053957
DESPATCH 900 SERIES
BENCH CHAMBER
INSTRUCTION MANUAL
REV. 3/90

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Despatch

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DESPATCH
BENCH CHAMBER

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I

GENERAL DESCRIPTION

The Despatch Industries Temperature Test Chamber permits component testing under either hot or cold temperature environments. A closed air flow system transfers heat to or from objects under test. The chamber is heated by a low-inertia coil heater and cooled by the injection and evaporation of a liquified gas. An advanced (Despatch RDC) control system holds chamber temperature to close tolerance.

A substantial variety of accessories and optional equipment are available for the test chambers; only the most frequently used models are described in this manual. Typical examples are control panels, test trays, test fixtures, rate-time programmers, and computer/buss interfaces.

Specification for test chamber models are given in data sheets at the rear of this manual.

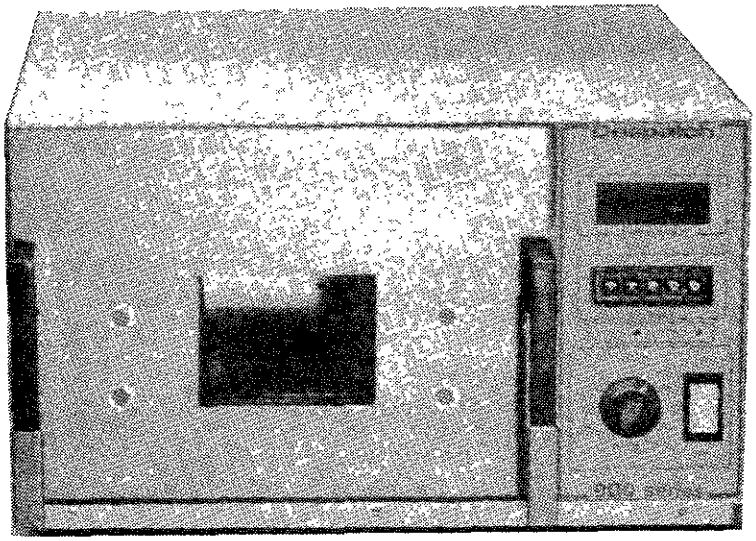


Figure 1

II

CONTROL OPTIONS

TEMPERATURE CONTROL

The Despatch RDC features a digital temperature set point switch and temperature display which is calibrated in degrees C, K or F. Refer to the enclosed electrical schematic and the instrument instruction manual.

HIGH AND LOW LIMIT CONTROLLER

This chamber may be equipped with a Honeywell Dialapak high and/or low limit controller. These instruments have an analog temperature set point dial calibrated either in °C or °F. Anytime the chamber temperature exceeds the limit set point, the control will trip, and conditioning will stop. Power will not be restored until the chamber temperature is within tolerance. Refer to the enclosed electrical schematic and the instrument instruction manual.

Note: If chamber is configured to accept the remote high and/or low limit controller, it will not operate unless either the limit controller or the jumper plug provided is installed.

III

OPERATION

The test chamber temperature is set and maintained by the control panel and control circuitry. This combination results in a constant, controlled, manually-selected chamber temperature. A Despatch DRP-13 Digital Rate Programmer can be added as an option to obtain a series of preset temperatures and time durations. Also available are computer interface buss accessories which allow the chamber to be controlled from a host computer.

In the event of a controller malfunction, the chamber and test object are protected by two overtemperature safety thermostat from excessive temperatures. Access to the object under test is provided by a test tray or fixture.

One of the overtemperature thermostats is adjustable and is located on the front panel of the chamber. The other overtemperature thermostat is factory calibrated and is mounted behind the chamber rear panel.

POWER CORD INSTALLATION

920 Series

These units are equipped with a 20 amp, 120 volt rated plug designed to be plugged with a Hubbell Model 5362, or equal, receptacle. This plug is required by the NEC and will provide necessary protection for this chamber installation.

930 Series

These units are equipped with a 30 amp, 120 volt rated plug designed to be plugged with a Hubbel Model 9308, or equal, receptacle. This plug is required by the NEC and will provide necessary protection for this chamber installation.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                WARNING                                *
*                                                                       *
* If your receptacle cannot accommodate these plugs, your wiring       *
* and/or receptacle must be upgraded to allow this plug to be used.     *
* If the plug is modified, this equipment will not meet code and        *
* could result in a wiring and/or receptacle overload. Failure to       *
* heed this warning can result in wiring and/or receptacle over-        *
* heating, fire and/or property damage, personal injury or death.       *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

230 VOLT, 50/60 HZ OPERATION

All 920 and 930 series units are designed for 115 volt, 50/60 hz. operation. An optional transformer kit is available to allow these units to be used on 230 volt power supply.

HEATING ONLY OPERATION

If the test chamber is to be heated only above chamber ambient, cooling gas supplies and plumbing are not needed. Operation of the chamber then requires setting the temperature control and overtemperature safety set-points. If the DRP-13 is to be used, refer to the controller instructions section included with these options.

1. Attach the test fixture or tray to the chamber.

2. Insure that the POWER switch is off.

3. Plug the chamber power cord to the correct line power receptacle. (See Power Cord Installation)

   Warning - Avoid adapters that will either unground the chamber or will permit connection to the wrong power source. Check the current rating of the circuit.

4. Set the TEMPERATURE SET-POINT control to the desired temperature.

5. Set the OVERTEMPERATURE SET-POINT control to a temperature that is higher than the desired chamber temperature but lower than a temperature at which the test object might be damaged.

6. Turn the POWER switch ON and allow the chamber to heat to the correct operating temperature.

7. Overtemperature thermostat function should be verified each time the chamber is started.

   Verify proper function of overtemperature thermostat by adjusting its setpoint lower than the chamber temperature. Power should be cut off to the heater(s) and fan motor(s).

   On chambers built between 8/86 (S/N 136665) and 12/89 (S/N 145355) an overtemperature trip requires manual reset by cycling the power switch.

   On chambers built after 12/89 (S/N 145355) an overtemperature trip or power outage requires manual reset by placing power switch to reset position.

Should a controller malfunction occur and the test chamber reach the adjustable overtemperature set point, the overtemperature thermostat will automatically cut off the line power to the heaters.

INSTALLATION OF COOLING GAS

If the test chamber is to be cooled below chamber ambient temperature, it is necessary to provide a source of liquified coolant gas. The type, quality, and handling of the gas is quite important as is the plumbing used to deliver the gas to the test chamber. Most test chamber operational problems 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, poor-ventilated areas.                           *
*                                                                       *
* Nitrogen and carbon dioxide as liquid or cold gases can cause         *
* freeze burns of the eyes and 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.

USE OF LIQUID CARBON DIOXIDE (CO_2)

Before purchasing or installing CO_2 gas supplies, insure that the test chamber is the correct model to use CO_2 (High 6205 KPA or 900 PSI or Low 2069 KPA or 300 PSI) and that the desired low temperature can be reached by use of this gas. The following special CO_2 requirements must be met:

1. The liquid CO_2 should be furnished by a reputable source, preferably one which furnishes coolant to laboratories, hospitals, etc.

2. The liquid CO_2 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" CO_2 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 CO_2 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 contaminates 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 CO_2 gas coolant are:

1. The interior of liquid CO_2 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 CO_2 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. All low-pressure CO_2 connecting hoses between the supply cylinder(s) and the chamber input valve should be kept as short as possible and should be insulated.

3. The low-pressure CO_2 supply line from the cylinder(s) should be removed prior to use and the line thoroughly dried for best results.

4. The hose connection may be cold after use. In this case, damp ambient air may collect or frost inside the hose. When the hose is connected to the test chamber, this frost is carried into the chamber input valve where a freeze-up may occur, or the frost may be carried directly into the test chamber to form ice crystals on the test object. The CO_2 supply hose must always be clean and dry.

   Note: After the hose is connected to the test chamber, the chamber shall be heated up to allow the moisture in the orifice to evaporate. This will prevent freeze up during the cooling cycle.

5. 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 substances which can jam the inlet valve or plug the valve orifice.

6. A filter is installed in the bulkhead fitting (CO_2 inlet or rear of chamber) and must be checked for cleanliness every 50 hours of operation, or oftener, if necessary. To remove the filter, unscrew the hollow Allen-head screw (item 7 in Figure 3) from the test chamber bulkhead fitting (item 5) and slide the filter (item 6) out of the fitting. Clean the filter in trichloroethylene and dry thoroughly using filtered, moisture-free compressed air at low pressure.

7. It is important that the CO_2 solenoid valve assembly and the orifice be kept clean. The orifice is carefully sized for each application; care should be taken not to ream it larger.

8. It is not possible to utilize all the CO_2 in a siphon-type cylinder. The ambient temperature at the cylinder will determine the amount of CO_2 available (about 95% of maximum). Thus, CO_2 usage may appear to be somewhat higher than it actually is.

WARNING

1. Never install CO_2 supply pipe fittings or valves of a larger internal diameter than those used "upstream" [beginning at the supply cylinder(s)].

2. Do not use fittings which allow undue expansion or restriction of the liquid CO_2. This could cause the CO_2 to reach a critical point where it would expand in the line and cause icing.

3. Do not use excessively long, small diameter supply hoses which might cause the liquid to change to gas in hot areas or during intermittent cycling conditions.

4. Do not meter the CO_2 through any type of valve that has a smaller ID than the supply hose and CO_2 supply cylinder siphon tube. The cylinder supply valve should be fully open during use.

5. The solenoid valve used to inject the CO_2 coolant into the test chamber should "pulse" or actuate rapidly. If the CO_2 valve remains open for long periods of time after pull-down, the chamber may be leaking cold, the test object may be introducing substantial amounts of heat beyond the capacity of the inlet valve orifice, or the temperature set-point may be set below -73.3°C (-100°F). These conditions can cause "snow" to be introduced into the chamber with resultant control problems and possible damage to the chamber and contents. Causes for these conditions should be located and corrected.

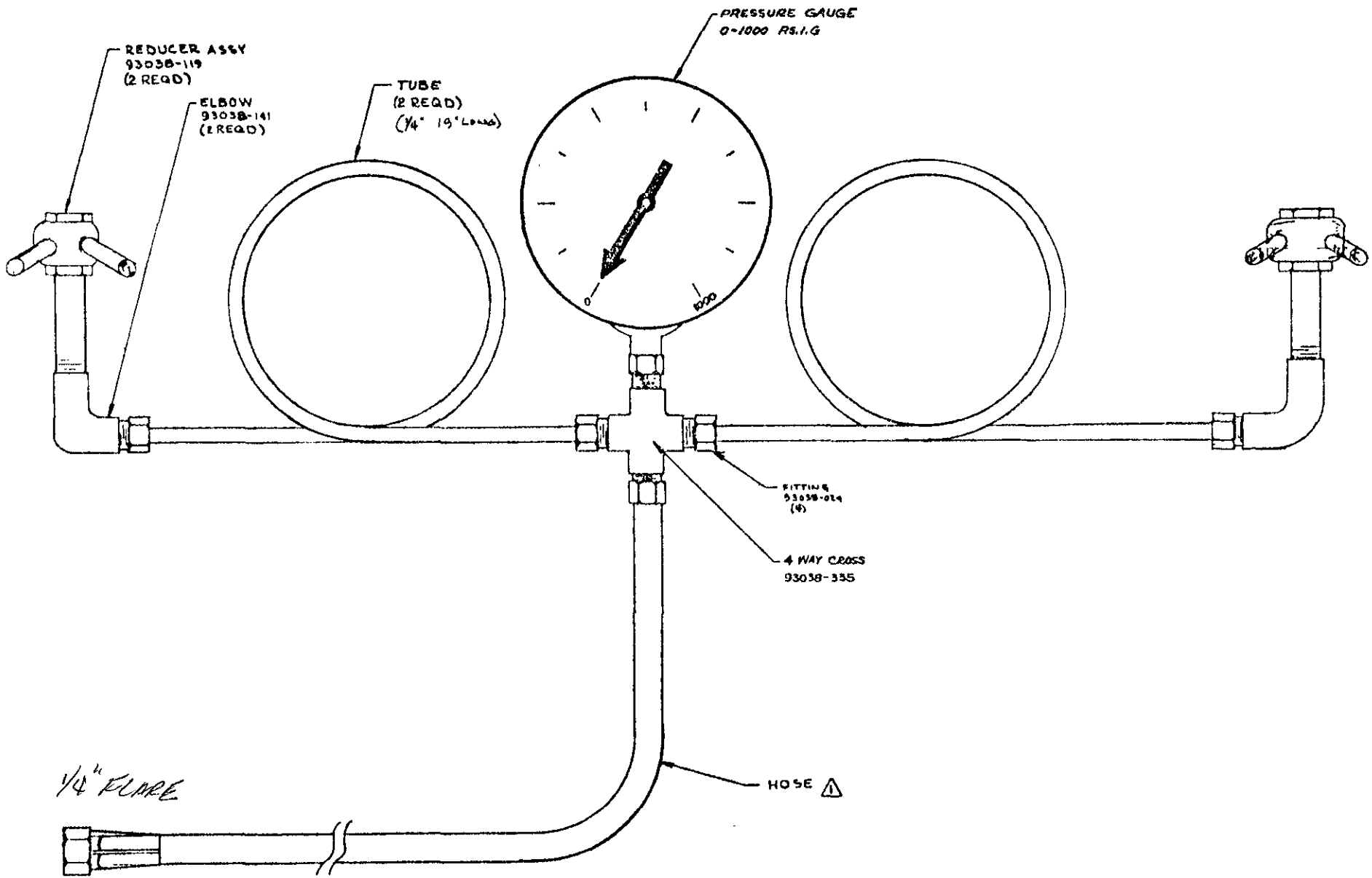


Figure 2. Connections of High or Low Pressure CO_2 Sources

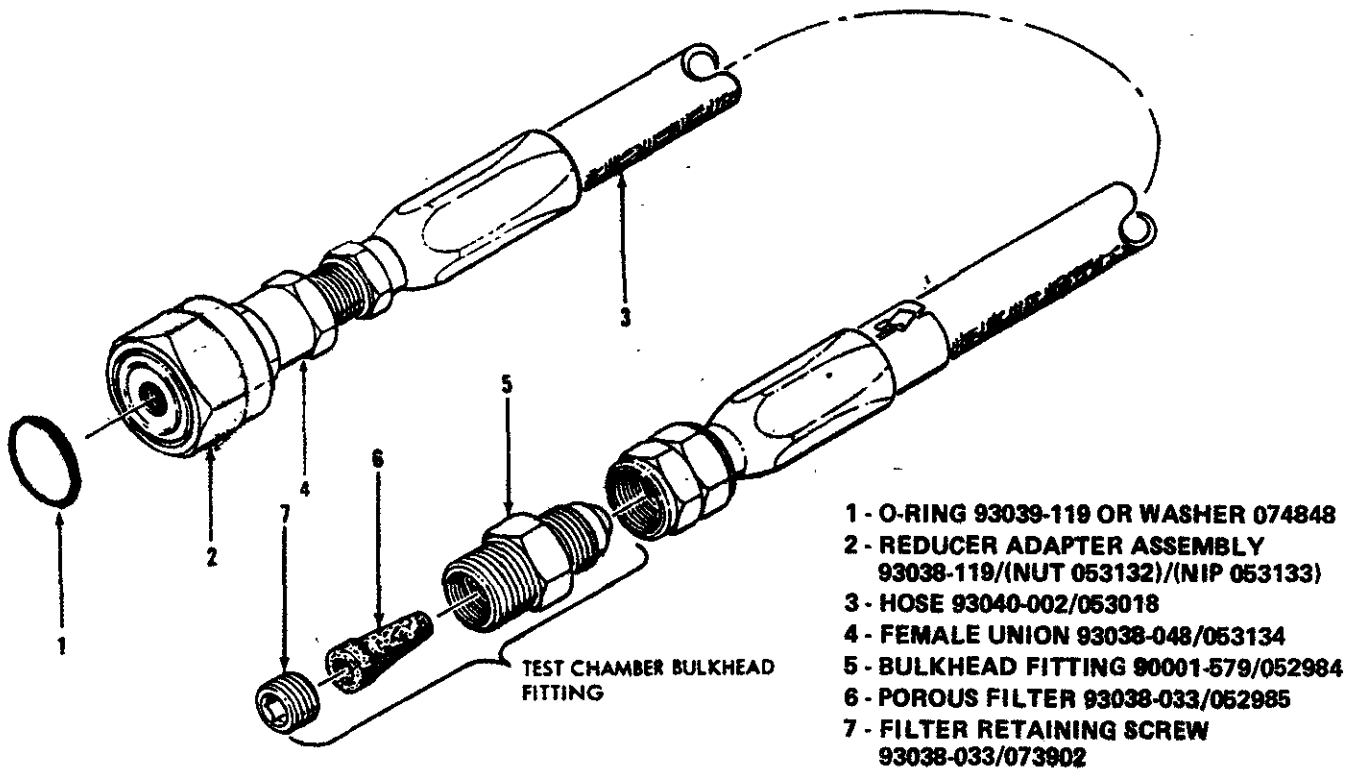


Figure 3. Filter Cleaning
(Typical CO_2 Reducer-Adapter Assembly)

INSTALLATION OF LIQUID CO_2 CYLINDER

For extensive use at low temperatures, it is recommended that two or more liquid CO_2 cylinders be used in parallel as shown in Figure 2. This will increase operating time between cylinder changes. Install the liquid CO_2 cylinder(s) as follows: (See Figures 4 and 5.)

1. Turn off POWER switch and disconnect AC input power.

2. Position the cylinder in a safe and convenient location. Secure the cylinder in an upright position with safety chains.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                WARNING                                  *
*                                                                         *
* Always use heavy safety chains to hold gas cylinders securely in       *
* an upright position.  A gas cylinder, damaged by hitting the            *
* floor, can become a dangerous projectile and cause serious damage       *
* or injury over a wide area.                                             *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

3. Carefully crack the cylinder valve slightly before connecting the hose assembly in order to blow out any loose scale or rust which may be in the cylinder.

4. Connect the hand wheel end of the hose assembly to the cylinder.

5. Connect the threaded fitting on the flexible hose to the threaded portion on the chamber bulkhead fitting. The bulkhead fitting must be held in place with a second wrench while the coolant hose is being attached to the bulkhead. See Figure 4.

6. When replacing the CO_2 cylinder, shut off chamber if controls calling for cool (see "Cool" LED on front panel). Shut off the valve at the cylinder, crack the hose fitting slightly, and allow the residual CO_2 pressure in the hose to bleed off before disconnecting the hose. Connect hose to new cylinder. Open cylinder valve. "Crack" the fitting at the bulkhead to bleed off gas and moisture. Turn chamber on.

USE OF LIQUID NITROGEN (LN_2)

Some models of test chambers use pressurized liquid nitrogen (LN_2) so that lower test temperatures may be reached. Line pressure should be between 55 kPa (8 PSI) and 310 kPa (45 PSI). The following precautions should be observed in handling LN_2:

1. Liquid nitrogen is extremely cold (-196°C or -320°F) at atmospheric pressure and can damage skin or eyes on contact.

2. Asbestos gloves and safety goggles or face plates should always be used in handling LN_2.

3. Clean cotton clothes or lab coats should be worn where LN_2 spillage or prolonged contact with its vapors is a factor.

