|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **1.0 Scope** | | | | | **2.0 Resource Required** | | |
| **1.1 Purpose:** The purpose is to provide the work instruction for operating Furnace.  **1.2 Area of Application:** Tempering Line 3 and 4  **1.3 Responsibility:** Shift Tempering Officer  **1.4 Accountability:** Tempering Production head | | | | | **2.1 Man:** Shift Tempering Officer  **2.2 Machine:** Tempering Machine  **2.3 Material:** Grounded Glass/Coated Glass/Drilled glass/Grid printed glass, Cleaning tools, | | |
| **3.0 Terms and Definition** | | | | | **4.0 Key Performance Requirements** | | |
| **3.1 TPD**: Tonnage per day  **3.2 SQM:** Square meter  **3.3 HMI:** Human machine interface  **3.4 HZB:** Heating zone  **3.5 QZB:** Quenching zone  **3.6 AZB:** Annealing(cooling) zone | | | | | **4.1 Quality:** Glass Should be Fulfilled with All Quality Parameter Regarding Tempering Process like General Bow, Edge Lift, Fragment, mechanical Strength which can make Glass Easy to fit into Solar Module.   * 1. **EHS:** Dust Pollution, Cut Injuries, burn injury, Noise level | | |
| **5.0 Frequency** | | | | | **6.0 Training & Communication** | | |
| **5.1** During production and when required as per the production planning | | | | | **6.1** Training on Tempering Machine Operation to be Given To all Shift Officer.  **6.2** Visual posters are to be used for Do’s & Don’ts & communication. | | |
| **7.0 Procedure** | | | | | | | |
| **7.1 Sequence of Operation** | | | | | | | |
| **7.1.1** The Following details Should be Checked Before operating The Machine**.**  **A.** Check all the surrounding boundaries of the Tempering Machine panel after receiving approval from Electrical department. | | | | | |  | |
| **B**. Turn on Power from the main panel after receiving approval from the Electrical department by Electrical team member.  **C.** Check all transport Drive Belt Should be Properly working. Also Check Bearing condition of shaft  **D**. Check Quenching and Cooling Felt ring Condition if Damage Then Replace  **E**. Check Kevlar roller conditions, and if roller rope is found damage, then replace it  **F**. check cullet particle does not Stuck into Furnace Block and Quenching plate. If found, then clear it.  **G**. Check furnace cage wheel pin if found damage then change wheel  **H**. Close both furnace and Quenching & cooling Section from Lisec HMI | | | | | |  | |
| **I**. check all furnace and Quenching belt are rotate in same Direction.  **J**. Now fit all furnace covers and close all Door of Cooling Zone for Safety Purpose. | | | | | |  | |
| * + 1. **Furnace Heating start up procedure:** | | | | | | | |
| **A.** Switch on the control from Lisec HMI | | | | | |  | |
| **B.** Set process temperature in heating zone  **1.** HZB 1    **2.** HZB 2  **3.**HZB 3 | | | | | |  | |
| **C.** Enter the Start time on same day with consider at least 3 hours to achieving the furnace heating  **D.** Heater ON, on the screen, until reaching process temperature. | | | | | |  | |
| **7.1.3. PROCEDURE FOR OPERATING** | | | | | | | |
| **A.** After attaining process temperature, set all zone temperature.  *Note: The heating zone has reached process temperature (660-680°C)*  **B.** Select heating profile, before sending glass  **C.** Set quenching plate position as per glass size.  **D.** Load the required recipe and enter size of glass on screen.    **E.** Press the key for starting automatic mode  (Press both buttons for put machine in auto mode (machine load recipe)    **F.** Cooling blower on, reaching required pressure    ***Note:*** *A bar lit in blue under the respective button indicates the key is active.*  **G.** Press the key for inlet glass inside furnace. | | | | | | C:\Users\Admin\Music\Documents\Downloads\WhatsApp Image 2025-10-03 at 9.59.49 AM.jpeg | |
| **7.1.4 Glass jammed inside furnace** | | | | | | | |
| 1. After confirming glass jam, take Lisec in hand mode and turn off blower and heating from HMI 2. Turn off Heating. 3. Turn off Blowers. 4. After taking Lisec in hand mode open furnace up to 180 mm 5. Take out the glass from the furnace with help of furnace cleaning tools shown in the photo. 6. Kindly ensure ceramic blocks must not be damaged while cleaning furnace. 7. After glass got clear from furnace, now clean furnace with help of pressurized air which is located near furnace i.e. **Air pipe**. 8. Confirm it, there should be no cullet left inside furnace. 9. Also check the furnace wheel, Drive healthiness, furnace belt and replace it if required. 10. Close the furnace up to 15mm. 11. Acknowledge (Clear) the alarm of cleaning mode. 12. Provide Heating to furnace 13. Now open the QZB. Clean this section if there are cullet / glass found. 14. Ensure the QZB section wheel, drive and timing belt 15. Now open the AZB. Clean this section if there are cullet / glass found. 16. Ensure AZB wheel, drive and Kevlar rope are in healthy condition. 17. Take help from engineering team if any abnormality is observed. 18. Operate AZB & QZB section to move individual transport units in manual operation use this key  & 19. Start the blower if the heating is achieved as per requirements. 20. Take Lisec furnace in Auto mode.  * Start automatic run * Switch to automatic operation  1. Take trial with 2 glasses and confirm quality specifications. 2. Start production continues if all quality specifications are under tolerance. | | | | | |  | |
