

TEMPERATURE TEST CHAMBER

LEY SERIES

INSTRUCTION MANUALS

MODEL NO. _____

SERIAL NO. _____

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WARNINGS

Failure to heed warnings in this instruction manual and on equipment can result in death, personal injury or property damage.

The user(s) of this equipment must comply with operating procedures and training of operating personnel as stated in the Occupational Safety and Health Act (OSHA) of 1970, Section 5, and the National Fire Protection Association (NFPA) 86A of 1985, Section 1.6.

DO NOT use chamber in wet, corrosive or explosive atmosphere.

DO NOT attempt any service on this equipment without first disconnecting the electrical power to this unit. Disconnect main power switch or power cord.

DO NOT exceed the maximum operating temperature, 177°C (350°F).

DO NOT use any flammable solvent or other flammable materials or enclosed containers in the work chamber.

FOR supply connections on LEY, use wire suitable for rated FLA. See nameplate for FLA.

A cloud of steam may be released when the door is opened on humidity models, and steam burns.

Always confirm proper voltage source to chamber.

DO NOT operate live (heat dissipating) load in this chamber unless its power source is interlocked with chamber's overtemperature limit.

All covers and panels should be in place when unit is operating and not in service.

Mechanical refrigeration systems operate at high pressure and, therefore, require special precautions:

- Service only by authorized personnel.
- Never over charge system.
- Before attempting to add charge or recharge system, read section of this manual regarding refrigeration charging, Section 11C.

Nitrogen and carbon dioxide gases can cause asphyxiation and death if used in confined, poorly ventilated areas.

Nitrogen and carbon dioxide as liquid or cold gases can cause freeze burns on the eyes or skin. Do not touch frosted pipes or valves.

In case of fire:

- Leave door as is.
- Shut off electricity.
- Shut off auxiliary LN2.
- Call fire department.
- Stay away

For additional safety details, see Section 10A.

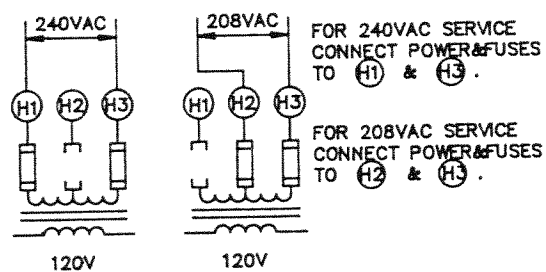
-CAUTION-

THIS UNIT HAS BEEN DESIGNED TO OPERATE WITH A POWER SOURCE OF EITHER 208 OR 230 VAC AND WITH EITHER THREE OR SINGLE PHASE. FOR ANY VOLTAGE OR PHASE COMBINATION THE JUMPERS ON THE SERVICE TERMINAL STRIP AND THE FUSING AND WIRING TO THE CONTROL TRANSFORMER MUST BE MODIFIED. FAILURE TO DO SO MAY CAUSE DAMAGE TO THIS UNIT.

REFER TO ELECTRICAL SCHEMATIC ENCLOSED IN THIS MANUAL.



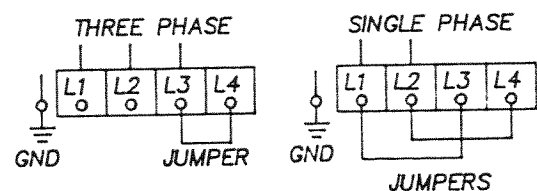
TO PREVENT DAMAGE TO CONTROL COMPONENTS ALWAYS INSPECT WIRING CONFIGURATION ON CONTROL TRANSFORMER BEFORE CONNECTING TO VOLTAGE SOURCE. THIS UNIT IS CONFIGURABLE FOR BOTH 240 & 208 VAC INPUT. VOLTAGE CHANGE IS MADE BY CHANGING TAPS & FUSE LOCATION ON CONTROL TRANSFORMER AS SHOWN BELOW.



NOTE: UNITS ARE FACTORY CONFIGURED FOR 240VAC



TO PREVENT DAMAGE TO CONTROL COMPONENTS ALWAYS INSPECT WIRING/JUMBER CONFIGURATION ON SERVICE TERMINALS BEFORE CONNECTING TO VOLTAGE SOURCE. THIS UNIT IS CONFIGURABLE FOR SINGLE OR THREE PHASE. PHASE CHANGE IS MADE BY CONNECTING JUMPERS AS SHOWN BELOW.



NOTE: UNITS ARE FACTORY CONFIGURED FOR 3 PHASE

PROPRIETARY RIGHTS

This manual is supplied by Despatch Industries solely for the purpose of instruction in the use of the equipments described, and repair of the equipments described. The contents of the Manual contain material proprietary to Despatch Industries. Some of the designs described in the Manual are either patented, protected by other means or rights, or are confidential proprietary information of Despatch Industries. Neither the Manual nor any of its contents may be reproduced or copied without Despatch Industries' written permission, and by accepting the Manual, the acceptor agrees: (1) to utilize information in the Manual solely for the purposes set out above; (2) to restrict dissemination of the Manual to those who need it for the above purposes; (3) to be responsible that the contents do not become available to unauthorized persons; (4) to take reasonable precautions that the Manual is not used for other than the above purposes. By furnishing this Manual, Despatch Industries gives the recipient no rights in the Manual or the contents thereof, nor does it give anyone the right to further disseminate the information contained in the Manual, except that Despatch Industries gives the recipient and its authorized agents the right to use the Manual for the purposes set forth above.

INDUSTRIAL EQUIPMENT COMMERCIAL WARRANTY

Despatch Industries, Inc. warrants the equipment manufactured by Despatch Industries, Inc. and not by others, to be free from defects in workmanship and material under normal use and service for a period of one (1) year from the date of delivery or the period of twenty-one hundred (2100) accumulated hours of use, whichever period is shorter.

The period of the foregoing warranty, in the case of furnaces shall be ninety (90) days or five hundred twenty-five (525) accumulated hours of use, whichever period is shorter.

Components manufactured by others, including expendable items, are warranted only in accordance with the warranty, if any, issued by such other manufacturer.

Use or service with corrosive or abrasive chemicals or materials is not deemed normal.

Purchaser shall give Despatch Industries, Inc. written notice of any defects within 14 days after discovery thereof, specifying each particular defect discovered. If such notice is properly given, Despatch Industries, Inc. will correct without charge any workmanship that is demonstrated to Despatch Industries, Inc. satisfaction to have been defective at the time of installation or erection and will repair or replace, at Despatch Industries, Inc. option, without charge, f.o.b. Despatch Industries, Inc. factory, parts covered by this warranty that upon inspection are found defective under normal use within the warranty period above stated.

All work of removal and reinstallation or installation of parts, whether or not found defective, and shipping charges for defective or replacement parts shall be at the sole expense of Purchaser.

The foregoing warranty shall not apply to (i) work done or materials furnished by others in connection with erection work performed without supervision by Despatch Industries, Inc. erection engineer, or (ii) equipment repaired or altered by others unless such repairs or alterations were specifically agreed to in writing by an Officer of Despatch Industries, Inc.

Despatch Industries, Inc. shall not be liable for consequential damages of any kind which occur during the course of installation of equipment, or which result from the use or misuse by Purchaser, its employees or others of the equipment supplied hereunder, and Purchaser's sole and exclusive remedy against Despatch Industries, Inc. for any breach of the foregoing warranty or otherwise shall be for the repair or replacement of the equipment or parts thereof affected by such breach.

The foregoing warranty shall be valid and binding upon Despatch Industries, Inc. if and only if Purchaser loads, operates and maintains the equipment supplied hereunder in accordance with the instruction manual to be provided upon delivery of the equipment. Despatch Industries, Inc. does not guarantee the process of manufacture by Purchaser or the quality of product to be produced by the equipment supplied hereunder and Despatch Industries, Inc. shall not be liable for prospective profits.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES WHATSOEVER, AND SPECIFICALLY THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.



BOX 1320, MINNEAPOLIS, MN 55440
612/331-1873 TELEX 29-0704

INTRODUCTION

Note: Read the entire introduction to this manual before you attempt to install the oven.

INSTRUCTION MANUAL

This instruction manual covers operation and maintenance of LEY series high/low and/or humidity environmental test chambers. The chamber size range of these ovens is 3.5 and 5.5 cubic feet.

This instruction manual is intended to be used with Despatch LEY series test chambers. An efficient way to learn about the oven would be to read the manual while you work with the oven. This will give you a balance between the ideas in the manual, and the mass of the oven, thus making the learning process efficient.

As you read this manual, be sure not to go past any word you do not fully understand. Look up any word you have any questions about and fully clear up its meaning. Then go back to the manual and begin reading again, just before the word you looked up.

If you go past words you do not fully understand, this may create a blank area in your understanding of the oven. That area of misunderstanding, or not understanding, could prevent you from being able to operate the oven efficiently and safely.

Several optional accessories are available on Despatch LEY ovens. This manual attempts to cover oven operation and maintenance with all the possible combinations in mind, thus you will see some instructions that are for ovens other than your exact model. After some experience with this manual and your oven, you may want to mark the parts of the manual that are applicable to your particular oven.

Options

- Auxiliary LN2 or CO2
- Extended range (auxiliary cool units only)
- Redundant solenoid (for aux. LN2 or CO2 option)
- Chart recorder/limit
- Elapsed time meter
- Window doors w/light
- Microprocessor programmer/controls
- Optional ports
- Cartridge demineralizer
- 5 gal. reservoir
- Recirculation system
- Transformers (to boost heat capacity on 208 volt)
- Base cabinet

If you want or need information that is not in this manual, call or write:

Customer Service
Despatch Industries, Inc.
P O Box 1320
Minneapolis MN 55440
Call Toll Free 800/328-5476
(in Minnesota 800/462-5396)

Note: When ordering parts or service, give oven model number and serial number.

LEY Series Chamber Specifications

50S - LEY

| | LEY1-35 | LEY1-35H | LEY1-55 | LEY1-55H |
|--|----------------------------|----------------------------|----------------------------|----------------------------|
| Interior Volume | 3.5 cu.ft. | 3.5 cu.ft. | 5.5 cu.ft. | 5.5 cu.ft. |
| Inside Dimensions (WxDxH) | 12½x20x24 | 12½x20x24 | 20x20x24 | 20x20x24 |
| Overall Dimensions ¹ (WxDxH) | 34-3/4x26½x43-1/8 | 34-3/4x26½x43-1/8 | 42½x26½x43-1/8 | 42½x26½x43-1/8 |
| Temperature Range | -30°C to +177°C | -30°C to +177°C | -30°C to +177°C | -30°C to +177°C |
| Humidity Capability ² | N/A | 20-95% RH | N/A | 20-95% RH |
| Heating Rate Ambient to 121°C ³ 177°C | 12 min. 21 min. | 12 min. 21 min. | 13½ min. 24 min. | 13½ min. 24 min. |
| Cooling Rate Ambient to -16°C ³ -30°C | 10 min. 18 min. | 10 min. 18 min. | 11½ min. 20 min. | 11½ min. 20 min. |
| Live Load Capacity At 0°C At -20°C | 800 Watts 550 Watts | 800 Watts 550 Watts | 800 Watts 550 Watts | 800 Watts 550 Watts |
| Refrig. System, HP | 1 HP | 1 HP | 1 HP | 1 HP |
| Heater Capacity (230/1/60) ⁴ | 2 KW | 2 KW | 2 KW | 2 KW |
| Amp Draw (230/1/60) ⁵ | 20 Amp | 24 Amp | 20 Amp | 24 Amp |
| Approx. Ship Weight | 460 lbs. | 470 lbs. | 480 lbs. | 490 lbs. |
| Typical Temperature Uniformity At 125°C 70°C -30°C | ±2.5°C ±1.1°C ±0.6°C | ±2.5°C ±1.1°C ±0.6°C | ±2.5°C ±1.1°C ±0.6°C | ±2.5°C ±1.1°C ±0.6°C |

1. Depth does not include 3" vent box at rear of chamber.
2. Humidity simulation from 20% to 95% ±5% R.H. as limited by a 4.5°C dewpoint and a 85°C dry bulb temperature.
3. Temperature change rates are with chamber empty.
4. Units will operate satisfactory on 208V with a 25% reduction in heater capacity.
5. Estimated amp draw with no options.

PL2/F1
8/13/87

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612/331-1873 • Telex 29-0704 • Easy Link 6288-5512 • FAX 612/623-0257

UNPACKING & INSPECTION

This shipment should include:

- One Despatch LEY Chamber
- One Instruction Manual
- Warranty Card

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

- See whether the crate and plastic cover sheet inside crate 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, and missing parts such as knobs and lenses.
- Look inside the control cabinet for loose or broken parts.
- Open the chamber door and look at all the chamber surfaces to see that they are flat and smooth.
- Check the door and latch for smooth operation.
- If anything is found to be out of order, check the rest of the oven very carefully for some other damage that could have occurred at the same time.

IF THERE IS DAMAGE, AND IT COULD HAVE HAPPENED DURING SHIPMENT, CONTACT THE SHIPPER IMMEDIATELY, AND FILE A FORMAL, WRITTEN DAMAGE CLAIM.

After you have filed a written damage claim with the shipper, contact Despatch Industries, Inc. to report your findings and to order replacement parts for those that were damaged or missing. Please send a copy of your filed damage claim to Despatch.

INSTALLATION INSTRUCTIONS

1. Set the unit on a level floor with clearances indicated in the previous section titled Specifications.
2. All utility connections are located at the rear of the chamber and are clearly labeled. Specific information regarding those connections can be found on the related schematic drawings found in this manual.

POWER: Observe proper voltage connection. Unless otherwise noted in this section, no rotation check is required as compressors may operate in either direction, and other motors are generally single phase, allowing them to run in the proper direction.

Note: LEY chambers are configurable for 208 VAC or 230 VAC, and for single or three phase.

- Always check for proper voltage connections on control transformer (located on back side of access panel). Failure to do so may result in damage to instrumentation.
- Phase (single or three) is selected by jumpers on supply terminal block located in control cabinet near access door. Verify proper wiring of jumpers on terminal block. Incorrect configuration will cause direct short.
- Refer to electrical diagram for instructions on selection of phase and voltage.

Note: On units operating on 150 volts or higher voltage, a lockable disconnecting means must be provided within sight of the unit. On some models, a separate disconnect must be provided by the customer. Portable units having a flexible power cord may not require a separate disconnect, as the plug may, in some cases, be considered as the disconnecting means. Consult local electrical codes for specific direction.

EXPENDABLE REFRIGERANTS - LN₂ or CO₂: Some chambers require the use of LN₂ or CO₂ for auxiliary boost. Connect the appropriate supply to the fittings provided on the chamber.

