

CLASSIC™ LFD SERIES
WITH PROTOCOL™
INSTRUCTION MANUAL

LFD Series Despatch Ovens are bench ovens to 343°C (650°F) with forced convection airflow.

<u>Model</u>	<u>Volts</u>	<u>Heater watts</u>	<u>Amps</u>	<u>HZ*</u>	<u>Phase</u>
LFD 1-42	240	6,000	28.7	50/60	1
LFD 2-11	208	12,000	39.7	60	3
	240	12,000	34.9	60	3
	480	12,000	17.5	60	3
LFD 2-24	208	24,000	76.2	60	3
	240	24,000	66.8	60	3
	480	24,000	33.4	60	3

* A kit is required for 240V-1Ph-50Hz operation. Units will operate on a 220V - 1 phase - 50 Hz line. Units are modified for 3-phase 50 Hz operation.

Prepared by:
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Customer Service 800-473-7373

Notice

Users of this equipment must comply with operating procedures and training of operation personnel as required by the Occupational Safety and Health Act (OSHA) of 1970, Section 6 and relevant safety standards, as well as other safety rules and regulations of state and local governments. Refer to the relevant safety standards in OSHA and National Fire Protection Association (NFPA), section 86 of 1990.

Caution

Setup and maintenance of the equipment should be performed by qualified personnel who are experienced in handling all facets of this type of system. Improper setup and operation of this equipment could cause an explosion that may result in equipment damage, personal injury or possible death.

Thank you for choosing Despatch Industries. We appreciate the opportunity to work with you and to meet your heat processing needs. We believe that you have selected the finest equipment available in the heat processing industry.

At Despatch, our service does not end after the purchase and delivery of our equipment. For this reason we have created the Service Products Division within Despatch. The Service Products Division features our Response Center for customer service. The Response Center will direct and track your service call to ensure satisfaction.

Whenever you need service or replacement parts, contact the Response Center at 1-800-473-7373: FAX 612-781-5353.

Thank you for choosing Despatch.

Sincerely,

Despatch Industries

Despatch Product Warranty

Parts, Materials and Labor

Despatch warrants all parts and materials to be free from defects in material and workmanship for a period of one (1) year from the date of shipment unless otherwise mutually agreed upon in writing, or 2,000 hours of operation, whichever occurs first. (Note: Laboratory oven electric heaters are warranted for a period of five [5] years from date of shipment.)

Despatch will repair or replace, at Despatch's option, FOB Despatch's factory, parts and materials covered by this warranty. Despatch is not responsible for parts or material failures resulting from misuse, abuse, inadequate preventive maintenance, acts of nature, or non-conforming utilities, including electrical, fuel supply, environmental and intake/exhaust provisions. This warranty also does not cover normal wear or routine maintenance parts and materials expressly designed as expendable/consumable and replaceable.

Labor services for parts and materials replacement and repair to support this warranty are available at Despatch's normal service fees. This service is provided worldwide by a network of factory trained professionals.

Terms and Conditions

The foregoing warranty shall be deemed valid and binding upon Despatch if and only if the Customer:

1. Installs, loads, operates and maintains the equipment supplied hereunder in accordance with the instruction manual provided upon delivery and product labeling affixed to the subject equipment.
2. Agrees to follow the Emergency Procedure spelled out below.

Exclusions/Limitations of Liability

This warranty DOES NOT cover expenses incurred in the process of diagnosing and/or repairing equipment resulting from: a) operator error, b) attempted service or modifications by other than Despatch authorized technicians, c) any use of the equipment which is inconsistent with the operation manual or labeling, d) inadequate preventive maintenance, or e) acts of nature, such as floods, fire, earthquake, or acts of war or civil emergency.

Despatch shall not, in any event, be liable for indirect, special, consequential or liquidated damages or penalties, including loss of revenue, profits or business opportunities resulting from interruption of process or production. Despatch shall further be held blameless for any damages or expenses resulting from delays in our attempts to diagnose and repair the equipment, unavailability of spare parts or inaccessibility of the equipment. Specifically excluded from this warranty is responsibility for internal and external corrosion damages to the equipment.

Non-Compliance

Despatch reserves the right to suspend and withhold service as provided under this warranty in the event of non-compliance by the Customer to any terms and conditions of this warranty. Further, Despatch is held harmless for any loss of production, incurred expenses, and other inconveniences due to suspension of service under this non-compliance provision.

Emergency Procedure

In an emergency situation, Customer agrees to: a) immediately shut off fuel or energy supply (gas and electricity), b) call 911 for emergency assistance if needed, and c) call Despatch Service.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES WHATSOEVER, AND SPECIFICALLY THERE ARE NOT IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

THE FOREGOING WARRANTY IS NOT TRANSFERABLE IN SITUATIONS WHERE EQUIPMENT OWNERSHIP IS TRANSFERRED TO ANOTHER PARTY.

Despatch Service
Worldwide Phone 612-781-5363; Worldwide Fax 612-781-5185; North American Phone 800-473-7373

Despatch Service Support Programs

Despatch continues to deliver exceptional products backed by a strong sense of responsibility and drive for long term customer satisfaction. Your partnership with Despatch can offer even higher value through your subscription to one of Despatch's high value service programs.

Warranty

Despatch's exclusive, comprehensive service programs start with the warranty which is described on the other side of this document. This warranty can be expanded immediately to meet your most stringent service needs. Despatch Service will be able to answer your service questions and provide a quotation for the immediate expansion of your product warranty.

Immediate Service Response

The key to an effective service program is response. Wherever your location, Despatch is only a phone call away. Our North American customers can reach Despatch at 1-800-473-7373. Worldwide customers can call 1-612-781-5363 or FAX 1-612-781-5485. Our Customer Service Technicians have over 200 years combined experience and access to detailed design and manufacturing documentation specific to your Despatch unit(s). This exacting level of service is a benefit only Despatch can provide and means that you can expect speedy, accurate and the most cost effective response.

Field Service Network

A worldwide network of factory trained Service Professionals is available to support your Despatch equipment. From routine repair to certified instrument calibration, the Despatch service network is positioned to respond to your needs. As a manufacturer of custom equipment, our service programs are customized to meet your specific needs regarding:

1. Service scope
2. Response time
3. Preventive maintenance frequency and content
4. Payment method

Sustained Service Support

At Despatch, long term customer satisfaction means more than just responding quickly and effectively to our customers' service needs. It means offering comprehensive customer support well beyond the scope and duration of our initial warranty. Despatch offers two basic service packages which are customized to each individual customer's need. These service packages are titled Full Service and Preventive Maintenance Plus+ service agreement products. Each is unique in the industry and offer the following benefits:

1. Priority response for minimum production interruption
2. Preventive maintenance for longer product life
3. Discounts on parts and services
4. Various payment plans to ease budgeting and recording expenses
5. Reduce purchase ordering costs

PREFACE

This manual is your guide to the Despatch oven. It is organized to give you the information you need quickly and easily.

The INTRODUCTION section provides an overview of the Despatch oven.

The THEORY OF OPERATION section details the function and operation of assemblies and subassemblies on the Despatch oven.

The INSTRUCTIONS section provides directions on unpacking, installing, operating and maintaining the Despatch oven.

The APPENDIX section contains Special Instructions for operating the control instrument, a Troubleshooting Table, a list of Accessories and a Warranty.

An efficient way to learn about the oven would be to read the manual while working with the corresponding oven control system. This will give you practical hands-on experience with information in the manual and the oven.

Before operating the equipment, be sure you understand all of the technical information contained in this manual. Information skipped, not understood or misunderstood could create the possibility of operating the equipment in an unsafe manner. This can cause damage to the oven or personnel or reduce the efficiency of the equipment.

NOTE:
Read the entire
INTRODUCTION and
THEORY OF OPERATION
before installing the oven.

WARNING:
Failure to heed warnings in
this instruction manual and
on the oven could result in
personal injury, property
damage or death.

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INTRODUCTION

This section provides an overview of the Despatch Classic™ LAD Series ovens. The LAD Series Ovens have the most effective heat distribution and the fastest processing time of any lab ovens their size. Air is discharged from the left side wall of the oven and circulates through the chamber.

Special Features

The sturdy construction and four inch insulation (five inches in the front) of the Despatch LAD Series ovens contribute to excellent temperature uniformity.

Despatch LAD Series ovens also incorporate a modular microprocessor based digital control. The Despatch Protocol™ temperature controller features:

- PID tuning
- programmable up to 48 segments
- built-in manual reset Hi-limit control
- built-in process timer
- self-diagnostics
- digital display
- three (3) event outputs
- recursive profile capability
- optional RS-422/RS-485 capability

Other special features include the following:

- Class A features forced exhaust with airflow switch, pressure relief panel and purge timer.
- Unique Despatch design to combine higher fan volume of forced recirculated air with a system of perforated stainless steel walls for the ultimate in temperature uniformity.
- Welded double wall construction and fiberglass insulation to reduce heat loss. Silicone rubber gaskets further minimize heat leakage.
- Rapid response heater with a five year warranty.
- Scratch-resistant Silver-Clay® baked enamel exterior and stainless steel interior for easy cleaning.

