Properties of Plastics

Disposal and the environment

- ✓ The plastics used for our products are environmentally neutral during disposal.
- ✓ The plastics can be stored on waste disposal sites without any problems as they do not give off any harmful substances to air, ground or water.
- ✓ The plastics PS, PP, PC and PE are valuable energy carriers to maintain incinerator temperature. The more plastics in waste the less use of fuel.

	Polystyrene	Polypropylene	Polycarbonate	Polyethylene
Abbreviation	**PS**	**PP**	**PC**	**HD-PE High Density** **LD-PE Low Density**
Optical features	transparent, bright surface 90% light permeability (at 400-800 nm)	translucent, bright surface	transparent, 88% light transmission (at 400-800 nm)	translucent to opaque, wax-like surface
General mechanical properties	low elongation at break and heat resistance, excellent electrical insulating features, not suitable for high centrifugal forces	high breaking strength, insensitive to tension cracks, high rigidity	displays high levels of mechanical, optical, electrical and thermal properties, autoclavable and gamma capable	relatively low breaking strength and surface hardness, high viscosity, soft to rigid, sensitive to tension cracks, water repellent
Autoclaving	not suitable	Products made from PP can be autoclaved up to 121°C without significantly impairing their mechanical properties. Users are to test for themselves if autoclaving may have any effect on other characteristic product features so as to influence the individual application concerned.	Products made from PC can be autoclaved up to 121°C without significantly impairing their mechanical properties. Users are to test for themselves if autoclaving may have any effect on other characteristic product features so as to influence the individual application concerned.	not suitable
Max. usage temperature*1	60 - 70°C	100 - 110°C	115 - 125°C	HD-PE 70 - 80°C LD-PE 60 - 75°C
Short-term max. usage temperature*1	75 - 80°C	120 - 140°C	125 - 140°C	HD-PE 90 - 120°C LD-PE 80 - 90°C
Suitable for application in temperature ranges below zero*2	not suitable	suitable for limited applications*1	down to -80°C	suitable for limited applications*1
Density g/cm³	1.05	0.90	1.19	HD-PE 0.95 LD-PE 0.92
Flammability	inflammable	inflammable	inflammable	inflammable
Ignition temperature*1	300 - 400°C	300 - 360°C	380 - 450°C	350 - 360°C
Humidity absorption	< 0.1%	< 0.1%	0.1 - 0.3%	< 0.1%
General chemical resistance	PS is resistant to salt solutions, leaching solutions, non-oxidizing acids as well as alkalis and alcohol. Fuel, etheric oils, strong oxidizing agents and aromatic substances lead to the formation of cracks in PS.	PP is resistant to aqueous solutions of inorganic salts, acids, organic solvents up to 60°C. Alcohols, esters and ketones do not “attack” PP either. Aromatic and halogenised carbon dioxides, oxidizing substances such as concentrated nitric acid and with higher temperature fat, oil and wax make PP swell.	PC is resistant to higher concentrations of mineral acids, many organic acids (e.g. carbonic, oleic and citric acid), oxidation and reduction agents, neutral and acidic saline solutions, a number of fats and oils, saturated aliphatic and cycloaliphatic hydrocarbons and alcohols, except for methanol. PC is destroyed by lyes, ammonia gas, its solution and amines. PC is soluble in a number of industrial solvents. Other organic compounds such as benzene, acetone and carbon tetrachloride tend to make it expand or swell.	PE is highly resistant to chemicals. The chemical resistance of HD-PE is generally higher than that of LD-PE. Aqueous solutions, leaching solutions, alcohol, oil as well as water and salt solutions do not “attack” PE. Concentrated, oxidizing acids such as nitric acid and halogens have a decomposing effect.
Disposal	PS is a pure hydrocarbon compound and thus environmentally neutral during disposal. Incineration does not yield any harmful substances.	PP is a pure hydrocarbon compound and thus environmentally neutral during disposal. Incineration does not yield any harmful substances.	PC is a pure hydrocarbon compound and thus environmentally neutral during disposal. Controlled incineration does not yield any harmful substances.	PE is a pure hydrocarbon compound and thus environmentally neutral during disposal. Incineration does not yield any harmful substances.

