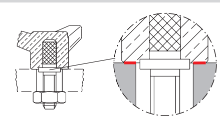
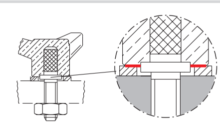
For threaded studs, instead of using a common screw available on the market, they use specially shaped threaded insert which protrudes a few tenths of mm from the plastic body so as to form a metal face on the screwing plane, thus freeing the plastic material of all stresses.

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.

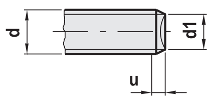
5. Threaded hole and champfer or countersinking with a larger diameter than that of the face on the stud.	
6. Cylindrical through hole with a larger diameter than that of the face on the stud.	
7. Threaded hole without any chamfer or countersinking, setting in between a steel washer whose hole has a diameter larger than that of the face on the stud.	

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

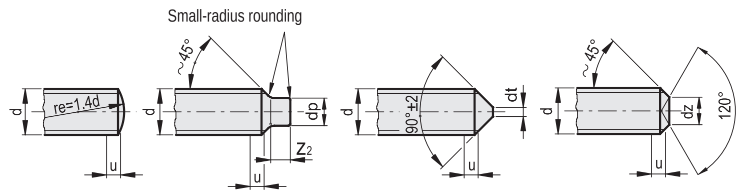
All threaded studs of the ELESA elements have a chamfered flat end in compliance with UNI 947 : ISO 4753.



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 UNI 947 : 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 anticorrosive grease.

3. OTHER MATERIALS

GASKETS
ELESA 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 A23, A24 and A25).
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.

AIR FILTERS for filler breather caps (SFN., SFP., SFV. e SFW. 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.

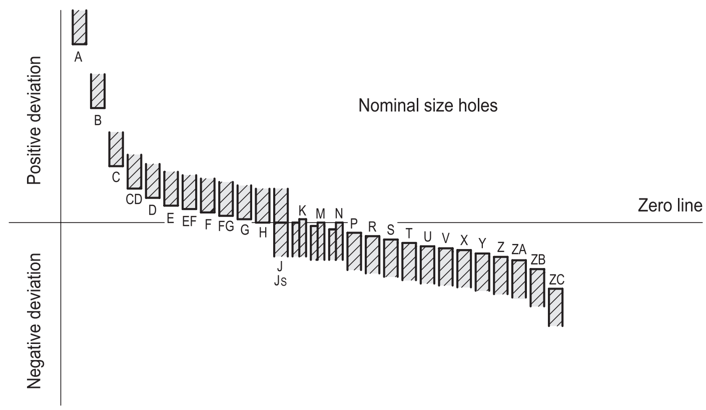
4. MACHINING TOLERANCES

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 diameters 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 (UNI 5545-65) for a normal screwing length (see table in chapter 10, page A18).

- 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 fi xed 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.

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 (original ELESA 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.

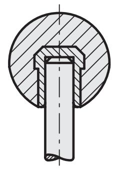


Fig. 1

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 laboratories are provided and they confirm the technical validity of the coupling with self-locking bushings made of special technopolymer (Fig. 2 and Fig. 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 O 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 handl 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.

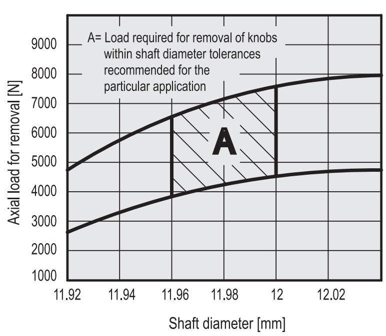


Fig. 2

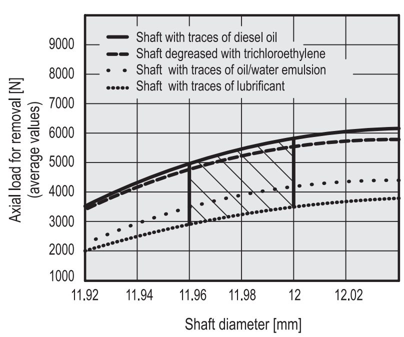


Fig. 3

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 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.

