PRECISION QUINCY

CASE STUDY

Electric Class A Cabinet Oven for Biological Sample Drying

Precision Quincy engineered this oven as a 40D-350 electric Class A cabinet oven for controlled batch drying of biological samples in a research environment. The delivered system combined a 55 in W × 30 in D × 60 in H work chamber, 284°F operating temperature, 350°F maximum temperature, ±10°F uniformity, full horizontal airflow, powered Class A exhaust for moisture removal, and data-capable temperature control in a compact cabinet-oven format.

OVERVIEW

The project was developed as a 40D-350 electric Class A cabinet oven for the the customer. The oven supported drying of biological samples within a university research setting that required controlled temperature, repeatable batch processing, flexible shelf loading, and documented process control.

The broader customer environment centered on agricultural and biological research activity associated with the the customer plant science and related research programs, including work conducted in the Carman research area. Within that setting, the oven supported laboratory-style drying and sample preparation work where batch size, sample geometry, and loading arrangement could vary from run to run.

The delivered oven was built around a 55 in W × 30 in D × 60 in H work chamber and operated at 284°F / 140°C, with a 350°F / 177°C maximum temperature and ±10°F / ±5.6°C work-zone uniformity. The thermal system used 24 kW of electric heat, full horizontal forced convection, a recirculation fan assembly delivering 2,496 CFM at 2 in. W.c., and a PQ1 exhauster delivering 225 CFM. The oven used the Class A configuration with powered exhaust, while the actual drying process carried no VOC load and used the exhaust path for moisture removal.

The final package included 2-inch insulated walls, 2 inches of 6 lb mineral wool insulation, an unpainted aluminized steel interior, a PQ Blue exterior, and an ANSI 61 gray NEMA 1 control enclosure. The controls architecture used an SSI 804 temperature controller with data acquisition, a dedicated excess-temperature controller, airflow proving, purge timing, two heater banks, and controlled cooldown logic.

CUSTOMER PROCESS REQUIREMENTS

The project required a compact, shelf-loaded drying oven for controlled biological sample processing in a university research environment. The customer needed a repeatable batch oven that supported research workflows rather than high-volume production, while still providing enough chamber space and thermal consistency for meaningful sample work.

Application requirement

- The system had to support drying of biological samples.

- The process had to work for batch-style sample preparation and drying.
- The oven had to support a research environment where sample type, batch size, and loading arrangement varied.
- The system had to provide controlled thermal conditions suitable for repeatable laboratory and research work.

Research-use requirement

- The oven had to fit a university setting tied to biological, agricultural, plant, grain, seed, soil, or related sample work.
- The process had to support sample preparation steps that benefited from controlled drying before analysis, storage, weighing, or further research handling.
- The equipment had to favor flexibility and repeatability over fixed single-product production.

Work chamber / loading requirement

- Required work chamber: 55 in W × 30 in D × 60 in H.
- The work area had to support shelf-loaded batches.
- The loading arrangement had to accommodate multiple sample trays, pans, or carriers within one chamber.
- Shelf adjustment had to support different sample heights and different batch layouts.

Operator / access requirement

- The oven required front loading and unloading through two swing doors.
- Operators needed straightforward control over the batch process, including fan operation, purge completion, and heat enable.
- The work area had to remain easy to load while avoiding excessive blockage of the airflow path.

Quality / control requirement

- The process required repeatable drying conditions at the target operating temperature.
- The oven had to maintain ±10°F uniformity through the work area.
- The customer required temperature control suitable for documented laboratory processing.
- The controls package needed to support data-capable process monitoring.

Safety / environmental requirement

- The oven had to be configured as an NFPA 86 Class A unit with a powered exhauster.
- The process required powered exhaust and purge sequencing before heat could be enabled.
- The actual drying load included no VOCs.
- The Class A solvent-capacity rating was 0.42 gal/batch o-xylene [rated capacity only; the actual process had no VOC load and used the exhaust for moisture removal].
- Safe operation required airflow proving for both exhaust and recirculation.

Site / utility requirement

- Required electrical service: 208V / 3PH / 60Hz.
- Design elevation basis: less than 1,000 ft.

THERMAL / PHYSICAL PROCESS REQUIREMENTS

The project required a controlled moderate-temperature drying process based on electric resistance heat, horizontal forced convection, Class A ventilation, and work-area temperature monitoring.

