SECTION 2

GENERAL DESCRIPTION

The recipient should first examine the instrument and all attachments to determine if any damage has occured in transit. This has specific value in terms of user safety during operation and also appropriate carrier liability. Should any defects be noted, immediately notify Ladd (and the commercial carrier if a damage is present) with a complete description of the part involved and the nature of the defect.

As received the shipping carton should contain the following:

1) The CPD instrument with viewing port cover and three (3) mounting nuts, and "O"-ring gasket.
2) 1 ea. specimen Holder Tray
3) Specimen Holders as follows:
    a) Small basket with cover
    b) Medium basket with cover
    c) Large basket with cover
    d) 8-sample holder
4) 2 ea. dead space filler blocks
5) High pressure connecting hose for coupling CPD unit to compressed gas tank
6) 2 ea. tank adapters (compressed gas tank)
7) Exhaust hose with nut
8) Spare parts
    a) 2 amp 250 V fuse
    b) "O"-ring chamber gasket of ethylene propylene for use with CO_2
    c) chamber illumination bulb
9) 2 ea. legs for raising front of unit for operation
10) Roll of sealing tape for high pressure fittings

The user must supply:

a) Tank of transitional fluid, e.g. a 9 or 25 pound bottle of compressed CO_2. Compressed gases are normally available through local vendors of bottled and compressed gas. When ordering for the critical point drying technique the user should specify that the compressed gas tank have a siphon or dipping tube (to allow the compressed liquid to readily enter the CPD chamber with the tank in the upright position. CO_2 should be "bone dry" and essentially free of impurities.

b) Dehydration (intermediate) fluids:
    For example: acetone, ethanol, amyl acetate for CO_2 drying
    Freon TF (Freon 113) for Freon drying

c) 110-120 Volts A.C., 50-60 Hz standard grounded receptacle.

The dryer can be operated on 220 Volts AC, 50-60 Hz by obtaining a step down transformer either locally or as an accessory.

d) Remote Venting of exhaust gas

During the CPD operation, the chamber environment can be monitored and controlled by the instrumentation on the front panel (see Fig. 1) as follows:

1) Pressure gauge, maximum reading of 3000 psi with 1300 psi mark as upper limit in normal technique with CO_2.
2) Specimen chamber cover with sapphire glass viewing port for monitoring specimen during operation.
3) Locking thumb nuts to secure chamber cover during operation.
4) Vent, fill, drain valves are stainless steel needle valves.

   Fill valve: allows entry of compressed gas into specimen chamber during flushing and filling of chambers.
   Vent Valve: allows top venting of compressed gas (and intermediate fluids) during flushing and after reaching critical point.
   Drain Valve: allows bottom draining of chamber to remove liquid if venting of the gas is not desired.

5) Temperature gauge in degrees centigrade
   Maximum reading of 50°C
6) Power switch is 3 step: 1) Off; 2) Power to main circuits and valve heaters; 3) chamber heater.
   Essentially an on/off switch with additional heater circuit switch.
7) Indicator lights: white indicates power to main circuits and valve heaters, red indicates power to chamber heater circuits.

On the rear panel (Fig. 2)

1) Fuse assembly (2 amp)
2) Flared bulkhead fitting (inlet) for attaching high pressure hose from compressed transitional gas.
3) Flared bulkhead fitting (exhaust) for attaching exhaust hose to direct vented gases into fume hood, etc.
4) Connection of power cord for 110-120 VAC power source.
5) Temperature set-point adjustment (factory set at 42°C for CO_2). Turning clockwise with a screwdriver increases the set point; turning counterclockwise decreases the set point.

SECTION 3

INSTALLATION

The power cord of the dryer must be connected to 110-120 Volt (AC), 50-60 Hertz source through a grounded outlet. Connection to the tank of transitional gas is made as follows:

1. Select one of the two adapters supplied which fits the particular tank of transitional fluid to be used. If the tank adapters supplied do not fit a particular type of tank it is because that tank is not a standard CO_2 or Freon tank. Most machine shops can make suitable adapters, or in many cases other adapters can be obtained locally from refrigeration wholesalers.

2. Wrap the male threaded fitting on the tank with a single continuous layer of the Teflon sealing tape supplied. The tape should be wrapped in the direction the connector will turn when attached (clockwise viewing the orifice of the fitting) and just overlap to complete the coverage.

3. Insert the fiber washer supplied into the tank adapter selected and screw the adapter onto the tank, tightening with a wrench but take care not to overtighten which may damage threads. (a 10-12 inch adjustable wrench is a convenient size).

4. The end of the adapter as well as the inlet fitting on the rear panel of the CPD unit should next be wrapped with Teflon tape as was done on the tank fitting.

5. Connect the high pressure connecting hose to the tank adapter and the inlet bulkhead fitting of the CPD unit. (It makes no difference which end is connected to which fitting).