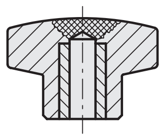


Fig. 4

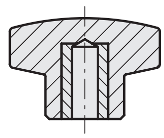


Fig. 5

- **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 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 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.

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.

C1		RAL 7021
C2		RAL 2004
C3		RAL 7035
C4		RAL 1021
C5		RAL 5024
C6		RAL 3000
C7		RAL 6001
C8		RAL 9006

C9		RAL 9005
C31		RAL 7031
C32		RAL 7030
C33		RAL 7040
C34		RAL 7042
C61		RAL 3002
CLEAN		RAL 9002

elesa®

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, hereunder there is a list of the parameters converted into the units currently used or into the British ones.

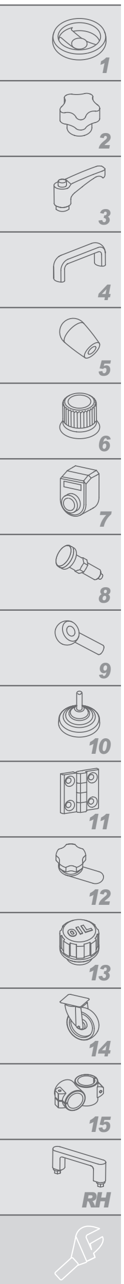
CONVERSION TABLE OF THE MAJOR PARAMETERS

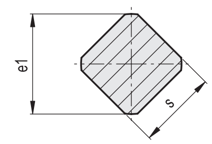
Parameter	To convert	in to	multiply by
Length Force	N	kg	0.1
Couple	Nm	kg · m	0.1
Work	J	kg · m	0.1

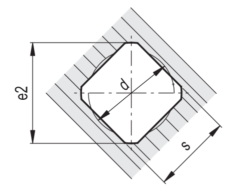
Parameter	To convert	in to	multiply by
Length Force	mm	inches	0.039
Torque	N	lbf	0.224
Couple	Nm	lb · ft	0.737
Work	J	ft · lb	0.737
Weight	g	lb	0.002
Temperature	°C	°F	(°C · 9/5) + 32

CONVERSION TABLE OF SOME TEMPERATURE VALUES from °C to °F
°C = (°F-32) 5/9   °F = (°C 9/5) +32

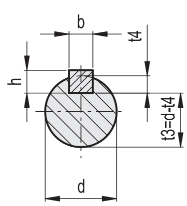
°C	°F	°C	°F	°C	°F
-50	-58	+50	+122	+150	+302
-45	-49	+55	+131	+155	+311
-40	-40	+60	+140	+160	+320
-35	-31	+65	+149	+165	+329
-30	-22	+70	+158	+170	+338
-25	-13	+75	+167	+175	+347
-20	-4	+80	+176	+180	+356
-15	+5	+85	+185	+185	+365
-10	+14	+90	+194	+190	+374
-5	+23	+95	+203	+195	+383
0	+32	+100	+212	+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	+112	+150	+302	+250	+482

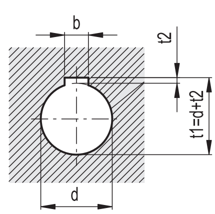






DIN 79 SQUARE HOLES AND SHAFTS				
s H11/h11	d max.	e1 max.	e1 min.	e2 min.
4	4.2	5	4.8	5.3
5	5.3	6.5	6	6.6
5.5	5.8	7	6.6	7.2
6	6.3	8	7.2	8.1
7	7.3	9	8.4	9.1
8	8.4	10	9.6	10.1
9	9.5	12	10.8	12.1
10	10.5	13	12	13.1
11	11.6	14	13.2	14.1
12	12.6	16	14.4	16.1
13	13.7	17	15.6	17.1
14	14.7	18	16.8	18.1
16	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