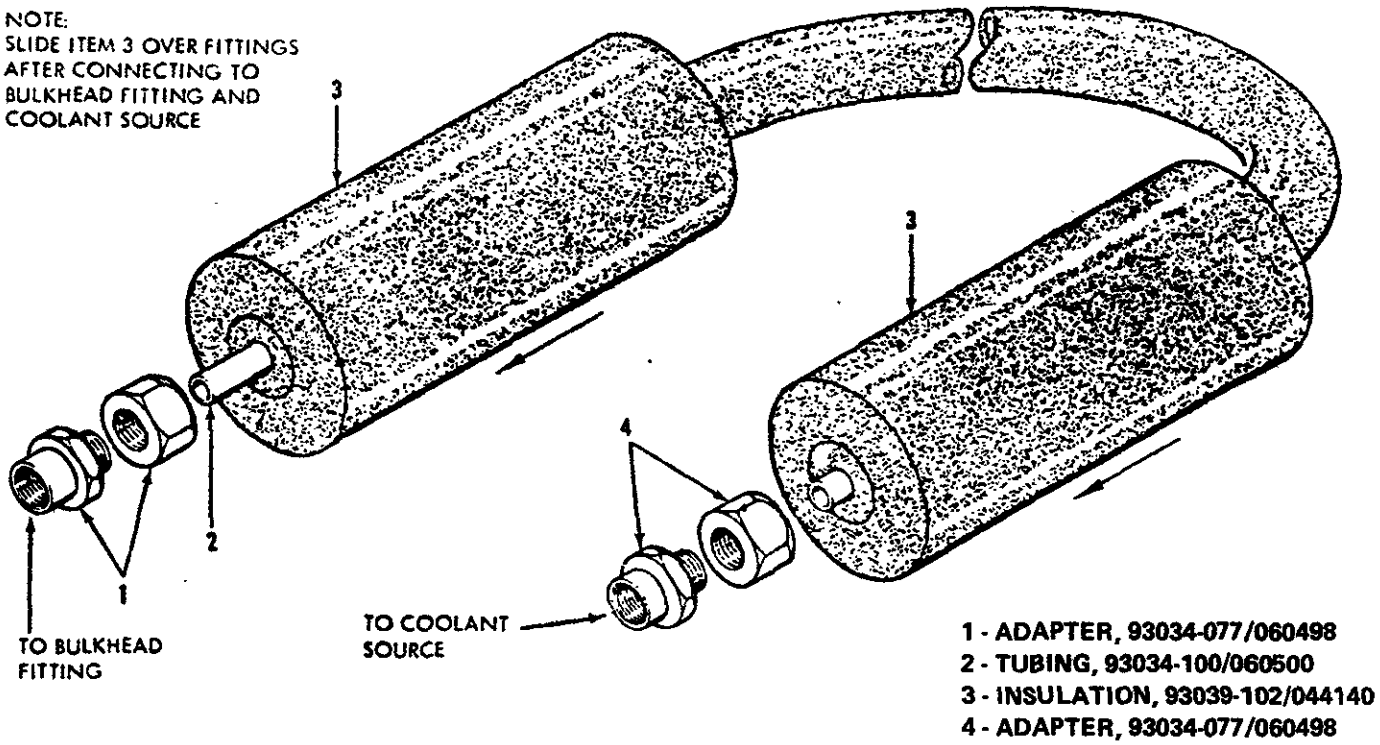


Figure 4. Typical Installation (Removal) of Coolant Hose to (from) Bulkhead Fitting

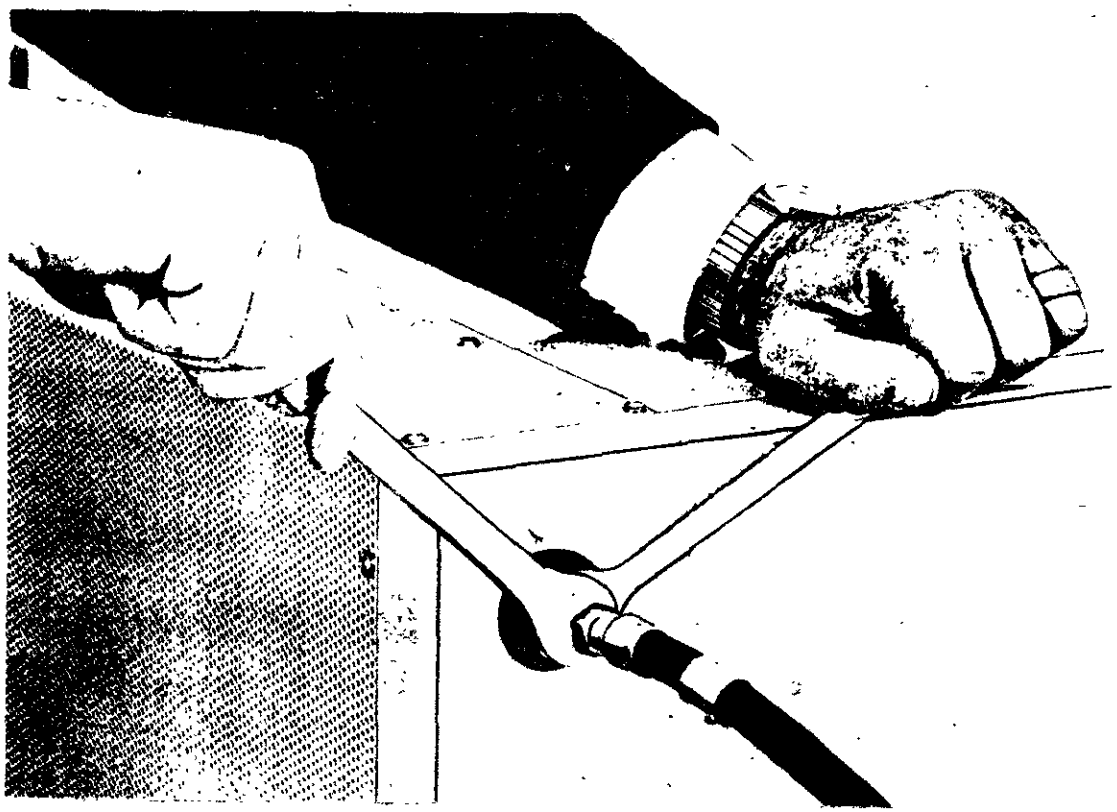


Figure 5. Liquid Nitrogen Hose Assembly

4. All handling equipment such as funnels, dewars, piping, and tubing must be clean, dry, and free of grease.

5. All transfer tubes, valves, and other equipment which reach liquid nitrogen temperatures should be properly insulated with a non-absorbent insulation which is properly contained within a vapor seal.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                WARNING                                  *
*                                                                         *
* 1. Liquid nitrogen is not in itself explosive or combustible;          *
*    however, its low temperature will cause condensation of the          *
*    water vapor in the air and all the gaseous constituents of the       *
*    air which liquify above -196°C (-320°F), including oxygen.           *
*    Therefore, supply lines, clothes, and equipment which are            *
*    subject to this temperature can absorb or liquify oxygen, which      *
*    will cause a severe fire if ignited and which can become             *
*    explosive when in contact with grease.                               *
*                                                                         *
* 2. Smoking should be prohibited in the immediate area where LN2 is      *
*    being handled.                                                       *
*                                                                         *
* 3. LN2 should not be left in sealed containers or hoses. When the       *
*    LN2 turns to nitrogen gas, it will build up very high pressure.      *
*    Unless LN2 is being actively used in test chamber operations,        *
*    care should be taken that an adequate vent is provided and that      *
*    excessive pressure is bled off.                                      *
*                                                                         *
* 4. The concentration of liquid oxygen suspended in the LN2 builds       *
*    up as the LN2 is used. Consequently, nearly empty LN2                *
*    containers should be handled as if they were liquid oxygen           *
*    containers. The presence of liquid oxygen in LN2 can be              *
*    determined by the milky appearance of the liquid. LN2 is             *
*    normally clear.                                                      *
*                                                                         *
* 5. If parts of the body are frozen by contact with these cold           *
*    liquids, first-aid treatment for frost bite should be given,         *
*    with slow thawing of the frozen parts. Severe cases should be        *
*    referred to a physician for treatment.                               *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

INSTALLATION OF LN_2 CYLINDER

The liquid nitrogen cylinder is connected to the test chamber by the hose assembly shown in Figure 5. To prevent ice crystals in the coolant line from entering the test chamber, an ice filter (optional) may be connected between the LN_2 cylinder and the test chamber as shown in Figure 6. The ice filter eliminates ice crystals and prevents them from freezing up valves or intruding into the test chamber. The ice filter should be cleaned periodically by a reverse purge using dry nitrogen. Install the LN_2 cylinder as follows:

1. Turn off POWER switch and disconnect AC power.

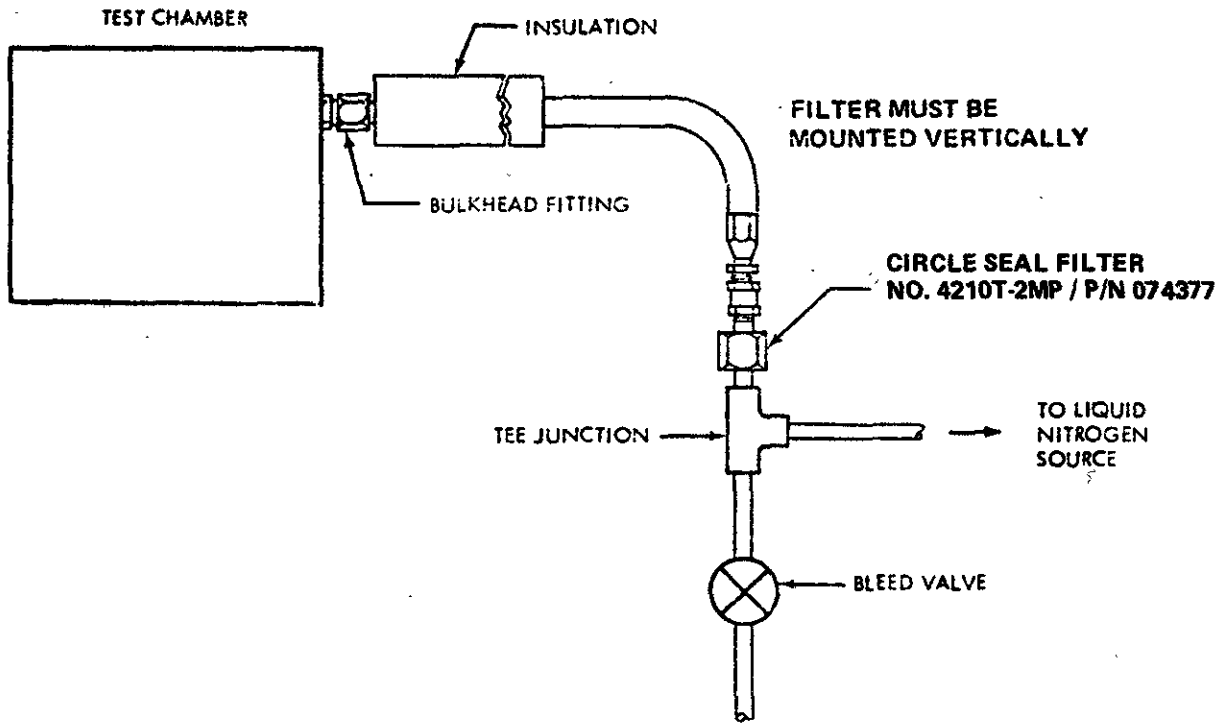


Figure 6. Liquid Nitrogen Ice Filter (Recommended)

2. Position the cylinder in a safe and convenient location.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                  WARNING                                *
*                                                                         *
* Store and use liquid nitrogen only in a well-ventilated area.          *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

3. Connect the cylinder to the test chamber as indicated. The large foam insulation sleeves (item 3 in Figure 5) are pushed over the fitting after the connections have been made. Use a second wrench as shown earlier in Figure 4 to prevent the bulkhead fitting from turning when the connection is being tightened.

COOLING OPERATION

Cooling operations with the temperature test chamber are essentially the same as those for heating operations. If the DRP-13 programmer is to be used, refer to the special instructions included with these options.

1. Attach the test fixture or tray to the chamber.

2. Insure that the POWER switch is off.

3. Plug in the chamber power cord to the correct line power. Avoid adapters that will either unground the chamber or will permit connecting to the wrong power source. Check current rating of circuit.

4. Set the TEMPERATURE SET-POINT to the desired temperature.

5. Turn the POWER switch ON and allow the chamber to cool to the correct operating temperature. The OVERTEMPERATURE SET-POINT control is not used during cooling operations.

A relief port has been included in the chamber to protect against excessive internal pressure.

The cooling system will operate efficiently only when there is no vapor lock in the coolant line. Vapor locks can be reduced by keeping the coolant cylinders and lines at the same temperature or by preventing the coolant lines from passing through areas of much higher temperature.

When the chamber is not in use, or when it is used for other than low temperature tests, the valves of the coolant cylinder(s) should be closed to prevent leakage.

After long periods of operation at low temperatures, a certain amount of moisture condenses inside the chamber in the form of snow and frost. Although the insulation in the test chamber is sealed against both internal and external accumulation of moisture, some moisture will eventually collect in the fiberglass insulation. The resulting loss in insulation efficiency tends to decrease cooling rate and increase coolant consumption. To avoid moisture collection in the insulation after sustained operation at low temperatures, the

test chamber should be operated for at least one hour at 205°C (400°F) to evaporate the moisture. Do not exceed this temperature with the cryogenic models which are insulated with high-temperature-resistant polyurethane (isocyanate) foamed-in-place resin. This insulation will be damaged if temperatures in excess of 205°C (400°F) are sustained.

SAFETY INFORMATION

Operating and burst pressures for various hose assemblies are given in Table A.

Component	Operating Pressure kPa²	Operating Pressure PSI	Burst Pressure kPa²	Burst Pressure PSI
CO_2	20,685	3,000	68,950	10,000
LN_2	310	45	2,586	375

TABLE A. OPERATING AND BURST PRESSURE

PERFORMANCE CHARACTERISTICS

Tables B through G list the performance characteristics for Ransco Industries test chambers. The tables are used topically as follows:

1. Find approximate temperature of test chamber in left-hand column.

2. Find temperature desired in second column from left.

3. Determine the CO_2 consumption from the right-hand column under CO_2 CONSUMPTION.

   Column AIR lists the amount of CO_2 needed to bring the air temperature in the test chamber to the desired degree.

   The AIR + WALLS column lists the associated amount of CO_2 needed to bring the air and the chamber walls to the desired temperature.

   Column RATE/HOUR lists the hourly rate of CO_2 consumption needed to maintain the low temperature.

   The CO_2 consumption in minutes may vary depending on the heat dissipated by the size and material of the test object.

4. Find the minutes needed to reach the desired temperature in the middle columns under MINUTES NEEDED TO REACH TEMPERATURE.

   Column AIR lists the time required for the air in the chamber to reach the selected temperature.

   The AIR + WALLS column lists the associated total time required for the air and walls to reach the selected temperature.

Figure 7 is a performance curve plotting blank. The data in the table for the appropriate test chamber model can be plotted for the temperature changes of interest to better visualize the chamber performance and to interpolate intermediate values.

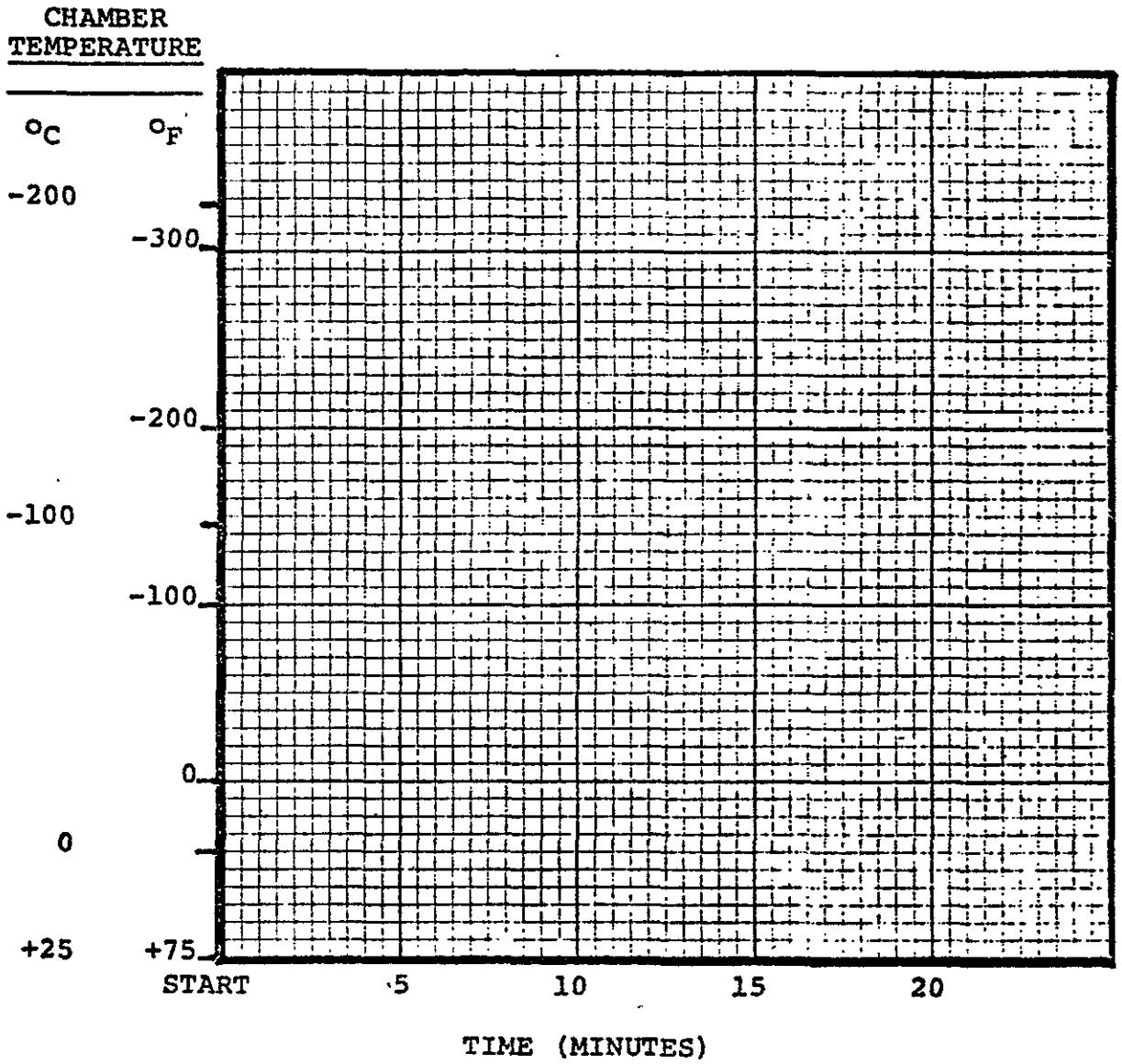


Figure 7. Performance Curve Plotting Blank

Temp. Set Points		Minutes Needed to Reach Temp.		CO_2 Consumption in Pounds (900 psi)		
°C	To	Air	Air + Walls	Air	Air + Walls	Rate/Hr.
+24 to -73	+75 to -100	4.0	13.0	5.0	5.5	8.5
+24 to -45	+75 to -50	3.0	8.0	3.0	3.5	8.0
+24 to -18	+75 to 0	.50	7.0	1.5	2.5	6.0
+24 to +38	+75 to +100	.75	5.0	---	---	---
+24 to +93	+75 to +200	4.5	13.0	---	---	---
+24 to +149	+75 to +300	9.0	18.0	---	---	---
+24 to +204	+75 to +400	13.0	23.0	---	---	---
+24 to +260	+75 to +500	17.0	27.0	---	---	---
+71 to -73	+160 to -100	7.0	12.0	7.0	7.5	8.5
+71 to -45	+160 to-50	6.0	10.0	5.0	6.0	8.0
+71 to -18	+160 to 0	5.0	10.0	4.0	5.0	6.0
+93 to +24	+200 to +75	4.0	8.5	3.0	3.5	4.5
+149 to +24	+300 to +75	5.0	10.0	5.0	5.5	4.5
+204 to +24	+400 to +75	7.0	12.0	6.5	7.0	4.5
+260 to -59	+500 to -75	10.0	13.0	10.5	13.0	8.5
+260 to -73	+500 to -100	16.0	19.0	12.0	14.0	8.5
-73 to +24	-100 to +75	6.0	9.0	---	---	---
-73 to +260	-100 to +500	22.0	32.0	---	---	---

TABLE B. PERFORMANCE CHARACTERISTICS, MODEL 925

Temp Set Points		Minutes Needed to Reach Temp.		LN_2 Consumption in Pounds		
°C	°F	Air	Air + Walls	Air	Air + Walls	Rate/Hr. C
+24 to -18	+75 to 0	3.75	7.0	2.5	3.0	10.25
+24 to -45	+75 to -50	4.5	8.5	3.5	4.0	11.0
+24 to -73	+75 to -100	6.0	10.0	4.0	5.0	12.75
+24 to -100	+75 to -150	7.0	11.0	6.25	7.0	15.0
+24 to -129	+75 to -200	8.0	11.5	7.5	8.5	17.5
+24 to -150	+75 to -250	10.0	12.0	9.0	10.5	18.0
+24 to -184	+75 to -300	12.5	15.0	10.5	14.0	20.0
+24 to +38	+75 to +100	1.5	3.5	---	---	---
+24 to +93	+75 to +200	3.5	6.0	---	---	---
+24 to +149	+75 to +300	7.0	11.0	---	---	---
+24 to +204	+75 to +400	12.0	23.0	---	---	---
+93 to -73	+200 to -100	8.0	11.0	6.0	7.5	12.75
+93 to -129	+200 to -200	9.0	11.5	9.5	12.0	17.5
+93 to -184	+200 to -300	13.0	16.75	14.25	18.0	20.0
+93 to +24	+200 to +75	6.5	9.0	3.5	4.0	---
+204 to -129	+400 to -200	15.5	18.0	13.5	15.0	17.5
+204 to -184	+400 to -300	17.5	20.0	19.0	20.0	20.0
-184 to +24	-300 to +75	13.5	16.5	---	---	---
-184 to +204	-300 to +400	19.0	35.0	---	---	---

TABLE C. PERFORMANCE CHARACTERISTICS, MODEL 935

Temp. Set Points		Minutes Needed to Reach Temp.		LN_2 Consumption in Pounds		
				Amount by Stages	Total	Rate/Hr.
°C	°F	A (Air)	Air + Walls	A (Air)	Air + Walls	C
+24 to -18	+75 to 0	2.0	0.9	1/4	3/4	6-1/4
+24 to -45	+75 to -50	4.5	11.0	1-3/4	2-1/2	7-1/2
+24 to -73	+75 to -100	5.0	12.0	2-1/4	3	8
+24 to -100	+75 to -150	6.5	13.0	2-3/4	4	9-3/4
+24 to -129	+75 to -200	7.0	14.0	4	4-3/4	10-3/4
+24 to -150	+75 to -250	8.0	14.5	5	6-1/4	12
+24 to -184	+75 to -300	8.5	15.0	5-1/2	6-1/2	13
+24 to +38	+75 to +100	1.0	4.5	--	--	--
+24 to +93	+75 to +200	3.5	16.0	--	--	--
+24 to +149	+75 to +300	10.0	30.0	--	--	--
+24 to +204	+75 to +400	12.0	41.0	--	--	--
+93 to -73	+200 to -100	6.0	19.0	1-3/4	3-3/4	8
+93 to -129	+200 to -200	8.0	22.0	3-1/2	5-3/4	10-3/4
+93 to -184	+200 to -300	9.0	23.0	5-1/2	9	13
+93 to +24	+200 to +75	2.5	10.0	3/4	1	--
+204 to -129	+400 to -200	11.0	24.0	7	10	10-3/4
+204 to -184	+400 to -300	13.0	26.0	8	11	13
-184 to +24	-300 to +75	3.5	13.0	--	--	--
-184 to +204	-300 to +400	8.0	50.0	--	--	--

