L&L Aerospace *Heat Treating Furnaces & Ovens*

L&L Aircraft-Grade Furnaces include:

- *Zone Control*
- *Extremely Even Heating*
- *Proprietary Ceramic Element Holders*
- *Tight Gradient Uniformity*
- *Optional Certified Testing*

L&L's Aircraft Grade FNA Furnace with Integrated Quench Tank

Heat treatment of tool steels, annealing fasteners, weldment stress relieving, solution heat treatment of aluminum, and heat treatment of rivets, bolts and other parts with Aircraft Grade Industrial Furnaces by ***L&L Special Furnace Co Inc.***

L&L Special FURNACE CO, INC

20 Kent Road, Aston PA 19014 USA Toll Free:877-846-7628 Phone:610-459-9216 Fax:610-459-3689 Email:sales@llfurnace.com Web:llfurnace.com

Your Thermal Investment Deserves Special Treatment

Bulletin No. AS 04-15

The L&L Difference

Confirmed Quality

L&L's proprietary element support design system evenly distributes the radiant heat throughout the furnace and promotes the kind of uniformity required for aircraft-grade heat treating. L&L's hard ceramic holders support the heating coils for long life, promote even heat transfer, and allow for easy, quick, inexpensive, in-house maintenance. L&L also uses convection and multi-zone control to guarantee temperature gradients within ±5°F (±2.8°C) in the work zone.

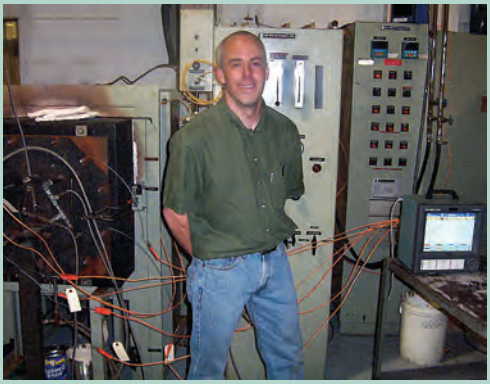
" We have been very pleased with our L&L furnace. The quick ramp up to temp without extreme spiking makes for quicker turn times on our parts. We are also pleased with how tight it holds to set temp."

Kris Schwab,
T/L Fab & Tooling
Goodrich Aerostructures

Acme Masking, as part of a coating facility set up in Jakarta Indonesia in 2008, utilizes a high uniformity L&L XLC retort furnace. The furnace is used to cure ceramic coatings on aircraft parts. It is imperative that the atmosphere is oxygen free. The system is also used for brazing of aircraft components.

Expert Satisfaction

"L&L Builds a Great Furnace"



"Our company, Aerospace Testing and Pyrometry, Inc., provides nationwide onsite calibration & testing services to the thermal processing industry. While recently performing a uniformity survey on two L&L furnaces for an aerospace client I was amazed by how uniform both these furnaces were. Both furnace uniformities were actually ±2°F at lower temperatures and ±5°F at higher temperatures (the requirement was ±10°F from 250°F to 1400°F on one furnace, and ±10°F from 450°F to 1600°F on the second furnace). In the fifteen years I have conducted temperature uniformity surveys, which include many types of furnaces, this is one of the BEST I have ever tested. With the thermal processing specifications that govern the Aerospace, Automotive and Nuclear Industries getting tighter & tighter, it is good to see a furnace manufacturer that can provide equipment that can stand up to these specifications. I will not hesitate to recommend to any one of my clients who may be looking for an excellent, heat treat furnace, L&L Special Furnace has my vote of confidence."

Andrew Bassett, President of Aerospace Testing And Pyrometry, Inc. (abassett@atp-cal.com)

L&L Special
FURNACE CO, INC

Aircraft Maintenance and Aerospace Manufacturing

Confirmed Quality is Essential

Problem

Many aircraft maintenance facilities require heat treatment. Hardening of tool steels, annealing fasteners, stress relieving of weldments, and solution heat treatment of aluminum are just some of these processes. Most of these are critical where certifiable uniformity and traceability are fundamental requirements of the job. Old, unreliable equipment can fail or may not meet the ever changing and increasingly stringent requirements of the aircraft industry (See the description of the AMS 2750E Specification on the back cover). Outsourcing wastes time and money and adds another layer of risk to the control of your most precious asset – your reputation. L&L has several proven solutions.

