SUBJECT OF THE OFFER

Glass tempering furnace model AG-1E50

(4-19 mm; 4 mm glass loading length 4.6 m)
with full convection



1. Description

1.1 Brief introduction

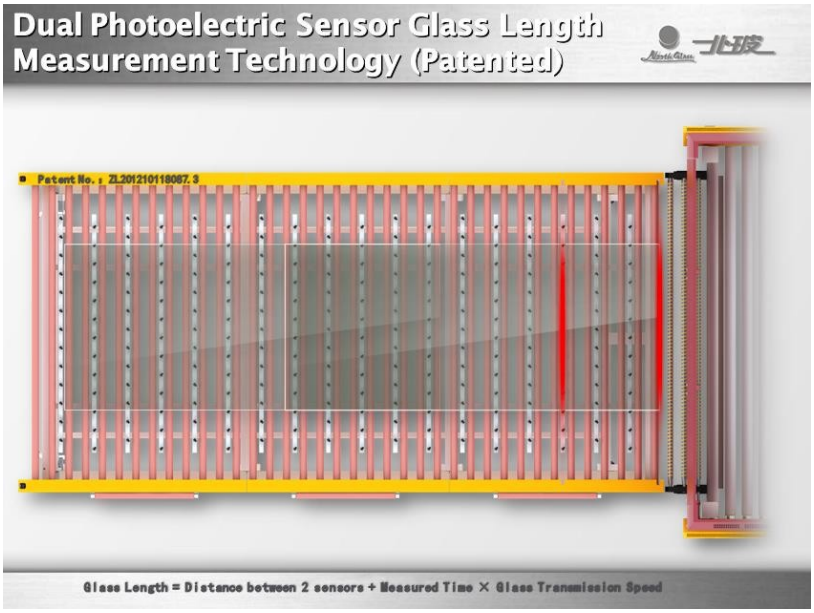
The AG series of forced-air convection glass tempering furnaces (NorthGlass fifth-generation furnace, incorporating proprietary patented convection technology) was developed to meet growing customer demand for more efficient tempering of low-emissivity glass, improved product quality and lower energy consumption. The AG series combines the advantages of a four-convection furnace and primarily offers higher productivity, superior product quality and easier process control. The furnace consists of loading conveyors, a heating section, upper and lower convection systems, a flat tempering/cooling section and an unloading conveyor. The equipment package also includes air ducts and the machine control system.

1.2 Loading table

The loading table is constructed of rubber-coated steel rollers. Each roller is driven by a round pulley installed on the drive side, except for the first roller, which is not driven. The table is equipped with a pneumatically operated, automatically activated vertical ball-transfer unit for easy glass positioning. Once the glass has been placed on the rollers, it is automatically conveyed to the furnace entrance and the rollers stop in the ready-to-load position. The computer controls every stage of the loading process. The infeed conveyor is fitted with non-driven side rollers for transverse loading of large sheets from either side of the loading table.

Key improvements

1.2.1 Glass length measurement using dual photoelectric sensors



Our patented technology ensures highly accurate glass-length measurement, helping to prevent dangerous collisions inside the chamber, most commonly caused by inaccurate glass measurement.

1.3 Heating section with convection system

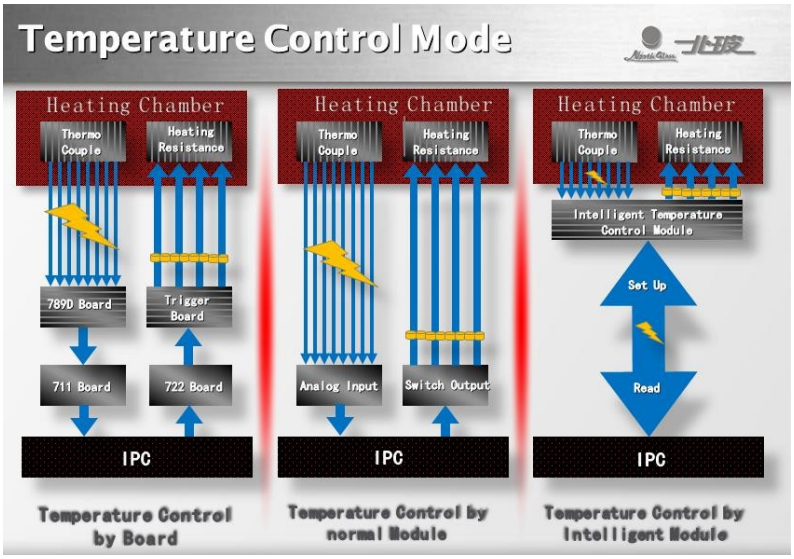
The heating section has a double-shell chamber lined with thermal insulation. Inside is a conveyor system using high-temperature-resistant ceramic rollers manufactured by Vesuvius, Haldenwanger or Ceradyne. Heating elements are installed in the upper and lower levels. The spiral heating elements are very easy to replace. Each heating zone is monitored by independent thermocouples and controlled by independent PID loops, ensuring exceptionally stable heating.

