QUARTZ

QUARTZ

helios quartz®

NATURAL QUARTZ

Quartz is a unique material, due to its high purity level of SiO2 and to its mechanical, electrical, thermal, chemical and optical properties.

These properties are really appreciated in several fields, like in the industry of the semiconductor, optical fiber, chemical industry, steel industry, electrical heaters, light industry and in research labs.

Helios is able to meet very different requests and offers its customers items made of clear, translucent or opaque quartz glass, which are produced with different production techniques and raw materials: synthetic or natural quartz sand with different levels of purity.

Since 1940 Helios has been on the market for the production of scientific equipment, of UV and IR emitters. Moreover it has a long-time experience in the production and processing of the following items in clear, translucent or opaque quartz glass:

- tubes
- domed tubes
- rods
- disks
- plates
- bars
- customized items on customer drawings
- lab items

PRODUCTION METHODS

One Step production method

This is the most common method used to produce quartz glass in a continuous process.
The quartz sand is melted in a tungsten crucible that contains electrical heating elements; the fused material flows down from the crucible through a bottom mould where it is shaped into tubes, plates and rods.
By this production method and with the proper raw materials selection we are able to obtain finished goods with high purity, excellent mechanical, thermal and optical properties and low OH content.

Oxygen hydrogen flame fusion production method

The fusion process occurs through a hydrogen/oxygen (H2/O2) flame.
The raw material is heated up through a H2/O2 flame until it melts. In this way, we obtain a lingot, which can be shaped into tubes, rods, disks, plates. The OH content is stable at 150 ppm., this value cannot be reduced through annealing processes. The optical properties of these qualities of quartz glass are excellent, in fact through the use of this type of process we can guarantee a finished good virtually free from bubbles content.

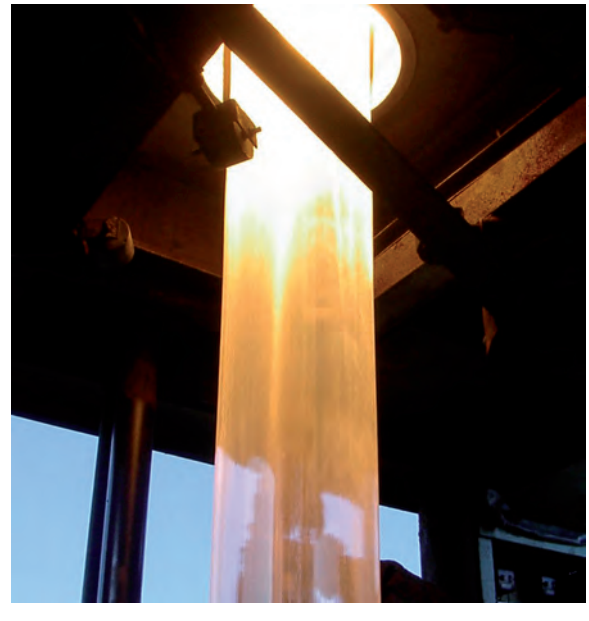
Electric vacuum two-step fusion method

The first production step consists in a quartz glass lingot that is obtained through an electrical vacuum fusion furnace; then it is fused again through an induction furnace to become tubes, rods and plates. All the heater moulds and crucibles of this producing method are made of high purity graphite. The quartz glass produced through this method has an excellent thermal stability, a very good resistance to high temperature, a great transmission from the UV to the IR range of wavelengths and stable and very low OH content (<3ppm).

Electric cylinder fusion method

The fusion process occurs into a mould represented by a cylinder. One elrctrical heating is placed in the middle of the cylinder, while the others externally all around. The particularity of this process consists in the rotation of the mould around its axis during the fusion of the quartz sand: in this way the melted quartz fixes on the inner wall of the wall by centrifugal acceleration.
This technology allows obtaining large diameter quartz glass tubes with big thickness.

H^2/O^2 flame fusion production method



One Step production method

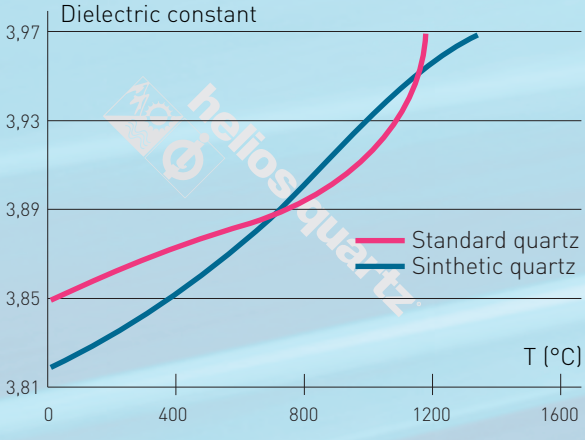
ELECTRICAL PROPERTIES

Quartz is an excellent electric insulating material and presents the following electrical properties:

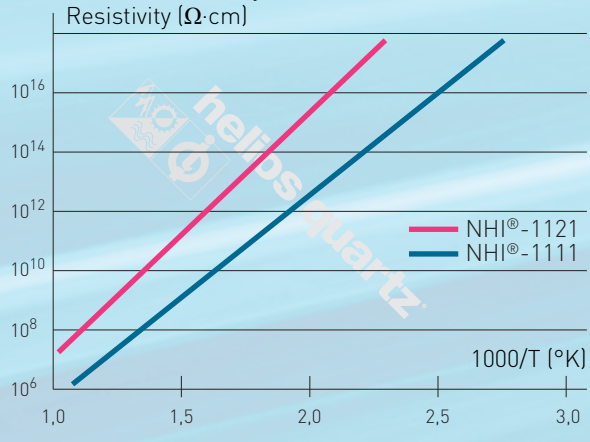
- electrical resistivity (350°): $7x10^7$ ohm x cm
- dielectric constant (20°C - 1MHz): 3,76
- insulated strength (20°C - 1MHz): 5×10^7 V/m
- dielectric absorbance constant: $<4 \times 10^{-4}$
- dielectric ullage constant: $<1 \times 10^{-4}$

The following graphs show the trend of the dielectric constant for synthetic and natural quartz, the trend of the electrical resistivity for the NHI®-1111 and NHI®-1121 quartz, according to the variation of the working temperature.

