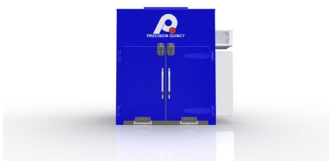
PRECISION QUINCY

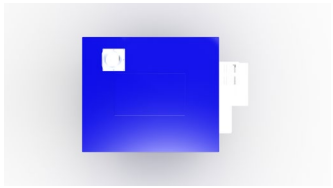
CASE STUDY

Electric Heated Cabinet Ovens

for Aerospace Component Testing

Batch of five identical electric-heated 40B-550 cabinet ovens engineered for controlled aerospace component testing — featuring a 48 in W × 30 in D × 48 in H work chamber, 350°F operating temperature with 550°F maximum capability and ±10°F uniformity, 31.5 kW electric resistance heating, seam-welded 316 stainless-steel interior, 750 lb maximum shelved capacity, NFPA 86 Class A safety architecture, and a WATLOW F4T ramp/soak controller with data acquisition.



OVERVIEW

A batch of five identical electric-heated cabinet ovens was engineered for aerospace component testing applications. The system was based on the 40B-550 platform and configured as a Class A unit for controlled batch processing at elevated temperature. The order was intended to provide multiple matching ovens with the same core thermal architecture and control approach across all units.

Each oven uses a 48 in W × 30 in D × 48 in H work chamber with full horizontal airflow, an operating temperature of 350°F, a maximum temperature of 550°F, and a stated work-area uniformity of ±10°F. Heating is provided by an electric heater bank delivering 31.5 kW total across 21 × 1,500 W elements, with a recirculation fan rated at 1,500 CFM and a PQ1 exhauster for Class A operation.

The ovens were configured with upgraded materials and features across the five-unit batch to meet aerospace service requirements, including seam-welded 316 stainless-steel interior walls, 316 stainless-steel recirculation airstream components, a 3/16 in 316 stainless-steel floor, and a 304 stainless-steel exhauster. Controls are housed in an oven-mounted NEMA 1 enclosure using a WATLOW F4T ramp/soak controller with data acquisition and USB access port.

CUSTOMER PROCESS REQUIREMENTS

The equipment was developed for an aerospace application requiring a group of matching cabinet ovens for repeatable elevated-temperature batch testing. The summary below focuses on the delivered equipment architecture and performance basis.

Application Requirement

- The equipment was used for testing aerospace components in a controlled elevated-temperature batch environment.
- A repeatable batch-process platform was required rather than a one-off laboratory fixture.
- Five identical ovens were required to support a multi-unit processing environment with consistent test conditions across all units.

Work Chamber / Load Requirement

- Required work chamber: 48 in W × 30 in D × 48 in H.
- Shelving required across the order, including 250 lb and 100 lb 316 stainless-steel shelves.
- Maximum shelved capacity per oven: 750 lb. Shelf spacing adjustable at 3 in increments.

Process Requirement

- The system had to support controlled elevated-temperature testing with repeatable airflow and temperature conditions across all five identical units.

Safety Requirement

- The ovens were configured as NFPA 86 Class A units. Maximum VOC load basis: 0.17 gal/batch.
- The process required powered exhaust, purge sequencing, and airflow proving as part of the safe operating sequence.

Utility / Site Requirement

- Required electrical service: 480V / 3PH / 60Hz. Full load amperage: approximately 45.7–46.6 A per oven.

Material / Construction Requirement

- Interior walls and recirculation airstream components were required to be 316 stainless steel with seam-welded interior wall construction.
- Floor: 3/16 in 316 stainless-steel plate. Exhauster: 304 stainless steel.

THERMAL PROCESS REQUIREMENTS

These thermal process requirements were established from the need for controlled thermal testing of aerospace components in a compact cabinet batch oven platform.

Temperature Capability

- Operating temperature: 350°F.
- Maximum temperature: 550°F.
- Required work-area uniformity: ±10°F.

Process Basis

- The thermal process basis is batch testing of aerospace components at controlled elevated temperature.
- The process required repeatable temperature exposure in matching ovens across the five-unit order, with consistent conditions at each unit.

Heat Input Requirement

- Heat source: electric resistance heat.
- Heater bank: 21 elements × 1,500 W. Total installed heat: 31.5 kW.
- Heat control basis: solid-state relay control.

Airflow Delivery Requirements

- Airflow style: full horizontal airflow.
- Recirculation airflow basis: 1,500 CFM at 2 in. w.c. Recirculation fan motor: 1.5 HP.

Exhaust / Ventilation Basis

- Exhaust fan: PQ1 exhauster. Exhaust airflow: 225 CFM at 1 in. w.c. Exhaust fan motor: 0.75 HP.
- Airflow switches used on both exhaust and recirculation fans as part of the safe operating sequence.
- Oven classification basis: NFPA 86 Class A. Purge timer basis: 3 minutes minimum.

