ŞİŞECAM
FLAT GLASS

Temperable Solar Control Low-E Glass

Temperable Low-E Glass

Processing Guideline

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TEMPERABLE
SOLAR CONTROL
LOW-E GLASS

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1. SCOPE OF APPLICATION

- This processing guideline helps manufacturers to manufacture high-quality insulating glass units by using the Şişecam Temperable Low-E and Şişecam Temperable Solar Control Low-E Glass. As the coated surface is weak against to damage during the manufacturing processes, care should be taken during the storage, transportation, handling and processing the glass panes.
- Performance values of offline coated temperable glass products are determined according to principal that view from outdoor to indoor. According to the requirements of the design, the coated surface of Temperable Low-E Glass in the Isicam unit can be on side 2 or 3, but for Temperable Solar Low-E Glass it must be located to only side 2. At different usage conditions, it is strongly recommended to get information from Şişecam Flat Glass for performance calculations and application details.

2. STORAGE CONDITIONS (REQUIRMENTS)

- Coated glass packs should be stored in a dry and well-ventilated area to prevent any condensation on glass surface or inside of glass pack. The temperature of the area, in which the coated glass panes are stored, should be minimum 15˚ C. Relative humidity level more than 60 % is not recommended. Besides additionally, short-term temperature changes in the storage area should be avoided.
- The storage area should not be close to the exit doors and water tanks.
- Care should be taken to ensure that areas of storage, processing and transportation are free from corrosive vapors. Corrosive substances such as hydrochloric acid, sulphur etc. should not be stored in the same area.

- The packaging material of glass packs (surrounding tape and silica gel) should not be removed until the cutting process. It is advised to consume all glass panes inside the pack once it is unsealed; if it is not possible, re-packing should be done very carefully.

- Coated glass packs should not be unsealed until the temperatures of the packs get roughly equal to the indoor temperature. Unsealing packs before achieving the indoor temperature may cause condensation of humidity between the panes with corrosive effects on the coating.
- If any condensation occurs on the outer surface of the front and back panes of the pack, it should be dried in order to avoid the entrance of water into the pack when it is unsealed.
- After unsealing the surrounding tape of the glass, silica gel must be removed completely. Any silica gel particles remaining between the panes may scratch the coating.
- Unsealed glass packs must be processed quickly. If it is not totally consumed after removing the surrounding tape of the glass pack, rest of the pack should be resealed immediately. If silica gel contacts with air for a long time, then it will lose its function.
- When aforementioned conditions are fulfilled, the shelf life of the sealed stack of coated glass is 6 months.

3. DETERMINING THE COATED SIDE OF THE GLASS

- During packing of coated glass, an (uncoated) float glass is placed as a cover sheet of each pack. Unless otherwise is requested by glass processor, the individual sheets are packed with the coated side towards the inside of the rack therefore cover sheet are placed facing towards to the rack of the cutting machine.
- It is important to identify which side of the glass is coated. In order to identify the coated surface, coating detectors should be used and detection should be carried out around the edges of the glass. Any contact with the coated surface of the glass with bare hands or hard objects should be avoided.

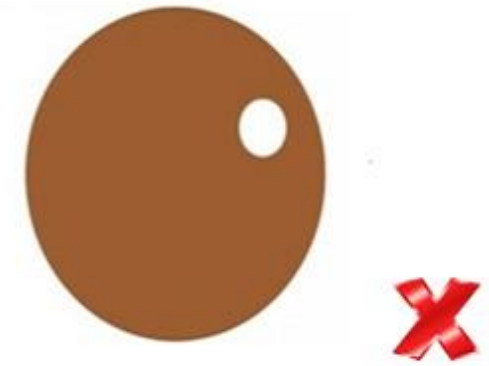
4. HANDLING

- Suction cups should be applied to the uncoated surface of coated glass. If contact with the coating is unavoidable, clean vacuum caps proper for coated glass should be used on suction cups. Şişecam Flat Glass suggest Eurotech MTC 2 brand of vacuum cap.

- Separator materials such as acid-free/neutral Lucite powder (Şişecam Flat Glass suggest Degacryl M286), paper, cardboard, anti-static cork and foam paper can be used. But it should be considered below mentioned:

- Foam paper is not recommended after tempering proses. If glass plates come to racks hotter than expected to after proses, foam paper can make a print trace to the coated surface of glass.
- Anti-static cork should not contact to coated area, should put to deleted edges.
- Separators must be clean and must not contain solid particles, dirt, oil, powder etc. that can cause scratches, prints and traces to glass surface.