The connecting hose can be tightened by hand but if a wrench is used avoid overtightening which might damage the brass fittings. On the bulkhead fittings particularly it is a good practice to use a wrench to steady the bulkhead fitting to keep it from turning while tightening the hose connecter. In this respect it is also important to stabilize the bulkhead fitting to avoid twisting the internal tubing connected to the fitting.

6. Connect the length of exhaust hose to the exhaust bulkhead fitting by sliding the attached nut and ferrule onto the exhaust tubing and then reattach to the fitting. The nut need only be finger tightened. The free end of the tubing should be routed to an exhaust or fume hood.

7. As a final step of installation again visibly inspect the unit for any apparent damage which may have occurred in transit. Particularly before any pressure is applied to the chamber, remove the thumb

nuts attaching the cover to the chamber and remove the cover. With a high quality lens tissue clean the sight glass (sapphire) thoroughly and hold it up to a strong light source to inspect for any possible fracture lines. If ever there is any question about the structural integrity of the sight glass or any parts of the pressure chamber notify Ladd Research before proceeding. With the cover off, inspect the "O"-ring chamber gasket to insure it is properly seated, clean and of the proper type for the transitional fluid being used (see Section 9).

If everything is in order, replace the cover and the thumb nuts. The nuts should be tightened gradually by degree so as to avoid uneven force on the cover plate. A snug, finger tight fit is desirable.

SECTION 4

PRE-OPERATION CHECK-OUT
(The following discussion assumes that CO_2 is being used as the transitional fluid)

After all attachments have been inspected and properly installed as described in Section 3, INSTALLATION, the unit is now ready for a trial operation.

1. The exhaust tubing should be vented to a fume hood or similar exhaust system.

2. Drain, Fill and Vent valves should be closed.

3. Turn main power switch to ON in order to illuminate the chamber and begin valve heating cycle, 10-15 minutes prior to filling chamber.*

4. Open the main valve on the tank of CO_2 briefly just to charge the connecting hose with pressurized gas and then close that valve. Inspect the fitting connections at the tank and CPD ends

for obvious hissing or the tell-tale white gas associated with expanding CO_2. If the fittings are not tight enough, leakage will most likely be apparent immediately. If a fitting leaks, tighten as before but avoid over tightening which may damage fittings. If there are no leaks, proceed to the next step.

5. With the supply tank main valve still closed, open the CPD Fill Valve which will allow only the gas in the supply line to enter the chamber. The pressure meter should register the surge of gas which has just entered the chamber. Again inspect for leaks and correct any before proceeding.

6. If all fittings are tight, open the Vent Valve and vent the chamber so that the pressure gauge reads zero.

Following the previous steps allows the user to insure that all valves and fittings are functioning at low pressure prior to charging the chamber to full pressure. We now recommend operating the CPD at full pressure in a trail run without a specimen. This will serve to acquaint the user with the unit and at the same time confirm that all the systems are working at operating conditions following transit.

1. Close the Drain Valve, Open the Vent Valve and lightly open the Fill Valve to allow the compressed gas to begin entering the chamber. With the Vent Valve open, the gas will stream through and adiabatically cool the chamber. In order to see the liquid you may have to experiment with a ratio of closing and opening the Vent Valve. Once the chamber has cooled below the ambient temperature the liquid compressed gas will readily enter the chamber. Allow the chamber to cool to 15-20°C. At this point close the Vent Valve and allow the chamber to fill one-half to three-quarters full with CO_2.

2. Close the fill valve and move the power switch to heat. Left-hand amber pilot light will light up. It will take several minutes for the chamber temperature to increase appreciably depending on the temperature reached during the cooling cycle. Monitor the increase on the pressure and temperature gauges. This trial will be an excellent opportunity to confirm the pressure and temperature safety set-points. The pressure set-point of 1300±10% psig normally will be reached before the temperature set-point of 42°C.

3. Monitor the pressure gauge closely as the pressure approaches the 1300 psi mark. At the pressure set point, heating will be interrupted and the red heat indicating light will go out. Carefully open the Vent Valve so that the chamber looses approximately 100--200 psi. The heating cycle should again start (red light comes on). Close the Vent Valve. Again note the pressure at set point when the heating cycle stops. If both pressure readings agree and are within 1300±130 psi proceed to the next step. If not and the pressure set point is not reached by 1450 psi, contact Ladd Research. See Section 7.

4. Once the pressure has reached the 1300 psi mark, open the vent valve slightly so that the chamber is vented just enough to keep the chamber pressure below the set point so that the heating cycle continues (red light stays on). If the chamber is not vented the pressure relay will continue to interrupt the heat cycle when the set point is reached. Increase the chamber temperature by allowing the heating cycle to remain on. When the chamber temperature reaches 40°C begin closely monitoring the temperature gauge. As the temperature increases you should note the point at which the heating cycle ends. This is the temperature set-point and can be manually adjusted on the back panel. (See Section 2). It was set at the factory at 42°±1°C.

   This is more or less an arbitrary point designed to be well above CO_2's critical temperature in order to avoid condensation of moisture on the specimen within the chamber and in general to insure that the transitional fluid passes through the critical point.