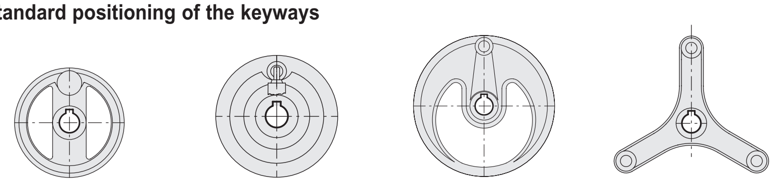




DIN 6885/1 KEYWAYS					
d	b P9/JS9 hole	b P9/N9 shaft	h	t2	t4
from 6 to 8	2	2	2	1 +0.1	1.2 +0.1
over 8 to 10	3	3	3	1.4 +0.1	1.8 +0.1
over 10 to 12	4	4	4	1.8 +0.1	2.5 +0.1
over 12 to 17	5	5	5	2.3 +0.1	3 +0.1
over 17 to 22	6	6	6	2.8 +0.1	3.5 +0.1
over 22 to 30	8	8	7	3.3 +0.2	4 +0.2
over 30 to 38	10	10	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 shaft	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

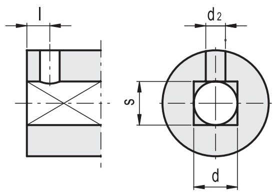


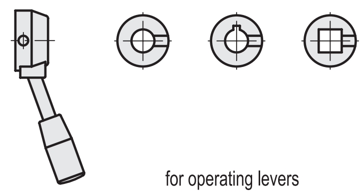
Positioning and standard dimensions of transversal holes with respect to keyway/square hole

An operating element is normally mounted on an axis using a transversal grub-screw or a security dowel. For the type, position and size of these holes, ELESA refers to the drawings and table shown hereunder.

EN 110 TRANSVERSAL HOLES					
d H7	s H11	d2 H11	d3	l -0.1 standard	l -0.1 for DIN 950 only
6	7	2.5	M3	4.5	-
8	9	3	M5	5.5	4.5
10	11	3	M5	5.5	4.5
12	13	4	M6	6.5	5.5
14	15	4	M6	6.5	5.5
16	17	5	M6	8	7
18	19	5	M6	8	7
20	21	5	M6	8	7
22	23	6	M6	10	9
24	25	6	M6	10	9
26	27	6	M6	10	9

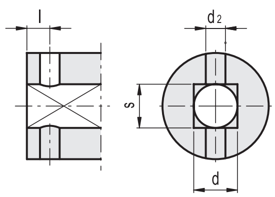
Type QE
Plain transversal hole

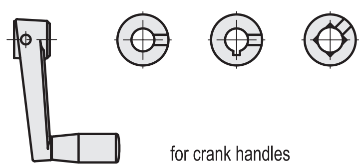




for operating levers

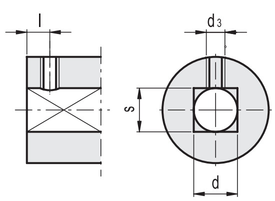
Type QD
Plain transversal pass-through hole

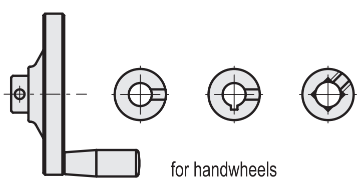




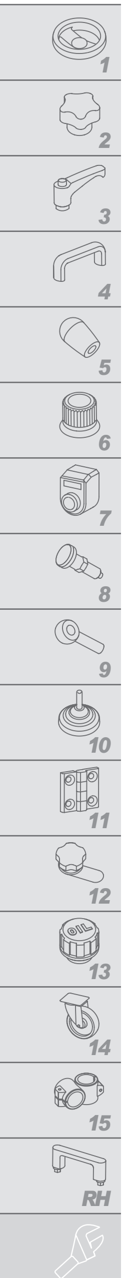
for crank handles

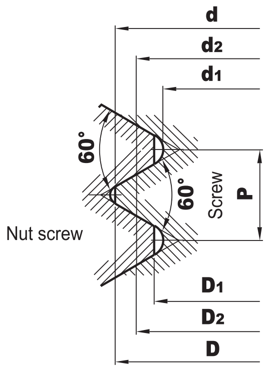
Type GE
Threaded transversal hole





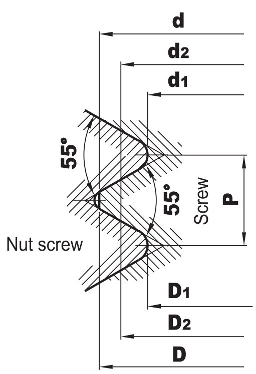
for handwheels





ISO METRIC THREADS
(Thread limits for standard engagement lengths to UNI 5545-65)

