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TUCKER MASTER DO NOT SHIP

ALPHA · MONARCH

INSTRUCTIONS
OPERATION & MAINTENANCE

TEST CHAMBERS
MODELS TC2, TC4

Model: _____

Serial: _____

Date: _____

Amendments _____

ALPHA-M CORPORATION

3009 Wildflower / Dallas, Texas 75229
214 620-0021

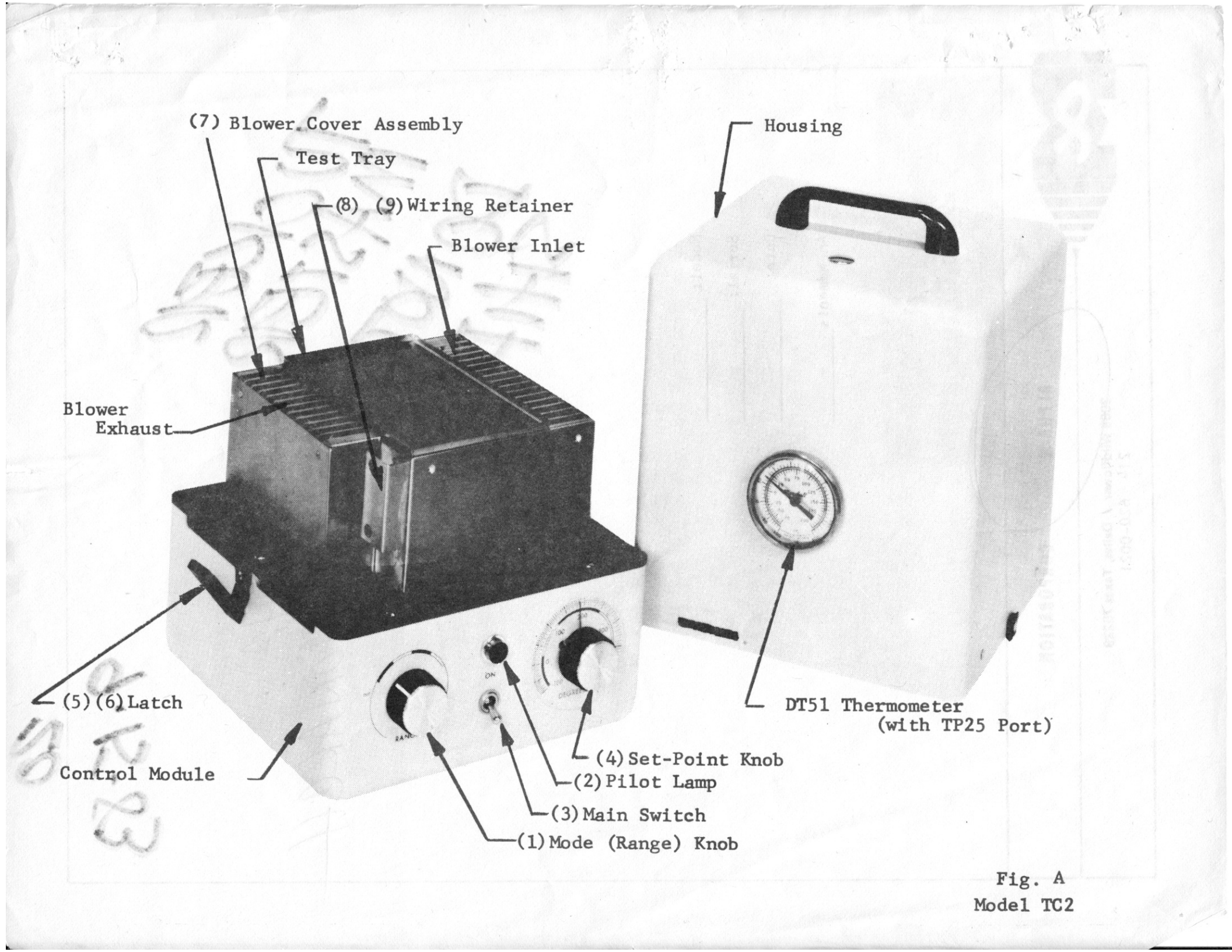


Fig. A
Model TC2

Specification

6080-76 Depot, Control Head Module.

