

Handling and processing instructions for temperable thermal insulation glass and thermal insulation glass from the Silverstar product family produced by:

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1. General

1.1 Product description

Silverstar® Low-E and Silverstar® Low-E T coating family are low emissivity glasses, manufactured by the method of magnetron sputtering.

The coatings offer a high value thermal insulation by reflection of long wavelength heat radiation inside a building.

The description "T" means that the product is from a family of coatings that require tempering.

Silverstar® Combi, Silverstar Combi T, Silverstar® Selekt, Silverstar® Selekt T, Silverstar® Superselekt and Silverstar® Superselekt T are high selective solar control glasses, manufactured by means of magnetron sputtering.

The coatings offer a high value of solar protection and enhanced thermal insulation by reflection of long wavelength heat radiation, thereby greatly reducing heat loss.

Silverstar® Low-E, Silverstar® Low-E T, Silverstar® Combi, Silverstar® Combi T, Silverstar® Selekt, Silverstar® Selekt T, Silverstar® Superselekt, Silverstar® Superselekt T must always be assembled into double or triple glazing units with the coating on face two (Silverstar® Combi, Silverstar® Combi T, Silverstar® Selekt, Silverstar® Selekt T, Silverstar® Superselekt and Silverstar® Superselekt T) or face three (Low-E and Low-E T).

All Silverstar® T products always have to be toughened before assembled into insulating glass units (IGU).

They cannot be used in annealed form as they obtain their final characteristics by the tempering process.

The coatings are complying the class C standard for coated glass as described in the European standards EN 1096-1 and 1096-3.

Silverstar® T products were developed to match their annealed counterpart.

Silverstar® products were developed to match their to tempering counterpart (excluding Selekt 70/38 and Combi Grey 70/35).

However, since the products are not identical, mock-up samples of both versions should be compared prior to mixing them in one facade.

Also the use of base substrates such as laminated glass (Non-T products) or other float glass or different thickness of glass, may show slight differences in colour perception.

1.2 Thickness and dimensions

Silverstar® Low-E and Silverstar® Low-E T products are available in sizes of 3210mm x 6000mm, 3210mm x 2550mm, 3210mm x 2250mm in thicknesses of 4, 6, 8 and 10mm.

Silverstar® Selekt, Silverstar® Selekt T, Silverstar® Superselekt, Silverstar® Superselekt T Silverstar® Combi and Silverstar® Combi T products are available in sizes of 3210mm x 6000mm in thicknesses of 6, 8 and 10mm.

For other dimensions and thicknesses please inquire

1.3 Marking

All Silverstar® and Silverstar® T products comply with the EN 1096 harmonized European standard for coated glass. These products are CE marked.

1.4 Quality criteria for coatings

The manufacturer continuously monitors the optical values and electrical resistivity of Silverstar® and Silverstar® T products throughout the production process.

Mechanical and chemical stability are also checked at samples taken from each production run.

Additionally, for Silverstar® T products, from each production run samples are taken and toughened in order to check their optical and mechanical properties according to EN 1096-1:

- colour values (L, a, b) for reflectance and transmittance
- photometric characteristics
- electrical surface resistance of the functional coating
- scattered light (haze)
- mechanical stability
- chemical stability

The conditions of observation for the detection and classification of glass and coating defects are also given in the standard EN 1096-1.

Without prior agreement between both parties only the standard EN 1096-1 will apply for acceptance criteria of coated glass defects.

2. Transport and packaging

The packaging and delivery of coated glass described here refers to deliveries within Europe under typical climatic conditions.

Separate instructions apply to deliveries outside Europe, particularly for deliveries via overseas transport.

2.1 Transport

We normally deliver coated glass using special inloader trucks.

The glass is packed either on:

- L racks – unloading from one side, left or right according to order,
- A racks – unloading from both sides

Alternatively, it is possible to load the container or train in a special way.

Standard formats here are:

- Jumbo (PLF, BM) Format: 3210 * 6000 mm
- Split (DLF, GBM) Format: 3210 * 2550/2250/2000 mm

Please contact our sales force for other sizes and possible tonnages.

2.2 Position of coating

Dependent on the order, the coated layer is either:

- Shipped with the layer against the sucker unit
- Or with the uncoated side against the sucker unit.

In both cases, an uncoated sheet, the so-called cover sheet, protects the outer-facing coated sheet.

Our designations in this case are:

- Yellow - coating facing in direction of suction unit
- Blue - coating facing in direction of rack backing

2.3 Separation of packages

Packages are separated by spacers for enable remove them from the rack with a suitable forklift, they usually weigh 2.5t or 5t. These spacers are made of recyclable material and can be returned to Euroglas/Glaströsch, when they are clean and undamaged.

2.4 Separation of sheets within a package

A layer of separating powder is placed between individual sheets. This powder serves to prevent contact between the glass and coating, and to separate individual sheets.

2.5 Adhesive sealing

After agreeing with the supplier the individual packages can be completely sealed with a special adhesive tape if requested by the customer. Before sealing, desiccant strips are applied to the vertical sides as a protection against moisture.

We recommend ordering packages with special adhesive tape for deliveries that take longer than 24 hours from the manufacturer to the customer between the months of October to March. The special adhesive tape should only be opened and removed when the glass is required for cutting.

Please contact our sales force for other packaging options, especially for delivery in non-EU countries.

3. Delivery on site

The customer must ensure a flat and free of other objects that ground, onto which the L or A racks are to be placed. For safety reasons, the offloaded rack must not wobble or exhibit an inclination where the packages are positioned more than 87° to the horizontal.

3.1 Inspection of delivery on site

The customer must carry out a visual inspection of the delivered glass before unpacking the individual packages. It aims to capture obvious defects that may arise in transport (cracks, moisture inside the package, flooding, incorrect amount of panes in the package, or the delivery of the wrong product).

Defects found on delivery must always be recorded on the consignment note (CMR) in the presence of the driver and signed by him.

If defects in the delivered order are noticed, the signed waybill (CMR) must be sent to Euroglas/ Glaströsch in accordance with the General Terms of Sale.

Claims for damage arising during and after processing will not be included. Therefore, the customer should ensure that the production process is adapted to glass processing, and the quality control staff are properly trained to detect possible quality problems as soon as possible.

In the case of complaints, samples of the advertised glass will be required.