5. If both set points check out satisfactorily, leave the heating cycle on and vent the chamber so that pressure is reduced at a rate of 100 psi per minute. This is the rate recommended during an actual specimen trial. The viewing port should be removed only after the pressure gauge reads zero. Then, as a precaution, loosen the thumb nuts but do not remove them until the port cover is loosened from its seat and there is positively no pressure remaining in the chamber.

   Upon initial receipt of the instrument several trial cycles of cooling, filling, flushing, heating and venting of the unit should be completed. This will serve to "clean out" any contamination which might be present in the new dryer and new installation and will further serve to acquaint the user with the operation.

   Following satisfactory completion of these trials the CPD unit is now ready for dehydration of an actual specimen.

*NOTE: The Vent, Fill and Drain Valves are heated when the main power switch is on. This is to avoid a potential freeze-up of the valves which are cooled as compressed gases expand and pass through them rapidly. The vent valve is particularly susceptible to excessive cooling due to the relatively large volumes of compressed gas which flows through the valve during flushing and venting.

To best use this heating facility, the operator should turn the main power switch on (vent heaters activated) approximately 10-15 minutes prior to actually filling the chamber. As with most preparatory techniques experience with the specific sample and this CPD unit will dictate the optimum warm-up time.

SECTION 5

OPERATION

A. Set-up

1. Set-up and pre-cool instrument as described in Pre-Op instructions, Section 4.

2. Drying chamber is now ready for the previously prepared sample which should now be promptly inserted into the chamber for flushing and drying.

B. Flushing Specimen

1. The sample is placed in the appropriate specimen holder which is then placed onto the specimen carrier shelf and inserted into the Drying Chamber. The viewing port is replaced and tightened as previously discussed.

2. Close the Vent Valve and partially open the Fill Valve to slowly fill the chamber. Vent momentarily if necessary to allow the chamber to fill.

3. Flush the solvents from the sample by one of the following methods:

a) Fill the drying chamber and let the sample "soak" for a few minutes. Partially open the Drain valve in order to lower the liquid level to just above the upper surface of the specimen. The specimen should remain completely submerged at all times. Repeat the soak-drain-refill cycle until the exhausting gas is free of the intermediate solvents. This may take 5-6 cycles or may have to be determined empirically with each specimen type. The formation of "fog" during venting following passage through the critical point indicates the recondensation of solvents and the need for more thorough flushing.

b) Run a continuous stream of liquid in the Fill Valve and out the Vent Valve. Frozen liquid snow balls will be noted flying out from the end of the exhaust hose if the flow is significant; however avoid excessive flow rates which may be injurious to the specimen or excessively cool the valves and tubing and lead to exhaust blockage.

c) Critical Point Drying of the Flushed, Solvent Free Sample

1. With samples totally liquid covered and all valves closed, turn power switch to Heat. Chamber should

be at least 1/2 - 3/4 full of liquid. Apparent "boiling" of the transitional fluid being heated within the chamber is of no concern as this does not normally produce specimen damage or disruption.

2. As the Drying Chamber heats up the pressure will also rise. As the pressure approaches 1300 psi it will be necessary to open the Vent Valve slightly to prevent the pressure cut-off from terminating the Heat cycle. By careful adjustment of the Vent Valve, the pressure can be maintained just below the set-point in order that the temperature can rise smoothly upward to 42°C.

3. At 42°C all the liquid has been converted to gas and the Vent Valve can be opened to lower the pressure at a rate of approximately 100 psig per minute. Avoid venting at a rate that causes the temperature to drop appreciably or liquid condensation on the sample may result in sample deformation.

4. When the pressure gauge indicates zero, turn main power switch to off. Open Vent and Drain Valves, loosen the three thumb nuts and remove the viewing port as previously discussed to assure than no pressure remains.

5. Remove the specimen holder from the chamber. The sample is now ready for mounting and further processing (coating) for examination in the electron miscroscope.

NOTES:

1. "Fog" in the chamber during venting of the actual CPD cycle indicates either the presence of solvents (H_2O, alcohol, amyl acetate, etc.) or that a too rapid venting of the chamber has caused the gaseous transitional fluid to cool and condense to liquid again. Since any liquid condensation upon the dried or semi-dried sample can cause damage, this is to be carefully avoided. If, upon bleeding off the gas, the chamber appears to cloud up, consider refilling and reflushing the sample if it is a rare or hard to obtain specimen. Although not desirable, many materials will tolerate such treatment.

2. If the extraction of solvents has been insufficient, increase the number of "soaking" cycles or increase the flow times on a new sample.

3. Only high quality intermediate fluids should be used. When ordering these gases, specify "bone dry" CO_2 or high grade "Freon 13" to be free of impurities. A dry run with clean transitional fluid only and no sample should be able to pass through the

critical point drying procedure with no evidence of fogging.

4. Avoid excessive flow rates when using the Drain Valve as blockage of the vent line by dry ice may occur. Such blockages may produce loud reports when the dry ice breaks free or may actually rupture the vent tubing.

