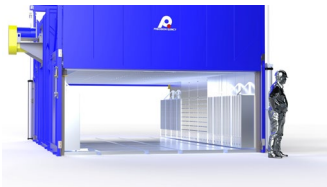




CASE STUDY

## Natural Gas Heated Walk-In Composite Curing Oven for Large Steel COPV Composite Curing

*Natural-gas-heated walk-in batch oven engineered for curing large steel composite overwrapped pressure vessels (COPVs)—featuring a 144 in W × 300 in D × 72 in H work chamber, top-mounted heat chamber, ±5°F uniformity at 230°F, combination horizontal-vertical airflow at 45,000 CFM total, 1,400,000 BTU/hr natural-gas firing, NFPA 86 Class A, powered vertical lift doors on both ends, and three-section shipment for field installation.*

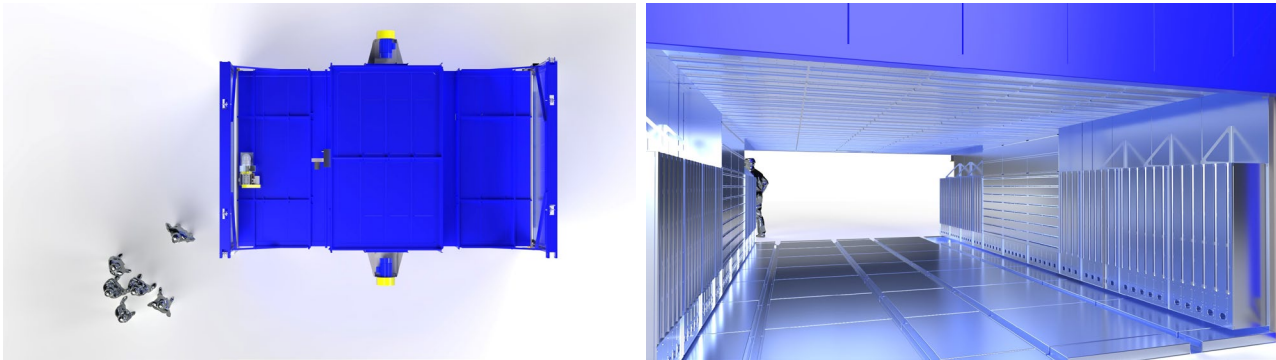


## OVERVIEW

A natural-gas-heated walk-in batch oven was engineered for curing large steel composite overwrapped pressure vessels (COPVs) and other long tubular composite structures. The equipment supports a composite curing application requiring a large pass-through work chamber, repeatable airflow delivery, and Class A safety architecture suited for solvent-bearing composite processing. These COPVs serve applications including natural gas storage, aerospace, aviation, drone, and marine service.

The oven was built around a 144 in W × 300 in D × 72 in H work chamber designed for an operating temperature of 230°F, a maximum temperature of 375°F, and required workroom uniformity of ±5°F at 230°F. To deliver that performance, a top-mounted heat chamber was used with an Access Combustion LP-18 burner rated at approximately 1,400,000 BTU/hr and two New York Blower 338 PLR plug fans delivering approximately 45,000 CFM total at 2.5 in. w.c. through a combination horizontal-vertical airflow pattern.

The equipment is configured as an NFPA 86 Class A oven with a PQ15 exhauster delivering approximately 1,098 CFM, a WATLOW F4T ramp/soak controller with data acquisition, and a NEMA 1 UL 508A open industrial control panel. The shell uses 4-inch-thick insulated panel construction with 4 inches of 6 lb density mineral wool, a structural steel base and frame, aluminized steel interior, and PQ Blue exterior. The design also includes powered vertical lift doors on both ends, an insulated floor with guide tracks, and a three-section shipment strategy for field installation.



## CUSTOMER PROCESS REQUIREMENTS

The equipment was developed for a composite manufacturing application requiring the batch curing of large steel composite overwrapped pressure vessels (COPVs) and similar long tubular composite structures.

### Application requirement

- The equipment had to process large steel composite overwrapped pressure vessels (COPVs) and related tubular composite structures.
- The oven had to support a curing process requiring repeatable heat delivery across a large batch chamber.
- The application required equipment suited for long, large-format composite pressure-vessel loads rather than small packaged product.
- The finished COPV products support applications including natural gas storage, aerospace, aviation, drone, and marine service.

### Work chamber / load requirement

- Required internal work chamber: 144 in W × 300 in D × 72 in H.
- Maximum product load basis: 2,500 lbs.
- The system had to support the loading and processing of long tubular composite pressure-vessel assemblies within a guided floor arrangement.

**Process requirement**

- The system had to support repeatable composite curing at a controlled operating temperature.
- A thermal process capable of holding a large work envelope to tight temperature tolerance was required.
- The process required airflow delivery that would maintain good heat transfer throughout the work area while accounting for large product geometry.