3.2 Unloading of packages

The unloading of packages must be carried out by properly trained personnel, in compliance with health and safety regulations. Only use appropriate devices that comply with the applicable regulations.

The supports on which the glass is placed must be free of dirt, e.g. glass fragments.

3.3 Storage of the packages

The place and method of storage has a huge impact on the subsequent processing of glass. It is important that the supports are at the same level. The edges of the glass must lie evenly on several support points so that the glass is free of stress.

If the supports are inclined differently or have different heights, or the support surface is unevenly worn on one side, stresses are induced in the glass, which are noticeable in the glass cutting process through the increased tendency to crack glass during cutting.

Glass packages must be stored at an angle between 87° and 83° to the ground.

For safety reasons, the glass packet can never be stored vertically or horizontally.

The storage location must be equipped with at least two stable supports that will not damage the edges of the glass.

In order to keep the spacing between packages, the delivered spacers can be used, they should be placed in the same places on the package as in the delivery of glass.

Make sure that the packages are not exposed to direct sunlight at the place of storage, which can lead to thermal cracks.

The storage location for the supplied glass should be in a closed building.

Glass is a fragile material and it shows that the colder it is, the more fragile it is, and the warmer it is, the softer it is.

Coated glass transported in trucks assume the ambient temperature during transport. In extreme cases, glass loads may have a temperature on transport of minus 20°C to plus 60°C. Acclimatization of glass to the temperature in the glass warehouse may take up to several days.

The glass manufacturer does not choose a specific processing temperature, however the processing temperature above 20°C has a positive effect on the subsequent cutting process.

Freshly delivered glass should acclimatize in the raw material warehouse for 2-3 days.

In this way, the temperature during the glass cutting process can be kept constant.

The storage space must be dry and the humidity must not exceed 60%.

The air temperature should be stable enough to avoid reaching the dew point.

We recommend a temperature above 18°C.

Chemicals may not be used near the glass storage area. Our experience shows that, for example: caustic soda or hydrofluoric acid can even from a considerable distance damage glass.

Apart from a time of delivery on site, glass must not be stored on the open air.

Storage location must be away from gates or doors to prevent cold draughts.

Stock management should be done on the FIFO principle.

3.4 Identification of stocked goods

To avoid mixing up Silverstar® / Silverstar® T products, we recommend leaving the supplied label on the last sheet.

The different Silverstar® / Silverstar® T products are not compatible with each other colour-wise.

3.5 Durability

If all previous points are complied with according to our specifications, product shelf life for the customer from the date of delivery by our carrier is as follows:

For the following countries:

Benelux, Denmark, Germany, England, Finland, Norway, Austria, Poland, Sweden, Switzerland, France, Spain, Portugal.

	<u>T products</u>	<u>Non-T products</u>
Unopened packages with		
special adhesive tape and desiccants:	4 months	6 months
Opened or unpacked packages:	1 month	2 months
Storage as cut to size pieces:	8 hours	8 hours

In all other recipient countries within the European Union not listed here

	<u>T products</u>	<u>Non-T products</u>
Unopened packages with		
special adhesive tape and desiccants:	2 months	4 months
Opened or unpacked packages: 1 month	1 month	2 months
Storage as cut to size pieces:	8 hours	8 hours

Outside the EU and countries requiring sea transport - to be individually agreed between the client and Euroglas/Glaströsch.

4. Handling

4.1 General information

The coating must not be touched with bare hands. Clean and dry special gloves must be worn for all work with Silverstar® and Silverstar® T thermal insulation glass.

Do never touch the coating with anything hard or with rough surfaces.

To prevent suction impressions on the coating when working with layers against the suction unit, suitable suction unit covers must be used.

We also recommend using suction unit covers when processing packages which have been delivered as layers against racks.

The suction units usually contain plasticisers that can leave impressions on the coating and on the uncoated sides. This can be avoided or significantly reduced by using suitable covers.

The coating must not be wiped with gloves, paper, etc.

If despite the protection on glass surface, some dirt will be appear use clean and soft cloth to wipe them immediately.

If the vacuum suction cups are too little or are not levelled correctly, middle stresses arise when lifting the sheet.

A device with suction cups spaced so as to distribute the lifting forces over the entire surface of the glass is preferred.

In the case of automatic loading devices, it must be ensured in advance that they have a sufficiently large number of vacuum suction arms to better distribute the forces over the entire glass surface.

Appropriate health and safety at work measures that comply with the generally applicable regulations must be observed during all work with glass.

4.2 Adhesive sealing unpacking

Packages with special adhesive sealing must be unpackaged before handling. Adhesive tape must be taken off without using sharp objects, in other wise there is a possibility to scratch glass surface. Make sure that employees are provided with personal protective equipment and use them.

4.3 Manual downloading of glass panels from a package

The suction frame used must be positioned so that it approaches the package centrally. Its height should be adjusted so that the glass angle changes so that it reaches about 90 ° during transport.

Be careful not to pull the whole package! You can move the pane slightly at the edges so that air gets between the glass and the removable pane detaches, so you can lift it.

Avoid lifting the glass up with the sheets joined and attempting to detach it from the package at a later time. Doing so may lead to the appearance of scratches.

A glass clamp can also be used. The area where the clamp is applied must not be included in the subsequent optimisation and must therefore be removed.

If the glass needs suction applied to the coated side, we recommend the use of crane scales. This can prevent the suction beam from sliding off over the coating or vice versa.

4.4 Automatic downloading of glass panels from a package

With automatic removal it is necessary to check of cycle, especially at the first delivery, for example: the time needed to separate the sheet from the packet (and the time the air is blown through the edge diffusers if the device is equipped with such a system).

Even if the panes are separated by a separator, the separation of the panes can be different for different suppliers.

Also with automatic downloading there is a rule that we first separate the pane from the next and then remove it. Avoid sliding the glass over the glass. Scratches will appear on the surface.

5. Glass cutting

5.1 General information

The coating must not be touched with bare hands. Clean and dry special gloves must be worn for all work with Silverstar® and Silverstar® T thermal insulation glass. Do never touch the coating with anything hard or with rough surfaces, coating must not be wiped with gloves, paper, etc. For wiping use clean and soft cloth.

Appropriate health and safety at work measures that comply with the generally applicable regulations must be observed during all work with glass.