| **7.1.5 Glass Breakage in the Quenching Zone** | | | | | | | |
| *Note: The tempering process is stopped by pressing the "Glass breakage” (heating zone or cooling zone) key. The key must be pressed and held for 2 seconds*   1. Press the **Glass breakage** key for 2 second. 2. Select nozzle QZB top 3. Select cooling nozzle QZB top 4. Open by pressing the **PLUS** key. Clean zone QZB. Check for glass fragments. 5. Close by pressing the **MINUS** key 6. Cancel the glass breakage by pressing the **“Glass breakage (heating or cooling zone)”** key again | | | | | | C:\Users\Admin\Music\Documents\Downloads\WhatsApp Image 2025-10-03 at 11.50.48 AM.jpeg | |
| **7.1.6 Cooling section** | | | | | | | |
| **A.**   * The bending tensile strength and distortion of glass are influenced by the cooling curve. * If the general distortion is “bulging inward”, there is insufficient cooling power on the upper surface. Position the top nozzle nearer to the glass lite. The correction value must be decreased. In 3-5mm steps depending on distortion.   **B.**   * If the general distortion is “bulging outward”, there is too much cooling power on the upper surface. The distance between top nozzle and glass lite is increased. In 3-5mm steps depending on distortion. | | | | | | **Distortion “inward bulging”**  **Distortion “outward bulging”** | |
| **7.1.7 Glass Quality Parameter** | | | | | | | |
| **a.** Ball Drop Test    *Note: The ball test is a common method to evaluate the strength and durability of glass. In this case, the test involves dropping a ball from a height of 1 meter onto the glass, and if the glass doesn't break, it passes the test.*  **b.** General Bow Check  **c**. Edge Lift Check  **d.** Fragment test    *Note: Thickness wise Fragmentation particles should be as below:*   * *3.2mm 40 pcs* * *2.8mm 40pcs* * *2.5mm 15 pcs* * *H/S glass 1 pcs*   **e.** Local Bow  **f.** Mechanical tensile Strength  *Note: Tensile strength should be >90 N/mm2 for 3.2mm fully tempered glass and >55 N/mm2 for 2mm HS glass* | | | | | |  | |
| **7.1.8** If Machine all condition ok found and If glass all Quality Parameter meets with Standard of Quality, then start the line. | | | | | | | |
| **7.2 Emergency condition tools or equipment’s required.** | | | | | | | |
| 1. Glass Breakage Tools   If Glass Breakage is in cooling zone, then we use metal rod to break Glass. | | | | | |  | |
| 1. Furnace Cleaning tools   If Glass Jam inside Furnace, we use fire irons for cleaning furnace | | | | | |  | |
| 1. Furnace cleaning tools   After cleaning furnace by glass removal tools, we use high pressure air pipe for remove culler particles from furnace | | | | | |  | |
| 1. Cullet Remover Spade | | | | | |  | |
| 1. e. Heat Resistance Hand Gloves   (Use for Cage wheel change) | | | | | |  | |
| 1. Fire Extinguisher | | | | | |  | |
| **7.3 Prevention & Detection** | | | | | | | |
| **7.3.1** All Quality Standard for Glass Should be required ok  **7.3.2** Continues monitoring the HMI for any alarm for power fail or drive fail | | | | | | | |
| **7.4 Controls Related to EHS** | | | | | | | |
| **7.4.1 PPE MATRIX** | | | | | | | |
|  | |  | |  | | |  |
| **Goggles** | | **Safety Shoes** | | **Hand Gloves** | | | **Arm Guard** |
| **7.4.2** Broken glass needs to dispose of in cullet bin without contamination of foreign material | | | | | | | |
| **8.0 EHS Compliance Obligations** | | | | | | | |
| **8.1** NA | | | | | | | |
| **9.0 Possible deviation & Impacts** | | | | | | **10.0 Proposed actions** | |
| **9.1** If prompt action is not taken in case of General Bow, Edge lift, Local bow, fragment Practical the Glass Quality will be impacted | | | | | | **10.1** Check the Machine Settings, Process Parameters, Blower Pressure, Condition of the sensor etc., and take appropriate action | |
| **11. Reference documented information** | | | | | | | |
| **11.1** Operation record & Process report of Tempering: 03 & 04 – TEMP /L4/001  **11.2** Work instruction of Tempering: 03 & 04 – TEMP/L3/006 | | | | | | | |
| **12. Revision History** | | | | | | | |
| **Revision No.** | **Date** | | **Description of changes** | | | | |
| 00 | 12.02.2020 | | Initial release. | | | | |
| 01 | 04.10.2025 | | Format standardized, revision history added, step correction done. | | | | |