This model features the following items.

1. Supplied with one commercial manual.
2. Coolant inlet on L.H. side. CO_2.
3. Temperature and mode selector Dials rotated 180°.
4. Temp Control module equipped with #2328 mounting brackets.
5. Blower cover supplied with Inlet air deflecter #6082.
6. Wired with PC-1 Programmer aeceptacle.
7. Equipped with #2036-3, 10 amp temp control.
8. Equipped with 2 300 Watt heating elements.
9. Equipped with CF-17 and CL-70 Hose assem.
10. Equipped with 2 ea DT-51 thermometer and TP-2 port
11. All other specifications same as commercial Model TC-2.

6080-77 Depot, Control Head Module

1. Same as above and including the following.
2. Liquid Nitrogen valve # 6080-6 and coolant system.
3. 230 VAC, 50/60 Hz, 1ph Power input.
4. CF-17 adapter is not required.

6080-78 Depot, Control Head Module.

1. Same as -77 except 120 VAC, 60 Hz, 1Ph inlet power.
2. CF-17 adapter is not required.

Amendment:

This manual has been amended to include information on the various special models supplied to General Dynamics-Ft. Worth, Texas.

Model 6080-76 Depot, Control Head Module.

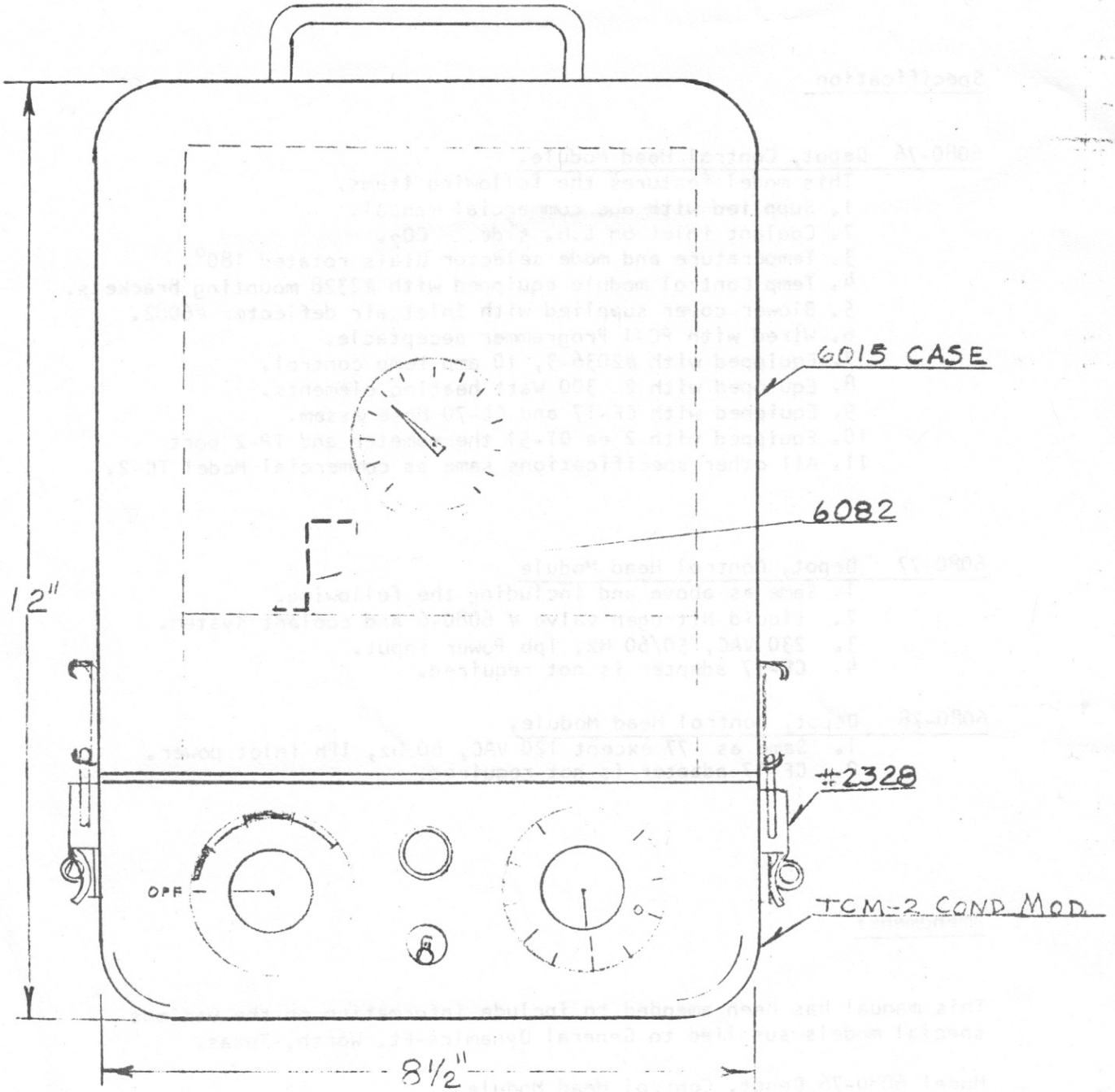
This module is a commercial model TC-2 with special hardware and accessories as listed in the appendix of this manual.

