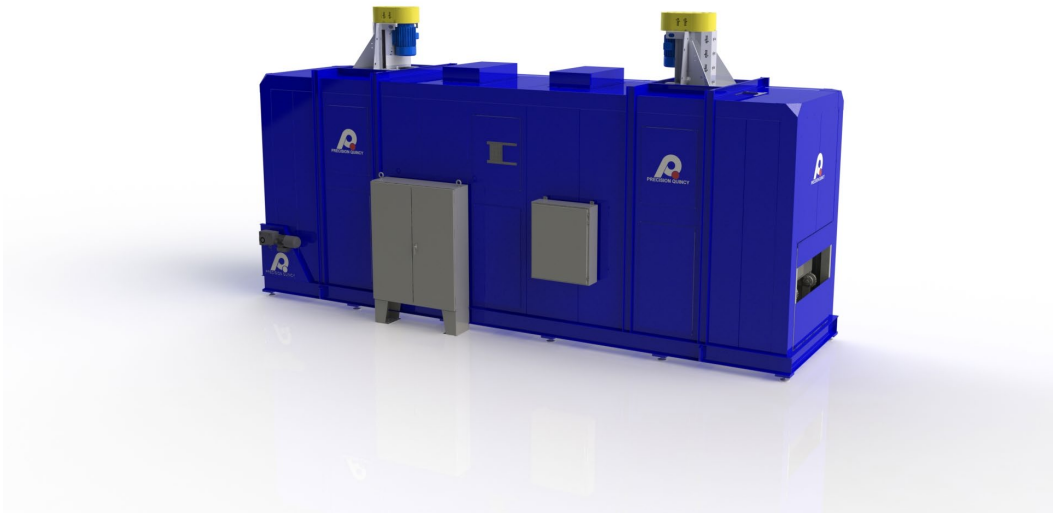


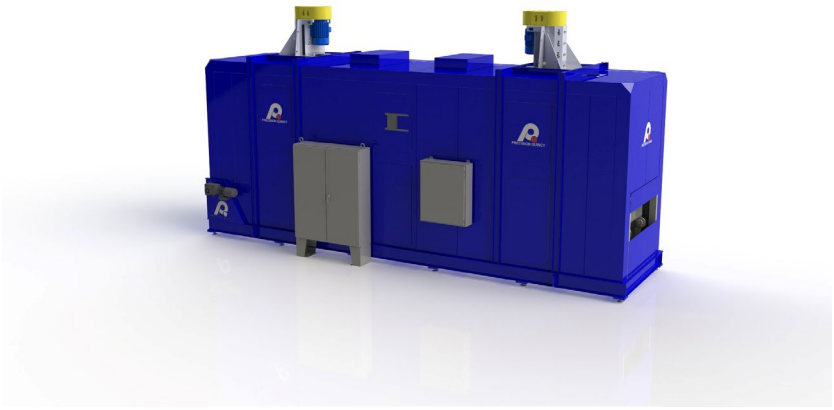
PRECISION QUINCY

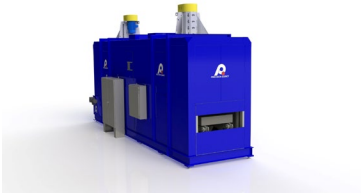
CASE STUDY

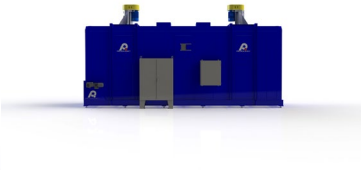
Electric Indexing Preheating Conveyor Oven System

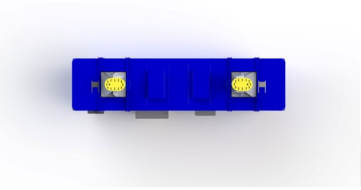
for Power-Electronics Burn-In Test Preparation

Dual-oven, staggered, single-pass indexing conveyorized preheat system for a leading electric vehicle manufacturer—delivering power-electronics motor-control modules to 100°C prior to automated burn-in, using alternating top-impingement airflow (4,000 FPM) with 144 kW electric heat and 21,600 ACFM recirculation to achieve 1 part/min throughput with a 115°C maximum product limit.