Specifications

Dimensions

Model	Chamber Size in (cm)			Capacity feet ³ (liters)	Overall Size in (cm)			Maximum Number of Shelf Positions
	W	D	H		W	D	H	
LFD 1-42	20 (50)	18 (46)	20 (51)	4.2 (120)	33 (84)	41 (104)	45 (114)	9
LFD 2-11	38 (96)	20 (50)	26 (66)	11.0 (310)	54 (137)	35 (88)	78 (198)	6
LFD 2-24	48 (122)	24 (61)	36 (91)	24.0 (680)	66 (166)	38 (98)	89 (226)	9

Capacities

Model		LFD 1-42	LFD 2-11	LFD 2-24
Maximum Load	Lbs	150	180	300
Maximum Shelf Load	Lbs	30	60	100
Exhaust at 177 °C (350 °F)	CFM	25	38	122
	HP	1/50	1/3	1/3
Recirculating Fan	CFM	300	1,000	1,500
	HP	1/4	1	2
Approximate Weight Net	Lbs.	380	795	1,015
	KG	173	361	461
Approximate Shipping Weight	Lbs.	510	1,095	1,415
	KG	232	498	643
Solvent Handling Capabilities at 177 °C (350 °F)		0.025 GPH of VM and P	0.042 GPH of VM and P	0.14 GPH of VM and P

Temperature

Model		LFD 1-42	LFD 2-11	LFD 2-24
Time to Temperature (approximate minutes with no load)	25°C - 100°C	4	4	2
	25°C - 200°C	11	11	10
	25°C - 343°C	29	28	38
Recovery Time Door Open 1 Min. (approximate minutes with no load)	100°C	<1	<1	<1
	200°C	2	3	3
	343°C	4	8	7
Temperature Uniformity at	100°C*	±1°C	±1°C	±1°C
	200°C*	±2°C	±2°C	±2°C
	343°C*	±4°C	±4°C	±4°C
Minimum Operating Temperature (Approximate w/20°C ambient)	dampers open	40°C	30°C	30°C
	dampers closed	50°C	40°C	55°C
Control Stability		±0.3°C	±0.3°C	±0.3°C
Repeatability		±0.5°C	±0.5°C	±0.5°C
Cooldown Time (approximate minutes with no load)	343 - 50°C dampers open	46	40	27
	343 - 75°C dampers closed	110	120	85

* Figures are based on actual tests in an empty oven. Uniformity can vary slightly depending on unit and operating conditions.

Power

Line voltages may vary in some geographical locations. If your line voltage is much lower than the oven voltage rating, warm up time will be longer and motors may overload or run hot. If your line voltage is higher than name plate rating, the motor may run hot and draw excessive amps.

If the line voltage varies more than 10% from the oven voltage rating, some electrical components such as relays, temperature controls, etc. may operate erratically.

Power Requirements

Model	Volts	Amps	Hertz*	Phase	Heater KW
LFD 1-42	240	28.7	50/60	1	6
LFD 2-11	208	39.7	60	3	9
	240	34.9	60	3	9
	480	17.5	60	3	9
LFD 2-24	208	76.2	60	3	16
	240	66.8	60	3	16
	480	33.4	60	3	16

* A kit is required for 240V - 1PH - 50Hz operation. Units will operate on a 220V - 1PH - 50 Hz line. Units are modified for 3 PH, 50Hz operation.

THEORY OF OPERATION

This section details the function and operation of assemblies and subassemblies on the Despatch LFD Series Ovens. These ovens have the most effective heat distribution system and the fastest processing time of any lab ovens their size. They are especially useful for testing, preheating, sterilizing, drying, aging and curing as well as other production applications. Horizontal airflow with precision digital control delivers uniform, fast processing. The overall result is efficient productivity under strenuous conditions.

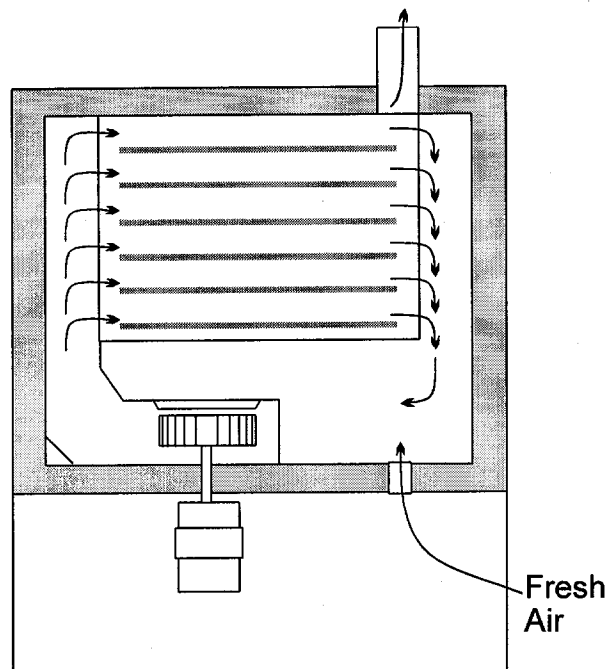


Figure 1. Horizontal Airflow

The unique Despatch computerized design, moves forced convected heat through perforated stainless steel walls. The air is recirculated with a high volume fan. Despatch LFD Series Ovens employ higher volume fans than any competitive model. The chamber can be densely loaded without interfering with the process. The LFD series air delivery temperature is within $1/2$ °C of the number appearing on the digital display. Also, fresh air intake is regulated by a panel-mounted damper control, while the exhaust rate is fixed. The exhaust rate is regulated by an adjustable control on the exhaust stack.

Protocol™

The ovens are equipped with a modular microprocessor based digital temperature controller.

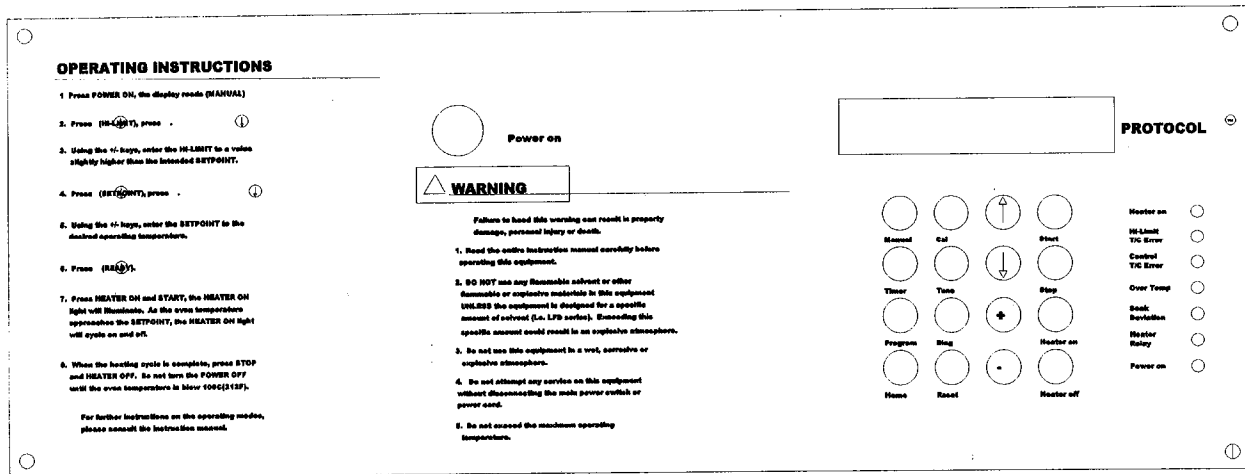


Figure 2. Control Panel

The Despatch Protocol™ temperature controller is a dual functioning controller/high limit instrument. The control portion of Protocol™ incorporates a microprocessor to digitally control process variables with minimal temperature fluctuations.

The high limit portion of Protocol™ protects the product and/or the oven itself. If the product being processed has a critical high temperature limit, the Hi-Limit parameter should be set to a temperature somewhat below the temperature at which the product could be damaged. If the product does not have a critical high temperature limit, the Hi-Limit parameter should be set to a value slightly higher than the highest programmed setpoint to protect the oven equipment.

Keypad Controls

The Despatch Protocol™ temperature controller has six keys that provide the six operating modes.

Protocol Keypad Controls

Mode	Display Code	Function	Description
Manual	MANUAL	Operation	Single setpoint control
Timer	TIMER	Operation	Single setpoint control with process timer
Program	PROGRAM	Operation	Programmable control with three event outputs
Tune	TUNE	Configure	Set instrument parameters
Calibrate	CALMODE	Service	Performs instrument calibration
Diagnostics	DIAGNOSE	Service	Performs instrument thermocouple tests, SSR power level and event output tests.

The Despatch Protocol™ temperature controller also has ten (10) touch-keys so that the user can easily operate the controller.

Protocol Touchkeys

Key	Description
▲	To move up through any mode
▼	To move down through any mode
+	To increase a setpoint or parameter
-	To decrease a setpoint or parameter
Home	To move to the beginning of any mode or segment
Reset	To reset the control when an error has been corrected or to view the profile number, segment number and the number of loops (repeat times) remaining.
Heater On	To initiate heater relay
Heater Off	To disengage heater relay
Start	To start an operating mode
Stop	To stop an operating mode

Status Indicator LEDs

Protocol™ has seven indicator LEDs that provide the following relevant information to the user.

Protocol Indicator LEDs

LED	Function
Power on	Lights when the power on pushbutton is pressed.
Heater relay	Lights when a mode is ready for operation and the heater on key is pressed.
Soak Deviation	Lights when the process temperature is not held within the user specified soak deviation limits. The light turns off when the temperature is within the soak deviation limit.
Over Temp	Lights when the process temperature exceeds the high limit value. The over temperature light remains lit until the Reset key is pressed.
Control T/C Error	Lights when Protocol™ receives a control thermocouple error.
Heater on	Lights when the heater is activated by the control circuits.
Hilimit T/C Error	Lights when Protocol™ receives a Hi-limit thermocouple error.

