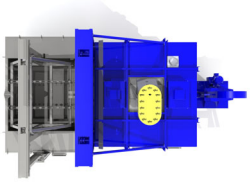
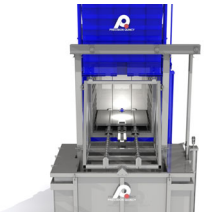
PRECISION QUINCY

CASE STUDY

Batch Solution Heat Treat Furnace with Integrated Hot Water Quench

Integrated batch solution heat treat + hot water quench system engineered to process up to 1,000 lb per batch on a WIRCO 54 in × 54 in tray (up to 54 in load height), supporting alloy-dependent solution treatment setpoints up to 1,100°F (wrought alloys 870–990°F; 8356 cast alloy at 538°C for 6–12 hours) with ≤ 10-second transfer to a 150–200°F hot water quench—an NFPA 86 Class B, electric design with 144 kW installed heat, engineered for repeatable thermal performance and rapid quench handling.





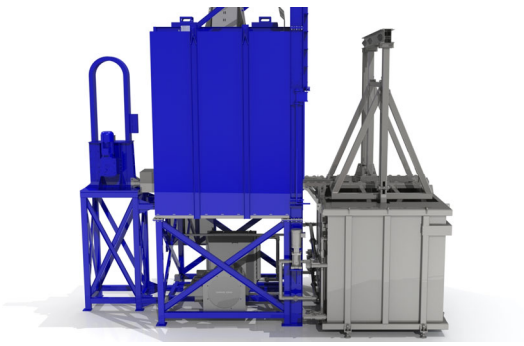
OVERVIEW

Precision Quincy engineered a batch solution heat treat furnace with integrated hot water quench to support high-integrity aluminum heat treatment across wrought and cast alloys. The system is designed to process up to 1,000 lb per batch on a WIRCO 54 in × 54 in tray with up to 54 in of load height, enabling solution treatment across a wide operating envelope—870°F to 990°F for common wrought alloys (6061, 6063, 7075, and 2024 tempers) and 538°C (≈1,000°F) for 8356 cast alloy—followed by rapid quench transfer to preserve metallurgical integrity.

To protect metallurgical results, the furnace integrates a rapid transfer mechanism that moves the tray from the hot chamber to the quench within a 10-second maximum allowable transfer window. Loads are staged by forklift on a carriage positioned above the quench tank; a furnace-side hook/gravity engagement feature pulls the tray onto a roller hearth for processing, and a rear-mounted pusher/extractor (8 in/sec, 105 in stroke) transfers the tray back onto the carriage at cycle completion before the carriage submerges the load into the quench. After the prescribed quench dwell, the carriage raises for forklift removal and the sequence repeats.

The furnace is an NFPA 86 Class B, electric design with 144 kW of installed heat using individual 3 kW elements. Convection performance is delivered by a New York Blower 18 in PLR recirculation fan rated at 7,500 CFM at 3.0 in. w.c. with a 7.5 HP motor, producing approximately 4,000 FPM air velocity at the product and supporting ±10°F air temperature uniformity. System controls are based on an Allen-Bradley CompactLogix PLC with SSI 804 temperature control for both furnace and quench subsystems.

The hot water quench system is sized for thermal stability and repeatability with a 1,900-gallon tank (316 stainless steel tank with 304 stainless interior), 36 kW immersion electric heat, and an air-to-water cooling system capable of rejecting 575,000 BTU/hr. The quench operates across 150°F to 200°F with a typical setpoint basis of 180°F, using pumped forward-flow agitation with all stainless steel piping. The insulated furnace shell uses a painted 3/16 in mild steel exterior with structural reinforcement and a 304 stainless interior liner, backed by 2 in (8 lb) ceramic wool plus 6 in (6 lb) mineral wool insulation.



CUSTOMER PROCESS REQUIREMENTS

The customer required a solution heat treatment system for aluminum parts (wrought and cast) with rapid transfer to a hot water quench.

Process objective (solution heat treat + quench)

- Heat treat aluminum loads to alloy-specific solution treatment conditions.

- Transfer the load to a hot water quench within the allowable transfer window.
- Note: After solution treatment, parts typically proceed to a separate aging process in other equipment (not part of this system).

Alloys / tempers to be processed (wrought)

- 6061-T6
- 6063-T6
- 7075-T6
- 2024-T3
- 2024-T4

Solution treatment temperature range (wrought)

- 870°F to 990°F (alloy-dependent).

Cycle time (wrought)

- Maximum cycle/soak time basis: up to 7 hours (product/alloy-dependent).