The rollers of the infeed conveyor and heating chamber move synchronously. Their motion is calculated by the automatic control system to ensure uniform glass heating. The upper section can be raised for maintenance. The upper and lower convection systems inside the chamber are suitable for tempering float glass and coated glass (hard and soft coatings), delivering the highest quality.

The high-temperature convection fans are made from special aerospace-grade superalloy and welded using a dedicated process. Effective sealing and thermal-bridge isolation prevent heat loss and provide long service life and stable operation. The fans are powered by reliable, efficient motors. With its well-designed heating, radiation

and convection systems, the furnace provides processing performance that meets the quality requirements for low-E and other glass types. If power fails, the glass can be removed using the emergency UPS system or a hand crank for manual roller drive.

1.3.1 Intelligent temperature-control module



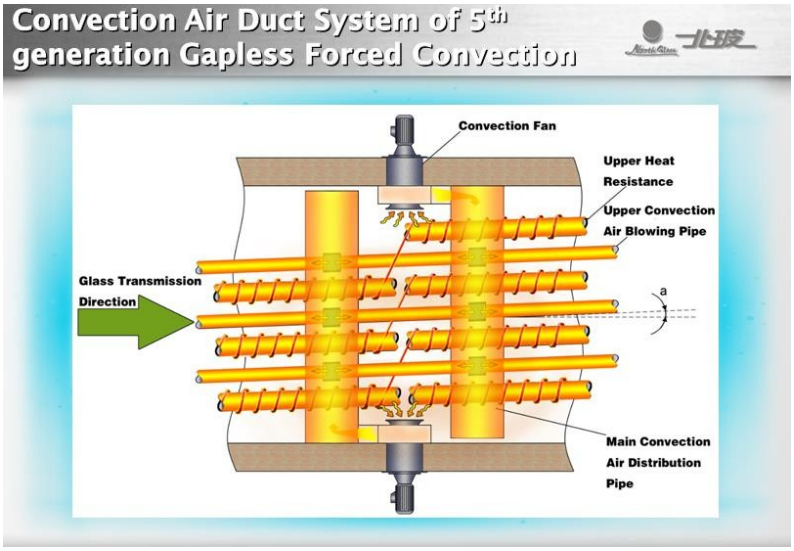
The intelligent temperature-control module developed by NorthGlass combines the company's extensive tempering experience with mature temperature-control technology supplied by an overseas partner. Temperature-flow control, calculations and output signals are handled directly by the module without passing through the PLC. Benefits include very simple wiring, improved interference immunity and a rapid 0.25-second temperature-control response.

1.3.2 Advanced gap-free arrangement of radiation and convection systems



Both heating and convection systems are arranged at an angle to the direction of glass travel. The interleaving, plug-in-style arrangement between the heating and convection zones helps balance heating between the center and edges of the glass, improves temperature uniformity and prevents the so-called leopard-spot effect.

1.3.3 Simple and efficient forced-convection system with easy maintenance



The forced-convection distribution system consists of heat-resistant steel pipes, ensuring lower pressure loss and greater resistance to deformation.

1.3.4 NorthGlass high-temperature convection fans

The fans are manufactured from aerospace-grade material (superalloy) using a special welding process. Their sealing properties and effective thermal-bridge isolation ensure long service life and stable fan operation. Constant and efficient motors power the forced-convection heating system.