The use of expendable refrigerants is particularly sensitive to proper LN₂ or CO₂ quality. Dirt, water, oils or other contaminants will affect proper operation. Consult the section on the use of CO₂ or LN₂ for further details and precautions.

Observe the correct connection of LN₂ or CO₂. Supply pressure must be appropriate for the particular chamber. The LN₂ system is protected by a relief valve in the unit. Supply pressures exceeding the setting of the relief valve will cause loss of LN₂ and possible system damage. CO₂ systems are generally set up for either bulk (300 PSI) refrigerated sources, or bottled (900 PSI) ambient temperature sources. Do not connect a bottled source to a system set up for 300 PSI service or vice versa.

Consumption rates for CO₂ systems vary widely between the 300 PSI and 900 PSI sources, with the 300 PSI source being far superior by a factor of approximately two. Proper piping and insulation of lines to the chamber will minimize consumption as well as service problems. In the event a bottled source is found to be inadequate or undesirable, the chamber may be converted to allow use of a bulk refrigerated source. Consult Despatch Industries factory service department for details.

DRAIN: Some chambers are provided with a condensate drain connection. If provided, it should be connected to an open drain. If an open drain is not available, DO NOT connect to a pressurized drain. An appropriate pumping system must be added to the equipment if a pressurized drain is to be utilized. In non-humidity models, a simple pan under the drain connection may be an acceptable method of handling liquid condensate.

VENT: All humidity chambers, and all chambers provided with liquid nitrogen or liquid CO₂ cooling, are provided with a pressure relief vent. In some cases a two way vent is provided to allow positive or negative equalization of pressure to the outside of the chamber. In the case of chambers cooled by

expendable refrigerant, the vent is usually outwards only. It is sometimes acceptable to have the chamber vent into the room in which the chamber is located. In some cases, however, chambers which utilize large quantities of liquid nitrogen or CO₂ must be vented to the outside of the building so as to prevent possible hazard as a result of displacement of oxygen within the room where the chamber is located. Chambers which may require outside exhausting of expendable refrigerant are generally provided with a hose connection at the back or top of the chamber. The user may wish to connect a flexible hose or duct to this fitting for the purpose of removing exhaust gases from the building. It is not necessary that this hose or duct be insulated. On all vents, care should be taken to make sure that the vent is free to operate, and it is not blocked by any portion of the equipment, etc.

D.I. WATER: Most humidity chambers utilize deionized water in the humidification system. The use of tap water for this purpose will greatly reduce system performance, and will ultimately result in a failure of the system. Deionized water must be provided to the system.

There are systems available which utilize a replaceable type deionizer. Tap water may be connected to these systems, as the cartridge deionizer will adequately treat the water for use in the humidification system. Periodic replacement of the cartridges is, however, required. Most larger equipments, as well as some smaller chambers require a connection of deionized water as cartridge type systems are ineffective in larger systems and require constant replacement. On such systems an appropriate source of deionized or demineralized water must be connected to the unit. Most water treatment companies can provide you with an appropriate system should it not already be available.

Prior to operation, visually inspect all electrical parts and refrigerant lines for shipping damage. Oil spots on the floor indicate possible system leaks. The compressor of a single stage system can be checked for leaks after the unit is operating by observing the system's sight glass (see Maintenance Section).

CHAMBER DESIGN

GENERAL DESCRIPTION

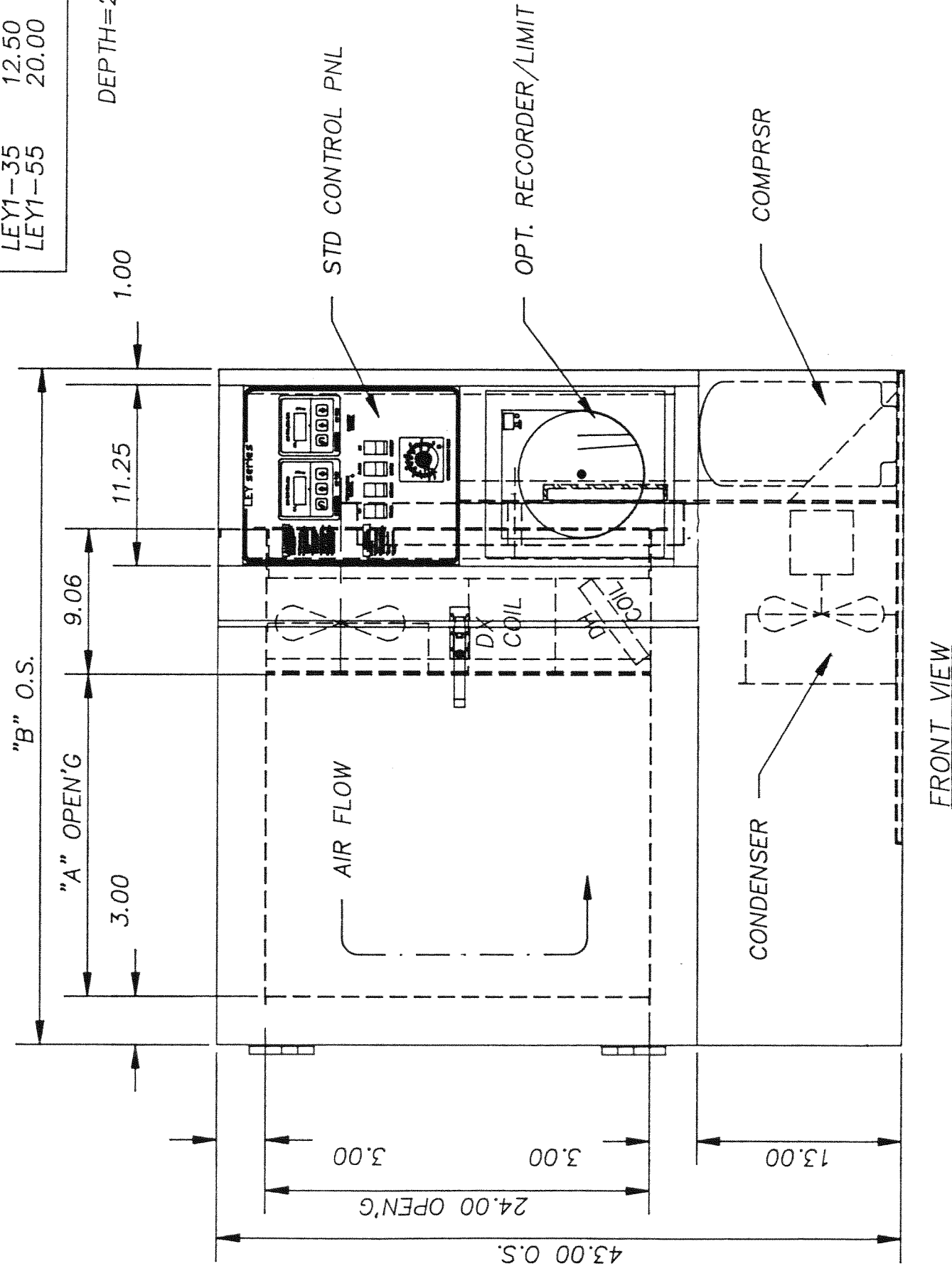
This manual is for a Despatch Industries LEY Series High and Low Temperature and/or Humidity Environmental Test Chamber. This environmental chamber has the capabilities of simulation of high and low temperature, and/or humidity levels as described in the specifications sections of this manual. The chamber incorporates a single stage mechanical refrigeration system, open element electric heaters, and a propeller fan for controlling the environment within the chamber. Humidity models also incorporate a steam generator and a dehumidifying coil.

An instrument panel is located on the front of the chamber, to the right of the chamber door. Located on the side of the access door is the bulk of the electrical components. The compressors, air cooled condenser, and related equipment are located below and to the right side of the chamber. Circuits are protected by fuses and are mounted on the control panel on the back of the access door.

The unit is self-contained requiring only the specified utilities as determined by options included and is designed for continuous trouble-free operation when operated in a manner consistent with the procedures outlined in this instruction manual.

| MODEL | DIMENSION LETTER "A" | DIMENSION LETTER "B" |
|---------|----------------------|----------------------|
| LEY1-35 | 12.50 | 34.50 |
| LEY1-55 | 20.00 | 42.00 |

DEPTH=26.62



FRONT VIEW

FIG. 1: GENERAL DESIGN

HEATING SYSTEM

System heating is provided by means of open element nichrome wire air heater(s) located in such a manner within the conditioning plenum as to avoid any direct radiation to items within the test area.

Heaters are actuated by means of a zero voltage switching solid state relay for quiet, reliable service. The heaters are wired in the control system in a manner that if the air circulation system should be de-energized, the heaters will be de-activated.

OVERTEMPERATURE PROTECTION

The standard overtemperature safety device is an FM approved overtemperature limit controller. Also, heat limiters (thermal fuses) are usually provided in series with the heaters. Other protection can include filled bulb thermostats (manual reset) or FM approved overtemperature limit controllers for redundant protection.

COOLING SYSTEM

The primary cooling is provided by a single stage mechanical refrigeration system. In the single stage system, the cooling is by direct expansion of refrigerant R-502 in a finned evaporator located in the conditioning plenum. The low pressure R-502 gas from the evaporator is pumped by the compressor to a higher pressure and conducted to the air cooled condenser where it is cooled and condensed to a high pressure liquid, giving up the heat it picked up on the evaporator. The liquid flows through a capillary tube where it is metered into the evaporator at a suitable pressure to evaporate and pick up heat from the chamber.

The function of many devices should be readily apparent by studying the schematic diagrams (see Section 12A). The function of some which might not be apparent are explained below:

Various devices such as liquid line driers and sight glasses are used to improve the efficiency and facilitate the charging of the system.

The hot gas bypass regulator opens whenever the temperature controller closes the liquid line solenoid. It is set to a low operating pressure to provide a minimum loading on the compressor for dependable operation. The suction cooling thermal expansion valve senses the suction line temperature and injects liquid R-502 into the suction line as necessary to prevent overheating of the suction gas which could damage the compressor. The valve will not feed at low temperature and maximum cooling. It usually feeds only on pulldown from high temperatures and during continuous hot gas bypassing.

Single stage units should be connected to power source to allow the crankcase heater to warm-up the compressor for a minimum of four hours if power has been removed for more than one hour.

Auxiliary cooling can be provided as an option and can either be liquid carbon dioxide or liquid nitrogen, refer to nameplate to determine which refrigerant this unit is designed to use. Also be sure to read the section titled Installation and Use of Liquid Carbon Dioxide, or Section titled Installation and Use of Liquid Nitrogen, whichever is applicable before operating this equipment.

Cooling is accomplished by evaporation of the expendable refrigerant due to a pressure drop, which occurs when the refrigerant enters the chamber, and the temperature difference between the chamber air and the refrigerant. This pressure drop and the available heat from the chamber cause a phase change, from liquid to gas, of the refrigerant which creates the major cooling effect.

Usage rates will vary with loading and the temperature setting.

Flow of the expendable refrigerant is controlled by a solenoid valve which is actuated by the temperature controller after an fixed time delay, if the controller continuously calls for cooling.

Note: Compliance with warranty requires that any unit with auxiliary cooling incorporate an undertemperature limit and/or extended range option. On units without extended range option, the low limit must not be set more than 5°C (9°F) below the standard operating range of the chamber. See nameplate for standard operating range. The danger to the compressor is that as temperatures become colder, then the compressor oil will become harder to return. At the same time, the expansion valve responds to the colder temperatures by cutting back the refrigerant flow. The result is not enough flow to "entrain" oil and return it to the compressor, causing low oil failure.

CAUTION: The spent refrigerant gas must be vented to the outside or adequate ventilation must be provided to avoid hazard to personnel due to suffocation as a result of displacement of oxygen in the air by the refrigerant gas. Regular inspection of vent lines and sampling of the air in the immediate area of the equipment should be conducted to insure that this hazard does not occur.

HUMIDIFICATION AND DEHUMIDIFICATION

The humidification and dehumidification systems are designed to operate within the following limits:

1. TEMPERATURE RANGE of 40°F (4°C) to 185°F (85°C). If the chamber is to be operated beyond these limits, the "Humidity Control" must be switched off to prevent boiling in the wet bulb sensor trough during high temperature operation and freezing of the trough during low temperature operation.
2. HUMIDITY RANGE is limited to 20% to 95% ±5% relative humidity and a minimum of 40°F dew point.

HUMIDIFICATION:

Humidification is accomplished by energizing an immersion heater to boil water in the vapor generator located in the equipment compartment. The generator is equipped with an immersion heater safety thermostat and/or liquid level float switch that will shut off the immersion heater in the event of low water. The immersion heater is controlled by a solid state relay which is actuated by the relative humidity controller. Should an overtemperature condition occur in the chamber, redundant contactors will de-energize the immersion heater in the steam generator as well as the chamber air heaters.

Note: On initial start-up, and when humidity has not been used for long periods of time, water fill float valve must have time to fill the steam generator with water before the control system calls for humidity. To accomplish this, the chamber must run for approximately 15 minutes with "cool" and humidity switches on, and humidity control instrument setpoint of zero for % RH or 35 for depression instruments.

Refer to Section 12D for piping schematic and 12E for steam generator assembly replacement parts.

CAUTION: Use only demineralized or distilled water in the humidification system. The use of untreated water will cause a build up of scale in the vapor generator and wet bulb trough.

DEHUMIDIFICATION:

Dehumidification is accomplished by a separate refrigerated dehumidification coil connected to the refrigeration system, and controlled by on/off cycling of a liquid solenoid valve on demand of the relative humidity controller. A capillary tube meters the liquid flow into the coil at a suitable pressure to evaporate. An evaporator pressure regulator is used to limit the lowest evaporating pressure to prevent icing of the coil.

The dehumidification coil is located in the bottom of the conditioning plenum at the right side of the chamber. The solenoid valve and evaporator pressure regulator are located in the refrigeration compartment. Access to this compartment can be obtained by opening the side access door and removing the refrigeration compartment access cover on the rear of the chamber.

On chambers where low levels of humidity are required an optional dry air package may be supplied.

Dry air dehumidification is accomplished by piping factory dry air (or factory compressed air if optional air dryer is supplied on chamber) to dry air bulkhead on back of chamber. Dry air is injected into the chamber by cycling of a gas solenoid valve on demand of the humidity controller. An adjustable time delay is built into the control system and is used to stabilize the system by preventing dry air injection when the humidity level is near setpoint.

NOTE: Different chamber loads may require different, or no, time delay. Consult factory for readjustment.

GENERAL INFORMATION ON HUMIDITY CHAMBERS

1. GLOSSARY OF TERMS

A. Relative Humidity (RH)

Amount of water vapor present in a given volume of air expressed as a percentage of maximum amount possible in that volume at a given temperature.

Example: A relative humidity of 75% means that air contains 75% of maximum moisture possible at that temperature.