Cast alloy process requirement

- **Alloy:** 8356 (cast)
- **Solution treatment temperature:** 538°C (≈ 1,000°F)
- **Time at temperature:** 6 to 12 hours

Batch / load capacity

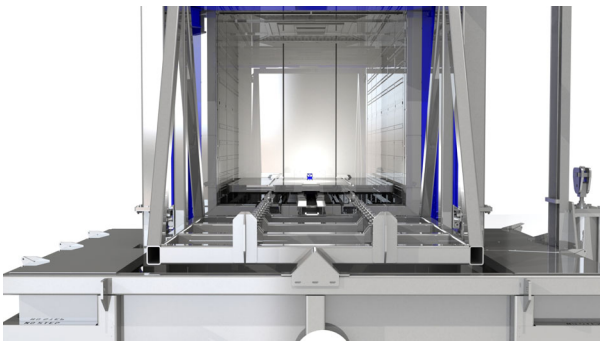
- Maximum batch weight: 1,000 lb per batch.

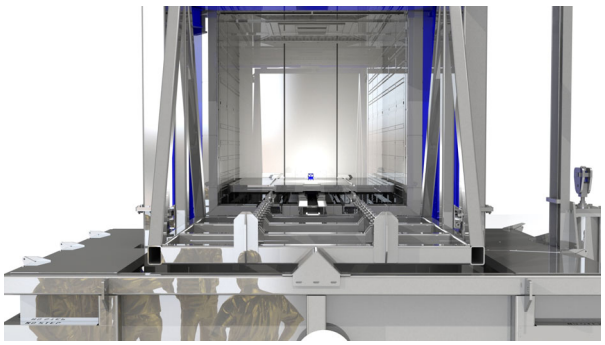
Load carrier / envelope

- **Load carrier:** WIRCO solution heat treat tray (customer-provided).
- **Customer tray size:** 54 in × 54 in.
- **Maximum load height above tray:** 54 in.
- Load handling: tray staged and removed via forklift.

Quench requirements

- **Quench medium:** water.
- **Water temperature range (hot quench):** 150°F to 200°F.
- **System setpoint basis:** 180°F.
- **Maximum allowable transfer time to water (total):** 10 seconds.





THERMAL PROCESS REQUIREMENTS

These thermal process requirements were developed to meet the customer's solution heat treat and quench process needs, based on the application conditions and operating parameters.

Operating temperature envelope

- Maximum equipment temperature capability: up to 1,100°F.
- Operating setpoints are alloy- and property-dependent, based on the required solution treatment conditions.
- Setpoint range basis: 870°F to 990°F for wrought alloys; 538°C (≈ 1,000°F) for 8356 cast alloy.

Heating / soak performance

- Must support long-duration solution treatment cycles: up to 7 hours for wrought loads, and 6–12 hours for 8356 cast alloy.
- Required heat-up / ramp-to-soak time: variable (product/load-weight dependent).

Airflow delivery (convection performance)

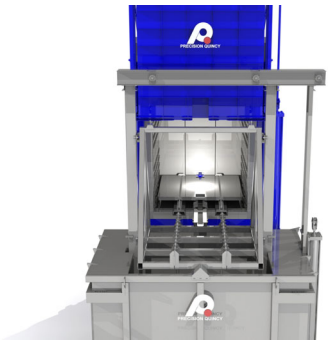
- Air velocity at the product: 4,000 FPM blowing on the side of the part.
- Air temperature uniformity: ±10°F.

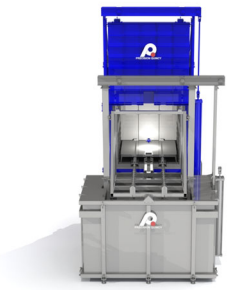
Quench transfer performance (thermal-critical timing)

- Maximum allowable transfer time from furnace discharge to quench immersion: 10 seconds (customer basis).

Quench thermal conditions (interface requirement)

- Hot water quench temperature control range: 150°F to 200°F; setpoint basis 180°F.
- Quench tank agitation basis: pumped/forward-flow agitation.





EQUIPMENT CONCEPT & ARCHITECTURE

To deliver the thermal process requirements (which deliver the customer process requirements), Precision Quincy settled on the following equipment concept and architecture.

Overall concept

- Batch, recirculating solution heat treat furnace with rapid discharge to hot water quench.
- Furnace configured to support alloy-dependent setpoints with a maximum equipment capability of 1,100°F.
- Load handling based on WIRCO 54 in × 54 in trays staged by forklift onto the quench carriage.

Material flow / transfer mechanism

- Load is staged on a quench carriage positioned above the tank.
- A furnace-side hook/gravity engagement feature captures the tray and pulls it onto a roller hearth inside the furnace for processing.
- At cycle completion, a rear-mounted pusher/extractor pushes the tray forward onto the carriage.
- Carriage lowers into the quench to allow the pusher dog to disengage; pusher retracts; furnace door closes.
- After the prescribed quench dwell, the carriage raises for forklift removal and the sequence repeats.

Heating system (electric)

- Total installed heat input: 144 kW.
- Heating elements: individual 3 kW electric heating elements.

Recirculation / convection system

- **Recirculation fan:** New York Blower (NYB) 18 in PLR.
- **Airflow:** 7,500 CFM at 3.0 in. w.c.
- **Motor:** 7.5 HP.