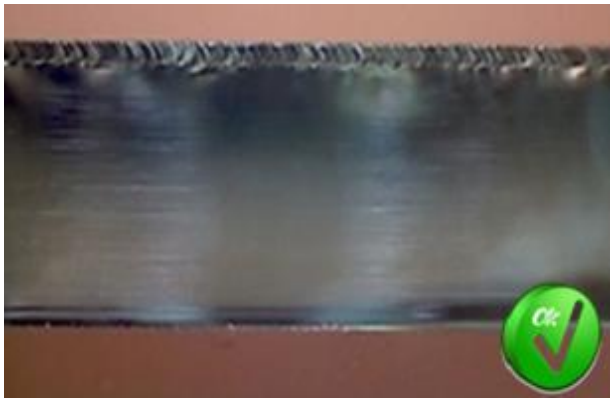
- Before taking out the separator material between glasses, firstly the glasses must be separated from each other. Otherwise, it is possible to scratch the coating.
- Separator materials must not be touched the floor. Otherwise, they may collect statically some harmful substances on the floor such as glass particles, chemical materials etc. and as a result the coating may be scratched due to these foreign harmful substances.
- Unnecessary contact with coated side of the glass must be avoided. Any contact with coated side might damage the coating.
- Throughout the entire production process, coated glass panes should be handled only with waterproof, clean nitrile gloves that is proper for coated glass.

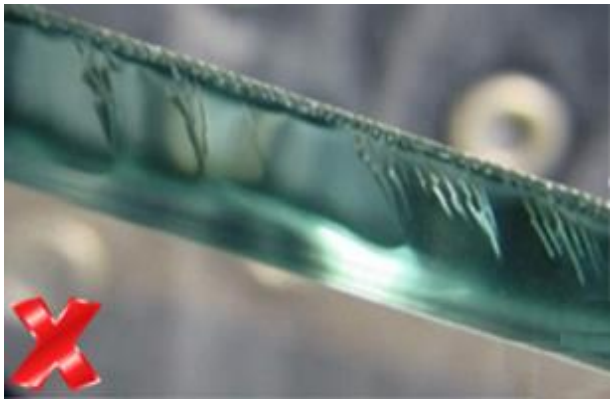


- Silicone pads are not allowed during handling.
- Any part of the human body should not be used to help handling or placing the glass to the rack.
- As a result of improper handling, scratches, finger prints, sweat or dirt on coated glass can lead to irreversible defects that are evident after thermal toughening process.

5. CUTTING

- It is advised to use an automatic cutting table for cutting process. Manual cutting by using rulers and templates should be avoided.
- Perspiration and oil can easily damage the coating, clean and waterproof nitrile gloves must be used while handling the coated glass. Handling the coated glass without gloves should be avoided. Dirty and oily gloves should be changed immediately.
- During the cutting process of coated glass, care should be taken that the coated side of the glass is placed upwards on the cutting table. Suction cups should be applied to the uncoated surface when placing the glass to the cutting table. The coated glass should always be cut from the coated side.
- While measuring the glass dimension, the tape measure should not contact to the coated surface of the glass.
- Cutting oil should be volatile, water soluble and compatible with the coating. Şişecam Flat Glass suggest Acecut 5503 brand of cutting oil.
- Cutting table should be cleaned by vacuum cleaner before and in the course of cutting proses, to prevent scratches and prints on the glass.
- During cutting, the amount of cutting oil is quite important. Using more cutting oil than required may damage the coating. Using less cutting oil than required may cause low cutting quality.
- After cutting and breaking of the glass, edge quality should be controlled. It is important because of the fact that if the edge quality of the glass is poor after cutting, breaking and also grinding, it may be broken down during tempering process.





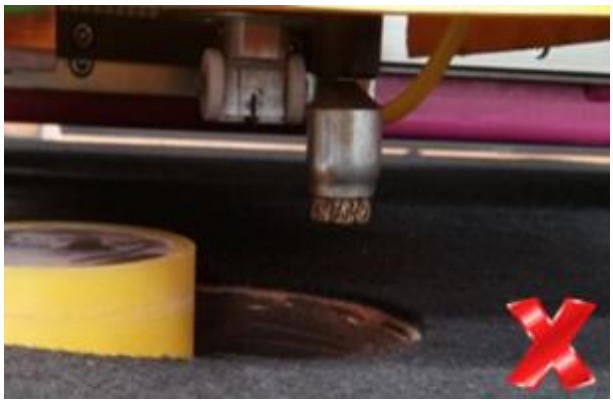
- During cutting, collecting, putting on the pallets and aligning of the glasses, there must be no contact of any part of the human body on the coated surface excluding proper gloves.

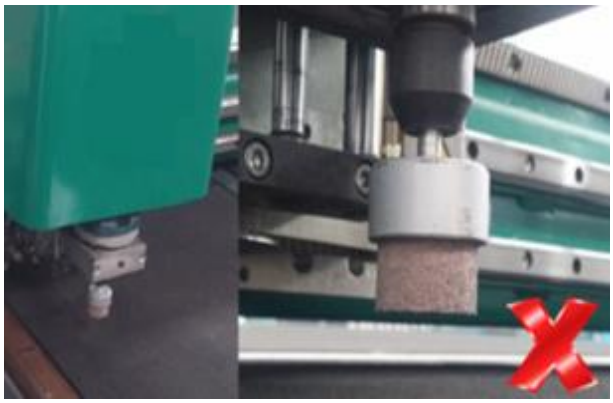
- When breaking glass sheets, any contact with the coated surface should be avoided in order to prevent scratching. To provide it, glasses must be cut by hand or a cutting system that is designed specifically for this operation.
- The glass panes which have been cut to size should not be stacked up on top of each other. As glass sheets separated by neutral Lucite powder, after the cutting process, there is no need to use a separator. However, for any reason (compressed air, washing etc.) if the Lucite powder on the glass surface is removed, the separators mentioned in section 4 should be used.
- The cut glass should be processed on the same day (within 24 hours) in order to avoid corrosion of coating layer.
- The cut glass should be processed in the same facility and should not be taken out of the facility before being sealed in an Insulating Glass Unit (IGU).

