

CONTROLLED ATMOSPHERE IR BELT FURNACE

Model LA-306

Operation & Theory

**Infrared Furnace Setup, Operation,
Theory and Troubleshooting Guide**

First Edition

Stephen L. Barber

James M. Clark



This manual contains operating instructions and information regarding features and options which may or may not be included in your furnace system.

Controlled Atmosphere IR Belt Furnace

Model LA-306 Operation & Theory

First Edition

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INTRODUCTION

This manual covers the LCI IR LA-306 furnace, high quality controlled atmosphere infrared belt furnace designed for industrial production and laboratory infrared thermal processing. If you have acquired an RTC LA-306 rebuilt by LCI, this manual describes its operation with the few exceptions noted in Section 14.

Achieving high performance and high yields is attainable with careful adjustment of the temperature and gas flow controls provided on the LA-306. Infrared furnaces are highly responsive to critical temperature settings. With lamps as the primary heat source, the equipment is literally heating with the speed of light. The unique gas management system provides an extremely even distribution and well regulated flow of gas throughout the process chambers. Understanding how to control both the heat and gas flow is essential to the effective operation of the furnace. When the interaction and performance of the control elements are well managed the tool can achieve its potential. For many, our furnaces become regarded more than just an effective tool; they are viewed as a fine instrument that can produce results over a variety of thermal processing situations.

There are many features in your equipment to help assure your success in achieving your goals. Many “firsts” involving the application of near infrared heating include: the first high temperature furnace capable of operating at 1000°C with extremely tight temperature control; the first thick film furnace; the first controlled atmosphere furnace capable of <5 ppm O₂; and the first hydrogen furnace.

WHAT IS IN THIS MANUAL

This manual explains furnace equipment installation and setup, operation and troubleshooting of LA-306 series furnaces as well as RTC LA-306 furnaces refurbished by LCI. Some equipment described in this manual is optional or may not apply to your model as configured. The manual also covers aspects of infrared processing theory and techniques to assist you in achieving highly repeatable and reliable thermal processes.

Study this manual carefully. Experience has shown that clients who thoughtfully master the contents of this manual can become expert in understanding the process system capabilities of our infrared furnaces. In doing so, many are able to push the initial process performance envelope and thus achieve higher degrees in both process reliability and throughput than previously anticipated.

Note that throughout this Owner’s Manual the equipment is generally referred to as a furnace. A dryer is a furnace with only the top lamp elements installed.

FORMATTING CONVENTIONS

This manual uses the following formatting conventions.



DANGER: This signifies a potential threat to human safety.

Warning: This signifies a potential threat to equipment damage or product loss.

Note: This signifies an important fact that could affect process control.

Examples are shown in italic text.

Bold text words or phrases embedded in this document, are terms with definitions in the glossary.

Bold Underlined text is used for pop-up windows, button descriptions & selector button/box choices.

Cross-references to “Section Titles” are bound with quotes.

(Optional) accessories will be shown in parenthesis with a checkbox. If supplied, please check the box as appropriate.

ABOUT LCI

LCI Furnaces specializes in the manufacture and sales of near infrared (0.5-5.5 μm) wavelength continuous belt dryers, ovens and furnaces worldwide. We provide the highest quality controlled atmosphere infrared thermal processing equipment, parts and service available anywhere.

We endeavor to improve our equipment design and performance. To this end, LCI encourages users to suggest ideas for improving designs and service. Additionally, we will discuss, in confidence, new thermal processing requirements, however difficult or routine they may be. If needed, LCI can design new equipment and features to meet the special and challenging needs our partners require.

Should you have a furnace operating question, contact LCI Furnaces or FurnacePros Technical Support.

WHERE TO GET HELP

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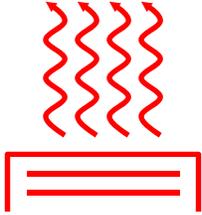
New Furnaces: www.LCIfurnaces.com
Aftermarket Support: www.FurnacePros.com

GENERAL SAFETY GUIDELINES

The following set of guidelines is intended to create awareness of potential health and safety hazards.

Normal Good Laboratory Practice

Normal good laboratory practices apply to the operation of IR furnaces. Do not use the space above the furnace as storage. Do not block the cabinet doors preventing the cooling of the electronic equipment inside. Do not operate with side covers off as this will prevent normal cooling of the electronic equipment thus voiding the warranty. Tuck electrical cords out of the way. Do not store flammables in the vicinity of the furnace and especially while operating the furnace with an oxygen atmosphere.