Quench tank system (hot water quench)

- **Tank capacity:** 1,900 gallons.
- **Tank construction:** 316 stainless steel with 304 stainless interior.
- **Water heating:** 36 kW electric, immersion heaters.
- **Water cooling:** 575,000 BTU/hr heat rejection, air-to-water cooler (5,000 CFM airflow basis).
- **Agitation:** Pumped forward-flow; 48 GPM pump, 65 ft TDH, 1.5 HP motor; all stainless steel piping.
- **Temperature control:** SSI 804 (quench tank controller).

Door system

- Pneumatically powered vertical lift door.

Pusher / extractor system

- **Location:** rear-mounted behind the furnace.
- **Push speed:** 8 in/sec; stroke length: 105 in.

Construction / shell

- Exterior shell: 3/16 in mild steel, two-part epoxy paint, with structural steel reinforcement.
- Wall construction: 8 in total; interior liner 304 stainless steel pans.
- Insulation: 2 in ceramic wool (8 lb/ft³) hot-face plus 6 in mineral wool (6 lb/ft³) backup.

Controls architecture

- PLC / system controls: Allen-Bradley CompactLogix.
- Temperature controller (furnace and quench): SSI 804.
- Airflow proving: airflow switch on recirculation fan.
- High temperature limit: workroom area high limit.

TECHNICAL SPECIFICATIONS

Furnace Configuration	
Type	Batch solution heat treat furnace with rapid transfer to hot water quench
Process	Solution heat treating aluminum; quench in hot water; aging performed in separate equipment
Maximum Equipment Temperature	1,100°F
Typical Operating Setpoints (Wrought)	870°F to 990°F (alloy-dependent)
Cast Alloy Requirement	8356 (cast) at 538°C (≈ 1,000°F) for 6–12 hours
Maximum Batch Weight	1,000 lb
Load Carrier	WIRCO solution heat treat tray
Tray Size	54 in × 54 in
Maximum Load Height Above Tray	54 in
Maximum Cycle / Soak Time (Wrought)	Up to 7 hours (product/alloy-dependent)
Working / Hearth Dimensions	54 in W × 54 in L × 54 in H
Overall Equipment Dimensions	243 in D × 115 in W × 250 in H

Thermal System (Electric Heating + Convection)	
Heat Source	Electric
Total Installed Heat Power	144 kW
Heating Elements	3 kW individual electric elements
Recirculation Fan	New York Blower (NYB) 18 in PLR
Fan Airflow	7,500 CFM
Fan Static Pressure	3.0 in. w.c.
Fan Motor	7.5 HP
Air Velocity at Product	4,000 FPM (blowing on side of part)
Air Temperature Uniformity	±10°F
Temperature Controller (Furnace)	SSI 804
Number of Control Zones	1

Quench Tank System (Hot Water)	
Quench Medium	Water
Water Temperature Range	150°F to 200°F
Water Setpoint Basis	180°F
Tank Capacity	1,900 gallons

Tank Construction	316 stainless steel tank with 304 stainless interior
Water Heating	36 kW electric heat, immersion heaters
Water Cooling	575,000 BTU/hr heat rejection, air-to-water cooler
Cooler Airflow Basis	5,000 CFM
Water Circulation / Agitation	Pumped forward-flow agitation
Water Pump	48 GPM, 65 ft TDH, 1.5 HP
Water Piping	All stainless steel
Temperature Controller (Quench)	SSI 804

Transfer / Handling System	
Loading / Unloading	Forklift handling of WIRCO tray on quench carriage
Maximum Allowable Transfer Time to Water	10 seconds (total)
Furnace Door	Pneumatically powered vertical lift door
Hearth / Internal Support	Roller hearth (tray pulled into furnace)
Tray Engagement	Hook/gravity engagement feature
Pusher / Extractor	Rear-mounted; pushes tray to carriage at cycle completion
Pusher Speed	8 in/sec
Pusher Stroke Length	105 in
Carriage Mechanism	A-frame style carriage on engineering chain, pneumatically operated

Construction Materials	
Exterior Shell	3/16 in mild steel, two-part epoxy paint
Structural Reinforcement	Structural steel reinforcement on shell
Interior Liner	304 stainless steel pans
Wall Thickness	8 in total
Hot-Face Insulation	2 in ceramic wool, 8 lb/ft³ density
Backup Insulation	6 in mineral wool, 6 lb/ft³ density

Safety & Compliance	
NFPA 86 Classification	Class B
Heat Source	Electric
Explosion Relief	Not required (NFPA 86 Class B, electric)
Airflow Proving	Airflow switch on recirculation fan
High Temperature Limits	High limit in workroom area

Controls & Electrical	
Power	480 V / 3 phase / 60 Hz
PLC / System Controls	Allen-Bradley CompactLogix
Temperature Controller (Furnace)	SSI 804
Temperature Controller (Quench Tank)	SSI 804

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