B. Dew Point

Temperature at which condensation begins at a given humidity, volume and pressure.

NOTE: dew point is always lower than dry bulb temperature, except when air is saturated. At saturation, dew point, wet bulb and dry bulb temperature coincide.

2. MOUNTING METHODS FOR INTERNAL FIXTURING

Many applications for temperature/humidity chambers involve installation of internal fixtures to support components being tested and necessitate additional lead-in ports to provide entrance for wires, cables, thermocouples, etc.

NOTE: DO NOT INDISCRIMINATELY PERFORATE THE INNER CHAMBER WALLS AS THIS WILL VOID WARRANTY.

A machine screw or sheet metal screw DOES NOT CONSTITUTE A VAPOR-TIGHT SEAL. When simulating high temperature, high humidity condition, water vapor will seep through screw threads into insulation, saturate insulation and water drippage will start at bottom of outer housing.

Fixtures must be designed to facilitate their removal during regular maintenance and cleaning of the chamber. Failure to design fixtures properly may cause unnecessary delay when equipment is shut down for cleaning or maintenance.

NOTE: ANY FIXTURING OR REMOVABLE PARTS OF CHAMBER SHOWING SIGNS OF PERMANENT CORROSION SHOULD BE REPLACED.

3. MATERIALS FOR CONSTRUCTION OF FIXTURES

- A. Type 316 stainless steel is recommended for all fixtures. Any additions to chamber must be of equal or better grade. This applies not only to ports and fixtures, but to screws and related hardware to construct and mount them.

- B. Do not use any iron or mild steel materials in cabinet interior. This applies to any type of cold or hot rolled steel, either painted or plated. Painted or plated surfaces soon deteriorate under high temperature and humidity conditions. Two reasons to avoid use of these materials are:
 - 1. Corroding steel will "seed" stainless steel with particles of rust. These particles will cause rapid deterioration in any stainless steel it contacts. Once such chemical corrosion starts, it can only be stopped by electropolishing or passivation.

 - 2. This "seeding process" will cause similar corrosion on test loads; effects of this corrosion will be impossible to separate from temperature and humidity effects, and may void test results.

- C. After fabrication of stainless steel fixtures, it is essential that they be passivated before being placed in chamber. This is the only effective method in assuring that fixtures are free of contaminants. Particles of tool steel remain inbedded in stainless steel after drilling, punching and other fabrication processes. These particles must be removed, or they will begin to corrode rapidly in high temperature and humidity conditions. If such corrosion is allowed to continue, surrounding stainless steel will also corrode.
- D. Supplementary items such as plugs, sockets, wiring and printed circuit boards must be of a quality to last longer than components under test. All supplementary equipment and fixtures are subjected to same conditions as test load, and should be chosen with care.
- E. When components to be tested are ferrous metals and are expected to corrode, or purpose of test is to "force" corrosion, provision should be made to provide drip pans to retain any residue produced. This prevents residue from contacting inner chamber areas and/or control sensors.
- F. ANY PART OF FIXTURING OR ANY REMOVABLE SECTIONS OF CHAMBER INTERIOR SHOWING SIGNS OF PERMANENT CORROSION THAT CANNOT BE ELIMINATED BY PROPER CLEANING SHOULD BE IMMEDIATELY REMOVED AND REPLACED.

4. ELECTRICAL INSULATING MATERIAL

When components under test have electrical voltages applied to them, all insulating materials must be suitable for high temperature/high humidity conditions. Even very small leakage currents traveling through cabinet or fixture will produce rapid electrolytic corrosion. Fixture must be completely insulated from chamber. This is necessary to confine electrolytic corrosion just to fixture. Glazed porcelain or glass insulators, treated with Dow Corning 200 Silicon fluid, appear to be some of the best materials presently available.

5. LOADING DENSITY

Personnel often overload chambers, seeking to make most use of test equipment. While some conditions will permit indiscriminate loading, most will not. If wide tolerances are permissible, maximum loading of work chamber is permissible. It should be kept in mind, however, that fewer components in work chamber generally means closer tolerances. It is recommended that no component be loaded closer than three inches to an internal surface. If extremely close tolerances in testing are required, it is recommended that a dummy load simulating the component in size and mass be placed in chamber and a test program run.

If it is difficult to produce desired accuracy, load may be too large for chamber.

Live loads in the work chamber will affect the units ability to control at a given temperature and humidity.

6. SEALING CABLE ENTRANCE PORTS

All entrance ports for large diameter cables or wire bundles must be sealed before chamber is placed in operation. This precaution is often neglected and can cause annoying problems. Condensation will continually run down the cable and drip on floor or external instruments. Excessive water usage will occur because of these openings to atmosphere. If opening is very large, internal control stability can be affected. Silicone RTV is a suitable filler for these points provided a more sophisticated sealing method is not available.

7. CONDENSATION

All chambers are capable of operating at high temperatures and up to 95% relative humidity without condensation forming on workload. Some condensation may form on walls of work chamber; these are areas of heat loss and are slightly cooler than rest of chamber. Such condensation is normal and should not be considered as a malfunction of chamber. Severe condensation normally forms on components when loaded into cabinet that is operating at high temperature and humidity. Any material at ambient temperature may be below dew point and condensation may form on surface and continue to form until material temperature exceeds the dew point.

TO AVOID CONDENSATION WHEN LOADING OR UNLOADING CHAMBER:

- A. Test load and chamber at ambient temperature.
 1. Turn humidity and power OFF.
 2. Load chamber, close door.
 3. Turn power ON.
 4. Set temperature control for desired temperature and allow chamber to stabilize.
 5. Turn humidity switch ON.
 6. In small steps, adjust humidity control for desired setting. If immersion heat is applied too quickly, dew point may rise faster than temperature of test load, creating condensation on load surface. This effect will be most noticeable on high mass loads.

B. Test load at ambient, chamber at high temperature and humidity.

1. Turn humidity switch OFF, allowing blower to continue operating.
2. Open door.

WARNING: A cloud of steam may be released when the inner door is opened, and STEAM BURNS!

3. Allow chamber to cool approximately 30 minutes.
4. Chamber can be loaded and operated normally as outlined in "A".

C. Unloading of the work chamber.

1. Remove load quickly upon completion of test before load cools below dewpoint. See warning above when opening door.

NOTE: FAILURE TO FOLLOW THESE INSTRUCTIONS MAY CAUSE DAMAGE TO UNIT. SUCH DAMAGE WILL NOT BE COVERED BY WARRANTY.

8. CORROSION

Corrosion is undoubtedly the most wide spread and probably the most costly water caused problem. Corrosion of ferrous and non-ferrous metals is basically an electrolytic action requiring presence of water or water vapor.

This chamber will be operating under ideal conditions for accelerating corrosion (i.e., water, water vapor, high temperature plus an infinite variety of contaminants introduced by products under test). Thereafter, it is reasonable to assume that the cost of maintaining its operation could be greater than the cost of maintaining non-humidity chambers.

Your chamber is constructed of high quality materials suitable for this type of application. It is, however, designed and manufactured to fulfill the widest variety of normal applications. Unusually corrosive applications may have special engineering problems and cannot be satisfactorily performed by a standard chamber. Frequently, only after a chamber is partially damaged does one become aware of his unusual application.

THE MOST COMMON CAUSES OF CORROSIVE ATTACK ARE AS FOLLOWS:

A. FAILURE TO PROVIDE A CLEAN WATER SUPPLY.

Dissolved solids and gases in a water supply serving the chamber are injurious to stainless steel alloys. High chloride content is particularly damaging.

B. INTRODUCTION OF THE HALOGEN SALTS (CHLORINE, FLUORINE, BROMINE, IODINE) EITHER BY THE WATER SUPPLY OR THE PRODUCTS UNDER TEST.

A rather common means of introducing chlorides occurs when products under test have been defluxed or degreased in a chlorinated solvent and transferred directly into the temperature/humidity chamber. Moreover, parts of vinyl chloride plastics which decompose at sustained high temperature and humidity contribute to deterioration.

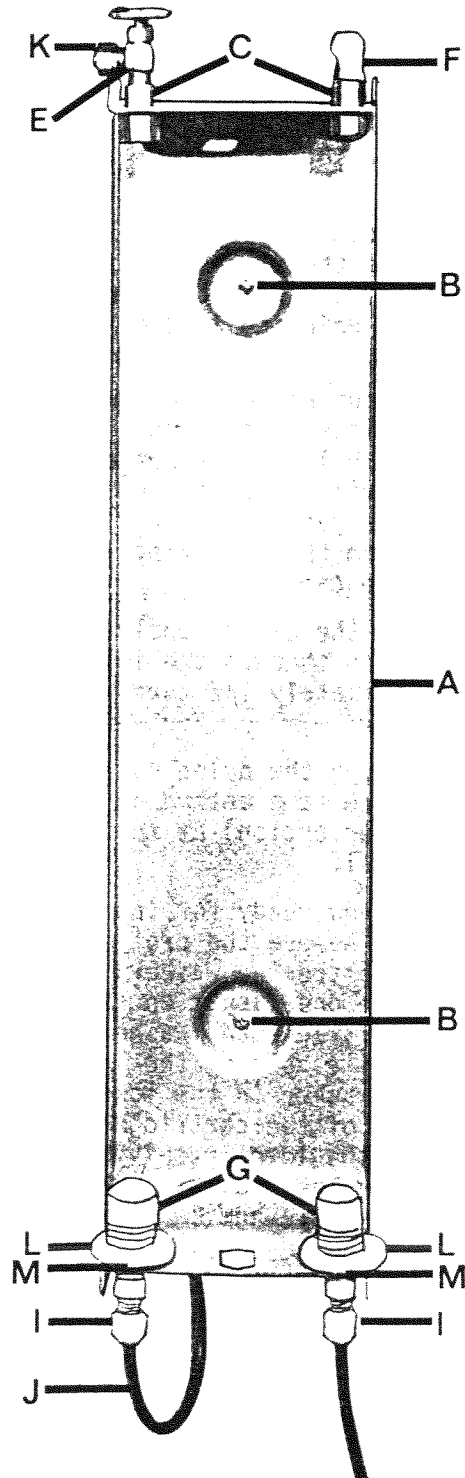
C. Failure to institute properly scheduled cleansing and preventative procedures. Failure to follow a rigid schedule of draining and flushing (10 days optimum - 30 days maximum) while chamber is in continuous operation will cause a concentration of solids and contaminants (due to water evaporation), and water will become very corrosive.

D. Operating in industrial atmospheres containing a high chloride content.

-
- E. Placing fixtures, fasteners, etc., which are not of stainless steel or equal and are not electropolished or properly cleaned of foreign matter, i.e., drill chips, etc., into the chamber.

INSTALLATION INSTRUCTIONS
CARTRIDGE TYPE
DUPLEX MOUNTING BRACKET ASSEMBLY

CAUTION: Install pressure reducing valve where line pressure is greater than 100 PSI.



1. Place bracket (A) in a vertical position. Attach by screws (B) through holes in bracket.
2. Place upper pressure fittings (C) in the two outside top slotted holes in the bracket. While holding the pressure fittings, screw the shut-off valve (E) and the threaded elbow (F) into the threaded end of the pressure fittings (C).
3. Place the teflon washers (M) over the bottom end of the lower receiving blocks (G) and then insert the lower receiving blocks and washers into the two outside bottom holes. While holding each receiving block, loosely screw the nylon nut (I) onto the receiving block. Be sure the slotted openings on the receiving blocks are facing you to allow entry of the cartridges.
4. Connect the long piece of tubing (J) to the left lower receiving block (G) by pushing the tubing completely into the receiving block through the nylon nut (I) and tighten the nylon nut approximately 1/2 turn after finger tight.

5. Pass the long piece of plastic tubing (J) behind the bracket upwards to connect to the threaded elbow (F). Connect the tubing, using the same method as described in step 4.
6. Connect tubing (preferably plastic) from the water supply to the inlet shut-off valve (E) by passing the tubing through the brass nut (K) and tightening as described in step 4.
7. Connect tubing (preferably plastic) to the right lower receiving block as described in step 4 for the outlet.
8. The duplex mounting bracket assembly is now ready for installation of the cartridges of your choice. Remove the protective end caps from a cartridge. Detach the two washers that are taped to the cartridge and place one washer on the top of the cartridge and then push the washer and cartridge into the upper receiving block (G) and slide the cartridge into place. Tighten the adjusting nut (L) on the lower receiving block to firmly hold the cartridge in the bracket. Only moderate tightening should be necessary to prevent leakage. Repeat for second cartridge.
9. To obtain water flow, open shut-off valve (E) and regulate for proper flow with either the shut-off valve or the outlet valve if one is installed. (Outlet valve is not provided in kit.)
10. To replace the cartridge, turn off inlet shut-off valve (E) and loosen the adjusting nut (L) on the lower receiving block (G). Pull cartridge from the bottom, disengaging it slightly from the lower receiving block before removing it completely from the bracket. Repeat for second cartridge.
11. To order replacement parts, the bracket assembly is part number 060710 and cartridge replacements are part number 060709.

-
1. Water pressure is not to exceed 100 pounds per square inch.
 2. Water temperature is not to exceed 100°F.
 3. Do not store in area where temperature will be below 33°F or above 100°F.
 4. When mounting cartridge in bracket, tighten nut moderately tight and turn on water. If leak occurs, tighten nut until leak is stopped.
 5. Cartridge stock should be rotated. Guaranteed shelf life is two years.

OPTIONAL WATER RECIRCULATION SYSTEM

This option consists of a 5 gallon reservoir, cartridge demineralizer, and a recirculation pump. The recirculation pump includes a condensate pan and float switch which turns pump on at a set water level. All recirculated water is routed through the demineralizer to prevent unnecessary contamination of the humidification system. An alternate location may be given to the reservoir as long as it is elevated to a level higher than the top of the chamber. This is due to the fact that the system is gravity fed.

If alarm light comes on while the humidification system is operating and the compressor continues to operate, the pump safety switch has tripped. This will shut down the humidity system and prevent the steam generator from draining and overflowing the pump condensate pan. The steam generator will stay filled until the pump is repaired or replaced even if power is turned off.

When turning off humidity during normal operation, be sure to leave power on for approximately 5 minutes after the humidity switch has been turned off. This will allow the steam generator to drain to the pump which will recirculate the water. This is to prevent buildup of contaminants in the steam generator.

The 5 gallon reservoir must be filled with demineralized water. Only recirculated water will go through the demineralizers, which means the water in the reservoir will be fed directly into the chamber. Failure to supply proper clean water will contaminate the chamber.

INSTRUMENT PANEL DESCRIPTION

An illustration of the standard front instrument panel is given on pg 8-D-3. The following is a description of front panel components.