Solution

L&L Special Furnace Co., Inc. designs, manufactures, and services a wide variety of heat treat equipment. We have several lines that are specific to the aircraft and aerospace industry. See the range of sizes and types on the back cover. Our FNA and XLA series, specifically designed for aircraft industry, include such standard features as calibrated thermocouples, complete NIST documentation certifications, zone control and optional in-house uniformity survey prior to shipment.

Customers

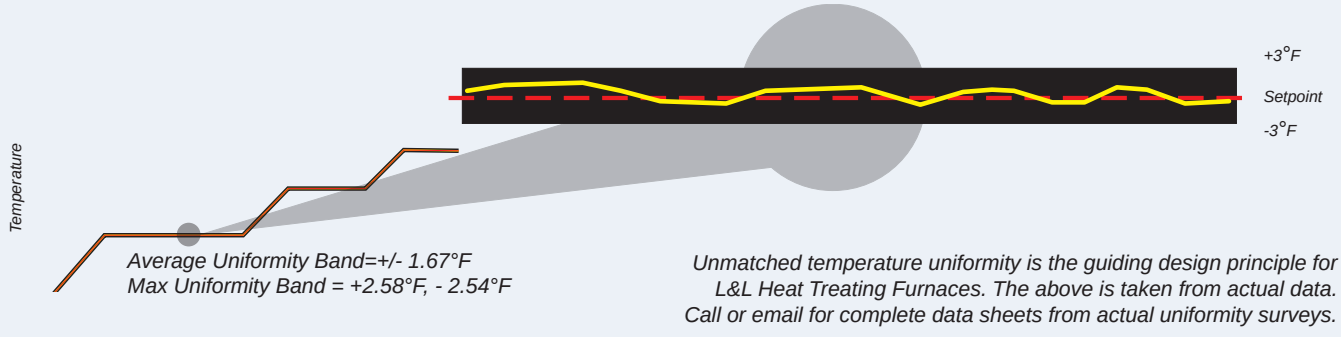
Our USA and international customers include Boeing, NASA Goddard Flight Center, Pratt & Whitney, Rolls-Royce Engine Services, US Air Force, US Airways, Atlantic Southeast Airlines, Northwest Airlines, PCC Airfoils for turbines, Lockheed Martin, Triumph Air Repair, Aero Component Repair, Dallas Airmotive, Chromalloy, and Goodrich Aerostructures, Philippines Airlines, Air Mauritius, China Air, SriLankan Airlines, HAESL Coopesa, G.E. Aviation, United Airlines and Continental Air Support Group.

Factory uniformity surveys are routinely done to insure certification upon commissioning.

"We have had excellent results with the furnace and it has opened up quite a few new possibilities for our shop."

Curt Wilhelm,
Duncan Aviation

With the DynaPro Multi Zone Control System, actual furnace temperature is guaranteed to stay within ± 5°F (± 2.8°C) of setpoint!



Average Uniformity Band=+/- 1.67°F
Max Uniformity Band = +2.58°F, - 2.54°F

Unmatched temperature uniformity is the guiding design principle for L&L Heat Treating Furnaces. The above is taken from actual data. Call or email for complete data sheets from actual uniformity surveys.

L&L SPECIAL FURNACE CO, INC. AVIATION MARKET PRODUCTS COMPARISON SHEET					
SERIES / MODEL	**MODEL GS1714**	**QDS & QDA SERIES**	**XLA SERIES**	**VBA / DVA / DRA SERIES**	**FNA SERIES**
PHOTOGRAPH OF TYPICAL MODEL					
COMMENTS	*Inexpensive, off-the-shelf model, few options.*	*Dual chamber system with separate high temperature hardening furnace and tempering oven chambers. Various quench tanks available.*	*Selected Sizes based on Standard XLE Series Furnaces with Aviation package. Can be uniform from 300ºF to 2350ºF with protective atmosphere capability.*	*Selected Sizes based on Standard DV & DR Series Ovens. Aviation package.*	*Large. Custom sizes. Heavy-duty loaders. Aviation package. Can be uniform from 300ºF to 2350ºF with protective atmosphere capability.*
APPLICATIONS	*Tool room heat treating / multi-purpose*	*Tool steel hardening and tempering / aluminum solution treating and aging*	*Full range of aviation heat treating solutions*	*As companion to XLA series - steel tempering; post-welding stress relief; aluminum heat treating*	*Full range of aviation heat treating solutions*
SIZE RANGE (UNIFORM VOLUME)	*One Size only 16" W X 10"H x 13" D (40 cm X 25 cm X 33 cm) 1.2 cubic feet (34 liters)*	*(8) Sizes from 1.15 cubic feet (33 liters) to 5.8 cubic feet (165 liters)*	*(27) Sizes from 1.95 cubic feet (55 liters) to 58.3 cubic feet (1651 liters) uniform space*	*(9) Sizes from 2 cubic feet (56 liter) to 54 cubic feet (1530 liters)*	*(11) Sizes from 8 cubic feet (227 liter) to 216 cubic feet (6116 liters)*
Class (See Below)	*Class 2, 3, 4, 5, 6*	*Class 2, 3, 4, 5, 6*	*Class 1,2, 3, 4, 5, 6*	*Class 2, 3, 4, 5, 6*	*Class 1, 2, 3, 4, 5, 6*
TEMPERATURE RANGE	*300ºF to 2350ºF (150ºC to 1290ºC)*	*300ºF to 2350ºF (150ºC to 1290ºC)*	*300ºF to 2350ºF (150ºC to 1290ºC)*	*300ºF to 1300ºF (150ºC to 700ºC)*	*300ºF to 2200ºF (150ºC to 1200ºC)*
ACCESSORIES			*See list below*		*See list below*