Dielectric constant



Electrical resistivity



MECHANICAL PROPERTIES

The mechanical properties are influenced from the shape, the impurity level or the presence of defects on the surface and from the age of the material.

The following table shows the main parameters of the mechanical properties of each quality of quartz produced by Helios.

QUALITY CLASS	DENSITY	HARDNESS	COMPRESSIVE STRENGTH	TENSILE STRENGTH
NHI®-1100 NHI®-1101 NHI®-1102	$2,2X10^3$ kg/m^3	550 KHN_{100}	$>1,1x10^9$ Pa	$4,7x10^7$ Pa (N/m^2)
NHI®-1111 NHI®-1112 NHI®-1121	$2,2X10^3$ kg/m^3	580 KHN_{100}	$>1,1x10^9$ Pa	$4,9x10^7$ Pa (N/m^2)
NHI®-1200 NHI®-1210	$2,2X10^3$ kg/m^3	580 KHN_{100}	$>1,1x10^9$ Pa	$5,0x10^7$ Pa (N/m^2)
NHI®-1300	$2,21X10^3$ kg/m^3	580 KHN_{100}	$1,2x10^9$ Pa	$5,0x10^7$ Pa (N/m^2)
NHI®-1100 UC NHI®-1103 UC	$2,15X10^3$ kg/m^3	550 KHN_{100}	$1,0x10^9$ Pa	$5,0x10^7$ Pa (N/m^2)
NHI®-1300 UC	$2,15X10^3$ kg/m^3	580 KHN_{100}	$1,0x10^9$ Pa	$5,0x10^7$ Pa (N/m^2)
NHI®-1400	2,15-2,18 g/m^3	580 KHN_{100}	$1,2x10^3$ Pa	$50x10^7$ Pa (N/m^2)

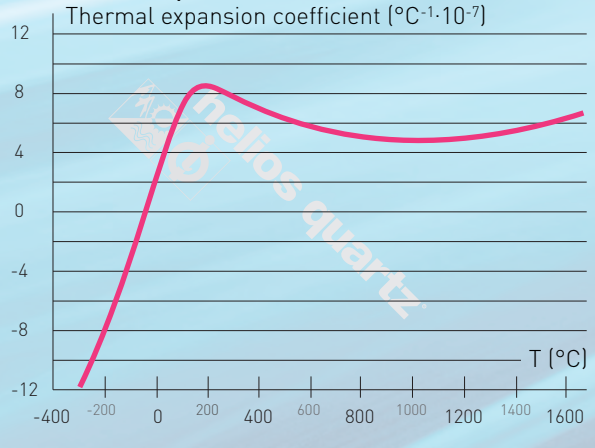
THERMAL PROPERTIES

The main characteristic of fused quartz glass under the thermal point of view is its low thermal expansion coefficient (5.5 x 10-7 cm/cm°C). The material has an exceptional thermal stability compared to traditional glass. If fused quartz glass is heated up to 1100°C and kept at this temperature for about an hour, it will not change color. It has also an excellent thermal shock resistance; if the material is warmed up to a temperature of 1100°C and then suddenly colled down to 20°C and if we repeat this procedure for three times, the piece of quartz glass does not break.

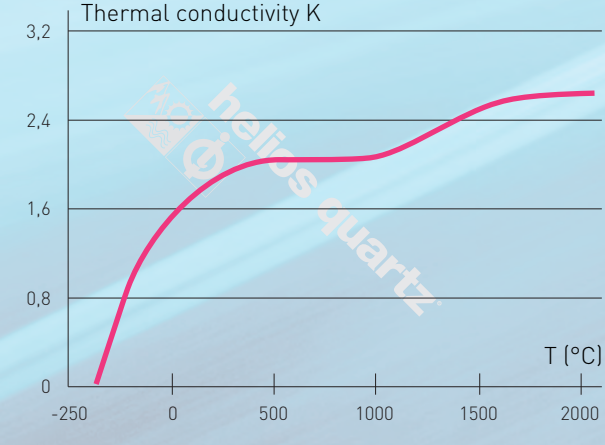
Fused quartz glass is a solid material at ambient temperature, however at high temperature it behaves just like any other glass type, it does not have a specific fusion temperature and it softens at about 1630°C acting like a plastic material. This state transformation lasts for a wide range of temperature and it is characterized by the changing of viscosity with the variation of temperature.

The following graphs show the trend of the thermal expansion coefficient and of the thermal conductivity, according to the temperature.

Thermal expansion coefficient



Thermal conductivity



The following table shows the main parameters of the mechanical properties for each quality of quartz produced by Helios Quartz.

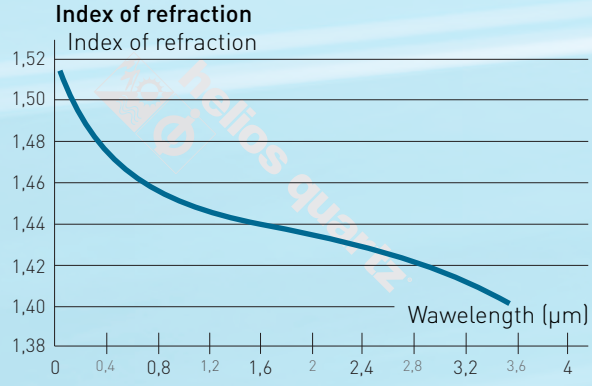
QUALITY CLASS	SOFTENING TEMPERATURE	ANNEALING TEMPERATURE	SPECIFIC HEAT (20°C)	THERMAL CONDUCTIVITY (20°C)	THERMAL EXPANSION COEFFICIENT (20°C-300°C)	MAX WORKING TEMPERATURE LONG/SHORT TERM
NHI®-1100 NHI®-1101 NHI®-1102	1630 °C	1150 °C	660 J/Kg °C	1,4 W/m °C	$5,5x10^{-7}$ cm/cm °C	1100/1250 °C
NHI®-1111 NHI®-1112 NHI®-1121	1680 °C	1215 °C	670 J/Kg °C	1,4 W/m °C	$5,5x10^{-7}$ cm/cm °C	1100/1250 °C
NHI®-1200 NHI®-1210	1700 °C	1220 °C	690 J/Kg °C	1,4 W/m °C	$5,5x10^{-7}$ cm/cm °C	1100/1250 °C
NHI®-1300	1690 °C	1200 °C	690 J/Kg °C	1,4 W/m °C	$5,5x10^{-7}$ cm/cm °C	1100/1250 °C
NHI®-1100 UC NHI®-1103 UC	1580 °C	1100 °C	640 J/Kg °C	1,4 W/m °C	$5,4x10^{-7}$ cm/cm °C	1100/1250 °C
NHI®-1300 UC	1600 °C	1120 °C	650 J/Kg °C	1,4 W/m °C	$5,4x10^{-7}$ cm/cm °C	1100/1250 °C
NHI®-1400 NHI®-1410	1600 °C	1120 °C	720 J/Kg °C	1,2 W/m °C	$5,4x10^{-7}$ cm/cm °C	1100/1250 °C