TABLE D. PERFORMANCE CHARACTERISTICS, MODEL 934

Temp. Set Points		Minutes Needed to Reach Temp.		CO_2 Consumption in Pounds (900 psi)		
				Amount by Stages	Total	Rate/Hr.
°C	°F	A (Air)	Air + Walls	A (Air)	Air + Walls	C
+24 to -73	+75 to -100	4.0	11.0	2.4	3.8	5.0
+24 to -45	+75 to -50	2.0	8.0	1.9	2.8	4.5
+24 to -18	+75 to 0	1.0	5.0	1.4	2.7	4.0
+24 to +38	+75 to +100	0.5	3.0	--	--	--
+24 to +93	+75 to +200	2.0	12.0	--	--	--
+24 to +149	75 to +300	5.0	22.0	--	--	--
+24 to +204	75 to +400	8.0	26.0	--	--	--
+24 to +260	+75 to +500	12.0	32.0	--	--	--
+71 to -73	+160 to -100	6.0	21.0	3.6	6.4	5.0
+71 to -45	+160 to -50	4.0	14.0	2.2	4.2	4.5
+71 to -18	+160 to 0	2.0	8.0	1.8	2.1	4.0
+93 to +24	+200 to +75	2.0	11.0	1.1	1.4	--
+149 to +24	+300 to +75	3.0	18.0	2.2	3.1	--
+204 to +24	+400 to +75	5.0	38.0	3.0	4.5	--
+260 to -59	+500 to -75	7.0	52.0	4.0	6.7	--
+260 to -73	+500 to -100	12.0	67.0	8.3	10.5	5.0
-73 to +24	-100 to +75	3.0	8.0	--	--	--
-73 to +260	-100 to +500	20.0	45.0	--	--	--

TABLE E. PERFORMANCE CHARACTERISTICS, MODEL 924

Temp. Set Points		Minutes Needed to Reach Temp.		LN_2 Consumption in Pounds		
				Amount by Stages	Total	Rate/Hr.
°C	°F	A (Air)	Air + Walls	A (Air)	Air + Walls	C
+24 to -18	+75 to 0	3.0	12.0	1-3/4	3	5-1/4
+24 to -45	+75 to -50	5.0	13.5	3-1/4	5-1/4	8-3/4
+24 to -73	+75 to -100	6.0	16.0	5	7-1/2	12-1/4
+24 to -100	+75 to -150	7.5	18.0	7	9-3/4	15-1/2
+24 to -129	+75 to -200	8.0	20.0	8-1/2	12	18-3/4
+24 to -150	+75 to -250	10.0	22.0	10-3/4	15-1/4	22-1/4
+24 to -184	+75 to -300	12.0	24.0	13	18	25-3/4
+24 to +38	+75 to +100	1.5	9.0	--	--	--
+24 to +93	+75 to +200	4.0	20.0	--	--	--
+24 to +149	+75 to +300	9.0	38.0	--	--	--
+24 to +204	+75 to +400	16.0	53.0	--	--	--
+93 to -73	+200 to -100	10.0	26.0	6-1/2	11	12-1/4
+93 to -129	+200 to -200	15.0	31.0	13	19	18-3/4
+93 to -184	+200 to -300	18.0	36.0	19	26-1/4	25-3/4
+93 to +24	+200 to +75	7.0	19.0	2-1/4	3-1/4	--
+204 to -129	+400 to -200	18.0	47.0	17-1/2	26	18-3/4
+204 to -184	+400 to -300	22.0	50.0	22	33	25-3/4
-184 to +24	-300 to +75	13.0	22.0	--	--	--
-184 to +204	-300 to +400	28.0	65.0	--	--	--

TABLE F. PERFORMANCE CHARACTERISTICS, MODEL 936

Temp. Set Points		Minutes Needed to Reach Temp.		CO_2 Consumption in Pounds (900 psi)		
				Amount by Stages	Total	Rate/Hr.
°C	°F	A (Air)	Air + Walls	A (Air)	Air + Walls	C
+24 to -73	+75 to -100	4.00	20.00	6.0	10.0	9.0
+24 to -45	+75 to -50	1.75	13.00	3.0	5.5	7.0
+24 to -18	+75 to 0	1.00	6.00	1.4	1.5	5.0
+24 to +38	+75 to +100	0.75	4.50	--	--	--
+24 to +93	+75 to +200	4.00	22.00	--	--	--
+24 to +149	+75 to +300	6.75	45.00	--	--	--
+24 to +204	+75 to +400	11.10	64.00	--	--	--
+71 to +260	+75 to +500	16.75	82.00	--	--	--
+71 to -73	+160 to -100	4.30	21.00	7.5	13.0	9.0
+71 to -45	+160 to -50	3.50	18.00	4.5	9.0	7.0
+71 to 0	+160 to 0	1.75	14.00	2.7	7.0	5.0
+93 to +24	+200 to +75	1.80	10.00	2.0	9.0	--
+148 to +24	+300 to +75	2.00	18.00	2.5	12.5	--
+204 to +24	+400 to +75	3.00	26.00	6.5	15.5	--
+260 to -59	+500 to -75	10.00	43.00	14.0	23.0	--
+260 to -73	+500 to -100	12.00	50.00	15.0	25.0	9.0
-73 to +24	-100 to +75	3.25	32.00	--	--	--
-73 to +260	-100 to +500	20.00	120.00	--	--	--

TABLE G. PERFORMANCE CHARACTERISTICS, MODEL 926

IV

THEORY OF OPERATION

INTRODUCTION

This section contains a functional as well as a detailed circuit description of the temperature control circuits in all models of these temperature test chambers. See Figure 10 for block diagram and circuit diagram information.

FUNCTIONAL DESCRIPTION

The Despatch Industries Temperature Test Chamber uses a closed airflow system to transfer heat to or from objects under test. A low inertia electric coil heater is used for elevated temperatures in the chamber. Cooling of the chamber is accomplished by injecting liquid carbon dioxide or liquid nitrogen into the test chamber, where the coolant rapidly evaporates. The operating temperature of the test chamber is determined by the setting of the Set-point switches.

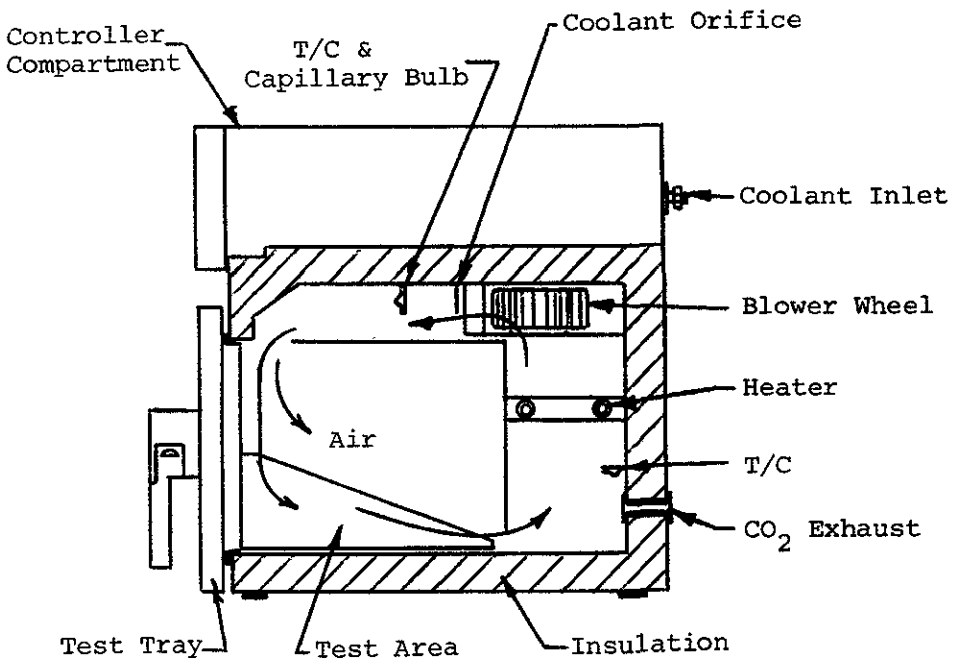


Figure 8. Air Flow in Temperature Test Chambers, Models 925 and 935

Temperature sensing elements in the chamber allow the control to automatically maintain the chamber temperature at the value indicated on the setpoint switches. A comparator circuit activates the heat or cooling as necessary.

The dual output control with non-adjustable dead-band ensures that only one function, heating or cooling, is in operation at any one time. This eliminates the possibility of the heat control circuit opposing the cool control circuit.

An overtemperature circuit protects the test chamber and test objects by removing power to heaters when the test chamber exceeds the maximum rating of the chamber (274°C).

An adjustable high limit allows the maximum operating temperature to be selected or varied for each test. This dial type unit will interrupt the power to the heater if the chamber temperature exceeds the high limit setting.

The detailed description of the temperature control circuits is similar for all test chamber models; therefore, only the temperature control circuit for Model 924 is discussed in detail.

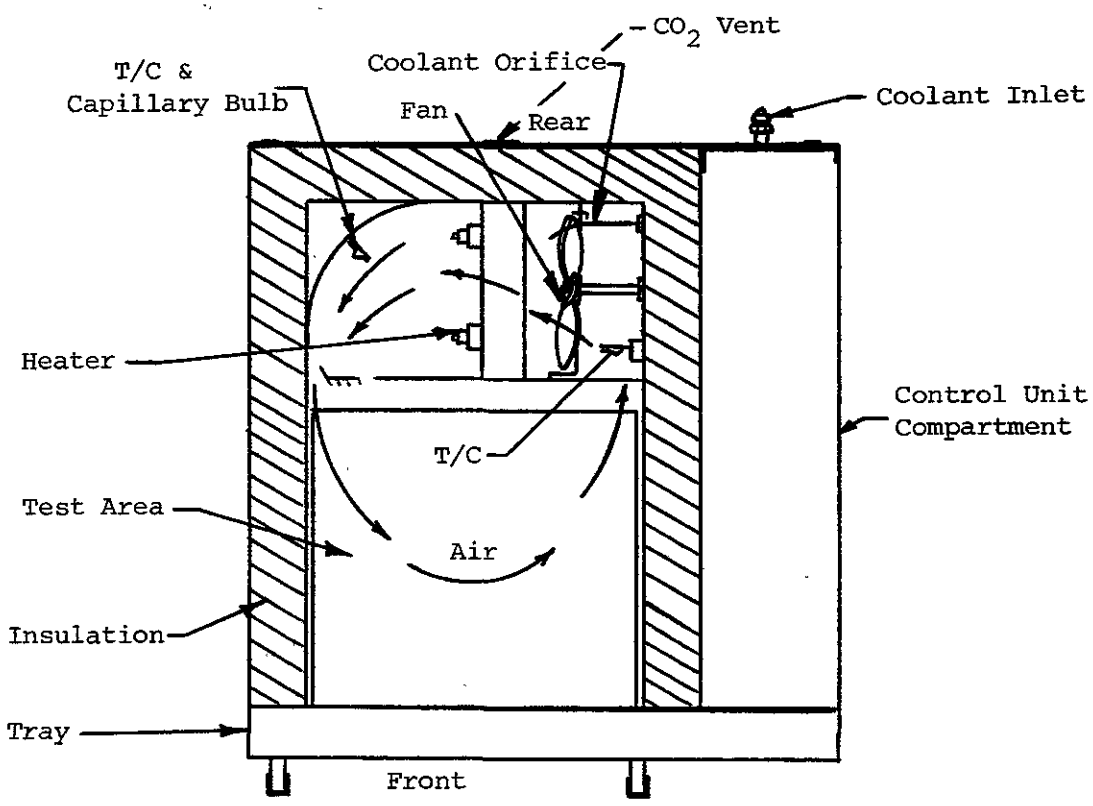


Figure 9. Air Flow in Temperature Test Chamber, Models 934 and 924 (Basically the same as in 936 and 926 which also have horizontal air flow)

Models 935, 934 and 936 use two additional heaters: HTR2 located under the opening gasket of the chamber and HTR3 located on the shaft bushing of motor B1. The 935 has an additional heater HTR4 located on the shaft bushing of the second motor B2. Heater HTR2 is controlled by thermoswitch S5, which is set at +10°F ±5°F.

The thermoswitch is located on the rear of the Transite liner and senses the door opening temperature of the liner and door opening frame assembly. The heaters prevent the test tray door from frosting excessively, the door seal from freezing at temperatures of -300°F. When the temperature test chamber is not being operated at extremely low temperatures, thermal switch S5 is open, disabling HTR2.

A factory set thermoswitch limits the chamber to the maximum chamber operating temperature.

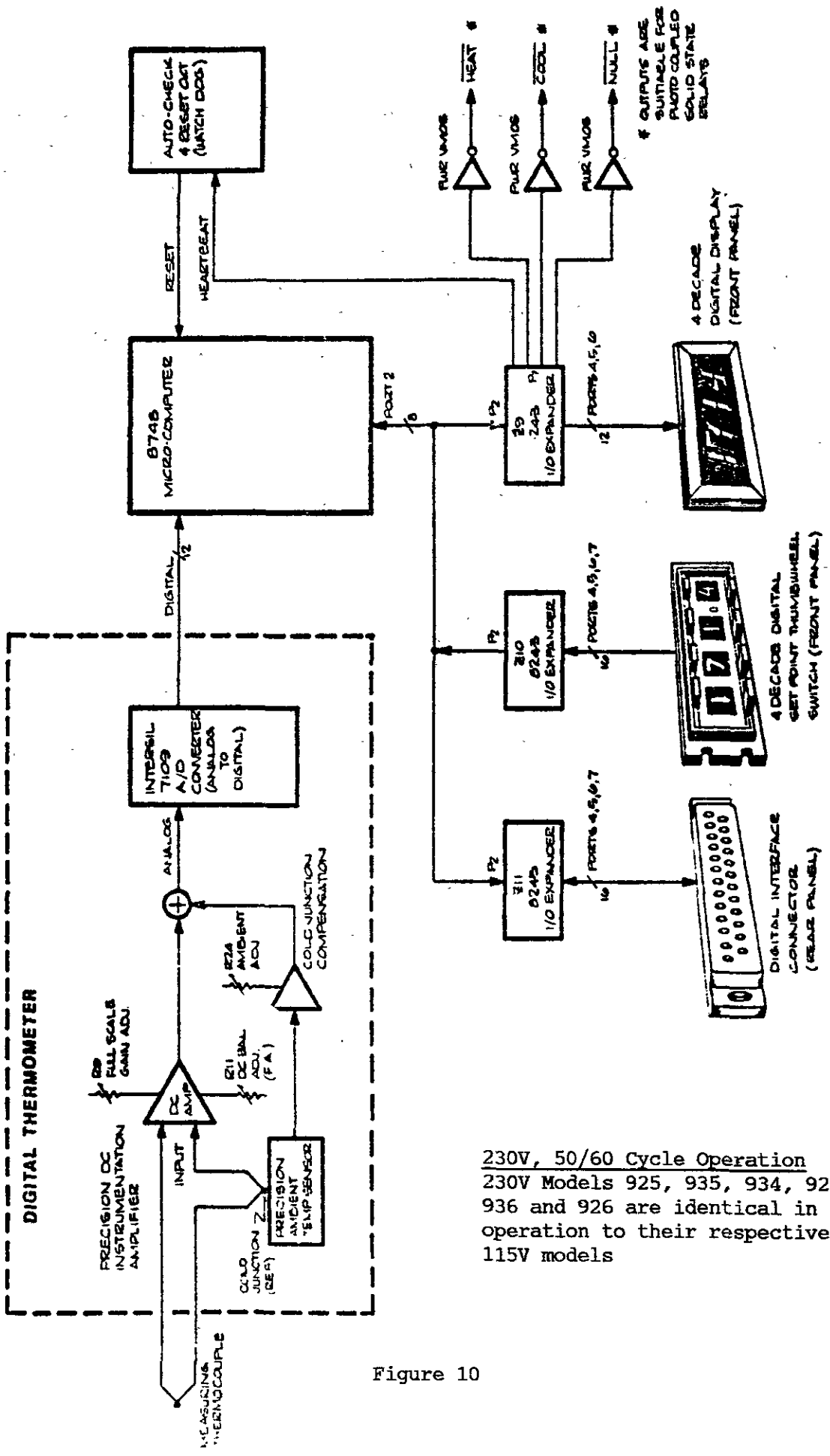
If the factory calibrated preset temperature is exceeded:

- for the chamber before rev. 1/86 (SN less than 135948) or after 8/86 (SN greater than 136665):

  The line power to the heater and fan are interrupted. To restart: The power on/off switch must be cycled on/off/on.

- for the chamber after rev. 1/86 to 8/86 (SN's 135948 to 136665):

  The line power to the heaters is interrupted. The power will restart automatically when the temperature is dropped below the overtemperature setpoint.



230V, 50/60 Cycle Operation

230V Models 925, 935, 934, 924, 936 and 926 are identical in operation to their respective 115V models

Figure 10

V

RDC CONTROLLER

INTRODUCTION

The Despatch RDC Double Adaptive Temperature Controller is a high-precision, microcomputer based temperature controller which uses digital techniques to control temperature systems. It has no moving parts such as cams, gears or slide wires. The controller's adaptive capability lets it change control parameters automatically, allowing the controlling action to adapt to the thermal response characteristics of the controlled environment in both the heat up and cool down phases. Brown-out protection for the microcomputer is built in, as well as open thermocouple detection circuitry.

The controller's microcomputer automatically regulates heat and coolant in the controlled environment by providing time proportioning or power proportioning outputs.

Input to the controller is from two type T thermocouples. The microcomputer compares the signal from the thermocouple to the setpoint selected on the digital thumbwheel switches. The difference is determined by subtracting the system temperature from the setpoint.

Other digital functions are also performed, including integral feedback, and correction of the non-linearities in the thermocouple's response. The controller uses these calculated values to automatically adjust variables in its temperature control program. This improves the settling characteristics of a system and results in precise control, steady rates of temperature change, reliable repeatability and high stable control at the setpoint.

Function

The signal from the thermocouple is amplified by a differential DC solid state feedback amplifier and is applied to the input of a 12 bit dual slope A/D converter. The A/D converter incorporates automatic zero drift compensation and has a conversion rate of 7.5 per second. The converted sensor output signal is processed by the controller's microcomputer.

System temperature is continuously displayed to 0.1° for Celsius and Kelvin (.2° Fahrenheit). The digital control mode is like proportional and integral control.

Related Despatch Equipment

IEEE-488 Double Port Interface, Model R188:

The Double Port Interface may be used to set temperature, read temperature and issue commands to the temperature controller. It includes two independent ports so that two temperature controllers or one temperature controller and one piece of additional equipment may be operated by a buss controller such as the Fluke 1720A Instrument Controller, the HP9825, or the Commodore PET Microcomputer.

Despatch Set-Point Programmer, Model RDP-13:

Temperature sequences, including rate of temperature change, setpoint temperature, duration at a particular temperature and three external events may be pre-programmed using the Despatch Set-point Programmer. A built-in digital connector on the temperature controller permits easy interface of the two units.

Specifications

Repeatability:	±0.15°C (±0.28°F)
Cold Junction Compensation:	Built-in, 0.03°/degree ambient
Control Mode:	Digital - like PID control
Display Update Rate:	7.5 readings per second
Power:	117 VAC, 50/60 Hz, 15 W
Calibration:	Ambient and full scale
Proportioning Automatic Heat-Cool	
Time Proportioning Period:	*1 second*
Heat and Cool Outputs:	Logic outputs, maximum load voltage 40 VDC, 100 MA maximum sink. (Suitable for driving photo-isolated solid state relays.)
Fixed Deviation Limit Output:	Logic output 100 MA, maximum sink. Switches beyond ±1.6°C from setpoint.

INSTALLATION

Interface

Thermocouple:

Type "T" thermocouples which are installed in the controlled environment must be connected at TB 1 at the top in the middle of the controller circuit board. A label specifies where the + (blue) and - (red) wires connect.

Double Port Interface (IEEE-488):

When the temperature controller application calls for all equipment to be operated by a buss controller or similar equipment, interconnection with the Double Port Interface is required. This is accomplished by connecting the interface cable to the remote connector (J1) on the back panel. Refer to the Double Port Interface instruction manual for additional installation guidelines before proceeding.

Despatch Set-Point Programmer (DRP-13):

Interconnection between the temperature controller and set-point programmer is accomplished with the cable provided with the programmer (J1) on the back panel of the chamber.

Calibration

The Despatch RDC controller is calibrated at the factory. Should it be necessary to recalibrate a unit, the following procedure is recommended:

Equipment Required:

Thermocouple calibrator or potentiometer

Procedure:

1. Remove heater fuse (20 amp).

2. Disconnect chamber themocouples and install Type T thermocouple wire from calibrator to control.

Ambient Calibration:

1) Turn on calibrator and chamber.

2) Adjust calibrator to give an output equivalent to 20.0°C.

3) On the controller p.c. board, adjust the AMBIENT pot (R24) until the reading on the digital display of the temperature controller matches the setting of the calibrator (20.0°C).

Full Scale Calibration:

1) Adjust the calibrator to give an output equal to 174.0°C.

2) Adjust the SLOPE pot (R9) on the controller p.c. board until the display reading matches the setting on the calibrator (174.0°C).

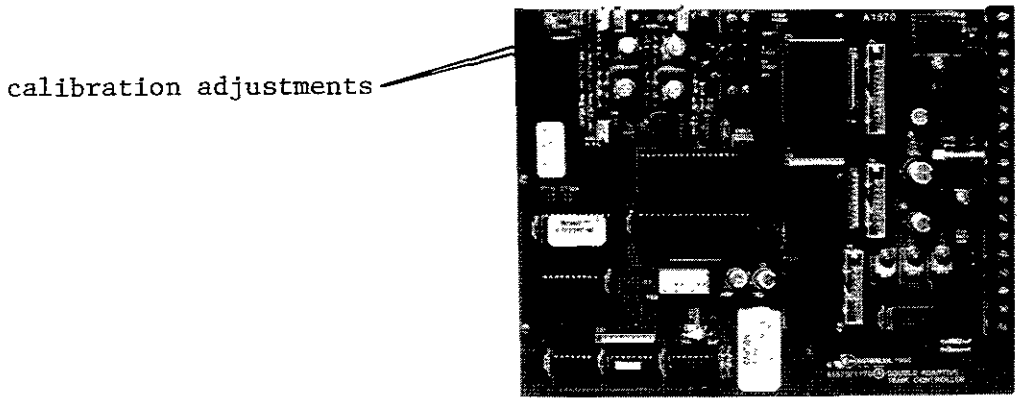
Calibration is now complete.