Temperature requirement

- Operating temperature basis: 284°F / 140°C.
- Maximum temperature basis: 350°F / 177°C.
- Required work-zone uniformity: ±10°F / ±5.6°C.

Drying-process requirement

- The process required controlled drying of biological samples.
- The thermal environment had to remove moisture in a repeatable way without localized overheating.
- The process depended on stable convective heating rather than direct radiant exposure.

Airflow / heat-transfer requirement

- Airflow direction basis: full horizontal airflow.
- The process required forced-convection airflow across the shelf-loaded work chamber.
- Chamber air velocity was approximately 200 FPM, which provided the heat-transfer rate needed for controlled drying through the load zone.
- Product arrangement had to allow air to move across the chamber without excessive restriction.

Heat-input requirement

- Heat source: electric resistance heat.
- Installed heat basis: 24 kW total.
- Heating arrangement basis: two 12 kW heater banks.
- The process required staged heater-bank operation through the temperature-control system.

Ventilation requirement

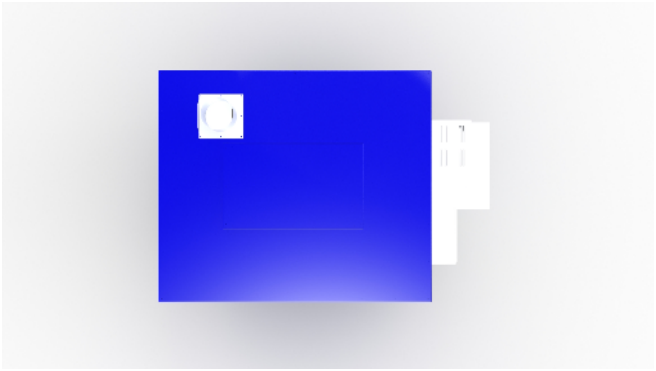
- The process required Class A exhaust and purge sequencing.
- Powered exhaust basis: 225 CFM.
- The actual drying load included no VOCs, and the powered exhaust served as the moisture-removal path.
- Rated Class A solvent capacity: 0.42 gal/batch o-xylene [rated capacity only; the actual process had no VOC load].
- Ventilation had to be established and proven before heat could be enabled.

Control / sequencing requirement

- The operating sequence required the oven to:
- Start the exhaust fan.
- Start the recirculation fan.
- Complete the purge cycle.
- Enable the heater banks.
- Heat and operate at the required setpoint.
- Minimum purge-time basis: 2 minutes.
- When enabled, the batch timer started after the oven reached temperature.

Cooldown requirement

- Fan operation had to continue during cooldown.
- Fans were not shut down while oven temperature remained above 250°F.
- The controls package included automatic fan shutdown and controller reset after the oven temperature fell below 150°F.



EQUIPMENT CONCEPT & ARCHITECTURE

To satisfy those requirements, Precision Quincy configured the project as a 40D-350 electric Class A cabinet oven with horizontal airflow, powered exhaust, flexible shelving, and interlocked controls suited for laboratory biological-sample drying.

Pages 6–8 — Technical Specifications

Overall concept

- One electric Class A cabinet oven.
- Compact front-loading batch configuration.
- Shelf-loaded work chamber sized for flexible laboratory and research batches.
- Full horizontal airflow across the work area.

Heating architecture

- Heat source: electric resistance heat.
- Total installed heat: 24 kW.
- Heating was split into two 12 kW heater banks.
- Each heater bank used twelve 1000 W elements.
- Heater-bank power was controlled through solid-state relays with backup contactors.

Airflow architecture

- Airflow pattern: full horizontal airflow.
- Recirculation fan assembly: 12.1875 in × 4 in RB fan assembly.
- Recirculation performance: 2,496 CFM at 2 in. W.c..
- Recirculation fan motor: 1.5 HP.
- Adjustable duct openings supported airflow setup across the chamber.

Exhaust / ventilation architecture

- Exhaust fan: PQ1 exhauster.
- Exhaust performance: 225 CFM.
- Exhaust fan motor: 0.75 HP.
- A fresh-air damper and powered exhaust path supported the Class A configuration, with the exhauster serving as the moisture-removal path for drying.
- Exhaust and recirculation airflow switches proved safe airflow conditions before heater enable.
- A timed purge cycle was integrated into the heat-enable logic.

