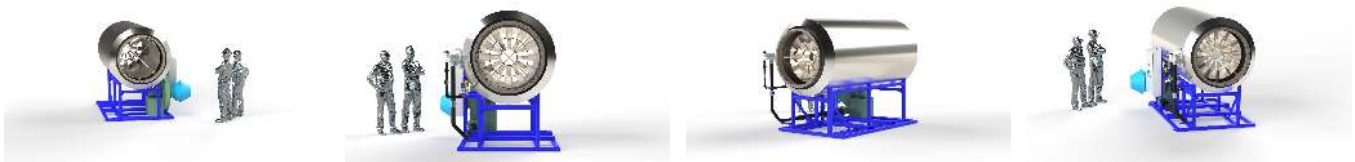




CASE STUDY

Natural Gas Heated Process Air Duct Heater for Ethanol Plant Air Preheating

Precision Quincy engineered this oven as a skid-mounted natural-gas-heated duct heater for ethanol plant service. The unit was designed to heat a high-volume process airstream in one pass, raising inlet air from 0°F to 40°F at 27,000 ACFM for downstream plant operations. The equipment combines a cylindrical insulated duct section, a Sela Superflame 1500 burner package, internal mixing vanes, and a remote-blower architecture suited for integration into larger plant air systems.



OVERVIEW

Precision Quincy engineered this oven as a natural-gas-heated process air duct heater for ethanol plant service. Rather than heating product inside a batch work chamber, this equipment heats a continuous high-volume airstream that is then used by the customer's downstream process. The unit was designed to take 0°F inlet air and increase it to 40°F in a 27,000 ACFM once-through airflow stream, providing controlled air preheat for cold-weather plant operation.

The system is built around a 46-inch inner duct diameter and an overall duct section length of approximately 150 inches. Precision Quincy used a Selas Superflame 1500 burner rated at 1,500,000 BTU/hr firing into the duct section, where the burner heat is blended into the process airstream through an internal mixing section. The design includes internal mixing vanes to help distribute heat across the air stream before discharge to the customer's downstream equipment.

The heater is mounted on a structural skid and supplied with a remote process-air blower by others and an exhaust system by others. The combustion system includes a Karl Dungs gas train, Siemens gas valve actuator, direct spark ignition, flame safeguard controls, and UV flame detection. Controls are housed in a NEMA 4 enclosure with a WATLOW F4T temperature controller with Ethernet connectivity. The duct section uses double-wall construction with a rolled steel inner shell, insulated wall cavity, and an industrial exterior suited for plant installation.



CUSTOMER PROCESS REQUIREMENTS

This oven was developed for an ethanol plant application requiring the preheating of process air before use in downstream operations. This equipment was not intended to thermally process discrete parts or products inside an oven chamber. Instead, the customer required a dedicated air-heating module capable of delivering a controlled temperature rise across a large airstream under cold ambient inlet conditions.

Application requirement

- The equipment had to heat a continuous process airstream for ethanol plant service.
- The system had to take 0°F inlet air and raise it to 40°F.

- The unit had to support downstream plant processes requiring a warmed airflow stream rather than direct product heating.
- This project is one of multiple Precision Quincy systems built for ethanol plant process-air heating.

Airflow / throughput requirement

- Required process airflow: 27,000 ACFM.
- Required temperature rise: 0°F to 40°F.
- The air stream passes through the unit in one pass and is then used by downstream equipment.

Construction / integration requirement

- The heater had to be built as a skid-mounted duct section for integration into the customer's larger air-handling system.
- The process-air blower is remote and supplied by others.
- The system required a combustion and controls package that could be integrated into plant utilities and ductwork.

Safety requirement

- The heater was designed as a gas-fired Class A duct heating system with flame safety, airflow proving, gas-pressure supervision, excess-temperature protection, and purge sequencing.
- The combustion controls package had to support safe startup, burner supervision, and fault shutdown in accordance with the project control and safety architecture.

Utility / site requirement

- Required electrical service: 575V / 3PH / 60Hz.
- Required fuel: natural gas.
- Natural gas inlet pressure: 2 PSI minimum design, with gas train design maximum of 5 PSI.
- Natural gas flow basis: 1,500 CFH.
- Design elevation: below 1,000 ft.

Installation / shipment requirement

- The unit was designed as a preassembled skid-mounted duct section.
- Approximate shipped weight: 6,500 lb.
- Approximate overall dimensions: 98 in W × 150 in L × 100.88 in H.
- Required dock / access basis: 12 ft W × 16 ft H.

THERMAL / PHYSICAL PROCESS REQUIREMENTS

These thermal process requirements were established from the customer's need to heat a high-volume ethanol-plant process airstream under cold inlet-air conditions.