	P (mm)	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		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	Not specified	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



$$P = \frac{25.4}{Z}$$

Cylindrical GAS-BSP THREADS
(Thread limits)

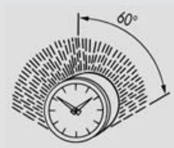
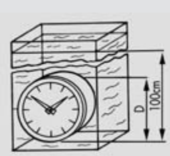
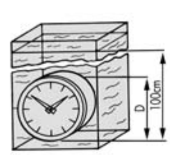
*	Z threads x 1"	Screw with tolerance of Classe B						Nut screw					
		Ø major d		Ø pitch d2		Ø minor d1		Ø major D		Ø pitch D2		Ø minor D1	
		max.	min.	max.	min.	max.	min.	min.	max.	min.	max.	min.	max.
G1/8"	28	9.728	9.514	9.147	8.933	8.566	8.298	9.728		9.147	9.254	8.566	8.848
G 1/4"	19	13.157	12.907	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	Not specified	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 13/8"	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

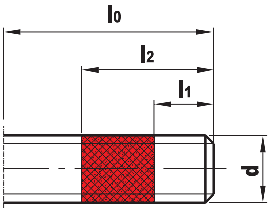
*** G in accordance with UNI-ISO 228/1**

IP PROTECTION CLASSIFICATION FOR CASES
according to International Standard IEC 529

1st digit Protection against intrusion of solid foreign bodies.		
0		No protection.
1		Protection against intrusion of solid foreign bodies, Ø larger than 50 mm (hands).
2		Protection against intrusion of solid foreign bodies, Ø larger than 12 mm (fi ngers).
3		Protection against intrusion of solid foreign bodies, Ø larger than 2.5 mm (tools, wires).
4		Protection against intrusion of solid foreign bodies, Ø larger than 1 mm (wires).
5		Protection against harmful deposits of dust, which damage the correct operation.
6		Complete protection against intrusion of durst.

As a specification for cases of rotary controls does not exist, we refer to International Standard IEC 529 for protection classification of cases for electrical machines, devices or materials.

2nd digit Protection against penetration of liquids.		
0		No protection.
1		Protection against drops of condensed water falling vertically.
2		Protection against drops of liquid falling at an angle equal to or smaller than 15° with respect to the vertical.
3		Protection against drops of liquid falling at an angle equal to or smaller than 60° with respect to the vertical.
4		Protection against liquid splashed from any direction.
5		Protection against water jets projected by a nozzle from any direction.
6		Protection against water from heavy sea on ship's decks.
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.



l0 ≈ length of thread

l1 ≈ from 2 to 3 times the pitch (p) of the thread

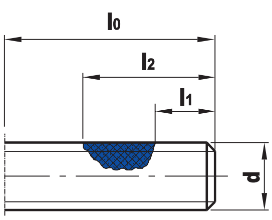
l2 ≈ 1.5 times the diameter (d) of the thread

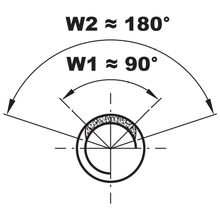
MVK - Fixing the threads by self-gluing.
(Coating with red microencapsulated hardener).

d	l1	l2 ≈	Max screwing torque (Nm)	Min craking torque (Nm)	Max unscrewing torque (Nm)
M5	1.5 ÷ 2.5	7.5	1	1	6.5
M6	2 ÷ 3	9	1.5	1.8	10
M8	2.5 ÷ 4	12	3	4	26
M10	3 ÷ 4.5	15	5.5	10	55
M12	3.5 ÷ 5	18	7.5	16	95
M16	4 ÷ 6	24	14	35	250
M20	5 ÷ 7.5	30	22	45	500

The torque values respect the DIN 237 standard, part 27, and are based on clamping tests without preloading, with a 6H nut and at ambient temperature. With a thread of l0 <l2, the length l2 is reduced to the point that one or two of the last threads are left uncovered (l1).