Calibration may be verified by randomly selecting temperatures. Set the calibrator and verify that the displayed temperature matches the calibration value.

Refer to Figure 11 for location of calibration adjustments.

Reinstall chamber thermocouples.

Replace chamber heater fuse. Chamber is now ready for use.



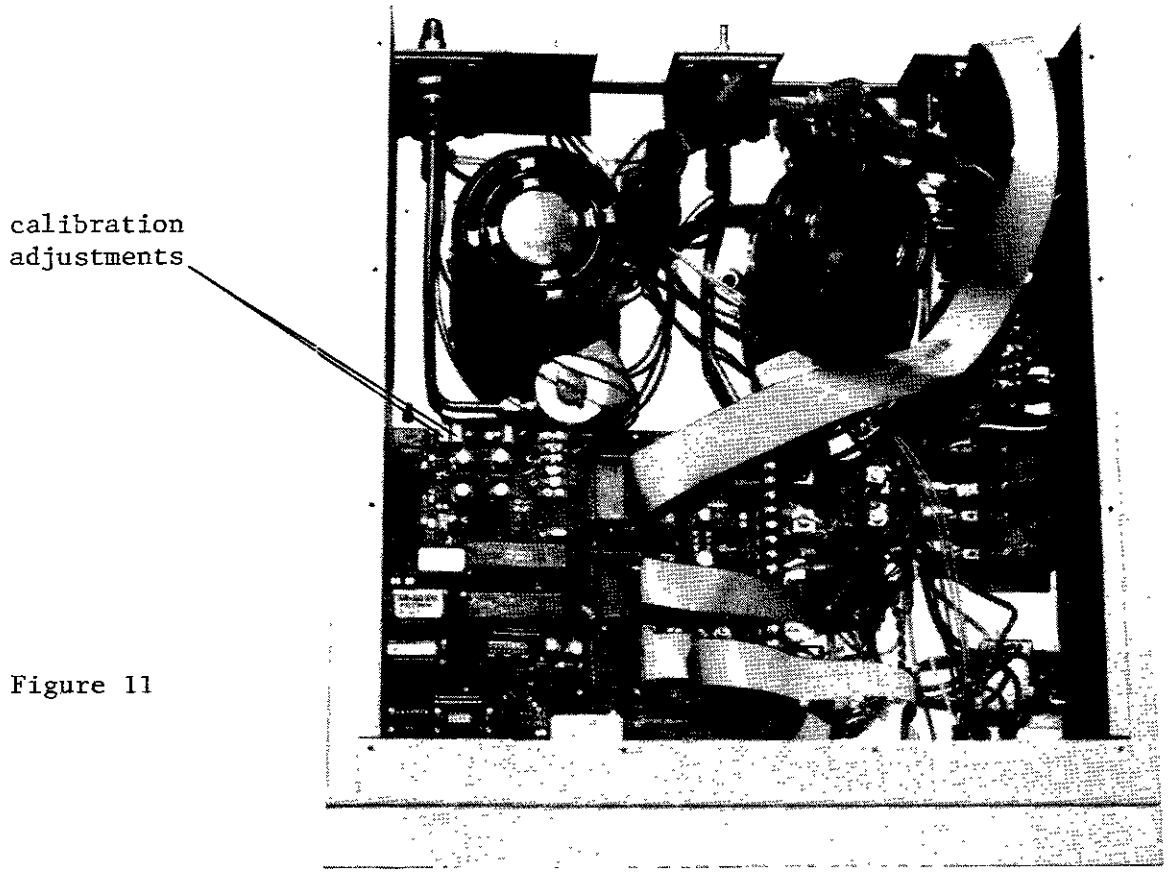


Figure 11

Figure 11

Fahrenheit and Kelvin Conversion

The RDC control is factory supplied in celsius range. The control can be field converted to any of the following ranges: celsius, kelven and fahrenheit. There is an 8-position dip switch (S1) located on the controller DC board beneath the (Z1) microprocessor. Pushing the first switch (#1) marked °F to the down (on) position will change the control to a fahrenheit model. A decal is included with this manual to change the hi-limit thermostat located on the front panel to fahrenheit also. Pushing switch #3 instead of switch #1 to the down (on) position will change the control to a kelvin model.

Conversion Procedure

1. Disconnect AC input power.

2. Remove vent screen from control unit compartment.

3. Locate 8-position dip switch and push desired switch to down (on) position.

4. Install fahrenheit decal for hi-limit thermostat if required.

5. Reinstall vent screen on control unit compartment.

6. Reconnect AC input power.

NOTE: To operate the chamber with temperature lower than -99°C, the switch shall be turned to K°. The reading on display will be Kelvin Degrees and it may compare to Celcius degrees by the conversion chart which Despatch Industries always sends along with chambers.

USING THE COMPUTER INTERFACE PORT

REMOTE DIGITAL INTERFACE
(ON REAR PANEL)

Pinouts and	Functions
1	.1 Tenths
14	.2 Tenths
2	.4 Tenths
15	.8 Tenths
3	1 Units (BCD)
16	2 Units
4	4 Units
17	8 Units
5	10 Tens (BCD)
18	20 Tens
6	40 Tens
19	80 Tens
7	100 Hundreds (BCD)
20	200 Hundreds
8	400 Hundreds
21	Minus Temperature
9, 10, 22, 23	Logic Common
11	Do Not Use
24	Read Temperature Command (LO = Read Temperature)
12	Remote Control (LO = Remote)
25	Setpoint Valid Command (HI = BCD Lines Have Valid Data)
13	Do Not Use

Output Drive Capability

Output Drive capability on pins containing BCD data - outputs are from Intel 8243 I/O device with 22K pull up resistor to +5 VDC. Logic HI true on BCD information lines.

Command Input Lines

Command INPUT lines (PINS 12, 24 and 25 connected to NMOS inputs with 10K to 22K pull up resistors to 5 VDC.

Input Interface

Input interference from the computer must be 5 volt logic levels with "0" volts connected to controller logic common.

Description of Operation of the Remote Digital Interface

The interface to the temperature controller is relatively simple. The microcomputer on the temperature control looks for four decades of BCD information on an I/O port (actually an Intel 8243 device). The microcomputer thus determines the system SETPOINT as information present at the inputs to the 8243 I/O.

A SETPOINT VALID input signal from the interface connector is utilized to convey information to the processor regarding the validity of the BCD information at the input to the 8243 I/O chip. A HI Setpoint Valid signal is an indication to the processor that the information at the input to the 8243 chip is valid and is not changing.

Dropping the Setpoint Valid signal tells the processor that the BCD information at the input to the 8243 I/O chip will remain valid for an additional 80 microseconds minimum and causes the processor to store the setpoint information in internal RAM memory for reference until the DATA VALID line goes HI again.

Two separate "Setpoint I/O" devices are provided on the controller. The selection of the I/O device utilized to read the required SETPOINT is determined by the logic level on the REMOTE CONTROL INPUT (Pin 12 on the Computer Interface Receptacle). A LO logic level selects the I/O chip Z15 (connected directly to the Remote Temperature socket J5 on the circuit board assembly.) A HI logic level on pin 12 of the rear panel interface receptacle causes the computer to read its SETPOINT from I/O device Z4 and the related panel Mounted Digitswitch.

When the controller is used in an environment where all of the setpoint input is via the remote digital interface. Pin 12 should be taken LO and kept in the LO state and the setpoint latched on the I/O BCD lines. In this manner, the current SETPOINT is the four decade BCD information connected to the remote digital interface.

NOTE: Please observe that the pinouts on the board mounted receptacle (P5) do not agree with the pinout numbers on the Remote Digital Interface Connector which is located on the rear panel of the chamber. The lines in the ribbon cable correspond to the pinouts on J5 (the p.c. mounted receptacle on the circuit board). The Remote Digital Interface is a "ribbon cable" mass terminated "D" subminiature 25 pin receptacle and the mass termination results in the pinouts on the connector not following lines in the ribbon cable.

Writing a Setpoint To the Temperature Controller Via the Remote Digital Interface

1) Line 12 must be LO and kept LO (logic 0 causes use of the I/O device (Z15) associated with the Interface).

2) Latch the BCD Setpoint information onto the data lines of the Interface. (HI = logic true).

Reading the Process Temperature Via The Remote Digital Interface

Reading the system temperature via the Interface consists of five steps:

1) Take the Setpoint Valid Line LO to the Interface (Pin 25). Keep the data on the BCD lines latched for another 120 microseconds so as to allow the microcomputer of the temperature controller to store the Setpoint in its internal memory.

2) Tri-state the data lines connected up to the BCD connections on the Controller Interface. This gets the user's computer ready to read the data that the temperature controller will output on the interface port.

3) Take the READ TEMPERATURE line LO (Pin 24) and look for the BCD character to appear on the Most Significant Decade (MSD) as that is the indication that the information is present at the output. Until the information is ready to be read, the information present at the MSD (pins 21, 8, 20, and 7) will be all logic highs (F hex).

4) Take the READ TEMPERATURE LINE HI (Pin 24). This action latches the data on the output of the Temperature Controller and the latched data can be read without any concern about it changing in the middle of the computer read.

5) After the data is read, take the SETPOINT VALID line HI and latch the setpoint data on the data lines for the Temperature controller.

An alternative to the above procedure is to follow the steps 1 and 2 above then proceed as follows:

6) Take the READ TEMPERATURE line LO and then wait for 330 milliseconds then take the READ TEMPERATURE line HI.

7) Wait for 60 microseconds then read the Setpoint Temperature on the BCD data lines. This data has been latched and the last 60 microseconds wait insured that the data was stable and not changing.

8) After the data has been read, take the SETPOINT VALID line HI and latch the Setpoint BCD data on the data lines going to the Remote Digital Interface.

OPERATION

Power Up

Power to the controller is supplied through the chamber. The heat and cool lights will come on and the controller will immediately begin to reach the setpoint temperature when the chamber power switch is turned on.

Heat and Cool Lights

The heat light is on solid while the controller is calling for heat. When the setpoint is reached, the light blinks, if some heat is required to maintain temperature.

The cool light is on solid while the controller is calling for cooling. When the setpoint is reached, the light blinks, if some cooling is required.

Remote Mode

The REMOTE connector on the back of the chamber is designed so that taking Pin 12 (Remote Interface Control) low puts the temperature controller in the Remote Mode. This may be done intermittently, depending on the type of equipment interfaced.

This connector is used with the Ransco Set-point Programmer, Temp Certifier, Double Port IEEE-488 Interface or special application programs. It accepts 16 lines I/O and two handhshake lines. The I/O lines may be steady state (BCD), latched input or bidirectional computer interface.

Temperature Setpoint Switch

Five thumbwheel switches are provided for setting temperature. The first switch sets plus or minus, the remaining four set temperature with a fixed resolution of 0.1°.

Overrange protection is built in so that if a temperature that is out of range is dialed on the setpoint switches, "----" appears on the display.

Temperature Display

Actual system temperature is digitally displayed continuously on the front panel. This shows ACTUAL system temperature while the setpoint temperature is indicated on the thumbwheel switches.

If a Set-point Programmer is being used, refer to the Set-point programmer manual for an explanation of front panel indications.

Normal Operation

All temperature control functions occur automatically after power is turned on.

Shutdown

To turn off the temperature controller, simply turn off system power.

Failure Modes

The display on the front panel to the controller will give the following error messages:

P.OP = probe open

If the temperature controller's probe opens, the controller's heat and cool outputs are automatically turned off.

MAINTENANCE AND REPAIR

Keep the interior of the controller relatively clean. Stray bits of wire can cause shorting and damage to components.

Replacing Modules

Functions in the temperature controller are performed by p.c. board modules. If a faulty module is suspected, it can be easily removed and replaced.

Replacing Thermocouples

If a thermocouple opens, it is easily removed and replaced with another thermocouple at TB1.

Recalibration

Recalibration is seldom necessary. However, it is recommended that calibration be checked once a year.

Non-Routine Repairs

Removal of the microprocessor from the socket is normally not necessary. Its removal will void the warranty unless the factory has been consulted previously, and authorization has been approved.

Diagnostic Procedure

1) Switch AC power off and unplug any accessories connected to the controller such as a Set-point Programmer or IEEE-488 interface.

2) Dial +000.0 (or +0000) on the setpoint switch and switch on the controller's AC power.

3) Switch S1 is located below the microprocessor Z1. Placing switch #2 to the down position will cause the control to go into a diagnostic mode of operation.

4) Verify that each digit of the temperature display cycles through its entire character set (0-9, -, E, H, L, P) except for the most significant digit, which will not display the character "0". After cycling the display, the diagnostic program will momentarily turn on decimal point 1 (xxx.x), decimal points, the NULL, HEAT, and COOL outputs in sequence.

NOTE: DIALING A "1" IN THE LEAST SIGNIFICANT SETPOINT DECADE CAUSES THE PROGRAM TO EXPEDITE TO STEP 4. DIALING A "9" CAUSES IT TO SKIP STEP 4.

5) Upon completion of Step 4, the program will echo the number dialed on the setpoint switch back to the display. Decimal point 1 (xxx.x) will be on.

NOTE: IF ANY OF THE SPECIAL CODES (-37XX) CALLED FOR IN THE FOLLOWING STEPS ARE DIALED ON THE SETPOINT SWITCHES, THE PROGRAM WILL EXIT IN STEP 5.

6) Dial -3700 on the setpoint switches. The status of the A/D converted "data valid" output will appear on the temperature display as an alternating "H" and "L", indicating a logic high and low, respectively. As this cycle repeats 7-1/2 times per second, a flicker is barely discernible.

7) Dial -3701. The A/D converter data output will appear on the display in decimal form. The range of its output extends from -4095 to +4095 decimal. An input voltage greater than that which generates +4095 will cause the message, "P.OP" to appear on the display. This indicates that the converter's FAIL output is operating properly.

NOTE: NEGATIVE DISPLAYS WILL NOT SHOW THE THOUSANDS DIGIT, AS THAT SPACE IS OCCUPIED BY THE SIGN. THE DIFFERENTIAL AMPLIFIER WILL TYPICALLY LIMIT THE NEGATIVE RANGE TO SOMETHING HIGHER THAN THE -4095 POINT.

8) Dial -3702. The "H"'s will appear on the display. If the pads for jumper A on the controller board are shorted together, the left hand "H" will change to "L", indicating a logic low, or ground on Z1-34. If the Setpoint valid line on the Remote Digital Interface is grounded, the right hand "H" will change to an "L". The latter two checks can be used to verify correct operation of the interface handshake lines.

9) Dial -3712. This code causes suppression of the program's autocheck "heartbeat" output, simulation entry into a "limbo" state or illegal endless loop. Absence of the autocheck heartbeat for 4 seconds causes the auto-restart circuit, Z2, to issue a power ON reset to the CPU to enable it to recover. The program will then revert to the operation described in step 4.

10) Dialing a -3711 at any time causes operation to revert to that described in step 4.

11) All hardware operation has been verified except for the bidirectional computer interface and differential amplifier and cold junction calibration. An error in normal operation not detected by the above procedure required replacement of the temperature controller program IC in socket Z1.

Bidirectional computer interface operation can be verified by switching the two 8243 chips on the temperature controller board and repeating steps 1-10. Replace the chips to their original locations when the procedure has been completed.

RDC

DIAGNOSTIC CHECK

Dial	Test Description	Symptoms	Check
+0000	Exercises outputs, slow.	Incorrect display sequence.	Display assembly, Z9.
		Display does not change.	Display assembly, Z9, XTAL1, Z4, Z3, Z2, C7.
		Display remains blank.	+5V supply (Q2).
		Incorrect cool output.	Z17, Q4, Z9.
		Incorrect heat output.	Z17, Q5, Z9.
		Incorrect null output.	Z17, Q6, Z9.
+0001	Exercises outputs, fast.	Same as above.	Same as above.
+0009	Jump to setpoint echo test. Setpoint Echo Test.	Incorrect echo on display.	Thumbwheel switch assembly Z10, Z16.
-3700	A/D "Data Valid" Output.	"H" and "L" not alternately flickering.	Z4, -5V supply.
-3701	A/D output display.	Display does not function as described in step 7.	Z4, -5V supply, analog circuitry.
-3702	Handshake input test.	Display does not function as described in step 8.	Check continuity to Z1-1, 6, 34 and to ground.
-3712	Auto Restart Test.	No auto restart.	Z2, Z3, Z9, CR2, C7.
-3711	Return to exercise outputs tests.	N/A	N/A

VI

CHAMBER MAINTENANCE

Insure trouble-free service by performing preventive maintenance when appropriate. Should service be required, specific procedures are described to locate and repair malfunctions.

TEST EQUIPMENT REQUIRED

The following equipment, or equivalent, is needed to perform maintenance and calibration operations on temperature test chambers.

Temperature calibrator (minimum adjustment 0.1°C or less).

Multitester, 100k ohms/volt, or VOM.

* *
* WARNING *
* *
* Always disconnect the AC power to the test chamber before *
* performing preventive maintenance. *
* *
* Maintenance should be performed by qualified personnel only. *
* *

PREVENTIVE MAINTENANCE

The temperature test chamber should be inspected for conditions that might damage it or shorten its service life and should be cleaned at frequent intervals.

Temperature test chamber inspection consists of the following checks:

1. Inspect the coolant cylinder valves to be sure they are properly closed.

2. Inspect the inside of the test chamber for moisture. If moisture is found, operate the test chamber for one hour at 205°C (400°F) to evaporate the moisture.

3. Check coolant lines for proper connections.

4. Check the test chamber motor(s) at elevated temperatures for quiet operation. (This insures proper bearing condition.)

Clean the control unit compartment as follows: (See Figure 11)

1. Disconnect AC input power.

2. Remove vent screen from control unit compartment.

3. Remove dust and foreign particles from components of the control unit compartment with a soft brush and vacuum cleaner, if available.

4. Reinstall vent screen on control unit compartment.

5. Reconnect AC input power.

The CO_2 filter should be cleaned every 30 days or 240 hours of operation, whichever occurs first. Clean the CO_2 filter as follows:

1. To remove the filter, unscrew the hollow Allenhead screw (item 7 in Figure 3) from the test chamber bulkhead fitting (item 5) and slide the filter (item 6) out from the fitting.

2. Wash filter in trichloroethylene.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                WARNING                                  *
*                                                                         *
*   Use trichloroethylene only in a well ventilated area.  Avoid         *
*   inhaling fumes and excessive contact with the skin.                   *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

3. Dry filter thoroughly with filtered, dry, compressed air at low pressure.

4. Reinstall filter in CO_2 bulkhead fitting.

The coolant solenoid orifice assembly should be cleaned only when necessary. Frequent cleaning should not be required if contaminant-free CO_2 is always used. Clean the coolant orifice as follows:

1. Disconnect AC power. Disconnect coolant hose.

2. Remove vent screen from control unit compartment.

3. Open heater compartment.

4. Remove coolant solenoid assembly from control unit compartment.

5. Remove orifice tube from solenoid assembly. Check position of orifice for reinstallation.

6. Carefully clean orifice using 0.46mm (0.18 inch) diameter music wire.

7. Replace orifice tube in solenoid assembly, performing the removal procedure in reverse order.

8. Reinstall coolant solenoid assembly in control unit compartment.

9. Close control unit and heater compartment.

10. Connect coolant hose.

11. Turn on coolant cylinder valve and check for leaks.

12. Connect AC power.

13. Operate test chamber at low temperature set-point to insure correct cooling function.

CORRECTIVE MAINTENANCE

The purpose of corrective maintenance is to locate test chamber malfunctions and to apply proper repair procedures. Trouble-shooting information to permit isolating test chamber malfunctions and pinpointing their probable causes is given in Table I.

The following procedure is used in trouble-shooting the test chamber:

1. Insure that all switches are in the proper position.

2. Check first for blown fuses and proper AC power connection.

3. Check coolant lines for proper plumbing. Check that all line valves are open. Make sure that the coolant lines are not clogged.

4. Check the coolant cylinders to be sure that they contain an adequate coolant gas supply.

Components in the temperature test chamber are removed and replaced as follows: Repair is limited to the replacement of defective parts.

Remove the heater assembly as follows: (see Figures 12 and 13)

1. Disconnect AC power.

2. Remove screws holding plenum plate.

3. Carefully allow plenum plate to drop downward.

   Caution: Care should be taken not to damage or disturb the location of the thermcouples.