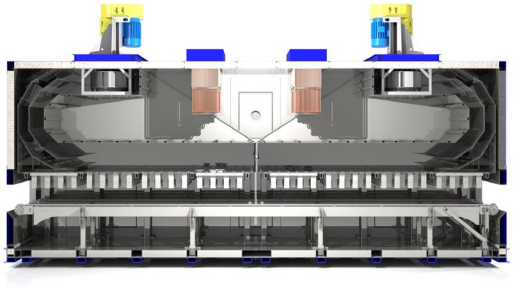
OVERVIEW

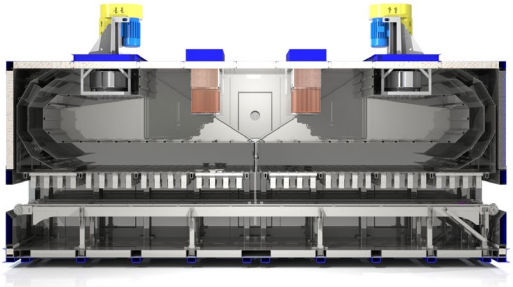
Precision Quincy engineered an electric indexing conveyorized preheat oven system for an industry-leading electric vehicle manufacturer to bring a critical power-electronics motor-control module to temperature prior to automated burn-in testing. By preheating the assemblies before electrical loading, the downstream burn-in operation can begin immediately, reducing warm-up delay and supporting high-volume production targets.

To meet a line demand of 1 part per minute, Precision Quincy implemented a staggered, two-oven architecture in which each oven indexes one pallet every two minutes. The system was validated through hot testing in Precision Quincy's applications lab with customer personnel on-site, using customer-built assemblies instrumented with embedded thermocouples to verify ramp performance and transfer temperature per the burn-in readiness specification.

Each oven is a Class B, electric preheat design with a dual control-zone rooftop package: (2) 24 in NYB PLR recirculation fans (10,800 ACFM each at 3.0 in. w.c.; 21,600 ACFM total) and (2) independent electric heater banks delivering 144 kW total heat input. A mirrored "nautilus" duct arrangement turns horizontal fan discharge through a 180° path into a bottom nozzle field, providing alternating top-impingement airflow at 4,000 FPM perpendicular to the product face.

The indexing conveyor system uses a two-strand engineering chain (700 mm strand spacing) with 440 mm index pitch, integrated into the customer's assembly line via SMEMA ready-to-send/ready-to-receive handshaking. The insulated, tongue-and-groove panel shell (4 in walls, 18-gauge aluminized skins on a structural steel frame) ships as one piece with overall dimensions of 293 in L × 90.32 in W × 153 in H.





CUSTOMER PROCESS REQUIREMENTS

The customer required a continuous preheat system to bring a critical power-electronics assembly—a motor-control module housed in an aluminum enclosure and transported on an aluminum pallet—to temperature prior to an automated burn-in test. Preheating enabled the burn-in operation to begin immediately at load, reducing required tester count and supporting the targeted production rate.

Process objective (preheat for burn-in testing)

- Preheat the electronic assembly prior to burn-in so the downstream tester can begin applying electrical load immediately.
- Ensure the part transfers into the burn-in process at temperature with no additional warm-up delay.

Temperature requirement

- Required preheat setpoint at transfer to burn-in: 100°C.
- Maximum product temperature limit: 115°C (must not be exceeded).

Throughput requirement (line rate)

- Line demand: 1 part per minute.
- Equipment strategy: (2) identical preheat ovens operating in a staggered sequence—each oven indexes 1 pallet every 2 minutes to achieve the combined 1 part/min line requirement.