*1 *Suitability depending on the plastic material and the nature of load applied.*

*2 *Caution: Plastics start to become brittle at temperatures below zero. The suitability of products intended for use in these temperature ranges should be tested prior to application. These notes serve as a guideline only and do not constitute any confirmation of warranted quality.*

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Chemical Resistance

The following table is to serve as a general guideline. The factors given are non-binding recommendations taken from details rendered by plastic manufacturers and from literature. As a matter of principle, it is the user's responsibility to check the resistance of the plastic material under the specific test conditions concerned, including though not limited to applications where any mixtures of chemical substances and modified temperatures are involved.
The first letter refers to the conditions at +20°C, the second to conditions at +60°C.

	LD-PE	HD-PE	PP	PS	PC
1.4-dioxane	G P	G G	P P	N N	N N
acetaldehyde	P N	G P	G N	N N	N N
acetic acid up to 10%	E E	E E	E E	E E	E G
acetic acid up to 50%	E E	E E	E E	G G	P P
acetone	P N	P P	E G	N N	N N
allyl alcohol	P P	EE	——	EP	——
aluminum salts	E E	E E	E E	G G	——
amino acids	E E	E E	E E	E E	E E
ammonia, conc.	E E	E E	E E	G P	N N
ammonium carbonate	E E	E E	E E	E E	P N
ammonium phosphate	E E	E E	E E	G G	——
ammonium sulphate	E E	E E	E E	G G	E G
amyl acetate	N N	P P	P P	N N	N N
amyl chloride	N N	P N	N N	N N	N N
aniline	N N	G G	G P	N N	N N
benzene	N N	P N	P N	N N	N N
benzine	P N	P P	N N	N N	P P
benzyl alcohol	G P	G G	G P	N N	P P
boric acid	E E	E E	E E	E G	E E
bromine	N N	N N	N N	N N	N N
butanol	E P	E E	E P	G G	N N
butyric acid	P N	G P	P N	N N	P N
calcium chloride	E E	E E	E E	E E	E E
calcium hydroxide	E E	E E	E E	G G	N N
calcium sulphate	E E	E E	E E	G G	E E
carbon tetrachloride	N N	P N	N N	N N	N N
chlorine in water	N N	P N	P N	N N	P N
chlorobenzene	N N	N N	N N	N N	N N
chromic acid up to 10%	E E	E E	E P	E E	G P
chromic acid up to 50%	E E	E E	G P	P P	P N
citric acid	E E	E E	E E	E E	E E
cresol	N N	P N	G P	N N	N N
cyclohexane	N N	N N	E –	N N	E –
diethyl ketone	P N	P P	G G	N N	N N
dimethylsulphoxide	E E	E E	E E	E G	N N
ethanol up to 95%	P P	G G	E E	E E	G G
ethyl acetate	P N	E N	P N	N N	N N
ethyl benzene	N N	N N	P N	N N	P P
ethylene glycol	E E	E E	E E	E E	E E
ethylene oxide	P P	G P	P P	N N	P N
fluoride	E E	E E	E E	G G	——
fluorine	N N	N N	P N	N N	——
formaldehyde up to 10%	E E	E E	E E	P N	E G
formaldehyde up to 40%	G P	E G	E G	N N	P P
glacial acetic acid	P N	E P	E P	N N	N N
glycerine	E E	E E	E E	E E	E E
heating oil	P N	G P	E G	N N	G P
hexane	P P	G P	G P	N N	P N
hydrochloric acid up to 5%	E E	E E	E E	E E	E E
hydrochloric acid up to 20%	E E	E E	E E	E E	P P
hydrochloric acid up to 35%	E E	E E	E P	P P	N N
hydrocyanic acid	E E	E E	E E	G G	——
hydrofluoric acid up to 4%	E G	E E	E G	G P	G P
hydrofluoric acid up to 40%	E E	E E	E –	N N	——
hydrofluoric acid up to 48%	E G	E E	E G	N N	N N
hydrogen peroxide up to 3%	E E	E E	E E	E G	E E
hydrogen peroxide up to 30%	E P	E E	E P	E G	E E
isobutyl alcohol	E P	E E	E E	G G	E E
isopropanol	E E	E E	E E	E G	P –
isopropyl acetate	G P	E P	G P	N N	N N
kerosene	N N	N N	G P	N N	P P
lactic acid	E E	E E	E E	G G	E E
lactose	E E	E E	——	E –	E –
lead acetate	E E	E E	E E	E E	——
mercury	E E	E E	E E	E E	E –
methanoic acid	E G	E E	E N	P P	P N
methanol	E P	E E	E P	P N	N N
methyl ethyl ketone	P N	G G	G P	N N	N N
methyl propyl ketone	N N	N N	G P	N N	N N

