



ŞİŞECAM

FLAT GLASS

Temperable Low-E Glass

Temperable Solar Control Low-E Glass

Processing Guideline



TABLE OF CONTENTS

1. SCOPE OF APPLICATION	.....	3
2. STORAGE CONDITIONS	.....	3 - 4
3. DETERMINING THE COATED SIDE OF THE GLASS	.....	4
4. HANDLING	.....	4
5. CUTTING	.....	5 - 6
6. EDGE DELETION	.....	6 - 7
7. EDGE PROCESSING	.....	7
7.1. ARRISING	.....	7
7.2. GRINDING	.....	7 - 8
8. WASHING	.....	8 - 9
9. SCREEN PRINTING	.....	9
10. THERMAL TOUGHENING	.....	9 - 10
11. HEAT SOAK	.....	11
12. BENDING	.....	11
13. LAMINATION	.....	12
14. DOUBLE GLAZING	.....	13 - 14
15. QUALITY PARAMETERS	.....	14
16. WARRANTY	.....	14
17. OTHER ISSUES	.....	14 - 15

1. SCOPE OF APPLICATION

This processing guideline helps manufacturers to manufacture high-quality insulating glass units with the Şişecam Temperable Low-E and Şişecam Temperable Solar Control Low-E Glass. As the coated surface is prone to damage during the manufacturing processes, issues such as storage, transportation, handling and processing should be considered.

2. STORAGE CONDITIONS

- Coated glass should be stored in a dry, well-ventilated area to prevent any condensation on the glass surface or inside the 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, short-term temperature changes should be avoided in the storage area.
- 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 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 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 adverse effects on the coating.
- If any condensation 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 packing tape of the glass, silica gel must be removed completely. Any silica gel particles 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

- In the production of coated glass, a float glass is placed as a cover sheet of each pack. Unless otherwise is requested by customer, 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, then suction cups should have clean protective cover which is proper for coated glass. Şişecam Flat Glass suggest Eurotech MTC 2 brand of protective cover.
- Separator material as acid-free/neutral Lucite powder, cardboard and paper can be used. Care should be taken for clean separators; any dirt, oil and dust on the separators should be avoided.
- Avoid unnecessary contact with coated side of the glass. Any contact with coated side might damage the coating.
- Throughout the entire production process, coated glass panes should be handled only with waterproof, clean, suitable nitrile gloves.
- 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 with rulers and templates should be avoided.
- As the human 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 with 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.
- During cutting, the amount of cutting oil is quite important. Using more cutting oil than enough may damage the coating. Using less cutting oil than enough 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 pure 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.
- 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 for 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.

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 grinding disc.
- The width of the deleted area must be 10 mm if polyurethane or polysulfide is used as a secondary sealant (if argon gas is used inside the igu cavity, it is 11 mm) and 13 mm if silicone is used as an outer sealant (if argon gas is used inside the igu cavity, it is 15 mm).
- After edge deletion, ensure that the deleted part is totally cleaned out of the glass surface. If edge deletion is done insufficiently, yellowish linear lines may appear after tempering process. In addition to that, 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 from this undesirable vision, rotation speed, linear movement speed and pressure parameters of the grinding disc must be optimized in a best way. These parameters may vary according to trade mark of the cutting machine and grinding disc. 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 grinding disc. Şişecam Flat Glass suggest Fischler AE100 and Lukas HP150 brand of grinding discs.
- 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.
- If width of the edge deleted area is equal to or greater than 20 mm, it is more suitable to make edge deletion at a time by using a grinding disc with a suitable width. To make a large edge deletion

using narrow grinding disc side by side may cause bad vision appearance 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.

- 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 brittle 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

- Vertical edge grinding machines, equipped with clamping pads are not suitable for edge processing of the coated glass. 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 to not damage the coated surface.
- There should be a water pulverizing nozzle on the glass entrance section to keep the top belt wet and clean. 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.

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 height should be between 40 mm – 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.
- 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 de-ionised water with the conductivity less than 30 $\mu\text{S}/\text{cm}$, pH between 6.0 - 7.5, hardness maximum 5 Fr and temperature minimum 30 °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 are not in use; 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 any algae and other microorganism formation, 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.
- Washed panes must be stored in racks as interleaved with acid-free/neutral Lucite powder, clean and neutral cardboard or paper.

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 enamelled. The edge deleted surface should be checked accordingly.
- In screen printing process, cleaning of screen should be done with pure alcohol. Thinner based solvents can not 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 dusting 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 production trials before large scale production.

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 dusting 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 to not rub too hard on coating side.
- The tape measure should not contact to the coated surface of the glass while measuring dimension of glass.
- After tempering, glass panes should be interleaved with a separator material as acid-free/neutral Lucite powder, cardboard and paper. Şişecam Flat Glass suggest Degacryl M286 as Lucite powder.
- 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 stripes (zebra).

- 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 unit immediately.

11. HEAT SOAK

- Heat soak can be performed according to EN 14179-1 standard.
- The separating materials used during the 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 5 x 5 cm area. If the amount of glass particles is quite less than the limit described in the standart, it may be one of the reason that glass is broken during tempering and also heat soak process.
- Heat soak testing is such a method to reduce the risk of potential field failures by providing a defined level of confidence although it is not a 100% effective method.

12. BENDING

- It is suitable to bend the coated glass. Before mass production, a mock-up must be produced absolutely.
- 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.

13. 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.
- 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 scratches the coating.
 - Any contact of suction equipments with coated side of glass is not recommended. If it is not avoidable, clean protective cover 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.
 - In autoclaving, any contact of metal clamping on edges or spacer materials to coated surface should be avoided.
 - Pressurised 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.

14. DOUBLE GLAZING

- 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 height should be between 40 mm – 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.
- It should be ensured that the glass panes are moving continuously inside the washing machine.
- Always use de-ionised water with the conductivity less than 30 $\mu\text{S}/\text{cm}$, pH between 6.0 - 7.5, hardness maximum 5 Fr and water temperature minimum 30 °C.
- There should 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; 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 any algae and other microorganism formation, 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.
- In an insulated glass unit, 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.
- The IGU must be kept away from sunlight, rain etc. during transportation and storage.

15. 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.
- Customer should perform quality controls in all stages of processing steps.
- Coated glasses must be inspected according to the European Standard EN-1096.

16. WARRANTY

- Customer 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 customer. 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 customer and Şişecam Flat Glass cannot be claimed to accept any responsibilities of end product.
- 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. Customer is the sole responsible for applications, and Şişecam Flat Glass will not be liable for these issues.

17. OTHER ISSUES

- Before the igu goes into mass production, a mock-up must be produced and also the customer 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.

- 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 structure. After each process, the glass must be sent to another one immediately.