The glue is made up of a liquid plastic and a hardener contained in microcapsules of polymer coated with a red film visible on a part of the thread. During the screwing operation, the capsules open under the pressure caused by the friction between the two threads.
The liquid plastic and the hardener react chemically with one another to lock the thread in position. The setting and positioning operations must be completed within a period of about 5 minutes, as the glue will start to set after about 10-15 minutes. An initial hardening sufficient to fix the thread is reached after about 30 minutes while complete hardening of the fixture will take place over a period of 24 hours.
The threaded element glued in this way may be unlocked by applying a torque equivalent to the one indicated in the table for each thread or by heating the element up to a temperature of over 180°C. Reuse after unlocking is not recommended. Threads free of oil and grease guarantee the maximum fixing effect of the glue.
Elements treated with this glue may be stored for a period of up to 4 years, without any deterioration in their properties. Threads with MVK microencapsulated glue are generally used on machines subjected to vibrations, in order to prevent spontaneous unscrewing.
The working temperature range is from -40°C to +170°C.
To order an article with microencapsulated glue, add the abbreviation MVK to the product description. Example: GN 615-M8-K-**MVK**





l0 ≈ length of thread

l1 ≈ from 2 to 3 times the pitch (p) of the thread

l2 ≈ 1.5 times the diameter (d) of the thread

w1 = central part of coating

w2 = total coating

PFB - Fixing threads by means of locking action.
(Polyamide based blue coating).

d	l1	l2 ≈	Max screwing torque (Nm)	Max unscrewing torque (Nm)
M3	1 ÷ 1.5	4.5	0.43	0.1
M4	1.5 ÷ 2	6	0.9	0.15
M5	1.5 ÷ 2.5	7.5	1.0	0.2
M6	2 ÷ 3	9	2.0	0.5
M8	2.5 ÷ 4	12	4.0	1.0
M10	3 ÷ 4.5	15	5.0	1.5
M12	3.5 ÷ 5	18	7.0	2.3
M16	4 ÷ 6	24	10.0	4

The torque values respect the DIN 237 standard, part 27, and are based on clamping tests without preloading, with a 6H nut and at ambient temperature. With a thread of l0 <l2, the length l2 is reduced to the point that one or two of the last threads are left uncovered (l1).

Application of the PFB polyamide-based coating is a process in which the elastic plastic (polyamide) is applied to a part of the thread, to create a locking action while a screw is being tightened. The play between the screw and the nut screw is filled with polyamide, thus ensuring a high degree of contact between the remaining uncoated threaded surfaces. The coating contrasts accidental unlocking and accidental unscrewing. The parts locked together may always be separated by applying a minimum unlocking torque.
There is no need to wait for it to be activated as the locking action between the threads is instantaneous. Elements threaded with PFB polyamide-based coating may be stored for a virtually unlimited period.
The working temperature range is from -50°C to +90°C.
To order an article with the polyamide-based coating, add the abbreviation PFB to the product description.
Example: GN 615-M8-K-**PFB**