Thermal Instrumentation / Control Basis

- Primary controller: WATLOW F4T ramp/soak temperature controller with data acquisition.
- Work-area thermocouple type: Type J.
- Work-area excess-temperature protection: Gefran 650L high-limit arrangement.

EQUIPMENT CONCEPT & ARCHITECTURE

To deliver the customer and thermal process requirements for this aerospace testing application, the following equipment concept and architecture was developed.

Overall Concept

- Five identical electric-heated 40B-550 cabinet ovens configured for aerospace component testing.
- Designed as Class A full-horizontal-airflow ovens in a standardized cabinet platform suited for multi-unit deployment with consistent performance across all units.

Heating Architecture

- Heat source: electric resistance. Total heat: 31.5 kW from 21 × 1,500 W elements.
- Heat control basis: solid-state relay control.

Airflow / Recirculation Architecture

- Airflow pattern: full horizontal airflow.
- Recirculation fan: 1,500 CFM at 2 in. w.c.; 1.5 HP motor.
- Exhaust fan: PQ1 exhauster — 225 CFM at 1 in. w.c.; 0.75 HP motor.

Chamber / Construction Architecture

- Internal work chamber: 48 in W × 30 in D × 48 in H.
- Wall thickness: 4 in. Insulation: 4 in of 6 lb mineral wool.
- Interior material: 316 stainless steel with seam-welded interior walls.
- Floor: 3/16 in 316 stainless-steel plate. Recirculation airstream components: 316 stainless steel. Exhauster: 304 stainless steel.
- Door style: two swing doors. Shelf spacing: 3 in adjustable increments. Maximum shelved capacity: 750 lb per oven.

Controls Architecture

- Oven-mounted NEMA 1 control enclosure, 42 in × 30 in × 12 in, listed to UL 508A Open Industrial Control Panel.
- WATLOW F4T ramp/soak controller with data acquisition. USB access port on enclosure face.
- Gefran 650L work-area excess-temperature controller. Type J thermocouples.
- Applicable standards basis: NFPA 79, NFPA 86, UL 508A.

Safety / Compliance Architecture

- NFPA 86 Class A architecture including purge timer (3-minute minimum), airflow switches on exhaust and recirculation fans, excess-temperature protection, and powered Class A exhaust.

Shipping / Installation Architecture

- Built as a standardized cabinet platform for multi-unit order fulfillment.
- First unit lead time was shorter than the remaining units within the five-oven batch.

TECHNICAL SPECIFICATIONS

Note: The specifications below reflect the as-built configuration. Any fields not explicitly stated remain intentionally omitted.

Oven Configuration	
Quantity	5 identical ovens
Type	Electric-heated 40 Series cabinet oven
Model	40B-550
Application	Aerospace component testing
Internal Work Chamber	48 in W × 30 in D × 48 in H
Airflow Style	Full horizontal airflow
Max Shelved Capacity	750 lb per oven
Shelf Spacing	3 in adjustable increments

Thermal Heat Power System	
Operating Temperature	350°F
Maximum Temperature	550°F
Uniformity	±10°F
Heat Source	Electric resistance heat
Installed Heat	31.5 kW
Heater Bank Basis	21 × 1,500 W elements

Recirculation / Airflow System	
Airflow Pattern	Full horizontal
Recirculation Airflow	1,500 CFM
Recirculation Static Pressure	2 in. w.c.
Recirculation Fan Motor	1.5 HP

Exhaust System	
Exhaust Fan	PQ1 exhauster

Exhaust Fan Material	304 stainless steel
Exhaust Airflow	225 CFM
Exhaust Static Pressure	1 in. w.c.
Exhaust Fan Motor	0.75 HP

Construction Materials / Shell System

Wall Thickness	4 in
Insulation	4 in of 6 lb mineral wool
Interior Material	316 stainless steel
Interior Wall Construction	Seam welded
Floor	3/16 in 316 stainless-steel plate
Recirc Airstream Components	316 stainless steel
Exhauster Material	304 stainless steel
Door Style	Two swing doors

Controls & Electrical

Temperature Controller	WATLOW F4T ramp/soak with data acquisition
High Limit	Gefran 650L
Thermocouples	Type J
Control Cabinet	Oven-mounted NEMA 1
Enclosure Size	42 in × 30 in × 12 in
Data Access	USB port on enclosure face
Panel Listing	UL 508A Open Industrial Control Panel
Primary Power	480V / 3PH / 60Hz
Full Load Amperage	45.7–46.6 A

Safety & Compliance

Classification	NFPA 86 Class A
Maximum VOC Load Basis	0.17 gal/batch
Purge Timer Basis	3 minutes minimum
Airflow Safety	Airflow switches on exhaust and recirculation fans
Applicable Standards	NFPA 79, NFPA 86, UL 508A

Process Summary

Product	Aerospace components
Market / Application	Aerospace testing
Process Type	Batch elevated-temperature testing
Order Structure	Five identical ovens

Key Verification Concept	Repeatable control of temperature, airflow, and safe operating limits across matching units in a demanding aerospace environment

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