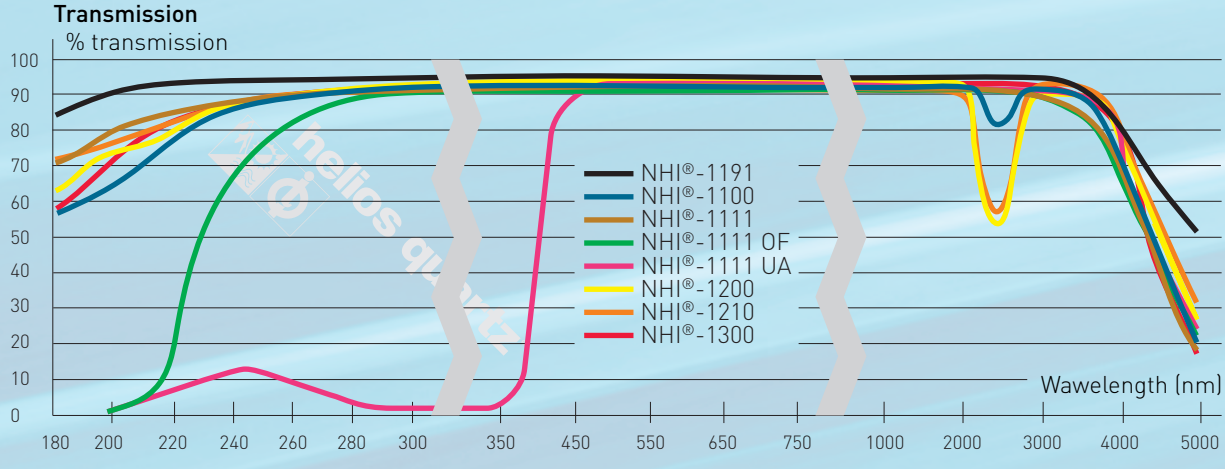
OPTICAL PROPERTIES

Fused Quartz's optical properties depend on its transparency level and on the production method and they are far better than the standard glass because quartz glass has a much higher purity level.

The graph on the right shows the trend of the index of refraction according to the wavelength.

The graph below shows the transmission spectrum according to the wavelength.



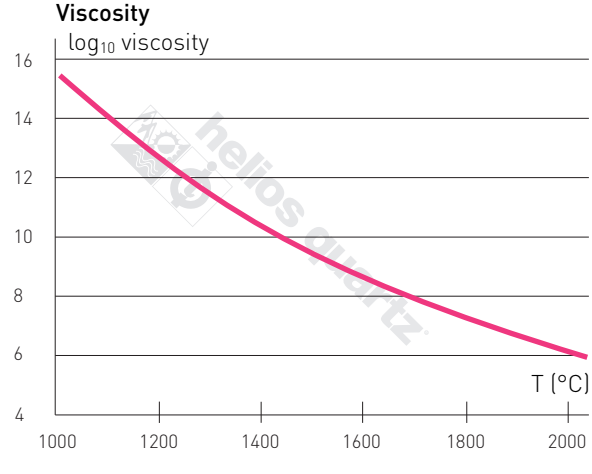


VISCOSITY AND DEVITRIFICATION

Fused Quartz has a very high viscosity and from the softening point onwards it is not in a solid state anymore but it slowly flows. The higher the temperature gets, the faster the quartz flows.
Viscosity is greatly influenced by the presence of impurities inside the material.

The graph on the right shows the logarithmic trend of viscosity according to temperature.

The process of devitrification happens after the material has been exposed for a long time to very high temperatures and the presence of impurities makes the process faster.
Devitrification process starts on the surface and this is the reason why it is better to accurately clean the outside part before the heat process starts.