Temperature capability

- Inlet air basis: 0°F.
- Outlet air basis: 40°F.
- Temperature rise basis: 40°F.
- Maximum stated operating temperature basis: 40°F, assuming 0°F inlet temperature.

Process basis

- The thermal process basis is once-through heating of a process airstream, not batch heating of product inside a work chamber.
- The heated air is delivered to downstream plant processes after passing through the duct heater.

Heat input requirement

- Heat source: natural gas.
- Burner: Selas Superflame 1500.
- Burner capacity: 1,500,000 BTU/hr.
- Natural gas flow basis: 1,500 CFH.
- Fuel inlet pressure basis: 2 PSI minimum design, 5 PSI maximum design.
- Regulated gas pressure at gauge: 30 in. W.c.

Airflow delivery requirements

- Process airflow basis: 27,000 ACFM supplied by others.
- Burner combustion blower basis: NYB 2306A7.5 blower.
- Combustion blower performance: 287 CFM at 42 in. W.c.
- Combustion blower motor: 7.5 HP.
- Airflow path: one-pass duct heating with internal mixing section and vanes.

Exhaust / ventilation basis

- Exhaust fan: supplied by others.
- The overall system requires exhaust capacity sufficient to remove combustion products from the duct-heating process.

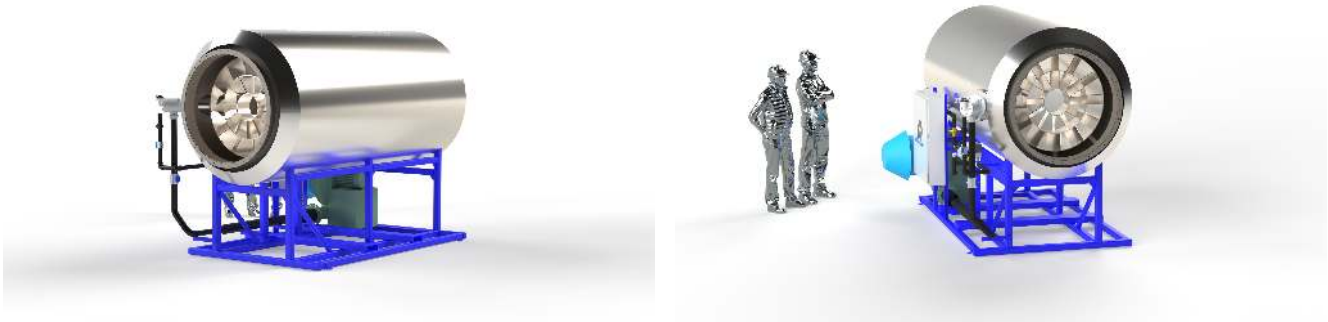
Thermal instrumentation / control basis

- Primary temperature controller: WATLOW F4T with Ethernet connectivity.
- Upstream and downstream duct temperature protection: Gefran 650L excess-temperature controllers.
- Thermocouple basis shown in the wiring package: Type K for duct sensing.
- Burner modulation signal: 4–20 mA.

Safety / classification basis

- The gas train and burner system include double safety shutoff valves, proof of closure, high and low gas pressure switches, airflow proving, flame safeguard controls, and UV flame detection.

- The system includes purge sequencing and burner interlocks tied to blower and airflow status.



EQUIPMENT CONCEPT & ARCHITECTURE

To deliver the customer and thermal process requirements for this oven, Precision Quincy developed the following equipment concept and architecture.

Overall concept

- One skid-mounted natural-gas-heated duct heater.
- Designed for heating a 27,000 ACFM process airstream from 0°F to 40°F for ethanol plant service.
- The design uses a cylindrical insulated duct section with an integrated burner package and internal mixing section.

Heating architecture

- Heat source: natural gas.
- Burner: Selas Superflame 1500.
- Burner capacity: 1,500,000 BTU/hr.
- Gas train manufacturer: Karl Dungs.
- Gas valve actuator: Siemens VA40.25 / SQM4-series actuator architecture.
- Burner supervision includes direct spark ignition, flame safeguard, and UV flame detection.

Airflow / mixing architecture

- Process airflow through duct: 27,000 ACFM supplied by others.
- Combustion blower: NYB 2306A7.5.
- Combustion blower performance: 287 CFM at 42 in. W.c. With 7.5 HP motor.
- The duct section includes internal mixing vanes to blend burner heat into the process air stream.
- The process blower and exhaust fan are provided by others as part of the larger plant system.

Duct / construction architecture

- Inner duct diameter: 46 in.
- Duct outer diameter: 66.50 in.