1.3.5 More uniform airflow with an open-pipe structure



The AG-series forced-convection system uses an open structure made of heat-resistant steel pipes. It provides excellent return-air flow and prevents overheating of glass edges and thermal-stress marks caused by uneven hot-air return flow.

1.4 Tempering and cooling section

The air-blowing heads are divided into upper and lower sections. The nozzles are made of aluminum alloy, and the distance between the glass and the upper/lower nozzles can be adjusted for different tempering requirements. Multiple glass-transport rollers are located between the blowing heads. When a glass pane leaves the furnace, the roller drive in this section synchronizes with the furnace rollers to provide continuous transfer into the tempering section.

The glass sheets then move back and forth on the rollers (oscillate) for uniform tempering. While the glass oscillates, the quenching elements (nozzles) oscillate transversely to reduce stress and ensure uniform cooling. The blower immediately directs air through the ducts onto the glass surfaces. Air pressure and flow are controlled

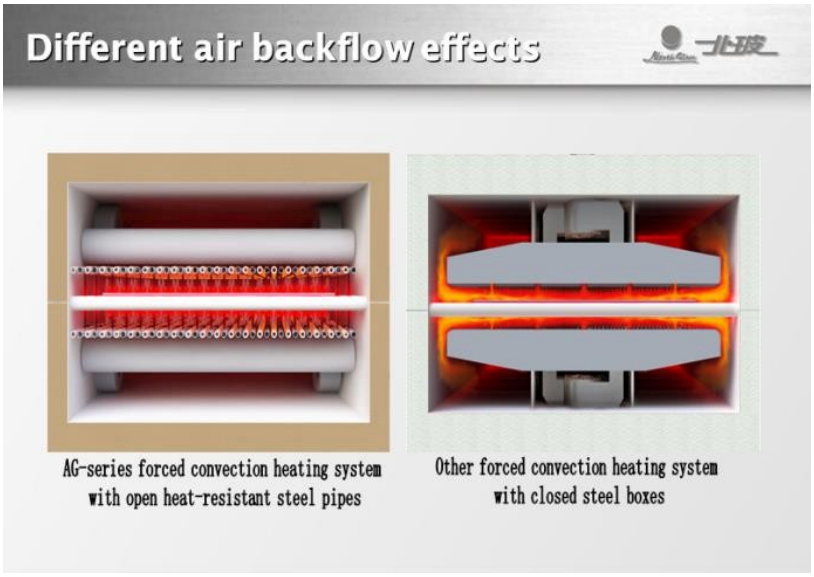
through blower speed, which is automatically adjusted by the control system. Kevlar cords are spirally wound around the rollers.

1.4.1 Convenient drive-belt replacement



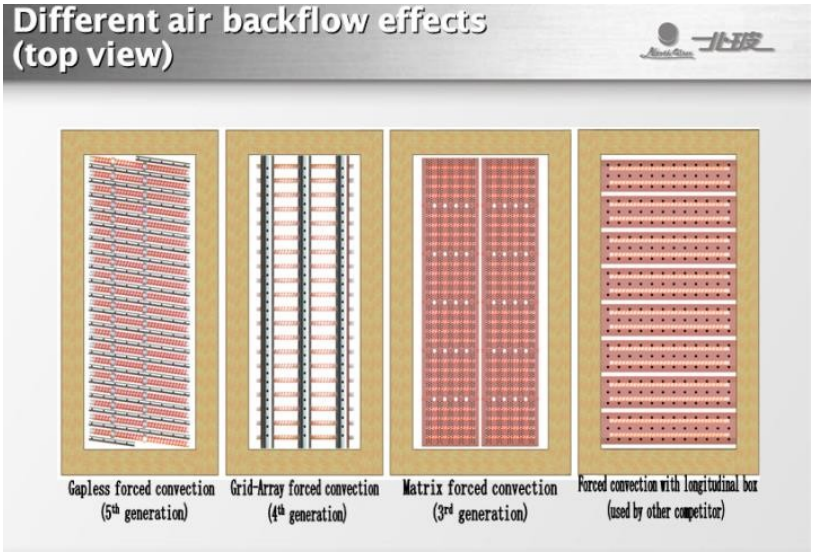
Thanks to this patented design, the drive belt can be replaced without stopping the conveyor, making replacement much easier and faster than before.