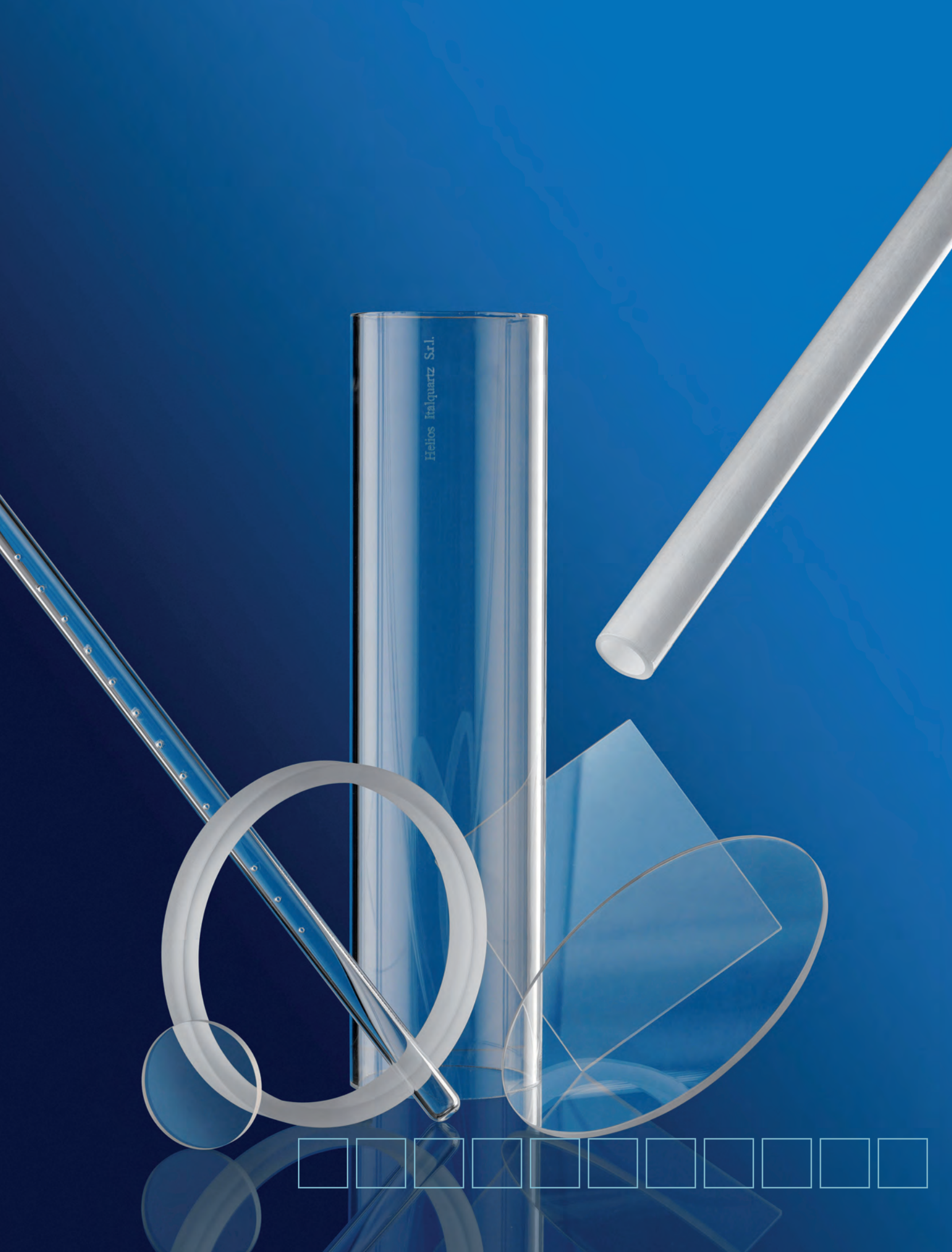
CHEMICAL PROPERTIES

Fused quartz glass is inert to most of chemical components; for this reason the material is widely used in the chemical industry and test laboratories.
Alkalis agents attack quartz glass causing and accelerating the devitrification process.
Hydrofluoridic and phosphoric acid are the only compounds able to etch the material even at the low temperature; in any case, we suggest costumers to contact Helios technical dept. in order to be informed about the behaviour of the quartz glass when it is put in contact with aggressive chemical and acid compound at different working temperatures.

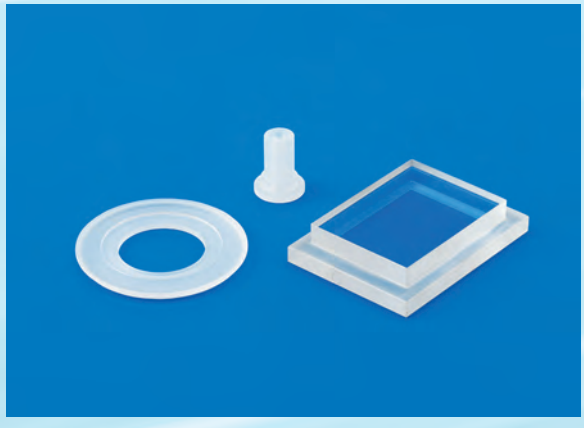
The following table contains the list of the chemical composition with impurity content expressed in ppm. - for each Helios fused quartz glass qualities:

	ppm										
QUALITY CLASS	Al	Fe	Ca	Mg	Ti	Mn	B	K	Na	Li	OH
NHI®-1100	16	1,2	0,08	0,40	0,1	0,1	0,8	2	2,3	0,5	125
NHI®-1101	16	1,2	0,08	0,40	0,1	0,1	0,8	2	2,3	0,5	<10
NHI®-1111	14	0,23	0,5	<0,05	0,6	<0,05	0,08	0,6	0,9	0,9	<8
NHI®-1112	14	0,23	0,5	<0,05	0,6	<0,05	0,08	0,6	0,9	0,9	<3
NHI®-1121	8	0,3	0,6	<0,05	0,6	<0,05	0,04	0,35	0,9	0,15	<10
NHI®-1122	8	0,3	0,6	<0,05	0,6	<0,05	0,04	0,35	0,9	0,15	<3
NHI®-1200	14	0,3	1,5	0,50	0,4	0,15	0,07	0,4	1,2	1,5	150
NHI®-1210	14	0,23	0,5	<0,05	1,6	<0,05	0,08	0,6	0,9	0,9	150
NHI®-1300	16	0,4	1,72	0,40	1,26	0,04	0,07	2,3	2,5	1,95	<3
NHI®-1101 OF	16	1,2	0,8	0,40	100	0,1	0,8	2	2,3	0,5	<10