The Despatch Protocol™ temperature controller has been designed for ease of use while maintaining elaborate and versatile control capabilities.

Operating Modes

Protocol™ has three primary modes of operation: the Manual mode, the Timer mode and the Program mode.

Manual Mode

The manual mode is a single setpoint control mode that controls the process at the user specified setpoint for an indefinite period of time. The manual mode controls the oven temperature within close limits as specified by the PID tuning parameters.

Whenever the instrument is powered by the **Power on** pushbutton, Protocol™ starts at the manual mode.

Timer Mode

The timer mode is a single setpoint control mode with a built-in process timer that starts timing either at the beginning of the process or at a user specified temperature. As in the manual mode, the timer mode uses the PID parameters set in the tune mode.

Program Mode

The program mode is a programmable ramp and soak control consisting of up to eight profiles. Each profile consists of up to six segments for a total of 48 segments (8 x 6 = 48). Any one profile may be run recursively from two to 99 cycles or even continuously if it is desired.

Each segment consists of a ramp and soak period. During the ramp period, the control will track oven temperature. For example, a ramp is entered to heat from 100° C to 150° C in 50 minutes. Protocol™ will track the temperature 1° C every minute for 50 minutes. During the soak period, temperature is maintained as specified by the tuning and soak deviation parameters.

Protocol™ will not allow a soak time to begin until the actual oven temperature is within the soak deviation limit. This process is called assured soak. The ramp and soak periods are adjustable from 0 to 99 hours, 59 minutes. Within each ramp and soak period, up to three event outputs can be programmed either on or off.

The event relay is used for factory installed modifications, then disconnected before shipping. Please consult the factory for information on connecting the event outputs. When the events are connected, the user has the capability of controlling relays, solenoid valves, etc., throughout the programming cycle.

Calibration Zero Offset

The Calibration Zero Offset (CZO) of Protocol™ has been preset and tested for the specified operating conditions. Special instructions for accessing the tune mode to change the CZO are referred to in the Appendix of this manual.



CZO 0.0

Figure 3. CZO Function in Tune Mode of Protocol™

NOTE:

The CZO value has been factory preset to match the center of the chamber at 300°C.

The CZO may be useful to make the following small temperature corrections to the control system.

- Correction of known sensor calibration errors.
- Correction of any known steady temperature offset between the heated work-piece (load) and sensor. This is useful for applications where the sensor cannot be located exactly at the work-piece.
- Alignment of temperature indications in a multi-zone/multi-controller application, e.g., at ambient temperature.

Note that the CZO changes the value of the controlled temperature when used in closed loop control. The CZO function can be represented by the equations:

$$\text{Temp Indication (°F)} = \text{Sensor Temp (°F)} - \text{CZO\%} [100 \text{ (°F)} - \text{Sensor Temp (°F)}]$$

$$\text{Temp Indication (°C)} = \text{Sensor Temp (°C)} - \text{CZO\%} [38 \text{ (°C)} - \text{Sensor Temp (°C)}]$$

The CZO function is a straight line pivoted around 100° F (38° C). Thus, the CZO functions as an offset and has the ability to change the slope of a temperature range.

Calibration Zero Offset Examples

CZO Display	Temperature measured by sensor	Offset °F	Temperature Indication
0	10	20	100°F
100°F	200°F	0°	0°
20°	100°F	100°F	180°F

NOTE:
The CZO function is easily set for specific operating conditions.

A more useful formula is one that the user can use to calibrate Protocol™ to match the center of the chamber. This requires the use of a temperature measuring device with its thermocouple junction located at the center of the chamber. CZO can be directly calculated by:

Tune Setting

The Protocol™ has been preset and tested for normal operating conditions. Special instructions for changing the tune setting are referenced in the Appendix of this manual.

$$CZO = 100 \left(\frac{\text{Center Temp } (^\circ F) - \text{Protocol}^\text{TM} \text{ Display } (^\circ F)}{\text{Center Temp } (^\circ F) - 100 (^\circ F)} \right)$$

$$CZO = 100 \left(\frac{\text{Center Temp } (^\circ C) - \text{Protocol}^\text{TM} \text{ Display } (^\circ C)}{\text{Center Temp } (^\circ C) - 38 (^\circ C)} \right)$$

The Protocol™ on the oven can be manually tuned. For your convenience the factory has tested and preset the PID action to its optimum values. These values need not be changed under normal operating conditions.

Factory PID Settings

Proportional Band	Reset Time	Rate Time
5°C	30 seconds/repeat	0 degrees/second

NOTE:
Reset times greater than 35 seconds/repeat are not recommended.

Protocol™ Hi-Limit

Protocol™ will not let the high limit value drop below the setpoint value. In certain situations, it may be necessary to change the setpoint first and then adjust the high limit value.

It will be necessary to reset the Hi-Limit whenever it has tripped. The Hi-Limit may be reset by first allowing the oven chamber to cool slightly (or increasing the parameter by several degrees) and pushing the **Reset** key. During a high limit condition the Over Temp LED will turn on thus deactivating the heater.

WARNING: Never operate the oven at a temperature in excess of the maximum operating temperature.

INSTRUCTIONS

The INSTRUCTIONS section provides directions for unpacking, installation, operation and maintenance of the Classic™ LFD Series oven.

Unpacking and Inspection

Remove all packing materials and thoroughly inspect the oven for damage of any kind that could have occurred during shipment.

- See whether the carton and plastic cover sheet inside carton are still in good condition.
- Look at all outside surfaces and corners of the oven for scratches and dents.
- Check the oven controls and indicators for normal movement, bent shafts, cracks, chips or missing parts such as knobs and lenses.
- Check the door and latch for smooth operation.

If there is damage that may have occurred during shipment, follow these instructions.

1. Contact the shipper immediately and file a written damage claim.
2. Contact Despatch Industries to report your findings and to order replacement parts for those that were damaged or missing.
3. Send a copy of your filed damage claims to Despatch.
4. Next, check to make sure you have received all the required materials. Your shipment should include:
 - One (1) Despatch oven,
 - One (1) Instruction manual,
 - One (1) Warranty card,
 - Two (2) Shelves

5. If any of these items are missing from the packaged contents, contact Despatch Industries to have the appropriate materials forwarded to you.
6. Finally, to protect the warranty on your new LFD Series Oven, complete the warranty card and mail it to Despatch within 15 days after receipt of the equipment.

Set-up

1. Select the location for installing your oven.

If solvents are going to be used in the oven, you must install an exhaust stack to the outside of the building. Go to step 2.

If no exhaust stack is necessary, go to step 3.

WARNING:

Do not use the oven in wet, corrosive or explosive atmospheres unless this oven is specifically designed for a special atmosphere.

2. Install an exhaust stack from the rectangular exhaust fan discharge stack to the outside of the building.

- If a round exhaust stack is used, a minimum area greater than the area of the exhaust stack is required.
- The flashing through the roof or wall must be capable of handling an exhaust stack temperature up to 343 °C (650 °F).
- All stacks must comply with state and local building codes to insure that surrounding combustible surfaces are below 71 °C (160 °F).
- Design the exhaust stack to limit the amount of restrictions to insure proper airflow. If more than two (2) elbows are used in the stack, over all airflow will be reduced. If airflow is reduced, the amount of solvent that can be safely used with the equipment must also be reduced.

WARNING:

All grounding and safety equipment must be in compliance with applicable codes, ordinances and accepted safe practices.

3. Place oven on a bench top or an optional cabinet base.

The oven must have a minimum 2 inch clearance in the rear to provide proper ventilation. When placed next to another cabinet, or next to another oven, a 3 inch clearance is required. The doors will still open.

4. Make sure oven is level and plumb; this will assure proper heat distribution and operation of all mechanical components.
5. Identify correct power source indicated on the specification plate.
6. On the larger units, remove the control panel and the filler panel to expose the equipment mounting area.
7. Hardwire the oven directly to the electric supply. On larger units the oven line connection is located on the equipment mounting panel.

Operating

Users and operators of this oven must comply with operating procedures and training of operating personnel as required by the Occupational Safety and Health Act (OSHA) of 1970, Section 5 and relevant safety standards, and other safety rules and regulations of state and local governments. Refer to the relevant safety standards in OSHA and National Fire Protection Association (NFPA), Section 86 of 1990.

WARNING:
Do not use oven in wet, corrosive or explosive atmospheres unless this oven is specifically designed for a special atmosphere.

Loading the Oven

Despatch Industries cannot be responsible for either the process or process temperature used, or for the quality of the product being processed. It is the responsibility of the purchaser and operator to see that the product undergoing processing in a Despatch oven is adequately protected from damage.

Carefully following the instructions in this manual will help the purchaser and operator in fulfilling that responsibility.

When loading the oven avoid spills of anything onto the heater elements or onto the floor of the oven. Do not place the load on the oven floor plate. This may cause the load to heat unevenly and the weight may cause shorting out of the heater elements. Use the shelves provided.

WARNING:
This equipment is designed for a specific amount of solvent. Exceeding this amount could result in explosion.

The two shelves are designed to be pulled out about half way without tipping. The support capacity of the shelves is listed in the Capacities Table in the Specifications section in this manual. Do not overload the shelves.

Distribute the workload evenly so that airflow is not restricted. Do not overfill your oven. The workload should not take up more than two-thirds of any dimension of the inside cavity.