- Control Instrument(s) Are located at the top of the instrument panel. The standard control is a MIC 2000. This is a microprocessor based 1/4 din controller [on humidity models (2) side by side, (1) for temperature control and (1) for humidity]. Control instrument may be a MIC 600 programmer controller in lieu of MIC 2000 on temperature only units. On humidity units, a series 1500 2-channel programmer may be provided in lieu of both standard controllers.
- Power Switch Is the left most switch on the switch and light section of the instrument panel. It turns on power to all circuits except crank case heater when in the on position. It must be in the off position to power crank case heater.
- Cool Switch Is located just to the right of power switch. This switch powers refrigeration circuits when in on position.
- Alarm Light Is located just to the right of the cool switch. This light is on if the temperature limit controllers have been tripped. On units with a series 140A limit control, the light is part of the reset switch.
- Reset Switch On units with 140A limit control, this is a lighted switch in the alarm limits position. This switch is used to reset the series 140A limit(s) once alarm condition is cleared.

| | |
|--|--|
| Humidity Switch (on Humidity Models Only) | Is a lighted switch located to the right of the alarm light/reset switch. This switch must be on in order to power the humidity system. (Note: Cool switch must also be on in order to power humidity.) This switch must be off when temperature is set outside of the range of 4°C (40°F) to 85°C (185°F). (Additional note: When light is off, water level in steam generator is low.) |
| Auxiliary Cool Switch (Optional) | Is the right most switch if the auxiliary cool option is present on unit. This switch powers the auxiliary cool option. |
| Timer Switch (Optional) | Is just to the left of the timer if timer option is included on unit. |
| Alarm Silence (Optional) | Is a momentary, lighted switch provided which works in conjunction with alarm light on units with alarm horns. Pressing this switch silences the alarm horn. |
| High Limit | Is located on lower portion of the standard instrument panel. |
| Low Temperature/Redundant Limit (Optional) | Is located just to the right of the standard high limit. It is jumper configurable for use as an undertemperature or redundant high temperature limit. |
| Recording Limit (Optional) | Is located on its own panel just below the standard instrument panel. It is jumper configurable for either undertemperature limit or redundant high limit. |

Note: For description of control components and control equipment panel, see Section 12B.

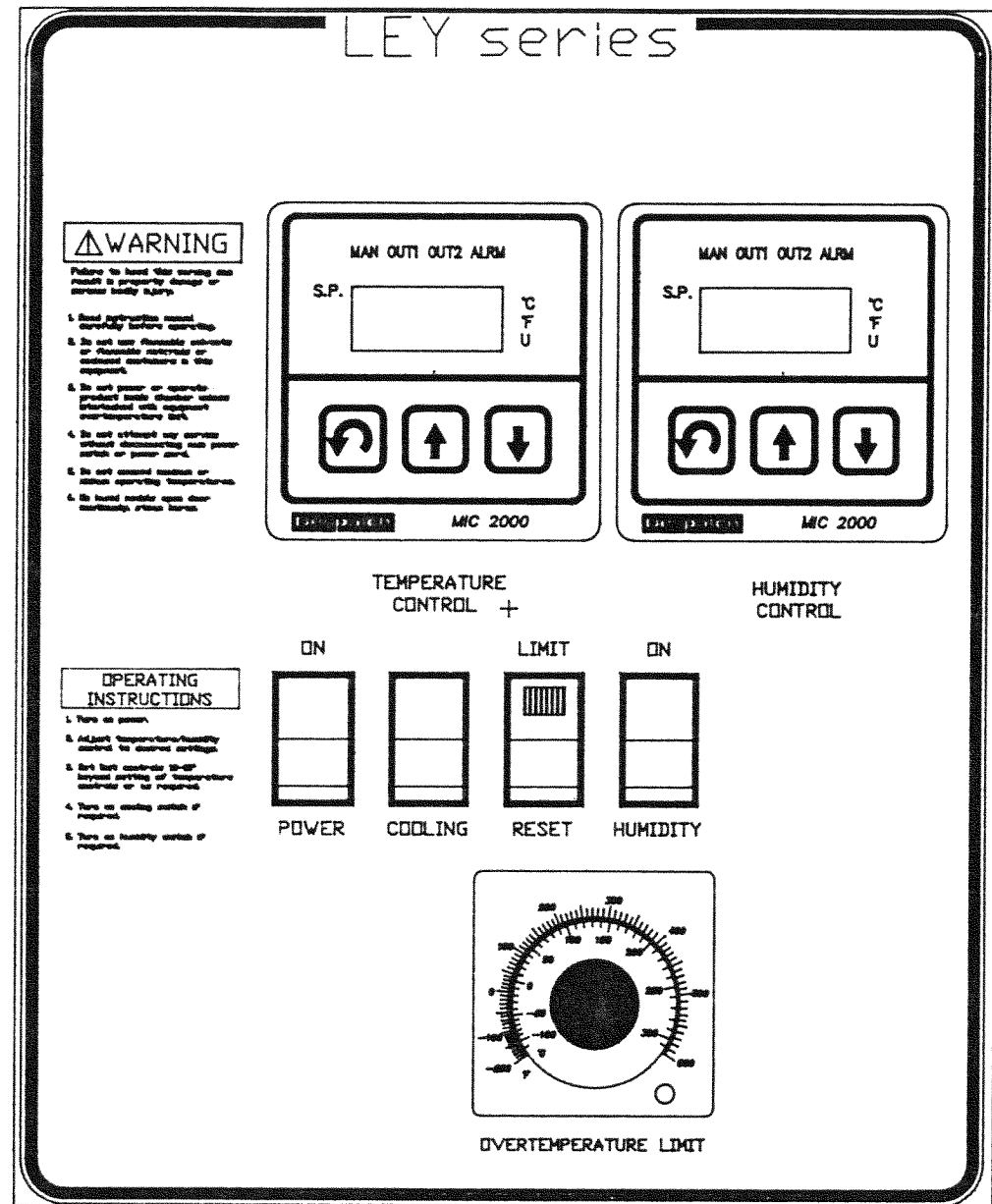


FIG. 2:
 STANDARD TEMP/HUMID CONTROL PANEL
 -STD MIC 2000 CONTROLS
 -STD 140A OVERTEMPERATURE LIMIT

INSTRUMENTATION

STANDARD CONTROLS (MIC 2000)

The MIC 2000 Series 1/4 DIN controller is a complete line of microprocessor based, single loop process controllers with many input and output options available for a variety of process applications. Input is RTD on temperature controller and volt input on humidity control. Outputs are solid state relay driver outputs on Output 1 and Output 2. The optional alarm output (Output 3) is also available with a 5 amp electromechanical relay or a solid state relay driver. Alarm options are programmable for either process alarm, deviation alarm, or deviation band alarm.

The MIC 2000 series incorporates proportional, integral (auto reset), and derivative (rate) actions for proportional control operation. Changing tuning parameters for proportional control operation is a front panel operation accomplished via the three key membrane pad. Also, through the keypad, parameters for second output position (spread from the first output), alarm adjustments and auto/manual selections are made.

The MIC 2000 series is terminated at the rear of the instrument at the two terminal strips where the power, input, and control outputs are wired. Remote setpoint and serial communications options are also connected on the back.

For further information on MIC 2000, see enclosed MIC 2000 manual.

INSTRUMENTATION (CONT'D)

WATLOW SERIES 1500 MICROPROCESSOR BASED 2-CHANNEL PROGRAMMER/CONTROL

(Optional on temperature/humidity units in lieu of MIC 2000's.)

See Chapter 1 of Series 1500 owner's manual for introduction to microprocessor.

Please Note: The series 1500 manual is a general purpose manual written with no specific application in mind. Therefore, any sample programs listed in the series 1500 manual are written for imaginary equipment. While useful as examples on programming procedures and Syntax, these programs will not work on this LEY chamber. This is because the events on the imaginary equipment used in the 1500 manual do not match the function of the events on the LEY series. On the LEY, 4 events are always wired when the 1500 is used on the humidity models. Additional events may be used depending on options or special customer requests. The function of the four standard events are as follows:

- Event 11 - Stops refrigeration flow to evaporator
- Event 12 - Turns on/off compressores
- Event 13 - Turns on/off main control circuits
- Event 21 - Turns on/off humidity control circuits

For a more complete description of event function and use, see pg. 10-C-1&2.

The following page contains a sample program that will work on your humidity chamber.

Program Number Sample Date DDMMYY

| Step | Setpoint | | Events | | Duration | | | |
|------|------------|------------|--------|------|----------|----|----|--|
| | Ch1=F/C=S1 | Ch2=%/T=S2 | E1 | E2 | HR | MN | SC | |
| 01 | 20 | 00 | 0000 | 0000 | -- | -- | 05 | Get initial set point to 20°C |
| 02 | 20 | -- | 0111 | ---- | -- | -- | 05 | Turn on main ckts & cmprsr(s), enable solenoid(s). Hold for 5 min. |
| 03 | 30 | 25 | 0111 | 0001 | -- | -- | 05 | Turn on humidity ckts & begin ramp to 30°C & 25% RH |
| 04 | W30 | W25 | ---- | ---- | -- | -- | -- | Hold until 30°C and 25% satisfied |
| 05 | 30 | 25 | ---- | ---- | -- | -- | 05 | Hold for 5 min. |
| 06 | 40 | 00 | 0100 | 0000 | -- | -- | 05 | Turn off humid ckt; cmprsr(s) & disable solenoid(s). Ramp to 40°C |
| 07 | 00 | -- | 0111 | ---- | -- | -- | 05 | Turn on cmprsr(s) & enable solenoid(s). Ramp to 0°C |
| 08 | W00 | -- | ---- | ---- | -- | -- | -- | Wait for 0°C |
| 09 | 00 | -- | ---- | ---- | -- | -- | 05 | Hold for 5 min. |
| 10 | 20 | -- | 0100 | ---- | -- | -- | 05 | Turn off cmprsr(s) & disable solenoid(s). Ramp to ambient |
| 11 | -- | -- | 0000 | ---- | -- | -- | 05 | Turn off main ckt. |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
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INSTRUMENTATION (CONT'D)

MIC 6000 MICROPROCESSOR BASED SINGLE CHANNEL PROGRAMMER/CONTROL

(Optional on temperature only units in lieu of MIC 2000)

See introductory description in the enclosed MIC 6000 operation manual for introduction to microprocessor.

On the LEY series, the MIC 6000 has only one output available as a programmable event. This event can be used to turn off/on compressors as required (see event 2 on pg. 10-C-2). It may also be used to turn on/off main control circuit for shut down at the end of test (see event 3 on pg. 10-C-1). It may also be used to turn off any device under test (DUT) which may be being tested in the chamber.

If the event is not needed to turn on/off DUT, it is recommended that the event be used as a compressor shut down when refrigeration is not required. Compressor shut down when not required reduces the amount of noise generated by the unit, cuts the number of hours running time on compressor which reduces mechanical wear, saves energy since compressor(s) cannot be run below a certain minimum load.

To wire the programmer for compressor shut down connect MIC 6000 terminal "G" to LEY terminal #14 and MIC 6000 terminal "H" to LEY terminal #15. Remove jumper between 14 and 15.

If DUT on/off is not required and user prefers to use event to turn on/off main control circuit, connect MIC 6000 terminal "G" to LEY terminal #3. Also connect MIC 6000 terminal "H" to LEY terminal #27. Remove jumper between 3 and 27.

If user would like to use event to turn on/off a DUT, MIC 6000 terminals "G" and "H" are relay contacts rated for 5A resistive, 3A inductive at 115 VAC or 2.5A inductive at 230 VAC. DUT's with power requirements beyond contact rating should use event contacts to drive a contactor appropriately sized to handle DUT load.

INSTRUMENTATION (CONT'D)

SERIES 140A TEMPERATURE LIMIT

Standard Overtemperature Limit: The standard overtemperature limit controller is a UL and FM recognized limit controller. It includes a temperature sensor within the conditioned environment. Also includes an analog setpoint dial with dual calibration in °F and °C.

The control "trips" in the event of an open sensor (upscale break). The control will "trip" anytime the sensed temperature exceeds the overtemperature setpoint. Once tripped, the unit must be manually reset and will not be reset unless the chamber temperature is below the overtemperature setpoint. The reset switch is located on the front panel. Auto reset will only occur on initial start-up.

The overtemperature control usually operates in conjunction with a thermal fuse protection device.

When an overtemperature condition occurs, the overtemperature control will trip. The instrument is connected to the control circuit such that this will de-energize the heater redundant and control contactors, thus disconnecting power to the heaters. In addition, the fan(s) will be shut off if fan heat generation is sufficient to elevate the chamber temperature to a potentially hazardous level. If the fan(s) are off, the refrigeration system is necessarily shut off to avoid detrimental operating conditions.

Note: Compliance with warranty requires that any live (heat dissipating) load placed in the chamber must have its power source interlocked with the overtemperature limit controller. Overtemperature protection will not be achieved if power to live loads placed in the chamber cannot be interrupted by the overtemperature control. This can be achieved by powering a 115 VAC relay coil across equipment terminals 12 and 2. Use the normally open contacts of this relay to provide or cut power to live load. The high temperature limit must not be set more than 10°C (18°F) above the maximum rated temperature of equipment. See nameplate for equipment range.

INSTRUMENTATION (CONT'D)

SERIES 140A TEMPERATURE LIMIT (CONT'D)

Low Temperature Limit: An additional series 140A may be provided and is jumper selectable for downscale break and direct acting control for low temperature limit protection.

A low temperature limit is recommended if test item can be damaged by runaway cooling. It is also recommended on any unit with auxiliary LN2 or CO2 cooling to protect refrigeration system.

The low limit controller should not be set more than 5°C (9°F) below the minimum rated temperature of unit. See nameplate for unit's operating range.

HI-LIMIT AND CHART RECORDER

RECORDER SPECIFICATIONS:

Pen #1 records temperature from -100 to -200°C.
Pen #2 records relative humidity from 0-100% (on humidity units).
Accuracy: 1% of span

8" diameter circular chart.
Disposable fiber tip cartridges used.
Red for pen 1, green for pen 2.
7-day standard rotation (24 hour optional).
120 Volt, 60 Hz.

NOTE: The high or low limit must be manually reset after a tripped condition.

INPUTS:

Pen #1: 100 ohm platinum, 3 wire RTD with temperature range of -100 to
-200°C.
Calibration to be .00385 ohm/ohm-C.
Pen #2: 0-500 mv linear signal with a recording range of 0-100 % RH.
Maximum impedance = 1.5 melohms.

OUTPUT:

High or low limit (Pen 1 only) relay, SPDT, resistive load 7.5A @ 115 VAC,
3.5A @ 230 VAC, inductive load 360 VA.