Material flow & layout

- Product transport: aluminum pallets/skids on a two-strand engineering chain conveyor.
- Flow: single-pass, indexing movement through the preheat sequence.
- Line integration: SMEMA ready-to-send / ready-to-receive handshaking with upstream and downstream equipment.
- Conveyor datum height: 940 mm line standard.

Time-to-temperature requirement

- Parts must reach 100°C within 30 minutes.
- The preheat sequence includes 15 indexed stations per oven.

Hold-at-temperature requirement

- Must prevent temperature drop during unexpected downstream delays.
- System must maintain the part at the required transfer temperature so it still enters burn-in at 100°C.

Product envelope & loading

- Maximum product size: 1000 mm W × 200 mm H × 400 mm L.
- Maximum product weight: 35 lb.
- Orientation: part transported flat on the pallet; side rails/guides for repeatable placement.

Indexing / positioning requirements

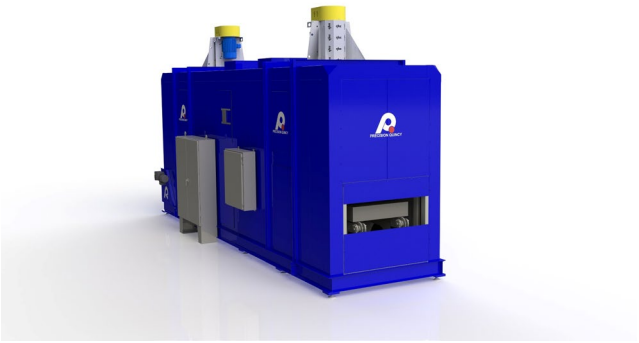
- Index pitch: 440 mm per index.
- High repeatability required; pallets must stop consistently at each station and align correctly at discharge.

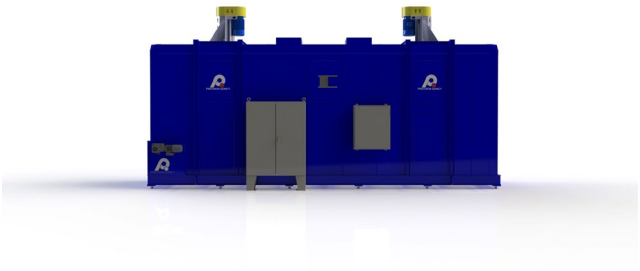
Validation / acceptance

- Customer-built assemblies instrumented with embedded thermocouples distributed throughout the unit.
- Acceptance based on meeting required temperature at all measurement locations per the customer’s test specification.

Site / installation constraints

- Installation location: customer facility, approximately 5,000 ft elevation.
- Electrical service: 480V / 3-phase / 60 Hz.





THERMAL PROCESS REQUIREMENTS

These thermal process requirements were developed to meet the customer's preheat needs for power-electronics motor-control modules, based on the application conditions, product thermal mass, and line rate requirements.

Temperature requirements

- Normal operating setpoint: 100°C (212°F).
- Maximum temperature capability: 115°C (239°F).
- Maximum product surface temperature limit: 115°C—must not be exceeded.

Load / product parameters

- Product: aluminum-enclosure motor-control module on aluminum pallet.
- Maximum product size: 1000 mm W × 200 mm H × 400 mm L.
- Maximum product weight: 35 lb.

Time-in-heat requirement

- 30 minutes maximum to reach setpoint across 15 indexed dwell stations.
- Each oven completes one pallet every 2 minutes (combined line rate: 1 part/min).

Heat input requirement

- Required heat input: 144 kW electric total per oven (2 independent heater banks, 72 kW each).
- Inconel-sheathed elements, 3 kW each, low watt density for even heat distribution.