Pre-Startup Checklist

- ✓ Know the system. Read this manual carefully. Make use of its instructions and explanations. The know how of safe, continuous, satisfactory, trouble-free operation depends primarily on the degree of your understanding of the system and of your willingness to keep all parts in proper operating condition.
- ✓ Check line voltage. Voltage must correspond to nameplate requirements of motors and controls. Refer to the section on power connections in the INTRODUCTION of this manual.
- ✓ Fresh air and exhaust. Do not be careless about restrictions in and around the fresh air and exhaust openings and stacks. Under no condition permit them to become so filled with dirt that they appreciably reduce the air quantity. The proper ventilation clearances should be fulfilled at all times. Refer to the Set-up instructions in this manual.
- ✓ Ventilation There is an exhaust opening in the rear of the unit that is covered by a hat bracket. Do not remove the hat bracket as it protects the exhaust opening from being completely covered.
- ✓ Helpful hints

For drying ovens, open vent to prevent buildup of moisture.

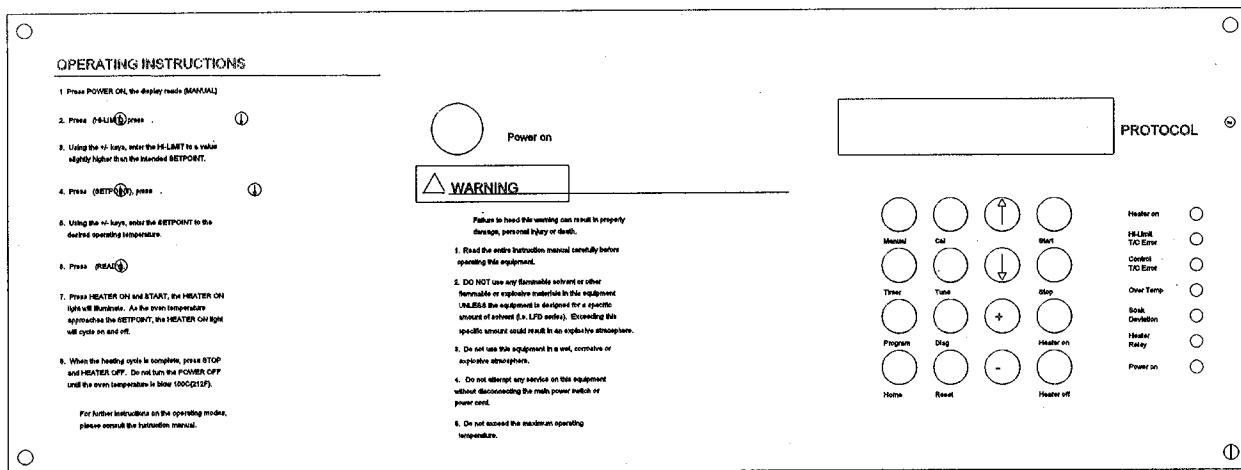
For sample heating, close the vent when no ventilation is required.

Startup

For fastest oven heat-up time, close the fresh-air vent. After the desired temperature is reached, the vent may be adjusted as needed. An outline and examples for the Manual mode, Timer mode and Program mode are referenced in the Appendix. A completed typical program worksheet accompanies all programmable event outputs installed at the factory.

WARNING: Never exceed design specifications posted on the oven.

1. Start the fan.
 - a. Open oven door.
 - b. Press **Power on** pushbutton. You will hear the recirculating fan start.
 - c. Shut oven door.
 - d. Check that the green **Power on** LED is on.



- e. The purge timer will begin timing. The minimum purge time is:

LFD 1-42 = 2 minutes
 LFD 2-11 = 3 minutes
 LFD 2-24 = 2 minutes

- f. Upon initial start-up on three (3) phase units, verify proper fan rotation (direction of arrow)

2. Check airflow switch. Check for proper make and break of the contacts when the exhaust fan is started and stopped.
3. Program the Protocol™ for the desired operating mode. Refer to the following

instructions for the Manual mode, the Timer mode and the Program mode.

Manual Mode

Startup

The following are startup instructions for the Manual mode.

1. Select the Manual mode. Press the **Power on** key or the **Manual** key. MANUAL will be displayed.
2. Enter the high limit temperature.
 - a. Press the ▼ key. HI-LIMIT will be displayed.
 - b. Press the ▼ key.
 - c. Use the + or - keys to enter the high limit temperature to a value slightly higher than the intended setpoint.
3. Enter the setpoint.
 - a. Press the ▼ key. SETPOINT will be displayed.
 - b. Press the ▼ key.
 - c. Use the + or - keys to enter the setpoint to the desired operating temperature.

WARNING: This equipment is designed for a specific amount of solvent. Exceeding this amount could result in an explosion.

NOTE: For safety reasons, Protocol™ will not let the operator set the Hi-Limit below the setpoint. It may be necessary to adjust the Protocol™ setpoint first, then adjust the Hi-Limit.

NOTE: During processing the display shows setpoint on the left and actual oven temperature on the right.

Run

The following are run instructions for the Manual mode.

1. Press the **▼** key. **READY** will be displayed.
2. Press the **Heater on** key. The **Heater Relay** LED will illuminate.
3. Press the **Start** key. The **Heater on** LED will illuminate and the setpoint and actual temperature will be displayed. As oven temperature approaches setpoint, the **Heater on** LED will cycle on and off.

NOTE:

When Protocol™ is run in the Manual mode, the setpoint can be adjusted without stopping the operation. The setpoint is adjusted by using the + or - keys.

Stop

The following are stop instructions for the Manual mode.

1. Press the **Heater off** key. The **Heater Relay** LED will shut off.
2. Wait for oven temperature to fall below 100°C (212°F).
3. When the Manual mode is complete, press the **Reset** key to display the final process temperatures.
4. Press the **Stop** key.
5. Press the **Power on** pushbutton to turn power off.

An example of the Manual mode is referenced in the Appendix.

Timer Mode

Startup

The following are startup instructions for the Timer mode.

1. Select the Timer mode. Press the **Timer** key. **TIMER** will be displayed.
2. Enter the high limit temperature.
 - a. Press the **▼** key. **HI-LIMIT** will be displayed.
 - b. Press the **▼** key.
 - c. Use the **+** or **-** keys to enter the high limit temperature to a value slightly higher than the intended setpoint.
3. Enter the setpoint.
 - a. Press the **▼** key. **SETPOINT** will be displayed.
 - b. Press the **▼** key.
 - c. Use the **+** or **-** keys to enter the setpoint to the desired operating temperature.
4. Enter the process time.
 - a. Press the **▼** key. **TIME** will be displayed.
 - b. Use the **+** or **-** keys to enter the time of the process. (HHMM (hours/minutes) or MMSS (minutes/ seconds) selected in the tune mode.)
5. Enter timer starting temperature.
 - a. Press the **▼** key. **TEMP YES/NO** will be displayed.
 - b. Use the **+** or **-** keys to select either YES or NO.
 - Press the **-** key to display **NO** and begin timing at ambient.
 - Press the **+** key to display **YES** and begin timing at the following input temperature.

NOTE:
For safety reasons, Protocol™ will not let the operator set the Hi-Limit below the Protocol™ **setpoint**. It may be necessary to adjust the Protocol™ **setpoint** first, and then the Hi-Limit.

- c. Press the ∇ key. TEMP and the begin timing temperature will be displayed.
- d. If YES was selected in step b, use the + or - keys to enter the temperature at which the process timer begins timing.

If NO was selected in step b, this setpoint has no bearing on oven operation.

NOTE:

During processing the display shows the setpoint on the left and the actual oven temperature on the right.

Run

The following are run instructions for Timer mode.

1. Press the ∇ key. READY will be displayed.
2. Press the **Heater on** key. The **Heater Relay** LED will illuminate.
3. Press the **Start** key. The **Heater on** LED will illuminate and the setpoint and the actual temperature will be displayed. As the oven temperature approaches the setpoint, the **Heater on** LED will cycle on and off.

NOTE:

When the Timer mode is running, pressing the **Start** key will display the time remaining in the cycle. The display will show TRHHMMSS which stands for the time remaining, hours, minutes and seconds.

Manual Stop

The following are manual stop instructions for the Timer mode.

1. Press the **Heater off** key.
2. Wait for oven temperature to fall below 100°C (212°F).
3. When the Timer mode is complete, press the **Reset** key to display the final process temperatures.
4. Press the **Stop** key.
5. Press the **Power on** pushbutton to turn power off.

An example of the Timer mode is referenced in the Appendix of this manual.

Program Mode

Startup

The following are startup instructions for the Program mode. In any one segment, if the ramp and soak times are zero, Protocol™ ignores the remaining segments of the profile. A soak period will not begin until the actual oven temperature is within the soak deviation limit. During any segment of a profile, if the actual oven temperature falls outside of the soak deviation limit, the **Soak Deviation** LED will be illuminated.

1. Select the Program mode. Press the **Program** key. PROGRAM will be displayed.
2. Enter the high limit temperature.
 - a. Press the ▼ key. HI-LIMIT will be displayed.
 - b. Press the ▼ key. The high limit temperature will be displayed.
 - c. Use the + or - keys to enter the high limit temperature to a value higher than the intended setpoints.
3. Enter the profile number.
 - a. Press the ▼ key. PROFILES will be displayed.
 - b. Press the ▼ key. PRO - 1 will be displayed.
 - c. Use the + or - keys to enter the profile number to program.
4. Program the profile.
 - a. Press the ▼ key. SEG - 1 will be displayed.
 - b. Program the ramp rate.
 - i. Press the ▼ key. RAMP0001 will be displayed.
 - ii. Use the + or - keys to enter the ramp time.

NOTE:

All profiles entered can be cleared by using the PROF CLR function in the TUNE mode.