SECTION 6

SPECIMEN PREPARATION

While some specimens can be successfully critical point dried without the necessity of prior fixation, most are better stabilized by using one or more of the common fixatives such as osmium tetroxide and glutaraldehyde. Of the two, O_sO_4 probably is used more often.

As a guide O_sO_4 and glutaraldehyde are normally used in aqueous solutions of 1-4%, but the optimum procedure for a specific sample (concentration and duration) will have to be determined empirically. Once fixed, the specimen is ready for dehydration.

If Freon is being used for CPD, the two suggested series are water-alcohol and then alcohol-Freon TF (Freon 113). If CO_2 is being used, the two suggested series are water-alcohol and then alcohol-amyl acetate. In choosing between the Freon method of CPD as opposed to the CO_2 method, the following information should be considered:

Freon 13 tends to be more expensive and also is under considerable criticism as an atmospheric pollutant. Freon 13 can, however, tolerate more intermediate fluid carry-over than can CO_2; therefore, less flushing is needed. Emitted vapors of Freon 13/Freon TF may have less immediate toxicity than CO_2/amyl acetate. Generally, the end results in drying are essentially the same.

The complete dehydration series for CPD according to the Freon method is a graded series of water-alcohol and a second graded series of alcohol-Freon TF. If the material is small (i.e. 2-3 mm^3), steps of 30%, 60%, 90% and two final 100% steps may be used, with about 10 minutes in each exchange. Larger material will require finer steps (i.e. 10%) and or longer times for exchange. In using the alcohol-Freon TF series, note that Freon TF is extremely dense. If the material is not in a closed container, it will seemingly "float" regardless of the amount of time in each step. By carefully noting that the material is just hanging below the surface and not floating, the exchange in that step may be considered complete.

In exchanging material according to the CO_2 method, the first series is water-alcohol, and the second is alcohol-amyl acetate, with the same degree of steps as described in the Freon method.

After the material is in 100% of the final intermediate fluid, the next operation is to quickly transfer the sample to the drying chamber of the critical point dryer.

COMMENTS ON HANDLING SPECIMENS

1. To effectively handle suspensions, microscope grids are best used. A holder to handle carbon filmed grids is available as an accessory. The material should be pipetted onto the film. A faintly turbid solution should be used with experience ultimately dictating how thick a suspension should be used. The material is then dehydrated and carried through the critical point.

2. To handle small particles either place the material between two membrane filters in an appropriate holder, or form a funnel from a piece of filter paper, fold over the top and staple shut. The entire package may then be dehydrated and critical point dried with the material being removed afterwards by "dusting" it off using a fine brush.

3. Cultures on Agar can be handled directly in one of the fine mesh baskets supplied.

4. Cultures on coverslips are best handled in a coverslip holder, available as an accessory.

5. Larger specimens can be handled directly in one of the baskets which were supplied.

6. Mounting the specimen on a SEM stub for critical point drying is not recommended. In all probability the solvent action of the intermediate and transitional fluids will dissolve the adhesive and result in contamination. Instead, first critical point dry the material and then mount it.

7. Most lipid material will not withstand the CPD technique, as the solvents remove the waxes. The best alternative is freeze-dehydration.

SECTION 7

SAFETY FEATURES

The Ladd Critical Point Dryer includes the following features which provide a high degree of user safety.

1. PRESSURE SWITCH. Cuts power to chamber heater at 1300 psig ± 10%. This eliminates build up of high pressures beyond that necessary for the critical point technique. The 1300 psi point is designed for the upper limit of the pressures utilized with CO_2. With Freon, for example, the critical pressure is much lower so that the 1300 psig point would never be reached. This setting is fixed at the factory and should not be adjusted by the operator.

2. TEMPERATURE SET POINT. Factory set at 42°C. Cuts power in the chamber heater when the temperature reaches the set-point which also eliminates excessive, unnecessary pressure build up. The set-point can be adjusted by the user by turning the set point adjustment on the rear panel. (See General Description, Section 2). Again the 42°C setting is for CO_2. Should the researcher be using Freon he may wish to lower the set point.

3. RUPTURE DISC ("safety valve"). Internally fitted and designed to rupture at 1800 psi at 25°C should the chamber pressure reach that pressure. The user should never tamper with the rupture disc without prior approval from Ladd Research.

4. OPERATOR MONITORING. It is of paramount importance that a trained operator, who is thoroughly versed in CPD techniques, be present to monitor the operating unit at all times.

5. FAIL-SAFE SYSTEM. If the operator constantly monitors the pressure and temperature gauges, it is virtually impossible for an excessive pressure to build up in the chamber without the operators knowledge. The pressure switch and the temperature set point both function to limit those pressures should the operator fail to control the temperature and pressure. In addition, the 1800 psi rupture disk would release in the event of pressure switch, temperature and operator failure. It should be noted that all of these safety features function independently of one another and therefore give the operator an extremely high degree of operational safety.