4. Remove two Phillips-head screws at the back of the heater assembly.

5. Remove the two wires connected to the heater coil.

6. Carefully remove heater from chamber.

7. To replace heater assembly, perform the removal procedure in reverse order.

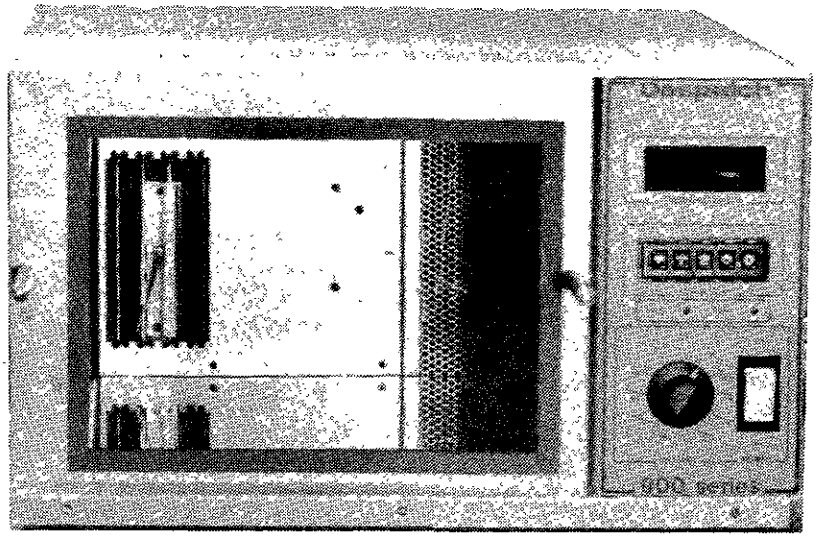


Figure 12. Plenum Plate Before Removal

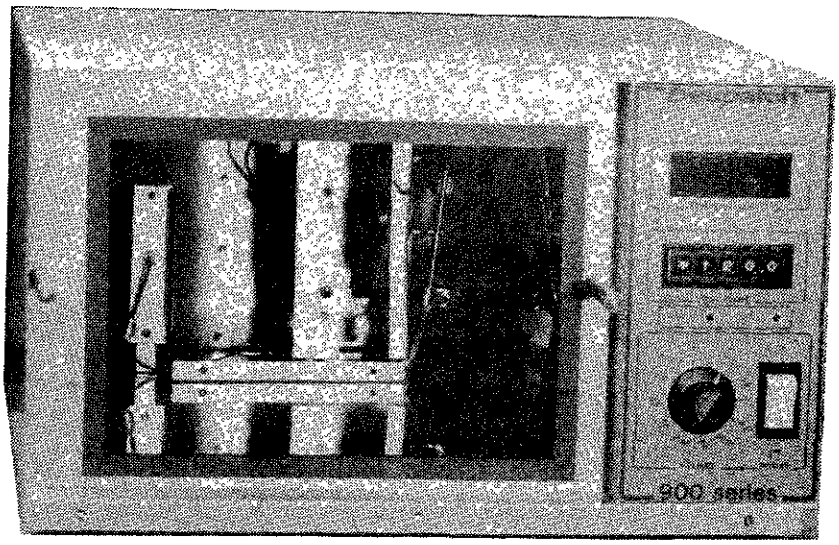


Figure 13. Plenum Plate Removed

TROUBLE	PROBABLE CAUSE
No controller display reading when power switch is on.	Loose wiring. Faulty transformer. Faulty readout. Faulty controller. Power cord not plugged into outlet. Outlet not powered. Defective line fuse (F1). Defective POWER switch (S1). Defective power cord.
Blowing line fuse when power switch is turned on.	Defective (grounded or shorted) heater (HTR-1). Defective motor(s) (shorted). Defective solenoid valve (shorted) (L1). Short in filter, transformer or control. Shorted wiring, or loose connection touching chassis.
Chamber temperature differs from set-point indication.	Defective sensor (1 or both). Control out of calibration. Defective control.
Lack of operation of appropriate heat or cool light when control setpoint differs from display by more than 0.3°C.	Faulty light. Defective controller.

CHAMBER TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE
Failure to control at a low temperature when cool light is on.	Cylinder valve not open. Lack of liquid coolant. Clogged CO_2 filter. Clogged orifice. Clogged line. Solenoid valve will not open. Defective solid state relay (SSR2).
Failure of chamber to heat when heat light is on.	Faulty heater fuse (F2). High limit (Dial) set below chamber temperature. Defective solid-state relay (SSR1). Defective contactors (K1 or K2). Defective heater (HTR-1). Defective heater cable. Solenoid valve will not close. Defective control.
Failure of solenoid valve to close when cool light is off.	Ice in valve. Defective valve. Defective solid state relay (SSR2). Defective control.
Failure of solenoid valve to open when cool light is on.	Defective valve. Defective solid state relay (SSR2). Defective control.

CHAMBER TROUBLESHOOTING (CONT'D)

SERVICE PROCEDURES

Remove the main blower motor as follows: (see Figure 14)

1. Disconnect AC power.

2. Remove screws holding plenum plate.

3. Carefully allow plenum plate to drop downward.

   Caution: Do not damage thermocouples or disturb placement.

4. Loosen Allen set screw holding blower motor fan blade or blower wheel to motor shaft.

5. Remove fan blade or blower wheel. In some cases, a gear puller will be needed for removal of the fan from the motor shaft.

6. Remove vent screws from control unit compartment.

7. Remove blower motor wires from terminal strip.

8. Remove three Phillips-head screws connecting the blower motor to this mounting platform.

9. On models 934 and 936, remove motor shaft pin.

10. Remove blower motor.

11. To replace blower motor, perform the removal procedure in reverse order.

Remove the electronic control chassis as follows:

1. Disconnect AC power.

2. Remove vent screen from motor compartment.

3. Remove holding screw located above rear of RDC control within motor compartment. (On Models 934, 924, 936, and 926.)

4. Remove two holding screws on rear of chamber above fuses.

5. Remove holding screws (two on Models 934, 924, 936 and 926 on exterior bottom of chamber; three holding screws through chassis on Models 925 and 936).

6. Remove wires connected to terminal strip, or remove screws fastening terminal block to bulkhead.

7. Remove control chassis by sliding it towards the front of the chamber.

8. To replace the control chassis, perform the removal procedure in reverse order.

ADJUSTMENT AND TESTING OF THE FACTORY CALIBRATED HIGH LIMIT THERMOSWITCH

1. The thermoswitch was factory set and tested at the chamber maximum rated temperature within normal tolerance.

2. If necessary to reset the thermoswitch, it is accessible by removing the snap in closure button in the rear cover panel.

3. A screwdriver can be inserted through the hole to find the end of the slotted adjusting screw.

4. Turn screw clockwise to reduce temperature. Adjusting rate is approximately 90°F per revolution.

5. To set a new temperature on the thermoswitch, set the chamber control to the desired trip temperature and allow temperature to stabilize. The panel mounted overtemperature setpoint must be set at a higher temperature for this test. Slowly turn adjusting screw clockwise until the thermoswitch trips and the chamber is shut down.

6. Test the setpoint by allowing the chamber to cool, open and close the power switch to reset, set the chamber controller above the set point and observe the temperature at the time it is tripped. The chamber with thermoswitch UE8625 will be reset automatically when the temperature drops below the over-temperature set point.

7. Reset the electronic overtemperature set point to the desired temperature.

BILL OF MATERIALS
(DRAWING #WD1003B & E)
(S/N LESS THAN 135948)

QUANTITY MODEL 924	925	926	ITEM	PART NO.	DESCRIPTION
					C82236-275CT
1	1	1	A1-1	047609	Temperature Controller Board
1	1	1	A1-2	047618	Line Filter
1	1	1	A1-3	047612	Setpoint Switch #A959
1	1	1	A1-4	047613	Digital Display #A1003
1	1	1	A1-5	047614	Remote Digital Interface
1	1	1	A1-6	047617	Transformer Signal #241-6-1456
1	0	0	B1	052987	Fan Motor Universal Electric #AB1N027
0	2	0	B1 & B2	060395	Fan Motor Universal Electric #AF1F-01-7N
0	2	0	Cap	057348	Motor Capacitor 3MFD 370 VAC
0	0	1	B1	060289	Fan Motor Universal Electric #DF10004
2	2	2	CR1 & 2	010398	Diode G.E. 1N5061
2	2	2	DS1 & 2		Red L.E.D.
			(S/N 134967)	047625	L.E.D. Light
				047626	Light Lens
				047630	Retainer Ring
			(S/N = 134967)	059164	LED Assy w/Leads
1	1	1	F1	047616	Fuss Buss ABC-3
1	1	1	F2	047615	Fuss Buss ABC-20
1	1	1	S2 (S/N 133683)	047622	High Limit Thermostat Capillary
1	0	0	HR1	053007	Air Heater Tuttle #04-0739-01
0	1	0	HR1	060374	Air Heater Tuttle #1037
0	0	1	HR1	053007	Air Heater Tuttle #04-0739-01
2	2	2	K1 & K2	047753	Relay DPDT 25 Amp 120 Vac Coil
1	1	1	L1 (L2)		Coolant Solenoid Valve
				053014	900 PSI CO_2 Asco XVA-158888
				060146	300 PSI CO_2 Asco XVA-158889
				060145	40 PSI LN_2 Asco X8262C22LT
1	1	1	R1	053504	Resistor 2.5 K - 10W
1	1	1	RV1	014643	Varistor G.E. V130LA10A
1	1	1	S1	012173	Power Switch Carling
1	1	1	S2 (S/N = 133683)	102148	High Limit Thermostat RTD
1	1	1	S3	053003	Overtemp. Thermostat Vulcan #1D282
1	1	1	SSR1	047610	Solid State Relay Opto 22 240D25
1	1	1	SSR2	047611	Solid State Relay Opto 22 Z240D10

BILL OF MATERIALS
(DRAWING #WD1003F ONLY)
(S/N 135948 TO 136664)

QUANTITY MODEL 924	925	926	ITEM	PART NO.	DESCRIPTION
1	1	1	A1-1	047609	Temperature Controller Board
1	1	1	A12	047618	Line Filter
1	1	1	A13	047612	Setpoint Switch #A959
1	1	1	A14	047613	Digital Display #A1003
1	1	1	A15	047614	Remote Digital Interface
1	1	1	A16	047617	Transformer Signal #241-6-1456
1	0	0	B1	052987	Fan Motor Universal Electric #AB1N027
0	2	0	B1 & B2	060395	Fan Motor Universal Electric #AF1F017N
0	2	0	Cap	057348	Motor Capacitor 3MFD 370 VAC
0	0	1	B1	060619	Fan Motor 00.08 HP 5KCP19M5815
2	2	2	CR1 & 2	010398	Diode G.E. 1N5061
2	2	2	DS1 & 2	059164	Red L.E.D. Assy
1	1	1	F1	047616	Fuss Buss ABC-3
1	1	1	F2	047615	Fuss Buss ABC-20
1	0	0	HR1	053007	Air Heater Tuttle #04-0739-01 2KW
0	1	0	HR1	060374	Air Heater Tuttle #1037 2KW
0	0	1	HR1	053007	Air Heater Tuttle #04-0739-01 2KW
1	1	1	K1	047753	Relay DPDT 25 Amp 120 Vac Coil
1	1	1	L1 (L2)		Coolant Solenoid Valve
				053014	900 PSI CO_2 Asco XVA-158888
				060146	300 PSI CO_2 Asco XVA-158889
				060145	40 PSI LN_2 Asco X8262C22LT
1	1	1	R1	053504	Resistor 2.5 K - 10W
1	1	1	RV1	014643	Varistor G.E. V130LA10A
1	1	1	S1	012173	Power Switch Carling
1	1	1	S2	~~102148~~ 104609	High Limit Thermostat RTD
1	1	1	S3	080177	Overtemp. Thermostat UE8625 or Vulcan 1D1B2
1	1	1	SSR1	047610	Solid State Relay Opto 22 240D25
1	1	1	SSR2	047611	Solid State Relay Opto 22 Z240D10

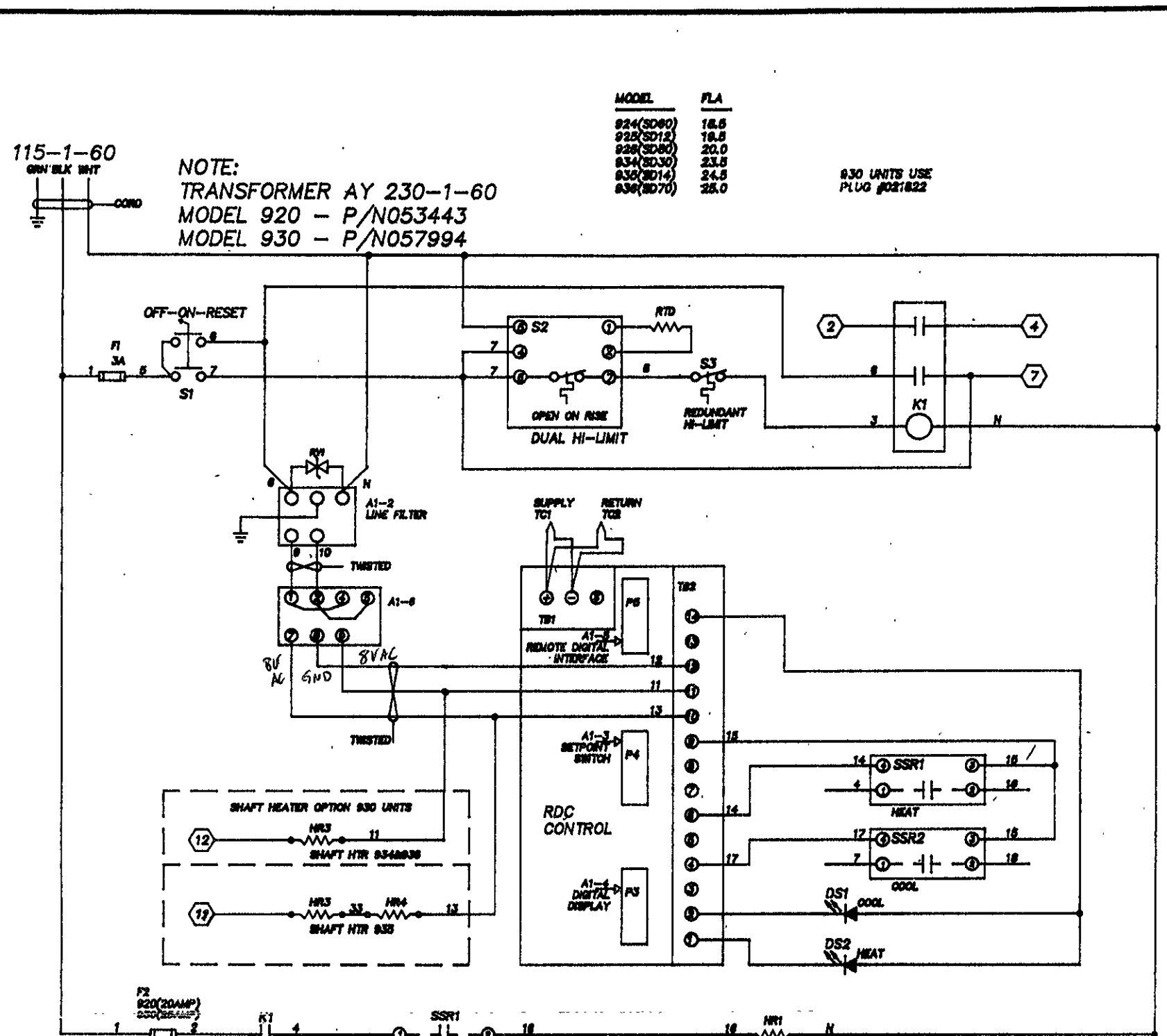
BILL OF MATERIALS
(DRAWING #WD1073D ONLY)
(S/N 136665 TO 145354)

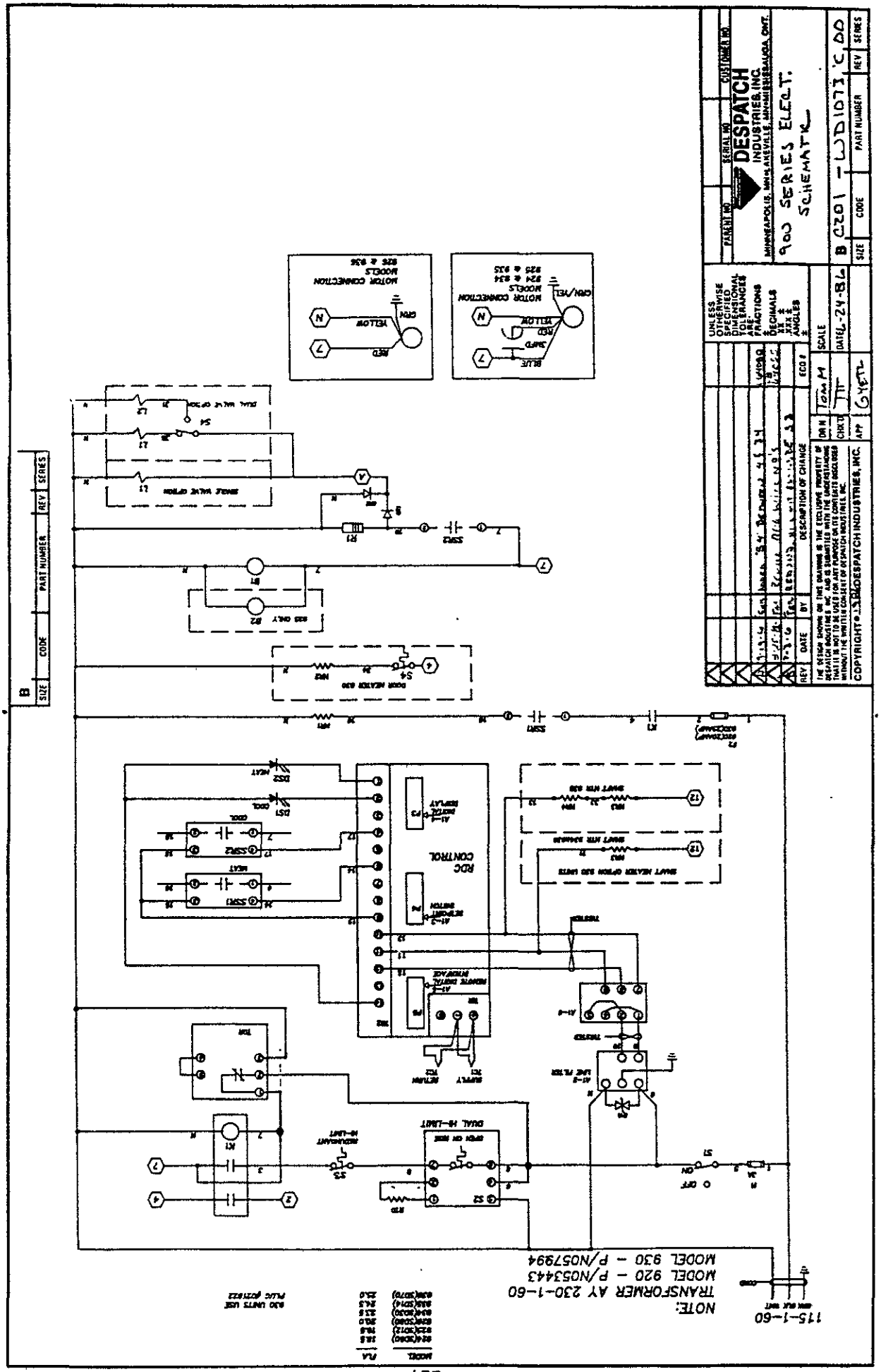
QUANTITY MODEL 924	925	926	ITEM	PART NO.	DESCRIPTION
1	1	1	A1-1	047609	Temperature Controller Board
1	1	1	A1-2	047618	Line Filter
1	1	1	A1-3	047612	Setpoint Switch #A959
1	1	1	A1-4	047613	Digital Display #A1003
1	1	1	A1-5	047614	Remote Digital Interface
1	1	1	A1-6	047617	Transformer Signal #241-6-1456
1	0	0	B1	062328	Fan Motor 0.02 HP KP-E29-BOL
0	2	0	B1 & B2	062327	Fan Motor 0.08 HP KP-G330-BOL
1	2	0	Cap	057348	Motor Capacitor 3MFD 370 VAC
0	0	1	B1	060619	Fan Motor 00.08 HP 5KCP19M5815
2	2	2	CR1 & 2	010398	Diode G.E. 1N5061
2	2	2	DS1 & 2	059164	Red L.E.D. Assy
1	1	1	F1	047616	Fuss Buss ABC-3
1	1	1	F2	047615	Fuss Buss ABC-20
1	0	0	HR1	053007	Air Heater Tuttle #04-0739-01 2KW
0	1	0	HR1	060374	Air Heater Tuttle #1037 2KW
0	0	1	HR1	053007	Air Heater Tuttle #04-0739-01 2KW
1	1	1	K1	047753	Relay DPDT 25 Amp 120 Vac Coil
1	1	1	L1 (L2)		Coolant Solenoid Valve
				053014	900 PSI CO_2 Asco XVA-158888
				060146	300 PSI CO_2 Asco XVA-158889
				060145	40 PSI LN_2 Asco X8262C22LT
1	1	1	R1	053504	Resistor 2.5 K - 10W
1	1	1	S1	012173	Power Switch Carling White
			S1	074116	Power Switch Carling Gray
1	1	1	S2	104609	High Limit Thermostat RTD
1	1	1	S3	080177	Overtemp. Thermostat UE8625 or Vulcan 1D1B2
-	-	-	S4 (All 930's)	080177	Overtemp. Thermostat UE8625 or Vulcan 1D1B2
1	1	1	SSR1	047610	Solid State Relay Opto 22 240D25
1	1	1	SSR2	047611	Solid State Relay Opto 22 Z240D10
1	1	1	TDR	070003	Relay T/D TS2423

047621 FUSE HOLDER

BILL OF MATERIALS
(DRAWING #WD1073D ONLY)
(S/N 145355 TO CURRENT)

QUANTITY MODEL			ITEM	PART NO.	DESCRIPTION
924	925	926			
1	1	1	A1-1	047609	Temperature Controller Board
1	1	1	A12	047618	Line Filter
1	1	1	A13	047612	Setpoint Switch #A959
1	1	1	A14	047613	Digital Display #A1003
1	1	1	A15	047614	Remote Digital Interface
1	1	1	A16	047617	Transformer Signal #241-6-1456
1	0	0	B1	062328	Fan Motor 0.02 HP KPE29BOL
0	2	0	B1 & B2	062327	Fan Motor 0.08 HP KPG330BOL
1	2	0	Cap	057348	Motor Capacitor 3MFD 370 VAC
0	0	1	B1	060619	Fan Motor 00.08 HP 5KCP19M5815
2	2	2	CR1 & 2	010398	Diode G.E. 1N5061
2	2	2	DS1 & 2	059164	Red L.E.D. Assy
1	1	1	F1	047616	Fuss Buss MDX-3
1	1	1	F2	047615	Fuss Buss ABC-20
1	0	0	HR1	053007	Air Heater Tuttle #04-0739-01 2KW
0	1	0	HR1	060374	Air Heater Tuttle #1037 2KW
0	0	1	HR1	053007	Air Heater Tuttle #04-0739-01 2KW
1	1	1	K1	047753	Relay DPDT 25 Amp 120 Vac Coil
1	1	1	L1 (L2)		Coolant Solenoid Valve
				053014	900 PSI CO_2 Asco XVA-158888
				060146	300 PSI CO_2 Asco XVA-158889
				060145	40 PSI LN_2 Asco X8262C22LT
1	1	1	R1	053504	Resistor 2.5 K - 10W
1	1	1	S1	094067	Power Switch Carling Gray
1	1	1	S2	104609	High Limit Thermostat RTD
1	1	1	S3	080177	Overtemp. Thermostat UE8625 or Vulcan 1D1B2
-	-	-	S4 (All 930's)	080177	Overtemp. Thermostat UE8625 or Vulcan 1D1B2
1	1	1	SSR1	047610	Solid State Relay Opto 22 240D25
1	1	1	SSR2	047611	Solid State Relay Opto 22 Z240D10


MODEL FLA
924(SD60) 18.5
925(SD12) 19.5
928(SD80) 20.0
934(SD30) 23.5
936(SD14) 24.5
936(SD70) 25.0
930 UNITS USE PLUG #021822
115-1-60
GRN BLK WHT
COND
NOTE:
TRANSFORMER AY 230-1-60
MODEL 920 - P/N053443
MODEL 930 - P/N057994
OFF--ON--RESET
F1 3A
S1
S2
RTD
OPEN ON RISE
DUAL HI-LIMIT
S3
REDUNDANT HI-LIMIT
K1
RV1
A1-2 LINE FILTER
TWISTED
A1-6
8VAC
GND
SUPPLY TC1
RETURN TC2
TB1
TB2
P5
A1-5 REMOTE DIGITAL INTERFACE
A1-3 SETPOINT SWITCH
P4
RDC CONTROL
A1-4 DIGITAL DISPLAY
P3
SHAFT HEATER OPTION 930 UNITS
HR3
SHAFT HTR 934&936
HR4
SHAFT HTR 933
SSR1
HEAT
SSR2
COOL
DS1
DS2
F2 920(20AMP)
HR1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TRANSFORMER AY 230-1-60
MODEL 920 - P/N053443
MODEL 930 - P/N057994
115-1-60

OMS/B

MODEL DRP-13 TEMPERATURE PROGRAMMER

INSTRUCTION MANUAL

Despatch Industries, Inc. ■ P.O. Box 1320 ■ Minneapolis, MN 55440-1320
(612) 781-5363 Fax: (612) 781-5353

Despatch

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TABLE OF CONTENTS

ILLUSTRATIONS

SETPOINT PROGRAMMER
OPERATING INSTRUCTIONS

INTRODUCTION

The DESPATCH DRP-13 Setpoint Programmer is a microcomputer based instrument for use with DESPATCH RDC Temperature Controllers. The Setpoint Programmer has been specifically designed for ease of programming and use. The Operator is sequentially led through the programming steps in a non-confusing manner.