Silverstar® and Silverstar® T thermal insulation glass must always be cut with the coated side upwards!

The cutting table must be free of glass fragments.

Do not use an adhesive tape on coating, it could be a reason of defects.

In case of the operations not included in this document, they must be reported to our customer service department before ordering.

Applications that are not described in handling and processing instructions for thermal insulation glass from the Silverstar® and Silverstar® T product family must be tested prior to deployment to production. In case of negative test results Euroglas/Glaströsch is not responsible for losses in production.

5.2 Cutting

Silverstar® and Silverstar® T thermal insulation glass can be cut and broken out like Eurofloat. We recommend a highly volatile cutting oil (suitable for Low-E coatings) for cutting the glass. The selection of the cutting oil depends on the applicable sequence. If the coating is removed from the edges before the glass is cut, evaporation can be significantly accelerated due to the temperature rise. In this case, a cutting oil must be used that, despite removal of coating from the edges, spreads 5 – 10 mm around the cut and remains present until the subplates have broken out.

If edge coating removal is implemented at a later stage of subsequent processing, the cutting oil can be more volatile.

The cutting oil can also be used for Eurofloat.

It must be ensured, during cutting, edge coating removal and break-out, that nothing comes into contact with the coating apart from the cutting wheel or grinding wheel.

Glass fragments and residue of abrasive material landing on the glass during break-out of the subplates must be removed. Do not remove with a broom or brush as this can scratch the coating.

For Superselekt 35/14 T, an edge cut of 100mm as shown in the picture below has to be performed. The useable width therefore becomes 3010mm instead of 3210mm. However, the full sheet, prior to cutting, is within the standards of EN 410. The edge cut area can be as small as only 50mm. The exact amount depends on production campaign and environmental conditions. We recommend either contacting us prior to production or doing a test with one full size sample. The manufacturer rejects any claims and complaints concerning discolouring in the edge areas. Please be also aware that defects such as flakes or crazing are not sorted out at the production line.



Possible problematic area in red

5.3 Cutting of models or manual optimisation

Markings or signs must be implemented where possible on the uncoated side or, where necessary, in the offcuts area on the coated side.

Templates and cutting angles can be laid on the layer, but may not be subsequently moved around.

When using a tape measure, ensure that the metallic part is not pushed over the coating; the same applies when retracting the tape. The points mentioned under 'Cutting' apply here and in all other areas.

5.4 Removal of edge coating

5.4.1 General information

The quality of edge coating removal must be ensured at all times, during or subsequent to cutting. The grinding process must completely remove the conductive coating layers. Only then can the appropriate bonding of the edge sealing system be ensured. This is essential for appropriate gas tightness and also to prevent subsequent corrosion of the coating within the insulation glazing.

This can be checked using a standard ohmmeter or continuity tester.

Ensure that the grinding dust is sufficiently sucked away in an appropriate manner. Grinding dust can lead to scratches during in-house transportation. In addition, washing brushes can subsequently pick up this dust and cause scratches. We recommend regular checking of suction performance at the cutting table.

5.4.2 Manual removal of edge coating

The general procedure is identical to the automatic procedure during cutting. Any grinding dust must be removed prior to washing. We recommend an extraction system for this purpose.

5.4.3 Removal of Edge coating on the insulation glass line

The general procedure for edge coating removal is also identical to the automatic procedure during cutting. Any resulting grinding dust must be removed immediately. Dust should not be transported into the area of the wash system.

5.5 Cullet bin

Euroglas/Glaströsch operates a fragment recycling program. We can provide fragment buckets which can then be returned when full to the Euroglas/Glaströsch works each time an order is delivered. Please note that each glass type must be sorted separately and there should not be any contamination in the buckets.

6. Stacking cut glass

When glass is not automatically transported for further processing to the insulating glass system, do not stack small sheets together from one optimisation and then transport. Always stack sheets individually.

6.1 General information

The coating must not be touched with bare hands. Clean and dry special gloves must be worn for all work with Silverstar® and Silverstar® T thermal insulation glass. Do never touch the coating with anything hard or with rough surfaces, coating must not be wiped with gloves, paper, etc. For wiping use clean and soft cloth.

Appropriate health and safety at work measures that comply with the generally applicable regulations must be observed during all work with glass.

Employees must avoid contact between the coating and items such as buttons, metallic parts (pens), zips, etc. Two employees must handle the sheets when over a specific glass weight.

6.2 Compartment rack

When stacking in a compartment rack, it must be ensured that the dividers of the individual compartments, which are usually sheathed steel cables, do not have any sharp-edged areas. The sheathing must be regularly checked for damage and replaced when necessary. Ensure, where possible, that the coating does not come into contact with the sheathing during loading/unloading and transport.

6.3 A or L rack

When stacking on an A or L rack, with the coating generally facing the employee, ensure that the glass is first set down and then pushed to the other glasses.

The sheets may not be moved again subsequently. If they do need to be moved, first incline the glass appropriately and then shift each sheet individually.

The glasses must stand firmly upright on the trestle and must not "wobble" in position. A suitable securing system to prevent tipping over should be used and the pressure must be selected to be as low as possible.

6.4 Interim storage

It is necessary to ensure that no direct sunlight can fall on the coated glass in the interim storage area, and that this area is in an enclosed building. Otherwise, there is a danger of thermal breakage.

The storage area must be dry and air humidity must not exceed 60%. The ambient temperatures in the vicinity of the cut sheets must not fluctuate so much that the dew point is undershot, recommended temperature is above 18°C.

It must be ensured that no chemicals are used in the same hall. Storage location must be away from gates, doors to prevent cold draughts.

Cut Silverstar® and Silverstar® T thermal insulation glass must be transported within 8 hours of cutting to edge processing and the subsequent washing process.

7. Product parameters (T products only)

The products listed below are pre-products that only achieve their final technical values through the tempering process.

Silverstar® EN2plus T
Silverstar® Zero NG T
Silverstar® Selekt 74/42 T
Silverstar® Combi Neutral 30/21 T
Silverstar® Combi Silver 32/21 T
Silverstar® Combi Neutral 40/21 T
Silverstar® Combi Bronze 40/21 T
Silverstar® Combi Grey 40/22 T
Silverstar® Combi Grey 50/28 T
Silverstar® Combi Neutral 51/28 T
Silverstar® Combi Neutral 61/32 T
Silverstar® Combi Neutral 70/35 T
Silverstar® Combi Neutral 70/35 NG T
Silverstar® Superselekt 35-14 T
Silverstar® Superselekt 60-27 T

Therefore, all the products listed above must be tempered to become SGS, ESG or HSG,TVG.