Airflow delivery

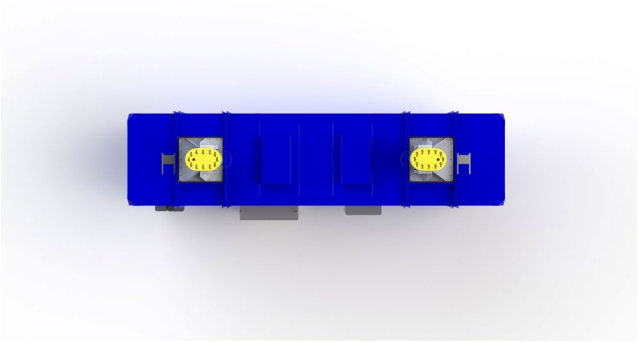
- Alternating top-impingement airflow delivered perpendicular to product face.
- Target nozzle discharge velocity: 4,000 FPM.
- Recirculation fans: (2) 24 in NYB PLR fans, 10,800 ACFM each at 3.0 in. w.c. (21,600 ACFM total).
- Fan speed control via Allen-Bradley PowerFlex 525 VFDs.

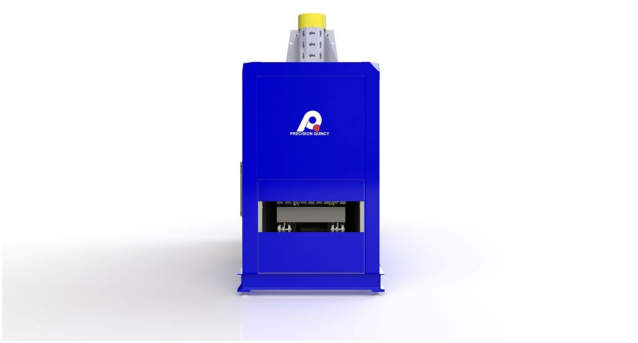
Temperature uniformity

- ±10°F (±5.6°C) from setpoint across the full work zone.

Altitude adjustment

- System designed for operation at approximately 5,000 ft elevation.
- Fan and airflow capacity sized to account for reduced air density at altitude.





EQUIPMENT CONCEPT & ARCHITECTURE

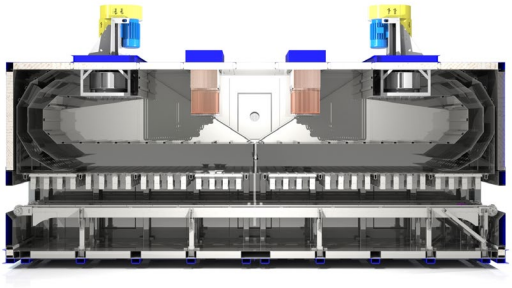
To deliver the thermal process requirements, Precision Quincy settled on the following equipment concept and architecture for the indexing preheat oven system.

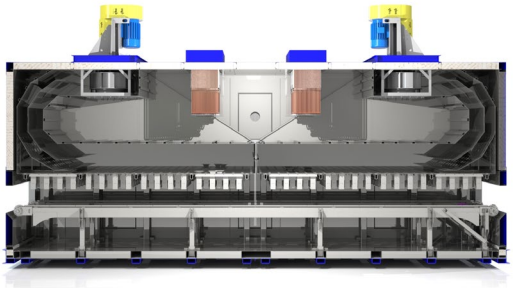
Overall concept

- Class B, electrically heated, single-pass indexing conveyorized preheat oven.
- Dual-oven, staggered architecture: (2) identical units operating in alternating sequence to achieve 1 part/min combined line rate.
- Heated zone length: 7,000 mm per oven; 15 indexed dwell stations.
- Overall dimensions per oven: 293 in L × 90.32 in W × 153 in H.

Airflow / ducting architecture (mirrored “nautilus” ducts)

- Double, mirrored-image “nautilus” duct arrangement—one duct per recirculation fan/heater bank.
- Fan shaft orientation: vertical. Air exits each fan horizontally, then turns through a 180° curved path down into the supply duct.
- Nozzle delivery: bottom-surface nozzle arrays direct air perpendicularly onto the top face of the product.
- Return path: after impingement, air flows up along both sides of each duct, back through the heater bank and to the recirculation fan.