OPERATING CONDITIONS:

Rate: 115 VAC ±10% @ 60 Hz.
0-50°C ambient
Humidity 0-70% RH
Extreme: 115 VAC ±15% @ 60 Hz.
Humidity 0-90%

RECORDER ADJUSTMENTS

1. THUMBWHEEL SWITCH

- A. The setpoint for the hi-limit can be set by dialing in the desired temperature into the thumbwheel switch located in the upper right hand corner of the recorder.
- B. NOTE: Hi-limit must be manually reset after an overtemperature condition exists.

2. RTD BREAK PROTECTION

The hi-limit incorporates RTD upscale break protection.

3. RTD CHANGE

RTD recorders are provided with 3-wire RTDs. For use with 2-wire RTDs, perform the following:

- A. Open control cover to expose circuit boards.
- B. Locate satellite RTD board mounted on stand-offs in the lower left corner of the main circuit board.
- C. Locate Terminal Block XTBl.
- D. For a 2-wire RTD, install a short jumper between XTBl-1 and XTBl-2.
- E. Lead length correction must be taken into account for 2-wire RTD.
Example: For this recorder, a 2-wire RTD with #20 gauge wire leads has a maximum lead length of 9.5 feet. The maximum length for #18 gauge wire is 15 feet.

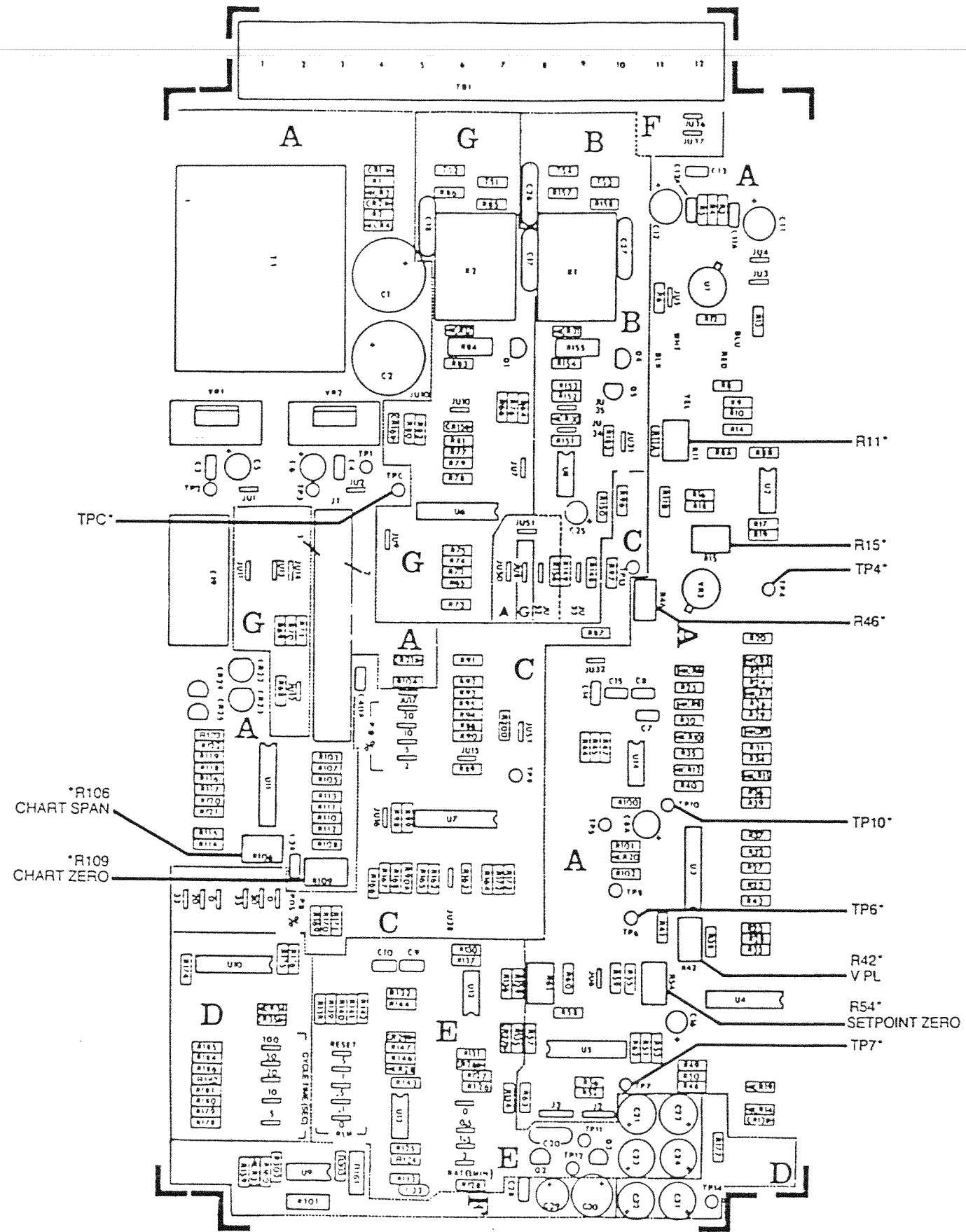
4. RECORDER CALIBRATION

A. Pen #1 Hi-Limit Calibration Procedure

1. Turn power switch off.
2. Disconnect sensor input and turn heater and immersion heater switches off.
3. Connect decade box to terminals XTBI-2 and XTBI-3.
4. Clip black lead of digital voltmeter to TPC.
5. Clip red lead to TP6.
6. Turn power switch on.
7. Adjust R46 for -5.000 ± 0.001 VDC.
8. Move red lead to TP4.
9. Adjust decade box for 60.25 ohms (-100°C).
10. Adjust R11 for 0.000 ± 0.003 VDC.
11. Move red lead to TP10.
12. Adjust R42 for 0.000 ± 0.003 VDC.
13. Adjust R109 so that pen is at minimum of span (-100°C).
14. Adjust decade box for 175.84 ohms (200°C).
15. With red lead on TP10 adjust R15 for 10.000 ± 0.001 VDC.
16. Adjust R106 so that pen is at maximum of span (200°C).
17. It may be necessary to go through procedure again to make sure zero and span did not shift.
18. Set the thumbwheel to 20°C .
19. Move red lead to TP7.
20. Adjust R54 for -2.00 ± 0.001 VDC.
21. Set the thumbwheels for 170°C .
22. With red lead on TP7 adjust R61 for -4.500 ± 0.001 VDC.
23. Repeat steps 14 through 18 until satisfactory results are obtained.
24. Adjust setpoint thumbwheel to midchart (50°C).
25. Adjust the decade box to make pen read the desired setpoint (119.40 ohms at 50°C). The red light will be on above setpoint.

B. Pen #2 Relative Humidity Recorder Calibration Procedure

1. Turn power switch off.
2. Disconnect input leads and connect voltage source instead.
3. Clip black lead of digital voltmeter to TPC.
4. Clip red lead to TP6.
5. Turn power switch on.
6. Adjust R46 for -5.000 ± 0.001 VDC.
7. Move red lead to TP4.
8. Adjust input voltage device for $0.00 \pm .003$ VDC (0% RH).
9. Adjust R11 for 0.000 ± 0.003 VDC.
10. Move red lead to TP10.
11. Adjust R42 for 0.000 ± 0.003 VDC.
12. Adjust R109 so that pen is at minimum of span (0% RH).
13. Adjust input voltage device for $.500 \pm .003$ VDC (100% RH).
14. With red lead on TP10 adjust R15 for 10.000 ± 0.001 VDC.
15. Adjust R106 so that pen is at maximum of span (100% RH).
16. It may be necessary to go through procedure again to make sure zero and span did not shift.



OPERATION

Warnings and Safety Precautions

Failure to heed warnings in this instruction manual and on equipment can result in death, personal injury or property damage.

Operator Training Requirements

The user(s) of this equipment must comply with operating procedures and training of operating personnel as stated in the Occupational Safety & Health Act (OSHA) of 1970, Section 5, and the National Fire Protection Association (NFPA) 86A of 1985, Section 1.6

The users selected must be alert and competent as their knowledge and training are vital for safe equipment operation and maintenance.

All users must be thoroughly instructed and trained under the supervision of experienced person(s). User(s) must demonstrate understanding of the equipment and its operation to assure knowledge of and practice of safe and proper operating procedures.

User(s) should receive regular re-training and testing as required to maintain a high level of proficiency and effectiveness.

Training should include:

- Function of controls and safety devices.
- Handling of special atmospheres (on units with LN2 or CO2 auxiliary cool).

Despatch will provide operating instructions which include:

- Piping and wiring diagrams
- Start-up procedures
- Shut-down procedures
- Emergency procedures
- Maintenance procedures

If additional manual(s) is required contact:

Customer Service
Despatch Industries, Inc.
P O Box 1320
Minneapolis MN 55440
Call Toll Free 800/328-5476
(in MN 800/469-5396)

Dangerous Atmospheres

DO NOT use in wet, corrosive or explosive atmospheres.

High Voltage

DO NOT attempt any service on this equipment without first disconnecting the electrical power to this unit. Disconnect main power switch or power cord. There are live circuits and connections even with power switch off.

High Temperature

DO NOT exceed maximum operating temperatures.

Take care when unloading for hot load.

Explosive Materials

DO NOT use any flammable solvent or other flammable materials or enclosed containers in this work space.

Electrical Service Connections

For supply connections on LEY chambers, use wire suitable for rated FLA. See nameplate for FLA.

Always check for proper voltage configuration and phase configuration before powering up unit. See Section 7-1, Item 2, and pg. 1-3 for details.

Steam Burns

On humidity chambers, a cloud of steam may be released when the door is opened. Be careful! Steam burns!

Protective Covers and Panels

All covers and panels must be in place when unit is operating and not being serviced.

Suffocation Danger (CO2 or LN2 Cooled Units)

Nitrogen and carbon dioxide gases can cause asphyxiation and death if used in confined, poorly ventilated areas.

Be sure unit is ventilated with fresh air before working in it.

Frost Bite Danger (LN2 and Low Pressure Liquid CO2 Cooled Units)

Nitrogen and carbon dioxide as liquid or cold gases can cause severe freeze burns to skin and eyes. DO NOT touch frosted pipes and valves.

Protect Chamber and Test Product from Overtemperature

DO NOT operate live (heat dissipating) load in this chamber unless its power source is interlocked with chamber's overtemperature limit.

Mechanical Refrigeration Systems

Operate at high pressure and therefore require special precautions:

- Service only by authorized personnel.
- Never over charge system.
- Before attempting to recharge system or add charge to system, read section of this manual regarding refrigeration charging (Section 11C).

In Case of Fire

- Leave door as is.
- Shut off electricity.
- Shut off auxiliary LN2. (Concentration of oxygen in LN2 increases as the LN2 is used up. Nearly empty cylinders of LN2 should be treated as liquid oxygen cylinders.)
- Call fire department.
- Stay away.

PRE-START-UP

1. 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.

2. Check Line Voltage

This LEY series chamber can be configured for (230 or 208) and (single or three) phase. Verify correct configuration for your voltage. See Section 7-1, Item 2, and pg. 1-3.

3. Fresh Air and Exhaust Openings

Avoid restrictions in and around the fresh air and exhaust openings. Under no condition permit them to become so filled with dirt that they appreciably reduce the air quantity.

4. Connect Other Utilities

Connections for LN₂, CO₂, water supply and drain should be clearly labeled on the chamber if applicable to this unit.

Note: All chambers are tested at the factory; however, shipping may cause damage or deviation. Therefore, before oven is put into regular service, the following items should be inspected and adjusted if necessary: hi-limit and control instrument calibration, doors, hinges, latches and other miscellaneous parts.

CHAMBER START-UP

1. Verify correct voltage for chamber's power configuration. Connect power to chamber. It is important for the life of the compressor that power be connected to unit for at least four hours before starting refrigeration system.
2. Push power switch to "on". This switch will activate fans and control circuit.
3. Set the hi-limit to desired setpoint, but no more than 10°C (18°F) over the maximum rating of the chamber. See nameplate for rating. On chambers with optional low limit, set the low limit to desired temperature but no lower than 5°C (9°F) below the minimum rating of the chamber.
4. Set temperature controller to desired setpoint. On humidity models, set humidity to desired setpoint if humidity testing is required. Refer to enclosed control instrument manual for instructions on instrument operation.

Programmer and Programmable Events

For units with programmers, enter the desired temperature (and humidity) profile. See enclosed programmer manuals for programmer operating instructions.

Note: Some programmers are equipped with event contacts. The following is a list of the typical event configurations on such equipment. These events must be programmed on for their corresponding functions to be activated:

- Event 3 (13 on Watlow 1500) is used to power the control circuit. This event must be on for all program segments except those where system is shut down (like last step of program).

- Event 2 (event 12 on Watlow 1500) is used to power compressors. This event must be on in order for compressor to run. This event may be off for setpoints above 50°C.
- Event 1 (event 11 on Watlow 1500) is used to stop refrigeration flow to the evaporator on units provided with humidity. On non-humidity units, this event is left open for customer use.
- Event 4 (event 21 on Watlow 1500) powers the humidity control system. If humidity control is not desired, or if temperature is below humidity range, this event should be off.

Some humidity testing profiles require a temperature drop to below freezing. To reduce the possibility of evaporator coil freeze up, the following steps are recommended for pull-down from high % RH to a below freezing setpoint:

1. In the first step of pull-down, enter setpoints of 10°C (50°F) and 40% RH. Event 1 (EV11) should be off and Events 2 (EV12), 3 (EV13) and 4 (EV21) should be on. Wait for 10°C \pm 2°. This allows the dehumidification coil to cool chamber in the above freezing range, minimizing the amount of icing on cooling coil.
 2. Next enter setpoint actually required by process. Event 1 (EV11), Event 2 (EV12) and Event 3 (EV13) should be on and Event 4 (EV21) should be off.
- Event 5 (EV22) is used to turn on/off auxiliary CO2 or LN2 if requested.

CHAMBER SHUT-DOWN

1. Set (program) controls to ambient. This is to avoid contact with hot load when unloading hot process or avoid frosting and condensation on load and chamber interior after a cold process.
2. Remove load when temperature is below 50°C (122°F).
3. Turn off power switch, cool switch (and humidity switch).

MAINTENANCE

General Equipment

Repair of electrical and refrigeration systems should be performed by qualified mechanics only.

Refer to the enclosed wiring and piping schematics with bills of materials for description and function of components.

1. Keep Equipment Clean

Gradual dirt accumulation impedes air flow. A dirty chamber can result in unsatisfactory operation such as non-uniform temperatures and/or humidity in the work chamber, reduced heating capacity, reduced production, overheated components, reduced refrigeration capacity, etc.

Keep the walls, floor and ceiling of the work chamber free of corrosion, dirt, and dust. Floating dust or accumulated dirt may produce unsatisfactory test results.

Keep condenser coil clean and free of foreign matter.

Keep all equipment accessible. Do not permit other materials to be stored or piled against chamber.