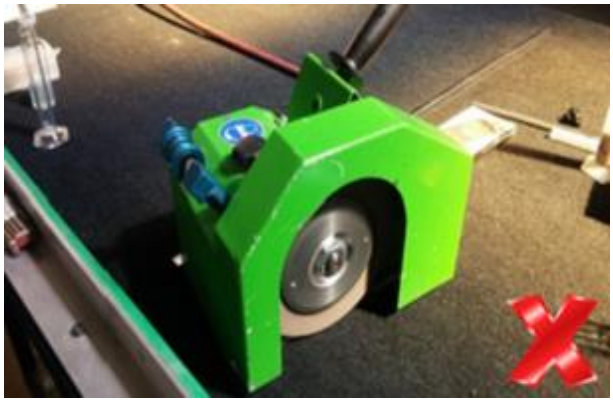
6. EDGE DELETION

- Coating layer is not compatible with sealants, so it should be completely removed in the areas where the primary and secondary sealants present.
- Edge deletion should be done with a proper machine including edge deletion wheel.

- Brush milling, felt milling and hand type edge deletion systems are not suitable.



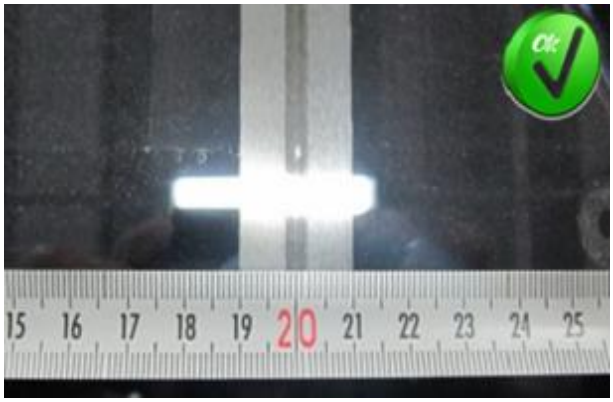


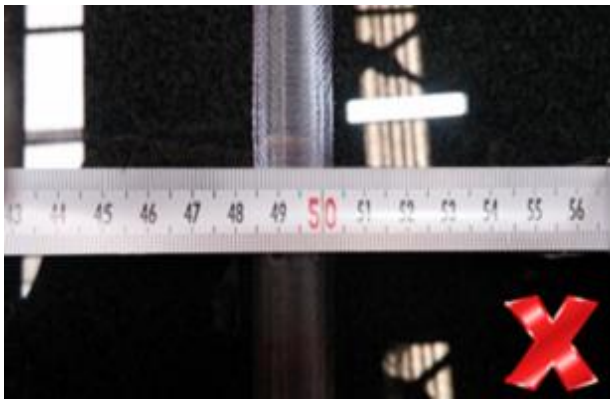


- In order to identify the edge deletion quality, coating detectors should be used.

- The width of the deleted area must be minimum 10 mm if polyurethane or polysulfide is used as a secondary sealant (if argon gas is used inside the IGU cavity, it must be minimum 11 mm) and minimum 13 mm if silicone is used as an outer sealant (if argon gas is used inside the IGU cavity, it must be minimum 15 mm).
- After edge deletion, ensure that the deleted part is totally cleaned out of from the glass surface. If edge deletion is done insufficiently, yellowish linear lines may appear after tempering process.

- Additionally, if frame printing, outer sealant application or a thin film application of structural silicon is done on this area, those yellowish linear lines may appear obviously. To prevent this undesirable view, rotation speed, linear movement speed and pressure parameters of the edge deletion wheel must be optimized in a best way. These parameters may vary according to trade mark of the cutting machine and edge deletion wheel. If edge deletion performance is not sufficient enough, the optimum parameters may be obtained by increasing the rotation speed and pressure and also decreasing the linear movement speed of the edge deletion wheel. Şişecam Flat Glass suggest Fischler AE100 and Lukas HP150 brand of edge deletion wheels. The width of the edge deleted area may be wider in special structural glazing application. At this point, the coating from the point that butyl touches the glass to the edge of the glass must be deleted totally. If this process is done inappropriately, you may be encountered with a malfunctioned IGU or it may have a bad appearance. Besides, adhesion performance between coating surface and bonding silicone is affected in a bad way.





- Edge deletion wheel must be hone periodically to provide a high level of erasing quality.
- After edge deletion process and before cutting process, particles of edge deletion wheel must be removed from coated surface of glass by compressed air. Although there are separators between glass plates, these solid particles may create scratches on glass surface, during putting to pallet or transportations between processes.
- At the above of edge deletion system, there must be a vacuum cleaning system to suck these edge deletion wheel particles, during erasing operation.
- If width of the edge deleted area is equal to or greater than 20 mm, it is strongly recommended to make edge deletion at one pass by using an edge deletion wheel with a suitable width. If a wide deletion width is made by using narrow width edge deletion wheel, more than one passes, it is strongly possible to create some visual problems that can be visible after tempering process. In

other words, to make edge deletion larger than 20 mm, an edge deletion table should be used apart from the edge deletion system that is assembled inside the cutting machine.