1.4.2 New air-nozzle structure



The unique internal air-duct structure, special staggered nozzle layout, optimized nozzle diameters and blowing angles provide truly gap-free air blowing so that air reaches the glass surface very uniformly.

1.4.3 Patented oscillating side walls, air supply and energy-saving LED lighting



1.4.4 New universal-joint screws for nozzle-wall oscillation



This solution provides more stable and uniform air-pressure distribution.

Note: The photograph is for reference only. The final appearance will depend on the final design.

1.5 Unloading table

The glass unloading table has the same design as the loading table. When the glass reaches the end of the table, an optical sensor stops it so that it can be removed.

1.6 Ventilation and air ducts

The fan section comprises high-efficiency centrifugal fans and an air-duct system. The fans are statically and dynamically balanced. Each drive motor is equipped with a frequency inverter for more economical operation. A butterfly valve opens and closes during each cycle. The system is actuated by a pneumatic cylinder and automatically controlled by computer. Air ducts connect the fan station to the nozzle blocks. Flexible connections prevent vibration transmission and balance pressure between the upper and lower nozzle blocks. The Seller supplies the air ducts from the fans to the air distributor. Valve adjustment is computer-controlled.

1.6.1 New PVC air duct

The new PVC duct is fully sealed to prevent air leakage. Its structure provides a more stable and efficient air inlet, and tensile strength has been increased threefold.

1.7 Control system

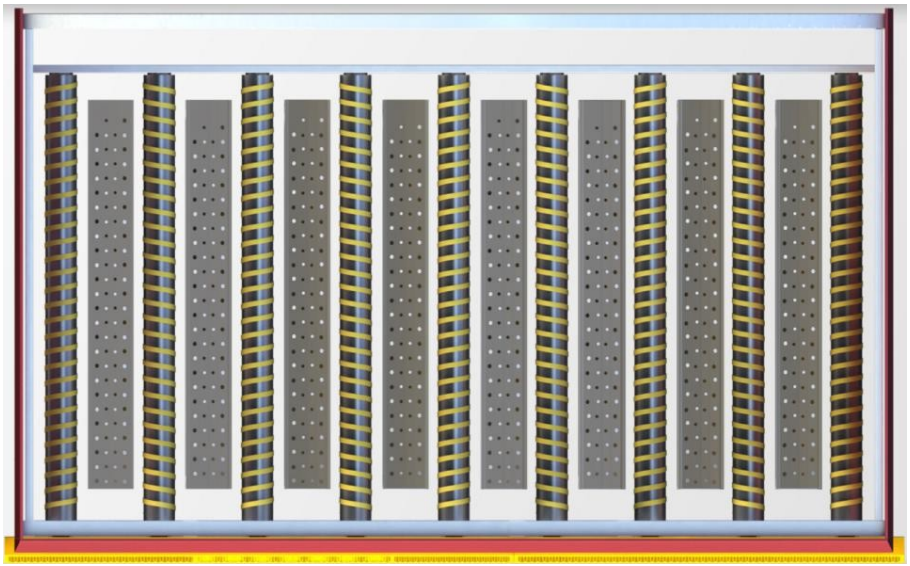
The control system includes storage and recall of process parameters (furnace recipes), including glass thickness and glass type, such as float glass from different suppliers. For a new order with a different thickness, size, color or type, the operator enters the process parameters and the system stores the data without limitation. When a similar order is received later, the relevant recipe can be selected and the machine automatically uses the stored processing data.

- Roller motion controller.
- Temperature-control controller.
- Tempering-process controller.
- Fault-warning system that identifies problems and indicates how to resolve them.
- Automatic preheating function: after the work shift, the furnace enters standby and heating-energy consumption falls to 15%, while the ceramic rollers remain in motion. The furnace automatically begins reheating before work starts the following day.
- The main control-computer display is installed with terminals on the control console. It shows analog process-status information: main screen, process-parameter screen, operating screen and machine-maintenance screen. Functions include writing and reading process parameters, automatic control, self-diagnostics and alarm display.
- The main-drive control system uses frequency inverters controlled by the computer.