NOTE:

For safety reasons, Protocol™ will not let the operator set the Hi-Limit below the setpoint. It may be necessary to adjust the Protocol™ setpoint first, then adjust the Hi-Limit.

c. Program the events desired during the ramp time.

i. Press the ▾ key. EVENTS will be displayed.

ii. Press the ▾ key for each event.

iii. Use the + or - keys to program the event outputs ON or OFF for the ramp period.

d. Program the ramp ending temperature.

i. Press the ▾ key. TEMP and the ramp ending temperature will be displayed.

ii. Use the + or - keys to enter the desired ramp ending temperature.

e. Program the soak time.

i. Press the ▾ key. SOAK and the soak time will be displayed.

ii. Use the + or - keys to enter the soak time.

f. Program the events desired during the soak time.

i. Press the ▾ key. EVENTS will be displayed.

ii. Press the ▾ for each event.

iii. Use the + or - keys to program the event ON or OFF for the soak period.

g. Enter the remaining segments 2-6 by following steps a through f.

5. Enter the Soak-Deviation.

a. Press the ▾ key until SOAK-DEV is displayed.

b. Press the ▾ key. The symbol ± will be displayed.

NOTE:

During processing, the display shows the setpoint on the left and the actual oven temperature on the right.

NOTE:

If all event relays are disconnected or no modifications involving event relays have been made to your particular oven, programming the events has no effect on oven operation.

WARNING:

Never operate the oven at a temperature in excess of the maximum operating temperature.

- c. Use the + or - keys to enter the soak deviation limit.

NOTE:
The SOAK-DEV limit is also the assured soak limit. This means that the soak times will not begin until the process temperature is within the SOAK-DEV parameter.

6. Enter the next profile.

- a. Press the ▼ key. GOTO will be displayed.
- b. Use the + or - keys to enter the profile number to continue to.

Options include END and 1 through 8. Select **End** to stop at the end of this profile. For continuous profiles enter the same number of the profile that is currently being programmed.

7. Enter the number of profile recursions.

- a. Press the ▼ key. REPEAT will be displayed.
- b. Press the ▼ key. TIMES will be displayed.
- c. Use the + or - keys to enter the number of times to complete the profile being programmed (1 - 99).

NOTE:
If the Protocol™ is in a hold condition, pressing the Reset key will display that the control is in segment 7 (HOLD).

8. Enter the profile end condition. The hold command is contingent on the final segment of the last profile to be run only.

- a. Press the ▼ key. HOLD will be displayed.
- b. Use the + or - keys to select YES or NO.

Selecting YES will hold at last setpoint. The event outputs will be held at their last value.

Selecting NO will not hold at last setpoint. The event outputs will be turned off.

Run

The following are run instructions for the Program mode.

1. Press the **Home** key until PROGRAM is displayed.
2. Press the **▼** key until PRO - 1 is displayed.
3. Make sure the correct starting profile is entered by pressing + or -.
4. Press the **▲** key until READY is displayed.
5. Press the **Heater on** key. The **Heater Relay** LED will illuminate.
6. Press the **Start** key. The **Heater on** LED will illuminate. As the oven temperature approaches the setpoint, the **Heater on** LED will cycle on and off. During processing, the display shows the setpoint on the left and the actual oven temperature on the right.

NOTE:

When in the Program mode, pressing the **Start** key will display the time remaining in the cycle (TRHHMMSS). Pressing the **Reset** key will display the profile number, segment number and the loops (REPEAT TIMES) remaining.

Manual Stop

The following are manual stop instructions for the Program mode.

1. Press **Heater off** key.
2. Wait for oven temperature to fall below 100°C (212°F).
3. Press the **Reset** key to display the final process temperature.
4. Press **Stop** key.
5. Press **Power on** pushbutton to turn power off.

Examples of the Program mode are referenced in the Appendix of this manual.

Maintenance

Do not attempt any service on this oven before opening the main power disconnect switch.

Checklist

- ✓ Keep equipment clean. Gradual dirt accumulation retards air flow. A dirty oven can result in unsatisfactory operation such as unbalanced temperature in the work chamber, reduced heating capacity, reduced production, overheated components, etc. Keep the walls, floor and ceiling of the oven work chamber free of dirt and dust. Floating dust or accumulated dirt may produce unsatisfactory work results. Keep all equipment accessible. Do not permit other materials to be stored or piled against it.
- ✓ Protect controls against excessive heat. This is particularly true of controls, motors or other equipment containing electronic components. Temperatures greater than 51.5°C (125°F) should be avoided.
- ✓ Establish maintenance & checkup schedules. Do this promptly and follow the schedules faithfully. Careful operation and maintenance will be more than paid for in continuous, safe and economical operation.
- ✓ Maintain equipment in good repair. Make repairs immediately. Delays may be costly in added expense for labor and materials and in prolonged shut down.
- ✓ Practice safety. Make it a prime policy to know what you are doing before you do it. Make CAUTION, PATIENCE, and GOOD JUDGEMENT the safety watchwords for the operation of your oven.
- ✓ Lubrication, Fan motor bearings are permanently lubricated. All door latches, hinges, door operating mechanisms, bearing or wear surfaces should be lubricated to ensure easy operation.

Tests

Tests should be performed carefully and regularly. The safety of personnel as well as the condition of equipment may depend upon the proper operation of any one of the functions of the Protocol™. Test the Protocol™ every 40 hours. Check that the heater LED is cycling on and off, indicating that the heater is working. In the manual mode, enter the HI-LIMIT to the same value as the setpoint. Run manual mode.

When the oven temperature reaches setpoint, the Hi-limit should shut down the system. The HI-LIMIT must be manually reset by pushing the **Reset** key.

WARNINGS: Failure to heed warnings in this manual and on the oven could result in death, personal injury or property damage.

Replacement

Parts

To order or return parts, contact the Service Products Division at Despatch. The Service Products features our Response Center for customer service. When returning parts, a Despatch representative will provide you with an MRA (Material Return Authorization) number. The MRA number must be attached to the returned part for identification. When you are ordering parts, be sure to give the model number, serial number and the part number. This will expedite the process of obtaining a replacement part.

WARNING:
Disconnect the main power switch or power cord before attempting any repair or adjustment.

When you have a **service** need, contact the **Response Center** at **1-800-473-7373**: FAX 612-781-5353.

Protocol™ Instrument

(Tools needed: one quarter (1/4) inch socket set)

1. Disconnect the power.
2. Remove the screws from the face of the control panel and slide it forward.
3. Disconnect the thermocouple wires and the ground wire.
4. Disconnect any event output wires, noting the proper connections.
5. Disconnect the control panel from the oven by unplugging the quick disconnect plug.

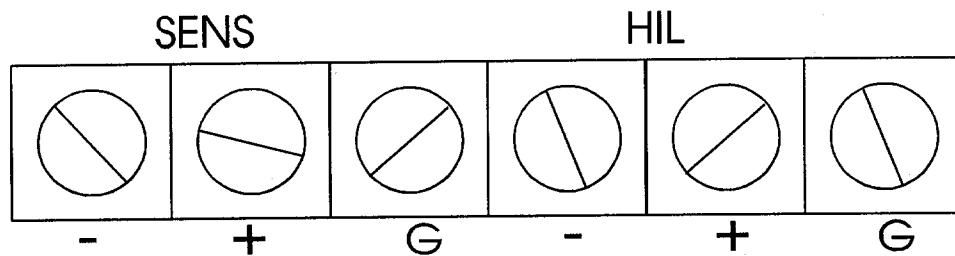


Figure 5. Top View of J Type Thermocouple Inputs on Protocol™

6. Connect the new control panel to the quick disconnect plug.
7. Connect the thermocouple wires and ground wire.
8. Connect the event output wires (if applicable).
9. Replace the control panel.

Heater Unit

(Tools needed: Crescent wrench, screwdriver, one quarter (1/4) inch socket set)

1. Remove the floor plate.
 - a. Remove the screws from the floor plate.
 - b. Lift the floor plate out of the oven.
2. Disconnect the heater leads from heater element with a wrench. Note which wires

go on which terminals.

3. Unscrew the screws holding the heater frame to the oven body.
4. Remove the heater and discard.
5. Screw down the new heater frame.
6. Attach the heater leads to appropriate terminals.
7. Replace the interior floor and screws.

Fan Motor

(Tools needed: Screwdriver, 5/32 inch Allen wrench, one quarter (1/4) inch socket set)

1. Remove the floor plate.
 - a. Remove the screws from the floor plate.
 - b. Lift the floor plate out of the oven.
2. Remove the left side wall.
3. Remove the fan inlet plate.
4. Loosen the set screws (2) on fan wheel in middle of oven bottom. You can reach the fan wheel by going through the heater or by disconnecting and removing the heater. Refer to the Heater Unit instructions.
5. Place the oven on its back.
6. Remove the bottom plate. This will reveal the fan motor.
7. Remove the fan motor.
 - a. Unscrew the screws (4) holding motor mounts to the body.
 - b. Disconnect the motor leads from the terminal strip on the power panel.
 - c. Lift the fan motor from the oven body.

After the fan wheel has run at temperature for awhile, it will stick to the shaft.

Some force may be required to separate the fan wheel from the fan motor shaft.

8. Take the motor mounts off old motor.
9. Put the motor mounts onto new motor.
10. Replace the fan motor.
 - a. Insert the shaft into shaft collar. Put the fan wheel onto shaft from inside oven.
 - b. Reattach the motor mounts to the oven body, making sure grommets are in place.
 - c. Reattach the motor lead wires to the terminal strip.
11. Replace the oven bottom.
12. Turn the oven right side up.
13. Adjust the fan wheel for 3/16 inch clearance between the wheel and the inlet ring.
14. Tighten the set screws on the fan wheel.
15. Check that the set screws hit the flats machined into the motor shaft.
16. Replace the floor plate.