- It is important to use an adjustable deletion system (width, speed, pressure), to meet different requirements of erasing process.

- At some projects, larger edge deleted areas (50 mm or wider) may be required especially at corner parts of the buildings. In similar cases, tempering problems like breakage, undulation etc. may be encountered. The reason of these problems are due to the fact that the edge deleted area of the glass is heated more rapidly than the area that is coated. Although generally it is not recommended, in such cases the edge deletion may be done after tempering by using an edge deletion table which is apart from the edge deletion system that is assembled inside the cutting machine. But at this point, special care must be taken of the coated glass because of the fact that tempered soft coated glass is more sensitive than the untempered one.

7. EDGE PROCESSING

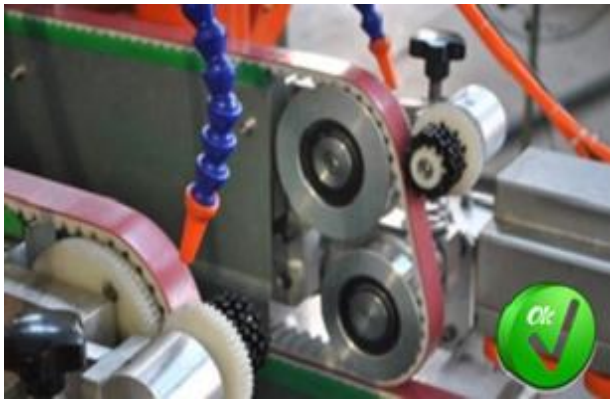
7.1. ARRISING

- For arrising process, an automatic arrising machine must be used. Glass must be transferred on conveyor system with coating side is not in contact with any conveyor elements. Make sure that there is adequate and clean cooling water in arrising process; otherwise coating can be scratched with accumulation of glass dust in the water. The glass must be washed immediately after arrising process. Manual arrising is not suitable for this process

7.2. GRINDING

- For grinding process, an automatic horizontal (double edger, CNC etc.) or vertical grinding machines must be used. Glass must be transferred on conveyor system with coating side is not in contact with any conveyor elements.

- For the horizontal edge grinding machines (double edger), top clamping belt must be smooth and non-textured in order not to damage the coated surface. Additionally, there must be a pulverize water nozzle and brush system to keep the upper belt wet and clean that located at entrance section.



- For other types of edging machines (CNC), care must be taken to avoid the contact of any transferring or processing elements with coating surface. During edge grinding, glass panes should not let dry and have to be washed immediately after processing.
- Double edger lines should work in both directions and should turn the glass 90 degrees automatically and at the end of the lines glass should be grinded at its 4 edges and washed. During the process contact with hands should not be allowed.
- Vertical edge grinding machines, equipped with clamping pads are not suitable for edge processing of the coated glass.

8. WASHING

- Glass panes have to be washed with clean and soft bristle brushes that are suitable for the coated surfaces.
- The bristle diameter of the brushes in contact with coated surface should be between 0,10 - 0,15 mm.

- The bristle should be made of 6-6 nylon or similar “soft” material that has high water absorption property.
- The bristle length should be between 40–50 mm.
- The pressure of the bristle on the coated surface has to be maximum 2 mm.
- Before washing the glass panes, washing machine must be operated for a while without glass inside the machine.
- Any contact of coating side with machine parts such as strip brush or rubber blade at inlet of washing machine must be avoided.
- In front of the washing machine, there should be a water pulverizing system to remove the water on the coated surface of the glass that contains quite amount of tiny glass particles in which they may scratch the coating.

- It should be ensured that the glass panes are moving continuously inside the washing machine. In case of any glass pane remains stood inside the washing machine, the brushes should be stopped immediately otherwise revolving brushes on coating side will scratch the coating.
- Always use deionized water with the conductivity less than 30 µS/cm, pH between 6,0–7,5, hardness maximum 5 Fr and temperature minimum 30 ^{o}C.
- There should not be added any detergent or chemical agents to washing machine water.
- The air knife filter must be kept clean.
- For brushes which are not in use for a while; dirt, glass dust etc. may collect on the brushes and may cause scratches on the coated glass surface. Before operating these parts, brushes should be cleaned thoroughly.

- In order to avoid formation of any algae and other microorganism, pipes and water tank walls have to be opaque.
- After washing, there should be no stain or water mark on the glass surface and the glass pane has to be completely dry.
- Separator materials such as acid-free/neutral Lucite powder (Şişecam Flat Glass suggest Degacryl M286), paper, cardboard, anti-static cork and foam paper can be used. But it should be considered below mentioned:

- Foam paper is not recommended after tempering proses. If glass plates come to racks hotter than expected to after proses, foam paper can make a print trace to the coated surface of glass.
- Anti-static cork should not contact to coated area, should put to deleted edges.
- Separators must be clean and must not contain solid particles, dirt, oil, powder etc. that can cause scratches, prints and traces to glass surface.