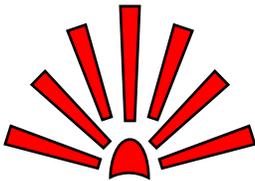


HIGH TEMPERATURES. In general, the operation of any furnace may expose operators or maintenance technicians to the risk of burns. After being processed in an infrared furnace, customer product may still be dangerous to handle. Each owner is responsible for providing a safe work environment and proper training in the handling of material being processed in a furnace.



ELECTRICAL SHOCK HAZARD. IR furnaces operate at high voltages. Operation with side covers off constitutes a safety hazard. Ensure that main power is off while side covers are removed.

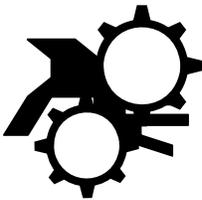
Electrical shock hazards exist for those technicians who service the furnace. High voltages are required to operate the furnace and precautions must be taken to reduce the exposure to these elements. Again, it is the responsibility of the furnace owner to assure that only properly trained service technicians, familiar with high voltage operations be allowed to service the equipment



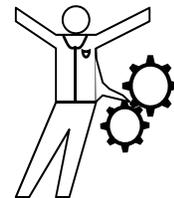
EXPLOSION Explosive dangers may exist in the high temperature process environment of the furnace. If the furnace operates with process gas containing hydrogen, measures must be taken to avoid the dangers of explosion. Furthermore, improper gas flow balance may draw oxygen rich air into the furnace, mixing with effluent gases and material from products, also creating a hazardous environment.



HAZARDOUS MATERIALS. Persons performing maintenance tasks such as replacement of lamps may become exposed to silica fiber compounds. Such tasks should be performed by qualified persons wearing gloves, eye protection and a facemask to prevent inhalation of particulates.



ROTATING EQUIPMENT. Roller dangers exist when working around the conveyor belt of the furnace. Care should be taken not to place hands on or near the belt drive mechanisms when the conveyor system is operating as roller crush may occur. Operators should avoid walking near the open ends of the conveyor belt. Those who must be near the moving parts should wear close fitting clothing.



SAFETY EQUIPMENT

EMO Buttons



Each LA-306 infrared furnace is fitted with at least two SEMI S2 compliant Emergency Machine Off buttons (EMO's), one located at each end of the furnace. Locate and insure their proper function prior to regular furnace operation.

Each Emergency Machine Off button (EMO) is attached directly to a switch that automatically shuts down all furnace electrical systems. In many cases, process gas flow will remain on after power is shut off.

Panel Interlock Switches

The LA-306 has (3) interlock switches located to prevent operation of the furnace with high voltage panel covers out of place. One is located on the control enclosure hinged back access panel, and one on each of the upper side panels closest to the furnace entrance safeguarding access to the high voltage at the chamber lamps.

Bypass this switch to allow furnace operation with the panels removed. Grasp the protruding switch and pull it out (See Figures) to override the switch. Setting the panel switches in bypass mode is useful during SCR calibration and other troubleshooting.



Panel Switches Showing Normal Operation Position



Panel Switch Installed - Bypass Mode Position



DANGER: Bypassing the panel interlock switches increases maintenance personnel exposure to electrical hazards. The user must ensure that any interlock switches placed in override mode are returned to normal operation following any inspection or adjustment..

Dual Gas - Forming Gas: Nitrogen/Hydrogen Premix (Option)

The dual gas option provides for use of forming gas (FG) as a process gas. Use of FG is generally safe provided the concentration of hydrogen in the mixture is lower than the lower flammable limit of hydrogen. Hydrogen is flammable in concentrations of 4-74% in air; explosive range is 18-59% in air. Dual gas furnaces are equipped with an audible alarm to indicate low nitrogen and forming gas supply pressure.



DANGER: Except for furnaces specifically equipped with the hydrogen option, combustible gas should NOT be connect to the furnace. Forming gas or other gas mixtures which have a combustible gas component can be safely introduced into furnace provided the delivered concentration is below its lower flammable limit (LFL) in air.