Recirculation fan system

- Fans: (2) 24 in NYB PLR fans per oven.
- Airflow: 10,800 ACFM each (21,600 ACFM total per oven) at 3.0 in. w.c.
- Motors: 10 HP each.
- Fan speed control: Allen-Bradley PowerFlex 525 VFDs.

Heating system (electric)

- Total heat input: 144 kW per oven.
- Inconel-sheathed, 3 kW elements with low watt density; (2) independent heater banks (one per fan/duct zone).

Shell / construction architecture

- Insulated, tongue-and-groove panel shell: 4-inch walls with 18-gauge aluminized steel interior and exterior skins.
- Structural steel frame provides a robust and stable platform.
- Free-floating interior sheet-metal pans accommodate thermal expansion/contraction while minimizing through-metal paths.

Service access

- 6 access plugs per side: 3 for heat-chamber access; 3 for product-area access.

Indexing conveyor system

- Two-strand engineering chain: 700 mm strand spacing, 440 mm index pitch.
- Move speed: 6 m/min (19.7 ft/min); each index is a 440 mm controlled move.
- Drive: 1 HP helical bevel gearbox, VFD-controlled.
- Side rails and positioning guides for pallet registration at each station.
- Line integration: SMEMA ready-to-send / ready-to-receive handshaking.

Controls architecture

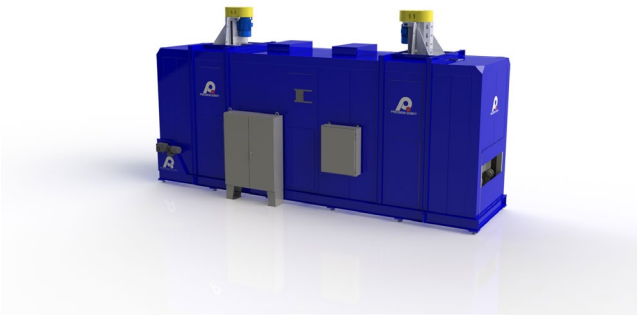
- PLC: Allen-Bradley Micro850.
- VFDs: Allen-Bradley PowerFlex 525 (recirculation fans and conveyor drive).
- Temperature monitoring: high-limit thermocouples in each control zone.
- Control cabinet: mounted inside oven structure.

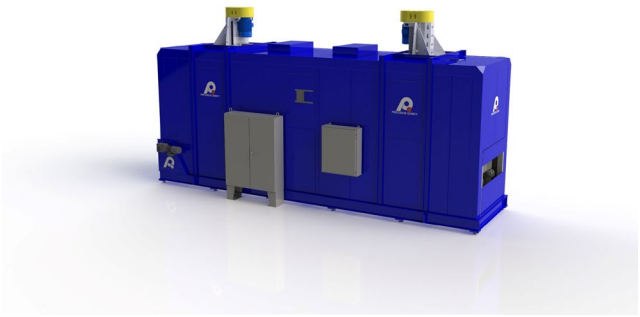
Safety systems

- NFPA 86 Class B compliance.
- Airflow switches on each recirculation fan as safety interlocks.
- High-limit thermocouples with independent cutout circuits.

Shipping & installation

- Ships as a single piece; recirculation fans removed from roof for over-road transport, reinstalled on-site.
- Supervised installation at customer facility.