Chamber / shell architecture

- Internal work chamber: 55 in W × 30 in D × 60 in H.
- Wall system: 2-inch insulated walls.
- Insulation: 2 inches of 6 lb mineral wool.
- Interior material: unpainted aluminized steel.
- Exterior finish: PQ Blue.
- Control enclosure finish: ANSI 61 gray.
- Approximate oven weight: 1,450 lb.

Door / loading architecture

- Door style: two swing doors.
- Shelf package: two 100 lb shelves.
- Shelf slotting: 3-inch centers.
- The chamber layout supported flexible shelf elevations for changing batch formats.

Controls architecture

- Primary temperature controller: SSI 804 with data acquisition.
- Excess-temperature controller: Gefran 650L.
- Control enclosure: NEMA 1 UL508A open industrial control panel.
- Enclosure size: 42 in × 36 in × 12 in.
- Separate operator controls were provided for the exhaust fan, recirculation fan, and each heater bank.
- The enclosure included purge complete, fan on, and heater-bank on indication.
- An enclosure cooling fan supported the control package.

Safety architecture

- Applicable standards basis: NFPA 79, NFPA 86, UL508A.
- Safety logic included:
- Exhaust airflow proving
- Recirculation airflow proving
- Timed purge before heat enable
- Excess-temperature shutdown
- Heat shutdown if required safe operating conditions were not met
- Controlled cooldown before fan shutdown

TECHNICAL SPECIFICATIONS

Oven Configuration	
Model	40D-350
Type	Electric Class A cabinet oven
Quantity	1 oven
Application	Biological sample drying
Airflow Pattern	Full horizontal
Work Chamber	55 in W × 30 in D × 60 in H
Doors	2 swing doors

Electrical System	
Power Supply	208V / 3PH / 60Hz
Full Load Amps	Approx. 79 A
Main Disconnect	100 A non-fused disconnect switch
Control Enclosure	NEMA 1
Enclosure Listing Basis	UL508A Open Industrial Control Panel
Enclosure Size	42 in × 36 in × 12 in
SCCR	5,000 amps

Heating System	
Operating Temperature	284°F / 140°C
Maximum Temperature	350°F / 177°C
Uniformity	±10°F / ±5.6°C
Heat Source	Electric
Installed Heat	24 kW
Heater Banks	2 × 12 kW

Element Basis	24 total elements, 1000 W each
Heater Control	SSRs with backup contactors

Recirculation / Airflow System

Airflow Pattern	Full horizontal airflow
Recirculation Fan Assembly	12.1875 in × 4 in RB fan assembly
Recirculation Airflow	2,496 CFM at 2 in. W.c.
Recirculation Fan Motor	1.5 HP
Chamber Air Velocity	Approx. 200 FPM

Exhaust / Ventilation System

Exhaust Fan	PQ1 exhauster
Exhaust Airflow	225 CFM
Exhaust Fan Motor	0.75 HP
Minimum Purge Time	2 minutes
Class A Solvent Capacity (Rated)	0.42 gal/batch o-xylene [process had no actual VOC load; exhaust was used for moisture removal]
Oven Classification	Class A

Construction

Wall Thickness	2 in
Insulation	2 in of 6 lb mineral wool
Interior Material	Unpainted aluminized steel
Exterior Finish	PQ Blue
Control Enclosure Finish	ANSI 61 gray
Approximate Weight	1,450 lb
Design Elevation	<1,000 ft

Shelving / Loading	
Shelf Package	2 × 100 lb shelves
Shelf Slotting	3 in centers
Shelf Type	Adjustable shelf support arrangement

Controls & Safety	
Main Temperature Controller	SSI 804 with data acquisition
Excess Temperature Controller	Gefran 650L
Airflow Proving	Exhaust and recirculation airflow switches
Indicators	Purge complete, fan on, heater bank on
Fan Shutdown Protection	Fans remained on above 250°F
Automatic Fan Shutdown	Below 150°F
Applicable Standards Basis	NFPA 79, NFPA 86, UL508A

Equipment Dimensions	
Overall Width	82.45 in
Overall Depth	43.02 in
Overall Height	92.89 in
Oven Body Width	65.00 in
Oven Body Depth	32.00 in
Oven Body Height	79.26 in
Height to Top of Control Enclosure	57.00 in
Work Area Bottom Above Floor	2.09 in
Exhaust Opening	3.25 in × 7.5 in

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