	LD-PE	HD-PE	PP	PS	PC
methylene chloride	P P	N N	P N	N N	N N
mineral oil	P N	E P	E E	E E	G P
nitric acid up to 10%	E E	E E	E E	E E	G P
nitric acid up to 50%	P N	P N	P N	N N	G P
nitric acid up to 70%	P N	P N	N N	N N	N N
n-octane	N N	P N	P N	N N	E –
oleic acid	P N	G G	G P	G G	E E
oxalic acid, sat.	E E	E E	E E	E G	E E
ozone	N N	P N	P P	N N	N N
perchloric acid	G N	G N	G N	G P	N N
perchloroethylene	N N	N N	N N	N N	N N
phenol up to 90%	P N	G G	G P	N N	N N
phosphoric acid 10%	E E	E E	E E	E –	P N
phosphoric acid 85%	E E	E E	E G	E P	N N
phosphorous trichloride	N N	N N	G P	N N	N N
potassium acetate	E E	E E	E E	E E	N N
potassium bromide	E E	E E	E E	P –	E G
potassium carbonate	E E	E E	E E	E E	G P
potassium hydroxide, conc.	E E	E E	E E	G G	N N
potassium permanganate	E E	E E	E E	P P	N N
propylene glycol	E E	E E	E E	E E	G P
pyridine	P N	G P	P N	N N	N N
salicylic acid, sat.	E E	E E	E E	E G	E G
silver acetate	E E	E E	E E	G G	——
silver nitrate	E E	E E	E G	G P	E E
sodium carbonate	E E	E E	E E	E E	G P
sodium chloride	E E	E E	E E	E E	E E
sodium dichromate	E E	E E	E E	E E	——
sodium hydroxide up to 1%	E E	E E	E E	G G	——
sodium hydroxide up to 50%	E E	E E	E E	G G	N N
sodium hypochlorite up to 15%	——	E E	E –	——	——
sodium nitrate	E E	E E	E E	E E	P N
sodium sulphate	E E	E E	E E	E E	E –
sucrose	E E	E E	E E	E E	——
sulphuric acid up to 6%	E E	E E	E E	E E	E E
sulphuric acid up to 20%	E E	E E	E E	E G	E G
sulphuric acid up to 60%	E G	E E	E G	G N	P N
sulphuric acid up to 98%	P N	P N	P N	N N	N N
tannic acid	E E	E E	E E	G G	N N
tetrahydrofurane	N N	N N	P N	N N	N N
toluene	N N	P N	P N	N N	N N
trichloracetic acid	P N	G P	P N	N N	N –
trichlorethane	N N	P N	N N	N N	N N
turpentine	N N	N N	N N	N N	——
urea, sat.	E E	E E	E E	E G	N N
xylene	N N	N N	N N	N N	N N
zinc chloride	E E	E E	E E	E E	E E

Explanations

E = excellent	This plastic is totally resistant to that substance.
G = good	Influence of that substance for an extended period of time does not cause any or only small defects.
P = partially resistant	Constant exposure of the plastic material might possibly lead to hairline cracks and a reduced mechanical strength or discolouration.
N = non-resistant	Plastics are not suitable for use in combination with this substance. Application is not recommended.
——	There are no tests available.