2. Protect Controls Against Excessive Heat

This is particularly true of controls, motors or other equipment containing electronic components. Temperatures in excess of 38°C (100°F) should be avoided.

3. Establish Maintenance and Check-Up Schedules

Recommended frequency for scheduled maintenance is included in each section.

Follow these promptly and follow them faithfully. Careful operation and maintenance will be more than paid for in continuous, safe and economical operation.

4. Maintain Equipment in Good Repair

Make repairs immediately. Delays may be costly in added expense for labor and materials and prolong eventual shutdown.

5. 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.

6. Check Safety Controls

This should be done as indicated.

Make these tests carefully and do them regularly. The safety of personnel as well as the equipment may depend upon the proper operation of any one of these controls at any time.

a. Temperature and Humidity Controllers (weekly)

Observe that the heater and immersion heater indicator lights flash every 6 to 10 seconds when the controls are operating at setpoint.

b. Hi-Limit (weekly)

With the oven operating at a given temperature, gradually turn the hi-limit control down to the setpoint operating temperature. The hi-limit should trip and shut off heater.

7. Practice Safety

Make it a prime policy to "know what you are doing before you do it."
Make CAREFULNESS, PATIENCE and GOOD JUDGMENT the safety watchwords for the operation of your chamber.

8. Ventilation

There are fresh air and exhaust openings in the rear and sides of the chamber that are always open to provide cooling for the chamber and control compartment.

9. Blower Shaft Seal

If chamber appears to use excessive amounts of water and water level control is operating properly, or if evaporator coil begins frosting up more than usual, check blower shaft seal for leakage. If worn, remove and replace.

10. Door Gaskets & Ports

Periodically inspect inner and outer door gaskets and port sealing for cracking, tearing, etc. If gaskets or seals are damaged, remove and replace. Strip old gasket from channel and force new gasket in.

Cooling System

1. Check refrigerant sight glass. Should be:

- Half to 3/4 full when on constant cooling.
- Green - if yellow, replace filter/drier.
- Also replace filter/drier if there is severe temperature difference across filter drier.

2. Verify condenser, evaporator (and dehumidification) coils are unobstructed and free of dirt.

3. On units with auxiliary cooling, check operation of relief vents. Also check operation of auxiliary cool solenoids.
4. On CO2 cooled units, check the supply line filter. Refer to Section 12-F on installation and use of CO2/LN2.

Humidification System

1. Verify that water level controls function properly.
 - When water is below heater, light on humidity switch is off.
 - Water level is controlled to \emptyset to 1/2" above top of float switch bulb when not calling for steam.
 - Sufficient water in wet wick "peace pipe."
2. The wet bulb wick in front of the recirculating fan should be replaced approximately once a month or whenever it becomes crusty or dirty.
3. Clean any scale from steam generator and its components. Check it for cleanliness once a month.
4. Work Chamber Interior

Program outlined below is minimal; if chamber is operated under abnormal conditions (i.e., dirty water supply, contaminated test loads, corrosive atmosphere, etc.), increase frequency of cleaning.

- a. Every 500 operating hours in humidity mode: Drain and clean wet bulb wick assembly, control sensors, and all interior surfaces (walls, bottom, door interior). Use clean cloth and warm water. If necessary, use stainless steel wool on stains. UNDER NO CIRCUMSTANCES USE ORDINARY STEEL WOOL: THIS WILL SCRATCH AND CAUSE CORROSION.

- b. Every 4,000 operating hours: Remove interior baffles, wet and dry bulb assembly, and sensors. Clean all interior surfaces, including all sensors with mild detergent. Scrub all exposed surfaces until clean, using stainless steel wool if necessary. (See "a") Rinse thoroughly and dry with clean cloth. Remove contaminants from water reservoir. Install all components removed earlier, fill reservoir, drain, and refill again.

- c. When humidity chamber is under continuous use for high temperature/humidity testing, chamber MUST be emptied after every test cycle. Chamber should be cleaned as is necessary to remove any stains or corrosion, then chamber may be refilled with water. Optimum cleaning (as outlined in "a" and "b") interval under these conditions is ten days. Maximum interval is thirty days.

TROUBLESHOOTING

Unit Fails to Start

1. Main power not turned on.
2. Utilities not hooked up. See section titled Installation, Page 7-1, and pg. 1-3.
3. Fuses burnt. Check for shorts and replace.
4. On units with microprocessors, the event relay is not programmed. See Page 10-C-1.
5. Temperature limits are tripped. Determine cause of trip and reset.

Unit Operates, but Fails to Reach Set High Temperature

1. Incorrect switch setting.
2. Heater fuse burnt. Check for shorts and replace.
3. Defective heater or heat contactor. Replace.
4. Temperature controller setting beyond range of unit. See nameplate for temperature range.
5. Thermal fuse burnt out.
6. Defective solid state relay. Check for open "heater" solid state relay. Check for shorted "cool" solid state relay.
7. Cool solenoid stuck open on refrigeration system or auxiliary cool.

TROUBLESHOOTING (CONT'D)

Unit Operates, but Fails to Reach Low Set Temperature

1. Chamber load larger than unit is rated for. See section titled Specification.
2. Compressor does not start.
 - a. Pressure switch tripped. Correct cause (see g.) reset.
 - b. On units with programmer, "cooling" events not on. See Page 10-C-6.
 - c. Fuse burnt, check for short and replace.
 - d. Defective contactor. Replace.
 - e. Defective pressure (or oil pressure) switch.
 - f. Defective compressor. Replace.
 - g. Compressor starts but shuts off and will not auto reset. Check for blocked airflow to condenser, dirty condenser, defective condenser fan or fan motor, overcharged.
 - h. Compressor starts but cycles on and off. Check for bad TX valves. Internal thermal overloads on compressor may be bad.
3. Defective solid state relay. Check for shorted "heater" solid state relay or open "cool" solid state relay.
4. Defective refrigeration solenoid.
5. Humidity system powered during below 35°F (2°C) desired setpoint. Turn humidity switch off.
6. Frosted up refrigeration coil. Blocked airflow. Defective recirculation fan and motor.
7. Expendable refrigerant solenoid valve failure.
8. Loss or blockage in expendable refrigerant lines.

TROUBLESHOOTING (CONT'D)

Alarm Light ON:

1. Hi-limit/low-limit thermostat set lower than necessary for adequate protection. Re-adjust setting.
2. Defective temperature controller. Replace.
3. Sensor leads broken or shorted.
4. Check if compressor is operating. If it is recirculation pump has failed.

Unit Fails to Control Humidity (Standard Depression & RH Units):

1. Wet bulb wick crusted or torn. Replace.
2. No water in wet bulb trough. Check for restriction in water piping. Check water level in steam generator.
3. Loss of water supply. Check for sticking float valve.
4. Dehumidification system failure. Have system checked by competent refrigerant service technician.
5. Defective humidity controller. Replace.
6. Sensor leads broken or shorted.
7. Immersion heater thermostat setting too low. Re-adjust.
8. Immersion heater relay or contactor failure. Replace.

TROUBLESHOOTING (CONT'D)

9. Defective solid state relay(s).
10. Defective float switch.
11. Incorrect switch setting. Cool or humidity switch not turned "on".
12. On systems with programmer, the humidity event is not on. See Page 10-C-1.

Unit Fails to Control Humidity (Optional Solid State Sensor):

1. Sensor requires recalibration.
2. Incorrect switch setting. Cool or humidity switch not turned "on".
3. Loss of water supply. Check for sticking float valve.
4. Dehumidification system failure. Have system checked by competent refrigerant service technician.
5. Defective humidity controller. Replace.
6. Sensor leads broken or shorted.
7. Immersion heater relay or contactor failure. Replace.

REFRIGERATION CHARGING PROCEDURES - SINGLE STAGE

NOTE: The following information is not intended to instruct the novice how to charge a refrigeration system but rather is intended only to supplement the knowledge of an experienced, qualified refrigeration mechanic. Unqualified personnel are cautioned against attempting any repair or service on this refrigeration system.

1. Never recharge the system with more refrigerant than is listed on the enclosed refrigeration schematic drawing.
2. If the system was allowed to stand at ambient pressure before recharging, evacuate the system and replace the filter drier before adding refrigerant charge.
3. Always add charge into the suction side of the compressor, from the gas line of the refrigerant bottle, with the compressor running. Never charge liquid refrigerant into the suction side of the compressor.
4. If it is necessary to add a charge to the system, only charge refrigerant until the sight glass becomes clear at steady state conditions and at the lowest operating temperature of the chamber.
5. It is normal to see occasional bubbles in the sight glass, especially when the hot gas bypass valve opens.
6. DO NOT OVERCHARGE THE SYSTEM.
7. In the case of a leak, if the amount of oil lost is small and can be reasonably calculated, this amount should be added to the compressor. If, however, there is a major loss of oil, the serviceman must remove the compressor, drain the oil, and add the correct charge before placing the compressor in operation.

ELECTRICAL CONTROL COMPONENTS DESCRIPTION

Temperature control is 3-mode control with dead band so if tuned properly will activate only heat or only cool when necessary.

An overtemperature limit cuts power to control solenoids and back-up contact relays for all heaters, motors and compressors.

2-CR is the back-up contact relay for the main heater. It is on whenever power switch is on and no limit is tripped.

1-CR is the main contact relay for the compressor. It is powered when power and cool switches are on and 1-PS is not tripped, indicating no problems with pressure limit.

4-CR is the back-up contactor for the immersion heater on humidity systems. It is activated if power, cool and humidity switches are on. Also, 1-LSW must be closed (indicating sufficient water in steam generator). 3-HL must be closed and no overtemperature condition exists.

1-HL is a thermal fuse on main heater meant as a back-up protection device.

2-HL is the standard overtemperature limit. This limit control uses a type "T" T/C to sense chamber temperature. It latches into the alarm condition until 1-SW is pressed to reset it. 1-Pot is used to select its trip temperature.

3-HL is a filled bulb temperature limit attached to the immersion heater on humidity systems. It is a back-up limit to protect the immersion heater from a low water condition when there is a failure in 5-SSR or 1-LSW.

1-LSW is used to inhibit the immersion heater on humidity systems by cutting power to 5-SSR on low water.

1-PS is a pressure switch which will shut off the compressor if discharge pressure is too high.

The control system may have four solenoids. 1-SOL is opened when unit calls for cooling.

2-SOL is actuated when dehumidification is called for by the humidity controller.

3-SOL and 4-SOL are the fill and drain solenoids on humidity systems. 3-SOL is normally closed and opens when the humidity system is actuated to fill the steam generator. 4-SOL is normally open and opens when humidity system is de-actuated to drain steam generator and pease pipe.

1-4SSR are zero crossover solid state relays. These isolate time proportioned signal from the controller to the actual control process component (i.e., heater or solenoid).

1-SSR controls the main heater.

2-SSR controls the liquid line solenoid (1-SOL).

3-SSR controls the humidity immersion heater.

4-SSR controls the dehumidification solenoid (2-SOL).

On humidity systems, there is an additional 5-SSR. This SSR isolates the liquid SW (1-LSW) from the immersion heater contactor (4-CR) that it is indirectly actuating to increase the life of that float switch.

INSTALLATION AND USE OF LIQUID CARBON DIOXIDE

Some chambers utilize liquid CO₂ as an expendable refrigerant both as a back-up system and also as a primary cooling means. The type, quality and handling of the cooling gas are quite important, as is the plumbing used to deliver the gas to the test chamber. Most test chamber operational problems with CO₂ are caused by improper gas use; thus, the installation procedures and precautions should be reviewed carefully before operating the chamber.

The liquid coolant gases should be used only after observing stringent safety considerations and practices.

WARNING

Nitrogen and carbon dioxide gases can cause asphyxiation and death if used in confined, poorly-ventilated areas.

Nitrogen and carbon dioxide as liquid or cold gases can cause freeze burns on the eyes or skin. Do not touch frosted pipes or valves.

Nitrogen is a non-toxic gas, but it can cause asphyxiation in a confined area that does not have adequate ventilation. Any atmosphere which does not contain enough oxygen for breathing (at least 18 percent) can cause dizziness, unconsciousness, or even death. Carbon dioxide affects the important acid-base balance within the body; the body can tolerate increased amounts of carbon dioxide only in limited concentration. This is recognized in OSHA standards where a Threshold Limit Value of 5,000 parts per million by volume (0.5 percent concentration) has been adopted. For safety, concentrations above this level should not be permitted; increased concentrations can cause bodily harm or death.

Nitrogen and carbon dioxide cannot be detected by the human senses and will be inhaled like air. If adequate ventilation is not provided, these gases may displace normal air without warning that a life-depriving atmosphere is developing. Store containers outdoors or in other well-ventilated areas. Never enter any confined area where these gases may be present until the area is purged with air and is checked for a breathable atmosphere.

Never use containers, equipment or replacement parts other than those specifically designated for use in nitrogen or carbon dioxide service. Gaseous nitrogen or carbon dioxide should be released only in an outdoor open area if disposal is required. Liquid nitrogen or carbon dioxide should be dumped into an outdoor pit filled with clean, grease-free and oil-free gravel, where they will evaporate rapidly and safely.

Before purchasing or installing CO₂ gas supplies, insure that the test chamber is the correct model to use CO₂ (High - 70 Kg/cm² or 1,000 PSI or Low - 21 Kg/cm² or 300 PSI) and that the desired low temperature can be reached by use of this gas. The following special CO₂ requirements must be met:

1. The liquid CO₂ should be furnished by a reputable source, preferably one which furnishes coolant to laboratories, hospitals, etc.
2. The liquid CO₂ cylinder must be a siphon-type.
3. The interior of the cylinder must be clean and absolutely dry before being filled by the supplier.
4. Use of "welding grade" CO₂ offers no assurance of proper trouble-free operation as the internal condition of the cylinder and its previous use are more important than the quality of the CO₂ in this case.
5. Never fully exhaust the cylinder after use or leave a cylinder which is to be returned to the supplier with the valve open. This will permit moisture or other contaminants to enter the cylinder and cause serious

problems when the cylinder is reused later. If a cylinder is returned to the supplier without a positive pressure, it must be purged with dry nitrogen by the supplier before filling.