HNO - Hydrogen/Nitrogen Mixing (Option)

Hydrogen/nitrogen mixing requires the addition of combustible gas sensors at key points on the furnace as well as additional flow and pressure sensors to assure the hydrogen introduced in an oxygen free furnace environment. Exhaust stack ignitors are also added to harmlessly flame any free hydrogen that maybe evacuated from the furnace. Use of Hydrogen (H₂) in the heating chamber requires special furnace owner safety considerations including:

1. Furnace installation ensuring proper ventilation and safe source gases,
2. Special warm up and cool down procedures must be followed.
3. Gas flow balance is critical to the safety of all personnel working near a infrared furnace operating with hydrogen process gas. Escaping hydrogen gas, or the admission of oxygenated gas into the process section is extremely hazardous.

These two events ensure that no additional H₂ gas is allowed into the furnace and that the remaining H₂ is diluted and removed as quickly as possible.

CONTENTS

INTRODUCTION	iii
WHAT IS IN THIS MANUAL	iii
ABOUT LCI	iv
GENERAL SAFETY GUIDELINES	v
CONTENTS	vii
Section 1	1-1
FURNACE EQUIPMENT	1-1
1.1 Furnace Description	1-1
1.2 Furnace Views	1-2
1.3 Furnace Elements	1-4
1.4 Console Controls & Indicators	1-7
Section 2	2-1
INSTALLATION	2-1
2.1 Unpacking the Equipment	2-1
2.2 Location & Initial Installation Work	2-1
2.3 Providing Power	2-4
2.4 Providing Process Gas	2-5
2.1 Exhaust Requirements	2-7
2.2 Water and Drain Connections	2-9
Section 3	3-1
INITIAL SETUP	3-1
3.1 Emergency Machine Off (EMO)	3-1
3.2 Interlocks	3-1
3.3 Control Console	3-1
3.4 Functional Checkout	3-2
Section 4	4-1
OPERATION	4-1
4.1 Furnace Operation	4-1
4.2 Furnace Alerts & Alarms	4-4
4.3 Energizing Lamps	4-7
4.4 Testing Lamps	4-8
4.5 Gas Flow Control	4-9
Section 5	5-1
MODIFYING CONTROL STRATEGIES	5-1
5.1 Modifying Zone Controllers	5-1
5.2 Controller PID Tuning	5-4
5.3 Automatic PID Group Selection	5-8
5.4 Manual PID Group Selection	5-8

5.5 Viewing Controller Output Level	5-8
5.6 Restoring Factory Presets	5-9
Section 6	6-1
ADVANCED FEATURES & OPTIONS	6-1
6.1 Advanced Features	6-1
6.2 Options	6-2
Section 7	7-1
SERVICE & MAINTENANCE	7-1
7.1 Service and Maintenance Access	7-1
7.1 Routine Maintenance	7-5
7.2 Daily Maintenance	7-5
7.3 Monthly Maintenance	7-5
7.4 Other Scheduled Maintenance	7-5
7.5 Troubleshooting	7-10
7.6 Troubleshooting Process Problems	7-14
7.7 Service	7-15
7.8 Calibration	7-22
7.9 Over Temperature Alarm Setpoints	7-28
Section 8	8-1
PROCESS ENGINEERING	8-1
8.1 IR Furnace Process	8-1
8.2 Furnace Construction	8-3
8.3 Heating Chamber Design	8-4
8.4 PID Tuning Concepts	8-6
8.5 Gas Flow	8-8
Section 9	9-1
THERMAL PROCESSING THEORY	9-1
9.1 Infrared Waves	9-1
9.2 Infrared Heating	9-2
9.1 Thermal Process	9-3
9.2 Temperature Profiling	9-3
Section 10	10-1
DRAWINGS & SCHEMATICS	10-1
10.1 Furnace Arrangement LA-306	10-2
10.2 Furnace Chamber	10-3
10.3 Process Gas Plumbing, Single Gas ...	10-4
10.4 Process Gas Plumbing, Dual Gas	10-5
10.5 Supply Gas Mixing	10-6
10.6 Safety Panel	10-7
10.7 Power Control Sch	10-8