If the processor controls the process chain, from storage, handling, cutting, edge processing, washing to tempering, the optical and radiation-related physical values that are reached after tempering will lie within the tolerances for the respective non-temperable product versions.

To calculate the data according to EN 410, the respective product version without T in the appendix can be used in the glaCE programme.

To ensure compatibility between the respective product types, Euroglas/Glaströsch Silverstar® T constantly monitors the optical and electrical values of the products.

Regular random samples are taken from each production campaign, tempered and subsequently checked in the laboratory regarding the following properties:

- colour values (L, a, b) for reflectance and transmittance
- photometric characteristics
- electrical surface resistance of the functional coating
- scattered light (haze)
- mechanical load capacity
- chemical load capacity

Euroglas/Glaströsch thus creates ideal conditions for the reproducibility of the tempered product by the processor.

8. Edge processing before tempering (T products only)

8.1 Cross-belt grinder, dry

Cut glass can be edged using a dry cross-belt grinder without using water. The glass must always be processed with the coating facing upwards. Ensure that the grinding dust is sufficiently sucked away in an appropriate manner. Grinding dust can lead to scratches during in-house transportation. In addition, washing brushes can subsequently pick up this dust and cause scratches.

8.2 Cross-belt grinder with water

When edging the cut glass with a cross-belt grinder using a water supply, ensure that the complete sheet is wetted with water. The glass must always be processed with the coating facing upwards. It must also be ensured that the complete surface of the sheet remains wetted with water until the washing process. Grinding water must not be allowed to dry on the surface at any time, as this can lead to irreversible stains that cannot be removed during the washing process. If this process is used, the washing machine should be directly connected to the cross-belt grinder.

8.3 Vertical spindle glass grinders

We do not recommend using vertical glass grinders with underlying spindles for edge processing of Silverstar® T thermal insulation glass. The transport belts can cause irreversible damage to the coating and it is not possible to keep the entire sheet wetted with the liquid. In addition, multiple passes increase the risk of damage to the glass.

8.4 Horizontal spindle glass grinders

We assume that these are automatic edges grinders with integrated washing machines.

As with the previously described edge processing options, the glass to be processed must be laid with the coating facing upwards. During edge finishing/polishing of the edges, it must be ensured that the complete glass surface is wetted with water and that the surface never dries out.

9. Edge processing (Non-T products only)

9.1 Cross-belt grinder, dry

Cut glass can be edged using a dry cross-belt grinder without using water. The glass must always be processed with the coating facing upwards. Ensure that the grinding dust is sufficiently sucked away in an appropriate manner. Grinding dust can lead to scratches during in-house transportation. In addition, washing brushes can subsequently pick up this dust and cause scratches.

9.2 Cross-belt grinder with water

When edging the cut glass with a cross-belt grinder using a water supply, ensure that the complete sheet is wetted with water. The glass must always be processed with the coating facing upwards. It must also be ensured that the complete surface of the sheet remains wetted with water until the washing process. Grinding water must not be allowed to dry on the surface at any time, as this can lead to irreversible stains that cannot be removed during the washing process. If this process is used, the washing machine should be directly connected to the cross-belt grinder.

9.3 Vertical spindle glass grinders

We do not recommend using vertical glass grinders with underlying spindles for edge processing of Silverstar® thermal insulation glass. The transport belts can cause irreversible damage to the coating and it is not possible to keep the entire sheet wetted with the liquid. In addition, multiple passes increase the risk of damage to the glass.

9.4 Horizontal spindle glass grinders

We assume that these are automatic edges grinders with integrated washing machines.

As with the previously described edge processing options, the glass to be processed must be laid with the coating facing upwards. During edge finishing/polishing of the edges, it must be ensured that the complete glass surface is wetted with water and that the surface never dries out.

10. Washing after edge processing

Processed glass must undergo a washing process immediately after processing the edge, the ideal solution is a washer connected to the edge processing device. Make sure that no residue from the previous process has dried on the glass surface before starting the washing process. In addition, before contact with the brushes in the washer, the sheet must be rinsed with enough water to remove the residue of fine glass dust from the grinding process.

The washer, especially all brushes must be clean. All glass particles and dirt must be deleted from other covers and parts of washing machine.

Wash with softened water. In the last, and if possible also in the penultimate washing zone water should meet the following requirements:

- Conductivity <20 Microsiemens
- Recommended temperature 30 - 45 °C
- No additional cleaning agents
- pH value of 6.0 - 8.0

Warning! Transporting the washer should not stop during glass washing, otherwise the glass surface may be damaged by the brushes.

We assume that the washing machine has an automatic glass thickness setting system.

A permanent service plan is recommended for the washing machine, the washer must be cleaned regularly. We recommend cleaning the filters every day and the water tanks at least once per week.

In addition, it is important to check the brush length. For rarely machining larger dimensions, the length of the bristles may show large differences. It should then be reduced to an even length.

In the pre-wash area and in the main wash area use soft brushes that have been defined by the washer manufacturer as brushes for coated glass (bristle diameter 0.15mm or 0.20mm).

Make sure the minimum bristle length recommended by the brush manufacturer and prevent this value from being exceeded.

11. Transport of treated and washed

Clean and dry special gloves must be worn for all work with Silverstar® and Silverstar® T thermal insulation glass. Do never touch the coating with anything hard or with rough surfaces. The coating must not be wiped with gloves, paper, etc. For wiping use clean and soft cloth if is necessary.

Appropriate health and safety at work measures that comply with the generally applicable regulations must be observed during all work with glass.

As already mentioned in 'Cutting', small sheets must not be stacked and then set down together.

Sheets with a higher weight or larger glasses must always be removed by two people. This prevents the sheets from being carried too close to the body and being unnecessarily scratched.

If the sheets need to be moved with a suction beam, suitable clean suction unit covers must be used to prevent suction impressions on the coating.

We recommend the use of crane scales in this working position.