	ppm										
QUALITY CLASS	Al	Fe	Ca	Mg	Ti	Mn	B	K	Na	Li	OH
NHI®-1111 OF	14	0,23	0,5	<0,05	100	<0,05	0,08	0,6	0,9	0,9	<10
NHI®-1101 UA	16	1,2	0,8	0,40	200	0,1	0,8	2	2,3	0,5	<10
NHI®-1111 UA	14	0,23	0,5	<0,05	200	<0,05	0,08	0,6	0,9	0,9	<10
NHI®-1100 UC	36	1,3	1,28	0,80	3,9	0,05	0,2	5	2,8	2	-
NHI®-1103 UC	36	1,3	1,28	0,8	3,9	0,05	0,2	5	2,8	2	-
NHI®-1300 UC	50	2	3	1,50	4	0,1	0,4	9	5	3,7	-
NHI®-1400	50	2	3	1,50	4	0,1	0,4	9	5	3,7	-
NHI®-1410	14	0,3	1,5	0,50	0,4	0,15	0,07	0,4	1,2	1,5	150
NHI®-1191	<0,01	0,02	<0,01	<0,01	<0,01	-	<0,01	<0,01	<0,01	<0,01	<10
NHI®-1192	<0,01	0,02	<0,01	<0,01	<0,01	-	<0,01	<0,01	<0,01	<0,01	<2
NHI®-1290	<0,01	0,02	<0,01	<0,01	<0,01	-	<0,01	<0,01	<0,01	<0,01	125,00


Helios Italquartz Sr.l.

CUSTOMIZED ITEMS ON DRAWINGS



Helios is able to produce quartz glass articles customized according to the customer's requests and drawings.
Helios quartz glass production department can process the material by mechanical, flame or surface finishing works; moreover, thanks to our production flexibility and our big stock of raw material, we can guarantee the best delivery time.

Main fields of application:

- semiconductor industry
- photovoltaic industry
- optical fibre industry
- chemical industry
- pharmaceutical industry
- universities and research centres

Helios can produce every kind of laboratory quartzware both with clear and with opaque quartz glass; these products are highly appreciated by research centres and universities.

The following ones are articles always ready at stock; for further requests on particular dimensions and models please contact our sales departments and ask for the Laboratory Quartzware catalogue:

- crucibles
- capsules
- cuvettes
- cones
- joints
- beakers
- flasks
- porous disks
- etc.

helios quartz

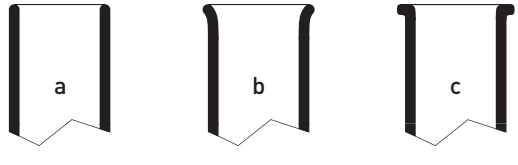
TUBES

Helios can offer a wide range of quartz glass tubes - clear, translucent or opaque - up to 500 mm of outside diameter and 25 mm of wall thickness. All the tubes are characterised by a great transmission spectrum in the wavelength range from UV to IR, by a high thermal and mechanical stability and by their resistance to almost all acid agents.

Thanks to its attention in the choice of raw materials, its incoming and outgoing quality control and high production standards, Helios provides its tubes for several applications in different markets:

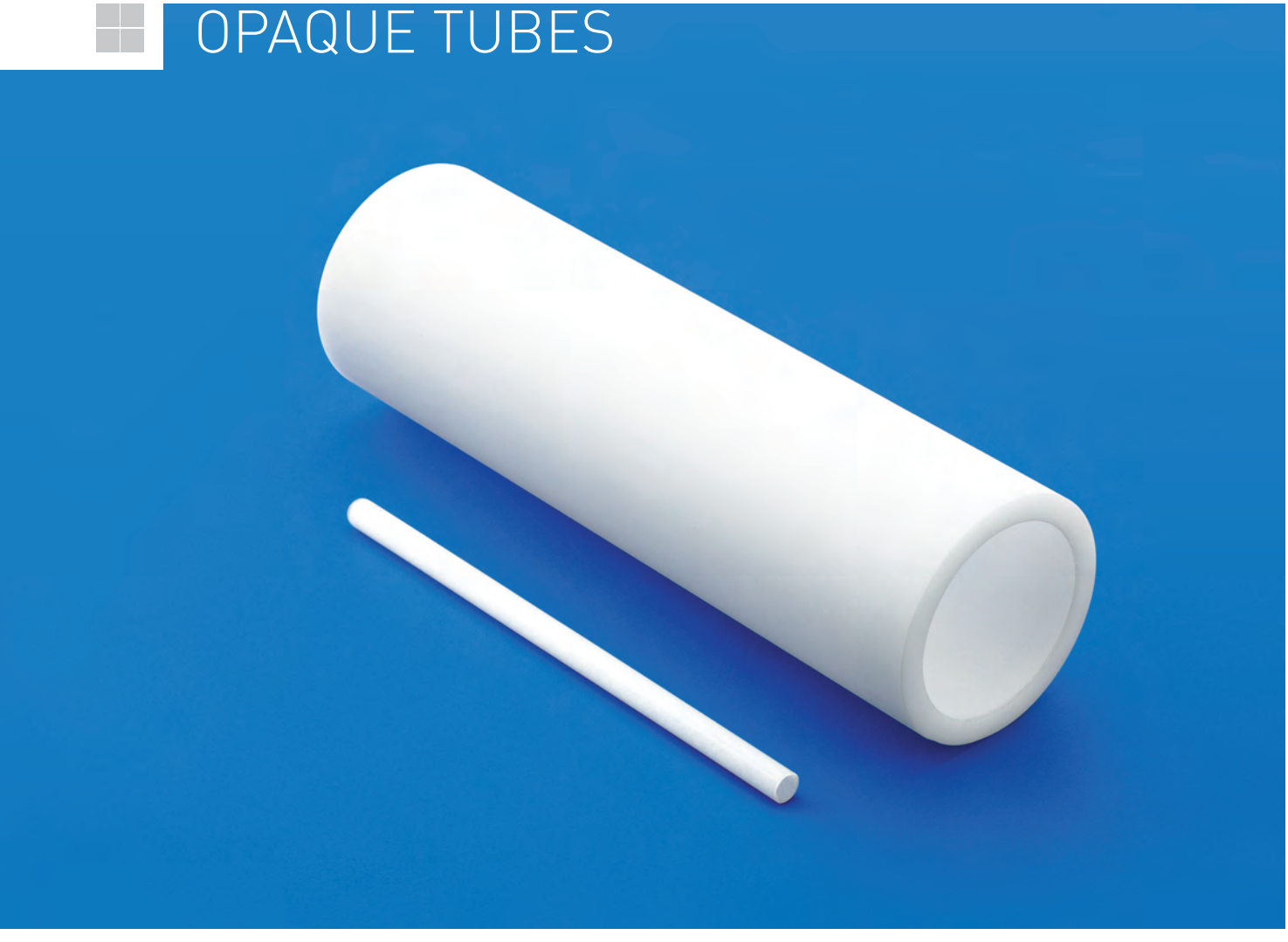
- lighting
- chemical industry
- semiconductor
- optical fiber
- solar market
- glass industry
- industrial furnaces
- UV disinfection and oxidation
- pharmaceutical industry