9. SCREEN PRINTING

- Screen printing process can be applied after removal of coating on glass.
- Proper removal of coating is a must to avoid color variations.
- Special care should be taken that the coating is removed completely from the surface to be enameled. The edge deleted surface should be checked accordingly.
- It is recommended there must be a washing machine which is located at the entrance of printing line (different than which is located at the end of edge grinding line).
- In washing machines, demineralized water which meets the following requirements should be used:

- Conductivity is maximum 10 µS/cm.
- pH is between 6,0–7,5.
- Hardness is maximum 5 Fr.
- Temperature is minimum 30 °C.

- Drying efficiency of washing machine is very important. After washing process, printing surface of the glass must be completely dry to prevent negative affect to printing quality.
- Cleaning of screen should be done with pure alcohol. Thinner based solvents cannot be used due to potential risk of corrosion on coating.
- Screen frames should be unique for a single glass pane. Using a tape to mask off the screen for glass panes at different sizes may cause damage on coating.

- Any dirt or dust on glass surface can only be wiped up with pure alcohol. Thinner based solvents should be avoided due to potential risk of corrosion on coating.
- Decorative screen printing may be applied on the coated surface. But at this point, colour differentiation and loss in performance may be occurred. During this kind of printing, variable parameters like thickness, hardness, chemical composition, particle size and coefficient of thermal expansion of the paint must be under control, and also glass processor and paint producer must be in agreement with the compatibility of paint and coating.
- Şişecam Flat Glass always recommends to make some production trials before large scale production.
- Paint preparation process is very important to achieve good quality of covering and target colour parameters. These parameters have very important role to achieve same view of final project. To manage paint preparation process successfully, a viscosity meter and spectrophotometer is recommended to use in laboratory.

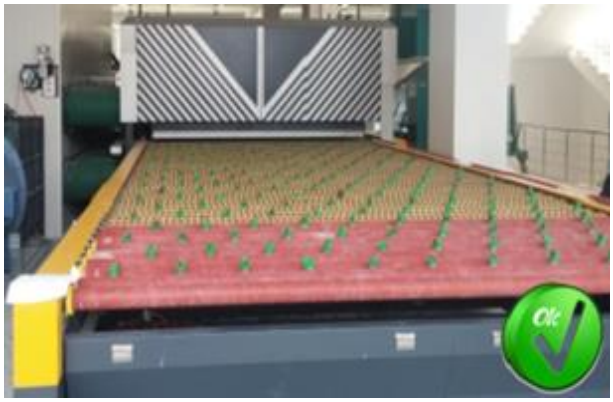
10. THERMAL TOUGHENING

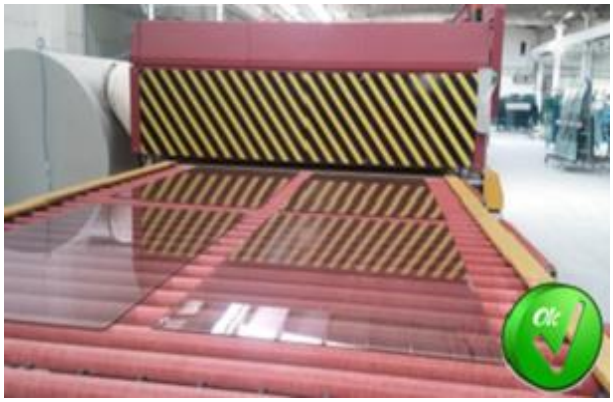
- Şişecam Flat Glass Heat-treatable Coated Glass is classified in low emissivity type coatings and thereof should be tempered only in a full convection tempering furnaces.
- During tempering, the coated surface should always be facing upwards.
- As a general rule, since silver based low-e coatings reflect heat from coating side, they should be toughened at lower furnace set temperatures, higher soak times, higher upper convection pressure and different quenching air balance setup compared to clear glass. Furnace parameters should be tuned by an experienced and trained operator to achieve homogeneous heating up in the furnace and cooling down in quench section.
- During heating period, the geometry of the glass must be observed by opening the front door of the furnace. The bow appearance must be prevented by adjusting the furnace parameters. This subject is quite important especially in terms of big size glasses.
- Not only the coated surface of the glass shows resistance to heating in the furnace but also to cooling in quench part. According to the uncoated clear glass, the amount of air on upper part of quench must be increased to obtain a homogeneous cooling.
- Furnace parameters may differ based on furnace designs. Prior to serial tempering process, trials can be made with Şişecam Flat Glass supervisory on request.
- It is advised to be installed roller waves horizontally in order to achieve high optical quality in the facade.

- The use of sulphur dioxide in the tempering furnace has to be switched off at least 24 hours prior to tempering and should not be used during tempering.
- Any dirt or dust can only be wiped up with pure alcohol and cotton fabric (Şişecam Flat Glass suggest Kimberly-Clark Kimtech Prep Wettask DS 7766 as fabric). Thinner based solvents should be avoided due to potential risk of corrosion on coating. During cleaning process, care must be taken not to rub too hard on coating side.
- The tape measure should not contact to the coated surface of the glass while measuring dimension of glass.
- Separator materials such as acid-free/neutral Lucite powder (Şişecam Flat Glass suggest Degacryl M286), paper, cardboard, anti-static cork and foam paper can be used. But it should be considered below mentioned:

- Foam paper is not recommended after tempering proses. If glass plates come to racks hotter than expected to after proses, foam paper can make a print trace to the coated surface of glass.
- Anti-static cork should not contact to coated area, should put to deleted edges.
- Separators must be clean and must not contain solid particles, dirt, oil, powder etc. that can cause scratches, prints and traces to glass surface.