APPENDIX

Special Instructions

The Protocol™ has been preset and tested at the factory for normal operating conditions. In most applications, it will not be necessary to alter oven settings. This section contains additional information and reference for special operating conditions.

Control Instrument

Tune Mode

Various functions of the control instrument are set by parameters in the tune mode. To access the tune mode, it is necessary to enter the proper code.

1. Press **Tune** key. The display reads TUNE.
2. Press **▼** key. CODE *** will be displayed.
3. Enter **+ - - + - +**. PID TUNE will be displayed.

The PID tuning parameters may be entered. The units are listed below.

- P = degrees
- I = seconds/repeat
- D = degrees/second

Tuning Outline

Display	Description
TUNE	Selects tune mode.
CODE ***	Enter + - - + - +
PID TUNE	Enter tuning parameters.
P-1	Proportional band in degrees (+ or - keys).
I-1	Reset in seconds/repeat (+ or - keys).
D-1	Rate in degrees/second (+ or - keys).
DEG -	Select °C or °F (+ or - keys).
SPL -	Setpoint limit, set to maximum temperature of oven (+ or - keys).
CZO -	Calibration zero offset -99.9 to 99.9 (+ or - keys).
DIS	Time set in MMSS (minutes/seconds) or HHMM (hours/minutes).
BEEP	Select beep on or off (+ or - keys).
PF-RECVR	<p>Power failure recovery mode. Use + or - keys to select from STOP, RESUME or HOLD.</p> <p>STOP Program terminates. Must restart from the beginning of the program.</p> <p>RESUME When power is restored, program resumes at the point where power failure occurred.</p> <p>HOLD Program waits for the operator. The operator has a choice of terminating or resuming the program.</p>
DIG COMM	Digital communications option. Disregard unless Protocol™ is supplied with optional digital communications interface. For proper setting, refer to the Protocol™ software manual or the Digital Communication User Guide. Select from NO COMM, CPIF or ASCII (+ or - keys). Select from RS232C or RS422A (+ or - keys). Select address (ADDR) from 1 to 999 (+ or - keys).
RECONFIG	For saving changes to DIG COMM options in memory.
PROF CLR	Entering code clears all profiles to default values.
VARS CLR	Entering code clears the SRAM in Protocol™. All parameters must be reset. Should be done in EXTREME circumstances only. Recalibration is essential.
CODE *E*	For factory installed modifications. Do not change the code setting.

Experience and experimentation with tuning parameters will guide the user in determining the proper settings when normal conditions are not present.

Tuning Worksheet

In most applications it is not necessary to alter tuning parameters. To enter the tune mode, press **Tune**. TUNE will be displayed. Press ∇ and enter + - - + - +. Using the ∇ key and the + or - keys, enter the desired settings. Press the **Home** key when finished.

Display	Setting	Factory Setting	Units
P-1		5	degrees
I-1		30	seconds/repeat
D-1		0	degrees/second
DEG-		C	°F (°C)
SPL-		343	°F (°C)
CZO		varies	% degrees - calibrated to center chamber at 300° C
DIS-		HHMM	minutes/seconds (hours/minutes)
BEEP		On	off (on)

Notes:

1. The alternate is listed in ().
2. See Table 10, Tuning Outline, for further information regarding display codes.
3. Tuning parameters may change from those set at the factory. Load mass, fresh air and exhaust damper settings will affect tuning parameters. Some experimentation is required to determine optimum settings.

Reset times greater than 35 seconds/repeat are not recommended.

Calibration Mode

Protocol™ has been tested and calibrated at the factory. Under normal operating conditions recalibration should not be necessary. However, if the instrument does not comply with known standards recalibration may be necessary.

Calibration Instructions

We recommend using a certified analog thermocouple simulator/calibration source with less than $\pm 1^\circ\text{F}$ noise. We have experienced signal stability problems with some microprocessor based thermocouple simulator/calibrators which induce an error during the calibration procedure. This error generally results in a non-linear shift in the controller's indicated temperature.

WARNING:
Calibration equipment without internal ambient compensation provisions requires subtracting the ambient mV signal from the calibration temperature mV signal to calibrate Protocol™ properly.

1. Disconnect AC power to the oven.

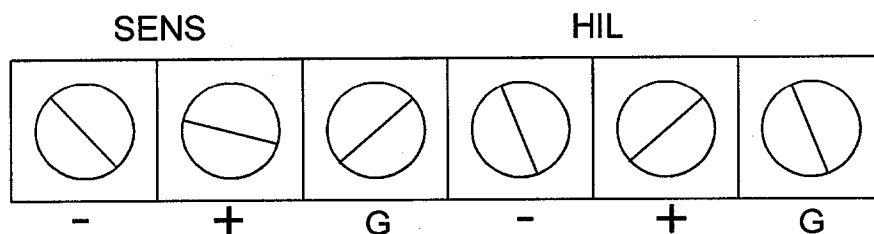


Figure 6. Top View of J Type Thermocouple Inputs on Protocol™

2. Remove Protocol™ controller to expose thermocouple input terminals.
3. Disconnect control and Hi-Limit thermocouples from controller thermocouple input terminals (Control T/C, and Hi-Limit T/C).
4. Mark thermocouple leads if not labeled.
5. Connect a 6 foot piece of type J thermocouple lead wire to each of the Control T/C and Hi-Limit T/C terminals.
6. Twist together or jumper the lead wire end not connected to the Control T/C and Hi-Limit T/C terminals. This creates a junction and prevents a control sensor error [S-T/C ERR] and Hi-Limit sensor error [H-T/C ERR] caused by an open thermocouple.

All errors must be cleared to perform calibration. Any active error will inhibit the calibration function. To clear a HI-Limit control error [HI LIMIT ERROR] caused by lost of calibration (Hi-Limit indication of 500° C or 932° F in the diagnostic mode):

1. Increase the HI-Limit setpoint to 500° C or 932° F.
2. Press the **Reset** key.

7. Loosely fasten the Protocol™ controller to the oven.
8. Re-connect AC power to the oven.
9. Press the **Power on** pushbutton to energize oven.
10. Press the **Tune** key. The display reads [TUNE].
11. Use the ▼ and ▲ keys to scroll through the tune mode configuration. The controller must be configured to operate in °F (Fahrenheit) and CZ0 should be set to zero (0.0).
 - a. Record initial tune mode parameters prior to making any changes.
 - b. Press the ▼ key. The display reads [CODE ***].
 - c. Press the following key sequence: +, -, -, +, -, +.
The display reads [PID TUNE]. Protocol™ is in the tune mode.
 - d. Use the following table to change the tune mode parameters.

Tune Mode Parameter Calibration

NOTE: ### or ## # represents a numeric value or parameter.

Press	Display	Factory Default Setting	Actual Setting	Press	Adjustable Range
▼ key	P-1 ###	5		+ or - keys	0° C to 500° C 32° F to 932° F
▼ key	I-1 ###	30		+ or - keys	0 to 999 seconds/repeat
▼ key	D-1 ###	0		+ or - keys	0 to 999 degrees/second
▼ key	DEG - C	C		+ key for C or - key for F.	
▼ key	SPL - ###	maximum designed operating temperature ¹		+ or - keys	0° C to 500° C 32° F to 932° F
▼ key	CZO - ##.#	can vary		+ or - keys to change parameter to 0.0	-99.9 to 99.9 degrees
▼ key	DIS HHMM	HHMM		+ key for HHMM (hours and minutes) or the - key for MMSS (minutes and seconds).	
▼ key	BEEP ON	ON		+ key for ON or the - key for OFF.	

¹ 204° C/400° F, 260° C/500° F, 343° C/650° F

- e. Press the **Manual** key. The display reads [MANUAL].
 - f. Allow the controller a thirty (30) minute warm up time before proceeding to the step #13 - CAL MODE.
12. Press the **Cal** key. The display reads [CAL--MODE].
 13. Press the ▼ key. The display reads [CODE ***].
 14. Press the following key sequence: -, +, +, -, +, -.
The display reads [HCAL 250].

15. Apply a 250° F signal to the high limit thermocouple input:
 - d. Connect the piece of type J thermocouple lead wire, wired to the High Limit T/C terminals, to a thermocouple simulator.
 - e. Set the simulator to output a type J thermocouple signal.
 - f. Twist together or jumper the piece of type J thermocouple lead wire, wired to the Control T/C terminals. This creates a junction and prevents a Control sensor error [S-T/C ERR] caused by an open thermocouple. Press the **Reset** key to clear a Control sensor error [S-T/C ERR] caused by an open thermocouple.
 - g. Adjust the simulator to supply a 250° F signal. Wait for 30 seconds while the control stabilizes.
16. Press the following key sequence: -, -, +. The display now reads HCAL 450.
17. Adjust the simulator to supply a 450° F signal. Wait for 30 seconds while the control stabilizes.
18. Press the following key sequence: +, +, -. The display now reads HIL 450.
19. To verify proper calibration, adjust the simulator to supply a 350° F signal. Within 30 seconds, the display should stabilize and read HIL 350.
20. To calibrate the control sensor, press the ▼ key. The display reads [SCAL 250].
21. Apply a 250° F signal to the control thermocouple input:
 - a. Connect the piece of type J thermocouple lead wire, wired to the Sensor T/C terminals, to a thermocouple simulator.
 - b. The simulator should be set to output a type J thermocouple signal.
 - c. Twist together or jumper the piece of type J thermocouple lead wire to the Hi-Limit T/C terminals. This creates a junction and prevents a hi-limit sensor error [H-T/C ERR] caused by an open thermocouple. Press the **Reset** key to clear a hi-limit sensor error [H-T/C ERR] caused by an open thermocouple.
 - d. Adjust the simulator to supply a 250° F signal. Wait for 30 seconds while the control stabilizes.
22. Press the following key sequence: -, -, +. The display now reads SCAL 450.