Helios always keeps at stock the whole range of standard diameters, the most used on the market, but it is also able to produce tubes with non-standard dimensions, also with slight tolerances and for small quantities.
Our glass production department can meet in a very short time every request, providing tailor-cut tubes with fired **(a)**, flared **(b)** or flanged **(c)** edges.



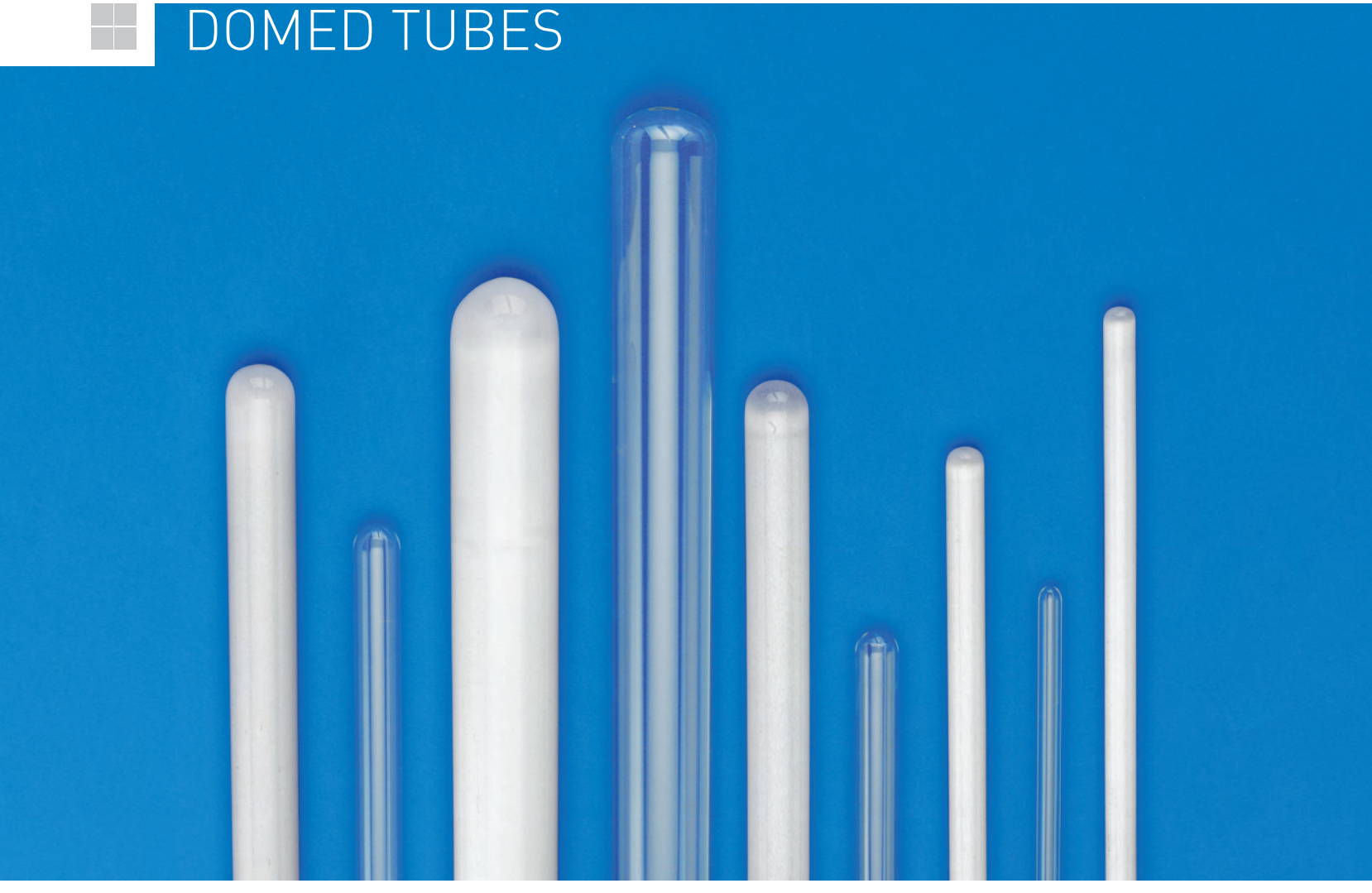
Thanks to its long-time experience in the production of quartz glass, Helios can advise the customers in the choice of the best quartz quality according to the application; Helios' technical department can advise also on the correct dimensions of quartz tubes according to the customers' requests.

OPAQUE TUBES



PRODUCTION TECHNOLOGIES	QUARTZ APPEARANCE	OUTSIDE DIAMETER	THICKNESS
Electric fused - One step	Clear	2 - 350 mm	0,5 - 10 mm
	Opaque	2- 50 mm	0,5 - 5 mm
Electric fused - Two steps	Clear	3 - 300 mm	1 - 15 mm
	Opaque	3 - 300 mm	1 - 15 mm
Electric fused - Arc fused	Opaque	60 - 500 mm	10 - 25 mm
Flame fused - Two steps	Clear	3 - 300 mm	1 - 15 mm
	Opaque	3 - 300 mm	1 - 15 mm

DOMED TUBES

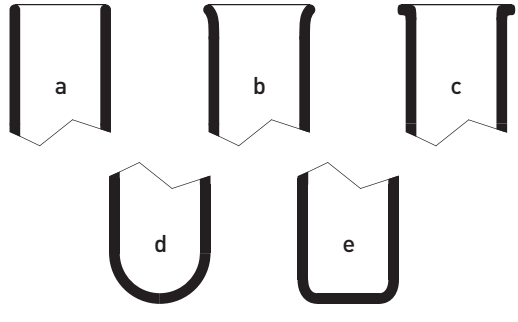


Helios can offer a wide range of quartz glass domed tubes - clear, translucent or opaque - up to 350 mm of outside diameter and 15 mm of wall thickness. All the domed tubes are characterised by a great transmission spectrum in the wavelength range from UV to IR, by a high thermal and mechanical stability and by their resistance to almost all acid agents.