The programmer allows automatic sequencing of temperature/events versus time such as is required in temperature cycling or time dependent temperature processing.

Temperature program parameters controlled are rate of temperature change, soak time (time at a specific temperature), setpoint temperature and deviation limits. In addition, three relays are provided for turning external devices on and off (Events).

In most temperature testing and temperature dependent processes, temperature is adjusted manually or with a set of cams that must be specifically designed and controlled for the operation. The Programmer performs temperature change functions automatically by carrying out the stored instructions in its non-volatile memory.

By executing temperature cycles automatically, a high degree of temperature reliability and precision is assured. Other safeguards include a keylock which permits program changes only when the key is in the "Reprogram" position.

FUNCTION

The Programmer determines the temperature controller setpoint through the "rate, temperature, soak-time, deviation, and events" programs stored in its memory. A program may have up to 30 segments and may be repeated up to 9999 times before the associated temperature controller is automatically shut down. Multiple programs may be stored in memory, provided that the total number of segments plus program separators does not exceed 30.

A program review function allows the operator to sequentially step through all program parameters and observe them on the

six-digit numeric display.

The first two digits of the display are the program segment number; the last four represent the program function. A red LED corresponding to rate, setpoint, soak time, process deviation or event status will also be ON indicating which function is being displayed.

EXTERNAL EVENTS

Isolated relay closures are provided so that up to three external events may be activated by wiring to the terminal strip on the back of the Programmer. When the event is turned ON, the relay contacts are closed.

SPECIFICATIONS

Setpoint: -99.9 to +799.9 (0 to 7999 on 1° resolution controllers)

Temperature resolution: 0.1° (1° for a 1° Resolution Controller)

Soak time resolution: 1 min.

Soak time duration: 1-9999 min. (only starts when process Temperature is within 0.4° (4° for 1° resolution controller) of desired setpoint.)

Process deviation limits: ± 0.1 to $\pm 799.9^{\circ}$

Program segments: 30

NOTE: One segment contains

(a) RATE OF TEMPERATURE CHANGE
(b) NEW TEMPERATURE SETPOINT
(c) SOAK TIME AT NEW TEMPERATURE
(d) ALLOWABLE PROCESS DEVIATION
(e) ON/OFF DETERMINATION OF THE THREE EXTERNAL EVENTS (ISOLATED RELAY CONTACTS)

Program repeats: 0-9999
Program input: 16 key numeric pad
Indicators: Power ON, Rate, Setpoint, Soak Time, Process Deviation Limits, Events, Review, "End of Program"/Cycles,and Run.
External Events: three, controlled by relay closures.
Rate: 99.9°/minute max (Clear causes execution of a "step" function and is displayed as "----".)

OTHER FEATURES

Automatic repeat cycle: allows selection of the number of times the preprogrammed temperature sequence is to be executed (up to 9999).

Keypad: a keypad is provided for easy data entry, advance, backup, turning on events, and clear functions.

Display: a six-digit LED display with the first two digits representing the segment number and the last four digits representing program functions.

Process Deviation Limits Alarm: flashing LED on the front panel of the programmer indicates temperature deviation limit has been exceeded. An alarm output is provided on the terminal strip on the back panel. (See separate writeup on "Dev. Limits Alarm".)

Power On: (on bench top unit only) located on the back panel to prevent accidental turn OFF of the Programmer.

Keylock: allows reprogramming only when in the "Reprogram" position. In the "Program Lock" position, no program changes are possible.

Hold Function: allows the operator to stop a program and hold, to examine parameters, etc. without interrupting the sequence of program execution. Program execution resumes upon pressing the START button.

DEFINITIONS

Temperature Program: a set of instructions stored in the memory of the programmer. It includes a series of temperature setpoints, rates of temperature change, time at which the temperature stays at a particular setting, process deviation limits, external event enable instructions, number of cycles, and an E.O.P. (end of program) separator segment.

Program Segment: one of a possible 30 segments of the complete temperature program. It includes rate, setpoint, soaktime, process deviation limits and events.

Rate: the rate of temperature change expressed in degrees per minute.

Setpoint: the temperature at which the program will stay during the soaktime.

Soak Time: a period of time during which the program stays at a pre-selected Setpoint Temperature (expressed in minutes.)

Process Deviation: the amount by which the process temperature may deviate from the setpoint. The deviation is expressed in degrees and must be the same for positive and negative deviations.

Events 1-3: three separate isolated relay closures brought ou to the rear of the unit - their status is determined by the program for each segment of the program.

SWITCH FUNCTIONS

Front Panel: (Refer to Figure 14)

Keypad:

0-9: for entry of numeric values into the program.

***:** used as a decimal point.

#: used to enter a minus sign.

Advance: ("A" on keypad) used to advance program parameters displayed during program review.

Backup: ("B" on keypad) used to examine the previous parameter when reviewing the program.

NOTE: The "A" and "B" keys have slewing capability, i.e. if held down, they will continuously scan through memory.

Clear: ("C" on keypad) used to clear displayed data or turn off all three events if displaying event status.

Data Entry: ("D" on keypad) must be pushed whenever data is to be stored in the memory.

NOTE: NO INFORMATION IS STORED UNLESS THE "DATA ENTRY" (D) KEY IS PUSHED AND THE KEYLOCK IS IN THE REPROGRAM POSITION. THE DISPLAYED PARAMETER IS THEN STORED IN PROGRAM MEMORY.

Start: push to start the temperature program.

Hold: push to stop the program's execution. (Does not turn off heat/cool.) - Program can be resumed by pushing START button.

End Program/Cycles: used to set the number of times the temperature program is to be executed and to define the end of the program.

Review: push to review the stored Rate, Setpoint, Soak Time, Deviation, and Event functions.

Reset: push to return to the first segment of the displayed program while in REVIEW or HOLD mode.

Keylock: disables the "DATA ENTRY (D)" key to prevent program changes when in the "Program Lock" position.

Back Panel: (Refer to Fig. 15)

Power: turns on AC power to the programmer. This switch must be on at all times for the programmer to be operative.

INDICATORS

Power: LED to indicate that power is ON.

Start: LED to indicate that the program is running.

Cycles: LED to indicate that the number of program executions is displayed.

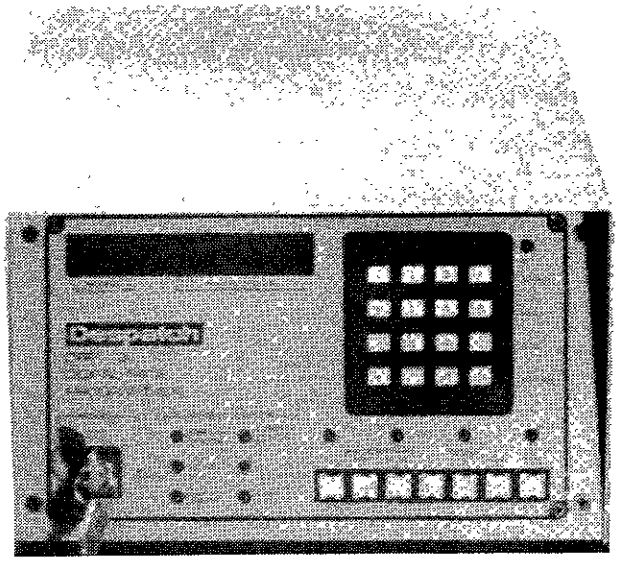
Review: LED to indicate that the REVIEW mode is selected.

Program Function LEDS: There is a seperate LED for rate, setpoint, soak time, process deviation limits and events. Each LED is turned ON when the parameter corresponding to it appears on the display. The setpoint LED is turned ON while the process temperature approaches the setpoint. The soaktime LED turns ON while the program is in the soak function.

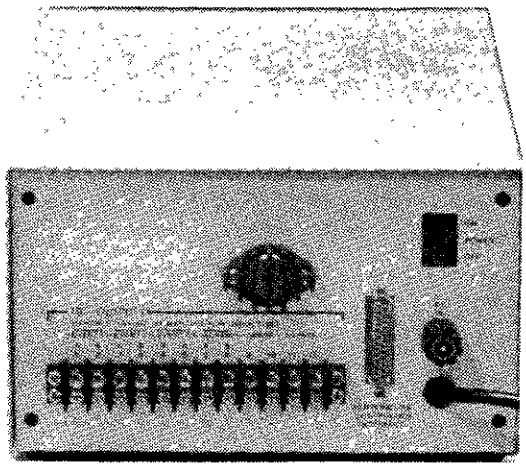
OPERATING THE PROGRAMMER

The programmer has the following modes:

(a) Start/Run



DRP-13 TEMPERATURE PROGRAMMER FRONT PANEL
FIGURE 14



DRP-13 TEMPERATURE PROGRAMMER REAR PANEL
FIGURE 15

(b) Hold

(c) Review and Reprogram

(d) End Program/Cycles

REPROGRAM

The Reprogram mode is the most important because it is in this mode that the data for the temperature program is stored into the Setpoint Programmer's memory.

To write the temperature program, determine the desired setpoint temperatures, soak times, and rates of temperature change, allowable process deviations, and any external events required and write them down on a PROGRAMMER WORKSHEET.

It is helpful to plot the temperature program on a chart as shown in Figure 3 and list the program parameters on the programming worksheet shown in Figure 4.

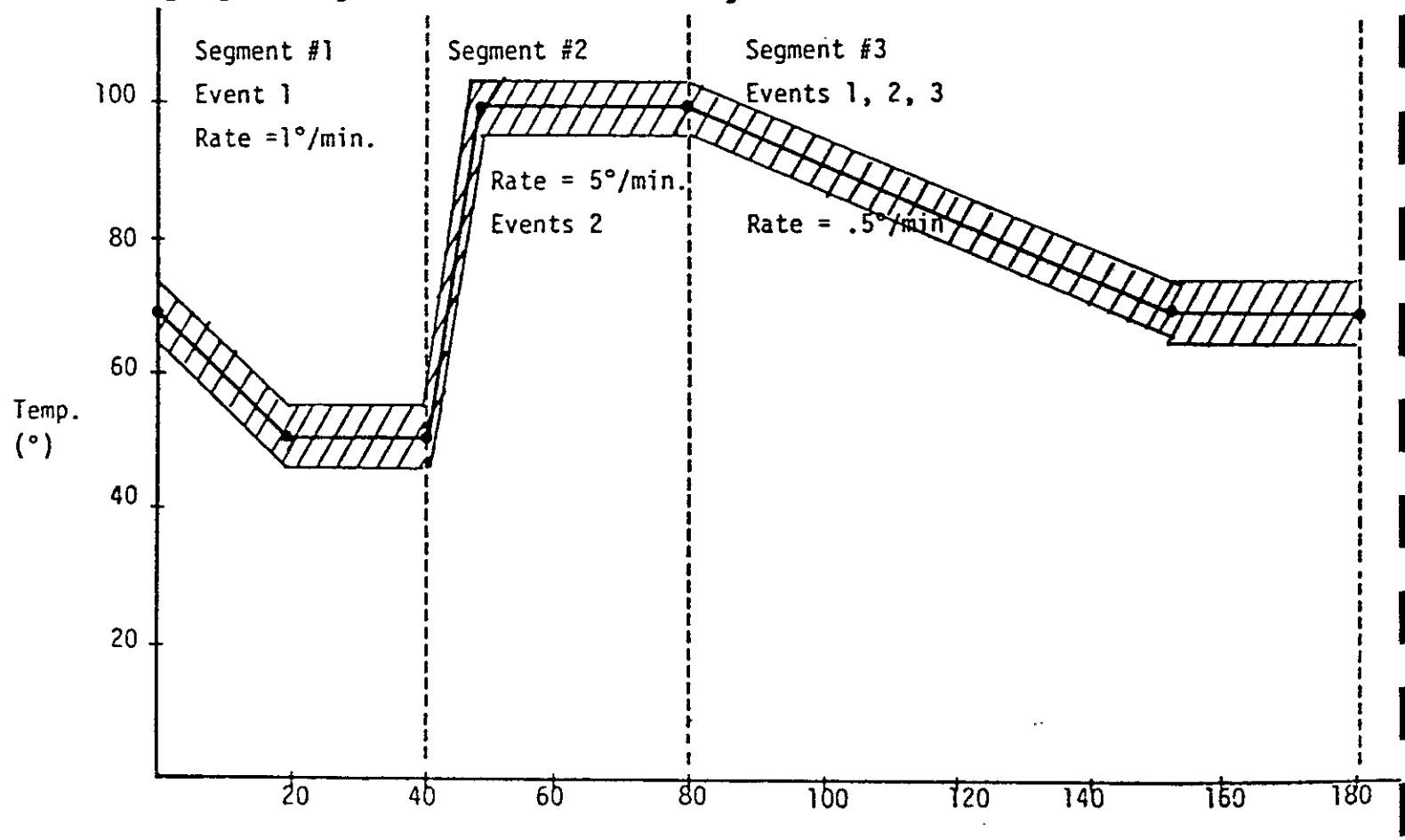


Figure 16

Date:_____

DRP-13 PROGRAMMER WORKSHEET

Program:_____

SEGMENT	RATE	SETPOINT	SOAK TIME	PROCESS DEV.	EVENTS		
	°/min.		(min.)	±° LIMITS	3	2	1
1	1.0	50	20	5			1
2	5.0	100	30	5		2	
3	.5	70	40	5	3	2	1
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Total program cycles LP = 4 (End of Program set by pushing End Program/ Cycles button.)

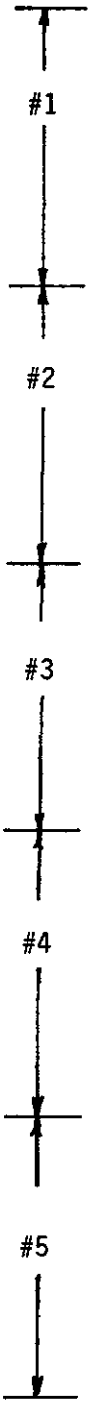
NOTE: 1. Press DATA ENTRY after each item gas been keycd in.
2. Program Segment Display should show the first program segment number before START is pressed.

Figure 17

SAMPLE WORKSHEET OF MULTIPLE PROGRAMS
DRP-13 PROGRAMMER WORKSHEET

Date:_____
Program:_____

	SEGMENT	RATE	SETPOINT	SOAK TIME	PROCESS DEV.	EVENTS		
		°/min.	°C	(min.)	±° LIMITS	3	2	1
	1	----	-55	10	4	3		
#1	2	----	+25	5	4	3		
	3	----	+85	10	4	3		
	4	----	+25	5	4	3		
DUMMY	5	----	+25	0	4	-		
E.O.P.	6	*25	CYCLES					
	7	----	-55	10	4	3		
#2	8	----	+25	5	4	3		
	9	----	+125	10	4	3		
	10	----	+25	5	4	3		
DUMMY	11	----	+25	0	4	-		
E.O.P.	12	*10	CYCLES					
	13	----	-65	10	4	3		
#3	14	----	+25	5	4	3		
	15	----	+150	10	4	3		
	16	----	+25	5	4	3		
DUMMY	17	----	+25	0	4	3		
E.O.P.	18	*15	CYCLES					
	19	----	-65	10	4	3		
#4	20	----	+25	5	4	3		
	21	----	+200	10	4	3		
	22	----	+25	5	4	3		
DUMMY	23	----	+25	0	4	-		
E.O.P.	24	*20	CYCLES					
	25	----	-65	10	4	3		
	26	----	+25	5	4	3		
#5	27	----	+300	10	4	3		
	28	----	+25	5	4	3		
	29	----	+25	0	4	3		
E.O.P.	30	*20	CYCLES					



Total program cycles LP = __*__ (End of Program set by pushing End Program/ Cycles button.)

NOTE: 1. Press DATA ENTRY after each item gas been keyed in.
2. Program Segment Display should show the first program segment number before START is pressed.

Figure 18

Reprogram (continued)

Having listed the functions for each program segment (up to 30, including the E.O.P. separator, are permitted), determine the number of times the temperature program is to be repeated. It is important to keep a written record of the temperature program. This will facilitate data entry into the Programmer and be a useful reference.

ENTERING PROGRAM DATA

The rate of temperature change selected should be one that the system can follow. If the change rate selected is not possible, the Programmer will wait until the environment reaches within 0.4° (4° for hi temp unit) of the desired temperature before proceeding with the program.

PROGRAMMING EXAMPLES

The "Rate" function in the first segment of the temperature program will start from ambient temperature. In the example in Figure 16, segment 1 begins with a room ambient temperature of 75°.

The program parameters include a process deviation of 5° for all segments of the program. Soak times and temperature change rates vary and various events are turned on for each program segment.

The program is to be executed four times before the programmer shuts the temperature controller down automatically.

The program for this is as follows:

Segment 1:

Rate: 1°/min.
Setpoint: 50°
Soak time: 20 min.
Process deviation: ±5°
Events: 1

Segment 2:

Rate: 5°/min.
Setpoint: 100°
Soak time: 30 min.
Process deviation: ±5°

Events: 2

Segment 3:

Rate: .5°/min.
Setpoint: 70°
Soak time: 40 min.
Process deviation: ±5°
Events: 1,2,3

Segment 4

E.O.P. - LP = 4

DATA ENTRY INSTRUCTIONS

(If a program has been running, press HOLD.)

1. Put the keylock in the "Reprogram" position.

2. Make sure that power is ON.

3. Press the REVIEW button.

4. The first segment of the program to be overwritten (replaced) and the RATE LED should be ON. If not, press the RESET button.
Multiple Programs: To enter a new program without overwriting an existing one, advance the display to the next segment past the E.O.P. separator of the existing program.

Observe that the RATE LED is ON. Enter the rate parameter for segment 1 on the keypad. A "1.0" will be displayed in the four-digit section of the display corresponding to a one degree per minute rate of change of temperature.

If an entry error is made, press the CLEAR button and re-enter the proper data.

6. When the display indicates the rate parameter desired, press the DATA ENTRY button ("D" on the keypad), causing the displayed value to be stored in memory and automatically advancing to the next parameter to be entered.

7. The Setpoint LED will come ON, indicating that the setpoint parameter is to be entered.

8. Enter 50 on the keypad and push the DATA ENTRY button.

9. The Soak time LED will come ON. Enter 5 on the keypad and press the DATA ENTRY button.

10. The deviation LED will come ON. Enter 5 on the keypad and press the DATA ENTRY button.

NOTE: If no process deviation limit is desired for the segment, press the CLEAR button (C) on the keypad, then push DATA ENTRY (Dashes will be displayed).

11. To enter EVENTS, press CLEAR to reset any previously entered events, and enter "1". The display will show "1...E". Push the DATA ENTRY button.

12. The Segment Number section of the display will now advance to the next program segment. Proceed, entering all functions for segments 2 and 3.