The main program screen is displayed during normal production. In English, it shows the status of the glass in the furnace, drive arrangement, temperature of each zone, heating time, tempering and cooling, fan settings and the combined length of all glass pieces in the furnace. It keeps the operator informed about the entire process.

The process-parameter screen records loading-table travel while the foot switch is operated, upper and lower furnace-zone temperature settings, fan pressure, cooling time and tempering time. Operators use these windows during normal operation. The service screen is used only by maintenance personnel to test individual system components. The system-parameter window is used only by the manufacturer to test the machine.

1.7.1 New interface



With the new interface, all key parameters (heating power, air pressure, frequencies, blower distance, etc.) appear in a dialog box when the mouse pointer is positioned over any part of the furnace structure shown on the display, such as the heating chamber, convection fans or tempering section. This supports precise production control as well as operation, maintenance and repair.

2. Technical specifications

2.1 Technical specification

Tempering / cooling section	Specification
Maximum working width	2,850 mm
Maximum loading length	5,000 mm
Maximum glass loading area	2,850 × 5,000 mm (5-19 mm) 2,850 × 4,600 mm (4 mm)
Minimum glass size	150 × 300 mm
Glass thickness range (EN 12150)	4-19 mm
Glass thickness range EN 1863-1:2000 (HS)	4-10 mm

Note: For 4 mm glass, each individual pane must not exceed 2.5 m².

Float glass productivity at 65% loading	Loads per hour
4 mm	24
5 mm	20
6 mm	17
8 mm	12
10 mm	9
12 mm	7
15 mm	5
19 mm	3

Note: The productivity figures are indicative, based on tests using 1 × 2 m glass, and may vary depending on the dimensions of the tempered pieces.

General data	Value
Loading height	920 mm
Furnace roller diameter	95 mm
Upper furnace lifting height	550 mm
Heating time, 20°C to 700°C	12 h (intermittent) / 4 h (continuous)
Heating time, 550°C to 680°C	≤ 1 h
Glass discharge temperature at unloading table	≤ 30°C + ambient temperature
Yield	≥ 97% for 4-19 mm glass, three months after acceptance

Main technical data - clear float glass at 60-65% loading

Glass thickness mm	4	5	6	8	10	12	15	19
Overall bow ≤ ‰	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Local bow ≤ */300	0.18	0.15	0.12	0.08	0.08	0.08	0.08	0.08

Iridescence: Not visible to the naked eye under the following conditions: (a) viewing angle not less than 15° at a distance of at least 1,000 mm in natural light; (b) total glass-panel thickness not greater than 30 mm, or individual glass thickness not greater than 19 mm.

Notes: (a) Panel-size limits: 4 mm - maximum area ≤ 2.5 m² and maximum length ≤ 2 m; 5 mm - maximum area ≤ 4 m² and maximum length ≤ 2.5 m; 6 mm - maximum area ≤ 5 m² and maximum length ≤ 2.5 m. (b) Glass must be edge-polished before tempering. (c) Specifications for low-iron glass, shaped glass, glass with holes, patterned glass and printed glass will differ. (d) The last 25 mm is excluded from the acceptance test.

Utilities and electrical supply	Requirement
Air compressor - supplied by Buyer	Air flow: 1.5 m³/min; maximum pressure: 1 MPa
Air receiver - supplied by Buyer	Volume: 0.6 m³; operating pressure: 0.6 MPa; pressure resistance: 1 MPa
Furnace electrical supply	3 PH + N + PE, 400 V ±10%, 50 Hz
Fan control supply	3 PH + N + PE, 400 V ±10%, 50 Hz

Installed / required power	Power
Heating	approximately 1,420 kW
Convection drives, each with one inverter	42 kW - upper: 6 × 4 kW; lower: 6 × 3 kW
Auxiliary drives	20 kW
Tempering section	630 kW - 315 kW × 2
Total	approximately 1,700 kW

Note: The required supply capacity may vary and must correspond to the actual design power data provided after the contract is signed.