The coating must not have any direct contact with the previous sheet when the glasses are set down.

The processor must use appropriate spacers for this purpose.

If, for instance, standard cork spacers are used, they may only be positioned in the area where the coating has been removed along the edges. Never place the suction side of the cork pads on the coating, as this will result in irreversible stains.

We recommend carrying out an appropriate quality control after this work operation.

12. Interim storage before the tempering process (T products only)

The storage area must be dry and air humidity must not exceed 60%. The ambient temperatures in the vicinity of the cut sheets must not fluctuate so much that the dew point is undershot, recommended temperature is above 18°C.

It must be ensured that no chemicals are used in the same hall. Storage location must be away from gates, doors to prevent cold draughts.

We recommend that the washed and edge processed Silverstar® T thermal insulation glass be subjected to a tempering process within 8 hours. Our experience shows that this time can be significantly longer in practice. This must be checked independently by the processor on site.

13. Tempering furnace (T products only)

The Silverstar® T thermal insulation glass must always be laid with the uncoated side on the transport rollers. The coated side must always face upwards; this must be checked in case of doubt with a coating test by the worker at the furnace before the glass is laid down.

The Silverstar® T thermal insulation glass can be damaged by excessively high temperatures or heating times that are too long. The furnace programme should therefore be set so that the furnace temperature does not exceed 700 °C.

In general, the setup parameters for Silverstar® T thermal insulation glass depend on the respective furnace type and must therefore be individually tested. The manufacturer offers the option of a qualification visit by a technician, during which the technical values of the product will also be tested. If this qualification is not implemented, the SGS producer retains sole responsibility for the manufactured product.

Notes for Superselekt 35/14 T:

Superselekt 35/14 T changes its colour during the tempering process depending on the amount of heat put into the coating. In order to avoid discoloured areas after the heating process it is extremely important that the furnace is kept at a constant temperature with absolutely no broken heating elements. Furthermore it is advised to keep glass sizes and load of the furnace as constant as possible. Group small glasses of similar sizes and run bigger panes as single batch.

Visible discoloration is usually caused by non uniform temperatures in the furnace or too short heating times and can be corrected by increasing the energy input by increasing temperature or heating time. In rare cases it might be necessary to adjust single heat elements or convection in certain parts of the furnace.

We recommend using a handheld spectrometer during production all the time. The measured average of a^* should not be higher than 0 and not lower than -3 (D65/10°). Thus it is assured that the product has the intended colours.

13.1 Cleaning the furnace and the tempering system

A clean furnace is an essential requisite for the successful processing of Silverstar® T thermal insulation glass. We recommend not operating the furnace with SO₂ (sulphur dioxide gas) for 3 to 5 days before tempering the thermal insulation glass.

If this is not possible, sufficient uncoated charges must be processed after the SO₂ supply is switched off to ensure that the concentration in the heating chamber is low enough not to affect the heat insulating layer.

We also recommend regular cleaning of the transport rollers to prevent damage to the glass side. The tempering system must be regularly cleared of any glass fragments.

13.2 Furnace without convection assistance

Tempering of the glass without effective convection assistance during heating solely via radiation is not recommended. Glass that has been processed in a tempering system without convection assistance may appear usable to the naked eye, but it must be assumed that the optical and thermal properties lie outside the specifications and below expectations.

13.3 Furnace with Convection assistance

Efficient convection assistance is necessary during heating as the coated glass side facing upwards has a significantly lower emissivity than the uncoated glass side facing downwards. These reflection properties lead to a significantly reduced heat transfer via radiation in the coated glass surface. The convection principle must be applied to compensate for this deficit in radiation heating of the coated surface. At the same time, both glass surfaces are rapidly heated and correctly brought up to the required tempering temperature. The convection proportion on the upper side must be very high.

Simply increasing the radiated heat from above or excessively long heating can cause damage to Silverstar® T thermal insulation glass.

With sufficiently high convection, the heating time in the furnace should be approx. 10% – 20% longer than for identically thick uncoated glass.

13.4 High convection furnace

High convection furnace are usually equipped with very powerful convection systems, in which hot air is supplied to the upper and lower sides of the glass charge. The main proportion of the heat transfer is transferred via convection into the glass. Depending on the design of the furnace system, the furnace setting options are manifold. The necessary heat transfer can be set depending on the glass surface properties required. However, excessive convection and high air temperatures can damage the Silverstar® T heat insulating layer.

13.5 Two-chamber furnace with pre-heating chamber

The benefit of heating up Silverstar® T heat insulating layers in a two-chamber furnace is that a part of the thermal energy can be applied at a lower temperature in the pre-chamber furnace, reducing dwell time in the main furnace and subjecting the coating to less stress.

The glass charge heating process takes place here in two stages during which the temperature load on the sheets can be significantly reduced at the start of the process, leading to a more uniform temperature distribution.

14. Thermal imaging (T products only)

In order to obtain an image of the heat distribution via an appropriate scanner, it is usually necessary to store the emissivity of a known surface in the scanner program for each individual product.

We specify the emissivity of our coatings at room temperature according to the standard tolerances, as follows:

Product	Emissivity in % as per factory certificate
Silverstar® EN2plus T	3
Silverstar® ZERO NG T	1
Silverstar® Selekt 74/42 T	1
Silverstar® Combi Neutral 30/21 T	3
Silverstar® Combi Silver 32/21 T	3
Silverstar® Combi Neutral 40/21 T	1
Silverstar® Combi Bronze 40/21 T	1
Silverstar® Combi Grey 40/22 T	1
Silverstar® Combi Grey 50/28 T	1
Silverstar® Combi Neutral 51/28 T	1
Silverstar® Combi Neutral 61/32 T	1
Silverstar® Combi Neutral 70/35 T	1
Silverstar® Combi Neutral 70/35 NG T	1
Silverstar® Superselekt 35/14 T	1
Silverstar® Superselekt 60/27 T	1

The abovementioned values cannot be used for furnace and scanner settings as the emissivity changes as a function of the surface temperature.

It has been shown that a nominal value emissivity plus 2 – 5 % is suitable for the scanner; the measured surface temperature should then lie between 630 and 650°C and the heat distribution should be displayed on the screen.