Contents

10.8	Frame Wiring	10-9
10.9	Control Console	10-10
10.10	Element Wiring	10-11
10.11	Element Wiring – Hi Power.....	10-12

Section 11 11-1

SPECIFICATIONS **11-1**

11.1	Furnace Specifications	11-2
11.2	Fuse List	11-3
11.3	Average Current at Temperature Curve	11-4

Section 12 12-1

APPENDIX - MSDS **12-1**

12.1	MSDS M0090 Fiberfrax® QF Cements	12-2
12.2	MSDS M0042 Fiberfrax® Duraboard®	12-8
12.3	Fiberfrax® Refractory Ceramic Fiber MSDS 0001	12-14
12.4	MSDS M0055 Fiberfrax® High Purity Papers	12-20
12.5	Kaowool® Insulation MSDS 203	12-26
12.6	MSDS 0732 RTV Silicone 732	12-31
12.1	MSDS MagnaForm Boards	12-32

Section 13 13-1

GLOSSARY **13-1**

Section 14 14-1

RTC LA-306 SUPPLEMENT **14-1**

14.1	The Rebuilt RTC LA-306	14-1
14.2	Console Controls & Indicators	14-2
14.3	Installation.....	14-4
14.4	Initial Setup	14-4
14.5	Operation	14-4
14.6	Modifying Control Strategies	14-4
14.7	Service & Maintenance.....	14-4
14.8	MSDS	14-4
14.9	Specifications.....	14-5
14.10	RTC LA-306 DRAWINGS	14-6
14.11	Furnace Arrangement, RTC LA-306...	14-7
14.12	Furnace Chamber, RTC LA-306.....	14-8
14.13	Frame Wiring – MAX JR.....	14-9
14.14	Frame Wiring – Red Lion.....	14-10

Section 15 15-1

Furnace Configuration **15-1**

FIGURES

Figure 1-1 Furnace Front Elevation	1-1	Figure 3-1 LA-306 Control Console ON	3-1
Figure 1-2 Furnace Entrance Elevation	1-1	Figure 4-1 Process Gas Control Flowmeters	4-9
Figure 1-3 Furnace Front Elevation	1-2	Figure 6-1 Pressure Switch	6-1
Figure 1-4 Entrance Elevation	1-2	Figure 6-2 Sample Port Chamber Penetration	6-1
Figure 1-5 Exit Elevation	1-2	Figure 6-3 Oxygen Analyzer	6-1
Figure 1-6 Exit Elevation	1-2	Figure 6-4 Oxygen Analyzer	6-1
Figure 1-7 Rear Elevation	1-3	Figure 6-5 Control Console showing 3 options: ..	6-2
Figure 1-8 Top Front View	1-3	Figure 6-6 Controls for Supply Gas Mixing	6-2
Figure 1-9 Process Sections	1-4	Figure 6-7 Over Temperature Monitor	6-3
Figure 1-10 Furnace Internals	1-4	Figure 6-8 Ultrasonic Cleaner installation	6-4
Figure 1-11 Transport Drive Motor	1-7	Figure 7-1 Front Access Panels	7-1
Figure 1-12 LA-306 Control Console	1-7	Figure 7-2 Front Access Panels	7-2
Figure 1-13 Power Panel Controls	1-8	Figure 7-3 Rear Access Panels	7-2
Figure 1-14 Energize Lamps Controls	1-8	Figure 7-4 Control Panel Dropdown Door Closed	7-3
Figure 1-15 Zone Temperature Controllers	1-9	Figure 7-5 Dropdown Door Open	7-3
Figure 1-16 Status Panel	1-10	Figure 7-6 Lower Access Panel Removal	7-3
Figure 1-17 Gas Flow Control Panel	1-11	Figure 7-7 Lower Access Panel Installation	7-3
Figure 1-18 Test Panel	1-12	Figure 7-8 Hanging Lower Access Panel	7-3
Figure 1-19 Transport Panel	1-12	Figure 7-9 Hanging Lower Access Panel	7-3
Figure 2-1 Name Plate	2-1	Figure 7-10 Top Panel In Place	7-4
Figure 2-2 Leveling Feet	2-2	Figure 7-11 Entrance Panels	7-4
Figure 2-3 Leveling Chamber Supports	2-2	Figure 7-12 Drive Enclosure Access Panels	7-4
Figure 2-4 Shipping Brackets	2-2	Figure 7-13 Test Panel: Lamp String Failure	
Figure 2-5 Belt Splice	2-2	Indicator	7-12
Figure 2-6 Lower Access Panel	2-3	Figure 7-14 Belt Installation	7-15
Figure 2-7 Belt Weight with packing	2-3	Figure 7-15 Inserting the Belt Splice	7-15
Figure 2-8 Belt Weight in Place	2-3	Figure 7-16 Sprocket Alignment	7-16
Figure 2-9 Proper Alignment of Belt Weight	2-3	Figure 7-17 Belt Tracking Adjustment Diagram	7-17
Figure 2-10 Standard Back Entry Power Port	2-4	Figure 7-18 Drip Tray Cleaning Diagram	7-18
Figure 2-11 Circuit Breaker (option)	2-4	Figure 7-19 Air Rake Alignment Ring	7-18
Figure 2-12 Process Gas Connections	2-5	Figure 7-20 SCR installed	7-19
Figure 2-13 Process Gas Flowmeters	2-5	Figure 7-21 Lamp Indicator Installation	7-20
Figure 2-14 Supply Gas Mixing System	2-6	Figure 7-22 Lamp in Panel	7-20
Figure 2-15 Exhaust Connection	2-7	Figure 7-23 Lamp Replacement	7-21
Figure 2-16 Exhaust Connection Detail	2-7	Figure 7-24 Belt Speed Calibration Diagram ..	7-24
Figure 2-17 Typical Hydrogen Furnace Process		Figure 7-25 Belt Speed Display Meter	7-25
Gas Exhaust Connection	2-8	Figure 7-26 IPS Inlet Pressure Switch	7-27
Figure 2-18 UCD Water Connections	2-9	Figure 7-27 Air Pressure sensor	7-27
Figure 2-19 CAWC Water Supply	2-9	Figure 8-1 IR Furnace Process Sections	8-1
		Figure 8-2 Heating Chamber Construction. End	
		view	8-4