6. Electrically, the unit if fully fused and grounded.

7. The sapphire viewing port is constructed from the highest quality material available for this service and has a bursting strength of 12,000 psi.

SECTION 8

IMPORTANT NOTE

CHECKING THE SAFETY CUT-OFF POINTS

We strongly recommend that a periodical check be made of the CPD instrument to insure that both the pressure and temperature cut-offs are functioning properly. This test should be performed relative to the degree of use given the unit. That is, at least once a month and if the unit is used for several trials each day, once a week is not too often.

For the test, simply fill the chamber approximately three-quarters full of transitional liquid, observing all the safe operating steps discussed previously in this manual. Start the heating cycle and allow the pressure to rise to the 1300 psi point. Confirm that the heating cycle actually cuts-off at or near the 1300 psi mark. Next by judicious venting, allow the temperature to rise to the 42°C set-point and confirm whether or not the heating cycle is terminated at that point. If either cut-off feature fails to function properly refer to Section 7. If all works well, continue routine operation with peace of mind.

SECTION 9

THE PROPER USE OF "O"-RINGS

It is important that the O-rings used as chamber gasket seals, which may come in direct contact with transitional fluids, be selected with care. In addition to the fact that O-rings should be properly sized for their application, they should also be manufactured from a compound which will properly resist the various solvents and solutions to which they may be exposed. It is not uncommon for an O-ring forming a chamber seal to absorb transitional fluids and be distorted by swelling. This distortion can lead

to further damage to the swollen O-ring when the cover is attached, or even worse, produce a seal failure which may lead to leakage under pressure. A slight leak at 50 psi may be noted with minimal alarm but a spontaneous leak at pressures of several hundred psi have a decided, unnerving effect on the operator. A real problem in using swollen or distorted O-rings is the difficulty in correctly placing the O-ring in its groove so that it is not pinched or cut during placement of the cover. And, an improperly seated O-ring may hold a seal at low pressures but fail at higher pressures. In addition to an unexpected audible rush of air, the quick release of even the small volume of gas at a pressure of several hundred psi can move small loose items such as tweezers and beakers in such a manner to present at the least a potential eye hazard to researchers in the immediate vicinity. We recommend that O-rings be examined following each trial for distortion and damage. Damaged or swollen O-rings should be replaced with new ones. Although some researchers use O-rings again after the swelling has reduced, we emphasize that only high quality defect-free gaskets be installed in order to insure a correct high pressure seal.

The following information describes the size and type of material recommended for use as a chamber gasket in the Ladd CPD:

REFERENCE: The Parker Seal Co.
2360 Palum Drive
Lexington, Kentucky 40509

1. For use with CO_2 in the presence of small amounts of acetone, water, amyl acetate, ethyl alcohol: Ethylene propylene, compound #E515-80 (mil. grade). Coded by presence of 2 yellow dots and one white dash painted directly on O-ring.

   OR Butyl, compound #B 612-70

2. For use with Freons: Neoprene, compound #C557-70.

3. Size: 1½" I.D.; 1-11/17" O.D. x 3/32" Thickness -- Parker #2-128.

SECTION 10

ADJUSTING THE VENT VALVE

Venting of the chamber is controlled by the two valve knobs marked VENT and VENT RATE located on the front panel (see Fig. 1).

The VENT valve is a stop valve designed to stop the flow of gas leaving the chamber when closed or to allow gas to be vented when opened. It is not, however, designed to accurately meter or control the rate of flow during the critical point technique; although, it is satisfactory for venting when flushing or adiabatically cooling the chamber.

To over come the lack of sensistivity of the stop valve, we have installed an in line metering valve marked VENT RATE which is designed to accurately meter or control the rate of flow of the vented gas. This allows the operator to precisely vent the chamber at the rate optimum for specimen preservation.

To reduce the vent rate, turn the VENT RATE knob clockwise (CW) and to increase the rate, turn the knob counterclockwise (CCW). For convenience and reproducibility of settings, the barrel of the knob of the metering valve is engraved with a vernier scale.

NOTE: The VENT RATE (metering) valve should never be used to completely stop the flow of gas as this may damage the precision stem and seat of the valve.

SECTION 11

TROUBLE SHOOTING LIST

NO POWER: Check the fuse and power source at the wall outlet. Check the power switch in the instrument. Begin wiring checks according to schematics.

ILLUMINATOR BULB BURNED OUT: Remove the cabinet as described in Section 10. Remove screw and twist bulb and pull out to remove from socket on side of pressure chamber. Replace according to parts list.

NO PRESSURE CUT-OFF: If pressure cut-off fails to operate before 1450 psi, Notify Ladd. DO NOT attempt to adjust.

NO TEMPERATURE CUT-OFF: Check setting adjustment as described in Section 2.

TEMPERATURE METER READS "ZERO" OR OBVIOUSLY LOW WHEN INSTRUMENT IS ON: Check resistance of thermistor probe PRI. Check temperature meter for proper voltage.