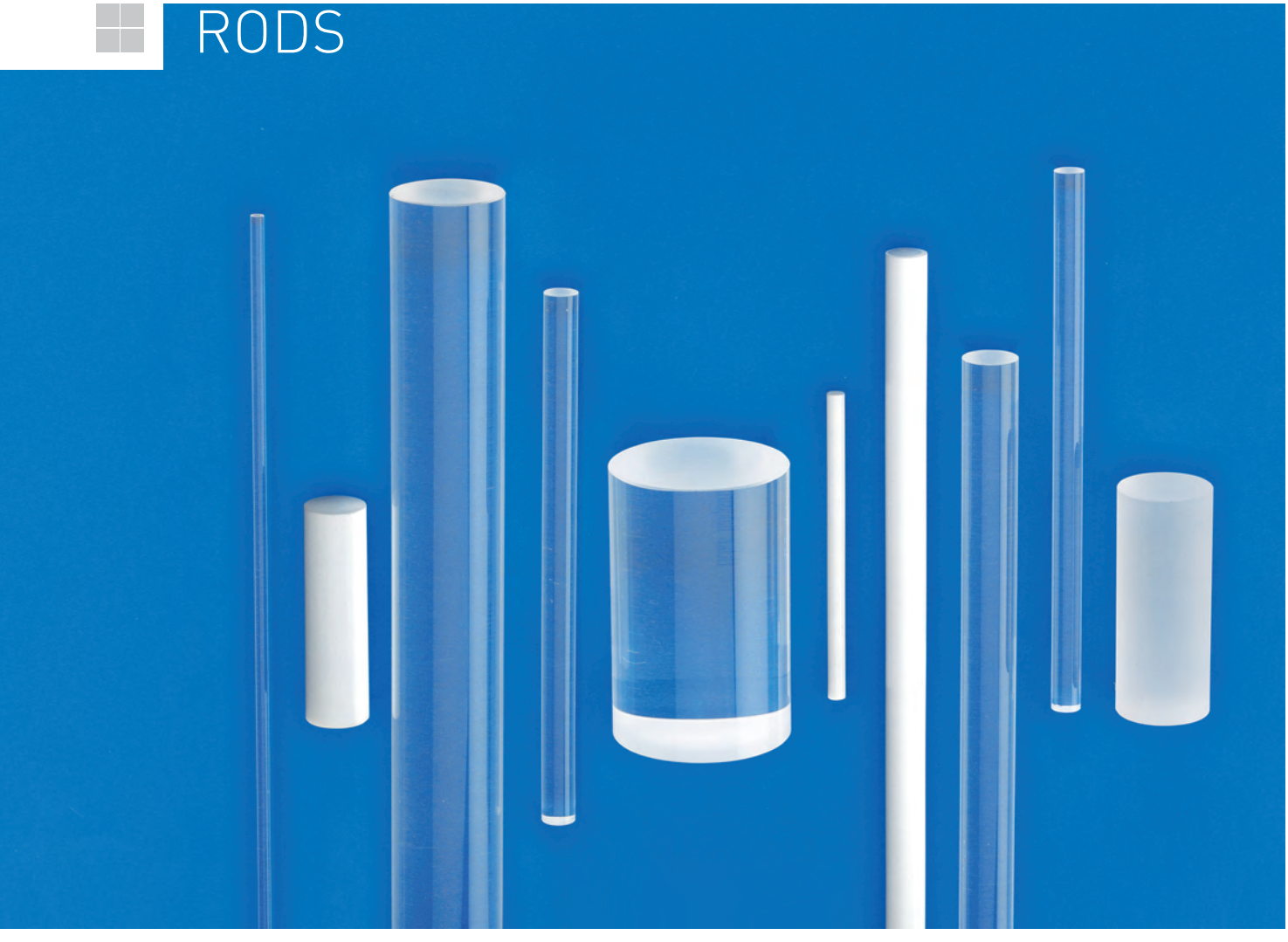
Thanks to its attention in the choice of raw materials, its incoming and outgoing quality controls and high production standards, Helios provides its domed tubes for several applications in different markets:

- chemical industry
- galvanic industry
- semiconductor
- solar market
- UV disinfection and oxidation
- pharmaceutical industry

Helios always keeps at stock the whole range of standard diameters, the most used on the market, but it is also able to produce domed tubes with non-standard dimensions, also with slight tolerances and for small quantities.
Our glass production department can meet in a short time every request, providing tailor-cut domed tubes with fired **(a)**, flared **(b)** or flanged **(c)** edges and round **(d)** or flat **(e)** bottom.



RODS



Helios can offer a wide range of quartz glass rods - clear, translucent or opaque - up to 80 mm of outside diameter, characterised by a high thermal and mechanical stability.
Helios always keeps at stock the whole range of standard diameters, the most used on the market, but it is also able to produce rods with non-standard dimensions, also with slight tolerances and for small quantities.

Thanks to its attention in the choice of raw materials, its incoming and outgoing quality controls and high production standards, Helios provides its rods for several applications in different markets:

- chemical industry
- semiconductor
- optical fiber
- solar market
- glass industry
- industrial furnaces

PRODUCTION TECHNOLOGIES	QUARTZ APPEARANCE	DIAMETER	DIAMETER TOLERANCE
Electric fused - One step	Clear	2 - 50 mm	+-5%
	Opaque	2- 30 mm	+-5%
Flame fused - Two steps	Clear	2 - 80 mm	+-5%
	Opaque	2 - 80 mm	+-5%

DISKS

Helios can offer a wide range of quartz glass disks and plates - clear, translucent or opaque - up to 650 mm of diameter and 20 mm. of thickness. All the disks and plates are characterised by a great transmission spectrum in the wavelength range from UV to IR, by a high thermal and mechanical stability.