Other important factors in the use of CO₂ gas coolant are as follows:

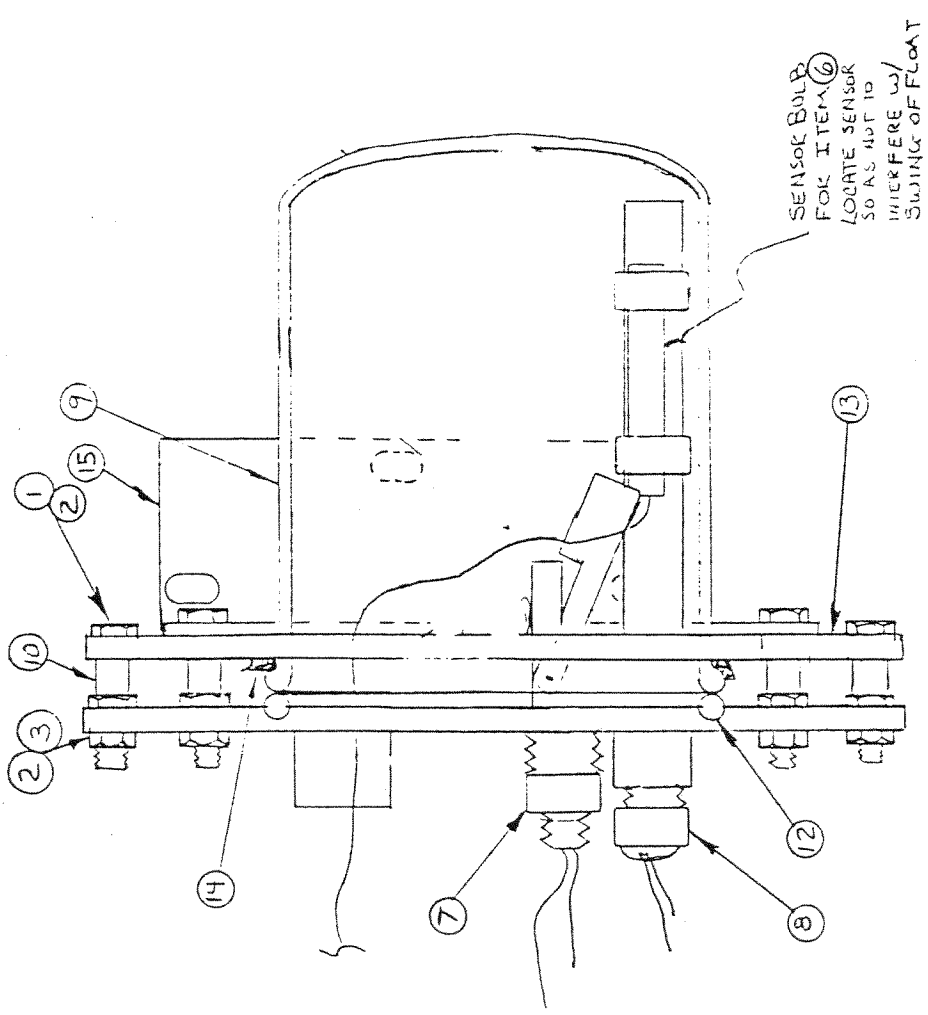
1. The interior of the liquid CO₂ pipe, tubing, hose and fittings used between the supply cylinder and the solenoid input valve of the temperature chamber must be kept clean and free of moisture at all times. Any moisture will turn to ice as the liquid CO₂ flows through the lines; the ice can then lodge on the solenoid valve seat or plug the orifice of the valve and cause system malfunction.
2. Any low-pressure CO₂ connecting hoses between the supply cylinder(s) and the chamber input valve should be kept as short as possible and should be insulated.
3. If the connecting hose is removed often or has been stored for a period of time, the line and fittings must be examined for presence of chips, rust or any foreign substance which can jam the inlet valve or plug the valve orifice.
4. A filter is installed in the line and must be checked for cleanliness every 50 hours of operation, or more often if necessary. Clean the filter in trichloroethylene and dry thoroughly using filtered, moisture-free compressed air at low pressure.
5. It is important that the CO₂ solenoid valve assembly and the orifice be kept clean.

Additional Precautions:

1. Never install CO₂ supply pipe fittings or valves of a larger internal diameter than those used "upstream" [beginning at the supply cylinder(s)].

List of MATL:

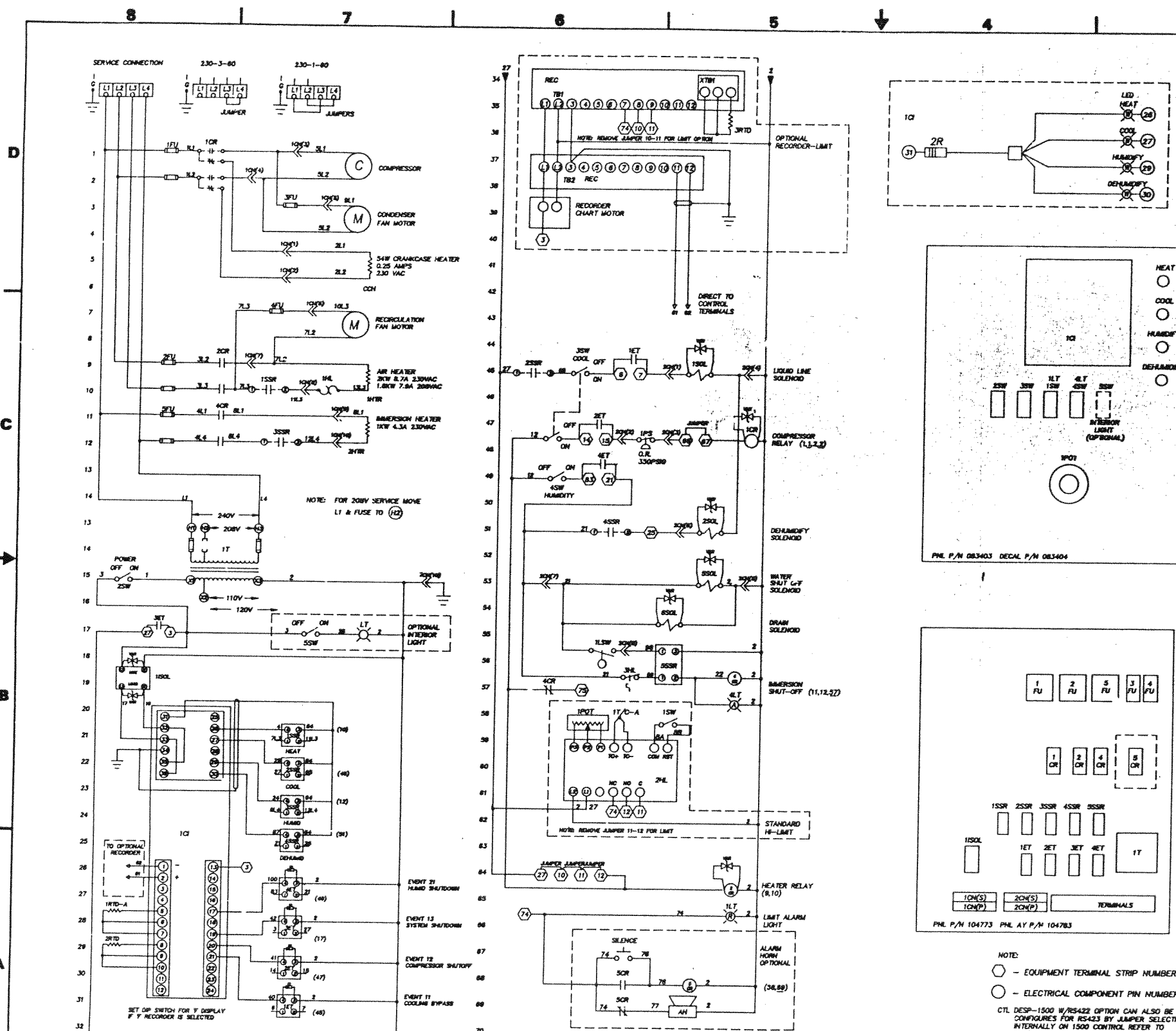
- ① 010839 8 SCW .31-18 X 2.00
- ② 012837 16 WSHR .31 LK SPG
- ③ 018214 10 NUT .31-18
- ④
- ⑤
- ⑥ 052162 1 H. Lim 102K
- ⑦ 061103 1 SW FLOAT
- ⑧ 074809 1 HTR 1000W
- ⑨ 074826 1 BELL JAR
- ⑩ 074827 8 SPARK SST. 500X 3/8" LG
- ⑪
- ⑫ 074831 1 SEAL O-RING 1.25ID
- ⑬ 074865 1 4" PIPE FLG
- ⑭ 074866 1 4" PIPE FLG INSERT
- ⑮ 104851 1 MITG BRKT



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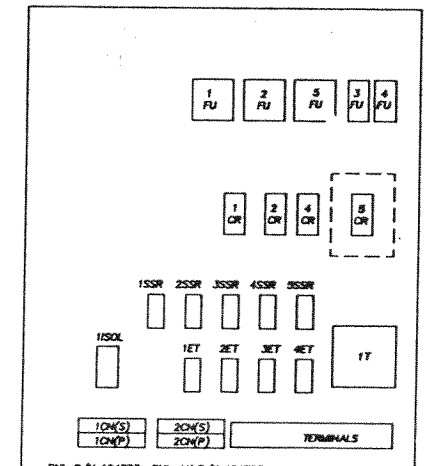
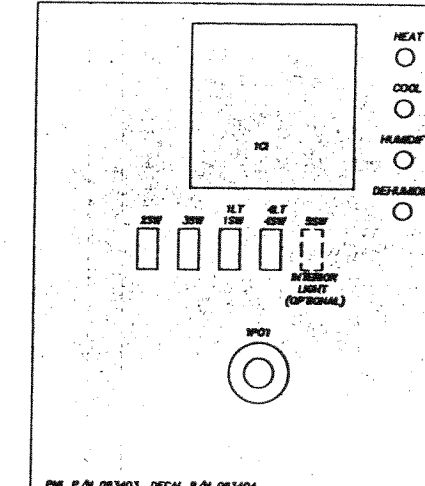
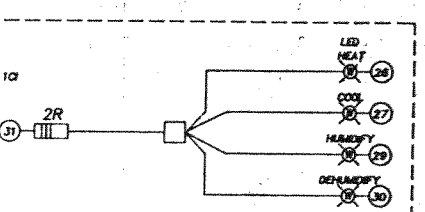


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LIST OF MATERIAL

| ITEM | PART NUMBER | QTY | DESCRIPTION |
|--------|-------------|-----|---|
| 1-SCR | 047753 | 2 | RELAY 20A DPDT 120V COE |
| 4CR | 080724 | 1 | RELAY 157-33700 SPDT MDTX |
| 1FU | 007471 | 1 | F30A25P FUSEBLOCK |
| | 007540 | 2 | FUSE 3-ELEMENT 15A |
| 2FU | 007471 | 1 | F30A25P FUSEBLOCK |
| | 007456 | 2 | FUSE A25 X 015 AMPTRAP |
| 1,4FU | 007470 | 1 | F30A15P FUSEBLOCK |
| | 007528 | 2 | FUSE 2-ELEMENT 8.5A |
| 3FU | 007455 | 2 | FUSE A25X010 AMPTRAP |
| | 007471 | 1 | F30A25P FUSEBLOCK |
| 1CTL | 072877 | 1 | 1500-0001 DESPATCH CONTROL 20MAN |
| | 073402 | 1 | 1500-0001 DESPATCH CONTROL 20MAN W/RS422 |
| 3HL | 080276 | 1 | CTL 945B 48V FUSE LINK |
| 3HL | 052142 | 1 | CTL 945B MANUAL RESET |
| 1HTR | 071208 | 1 | HTR W/IN 2.0CF 230VAC |
| 2HTR | 074609 | 1 | HEATER W/ATLW FROM 1000W 230V |
| 1OCH | 074817 | 1 | HTR CRANKCASE 54W 230VAC |
| 1PS | 063394 | 1 | SW PRESS 287-300469 SSR SPST OPEN/RESE 350P/380 |
| 1POT | 074884 | 1 | POT ADDR-0417-008 |
| 1VAR | 014645 | 6 | 1/2 30LATA VARISTOR |
| 1SOL | 074884 | 1 | 1/2V SOLENOID 1/2" RAPID CYCLE |
| 2SOL | 074884 | 1 | 1/2V SOLENOID 3/8" RAPID CYCLE |
| 3SOL | 056388 | 1 | 1/2V SOL 5/8"X3/4" 20MPT ASSC |
| 4SOL | 080140 | 1 | 1/2V SOL 5/8"X3/4" 20MPT 25T/20V |
| 1SSR | 047810 | 1 | RELAY SSR 25A |
| 2SSR | 047811 | 1 | RELAY SSR 10A |
| 3SSR | 047810 | 1 | RELAY SSR 25A |
| 4SSR | 047811 | 1 | RELAY SSR 10A |
| 5SSR | 008488 | 1 | RELAY SSR 25A |
| 1RTD | 070274 | 1 | RTD 100 OHM 3" ELEMENT |
| 2,3RTE | 070274 | 2 | RTD 100 OHM |
| 1T/C | 053454 | 1 | T/C "T" J" ELEMENT |
| 1-2 | 084151 | 2 | 93.001.1053 SOCKET CONNECTOR |
| 1CN | 084152 | 2 | 93.002.1053 PLUG CONNECTOR |
| 2,3SW | 074118 | 1 | DPST SWITCH |
| 4SW | 074182 | 1 | SPST SWITCH W/AMBER PILOT LIGHT |
| 1LSW | 081103 | 1 | SW LID LEV (RS-650-P) MAGNETIC |
| 1T | 013315 | 1 | 8X250MPT12L-3PH 200VA |
| 1T | 007502 | 2 | FRM-2 250V |
| 1SOL | 050410 | 1 | 1-10" ISOLATION TRANSFORMER |
| 4LED | 059164 | 4 | 5V LED PILOT LIGHT |
| 1-4RT | 052181 | 4 | A1225 SOLID STATE RELAY |
| 1R | 045880 | 4 | 3.0K OHM RESISTOR |
| 2R | 010500 | 1 | 380 OHM RESISTOR |
| | | | 18-LIMIT STANDARD |
| 2HL | 080581 | 1 | 140A-2805-4000 18-LIMIT 315°C |
| 1SW | 081813 | 1 | DPST MOM SWITCH |
| 1LT | | | PILOT LIGHT RED |
| | | | RECORDER-LIMIT OPTION |
| REC | 074836 | 1 | 24HR 2 PEN RECORDER -100 TO 200°C 3RH |
| | 074837 | 1 | 7 DAY 2 PEN RECORDER -100 TO 200°C 3RH |
| CHART | 074840 | 1 | 24HR CHART -100 TO 200°C 3RH |
| | 074839 | 1 | 7 DAY CHART -100 TO 200°C 3RH |
| 1LT | 008862 | 1 | PILOT LIGHT RED |
| | | | ALARM HORN OPTION |
| SCR | 047753 | 1 | RELAY DPDT -100 TO 200°C |
| 1BLNDR | 081608 | 1 | SPST MOM SWITCH |
| 1AH | 004052 | 1 | SC110 ALARM HORN |
| | | | INTERIOR LIGHT OPTION |
| SSW | 074118 | 1 | DOUBLE POLE SINGLE THROW SWITCH |
| 1LT | 084586 | 1 | 40 WATT INTERIOR LIGHT |