We recommend running a test series to determine the emissivity to be set at the scanner. Initially, the nominal value should be increased roughly in steps of 1 %. Once an image can be seen, the percentage value should be increased with smaller percentage steps until the image is set with the average displayed temperature lying at around 640 °C.

15. Heat Soak Test (T products only)

During the Heat Soak Test, it must be ensured that the spacers are not pressed too strongly into the coating side by the weight of the glass, as this can cause irreversible stains/markings. In addition, "clattering" of the sheets during the Heat Soak process must be avoided. Spacers must be suitable for the heat insulating layers.

16. Glass bending (T products only)

Please to inform our customer service about bending intention before ordering, than we can do individual consultation between customer and Euroglas/Glaströsch.

Glass bending must be tested prior to deployment to production. In case of negative test results Euroglas/Glaströsch is not responsible for losses in production.

17. Screen printing (T products only)

Application of screen printing must be tested prior to deployment to production. In case of negative test results Euroglas/Glaströsch is not responsible for losses in production.

Do not use an adhesive tape on coating, it could be a reason of defects. If screen printing process requires to leave some areas free of print, adhesive tape can be used, but only on sieve surface.

If ceramic colours (screen printing) are burnt on in the tempering furnace, the properties of the Silverstar® T heat insulating layers will be lost in those areas.

In the interest of long-term stability, we recommend removing the coating on the areas to be printed through edge coating removal.

If ceramic paints are used the performance of Silverstar® T products will break down emissivity as well as Ug-value will increase.

18. Quality control (T products only)

The defect assessment of the tempered Silverstar® T heat protection layers is implemented according to EN 1096-1 and must be implemented after tempering.

18.1 Destacking

Destacking is implemented analogous to the procedure before the tempering process.

19. Insulation glazing assembly

19.1 Processing on site into insulation glazing

The manufacturer recommends further processing of Silverstar® and Silverstar® T thermal insulation glass directly on site during (SGS) production.

We recommend that Silverstar® and Silverstar® T thermal insulation glass is processed within 8 hours into insulation glazing. Our experience shows that this time can be significantly longer in practice. This must be checked independently by the processor on site.

19.2 External processing into insulation glazing

If Silverstar® and Silverstar® T thermal insulation glass is not processed directly on site into insulation glazing, packaging for onward transport must be implemented with extreme care:

- an intermediate chlorine free paper layer must always be laid between two glasses.
- in addition to this paper, both glass sides must be dusted with powder suitable for soft coatings.

This results in the following layer sequence:

glass - powder - paper - powder.

If transported outside the fabrication hall, the glass has to be packed in plastic wrapping liner to protect the coating from humidity.

19.3 General information

The coating must not be touched with bare hands. Clean, dry special gloves must be worn for all work with Silverstar® and Silverstar® T thermal insulation glass.

Do never touch the coating with anything hard or with rough surfaces. The coating must not be wiped with gloves, paper, etc. For wiping use clean and soft cloth if is necessary.

Appropriate health and safety at work measures that comply with the generally applicable regulations must be observed during all work with glass.

Silverstar® and Silverstar® T thermal insulation glass is classified in Class C according to EN 1096-3. The coated side of the Silverstar® and Silverstar® T thermal insulation glass must therefore always face the pane interspace. In standard insulation glazing, the coating is located in position 3 (Combi / Combi T / Selekt / Selekt T / Superselekt / Superselekt T products on position 2). In triple glazing, the coating position is set during assembly at positions 2 and 5. In triple glazing with Combi / Combi T / Selekt / Selekt T / Superselekt / Superselekt T products coating position is set during assembly at positions 2.

19.4 Placing sheets on the insulation glazing line (IGU)

The position of the coating must be checked by the worker. During assembly into standard insulation glazing, the sheet must be laid with the uncoated side facing the system.

If the Silverstar® and Silverstar® T thermal insulation glass has already been subjected to edge removal during cutting, the coated side can be easily recognised by the ground edge. If it is not clear which side is coated, this can be determined using a continuity tester or ohmmeter.

19.5 Compartment rack

During automatic placing on the insulation glazing line, it must be ensured that the coated side has no contact with the separation. The same applies when a worker removes a sheet from the compartment rack. Contact with the coated side must be limited to the minimum possible.

19.6 A or L rack

When removing from an A or L rack, ensure that the sheet is first tilted away from the stack and then removed from the trestle. Avoid pulling a sheet up across the next sheet. It must also be ensured that sheets are not simply pulled out of the stack as this will damage the coating.

19.7 Placing the glasses for triple glazing

The customer must check whether the system used for assembly triple glazing is suitable, as in this case, the coating will travel against the system.

We recommend checking all rollers that come into contact with the coating for smooth play. The rollers must not be too hard, must be free of splinters and not evidence any sharp-edged defects.

20. Washing (T products only)

The washer, especially all brushes must be clean. Wash with softened water. In the last, and if possible also in the penultimate washing zone water should meet the following requirements:

- Conductivity <20 Microsiemens
- Recommended temperature 30 - 45 °C
- No additional cleaning agents
- pH value of 6.0 - 8.0

Warning! Transporting the washer should not stop during glass washing, otherwise the glass surface may be damaged by the brushes.

We assume that the washing machine has an automatic glass thickness setting system.

21. Quality control examination

21.1 Recommendation

We recommend that customers working with Silverstar® and Silverstar® T coatings for the first time should check the glass after each working step. This enables rapid detection and avoidance of sources of error. Workers should be appropriately sensitised and trained.

21.2 Acceptance criteria of coated glass defects EN1096-1

Euroglas/Glaströsch supplies Silverstar® and Silverstar® T thermal insulation glass product to Europe and the rest of the world. For this reason, we produce strictly according to EN 1096 for coated glass.

The examination described in this standard is as follows:

Extract from EN 1096-1

Coated glass may be examined in stock size plates or in finished sizes ready for installation. The pane of coated glass being examined is viewed from a minimum distance of 3 m. The actual distance will be dependent on the defect being considered and which illumination source is being used. The examination of the coated glass in reflection is performed by the observer looking at the side which will be the outside of the glazing. The examination of the coated glass in transmission is performed by the observer looking at the side which will be the inside of the glazing. During the examination the angle between the surface normal of the coated glass and the light beam proceeding to the eyes of the observer after reflection or transmission by the coated glass shall not exceed 30°.