AMS-2750E SPECIFICATION & UNIFORMITY

AMS Revision E allows for several classes of equipment. The class 1 equipment calls for a temperature uniformity requirement of ±5ºF (±2.8ºC). There are also specifications for calibrated thermocouples and standard instrument accuracy. Class 2 requires ±10ºF (±5.5ºC) and same system requirements. Class 3 requires ±15ºF (±8.3ºC) and same system requirements. Class 4 requires ±20ºF (±11ºC) and same system requirements. Class 5 requires ±25ºF (±12.7ºC) and same system requirements. Class 6 requires ±50ºF (±27ºC) and same system requirements. Refer to Figure 2 on Page 16 of the AMS-2750E for complete list of classification.

Class A instrumentation calls for each zone to have an independent control thermocouple. Each zone must be recorded by a recording instrument along with a reference thermocouple port located within 2" of the control sensor. Two additional recording sensors in each control zone located to best represent the hot and cold points in the oven based on the most recent survey. L&L accommodates this by having one thermocouple port located at each corner of the oven along with reference thermocouple ports located next to each control and overtemperature thermocouple respectively. Refer to table 3 Page 36 of AMS-2750E for complete information on instrumentation.

The survey interval is specified in tables 8 and 9 of AMS-2750E. The required minimum number of sensors is specified in table 11 of AMS-2750E. Type, quantity and location of thermocouples will have an impact on the frequency of calibration and testing. Optional type N thermocouples do not drift like type K and may not require monthly calibration.

L&L Aircraft Grade Furnaces are capable of meeting the requirements as specified in AMS-2750E ,ASM5590E, AMS55589E, AMS2772E, Boeing BAC5621, Airbus Industries 01-03-12, 01-03-17, 01-03-18, Rolls Royce 70-00-00-300-711, 70-49-01-370-002, 70-49-11-370-004, and AMS2770H for aluminum, along with many other specific aircraft requirements.

AVIATION PACKAGE

(FOR XLA & FNA SERIES FURNACES)

INCLUDED ACCESSORIES & SERVICES

4 to 6 Zone SCR element banks with single PID loop and digital biasing to adjust temperature gradients
Digital Program control
Digital Overtemperature control
Lot calibrated thermocouples with certification
Instrument calibration with certification
(4) 1" NPT uniformity survey ports at each corner of the furnace
1875ºF (1023ºC) air cooled fan
Pneumatic or electric vertical door operation
Pneumatic clamps on each corner of the door for the FNA series
Triple seal door gasket for the FNA Series door

OPTIONAL ACCESSORIES & SERVICES

Honeywell HC900 multizone control with data logger
4 to 6 Zone SCR control with independent PID loops
Additional zone control up to 16 zones
Cast alloy hearth
Agitated quench tanks with or without elevators
Individually calibrated thermocouples
Type S thermocouples or Type N thermocouples
Upgraded insulation for 2190ºF / 1200ºC operation
2200ºF (1200ºC) water cooled fan
Reference ports within 3" of control points
In house testing including furnace profile (up to 24 points)
In house certification by outside contractor (up to 24 points)
Start up service
Atmosphere sealed case and inert flow panel
Thermocouple jack panel (for work thermocouples)

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