- Overall unit length: 150 in.
- Overall width: 98 in.
- Overall height: 100.88 in.
- Construction style: double-wall cylindrical duct section on a skid frame.
- Inner shell: rolled steel inner duct shell.
- Inner shell thickness: 0.25 in rolled steel.
- Wall thickness: 4 in.
- Insulation: 4 in of 8 lb Superwool / ceramic-fiber insulation.
- The unit includes mounting flanges, forklift lifting points, and anchor locations for installation.

Controls architecture

- Control enclosure: remote-mounted NEMA 4 control enclosure.
- Controller: WATLOW F4T with Ethernet connectivity.
- The control panel is identified as a UL 508A open industrial control panel.
- The system includes burner enable logic, remote run fan logic, purge indication, flame fault indication, and temperature monitoring.
- The controls package can receive remote commands from an external PLC via Ethernet/IP.

Safety / compliance architecture

- Applicable standards shown in the electrical package: NFPA 79, NFPA 86, UL 508A.
- Gas train includes double blocking safety shutoff valves, proof of closure, pressure switches, regulator, test ports, and visual indication.
- Safety devices include airflow switches, high- and low-gas-pressure switches, upstream and downstream excess-temperature limits, flame safeguard logic, and manual reset functions.

Shipping / installation architecture

- The equipment is configured as a skid-mounted preassembled duct heater section.
- Approximate shipping weight: 6,500 lb.
- The design supports unloading and installation using the structural frame and forklift access points shown on the GA.

TECHNICAL SPECIFICATIONS

Equipment Configuration

Type	Natural-gas-heated skid-mounted process air duct heater
Quantity	1 unit
Application	Ethanol plant process-air preheating
Airflow Duty	27,000 ACFM one-pass airflow
Temperature Rise	0°F to 40°F
Configuration	Cylindrical insulated duct section on structural skid

Thermal Heat Power System

Inlet Air Basis	0°F
Outlet Air Basis	40°F
Temperature Rise	40°F
Heat Source	Natural gas
Burner	Selas Superflame 1500
Burner Capacity	1,500,000 BTU/hr
Natural Gas Flow Basis	1,500 CFH
Fuel Inlet Pressure	2 PSI minimum design; 5 PSI maximum design
Regulated Gas Pressure	30 in. W.c.
Design Elevation	<1,000 ft

Airflow / Mixing System

Process Airflow	27,000 ACFM supplied by others
Combustion Blower	NYB 2306A7.5
Combustion Blower Airflow	287 CFM
Combustion Blower Static Pressure	42 in. W.c.

Combustion Blower Motor	7.5 HP
Air Distribution Feature	Internal mixing vanes
Exhaust Fan	By others

Construction Materials / Duct System

Construction Style	Double-wall cylindrical duct section on skid frame
Inner Duct Diameter	46 in
Outer Duct Diameter	66.50 in
Overall Length	150 in
Overall Width	98 in
Overall Height	100.88 in
Inner Shell Material	Rolled mild steel
Inner Shell Thickness	0.25 in
Wall Thickness	4 in
Insulation	4 in of 8 lb Superwool / ceramic-fiber insulation
Exterior Finish	Unpainted stainless steel
Interior Finish	Unpainted mild steel

Gas Train / Burner Package

Gas Train Manufacturer	Karl Dungs
Gas Valve Actuation	Siemens VA40.25 / SQM4 modulation actuator
Safety Shutoff	Double blocking valves with proof of closure
Pressure Supervision	High- and low-gas-pressure switches
Control Signal	4–20 mA
Control Voltage	120 VAC
Flame Detection	UV scanner / flame safeguard supervision

Controls & Electrical

Control Enclosure	NEMA 4
Controller	WATLOW F4T with Ethernet connectivity
High-Limit / Excess Temp Protection	Gefran 650L controllers
Thermocouple Basis	Type K duct thermocouples
Panel Compliance	UL 508A open industrial control panel
Applicable Standards	NFPA 79, NFPA 86, UL 508A
Primary Power	575V / 3PH / 60Hz
Full Load Amps	10.3 A wiring package / 12.6 A GA equipment requirement
External Integration	Remote commands from external PLC via Ethernet/IP

Shipping / Installation

Shipment Style	Preassembled skid-mounted unit
Approximate Weight	6,500 lb
Dock Door Requirement	12 ft W × 16 ft H
Lifting Features	Forklift lifting points shown on GA
Base Features	Structural skid with anchor points

Process Summary

Process Medium	Air
Market / Application	Ethanol plant process-air heating
Process Type	One-pass air preheating for downstream plant processes
Key Functional Requirement	Raise 27,000 ACFM inlet air from 0°F to 40°F
Key Verification Concept	Controlled burner input, proper airflow proving, safe combustion supervision, and mixed discharge air temperature control



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