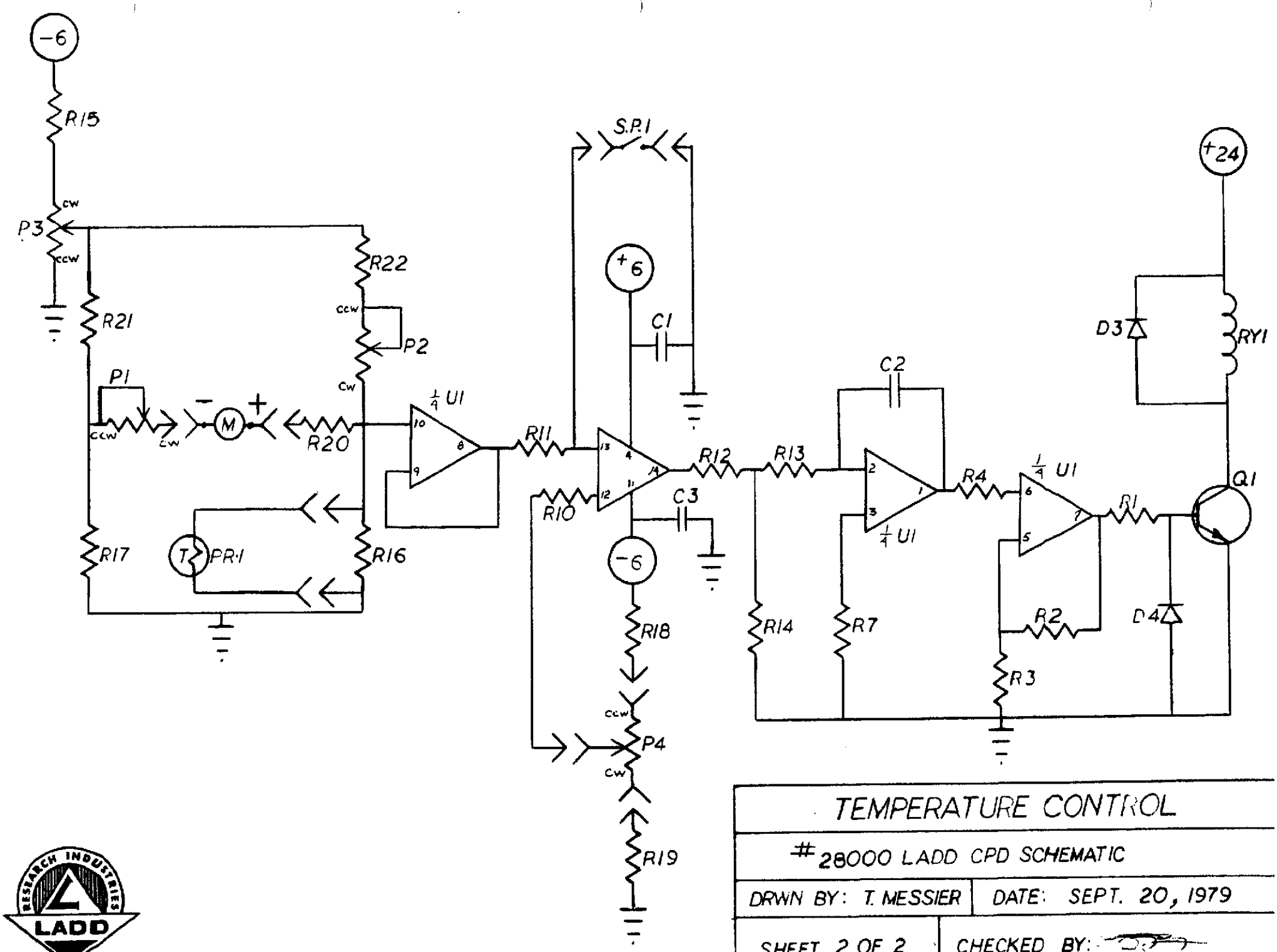
VIEWING PORT SIGHT GLASS CRACKED: Do Not Use. Contact Ladd.

RUPTURE DISC BLOWN: Obtain replacement and instructions from Ladd.

DRAIN, FILL, OR VENT VALVE LEAKS: This normally indicates that the seal within the valve has failed or that the valve has been overtightened. Field repair is not recommended. Contact Ladd.

NO HEATING OF SPECIMEN CHAMBER: Check continuity of heating tape. If open, contact Ladd. If OK begin wiring checks.

VIEWING PORT WILL NOT SEAL (GAS LEAKS): If the glass to metal seal has failed, contact Ladd for a replacement as this is not repairable. If not, look for a defective O-ring or defaced mating surface at the cover-chamber interface. A defective O-ring should be replaced. Contact Ladd concerning a defaced mating surface.