- This type of coating is sensitive to heating. So, it must be prevented to heat the glass much more than enough. It is suggested to control the surface distortion (roller wave) by using a screen bearing an assembly of black and white or yellow and black stripes.





- Care must be taken that the upper set point of the temperature control unit do not exceed 685 °C. If it exceeds, roller print risk increase and some invisible defects like scratches, stains etc. at the coated surface, which formed at previous processes like cutting, deletion, edge grinding, drilling, washing etc., may become more visible after temper process.

- At the periodically maintenances of temper furnace, care must be taken for cleaning of ceramic rollers, to prevent occurrence of roller print defects.
- Due to the fact that the cut glasses must be assembled in an IGU within 24 hours, tempered glasses also should be assembled in an IGU immediately.
- To control tempering quality at the target level, required quality control equipment must be supplied and used properly.

11. TEMPORARY PROTECTIVE FILM

- There is a temporary protective film (TPF) on double and triple silver Temperable Solar Control Low-E glass. The aim of TPF is to protect the coated glass product against mechanical and environmental effects during transportation, handling and processing operations. It is highly advised to pay attention to following items.
- Edge deletion process is must before cutting process for those products protected with TPF.
- The edge deletion of coated glass with TPF must be processed in automatic cutting machines and edge deletion wheel.
- An appropriate edge deletion wheel must be chosen according to cutting table suppliers recommendation and the company's experience. If necessary, glass processor can consult to Şişecam Flat Glass.
- Edge deletion parameters may vary according to cutting table design. In general, for better edge deletion; decrease linear deletion speed, increase wheel pressure and increase grinding frequency of edge deletion wheel.
- Performance of edge deletion must be checked after each sheet with a conductivity meter.
- After edge deletion process, edges of TPF must be smooth and no wrinkled edges.
- Cutting fluid can damage adhesion of TPF therefore minimum volume of cutting fluid should be used during cutting process and wiped off immediately after cutting process before collecting on racks.
- In case of an undesirable peel off or wrinkle at TPF edges, or interaction of TPF with the cutting fluid, these areas must be taped with paper tape before edge processing steps.
- Glass panes can be handled from TPF surface by using clean suction cups.
- There should be no friction from any machinery parts on TPF, therefore TPF side of coated glass should be processed by facing towards air for all processing steps.
- Glass with TPF must be completely dry at the end of washing process.

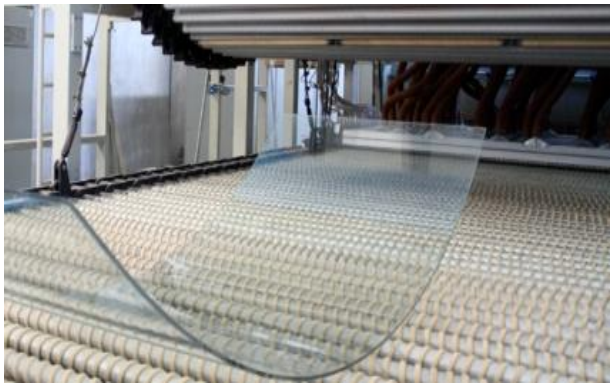
- Glass with TPF must be washed with clean and soft bristle brushes for coated glass. No detergents or chemicals should be used.
- Revolving brush on TPF surface is not allowed during the washing process.
- TPF should be on coated surface until tempering process.
- TPF should be peeled off from the corner to center before tempering.

12. HEAT SOAK

- Spontaneous breakages can occur for several reasons in tempered glass products. One of them is Nickel Sulfide (NiS) inclusions.
- Nickel sulfide can always presence in float glass but can only cause spontaneous breakage in tempered glass. It is not possible to eliminate nickel sulfide in glass composition, in terms of characteristics of raw material of glass and current technology.
- This “phenomenon” is not defined as production/processing failure according to the related European Standards. So, the damages may occur due to spontaneous breakages are the sole responsibility of the glass processor, Şişecam Flat Glass doesn’t accept any responsibility for this kind of damages.
- Possibility of breakage due to nickel sulfide can be reduced by heat soak treatment but cannot be eliminated 100%, as it is defined in EN 14179-1: Glass in building – Heat soaked thermally toughened soda lime silicate safety glass – Part 1: Definition and description.
- The separating materials used during the heat soak test, should contact only with deleted edges. Any material (separator, thermocouple) contacts with the coated side of glass can scratch the coating.
- If quite amount of glass breakage is observed during heat soak process, it should be observed whether edge processing quality of the glasses is good or not and also there is enough empty space between the glasses. Bad edge processing quality and also unbalanced air circulation between the glasses which occurs because of not enough empty space between the glasses may increase the breakage percentage.