Table 1 — Acceptance criteria for coated glass defects

DEFECT TYPES	ACCEPTANCE CRITERIA		
	PANE/PANE	INDIVIDUAL PANE	
UNIFORMITY/STAIN	Allowed as long as not visually disturbing	Allowed as long as not visually disturbing	
PUNCTUAL Spots/Pinholes; > 3 mm > 2 mm and ≤ 3 mm Clusters; Scratches; > 75 mm ≤ 75 mm	Not applicable	MAIN AREA	EDGE AREA
		Not allowed	Not allowed
		Allowed if not more than 1/m ²	Allowed if not more than 1/m ²
		Not allowed	Allowed as long as not in area of through vision
		Not allowed	Allowed as long as they are separated by > 50 mm
Allowed as long as local density is not visually disturbing	Allowed as long as local density is not visually disturbing		

Test setup, see EN 1096-1

The evaluation criteria for the later end product may differ in specific countries. It is the responsibility of the processor to appropriately meet the quality requirements within the scope of the legal guidelines and regulations.

22. Apparent defects during the production of insulation glazing

The following are excluded in the assessment and do not represent grounds for complaints:

- **Interference phenomenon**
- **Double sheet effect**
- **Multiple reflections**
- **Condensation on outer surfaces**

22.1 Interference phenomenon

Interference phenomena can occasionally occur in multiple sheet insulation glazing. This aspect is due to mutual influencing of light rays and the precise plane parallelism of float glass panes, a requirement for distortion-free view. These interferences consist of rings, stripes or stains visible to a greater or lesser extent in spectral colours. They move around in response to a finger pressing on the glass surface.

Interference phenomena do not affect the view through or function of insulating glazing; they are a physical feature and therefore do not represent grounds for complaint. Interferences can, in certain cases, be eliminated by turning or slightly changing the inclination angle of the insulation glazing.

22.2 Double sheet effect

Air is hermetically sealed in the cavity in all insulation glazing. The pressure inside the insulation glazing is therefore determined by the height of the manufacturing location, the atmospheric pressure and the air temperature at the time of manufacturing.

If conditions differ at the installation site, there will be a difference between the outside air pressure and the air pressure in the insulation glazing cavity.

This can lead to temporary bulging out or in of the individual float glass sheets. Reflected images may appear distorted to some extent when viewed from outside. This does not in any way affect the quality of the insulation glazing, its thermal and sound insulation properties, light transmittance or clear view.

The outer sheet can be slightly thicker to improve the optical quality of solar control glazing. The pressure difference is then absorbed by the thinner sheets while the thicker sheet remains stable. However, care is required with regards to smaller-format insulation glazing or glazing with unfavourable height-width ratios. The permissible bending tensile stress can be more rapidly exceeded than in large format glazing. This can lead to the glass fracturing.

The double sheet effect is based on physical laws and does not therefore represent any grounds for complaint.

22.3 Multiple reflections

Varying intensities of multiple reflections can occur on the different surfaces of the insulation glazing.

This effect may be reinforced by reflective coated sheets. As this is a natural property of the glass, multiple reflections are not grounds for complaint.

22.4 Condensation on outer surfaces

Interior side

The dew point on the glass surface facing into a room is determined by the heat transmission value (U value), air humidity, room temperature and air circulation. More recently constructed windows are more tightly sealed than older frame systems, thereby preventing heat losses, but also moisture exchange. This increases room humidity and, once a certain level of humidity is reached, the room-facing glass surface will be subject to condensation. This increase in humidity can be prevented by frequently airing the room for a brief period.

Exterior side

Due to the higher thermal insulation of modern insulation glazing, the outer sheet only warms up to a negligible extent as very little energy can be transmitted from the inside to the outside. The outer sheet cools even further during low temperatures at night and condensation will occur if there is high humidity.

23. Troubleshooting

Symptom	Possible cause	Possible remedy
Fine, parallel scratch marks on the coating	Bristles in washing machine too hard	Check brushes, replace with softer brushes if necessary
	Brush pressure in washing machine too hard	Reduce brush pressure (raise WM)
	Glass thickness changes not correctly adjusted for	Check sensors
	Dirty washing brushes	Clean the washing machine
Hazing of glass centrally on the uncoated side	The glass bends when entering the furnace	Reduce temperature input from below and significantly increase temperature input from above
Hazing of glass over the side edges on the uncoated side	The glass bends significantly when entering the furnace, touching the heating elements	Increase temperature input from below and reduce from above
Hazing of glass centrally on the coated side	The glass bends significantly when entering the furnace, touching the heating elements	Reduce temperature input from below and significantly increase temperature input from above
Hazing of glass over the side edges on the coated side	The glass bends significantly when entering the furnace, touching the heating elements	Reduce temperature input from below and significantly increase temperature input from above
Spotting of the glass surface	Glass was heated too strongly	Reduce temperatures or heating times
Fracture pattern too coarse	Quench pressure insufficient or cooling air too warm	Increase the quench pressure
Fracture pattern too fine	Quench pressure too high, cooling air too cold	Quench pressure can be reduced if necessary
Glasses break directly after heating	The glass does not have the necessary tempering temperature	Increase the heating time

24. Legal information

The data in this guideline make no claim to be complete. Euroglas/Glaströsch has drawn up its main specifications and recommendations to the best of its knowledge and with great care at the time of publishing.

Euroglas/Glaströsch is not liable for any information missing from these guidelines for products in the Silverstar® T thermal insulation glass product family.