2.2 Glass standard

2.2.1 Standard for thermally toughened glass: EN 12150-1:2000.

2.3 Suitable glass types

- Float glass.
- Coated glass, including all temperable hard and soft coatings capable of withstanding approximately 700°C.
- Body-tinted glass.
- Enameled glass.
- Low-emissivity glass with emissivity ≥ 0.01.

2.4 Scope of supply

- Loading table.
- Heating section with continuous full convection, upper and lower.
- Flat tempering/cooling section.
- Unloading table.
- Control system.
- Electrical cabinets and PLC controllers.
- Fan stations with air-duct system.
- Blower frequency inverters for two 315 kW fan drives.
- Emergency UPS system.
- SO_2 gas supply system, excluding gas cylinder.
- Modem and software for remote diagnostics.
- Spare parts as listed in Appendix 1.

2.5 Control system

1. The entire control procedure, industrial-computer software and PLC program are developed by Shanghai NorthGlass Industrial Technology Co., Ltd., which owns all intellectual-property rights and is responsible for software-system upgrades.
2. SIEMENS S7-300 PLC.
3. EVOC industrial computer, manufactured in Taiwan.
4. SCHNEIDER or SIEMENS frequency inverters.
5. OMRON or equivalent optical sensors.
6. 17-inch LCD monitor.

3. Commercial terms

3.1 Responsibilities of both parties

3.1.1 Seller’s responsibilities

7. Manufacture and supply the equipment in accordance with the contract.
8. Pack and load the equipment in accordance with the contract and INCOTERMS 2010.
9. Provide one or two Seller’s technicians to supervise assembly and installation with assistance from the Buyer’s technicians. If installation time is exceeded for reasons attributable to the Buyer, the Buyer shall pay the Seller EUR 250 per person-day. If the delay is attributable to the Seller, the technicians shall remain until installation, commissioning, acceptance and training have been completed.
10. Provide the equipment-layout design and all consultations required by the Buyer in connection with delivery, installation and commissioning. The final installation-layout drawing shall be supplied no later than six weeks after the advance payment reaches the Seller’s account. The drawing shall precisely identify the electrical-power and compressed-air connection points specified by the Seller.
11. Provide complete operating documentation in English, including electrical diagrams, operating and maintenance instructions and principal process-parameter settings.
12. Provide a 24-month warranty commencing on the date the acceptance certificate is signed, or seven days after commercial production begins, and supply a set of free spare parts as listed in Appendix 1.
13. Provide long-term technical support and spare-parts availability, including assistance with new problems that may arise during production.

14. Train the Buyer's technical personnel. After commissioning, one Seller's technician shall remain for two weeks to train the Buyer's employees and assist with production.

3.1.2 Buyer's responsibilities

15. Make payments on time to the bank and accounts designated by the Seller, in accordance with the contract or invoice.
16. Provide electrical power and compressed air at the points specified by the Seller.
17. Provide local accommodation, meals, transport and communications for the Seller's technicians while they supervise installation and commissioning at the Buyer's plant. In the event of illness or accident, the Buyer shall take all necessary steps to care for them or arrange hospital transport and shall immediately notify the Seller. In particularly serious cases, the Seller shall arrange repatriation and replacement. The costs shall be borne by the Seller's personnel or, where initially paid by the Buyer, subsequently reimbursed by the Seller.
18. Provide the materials and personnel required for installation and acceptance: two qualified workers continuously; when required, four workers for moving heavy items; welding machines, grinders, drills and other power tools; a 10-ton crane or 35-ton mobile crane; and one 5-ton forklift with ropes, slings and related equipment.
19. When the equipment is delivered, ensure all conditions are met and all materials and utilities are available so installation and commissioning can be completed on schedule. For Buyer-caused delay, pay EUR 250 per person-day for each technician-day beyond the planned period. Notify the Seller no later than two weeks before the technicians' arrival that the installation site is ready.
20. Prepare the foundation at the installation site in accordance with the foundation drawing supplied by the Seller.
21. Supply all glass, power and labor required for commissioning and tests.
22. Provide connections and cabling from the Buyer's main power supply to the contracted equipment, including the connection between the inverters and fans, in accordance with the Seller's layout drawing.
23. Supply and install acoustic enclosures, if necessary, for the tempering/cooling station and fan stations. Also supply suitable inlet-air filters, silencers and environmental-protection measures. Noise insulation for the air ducts is the Buyer's responsibility. The Buyer shall provide suitable air-intake arrangements for the fan station.