13. After all data for all segments have been entered, and the segment display is indicating the next (unused) segment,push the End Program/Cycles button. The segment number is now replaced by "LP" (for loops i.e. cycles). Note: do not reset before pressing End Program/Cycles Button. The segment number displayed prior to entering the End Program Mode will be defined as the End Of Program (E.O.P.) separator.

14. Enter 4 on the keypad for 4 cycles of the program. Push the DATA ENTRY button and the Programmer will display the segment number of the first segment in the program, as it is automatically positioned at the start of the program. Turn the Keyswitch to the Program Lock Position.

PROGRAM REVIEW

After the program has been entered, it is a good idea to review it to assure that all data has been correctly entered.

To review, press the REVIEW button and be sure that the key switch is in the LOCKED position. The display will indicate the program segment and the numbers shown in the Program Function portion of the display will correspond to the function indicated by the ON LED. To step through all parameters, push the ADVANCE button ("A" on keypad). This will advance the display successively through all parameters. Holding the "A" or "B" button down slews the program through the segments.

RUNNING THE PROGRAM

To run the program, push the START button.

The key can only be removed in the PROGRAM LOCK position.

When the START button is pushed, the program will start at the beginning of the segment displayed when the key switch was turned to the PROGRAM LOCK position. This feature allows the program to be started at any segment by entering the REPROGRAM MODE and advancing the segment number to the desired starting point. This feature also allows multiple programs to be stored in memory and selectively executed by calling up the starting segment number in the REPROGRAM MODE then turning the keyswitch to the PROGRAM LOCK position.

PROGRAM EXECUTION

While the program is running, the display will indicate the segment number and the LED above the START button will be ON. The program function LEDS will indicate what is shown in the Program Function section of the display.

While the temperature is changing to reach the soak temperature, the Setpoint LED will be ON and the display will indicate the actual setpoint transmitted to the controller. Process deviation is monitored at all times except during a step function if a deviation limit is programmed.

Soak time begins when the temperature is within + or - 0.4° of the setpoint. At this time, the SETPOINT LED will go OFF and the SOAK LED will come ON. The display will show the soak time remaining in the segment. During the soak time, process deviation is monitored. If the deviation limit is exceeded, the PROCESS DEVIATION LED will flash and a steady state contact closure will be present on pins 7 and 8 of the terminal strip on the rear panel and the program will stop. The program can be restarted by pushing the START button.

When the program has been completed, the programmer will automatically shut off the temperature controller and E.O.P. will appear on the display. The programmer will then stay in the HOLD mode until restarted.

The remaining sections will describe the programmer functions.

ENTERING A NEW PROGRAM

Before entering a new program turn the keyswitch to REPROGRAM, and advance or backup to the desired location of the first segment of the new program.

TO CHANGE EXISTING PROGRAM DATA

Put the keyswitch into the REPROGRAM position. If running, press HOLD then REVIEW. Advance or backup to the desired segment and change the data by pressing the appropriate keys and the DATA ENTRY button.

RESET

To stop a program and restart it at the beginning of the program, push the HOLD and and then the RESET buttons. This returns the program to its first segment. Push the START button to begin program execution.

REVIEW

Program functions may be reviewed by pressing the REVIEW button. The advance and backup buttons can be used to step or scan through the program. Program execution must have been halted previously by pressing HOLD. The REVIEW LED will be ON.

When START is pressed and the keyswitch has remained in the PROGRAM LOCK position, the program will continue from the segment where it was halted. If the keyswitch is in the REPROGRAM position during review, the program will restart from the segment shown on the display at the time it is returned to PROGRAM LOCK position.

CYCLES

Cycles is the number of times a program is executed and is the last step in program entry. Up to 9999 are possible.

If less than 30 program segments are used, the end of the sequence is defined by the entry of the Cycles function. If all 30 are used (no cycles entry) the program will cycle endlessly.

A built-in counter decrements each time the program is repeated. When the HOLD and then the CYCLES button is pressed, the number of remaining CYCLES, including the one currently being executed, is displayed.

HOLD

The HOLD mode can be used to temporarily stop the program. During this mode, the setpoint, soak timer, and cycles counter are maintained at the point where the HOLD button was pushed.

To resume the program, push the START button and the program will continue at the segment where it was stopped.

PROCESS DEVIATION

The Process Deviation Limit function in the programmer monitors the actual process temperature during temperature ramp and soak time. In the case of a "Step Change of Setpoint" i.e. "----" Rate function, Deviation limits are only monitored after the process temperature has approached to within 0.4° (4°) of the new Setpoint.

The magnitude of the deviation limit is programmable for each of the program segments; the positive and negative deviation limits must be the same.

When the deviation limit is exceeded, the PROCESS DEVIATION LED flashes. In addition, a steady contact closure is provided between pins 7 and 8 on the rear panel terminal strip.

The minimum deviation limit is 0.1° (1° on high temp units); however, it is advisable to use 2.0° as a minimum to prevent false alarms. Maximum deviation is 799.9° (7999° on high temp units).

If Process Deviation monitoring is not required for the program segment, it must be "cleared" by the "Clear Key" ("C" key on the keypad) followed by the "Enter key".

When no Process Deviation function has been selected, the display will show four dashes (----) when the Process Deviation LED is ON.

EXTERNAL EVENTS

Three relays in the programmer allow control of external events. Any combination of the three relays may be used in each program segment. The events to be turned ON must be entered for each program segment.

When the segment is running, the selected events will be ON, i.e. the relays will be closed. The selected events will remain ON (even in HOLD mode) until the next segment is executed.

A terminal strip on the back panel provides connections.

PROGRAMMING EVENTS

The keyswitch must be in the REPROGRAM position.

The Events are programmed as a function in each segment when the EVENT LED is ON. Enter the number of each "ON" event via the keypad, and then press the the DATA ENTRY button.

The right-hand position of the display will contain an "E" and the remaining segments will show which events are ON.

Pushing the CLEAR button turns OFF the events displayed, but does not alter the memory until the DATA ENTER button is finally pushed.

All events remain in this last state at the end of the program.

END OF PROGRAM

The Programmer automatically shuts off the Heat & Coolant at the end of the program sequence. Power remains on to protect the memory and E.O.P. appears on the display.

E.O.P. is determined when the last segment of the sequence is completed and the cycles counter has reached zero. To restart, press the START button. The previously programmed number of cycles will again be executed.

BATTERY BACKUP

Battery Backup is not required as the program information is stored in the Non Volatile Memory. A power fail detection circuit in the system senses loss of AC power and allows the microcomputer to store the pertinant information before the power is lost completely.

After a power failure, during program run, operation will continue from where it left off. If not "running" at the time of power failure, the programmer operation will be identical to an initial power-up situation, but the program memory will be preserved. The programmer will come up in a REVIEW mode,

displaying the first function of the program sequence.

If power is returned and, for any reason, the memory has not been preserved, the display will read HELP. Program data must then be reentered.

AUTO CHECK

In the event of a "brown out" or momentary decrease of power to the programmer or line transient, the memory will be preserved and the temperature program will automatically be continued from the point at which it was interrupted.

MALFUNCTION

If the temperature controller malfunctions for any reason, such as an open probe, exceeded temperature limits, or if it is not in the remote mode, program execution will not start, and the display on the programmer will show four dashes (----) until the malfunction or error condition is corrected.

DESPATCH 422 SERIAL INTERFACE MODULES

The DESPATCH Model 422 Serial Interface makes it easy to "remotely operate" temperature controllers and other functions based on a parallel port (like the DESPATCH Model RS 232 GPIB Interface Module) with a terminal or computer system over an RS422 full duplex "party-line" network.

Each module has a built-in photo isolator which electrically isolates the 422 party-line from the satellite module.

The serial interface module services two temperature controllers or two 16 line parallel ports like those of the DESPATCH IEEE-488 GPIB Interface. Consequently, only one module is required for every two temperature controllers, parallel ports, or combination thereof. A third optional 16 line parallel port is also available.

All reference to the ports are direct (i.e. IO1, IO2, or IO3).

Switches S1 & S2 located on the rear panel of the 422 Interface Module assign the module address.

The acceptable address numbers are 00 through 99, and must be preceded by a # sign. If both digits are not present when addressing a module a leading zero is assumed.

If any port selection is made other than IO1, IO2 or IO3 the previously selected port will remain active. A response of "BAD CMD "is returned.

Once a module is addressed and a port selected, it will remain active and all following commands will be executed at that port until the next legal address and or port assignment is sent, or a parity error is detected.

Upon power up the module is configured for Binary input mode with Port 1 selected.

Despatch Industries, Inc. ■ P.O. Box 1320 ■ Minneapolis, MN 55440-1320
(612) 781-5363 Fax: (612) 781-5353

Despatch

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Each module has an "input" RS422 37 pin connector and an "output" RS422 37 pin connector. The modules can be connected in a party line or star configuration as required and can be operated at a total cable length of up to 4000 ft. Terminator plugs must be installed at the end of each chain. These are the "H" and "J" jumper plugs on each satellite module.

The network can be expanded to a maximum of 100 modules by simply adding modules as required. Again, note that one module will service two controllers and the optional third parallel port.

Example: 50 temperature controllers can be serviced by 25 JCS interface modules.

The network will continue to operate even if some modules are switched OFF. However, switching a module ON may momentarily interfere with an on-going transmission from another module to the computer.

BAUD RATES (JUMPER SELECTABLE)

300
1200
2400
4800
9600
19200

PARITY (JUMPER SELECTABLE)

EVEN/ODD
DISABLE/ENABLE

OPTIONAL AUTOMATIC LINEFEED GENERATION (JUMPER SELECTABLE)
(to go with Carriage Return)

THE LIST OF INSTRUCTIONS ARE AS FOLLOWS:

TEMP CONTROLLER MODE:

Select Port 1 Reply is: OK	IO1
Select Port 2 Reply is: OK	IO2
Select Port 3 (optional) Reply is: OK	IO3
Is addressed port operational ? Reply is: OK(cr)	#nn?
Change setpoint to new value and set addressed controller to "REMOTE" mode Reply is: OK(cr)	#nn(sp)xxx.xT(cr)
Read previously sent setpoint Reply is: xxx.x(cr)	#nn(sp)RS(cr)
Read the process temperature Reply is: S+xxx.x(cr) (Ports 1 & 2 only)	#nn(sp)RT(cr)
Kill (turn off both heat and coolant if not in "Scaled" mode) Reply is: OK(cr)	#nn(sp)K(cr)
Set addressed temp controller to "Local" mode Reply is: OK(cr) (Ports 1 & 2 only)	#nn(sp)LCL(cr)
Set addressed temp controller to "Remote" mode Reply is: OK(cr) (Ports 1 & 2 only)	#nn(sp)RMT(cr)

BINARY MODE:

Manipulation of parallel port bits and BCD or HEX Reads and Writes:

Select Port 1 — IO1
Reply is: OK

Select Port 2 — IO2
Reply is: OK

Select Port 3 (optional) — IO3
Reply is: OK

Set bit 0 to the "1" or hi state — #nn(sp)S0(cr)
Reply is: OK(cr)

Bits 1 through F are set in the same manner.

Reset bit 0 to the "0" or low state — #nn(sp)R0(cr)
Reply is: OK(cr)

Bits 1 through F are reset in the same manner.

Latch (write) 4 hex (BCD) characters to a port (where hhhh means 4 digits of Hex) — #nn(sp)hhhhP(cr)
Reply is: OK(cr)

Read the 4 hex (BCD) characters (16 lines) of a port — #nn(sp)RP(cr)
Reply is: hhhh(cr)

Can be used for handshaking on ports 1 & 2 only. Takes RMT line low. — #nn(sp)RMT(cr)
Reply is: OK(cr)

Can be used for handshaking on ports 1 & 2 only. Takes RMT line high. — #nn(sp)LCL(cr)
Reply is: OK(cr)

8 BIT INPUT/8 BIT OUTPUT BINARY PORT COMMANDS

Read low byte (lines 0-7) from selected port. This command returns a two character ASCII string representing the HEX or BCD state of the low byte, just as RP returns a 4 character string representing the entire 16 line port. It also configures the low byte as an input. The high byte configuration is unchanged.	#nn(sp)RL(cr)
Read high byte (lines 8-15) from selected port. Similar to action of RL.	#nn(sp)RH(cr)
Write low byte, where hh represents two ASCII coded hex or BCD characters, of selected port (lines 0-7), just as hhhhP writes a four character string to the entire 16 line port. This command also configures the low byte as an output. The high byte configuration is unchanged.	#nn(sp)hhL(cr)
Write high byte (lines 8-15) of selected port. Similar to action of hhL.	#nn(sp)hhH(cr)

On power up all bytes are configured for the Binary input mode with port 1 selected.

The set and reset bit commands configure only the byte in which they reside as an output. The other byte of the selected port is unchanged.

The read and write byte commands will not change the configuration of the other byte unless the command is changed. For example; if the low byte is configured as an output, and the high byte is changed from an input to an output or an output to an input, the low byte will be cleared and immediately restored.

SCALED MODE:

Select Port 1 Reply is: OK	IO1
Select Port 2 Reply is: OK	IO2
Select Port 3 (optional) Reply is: OK	IO3
Set zero scaling point (decimal number which causes an output of binary 000) and turn on "Scaled" mode for addressed port Reply is: OK(cr)	#nn(sp)xxx.xZ(cr)
Set full scale point (decimal which causes an output of binary (hex)FFF & turn on "Scaled" mode for addressed port Reply is: OK(cr)	#nn(sp)xxx.xX(cr)
Read the zero scaling point of the addressed port Reply is: xxx.x(cr) or ----(cr) if not in "Scaled" mode	#nn(sp)RZ(cr)
Read the full scale point of the addressed port Reply is: xxx.x(cr) or ----(cr) if not in scaled mode	#nn(sp)RX(cr)
Change scaled setpoint to a new value. Reply is: OK(cr)	#nn(sp)xxx.xT(cr)
Read BCD setpoint Reply is: S+xxx.x(cr)	#nn(sp)RT(cr)
Kill scaled mode.	#nn(sp)K(cr)

Place port in temp controller mode. (See "K" command in temp controller mode.)

Can be used for handshaking on ports 1 & 2 only. Takes RMT line low. Reply is: OK(cr)	#nn(sp)RMT(cr)
Can be used for handshaking on ports 1 & 2 only. Takes RMT line high. Reply is: OK(cr)	#nn(sp)LCL(cr)

Command format:

The following codes and symbols are used:

(cr)	means an ASCII carriage return
(sp)	means an ASCII space. Additional spaces are ignored.
#nn	means an ASCII pound sign followed by a two digit decimal number between 00 and 99 (inclusive). The two digits are the address of the JCS RS-422 module.
xxx.x	means 3 decimal digits followed by a decimal point followed by a decimal digit. A "+" or a "-" can precede the numerical value.
hhhh	means 4 or less hex characters.
S	means a status character in the reply from a temperature controller. The actual character is "N" if the process temperature differs from the setpoint temperature by more than the controller's preset null band. An "L" is presented if the Setpoint exceeds controller LIMITS causing controller shutdown. "L" is also presented if a KILL command is in effect. An "F" is presented if there is a problem at the controller i.e. no response from controller due to open thermocouple, hardware failure, power failure or disconnected cable. In all other cases a (sp) is returned.

Notes:

1. The Serial interface will transmit a reply of "BAD CMD" to unrecognized or incorrect commands.

2. A command can be aborted (and the port disconnected) by terminating it with #(cr).

3. If #nn(sp) is omitted from a command, it will be executed by the most recently addressed port, provided that the port has not been disconnected with #(cr). This holds true even if the module's address switches are changed.

4. When addressing a module if two digits are not present, a leading zero is assumed. A module will only become active with a valid address command. An invalid address command will disconnect the module from the Party Line.

5. A parity error will disconnect the module from the Party Line.

6. All replys will be in the form of "OK", "BAD CMD", Data, or No Response.

CONNECTING THE INTERFACE (422A) TO THE USER'S EQUIPMENT:

You will be connecting to a RS-422A level port.

Utilize the 37 pin connector (P3) for RS-422A level signals.

Pin outs on RS-422A port (P3)

Function		Pin Number
Chassis Ground		1
XMT Data (A)	(serial data output)	4
XMT Data (B)	(serial data output)	22
RCV Data (A)	(serial data output)	6
RCV Data (B)	(serial data output)	24
Signal Ground	(Network common for MODULE)	19

Please note: The **Bold Face** functions are absolutely necessary to the operation of the JCS Serial Interface.

Connect the twisted signal pair containing the data coming to the Serial Interface to pins 6 and 24.

Connect the twisted signal pair for the data being transmitted to the users equipment to pins 4 and 22.

Connect the signal ground from the network to pin 19 to ensure that there is a proper ground return for the photo isolators of the 422 MODULES.

This completes the interface connections between the User's equipment and the Serial Interface Module.

Remove the cover on the module (bench mount type of package) then proceed as follows:

Note: A jumper is active when it is placed across two adjacent pins on the header.

1. Place a jumper on header S3 for the appropriate baud rate selected.

2. Select ODD Parity by placing the jumper on the "ODD Parity" header location.

3. Enable PARITY by placing the jumper on the "PARITY" header location.

4. Enable AUTOMATIC LINE FEED by placing the jumper on the "AUTO LF" header location. (This causes a CR LF to be generated with the reply from the Satellite instead of just a CR as the message terminator.)

Use three twisted pair shielded cable for the inter-connections between the computer and the Modules. The same cable is used for the party line connections Module to Module.

Make up the interconnection cable per the following pin out information using #24 AWG stranded shielded twisted pair wire and connect the various modules together. Larger size wire may be utilized but 24 gauge is the minimum that should be used.

Cinch DC-37P 37 pin male plug (P3)				Cinch DC-37S 37 pin female plug (P4)
#1	--	shield	--	#1
#6	--	(A) rcv data	--	#6
		twisted pair		
#24	--	(B) rcv data	--	#24
#4	--	(A) xmt data	--	#4
		twisted pair		
#22	--	(B) xmt data	--	#22
#19	--	----- signal ground --	--	#19
		twisted pair		
N/C	--	----------	--	N/C

Serial Coding **XMT & RCV:**

ASCII, with 7 bit frame width plus selectable parity bit. One start bit, one stop bit. If Parity Enable jumper is disconnected (out), Parity xmtd is 0, and rcvd Parity bit is ignored. The Parity Bit is the most significant bit and is the last bit transmitted.

PARITY ENABLE JUMPER	EVEN/ODD JUMPER	XMT	RCV
OUT	OUT	PARITY BIT = 0	PARITY BIT IGNORED
OUT	IN	PARITY BIT = 0	PARITY BIT IGNORED
IN	OUT	ODD PARITY BIT	ODD PARITY BIT (OTHERWISE NO RESPONSE)
IN	IN	EVEN PARITY BIT	EVEN PARITY BIT (OTHERWISE NO RESPONSE)

NOTE: XMT & RCV 8 BITS TOTAL REQUIRED.

OPTIONAL ACCESSORIES:

The RS-422 Serial Interface has three options available.

1) A1740 RS232 - RS-422 LEVEL SHIFTER

   The A1740 converts RS-232C to RS-422A signal levels. It has a self-contained power supply, and can provide optional photo isolation between the computer control being used and the RS-422 network.

2) OPTIONAL THIRD INPUT/OUTPUT PORT (PORT 3)

   This optional port is contained within the RS-422A module. It is comprised of an additional PC Board and rear connector. The optional third output port is configured for all but two port operations.

   1. There is no RMT line on port 3. (No LCL or RMT command)

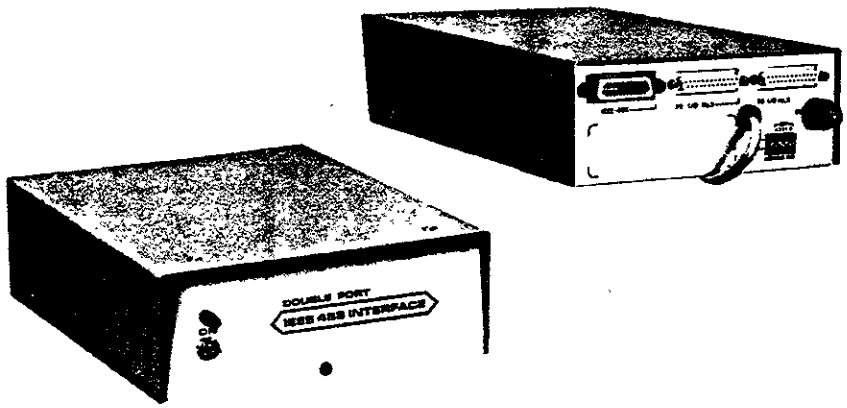
   2. A process temperature can not be read from this port. (No RT command)

3) MODEL A1034 4-20 ma. (0-16 ma.) CURRENT LOOP:

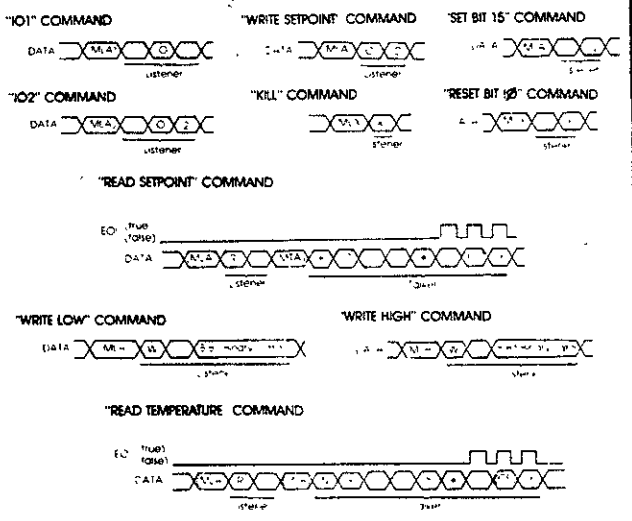
   The A1034 can be plugged into any one of the 16 bit ports on the Serial Interface Module(s).

   Special commands allow the current loop output to be scaled so that an external controller, valve positioner, power controller, etc. can be remotely manipulated via the Serial Interface Network in engineering units. This eliminates the requirements for converting all desired setpoints to percentages of full scale.