23. Adjust the simulator to supply a 450° F signal. Wait for 30 seconds while the control stabilizes.
24. Press the following key sequence: +, +, -. The display now reads SENS 450.
25. To verify proper calibration, adjust the simulator to supply a 350° F signal. Within 30 seconds, the display should stabilize and read SENS 350.
26. Press the Manual key. The display reads [MANUAL]. If the control did not calibrate properly repeat steps 12 - 25.
27. Press the **Power on** pushbutton to de-energize oven.
28. Disconnect AC power to the oven.
29. Remove Protocol™ controller to expose thermocouple inputs terminals.
30. Disconnect the two pieces of type J thermocouple lead wire connected to the Control T/C and Hi-limit T/C terminals.
31. Re-connect control and Hi-Limit thermocouples to the controller thermocouple terminals (Control T/C, and Hi-limit T/C).
32. Re-install the Protocol™ controller onto the oven.
33. Re-connect AC power to the oven.
34. Press the **Power on** pushbutton to energize oven.
35. Press the **Tune** key. The display reads [TUNE].
36. Reset any tune mode parameters that were changed in step 12 to perform calibration (examples: DEG = F and CZ0 = 0 .0).
37. When changes have been completed, press the **Manual** key. The display reads [MANUAL].

The calibration procedure is complete.

Calibration Recovery

The Protocol control has a factory calibration recovery feature. This feature allows the operator to restore the Protocol to an operational condition should a calibration error occur. The Factory Calibration Recovery feature should only be used as a temporary fix until a proper calibration procedure utilizing a calibration source can be performed. Only a complete calibration will restore the Protocol to an optimum performance level.

For proper calibration instructions refer to the calibration section of this manual.

Instructions

1. Select the Diagnose mode by pressing the DIAG key.
2. Press the ▼ (down arrow) key until RCVR SEN is displayed.
3. To recover the control sensor calibration value, press the key sequence +, -, -, +, -, +.
4. Press the ▼ (down arrow) key until RCVR HIL is displayed.
5. To recover the high limit sensor calibration value, press the key sequence +, -, -, +, -, +.

The calibration recovery is now complete.

Diagnostics Mode

The diagnostics mode is provided to give certain relative information about Protocol™. The following table gives an outline of the diagnostics mode.

Display	Description
DIAGNOSE	Select Diagnostics mode.
SSR	Protocol™ SSR output level.
EVENTS	Events 1-3 follow
E-1	Event 1 output
E-2	Event 2 output
E-3	Event 3 output
SENS-T/C	Control thermocouple display follows
GOOD	Control thermocouple test and input reading
HL - T/C	Hi-limit thermocouple display follows
GOOD	Hi-limit thermocouple test and input reading
PWR	% output
RCVR SEN	Recover factory calibration for control sensor
RCVR HIL	Recover factory calibration for high limit sensor

Items that can be adjusted by the user include SSR (ON or OFF), Events E-1, E-2 and E-3(ON or OFF) and PWR. The SSR and PWR items can be used to test the solid state relay for proper operation. The SSR item allows the SSR to output 100% (ON) or 0% (OFF). The PWR item allows for adjustable output from 0% to 100%. to implement, adjust the PWR level with the +/- keys and turn on the heater relay.

RCVR SEN and RCVR HIL are used to restore the factory calibration should a calibration error occur.

Power Failure

In the event that the power supplied to Protocol™ is insufficient at any point during a running mode, the display will read PWR-FAIL. In the tune mode the user can choose the Power Fail Recovery mode from Stop, Resume and Hold. To restart after a power failure in the hold mode, press the **Start** key to resume oven operation. Otherwise, press the **Reset** key to clear the PWR-FAIL display. Do not shut off the power during a running mode. This creates an error condition and PWR-FAIL will be displayed the next time Protocol™ is powered up. Instead, press the **Stop** key and the **Heater Off** key. This will power off Protocol™ without creating an error condition.

Power Failure

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Programming Examples and Outline

The following examples show a step by step procedure for programming Protocol™ in the Manual, Timer and Program modes. Example 1 covers the Manual mode and example 2 covers the Timer mode. A detailed outline covers the Program mode with a programming worksheet and examples 3-5 following the outline.

NOTE:
Do not turn the power off until the oven temperature is below 100°C (212°F).

Example 1 - Manual Mode

Control the process at 250°F.

NOTE:
°F is selected in the tune mode.

Manual Mode Example

Key	DISPLAY	Description
Manual	MANUAL	Select Manual mode
↓	Hi-Limit	Enter the high limit temperature
↓	HL 200	High limit temperature currently set at 200°F
0	HL 275	Increase high limit temperature to 275°F
↓	SETPOINT	Enter the setpoint
↓	180 75	Setpoint at 180°F, actual oven temperature at 75°F
0	250 75	Increase setpoint to 250°F
↓	READY	Protocol™ is ready to run Manual mode
Heater On	READY	Heater relay initiated, heater ready for power
Start	250 75	Setpoint = 250°F, actual oven temperature = 75°F
Stop	READY	Stop Manual mode
Heater Off	READY	Heater relay LED is off, heater secured off

Example 2 - Timer Mode

Control the process at 200°C for three hours and 15 minutes with the timer beginning at 195°C. Protocol™ will stop automatically when run in Timer mode.

NOTE:
°C and HHMM
(hours/minutes) is selected
in the tune mode.

Timer Mode Example

Key	DISPLAY	Description
Timer	TIMER	Select timer mode
↓	Hi-Limit	Enter the high limit temperature
↓	HL 225	Hi-Limit currently set at 225°C
-	HL 215	Decrease high limit to 215°C
↓	SETPOINT	Enter the setpoint
↓	210 25	Setpoint at 210°C, actual oven temperature at 25°C
-	200 25	Decrease setpoint to 200°C
↓	TIME0010	Timer currently set for ten minutes
+	TIME0315	Increase timer to three hours and 15 minutes
↓	TEMP NO	Timer currently set to begin timing at ambient
+	TEMP YES	Timer set to begin timing at the following temperature
↓	TEMP 79	Timer currently set to begin timing at 79°C
+	TEMP 195	Timer set to begin timing at 195°C
↓	READY	Protocol™ is ready to run Timer mode
Heater On	READY	Heater relay LED on, heater ready for power
Start	200 25	Setpoint = 200°C, actual oven temperature = 25°C
Stop	READY	Stop Timer mode
Heater Off	READY	Heater relay LED is off, heater secured off

Program Mode

Program Mode Outline

Display	Description
PROGRAM	Select Program mode.
Hi-Limit	Hi-Limit for Program mode
HL	Enter high limit temperature (+ or - keys).
PROFILES PRO-	Enter profile number (1-8).
SEG-	Segment number of profile (1-6)
RAMP	Ramp time entered
EVENTS	Event status for ramp time
E-1	Event 1 status (ON or OFF)
E-2	Event 2 status (ON or OFF)
E-3	Event 3 status (ON or OFF)
TEMP	Ramp ending temperature
SOAK	Soak period of ramp ending temperature
EVENTS	Event status for soak period
E-1	Event 1 status (ON or OFF)
E-2	Event 2 status (ON or OFF)
E-3	Event 3 status (ON or OFF)
SOAK-DEV	Soak-Deviation limit for profile (Also assured soak limit)
+/-	Enter soak-deviation limit.
GOTO	Enter profile to GOTO End = Move to REPEAT TIMES command 1 = GOTO profile 1 2 = GOTO profile 2 : 8 = GOTO profile 8
REPEAT TIMES	Enter number of recursions (1-99) 1 = Execute profile 1 times 2 = Execute profile 2 times : 99 = Execute profile 99 times
HOLD	Hold at last setpoint?
YES	Hold at last setpoint indefinitely. Holds event outputs at last value.
NO	No hold at last setpoint. Event outputs turn OFF.

Notes on the Program mode.

- The profile number is manually entered using the + or - keys.
- Six segments exist for each profile.
- If the ramp time and soak time for any one segment is zero, Protocol™ ignores the remaining segments.
- The REPEAT TIMES command is the number of times to execute the profile being programmed.
- The HOLD command is contingent on the final segment of the last profile to be run only.
- A soak time will not begin until the actual temperature is within the soak-deviation limit. (Assured soak limit).
- Make sure the proper starting profile number is displayed in the PRO- prompt before executing the profile to be run.

While a program is being executed, pressing the **Reset** key will display the profile number, segment number and the number of loops (REPEAT TIMES) remaining. Pressing the **Start** key will display the appropriate ramp or soak time remaining (TR.)

If Protocol™ is in a HOLD condition, pressing the **Reset** key will display that the control is in segment 7 (HOLD.)