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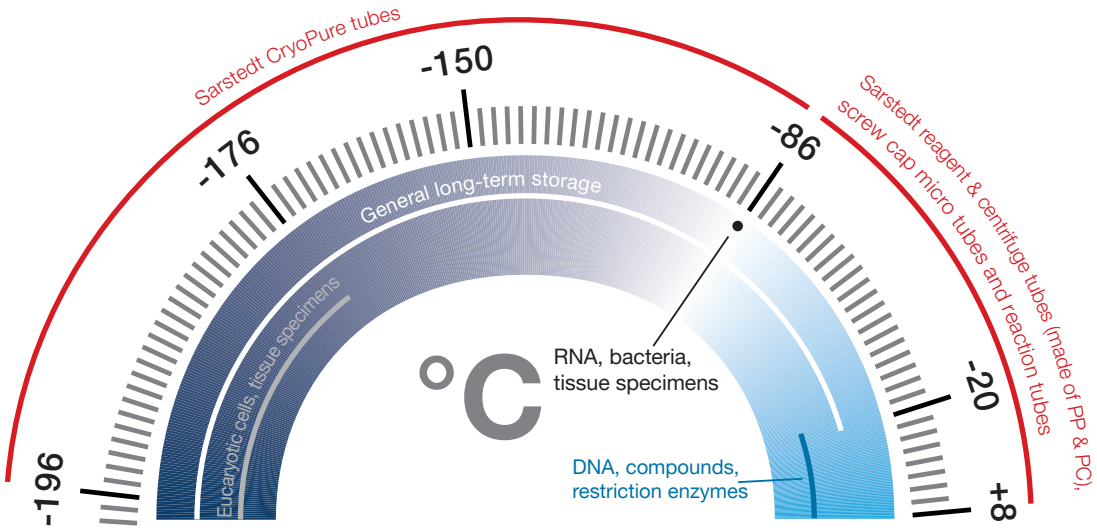
Freezing Sarstedt Tubes



Backup storage of a range of substances and samples sometimes requires storage temperatures below 0°C. DNA or restriction enzymes, for example, are stored at +8°C to -20°C or RNA, bacteria or tissue specimens at up to -80°C. At these low temperatures, however, the plastic vessels typically used for storage are exposed to excessive strain. As a rule, Sarstedt therefore proposes to only use **tubes** and **storage boxes** made from suitable plastic materials like, for example, polypropylene or polycarbonate. Moreover and in view of the safe sealing principle that is of particular importance during and after the thawing process, **screw cap tubes** rather than push cap tubes are the products of choice. Sarstedt's screw cap micro tubes are ideally suited for these purposes. For the storage of tissue specimens or eucaryotic cells at temperatures up to -196°C we exclusively recommend using our **CryoPure tubes**, which have been especially optimised for cryogenic storage.

Based on our experience and on tests conducted with plastic tubes, we can provide the following information:

- As a rule, temperatures below 0°C reduce the strength values of plastic materials. Therefore excessive **mechanical stress** is to be avoided.
- The freezing conditions must be selected in a way to enable the contents to freeze **evenly**, i.e. starting in the **lower part** and freezing **upwards**. If unfavourable conditions cause the tube to start freezing in the upper part, expansion cracks are likely to occur in the lower section.
- Use **suitable racks or storage boxes** enabling sufficient free play in the rack to allow them to expand. Due to their pronounced insulating properties, we cannot recommend storage in Styrofoam containers.

As the stress exerted on the tubes tends to vary significantly depending on both the medium to be frozen and the respective routine conditions, the suitability of the tubes in a temperature range below zero must be tested under **your specific conditions of application**.

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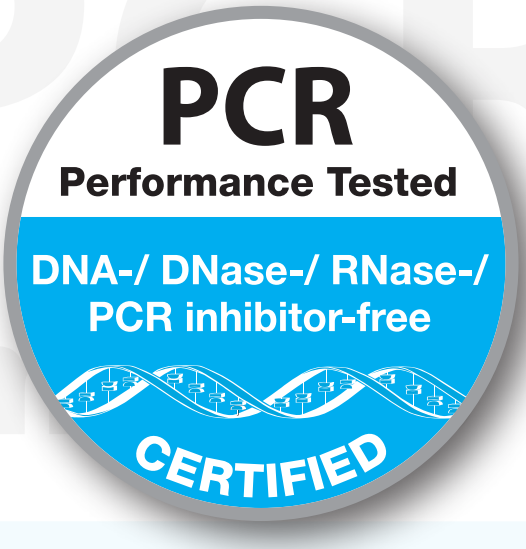

For the use of Sarstedt consumables in nucleic acid analytics

PCR Performance Tested items fulfil the following purity criteria certified by an independent laboratory:

- ✓ DNA-free
- ✓ DNase/RNase-free
- ✓ PCR inhibitor-free

We guarantee that the following limit values are met:

Human DNA <0.5 pg/µl
Bacterial DNA <0.02 pg/µl
DNase $<1x10^{-5}$ U/µl
RNase $<1x10^{-9}$ Kunitz units/µl
Real Time PCR <0.5 cycles Ct value shifting compared to control

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Certificate Biosphere® plus quality

For the use of Sarstedt consumables in highly sensitive analysis methods

Biosphere® plus items fulfil the following purity criteria certified by an independent laboratory:

- ✓ Sterile
- ✓ DNA-free
- ✓ DNase/RNase-free
- ✓ PCR inhibitor-free
- ✓ ATP-free
- ✓ Pyrogen-free/endotoxin-free

We guarantee that the following limit values are met:

Sterility validated according to ISO 11135
Human DNA <5.0 fg/µl
Bacterial DNA <0.2 fg/µl
DNase $<5x10^{-7}$ U/µl
RNase $<5x10^{-11}$ Kunitz units/µl
Real Time PCR <0.5 cycles Ct value shifting compared to control
ATP $<1x10^{-12}$ mmol/µl
Pyrogens/endotoxins <0.002 EU/ml

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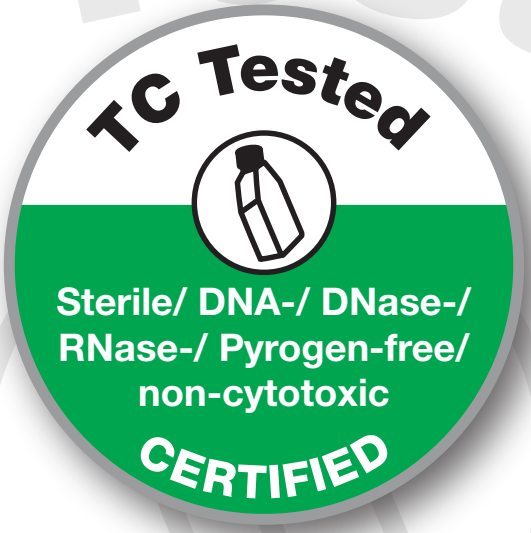

For the use of Sarstedt consumables in the field of cell and tissue culture

TC Tested items fulfil the following certified purity criteria:

- ✓ Sterile
- ✓ Pyrogen-free/endotoxin-free
- ✓ Non-cytotoxic
- ✓ DNA-free
- ✓ DNase/RNase-free

We guarantee that the following limit values are met:

Sterility validated according to ISO 11137
Pyrogens/endotoxins <0.06 EU/ml
Non-cytotoxic according to ISO 10993
Human DNA <0.5 pg/µl
Bacterial DNA <0.02 pg/µl
DNase <7.1×10^{-5} U/µl
RNase <7.1×10^{-9} U/µl

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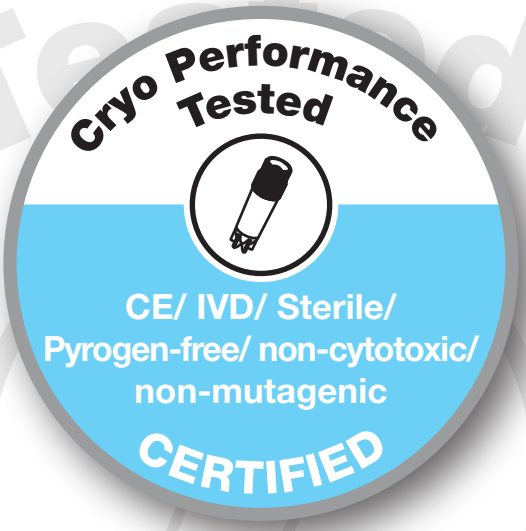
Certificate Cryo Performance Tested quality



For the use of Sarstedt consumables in cryopreservation

Cryo Performance Tested items fulfil the following certified purity criteria:

- ✓ Sterile
- ✓ Pyrogen-free/endotoxin-free
- ✓ Non-cytotoxic
- ✓ Non-mutagenic
- ✓ CE IVD

We guarantee that the following limit values are met:

Sterility validated according to ISO 11137
Pyrogens/endotoxins <0.06 EU/ml
Non-cytotoxic according to ISO 10993
Non-mutagenic according to the Ames Test II

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