DOUBLE PORT IEEE-488 INTERFACE
MODEL C80188



BUS DATA TRANSFER DIAGRAM



- Ideally suited to process control applications
- Special commands for temperature control
- Two 16-bit I/O ports
- On/off control of up to 32 devices
- Control up to two temperature controllers
- Bit manipulation commands
- All functions software controlled by user
- Self-contained; no packaging required
- All bits addressed and read
- Self-contained microcomputer
- Use with any GPIB controller
- Meets IEEE Std. 488-1978
- Compatible with **the** Double Adaptive Digital Temperature Controller

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Despatch

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DOUBLE PORT INTERFACE MODEL C80188

Automatic process control functions are possible with the **RII** Intelligent Double Port IEEE-488 Interface. Designed for use with bus controllers such as the HP 9825 or the Fluke 1720A Instrument Controller, the **RII** Double Port Interface provides two 16 bit I/O ports. Both can be used for either temperature control or binary applications, allowing instruments on the bus to be "talkers" and "listeners"

FLEXIBILITY

For added flexibility, each port may be partitioned into two separately controlled 8-bit ports, allowing a total of four 8-bit ports. This permits input and output to occur simultaneously at the same port.

Ports may be further subdivided to the bit level so that each of the port's 16 bits may be individually addressed. Special bit manipulation commands simplify on/off control.

COMMANDS

Standard ASCII characters are used in the commands which include status characters and specially created commands for use with temperature control applications. Invalid characters are ignored by the software.

MODES

Temperature control mode (with its own command set) and binary mode (for all other applications) are available at both ports. For ease of operation, port I/O configuration is automatic; the correct mode is always assumed for the command issued.

DATA TRANSMISSION

Data is transmitted only after the computer gives a "ready for data" signal. EOI (end or identify) signal, CR (carriage return) and LF (line feed) all end the transmission. EOI is always raised with the last character transmitted. However, these signals are not required by the interface for command termination

CONTROL

On/off control of up to 32 devices.

PROGRAMMING

All functions are user programmable. A complete list of commands and software examples are shown
No factory pre-programming or reconfiguration is required.

PACKAGING

The interface is attractively packaged in a sturdy baked-enamel aluminum enclosure. It is supplied complete with connectors, address switch, and power-on LED indicator. No modifications are required prior to installation.

SPECIFICATIONS

Package size: 15"×7"×3"
Port connectors: two 25-pin connectors, Ansley PN 60925S. Mating connector is Cinch DB-25P or equivalent.
Bus connector: conforms to IEEE-488-1978 standard.
Address: 5 bit address switch
Commands: all ASCII characters
8 commands for binary mode
4 commands for temperature controller mode
LED power-on indicator.
4 Status characters
Weight: 3.5 lbs.
Power: 120V, 20W, 50/60 Hz.
Options: 16 line input isolator accessory A1160
16 line output isolator accessory A1164
8 line input/8 line output isolator A1176

COMMAND SET

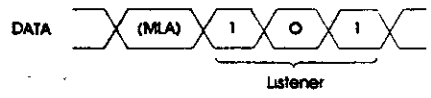
NOTE: Commands and modifiers are written as ASCII characters or strings.

Command	Modifier	Function (Binary Commands)
IO	1	Set IO1 mode. All I/O operations which follow will be at P1.
IO	2	Set IO2 mode. All I/O operations which follow will be at P2.
S … S	Ø … F	SET bit line (Ø-15) designated by the modifier character on the port selected by the last IO command. This command places the accessed byte into the latched binary output mode.
R … R	Ø … F	RESET bit line (Ø-15) designated by the modifier character on the port selected by the last IO command. This command places the accessed byte into the latched binary output mode.
W	Lb	WRITE LOW order byte on the port selected by the last IO command. The 8-bit binary word, b, is latched on the lower half of the output port.
W	Hb	WRITE HIGH order byte on the port selected by the last IO command. The 8-bit binary word, is latched on the upper half of the output port.
R	L	Prepare to READ LOW order byte from the port selected by the last IO command. This command places the accessed byte into the binary input mode.
R	H	Prepare to READ HIGH order byte from the port selected by the last IO command. Places the accessed byte into the binary input mode.
		Function (BCD/HEX Commands)
P		Preceding data is latched onto selected port. Four digits maximum. Leading zeroes may be omitted.
R	P	Prepare to READ BCD or HEX data from selected port. Data consists of a four digit ASCII string.
		(Special commands for use with the RII Double Adaptive Temperature Controller)
K		KILL heat, cool, and temperature display.
T		When preceeded by a number, the previous data string is interpreted as a setpoint in degrees. Data is decimal point, sign and four digits max. The setpoint is latched onto the port last selected with the IO command. This places the selected port into the temperature controller mode.
R	S	Prepare to READ the previously written SETPOINT from the last port selected. Accessed port is placed into the temperature controller mode.
R	T	Prepare to READ TEMPERATURE and status characters from the last port selected. Accessed port is placed into the temperature controller mode.

DOUBLE PORT INTERFACE

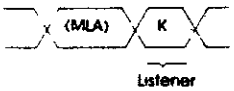
BUS DATA TRANSFER DIAGRAM

"IO1" COMMAND

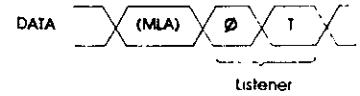


"IO2" COMMAND

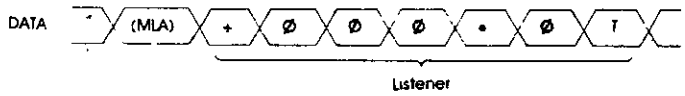
"KILL" COMMAND



"WRITE SETPOINT" COMMAND



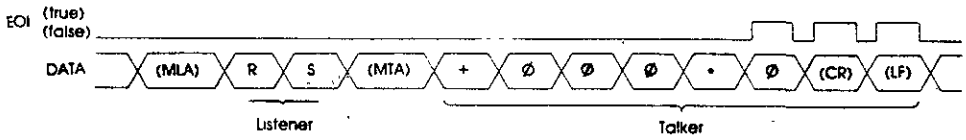
OR



(3 digits maximum if setpoint is an integer. Inclusion of "+" sign is optional. Data need not be terminated with CR, LE, or with EOI signal.)

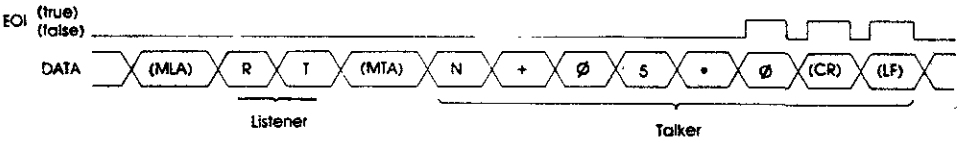
(4 digits maximum if setpoint is a decimal fraction. "+" sign is optional. Data need not be terminated with CR, LF, or with EOI signal.)

"READ SETPOINT" COMMAND



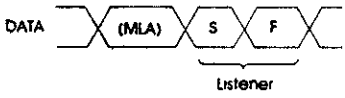
(Algebraic sign is always returned first.)

"READ TEMPERATURE" COMMAND

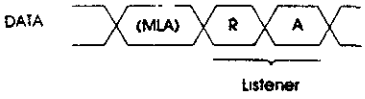


(Status character is always returned first, algebraic sign second.)

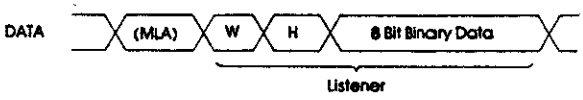
"SET BIT 15" COMMAND



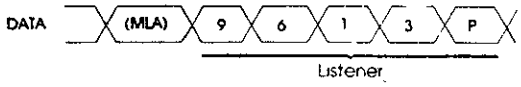
"RESET BIT 10" COMMAND



"WRITE HIGH" COMMAND

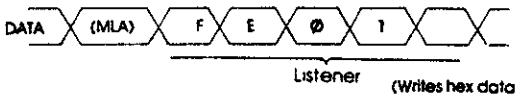


"WRITE PORT"



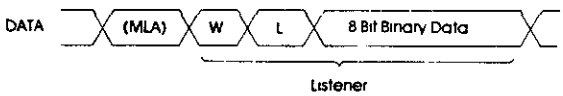
(Writes BDC data 9613 to selected port) NOTE. Teading zeroes may be omitted. Data need not be terminated with CR, LF, or EOI signal

OR

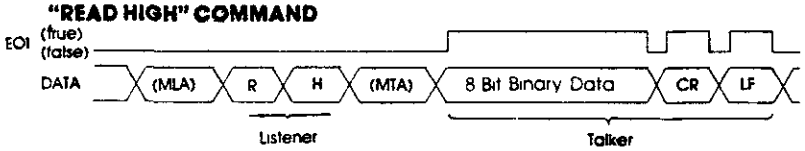


(Writes hex data FE Ø) to selected port

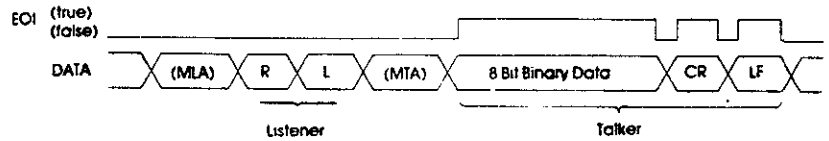
"WRITE LOW" COMMAND



"READ HIGH" COMMAND

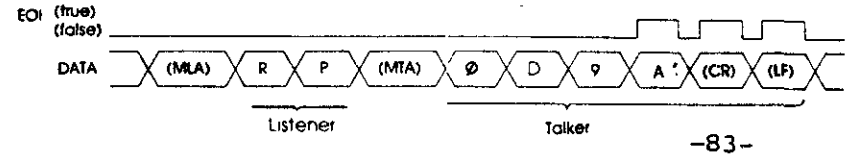


"READ LOW" COMMAND



(the timing of the READ HIGH command is identical.)

"READ PORT"



STATUS CHARACTERS

STATUS	CONDITION
	(ASCII space) Operation is normal; no alarms.
N	Controller NOT nulled. Temperature error is greater than 1.6°. (Can be detected only at Port 1.)
L	Setpoint exceeds controller LIMITS causing controller shutdown. Also indicated when a KILL command is in effect.
F	Controller failure. No response from controller due to open thermocouple, hardware failure, power failure or disconnected cable

Typical Application

OPERATION

First Power On
When turning on interface power, Ports 1 and 2 are automatically placed in the binary input mode. However, mode is automatically adapted to the requirements of the commands supplied.

VERIFY WITH AN OHMMETER THAT FRAME GROUNDS ARE CONNECTED TOGETHER IN THE SYSTEM BEFORE PLUGGING IN ANY PORT OR BUS CABLES.

Selecting a Port
On power-up P1 is automatically selected. To change, write IO followed by the number of the port to be addressed. Example: IO2 turns on P2. All further commands will be executed at P2 until P1 is selected by writing "IO1".

Temperature Control Mode
When both ports are in this mode, the temperature registers are updated once per second. If only one port is in the temp control mode, the register is updated twice per second.

Special commands for use with this mode are: RT, RS, T and K. Status characters L, N, F and [ ] are also unique to this mode.

Binary Mode
Either or both ports may be used in the binary mode. When changing mode, ignore the first read operation.

I/O PORT D.C. CHARACTERISTICS

SYMBOL	PARAMETER	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{IL}	Input Low Voltage	−Ø.5	Ø.8	V	I_{IL} = −4ØØ uA
V_{IH}	Input High Voltage	2.Ø	5.5	V	
V_{OL}	Output Low Voltage		Ø.45	V	I_{OL} = 5mA
V_{OH}	Output High Voltage	2.4			I_{OH} = 24Ø uA

DOUBLE PORT INTERFACE PINOUTS

I/O PORTS 1 AND 2

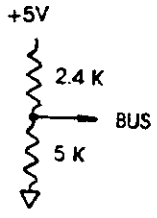
PIN #	Binary Mode Function	Temperature Controller Function • •
1	I/O Bit Ø	Setpoint/Temp. .1 Bit
14	1	.2
2	2	.4
15	3	.8
3	4	1
16	5	2
4	6	4
17	7	8
5	8	1Ø
18	9	2Ø
6	1Ø (A)	4Ø
19	11 (B)	8Ø
7	12 (C)	1ØØ
2Ø	13 (D)	2ØØ
8	14 (E)	4ØØ
21	15 (F)	Negative
9, 1Ø, 22, 24	Logic Common	Logic Common
11	(Do not use)	$\overline{\text{Controller Nulled}}$ •
24	(Do not use)	$\overline{\text{Temperature Interrogate}}$ Command
12	(Do not use)	$\overline{\text{Temperature Remote Enable}}$
25	(Do not use)	Setpoint Valid Command
13	+5V	+5V

• I/O Port #2 pinout is identical except for Pin 11, which has no connection.

•• **For the R11 Double Adaptive Temperature Controller**

TYPICAL BUS LINE

The Double Port Interface uses an IEEE-488 standard bus tranceiver which includes internal termination resistors for each bus line, as shown.



SOFTWARE EXAMPLES

In the following examples, 728 refers to the port number (7) and the bus address (28). This number may vary depending on the application. Examples shown are for the Fluke 1720A Instrument Controller, HP 9825, and PET Microcomputer.

BINARY COMMANDS

FLUKE 1720A	HP 9825	PET	FUNCTION
PRINT @28, "IO2"	wrt 728, "IO2"	OPEN 9, 28 PRINT #9, "IO2"	Sets IO2. All subsequent operations occur at Port 2.
PRINT @28, "SØ"	wrt 728, "SØ"	OPEN 9, 28 PRINT #9, "SØ"	Sets (raises to +5V) line Ø of selected I/O port.
PRINT @28, "RA"	wrt 728, "RA"	OPEN 9, 28 PRINT #9, "RA"	Reset (drop to ØV) line 1Ø of selected I/O port. A is a hexadecimal number for 1Ø.
PRINT @28, "WL"; CHR$ (A)	fmt "WL", b wrt 728, A or wtb 728, "WL", A	OPEN 9, 28 PRINT #9, "WL"; CHR$ (A)	Latch 8 bit binary number whose decimal equivalent is contained in variable A onto the lower byte of selected port.
PRINT @28, "RH" INPUT @28, A$ A=ASCII (A$)	wrt 728, "RH" rdb (728) →A or wrt 728, "RH" fmt b red 728, A	OPEN 9, 28 PRINT #9, "RH" GET #9, A$ A=ASC (A$)	Read high byte of selected port and store decimal equivalent of 8 bit binary number in variable A. CAUTION A binary zero cannot be read with PET'S GET command.
PRINT @28, USING "####", A$; "P"	fmt 4c, "P" wrt 728, A$	OPEN 9, 28 PRINT #9, A$; "P"	Write string variable A$ (4 hex characters max.) to previously selected port.
PRINT @28, "439EP"	wrt 728, "439EP"	OPEN 9, 28 PRINT #9, "439EP"	Write 439E to previously selected port.
PRINT @28, "RP" INPUT @28, A$	wrt 728, "RP" dim A$ (4) red 728, A$	OPEN 9, 28 PRINT #9, "RP" INPUT #9, A$	Read four digit hex data from previously selected port into A$.
PRINT @28, "RP" INPUT @28, A$ A=VAL (A$)	wrt 728, "RP" fmt f 4 red 728, A	OPEN 9, 28 PRINT #9, "RP" INPUT #9, A$ A=VAL (A$)	Read four digit decimal data from previously selected port into A.

TEMPERATURE CONTROL COMMANDS

FLUKE 1720A	HP9825	PET	FUNCTION
PRINT @28, "-11.1T"	wrt 728, "-11.1T"	OPEN 9, 28 PRINT #9, "-11.1T"	Write setpoint of −11.1° to selected I/O port.
PRINT @28, "1T"	wrt 728, "1T"	OPEN 9, 28 PRINT #9, "1T"	Write 1° to controller setpoint.
PRINT @28, "ØØ1.ØT"	wrt 728, "ØØ1.ØT"	OPEN 9, 28 PRINT #9, "ØØ1.ØT"	Write 1° to controller setpoint.
PRINT @28, "+319.7T"	wrt 728, "+319.7T"	OPEN 9, 28 PRINT #9, "+319.7T"	Write 319.7° to controller setpoint.
S$=NUM$ (S) + "T" PRINT @28, S$	fmt f6.1,"T" wrt 728, S	OPEN 9, 28 S$=STR$ (S) + "T" PRINT #9, S$	Write contents of variable S to controller setpoint. (S is a fixed point decimal quantity.)
PRINT @28, "RS" INPUT @28, S$	dim S$ (6) wrt 728, "RS" red 728, S$	OPEN 9, 28 PRINT #9, "RS" INPUT #9, S$	Read previously written controller setpoint from selected port and store six character ASCII string in variable S$. (First character is sign. 5th character is decimal point.)
PRINT @28, "RS" INPUT @28, S$ S=VAL (S$)	wrt 728, "RS" fmt f 6.1 red 728, S	OPEN 9, 28 PRINT #9, "RS" INPUT #9, S$ S=VAL (S$)	Same as above, except setpoint is stored as a fixed decimal quantity in variable S.
PRINT @28, "RT" INPUT @28, T$	dim T$ (7) wrt 728, "RT" red 728, T$	OPEN 9, 28 PRINT #9, "RT" INPUT #9, T$	Read controller temperature and status from selected port and store seven character ASCII string in variable T$. (First character is status, 2nd is sign, 6th is decimal point.)
PRINT @28, "RT" INPUT @28, T$ T=VAL (RIGHT (T$, 6)) T$=LEFT (T$, 1)	dim T$ (1) wrt 728, "RT" fmt c, f6.1 red 728, T$, T	OPEN 9, 28 PRINT #9, "RT" INPUT #9, T$ T=VAL (RIGHT$ (T$,6)) T$=LEFT$ (T$, 1)	Same as above, except status character is stored in string variable T$ and temperature is stored as a fixed point decimal quantity in variable T.

Industrial Equipment Commercial Warranty

Despatch Industries, Inc. warrants equipment manufactured by Despatch Industries, Inc., to be free from defects in workmanship and materials 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.

Components manufactured by others, including but not limited to expendable items, are excluded from this warranty and are warranted (if at all) 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.

If Purchaser gives written notice specifying the particular defect or defects within 14 days after discovery thereof, Despatch Industries, Inc. will correct without charge any workmanship that is demonstrated to Despatch Industries, Inc. satisfaction to have been defective at time of installation or erection and will repair or replace, at the warrantor's 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 equipment repaired or altered by others, unless such repairs or alterations were specifically agreed to in writing by an officer of Despatch Industries, Inc.

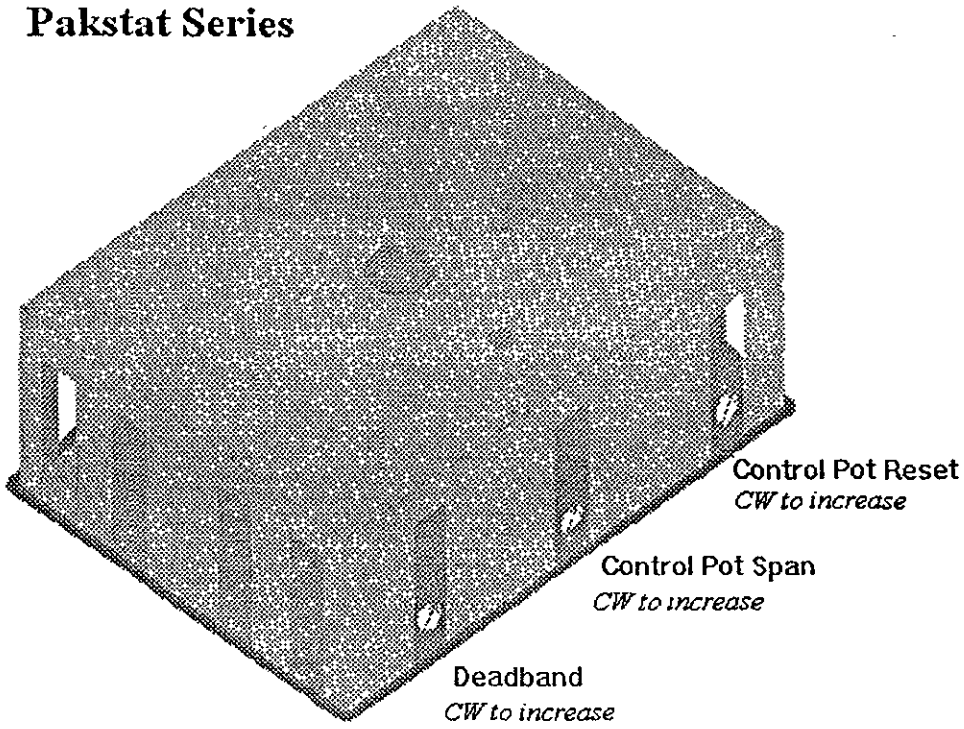
Despatch Industries, Inc. shall not be liable for incidental or consequential damages of any kind (whether for personal injury, lost profits or otherwise), whether arising from breach of this warranty, negligence or other tort or otherwise, which occur during the course of installation of equipment, or which result from the use or misuse by user, its employees or others of the equipment supplied hereunder, or from any malfunction or nonfunction of such equipment, 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.

The foregoing warranty shall be valid and binding upon Despatch Industries, Inc. if and only if user 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 user or the quality of product to be produced by the equipment supplied hereunder and Despatch Industries, Inc. shall not be liable for lost profits.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES AND REPRESENTATIONS WHATSOEVER, INCLUDING BUT NOT LIMITED TO THOSE OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

Pakstat Series



P14A0318-903 Pakstat

Calibration points:

Cal 1: 1360 +/- 12 ohms
Cal 2: 1978 +/- 12 ohms
Cal 3: 1666 +/- 12 ohms