Thanks to its attention in the choice of raw materials, its incoming and outgoing quality controls and high production standards, Helios provides its disks and plates for several applications in different markets:

- chemical industry
- semiconductor
- optical fiber
- solar market
- glass industry
- industrial furnaces
- universities and labs

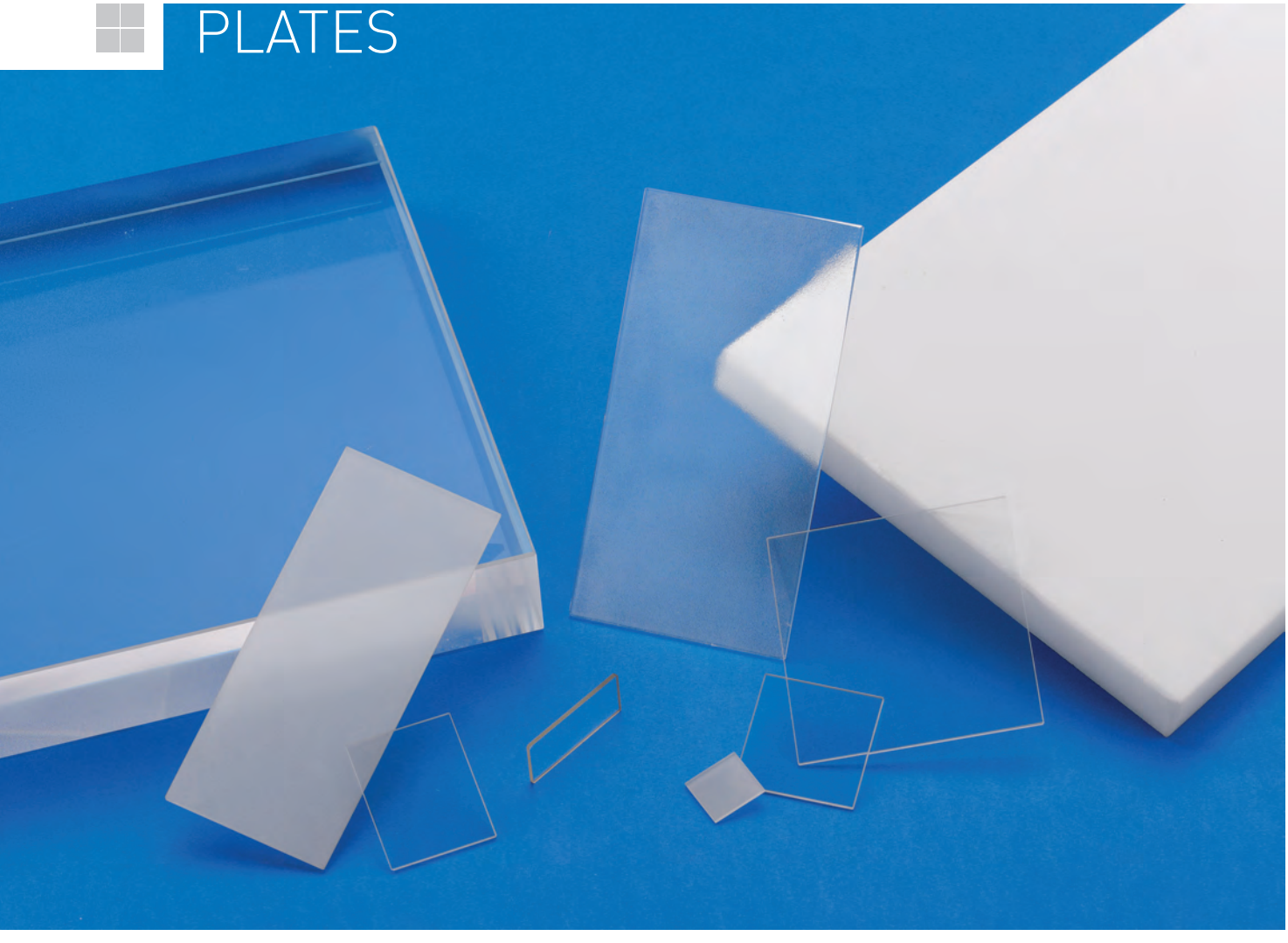
Helios quartz glass production department can meet in a short time every request, providing tailor-cut plates and disks, with different optical qualities and surface finishing processes:

- optical polished
- mechanical polished
- flame polished
- grinded

with fired **(f)** or arises **(g) edges.**

Helios can make every type of mechanical process on the surface of disks, plates and bars.

PLATES



PRODUCTION TECHNOLOGIES	QUARTZ APPEARANCE	PLATE SIZE	THICKNESS	TOLERANCE	
				THICKNESS	LENGTH
Electric fused - One step	Clear	up to 400 x 400 mm	2 - 10 mm	+-0,3 mm	+-0,5 mm
Electric fused - Two steps	Clear	up to 350 x 350 mm	3 - 15 mm	+-0,3 mm	+-0,5 mm
Flame fused	Clear	up to 700 x 700 mm	1 - 40 mm	+-0,3 mm	+-0,5 mm
	Opaque				

PRODUCTION TECHNOLOGIES	QUARTZ APPEARANCE	DISK SIZE	THICKNESS	TOLERANCE	
				THICKNESS	LENGTH
Flame fused	Clear	up to 50 mm	0,5 - 3 mm	+-0,2mm	+-0,3 mm
	Opaque				
Flame fused	Clear	from 50 to 200 mm	4 - 20 mm	+-0,3 mm	+-0,5 mm
	Opaque				
Flame fused	Clear	from 300 x 500 mm	4 - 20 mm	+-0,5 mm	+-1 mm
	Opaque				

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