**Safety requirement**

- The oven was required to be designed as an NFPA 86 Class A unit.
- The equipment required appropriate exhaust, combustion, and control architecture for safe natural-gas-fired operation in a composite curing environment.

**Utility / site requirement**

- Required electrical service: 480V / 3PH / 60Hz.
- Required fuel: natural gas. Gas inlet pressure basis: 2 PSI.
- Natural gas flow basis: approximately 1,350–1,400 CFH.
- Air service inlet pressure: 80 PSI.
- Design elevation basis: less than 1,000 ft above sea level.

**Installation / shipment requirement**

- The oven body was designed to ship in three sections for field reassembly.
- Shipping access basis included a 12 ft × 16 ft dock door.
- The project required a large oven format while still remaining practical to transport and install.

**THERMAL PROCESS REQUIREMENTS**

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These thermal process requirements were established from the need to cure large steel composite overwrapped pressure vessels (COPVs) in a controlled, high-airflow batch environment.

**Temperature capability**

- Operating temperature: 230°F.
- Maximum operating temperature: 375°F.
- Required workroom temperature uniformity: ±5°F at 230°F operating temperature.

**Process basis**

- The thermal process basis is composite curing.
- The application requires repeatable heat delivery across a large work envelope processing large steel composite overwrapped pressure vessels and similar tubular composite structures.
- The process required consistent airflow and temperature control around large product geometry occupying substantial chamber space.

**Heat input requirement**

- Heat source: natural gas.
- Burner: Access Combustion LP-18. Heat input basis: approximately 1,400,000 BTU/hr.
- Natural gas inlet pressure basis: 2 PSI. Design elevation basis: less than 1,000 ft above sea level.

**Airflow delivery requirements**

- Required airflow style: combination horizontal-vertical airflow.
- Recirculation airflow basis: approximately 45,000 CFM total. Static pressure basis: 2.5 in. w.c.
- Air discharge concept included approximately 3,000 FPM supply slots with approximately 4,000 FPM bottom-row nozzles to force airflow below the load and into the center of the oven.

**Exhaust / ventilation basis**

- Exhaust airflow basis: approximately 1,098 CFM.
- Exhaust fan basis: PQ15 exhauster delivering approximately 1,098 CFM at 1 in. w.c.
- VOC design basis: approximately 0.6 gallons per batch on an o-xylene basis.
- Oven classification basis: NFPA 86 Class A.

**Thermal instrumentation / control basis**

- Primary temperature controller: WATLOW F4T ramp/soak controller.
- Work area sensing thermocouple type: Type J.
- The system includes work-area temperature control with additional overtemperature protection for the work area and combustion chamber.

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**EQUIPMENT CONCEPT & ARCHITECTURE**

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To deliver the thermal process requirements, the following equipment concept and architecture was developed for this composite curing application.

**Overall concept**

- One natural-gas-heated walk-in batch oven designed for curing large steel composite overwrapped pressure vessels (COPVs) and similar tubular composite structures.
- The design uses a top-mounted heat chamber and a pass-through vertical-lift-door arrangement.

**Heating architecture**

- Heat source: natural gas. Burner: Access Combustion LP-18. Heat input basis: approximately 1,400,000 BTU/hr.
- Burner control valve actuator: Siemens SQM41.25.
- Gas train arrangement: NFPA 86 gas train with double blocking valves and proof of closure. Gas inlet pressure basis: 2 PSI.

**Airflow / recirculation architecture**

- Airflow pattern: combination horizontal-vertical airflow.
- Recirculation fans: (2) New York Blower 338 PLR plug fans delivering approximately 45,000 CFM total at 2.5 in. w.c.; (2) 20 HP motors.

- Supply duct system uses 3,000 FPM slots with 4,000 FPM bottom-row nozzles to drive airflow below the load and into the center of the work area.
- Exhaust fan: PQ15 exhauster delivering approximately 1,098 CFM at 1 in. w.c.; 1 HP motor.
- The design includes fresh-air dampers, an exhaust damper, and airflow proving on process-critical fans.

**Chamber / construction architecture**

- Internal work chamber: 144 in W × 300 in D × 72 in H.
- Construction style: tongue-and-groove insulated panel construction with structural steel reinforcement and channel base frame.
- Wall system thickness: 4 inches. Insulation: 4 inches of 6 lb density mineral wool. Interior material: aluminized steel. Exterior finish: PQ Blue.
- Floor system: insulated floor with cart guide tracks and plate floor surface.
- The oven includes explosion relief plugs in the shell design.

**Door / access architecture**

- Door style: powered vertical lift door on both ends of oven. Door thickness: 4 inches.
- Doors include manual safety latches for personnel entry.
- Front and rear door functions are pneumatically actuated through dedicated raise/lower door controls.

