

CONTROLLED ATMOSPHERE IR BELT FURNACE

Model LA-306 Operation & Theory

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

Second Edition

Stephen L. Barber

James M. Clark



**Covers LCI LA-306 Models with PLC
Includes supplement for LCI refurbished RTC LA-306 models**

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

Controlled Atmosphere IR Belt Furnace

Operation & Theory

Second 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. This edition is for models manufactured in 2013 and later, controlled with a programmable logic controller (PLC). If you have acquired an RTC LA-306 rebuilt by LCI with a PLC, this manual describes its operation with the few exceptions noted in Chapter 14.

Achieving high performance and high yields is attainable with careful adjustment of the sophisticated digital temperature controllers and exceptional process gas system 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 light. The unique gas management system provides an extremely even distribution and well regulated flow of gas throughout the process chambers. While the furnace is very easy to use, understanding how to control both the heat and gas flow is essential to achieve exceptional performance of the furnace. When the interaction 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 conditions.

WHAT IS IN THIS MANUAL

This manual explains furnace equipment installation and setup, operation and troubleshooting of LA-306 series and LA-309-V series PLC controlled 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 or operated.

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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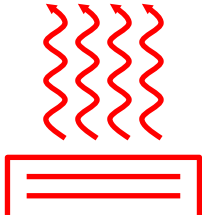
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GENERAL SAFETY GUIDELINES

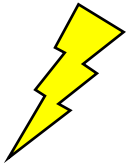
The following set of guidelines is intended to create awareness of potential health and safety hazards.

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.

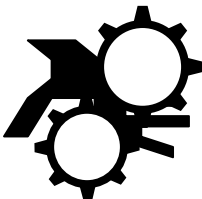
Electrical shock hazards exist for those technicians who service the furnace. High voltages are required to operate the furnace and precautions must be taken to reduce the exposure to these elements. Again, it is the responsibility of the furnace owner to assure that only properly trained service technicians,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



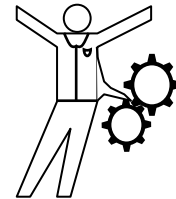
EXPLOSION Explosive dangers may exist in the high temperature process environment of the furnace. If the furnace operates with process gas containing hydrogen, measures must be taken to avoid the dangers of explosion. Furthermore, improper gas flow balance may draw oxygen rich air into the furnace, mixing 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 and/or toxic process residue. Such tasks should be performed by qualified persons wearing gloves, eye protection and a facemask to prevent inhalation of particulates or contact with toxic materials.



ROTATING EQUIPMENT. Roller dangers exist when working around the conveyor belt of the furnace. Care should be taken not to place hands or garments 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. 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.

Locate the EMO buttons and insure their proper function prior to regular furnace operation.

Panel Interlock Switches

The LA-306 has (3) interlock switches positioned to prevent operation of the furnace with high voltage panel access covers out of place. One is located on the control enclosure hinged back access door, and one on each of the lower side panels closest to the furnace entrance safeguarding access to the high voltage at the chamber lamps. The control enclosure top access plate is not interlocked.

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



Panel Switch in Normal Operation Position (in)



Panel Switch Installed - Bypass (out) 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 (DGO 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.

Hydrogen/Nitrogen Mixing (HO/NHM 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 three elements ensure that no additional H₂ gas is allowed into the furnace and that the remaining H₂ is diluted and removed as quickly as possible.

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