These **handling and processing instructions for temperable thermal insulation glass and thermal insulation glass, revision number 20201201-01-T and revision number 20201201-01**, apply to the following products:

SILVERSTAR® Non T-Products	SILVERSTAR® T-Products
SILVERSTAR® EN2plus	SILVERSTAR® EN2plus T
SILVERSTAR® TRIII E	SILVERSTAR® ZERO NG T
SILVERSTAR® ZERO	
SILVERSTAR® ZERO NG	
SILVERSTAR® COMBI Neutral 41/21	SILVERSTAR® COMBI Neutral 30/21 T
SILVERSTAR® COMBI Neutral 51/28	SILVERSTAR® COMBI Silver 32/21 T
SILVERSTAR® COMBI Neutral 61/32	SILVERSTAR® COMBI Neutral 40/21 T
SILVERSTAR® COMBI Neutral 70/35	SILVERSTAR® COMBI Bronze 40/21 T
SILVERSTAR® COMBI Grey 70/35	SILVERSTAR® COMBI Grey 40/22 T
SILVERSTAR® COMBI Neutral 70/35 NG	SILVERSTAR® COMBI Grey 50/28 T
SILVERSTAR® SELEKT 70/38	SILVERSTAR® COMBI Neutral 51/28 T
SILVERSTAR® SELEKT 74/42	SILVERSTAR® COMBI Neutral 61/32 T
SILVERSTAR® SUPERSELEKT 60/27	SILVERSTAR® COMBI Neutral 70/35 T
	SILVERSTAR® COMBI Neutral 70/35 NG T
	SILVERSTAR® SELEKT 74/42 T
	SILVERSTAR® SUPERSELEKT 35/14 T
	SILVERSTAR® SUPERSELEKT 60/27 T
Revision number 20201201-01	Revision number 20201201-01-T

and replace, from the date of their publication instruction listed in **handling and processing instructions for temperable thermal insulation glass and thermal insulation glass, revision number 20190304-02-T and 20190304-02**.

Euroglas/Glaströsch reserves the right to change and/or upgrade the revision status and contents at any time.

These **handling and processing instructions for thermal insulation glass** do not regulate the ordering and handling of coated fixed dimensions.

The relevant guidelines for fixed dimensions can be obtained from our sales force.

25. Recommendations

25.1 Using cork pads as spacers

Cork pads used as spacers must never be placed with the suction side on the coating as the plasticisers in them will leave a permanent mark. If necessary, cork pads should only be placed in the area of the edge removal.

We recommend positioning the cork pads on the sheet facing inwards when used on a finished insulation glazing unit, so that the marks are then only visible when cleaning the window. If the cork pads are attached externally, the marks will be visible each time the dew point is undershot.

25.2 Stickers and labels

We recommend the use of labels with acrylic adhesive. These can normally be re-used several times, and leave the least marks on the glass.

25.3 Float glass

In standard insulation glazing assembly, the uncoated sheet is usually installed on the outside. We always recommend installing the tin side of the float glass at position 1.

25.4 Washing process

Biological contamination can occur, depending on the environmental conditions on site. This can be indicated by discolouration of the rollers or rolls. A slimy coating on the walls may also indicate this. The use of a suitable biocide can counteract this effect. In addition, the environment can be specifically improved by flushing the washing machine with suitable chemicals.

Before doing so, contact the machine suppliers (washing machine and water treatment) to ensure that this is possible in your case.

Euroglas/Glaströsch does not accept any liability for damages in this respect.

25.5 Storage of coated insulation glass

Insulation glass must never be exposed to direct sunlight or partial shade, especially in summer. There is a high risk of thermal breakage if this happens.

25.6 Identification of stocked goods

To avoid mixing up Silverstar® / Silverstar® T products, we recommend leaving the supplied label on the last sheet.

The different Silverstar® / Silverstar® T products are not compatible with each other colour-wise.

25.7 Identification of the coated side

A commercial continuity tester can be used, for example, for this purpose.
In addition, a detector such as the Low-E Coating Detector from Bohle can be used.

25.8 Identification of the thin side

A UV lamp can be used to identify the tin side.
In addition, a measuring device such as the TinCheck from Bohle, can also be used.

25.9 Cutting pressure

The cutting pressure must be checked at regular intervals directly at the cutting wheel.
A suitable load cell must be used for this purpose.
For example, a suitable manometer is available from Silberschnitt.

25.10 Determination of insulating glass units

Glass thickness once installed can be subsequently determined using a device such as the Merlin Laser from Bohle.

26. Standards for glass in building

EN 356: Glass in buildings

Security glazing - Testing and classification of resistance against manual attack

EN 410: Glass in buildings

Determination of luminous and solar characteristics of glazing

EN 572: Glass in buildings

Part 1/2/8/9 Basic soda lime silicate glass products

EN 673: Glass in buildings

Determination of thermal transmittance (U-value) – Calculation method

EN 674: Glass in buildings

Determination of thermal transmittance (U-value) – Guarded hot plate method

EN 1096: Glass in buildings

Part 1-4 Coated glass

EN 1279: Glass in buildings

Part 1-6 Insulating glass units

EN 1863: Glass in buildings

Part 1/2 Heat-strengthened soda lime silicate glass (HSG)

EN 12150: Glass in buildings

Part 1/2 Thermally toughened soda lime silicate safety glass (SGS)

EN ISO 12543: Glass in buildings

Part 1-6: Laminated glass and laminated safety glass

EN 12600: Glass in buildings

Pendulum tests, impact test method and classification for flat glass

EN 12898: Glass in buildings

Determination of the emissivity

EN 13363: Solar protection devices combined with glazing

Part 1/2 Calculation method

EN 20140-3: Acoustics

Measurement of sound insulation in buildings and of building elements

Part 3: Laboratory measurements of airborne sound insulation of building elements

DIN 1055-5: Design loads for buildings. Live loads, snow loads and ice loads

DIN 1249-10: Glass in building - Chemical and physical properties

DIN 4102: Fire behaviour of building materials and building components

DIN V 4108-4: Thermal insulation and energy economy in buildings

DIN 4109: Supplementary sheet 1 / A1: Sound protection in buildings

DIN 18032-3: Testing of safety against ball throwing Halls for gymnastics, games and multi-purpose use

DIN 18516 Part 4: External enclosures of buildings, made from tempered safety glass panels; Requirements and testing

DIN 18545: Glazing with sealants, Part 1–3

DIN 52210: Airborne impact and sound insulation

DIN 52294: Determination of the loading of desiccants in insulating glass units

DIN 52460: Sealing and glazing terms

DIN 52611: Determination of thermal resistance of building elements

DIN 52612: Testing of thermal insulating materials

Determination of thermal conductivity by means of the guarded hot plate apparatus, test procedure and evaluation

DIN 52619: Determination of the thermal resistance and the thermal transmission coefficient of windows

DIN 53122: Determination of water vapour transmission

DIN 58125: Construction of schools

Constructional requirements for accident prevention

TRLV: Technical rules for the use of linear supported glazing

Complete text extracts and secondary standards for the glass in the building sector are available at www.beuth.de and also www.pkn.pl