- The other reason that causes the glass breakage during heat soak test is unbalanced conditions during tempering. Heating or cooling the glass much over than enough may increase the stress level inside the glass. Stress level may be decided by counting the broken glass particles in a 5x5 cm area. If the amount of broken glass particles is quite much more than the limit described in the standard, it may be one of the reason that glass is broken during tempering and also heat soak process.

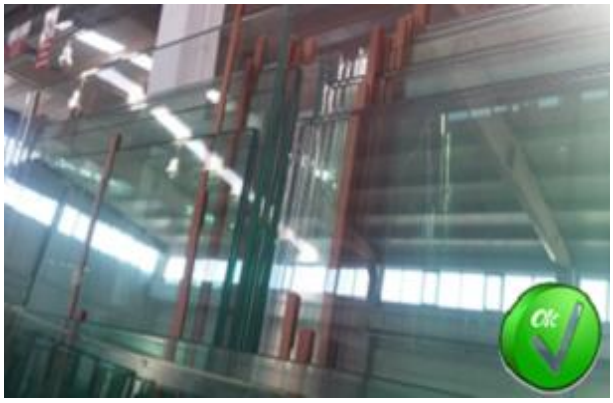
13. BENDING



- It is suitable to bend the coated glass. Şişecam Flat Glass strongly recommends to produce a mock-up before mass production.
- If the camber is performed in quench part of the furnace, all the materials like Kevlar that touch the coated surface must be clean and in same level.

14. LAMINATION

- The heat treatable coated glass can be laminated with the coated surface facing outside, away from PVB. Care should be taken for avoiding physical damages on the coating during lamination processes.



- The heat treatable coated glass can also be laminated with the coated surface facing PVB. As the heat insulation performance will be affected negatively, lamination with the coated surface facing PVB is not recommended. Carrying out the tests in accordance with EN 12543 is recommended.
- Lamination should be done in such a way that the tin side of the flat glass is in contact with the PVB (in hard or soft coated glass, the coating is made on the opposite side (air side) of the glass).
- Although it is not recommended, in case of coated glass laminated with coated surface facing to PVB interlayer, there is a risk of potential coating corrosion at the edge of laminated unit. In order to prevent that edge corrosion, edges of laminated glass unit should be sealed with such a seal tape or paste which is recommended by PVB supplier or coated glass should be laminated after edge deletion process. Visible appearance of coated glass may differ from a single tempered pane to laminated glass unit. Therefore it is recommended to produce a sample unit to compare the color variations.
- Issues to be considered when laminating with heat treatable coated glass:

- Brushes used in assembly line washing machine should be soft enough to not damage coating on glass. Hard and dirty bristles of brush may scratch the coating.
- In washing machines, demineralized water which meets the following requirements should be used:

✓ Conductivity is maximum 10 µS/cm.

✓ pH is between 6,0–7,5.

✓ Hardness is maximum 5 Fr.

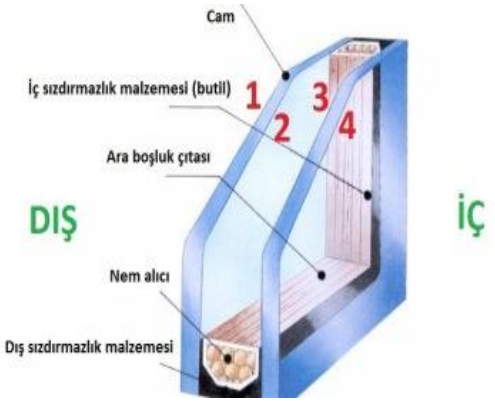
✓ Temperature is minimum 30 °C.

- Any contact of suction equipment with coated side of glass is not recommended. If it is not avoidable, clean vacuum caps should be used on suction cups.
- Nip rollers should be clean and have no groove on surface. A groove pattern may damage the coating on glass.
- Any contact of hard materials to coated side should be avoided.

- Air conditioned atmosphere must be supplied in the laminating chamber.
- To keep clean and to prevent conditioned atmosphere loses from laminating chamber, door design must be two passes.
- In autoclaving, any contact of metal clamping on edges or spacer materials to coated surface should be avoided.

- Compressed air in autoclave should be conditioned, therefore air driers and oil filters should be utilized at the outlet of air compressor. Humidity inside the autoclave may result corrosion on coating. Hence laminated glass should be assembled in an IG unit immediately.

15. DOUBLE GLAZING



- In an IGU, the coated surface must be facing the air cavity of the unit. The coating should be positioned on the inner side (#2) of the outer pane that is exposed to outdoors of the building. The sides that will face the inside of the building must be labeled.
- Coating layer is not compatible with sealants, so it should be completely removed in the areas where the primary and secondary sealants present.
- In case of using specific materials such as structural silicone, the approval for the compatibility of the material with coating must be requested from material manufacturer.
- The processed glass panes must be assembled in an IGU within 24 hours after cutting.
- Glass panes have to be washed with clean and soft bristle brushes that are suitable for the coated surfaces.
- The bristle diameter of the brushes in contact with coated surface should be between 0,10 - 0,15 mm.
- The bristle should be made of 6-6 nylon or similar “soft” material that has high water absorption property.
- The bristle length should be between 40–50 mm.
- The pressure of the bristle on the coated surface has to be maximum 2 mm.
- Before washing the glass panes, washing machine must be operated for a while without glass inside the machine.
- Any contact of coated side with machine parts such as strip brush or rubber blade at inlet of washing machine must be avoided.
- It should be ensured that the glass panes are moving continuously inside the washing machine.
- In washing machines, demineralized water which meets the following requirements should be used:

- Conductivity is maximum 10 µS/cm.