TECHNICAL SPECIFICATIONS

Oven Configuration	
Type	Indexing conveyorized preheat oven, electric, single-pass
Quantity	(2) identical units, staggered operation
Heated Zone Length	7,000 mm (275.6 in) per oven
Indexed Stations	15 per oven
Overall Dimensions	293 in L × 90.32 in W × 153 in H (per oven)
Equipment Weight	Approximately 9,500 lb (per oven)

Thermal Performance	
Operating Temperature	100°C (212°F)
Maximum Temperature	115°C (239°F)
Temperature Uniformity	±10°F (±5.6°C) from setpoint
Heat Source	Electric, 144 kW total per oven
Heating Elements	Inconel-sheathed, 3 kW each; (2) independent heater banks
Airflow Pattern	Alternating top-impingement, perpendicular to product face

Recirculation / Airflow System	
Fans	(2) 24 in NYB PLR per oven
Airflow	10,800 ACFM each @ 3.0 in. w.c. (21,600 ACFM total per oven)
Fan Motor	10 HP each
Fan Speed Control	Allen-Bradley PowerFlex 525 VFDs
Nozzle Discharge	4,000 FPM target
Duct Architecture	Mirrored “nautilus” ducts (vertical fan shaft, 180° turn to bottom nozzle field)

Conveyor / Handling System	
Configuration	Two-strand engineering chain, single-pass indexing
Strand Spacing	700 mm
Index Pitch	440 mm per index
Move Speed	6 m/min (19.7 ft/min)
Drive	1 HP helical bevel gearbox, VFD-controlled
Conveyor Datum	940 mm
Line Integration	SMEMA ready-to-send / ready-to-receive handshaking

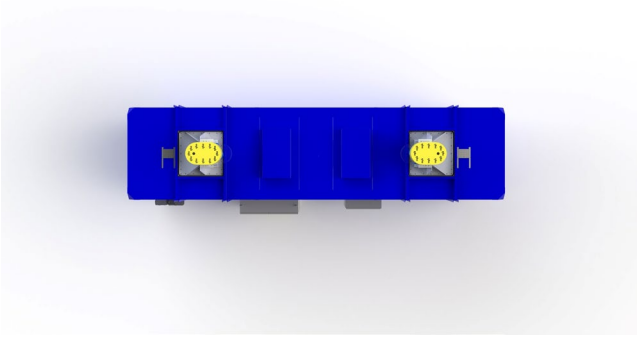
Product Specifications	
Product	Power-electronics motor-control module (aluminum enclosure on aluminum pallet)
Max Product Size	1000 mm W × 200 mm H × 400 mm L
Max Product Weight	35 lb
Throughput	1 part/min system rate (1 pallet / 2 min per oven, staggered)

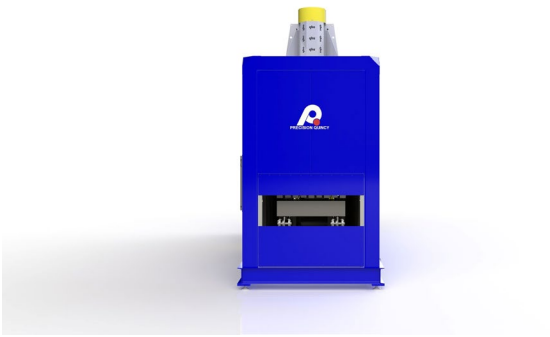
Construction Materials / Finish	
Primary Structure	Structural steel frame
Shell Type	Insulated tongue-and-groove panel
Interior/Exterior	18-gauge aluminized steel skins
Wall Thickness	4 inches
Interior Pans	Free-floating aluminized steel (thermal expansion tolerant)

Controls & Safety	
PLC	Allen-Bradley Micro850
VFDs	Allen-Bradley PowerFlex 525 (fans and conveyor)
Temperature Monitoring	High-limit thermocouples, independent cutout circuits
Control Cabinet	Mounted inside oven structure
NFPA Classification	Class B
Safety Interlocks	Airflow switches per fan, high-limit thermocouples

Utilities	
Electrical	480V / 3-phase / 60 Hz
Site Altitude	~5,000 ft above sea level (customer facility)

Testing & Validation	
Factory Test	Hot testing at Precision Quincy applications lab
Customer Witness	Customer personnel on-site during FAT
Validation Method	Customer-built assemblies with embedded thermocouples
Acceptance Criteria	Target temperature achieved at all measurement points per customer specification





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