3.2 Price and payment terms

3.2.1 Complete quotation for model AG1E50 (4-19 mm)

Item	Price / inclusion
a) NorthGlass flat-glass tempering furnace	EUR 626,000.00 net, DDP Karo Augustów
b) Infrared scanner - bottom-mounted RAYTGS150G5R1 line scanner, far focus	Included
c) Tilting arms on the loading and unloading tables	Included

3.2.2 Payment schedule

- 30% of the contract value as an advance payment, payable to the Seller's account immediately after signing the contract.
- 65% of the contract value payable when the machine is reported ready for shipment.
- 5% of the contract value payable immediately after three months have elapsed following successful completion of acceptance testing. The acceptance certificate shall be signed by both parties after installation, commissioning, testing and on-site training are complete.

3.3 Validity period

This offer is valid for 60 days.

3.4 Delivery schedule

The equipment will be ready for shipment two months after receipt of the 30% advance payment made immediately after contract signature. The goods will be shipped after a letter of credit covering 65% of the order value is obtained as the second installment at least 20 days before the planned delivery date, or after receipt of a telegraphic transfer covering 65% of the contract value as the second installment at least 20 days before the planned delivery date.

3.6 Force majeure

Neither the Seller nor the Buyer shall be liable for unforeseen circumstances arising from force majeure. In such a case, the parties shall notify each other of the event by fax. At the Buyer's request, the Seller shall send by registered mail a certificate issued by the China Chamber of Commerce or another competent authority.

4. Spare parts

A spare-parts package sufficient for one year of operation is included in the price. The list will be supplied after the contract is signed. See Appendix 1.

5. Environmental data

Environmental data are essential for machine design. The Buyer shall complete the data sheet after signing the contract. See Appendix 2.

6. Acceptance test and acceptance of equipment

An acceptance test shall be performed to verify correct furnace operation:

- A. Test products: three products representing different dimensions and thicknesses.
- B. Test criteria: applicable quality standards for finished products.
- C. Test method: When the Seller's technicians consider the equipment ready, acceptance testing shall begin. The test shall consist of 2 to 8 hours of normal continuous production. If a test fails, it may be repeated, but no more than three times. If more than three repeat tests are required, the equipment shall be deemed non-compliant.

Unless otherwise agreed, the equipment shall be deemed accepted after a two-hour production run during which the glass is tempered in accordance with the agreed standard. The acceptance certificate may be signed after the two-hour run.

Appendix 1 Spare parts list for A-series furnaces

No.	Description	Unit	A	AU	AG	Remarks
Heating section						
1	Ceramic tube	pcs	15	30	30	
2	Upper T-shaped ceramic tube	pcs	10	10	10	
3	Heating element	pcs	10	10	10	
4	Roller bearings	set	2	2	2	
5	Main-drive bearing	set	2	2	2	
6	Drive-section bearings	set	2	2	2	
7	Pulley bearings	set	2	2	2	
8	Main drive belt	pcs	5	5	5	
9	Insulation board	box	1	1	1	
10	Upper ceramic connecting unit	pcs	10	10	10	
11	Connecting screw, upper	set	4	4	4	
12	Rigid adhesive	kg	1	1	1	
13	High-temperature adhesive	kg		2	2	
14	Heating-element locking component	pcs	30	30	30	
15	Insulated ceramic components for heating elements	pcs	-	20	20	
16	Ceramic ring for suspending heating elements	pcs	-	20	20	
Cooling section						
1	Kevlar cord	m			40	
2	Roller bearing	set			2	
3	Main-drive bearing	set			2	
4	Drive-section bearings	set			2	
5	Wheel bearing	set			2	
6	Main drive belt	pcs			5	
7	Flexible air duct	pcs			1	
Loading / unloading table						
1	Roller bearing	set			2	
2	Self-aligning caster, when lifting platform is used	pcs			20	