STAINLESS STEELS

Description		AISI 303	AISI 304+Cu	AISI 304	AISI 316	AISI 316 L	AISI 302
Material description	Symbol	X 8 CrNiS 18-9	X 3 CrNiCu 18-9-4	X 5 CrNi 18-10	X 5 CrNiMo 17-12-2	X 2 CrNiMo 17-12-2	X 10 CrNi 18-8
	Number	1.4305	1.4567	1.4301	1.4401	1.4404	1-4310
UNI standard		UNI EN 10088-3	UNI EN 10088-3	UNI EN 10088-3	UNI EN 10088-3	UNI EN 10088-2	UNI EN 10088-3
% components of alloy		C ≤ 0.10 Si ≤ 1.0 Mn ≤ 2.0 P ≤ 0.045 S ≤ 0.15 ÷ 0.35 Cr 17.0 ÷ 19.0 Ni 8.0 ÷ 10.0	C ≤ 0.04 Si ≤ 1.0 Mn ≤ 2.0 P ≤ 0.045 S ≤ 0.030 Cr 17.0 ÷ 19.0 Ni 8.5 ÷ 10.5	C ≤ 0.07 Si ≤ 1.0 Mn ≤ 2.0 P ≤ 0.045 S ≤ 0.030 Cr 17.0 ÷ 19.5 Ni 8.0 ÷ 10.5	C ≤ 0.08 Si ≤ 1.0 Mn ≤ 2.0 P ≤ 0.045 S ≤ 0.030 Cr 16.0 ÷ 18.5 Ni 10 ÷ 13	C ≤ 0.08 Si ≤ 0.9 Mn ≤ 0.1 Mo ≤ 2.0 ÷ 4.0 Cr 16.0 ÷ 19.0 Ni 10 ÷ 14	C ≤ 0.08 Si ≤ 0.6 Mn ≤ 1.2 Cr 18.0 Ni 9.0
Minimum load at breakage Rm N/mm^2		500 - 700	450 - 650	500 - 700	500 - 700	330	600-800
Yield point Rp 0.2 n/mm^2		≥ 190	≥ 175	≥ 190	≥ 205	≥ 250	≥ 210
Machinability		very good	excellent	fair	fair	good	good
Forgeability		poor	good	good	good	good	poor
Suitability for welding		poor	very good	excellent	good	very good	poor
Special features		Non-magnetic structure Excellent for machining on automatic machines	Non-magnetic structure suitable for low temperatures	Non-magnetic structure suitable for low temperatures may be used at up to 700 °C	Non-magnetic structure suitable for low temperatures	Non-magnetic structure suitable for low temperatures	Non-magnetic structure suitable for low temperatures
Corrosion resistance		fair Due to sulphur content, use in environments containing acids or chlorides should be avoided.	very good Resistant to corrosion in natural environments: water, urban or country climates with no significant concentrations of chlorides, in the food industry	good Resistant to corrosion in natural environments: water, urban or country climates with no significant concentrations of chlorides, in the foodi industry	excellent Resistant to corrosion also in marine environments or wet environments and in the presence of acids.	very good The corrosion resistance is generally reduced, due to its porosity, in comparison with stainless steels. Suitable for use in marine environments, humid environments and in the presence of acids.	fair
Main fields of application		Construction of vehicles. Electronics. Furniture finishings.	Food, chemical and pharmaceutical industries. Agriculture. Construction of machines. Electronics. Shipping. Furniture finishings.	Food, chemical and pharmaceutical industries. Agriculture. Construction of vehicles and machines. Building. Furniture finishings.	Food and chemical industries. Ship building and manufacture of components for marine environments or use in highly corrosive conditions.	Cellulose, paper, chemical and textile industry.	Used for the manufacture of springs in various fields of application.

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

CARBON STEELS, ZINC ALLOYS, ALUMINIUM AND BRASS

Description		Steel for threaded studs	Steel for threaded studs	Zinc alloy for pressure die-casting	Aluminium for handle 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	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 Al rest	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.

ELASTOMERS (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	outstanding	good	good	good	good	very good
solvents	good	good in part	good in part	very good	outstanding	satisfactory
acids	good	restricted	good	very good	outstanding	outstanding
caustic solutions	good	good	very good	very good	outstanding	outstanding
fuels	outstanding	good	slight	good	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.

The characteristics described should be treated as guidelines only. No guarantee is made.
The exact conditions of use have to be taken into account individually.

TECNOPOLYMERS AND RUBBERS

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)			Polypropylene (PP)			Acetal resin (POM)			Polycarbonate (PC)			Soft-Touch thermoplastic elastomer (TPE)		Rubber NBR			Flourated Rubber FKM			Natural rubber NR
	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			▲			▲			▲			●						❐		●							●

Chemical agents and solvents	Polyamide (PA)			Transparent polyamide (PA-T)			Alcohol-Resistant transparent polyamide (PA-T AR)			Polypropylene (PP)			Acetal resin (POM)			Polycarbonate (PC)			Soft-Touch thermoplastic elastomer (TPE)		Rubber NBR			Flourated Rubber FKM			Natural rubber NR
	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	●			●			●	❐
Petrol			●			●			●			❐			●			●		▲			●			●	●
Petrol			●			●			●			❐			●			❐		▲	Swell.		❐			●	●
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

The characteristics described should be treated as guidelines only. No guarantee is made. The exact conditions of use have to be taken into account individually.