**Controls architecture**

- Primary temperature controller: WATLOW F4T ramp/soak controller with data acquisition.
- Work area thermocouple type: Type J.
- Control enclosure: oven-mounted NEMA 1 UL 508A open industrial control panel.
- The design includes work-area excess-temperature protection, combustion-chamber excess-temperature protection, flame safety, gas pressure switches, airflow switches, and burner fault indication/reset.
- Flame safety package: Karl Dungs MPA4112.
- The control package uses a controller-based architecture rather than a PLC-based system.

**Shipping / installation architecture**

- The oven body was designed to ship in three sections.
- Top door mast sections are removable for shipping.
- Shipping and installation basis developed around a 12 ft × 16 ft dock access opening.

**TECHNICAL SPECIFICATIONS**

Oven Configuration	
Type	Natural-gas-heated walk-in batch oven
Quantity	1 oven
Application	Curing large steel composite overwrapped pressure vessels (COPVs) and similar tubular composite structures
Internal Work Chamber	144 in W × 300 in D × 72 in H
Heat Chamber Arrangement	Top-mounted heat chamber
Door Arrangement	Powered vertical lift doors on both ends

<b>Shipment Style</b>	Three-section shipment for field reassembly
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**Thermal Heat Power System**

<b>Operating Temperature</b>	230°F
<b>Maximum Operating Temperature</b>	375°F
<b>Temperature Uniformity</b>	±5°F at 230°F
<b>Heat Source</b>	Natural gas
<b>Burner</b>	Access Combustion LP-18
<b>Burner Heat Input</b>	Approx. 1,400,000 BTU/hr
<b>Natural Gas Inlet Pressure</b>	2 PSI
<b>Natural Gas Flow Basis</b>	Approx. 1,350–1,400 CFH
<b>Design Elevation</b>	< 1,000 ft above sea level

**Recirculation / Airflow System**

<b>Airflow Pattern</b>	Combination horizontal-vertical airflow
<b>Recirculation Fans</b>	(2) New York Blower 338 PLR plug fans
<b>Recirculation Airflow</b>	Approx. 45,000 CFM total
<b>Recirculation Static Pressure</b>	2.5 in. w.c.
<b>Recirculation Fan Motors</b>	(2) 20 HP
<b>Supply Duct Discharge</b>	Approx. 3,000 FPM slots
<b>Lower Discharge Rows</b>	Approx. 4,000 FPM nozzles

**Exhaust System**

<b>Exhaust Fan</b>	PQ15 exhauster
<b>Exhaust Airflow</b>	Approx. 1,098 CFM
<b>Exhaust Static Pressure</b>	1 in. w.c.
<b>Exhaust Fan Motor</b>	1 HP
<b>Ventilation Basis</b>	NFPA 86 Class A / VOC ventilation

**Construction Materials / Shell System**

<b>Shell Style</b>	Tongue-and-groove insulated panel construction with structural steel reinforcement
<b>Wall Thickness</b>	4 in
<b>Insulation</b>	4 in of 6 lb density mineral wool
<b>Interior Material</b>	Aluminized steel
<b>Exterior Finish</b>	PQ Blue
<b>Floor Feature</b>	Insulated floor with cart guide tracks and plate floor surface

<b>Door Style</b>	4 in powered vertical lift doors on both ends
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<b>Safety &amp; Compliance</b>	
<b>Classification</b>	NFPA 86 Class A
<b>VOC Design Basis</b>	Approx. 0.6 gal/batch (o-xylene basis)
<b>Flame Safety</b>	Karl Dungs MPA4112
<b>Gas Train</b>	Double blocking valves with proof of closure
<b>Airflow Proving</b>	Provided on process-critical fans
<b>Applicable Standards</b>	NFPA 79, NFPA 86, UL 508A

<b>Controls &amp; Electrical</b>	
<b>Temperature Controller</b>	WATLOW F4T ramp/soak controller
<b>Data Acquisition</b>	Non-encrypted
<b>Thermocouples</b>	Type J
<b>High-Limit Protection</b>	Work area and combustion chamber excess-temperature protection
<b>Control Cabinet</b>	Oven-mounted NEMA 1 UL 508A open industrial control panel
<b>Burner Actuator</b>	Siemens SQM41.25
<b>Primary Power</b>	480V / 3PH / 60Hz
<b>Full Load Amperage</b>	59.8 A FLA
<b>SCCR</b>	30,000 A
<b>Compressed Air Requirement</b>	80 PSI inlet pressure

<b>Process Summary</b>	
<b>Product</b>	Large steel composite overwrapped pressure vessels (COPVs) / tubular composite structures
<b>Market / Application</b>	Composite curing for natural gas storage, aerospace, aviation, drone, and marine COPV applications
<b>Process Type</b>	Batch curing in a Class A natural-gas-heated walk-in oven
<b>Load Basis</b>	Up to 2,500 lbs max product load
<b>Key Verification Concept</b>	Repeatable control of temperature, airflow, combustion, VOC handling, and safe operating limits across a large work envelope



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