Ventilation system						
1	Flexible connection at blower air outlet	pcs			1	
Electrical parts						
1	Thermocouples	pcs			10	
2	Contactor	pcs			2	
3	Relay	pcs			2	
4	1P circuit breaker	pcs			1	
5	2P circuit breaker	pcs			1	
6	3P circuit breaker	pcs			1	
7	Lower normally-open relay	pcs			2	
8	Lower normally-closed relay	pcs			2	
9	Knob indicator light	pcs			5	
10	Button indicator light	pcs			2	
11	2 A cartridge fuse	pcs			5	
12	6 A cartridge fuse	pcs			5	
13	SSR	pcs			5	
14	SSR	pcs			5	
15	Fast-acting cartridge fuse	pcs			10	
16	Fan	pcs			2	
17	Proximity sensor	pcs			1	
18	Photoelectric switch	pcs			1	
19	Travel switch for pressure roller	pcs			1	
20	Travel switch for swing lead-screw structure	pcs			1	

Note: The above list is preliminary. The final spare-parts list will be supplied with the delivery and may change as a result of technological upgrades.

Appendix 2 Local environmental conditions

Item	Value to be completed
1. Phase voltage	_____ V
2. Line voltage	_____ V
3. Frequency	_____ Hz
4. Humidity	_____ %
5. Air density	_____ kg/m³
6. Average summer temperature	_____ °C
6. Average winter temperature	_____ °C
7. Atmospheric pressure	_____ Pa
8. Altitude above sea level	_____ m

Appendix 3 Acceptance Certificate

The AG1E50 (4-19 mm) stepless convection glass tempering furnace is manufactured by Shanghai North Glass Technology Industrial Co., Ltd. and supplied to _____ in accordance with the contract dated _____.

The acceptance test of the above equipment was carried out in the presence of representatives of both parties, the Buyer and the Seller, on _____ at the Buyer's premises in _____.

The performance of the supplied equipment is hereby confirmed as satisfactory and fully compliant with the specifications attached to and forming part of the contract.

Being satisfied with the performance of the equipment, we hereby accept delivery and installation of the equipment and agree that the equipment warranty period shall commence today.

Signed on day _____ month _____ year _____

For the Buyer: _____

For the Seller: _____

Appendix 4 Main components of A-series glass tempering furnaces

No.	Component	Standard brand / feature	Specified
1	Gear reducer	China	
2	Drive or motor control	WEG, ABB, Siemens	WEG
4	High-temperature fan motor	Siemens, WEG	WEG
5	Cooling-section motor	Siemens, WEG, ABB	WEG
6	Pneumatic control components, excluding non-standard large-volume valve	Airtac	
7	Ceramic rollers	Vesuvius, Haldenwanger, Ceradyne	VESUVIUS
8	High-temperature fan	NorthGlass	
9	Insulation material	China	
10	Heating elements - radiation / convection	China	
11	Kevlar cord	China	
12	Aluminum profiles for cooling section	NorthGlass	
13	Roller bearing	NorthGlass	
15	Cooling fan	NorthGlass-Taixin, Ningbo Fangyuan	
16	Industrial PC	ADVANTECH	
17	LCD	Nodka	
18	PLC	Omron, Siemens	OMRON
19	Inverter below 15 kW - general use / bending	Schneider, Siemens / AB	SIEMENS
20	Inverter for large fan	Siemens, Schneider, AB	SIEMENS
21	Encoder	Omron, Banner	OMRON
22	Proximity sensor	Omron	
23	Photoelectric switch	Omron	
24	Temperature module	Shinko	
25	Contactor / thermal relay	Siemens, ABB	
26	Travel switch	Schneider	
27	Power supply, 24 V / 12 V	Schneider	
28	Intermediate relay	Omron, Phoenix	OMRON
29	SSR	China	
30	Button, knob	ABB, Schneider	
31	UPS, optional	INVT, Kehua	

Note: NorthGlass reserves the right to make required technical modifications using products of the same or better quality.