NOTE:
 ○ - EQUIPMENT TERMINAL STRIP NUMBER
 ● - ELECTRICAL COMPONENT PIN NUMBER
 CTL DESP-1500 W/RS422 OPTION CAN ALSO BE CONFIGURED FOR RS423 BY JUMPER SELECTION INTERNALLY ON 1500 CONTROL. REFER TO 1500 MANUAL FOR INSTRUCTIONS.

| | | | | | | | | | | |
|--|------|----|-----------------------|-------|---|--|---|------|--------|--------------|
| REV | DATE | BY | DESCRIPTION OF CHANGE | ECO # | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES | DECIMALS TO 2 0.005 ANGLES TO 30° TOLERANCES ± .1" | THE DESIGN SHOWN ON THIS DRAWING IS THE EXCLUSIVE PROPERTY OF DESPATCH INDUSTRIES, INC. AND IS SUBMITTED WITH THE UNDERSTANDING THAT IT IS NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER WITHOUT THE WRITTEN CONSENT OF DESPATCH INDUSTRIES, INC. | DRN | RICH E | SCALE |
| | | | | | | | | CHKD | TGA | DATE 3/21/89 |
| COPYRIGHT © 1989 DESPATCH INDUSTRIES, INC. | | | | | | | | | | |

141473-74

PARENT NO SERIAL NO CUSTOMER NO

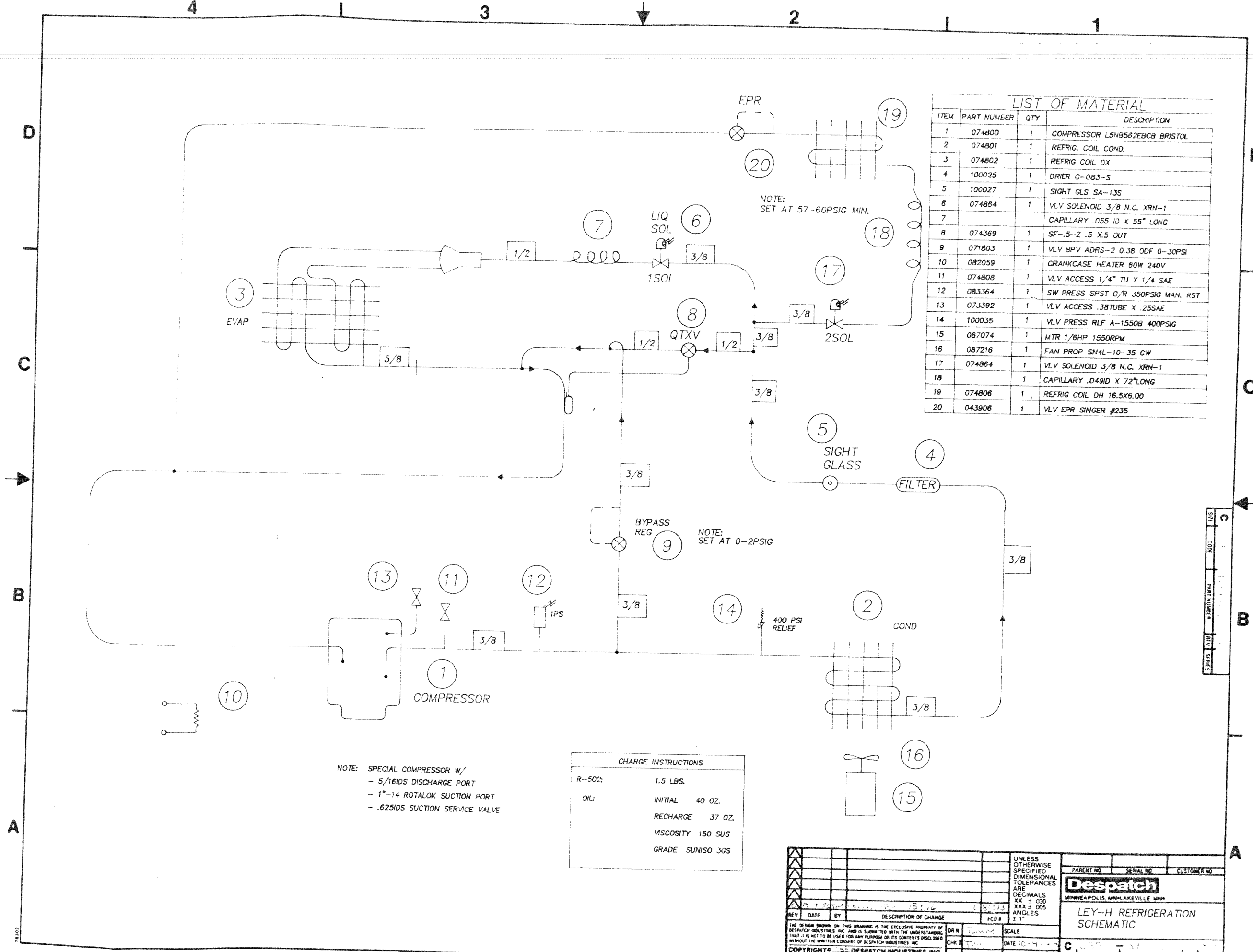
Despatch
 MINNEAPOLIS MN LAKEVILLE MN
 LEY H W/1500 CONTROL

D C 351 - W01246 E 00

SIZE CODE PART NUMBER REV SERIES

D C 351 - W01246 E 00

ERS 04/17/89



NOTE: SPECIAL COMPRESSOR W/
 - 5/16IDS DISCHARGE PORT
 - 1"-14 ROTALOK SUCTION PORT
 - .625IDS SUCTION SERVICE VALVE

CHARGE INSTRUCTIONS

| | |
|--------|-------------------|
| R-502: | 1.5 LBS. |
| OIL: | INITIAL 40 OZ. |
| | RECHARGE 37 OZ. |
| | VISCOSITY 150 SUS |
| | GRADE SUNISO 3GS |

LIST OF MATERIAL

| ITEM | PART NUMBER | QTY | DESCRIPTION |
|------|-------------|-----|------------------------------------|
| 1 | 074800 | 1 | COMPRESSOR L5NB562EBC8 BRISTOL |
| 2 | 074801 | 1 | REFRIG. COIL COND. |
| 3 | 074802 | 1 | REFRIG COIL DX |
| 4 | 100025 | 1 | DRIER C-083-S |
| 5 | 100027 | 1 | SIGHT GLS SA-13S |
| 6 | 074864 | 1 | VLV SOLENOID 3/8 N.C. XRN-1 |
| 7 | | | CAPILLARY .055 ID X 55" LONG |
| 8 | 074369 | 1 | SF-.5-Z .5 X.5 OUT |
| 9 | 071803 | 1 | VLV BPV ADRS-2 0.38 ODF 0-30PSI |
| 10 | 082059 | 1 | CRANKCASE HEATER 60W 240V |
| 11 | 074808 | 1 | VLV ACCESS 1/4" TU X 1/4 SAE |
| 12 | 083364 | 1 | SW PRESS SPST O/R 350PSIG MAN. RST |
| 13 | 073392 | 1 | VLV ACCESS .38TUBE X .25SAE |
| 14 | 100035 | 1 | VLV PRESS RLF A-1550B 400PSIG |
| 15 | 087074 | 1 | MTR 1/6HP 1550RPM |
| 16 | 087216 | 1 | FAN PROP SN4L-10-35 CW |
| 17 | 074864 | 1 | VLV SOLENOID 3/8 N.C. XRN-1 |
| 18 | | | CAPILLARY .049ID X 72" LONG |
| 19 | 074806 | 1 | REFRIG COIL DH 16.5X6.00 |
| 20 | 043906 | 1 | VLV EPR SINGER #235 |

UNLESS OTHERWISE SPECIFIED DIMENSIONAL TOLERANCES ARE DECIMALS
 XX ± .030
 XXX ± .005
 ANGLES ± 1°

REVISIONS

| REV | DATE | BY | DESCRIPTION OF CHANGE | ECO # |
|-----|------|----|-----------------------|-------|
| 1 | | | | |

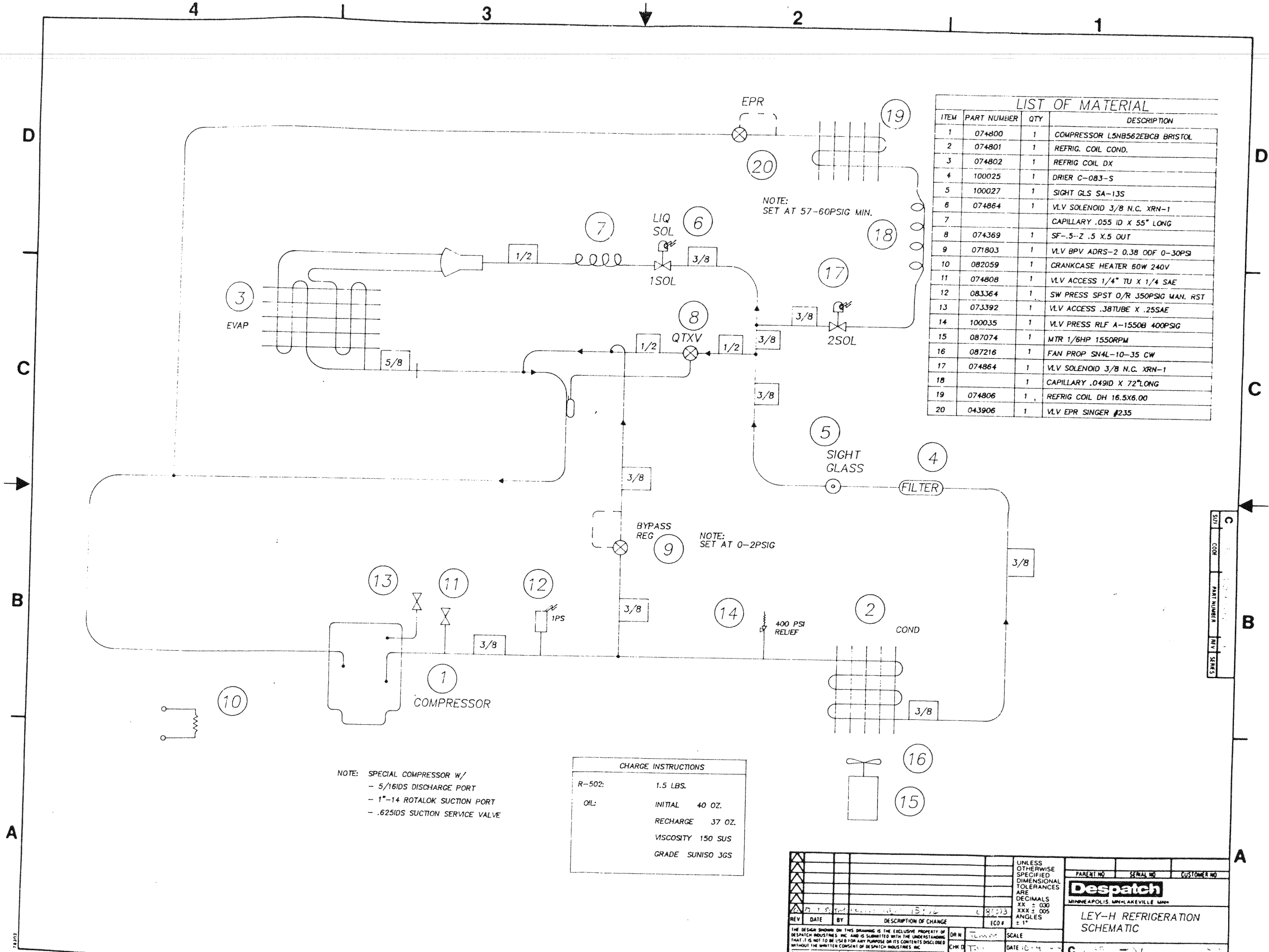
DRN: TMM SCALE: C
 CHK D: TMM DATE: 10-4-83
 APP: C 48

Despatch
 MINNEAPOLIS, MINN. LAKEVILLE, MINN.

LEY-H REFRIGERATION SCHEMATIC

PARENT NO. SERIAL NO. CUSTOMER NO.

SIZE CODE PART NUMBER REV SERIES



LIST OF MATERIAL

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|------|-------------|-----|------------------------------------|
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| 2 | 074801 | 1 | REFRIG. COIL COND. |
| 3 | 074802 | 1 | REFRIG. COIL DX |
| 4 | 100025 | 1 | DRIER C-083-S |
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| 6 | 074864 | 1 | VLV SOLENOID 3/8 N.C. XRN-1 |
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| 9 | 071803 | 1 | VLV BPV ADRS-2 0.38 ODF 0-30PSI |
| 10 | 082059 | 1 | CRANKCASE HEATER 60W 240V |
| 11 | 074808 | 1 | VLV ACCESS 1/4" TU X 1/4 SAE |
| 12 | 083364 | 1 | SW PRESS SPST O/R J50PSIG MAN. RST |
| 13 | 073392 | 1 | VLV ACCESS .38TUBE X .25SAE |
| 14 | 100035 | 1 | VLV PRESS RLF A-1550B 400PSIG |
| 15 | 087074 | 1 | MTR 1/6HP 1550RPM |
| 16 | 087216 | 1 | FAN PROP SN4L-10-35 CW |
| 17 | 074864 | 1 | VLV SOLENOID 3/8 N.C. XRN-1 |
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| | | | | |
|---|------|--|-----------------------|----------------------|
| UNLESS OTHERWISE SPECIFIED DIMENSIONAL TOLERANCES ARE DECIMALS XX ± .030 XXX ± .005 ANGLES ± 1° | | PARENT NO. | SERIAL NO. | CUSTOMER NO. |
| <small>THE DESIGN SHOWN ON THIS DRAWING IS THE EXCLUSIVE PROPERTY OF DESPATCH INDUSTRIES, INC. AND IS SUBMITTED WITH THE UNDERSTANDING THAT IT IS NOT TO BE USED FOR ANY PURPOSE OR ITS CONTENTS DISCLOSED WITHOUT THE WRITTEN CONSENT OF DESPATCH INDUSTRIES, INC.</small> | | Despatch MINNEAPOLIS, MINN. LAKEVILLE, MINN. | | |
| | | LEY-H REFRIGERATION SCHEMATIC | | |
| REV | DATE | BY | DESCRIPTION OF CHANGE | ECO # |
| | | | | |
| <small>APP</small> | | <small>CHK</small> | <small>DATE</small> | <small>SCALE</small> |
| <small>APP</small> | | <small>CHK</small> | <small>DATE</small> | <small>SCALE</small> |
| SIZE | CODE | PART NUMBER | REV | SERIES |