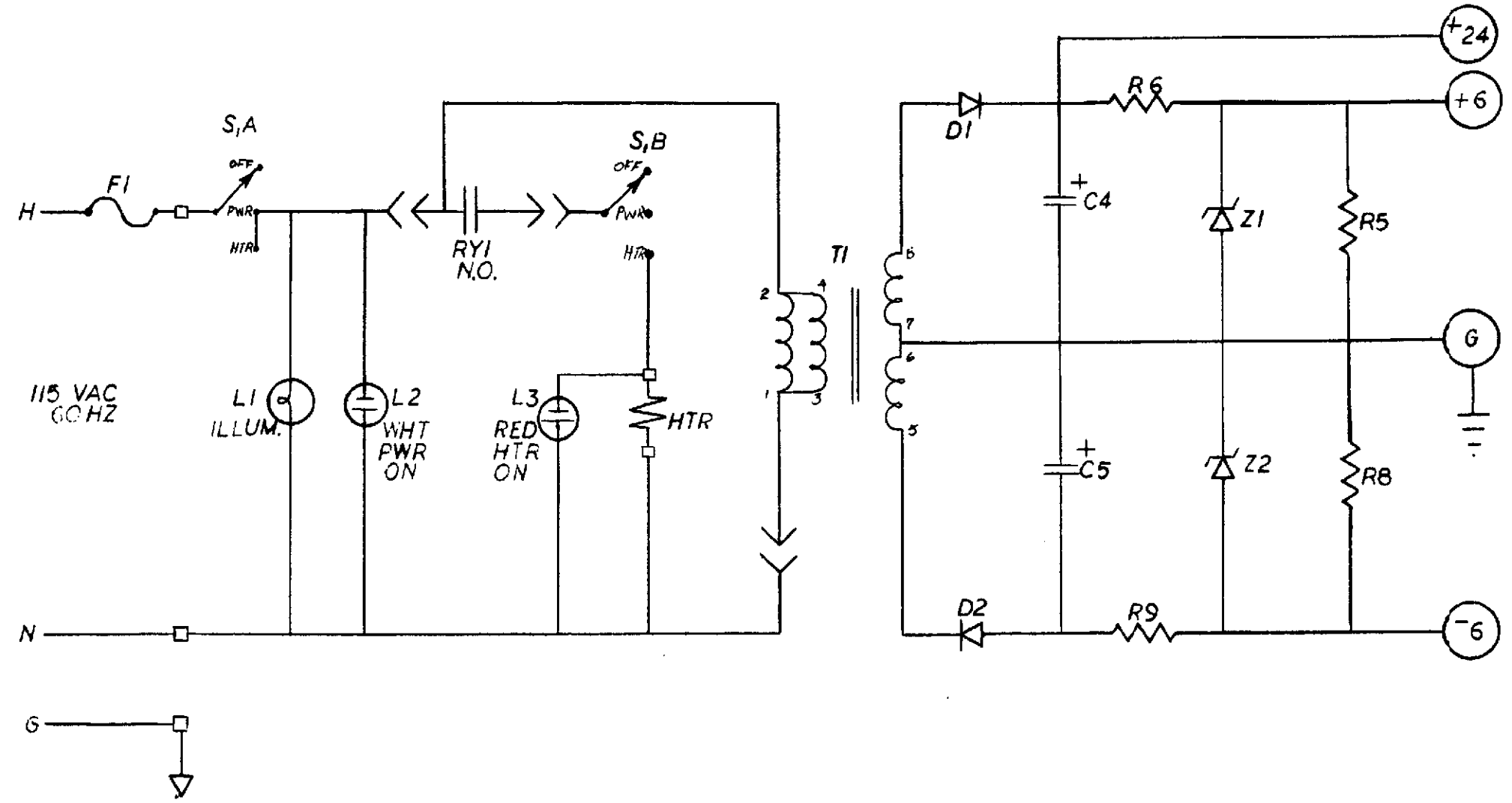


RESEARCH INDUSTRIES LADD

TEMPERATURE CONTROL

28000 LADD CPD SCHEMATIC

DRWN BY: T. MESSIER	DATE: SEPT. 20, 1979
SHEET 2 OF 2	CHECKED BY:



AC/DC POWER SUPPLY	
# 28000 LADD CPD SCHEMATIC	
DRWN BY: T. MESSIER	DATE: SEPT. 20,1979
SHEET 1 OF 2	CHECKED BY:

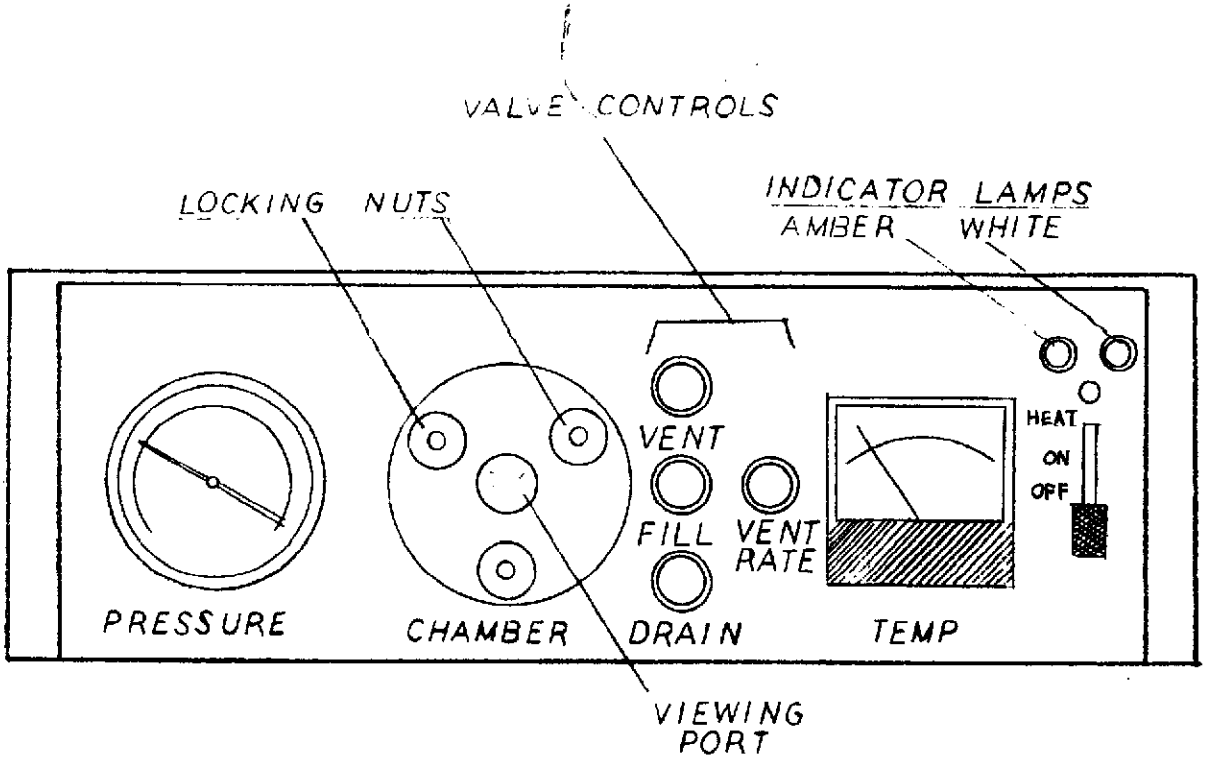

VALVE CONTROLS
LOCKING NUTS
INDICATOR LAMPS
AMBER
WHITE
VENT
FILL
VENT RATE
DRAIN
HEAT
ON
OFF
PRESSURE
CHAMBER
TEMP
VIEWING PORT

FIG. 1

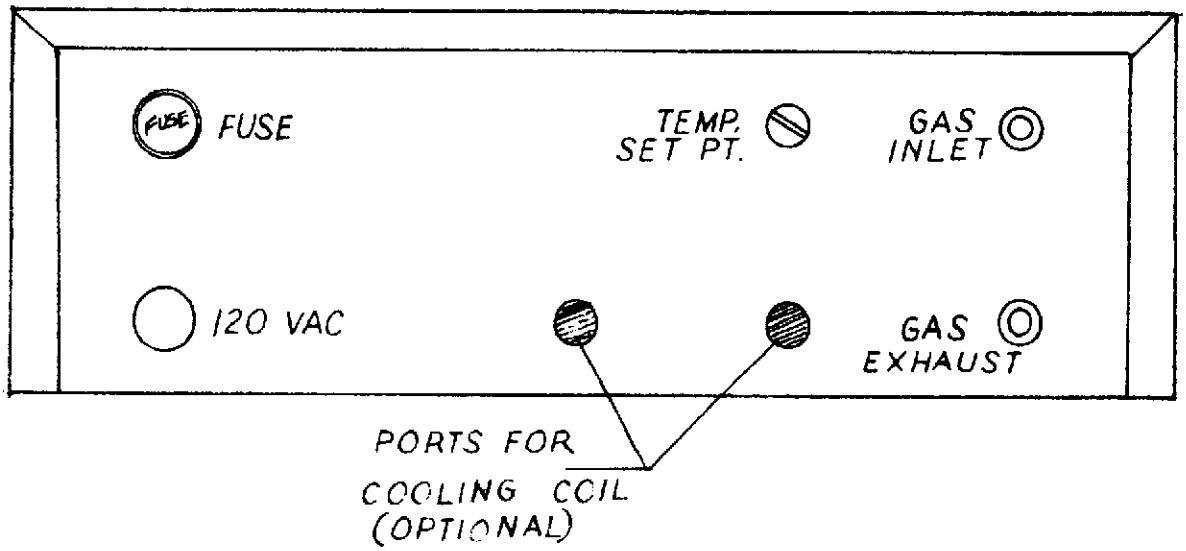

FUSE
FUSE
TEMP. SET PT.
GAS INLET
120 VAC
GAS EXHAUST
PORTS FOR COOLING COIL (OPTIONAL)

FIG. 2

LADD/CRITICAL POINT DRYER 5-1-84