Program Worksheet

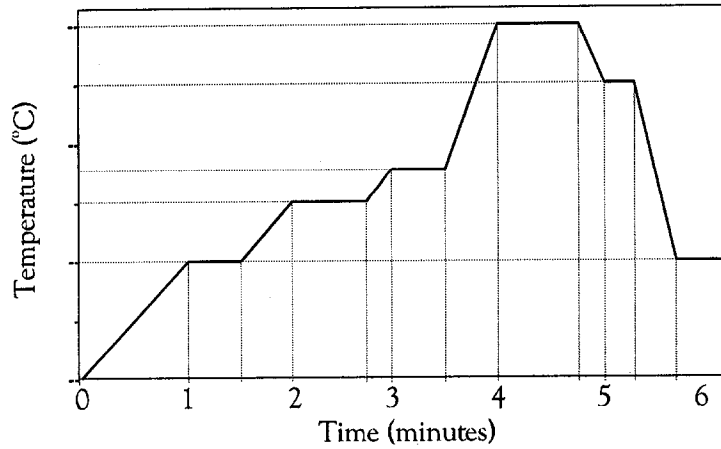
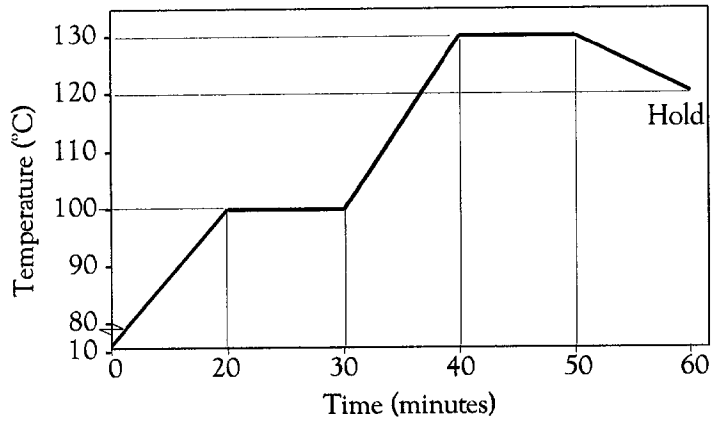


Figure 7. Sample Profile

The program worksheet serves as a guide to the input parameters for the program mode.

Display	Setting(s)					
HL						
PRO-						
SEG-	1	2	3	4	5	6
RAMP						
E-1						
E-2						
E-3						
TEMP						
SOAK						
E-1						
E-2						
E-3						
SOAK-DEV						
GOTO						
REPEAT TIMES						
HOLD						

Example 3 - Program Mode



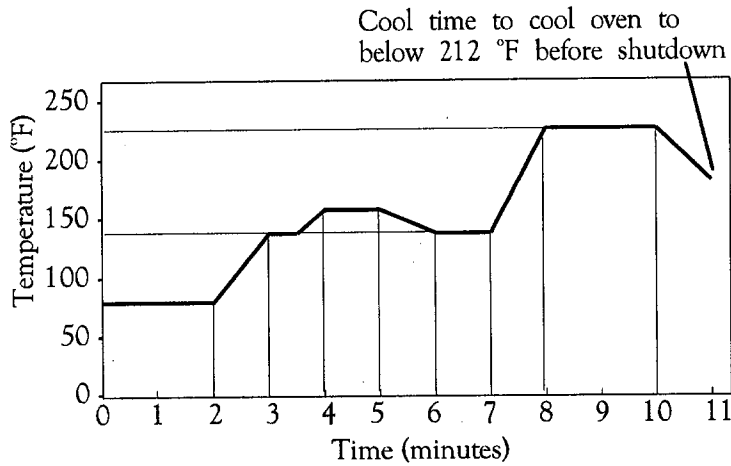
NOTES:
 HHMM (hours/minutes) and °C selected in the tune mode. No event outputs are being used. Soak-Deviation limit = $\pm 7^{\circ}\text{C}$ (also assured soak limit). Hold at last set-point. Ramp and soak times of zero in any one segment ignores remaining segments.

Figure 8. Example Temperature Profile

Follow the characteristic curve listed below.

Display	Setting(s)					
HL	150					
PRO-	1					
SEG-	1	2	3	4	5	6
RAMP	0020	0010	0010	0000		
E-1						
E-2						
E-3						
TEMP	100	130	120	120		
SOAK	0010	0010	0001	0000		
E-1						
E-2						
E-3						
SOAK-DEV	7					
GOTO	End					
REPEAT TIMES	1					
HOLD	Yes					

Example 4 - Program Mode



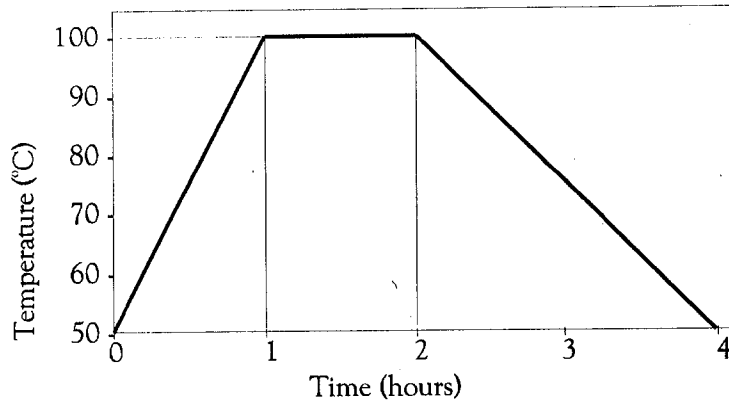
NOTES:
 MMSS (minutes/seconds) and °F selected in the tune mode. Event 1 wired properly for autostart, events 2 - 3 are not used. No hold at last setpoint.
 Soak-Deviation = ±5°F (also assured soak limit). Minimum operating temperature is 70°F.

Figure 9. Example, Temperature Profile

Autostart the oven after two hours and follow the characteristic curve below.

Display	Setting(s)					
HL	240					
PRO-	1					
SEG-	1	2	3	4	5	6
RAMP	0001	0100	0030	0100	0100	0030
E-1	OFF	ON	ON	ON	ON	ON
E-2						
E-3						
TEMP	70	130	160	130	220	100
SOAK	0200	0030	0100	0100	0200	0000
E-1	OFF	ON	ON	ON	ON	OFF
E-2						
E-3						
SOAK-DEV	5					
GOTO	End					
REPEAT TIMES	1					
HOLD	No					

Example 5 - Program Mode



NOTES:
 HHMM (hours/minutes) and °C selected in the tune mode. No events used. Soak-Deviation = 10°C (also assured soak limit). Minimum operating temperature = 50°C. Ramp and soak times of zero in any one segment ignores remaining segments.

Figure 10. Example, Temperature Profile

Complete characteristic curve five times.

Display	Setting(s)					
HL	115					
PRO-	1					
SEG-	1	2	3	4	5	6
RAMP	0100	0200	0000			
E-1						
E-2						
E-3						
TEMP	100	50	50			
SOAK	0100	0001	0000			
E-1						
E-2						
E-3						
SOAK-DEV	10					
GOTO	End					
REPEAT TIMES	5					
HOLD	No					

Troubleshooting

Equipment which operates for long periods of time may develop problems. Below are possible problems and suggested solutions. If you have a problem not listed and do not know what to do, contact Despatch Industries at our toll free Help Line 800-473-7373.

Difficulty	Probable Cause	Suggested Remedy
Failure to heat	No power Broken or frayed cord Burned out heater Protocol™ malfunction Loose wire connections	Check power source and/or oven and wall fuses. Replace with new cord. Replace heater (see warranty.) Replace controller. Disconnect power and check connections behind control panel.
Slow heat up	Improperly loaded Low line voltage Heating element(s) are burned out 240 volt oven is connected to a 208V line Fan motor failure	Reduce load or redistribute load in chamber. Supply sufficient power and proper connections. Check for circuit overload. Replace burned out element (see warranty statement.) Raise line voltage to a 240 volt line. Replace fan motor.
Frequent heater element out	Harmful fumes generated by load Spillage or splattering of material on heater elements Overheating oven	Increase vent opening or discontinue process. Disconnect power and clean oven chamber and elements. Check the Hi-limit.

Difficulty	Probable Cause	Suggested Remedy
Erratic temp. or inaccurate temp.	Protocol™ malfunction	Replace Protocol™.
	Improper tuning parameters	Check tuning parameters.
	Protocol™ miscalibration	Recalibrate Protocol™ (see section on Calibration mode.)
	Hi-limit setting	Hi-limit should be 10-25°C higher than setpoint.
	Improper offset	Check calibration zero offset.
Excess surface or door temp.	Door seal deterioration	Replace door seal.
Improper airflow	Fan motor failure	Replace fan motor.
	Unbalanced fan wheel	Replace fan wheel.
Excessive vibration	Dirty fan wheel	Clean fan.
	Unbalanced fan wheel	Replace fan wheel.
Oven will not control at setpoint	Hi-limit set too low	Set the Hi-limit higher
	Protocol malfunction	Replace control.
	SSR malfunction	Replace SSR and/or check control output voltage.
	Air friction of recirculation fan	Open exhaust air vent. Unit will not control below minimum operating temperature with vent closed.
Heater does not shut down until temp. reaches the Hi-limit setting	Protocol malfunction	Replace Protocol
	SSR malfunction	Replace SSR

Accessories

The ovens have options that can easily be field installed.

Accessories

Option	Functional Description
Recorder kit	The round chart recorder follows the temperature changes and records them for permanent record.
Door switch	Disables heater when the door is opened.
Extra shelves	
Stands	This support frame includes one open shelf.
Base cabinets	These steel, 22 inch high cabinets are painted to match the ovens. The cabinets store supplies and hold workloads. A magnetic latch secures the door. Standard Despatch shelves fit in the cabinets. shelves for base cabinets must be ordered separately.
Stacking kit	Allows ovens to be stacked to save space. Kit includes angles mounted on top of the lower oven to stabilize the upper oven (LFD 1-42 only).

The above items can all be field installed. For further information on these items or other available options, please contact your Despatch representative.