- pH is between 6,0–7,5.
- Hardness is maximum 5 Fr.
- Temperature is minimum 30 °C.

- There should not be added any detergent or chemical agents in washing machine water.
- The air knife filter must be kept clean.
- For those brushes not in use for a while; dirt, glass dust etc. may accumulate on the brushes and cause scratches on the coated surface of glass. Before operating the washing machine, ensure that brushes are cleaned thoroughly.
- In order to avoid formation of any algae and other microorganism, pipes and water tank walls have to be opaque.
- After washing, there should be no stain or water mark on the glass surface and the glass pane has to be completely dry.
- The IGU must be kept away from sunlight, rain etc. during transportation and storage.

16. QUALITY PARAMETERS

- Şişecam Flat Glass coated glasses in the market are all produced in accordance with the high quality standards of Şişecam Flat Glass. All coated glasses are inspected and visually controlled according to related quality standards.
- Glass processor should perform quality controls in all stages of processing steps.
- Coated glasses must be inspected according to the European Standards:

- EN 12150 Glass in building-Thermally toughened soda lime silicate safety glass
- EN 1863 Glass in building-Heat strengthened soda lime silicate glass
- EN 1279 Glass in Building-Insulating Glass Units
- EN ISO 12543 Glass in Building-Laminated Glass and Laminated Safety Glass
- EN 14179 Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass
- EN 1096 Glass in Building-Coated Glass

17. WARRANTY

- Glass processor should ask for supervision of Şişecam Flat Glass before large scale production.
- The aim of trial production of coated glass accompanied by Şişecam Flat Glass experts is only to evaluate the machinery capabilities of the glass processor. Positive feedback of the evaluation should not be understood as a guarantee of high quality in production, therefore all responsibilities and charges should be covered by glass processor and Şişecam Flat Glass cannot be claimed to accept any responsibilities of end product.

- Spontaneous breakages can occur for several reasons in tempered glass products. One of them is Nickel Sulfide (NiS) inclusions. This "phenomenon" is not defined as production failure according to the related European Standards. So, the damages may occur due to spontaneous breakages are the sole responsibility of the glass processor, Şişecam Flat Glass doesn't accept any responsibility for this kind of damages.
- In case of a quality problem, the glass processor should inform immediately Şişecam Flat Glass, the glass processor must not cut or continue to process the glass without informing Şişecam Flat Glass. No requests shall be accepted after the glass has been handled or used, cut or processed by the glass processor or another third party. The glass processor will send the details of the product (barcode numbers, quantity etc) and some samples/pictures to Şişecam Flat Glass which are showing the defect. According to investigation results of the samples and pictures, Şişecam Flat Glass decides to organize a visit to the glass processor. The glass processor has to keep all claimed glass amount until the decision is declared by Şişecam Flat Glass.
- Şişecam Flat Glass will in his sole discretion determine to take the defective glass back or refund the purchase price. Any other direct or indirect costs will not be refunded.
- The information given in this document based on the compilation of experiences of Şişecam Flat Glass and has to be used only as a recommendation. Glass processor is the sole responsible for applications, and Şişecam Flat Glass will not be liable for these issues.

18. OTHER ISSUES

- Before the IGU goes into mass production, a mock-up must be produced and also the glass processor should approve it. It is suggested that after each mass production in the IGU factory, it should be checked against mock-up under day light condition.
- After the startup of project and installation of first reference facade, building owner, assemble subcontractor and glass processor should check it visually. If they agree that reference facade meets EN standards, contract terms and visually conformity, rest of glass should be continued to process.
- Coated glasses cannot be used in spandrel areas as opacified or enameled glass.
- Off-line coatings are prone to scratching and corrosion. Hence, coated glass cannot be evaluated as a monolithic pane and coating side must be placed facing the air cavity of IGU.
- During mass production, one glass should be washed after tempering process and controlled under day light condition once per hour.
- All processes (cutting, edge processing, thermal toughening, double glazing, etc.) must be done under the same processing facility. After each process, the glass must be sent to another one

immediately. If the processes are not carried out under the same facility, there is a big possibility of damage of the coated glass due to the storage conditions, transport and atmospheric conditions like solar heat, direct sunlight, rain etc. In this regard, all responsibility belongs to the glass processor in case of any glass quality complaints.

- All inspections/tests related with material/production/product which are mentioned in EN 1279-6 (Glass in building – Insulating glass units – Part 6: Factory production control and periodic test) must be done periodically. All datas should be recorded.
- All test instruments must be calibrated. It is recommended to make the tests in a conditioned laboratory.

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The signature below verifies that the glass processor has read and understood the full content of this processing guideline.

Company name

Name/Surname

Title

Date

Company stamp and signature