Contents

Figure 8-2 Heating Chamber Construction. End view	8-4	Figure 14-2 Entrance.....	14-1
Figure 9-1 Dominant Wavelength Graph	9-1	Figure 14-3 RTC LA-306 Control Console	14-2
Figure 9-2 Temperature Profile	9-3	Figure 14-4 Transport Panel- MAXjr	14-2
Figure 9-3 880 °C Temperature Profile	9-5	Figure 14-5 DynaPar Max jr Controls.....	14-3
Figure 14-1 RTC LA-306 Furnace Front Elevation	14-1	Figure 14-6 Transport Panel-Red Lion.....	14-3

TABLES

Table 1-1 Furnace Arrangement.....	1-5
Table 1-2 Furnace Lamps Wiring Configuration	1-5
Table 3-1 Functional Checkout	3-2
Table 4-1 Cold Start Up	4-1
Table 4-2 Changing the Profile	4-2
Table 4-3 Standby	4-3
Table 4-4 Resume Operation from Standby	4-3
Table 4-5 Shut Down	4-4
Table 4-6 Alerts & Alarms – Controls ON	4-4
Table 4-7 Alerts & Alarms – Lamps ON	4-5
Table 4-8 Over Temperature Alarm	4-6
Table 4-9 Lamp String Test	4-8
Table 5-1 Unlock/Lock Temperature Controller Keys	5-1
Table 5-2 Changing Temperature Deviation Alert Limits	5-2
Table 5-3 Changing Over temperature Alarm Limit	5-2
Table 5-4 Changing READY Light Limits	5-3
Table 5-5 View & Change PID Parameter Group	5-5
Table 5-6 Zone Auto Tuning	5-6
Table 5-7 Start/Stop Autotune Process.....	5-7
Table 5-8 View Temperature Controller Output Level.....	5-8
Table 5-9 Restore Temperature Controller Factory Settings	5-9
Table 5-10 Restore Temperature Controller Factory Operation Settings.....	5-10
Table 6-1 Initial Alarm Settings	6-1
Table 7-1 Recommended Maintenance & Frequency.....	7-5
Table 7-2 Troubleshooting Power.....	7-10
Table 7-3 Temperature Control Troubleshooting	7-12
Table 7-4 Zones, Lamp Strings and Lamps	7-13
Table 7-6 Initial Alarm Settings	7-27
Table 9-1 Equilibrium Belt Speed Recommendations.....	9-7
Table 14-1 Applicable Drawings for LCI Rebuilt RTC LA-306.....	14-6