Model 6080-77 Depot, Control Head Module.

This is a commercial model TC-2 designed to operate from a LN_2 tank and 230VAC, 50/60 Hz., 1 Ph. power.

Model 6080-78 Depot, Control Head Module.

This is a commercial model TC-2 suitable for operation from a LN_2 supply and 120VAC, 60 Hz, 1 Ph. power.



6078	ROTATE MODE DIAL 180°	5/76	WLC	
6077-2	ROTATE TEMP SCALE 180°	5/76	WLC	
6035				
6027	ROTATE LN2 INLET 90° CCW	5/76		

NEXT ASSY	USED ON	NEXT ASSY	SYM	DESCRIPTION	DATE	APPROVAL
APPLICATION		QTY REQD	REVISIONS			

-2	-1	ITEM	MANUFACTURER	PART NO.	DESCRIPTION
	1		VALCOR	7551	VALVE LN2 ~ 1/4" ~ 120V
	1		AMC	6082	INLET DEFLECTOR
	1		AIRSCO	CL-70	HOSE ASSEM 900 PSI
	1				
	1		AMC	TP-25	PORT 1/4" I.D.
	1		MI	DT-51	THERMOMETER
	1		AMC	2036-3	10 AMP CONTROLLER
	2		AMC	2328	LATCH ASSEM.
	1		AMC	PC-1	PROGRAMMER CONNECTOR
	2		AMC	6051-1	HEATER ASSEM. 300W-120V
		1	AMC	6080-1	TC-2 CHAMBER ASSEM.

DASH NO. & QUANTITY

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED

TOLERANCES

2 PLACE DECIMALS ±	3 PLACE DECIMALS ±	ANGLES ±

HOLE DIAMETER TOLERANCE

THRU .250	.251 THRU .500	.501 & LARGER
+.003 -.002	+.005 -.003	+.010 -.005

REMOVE ALL BURRS & SHARP EDGES

DO NOT SCALE THIS DRAWING

ALL DIM. IN INCHES

DRAWN	W.L.C.	DATE 5-10-76
CHECKED		
ENGR.		
RELEASED		
SUPERSEDES		
SUPERSEDED BY		

TITLE: TEMPERATURE CYCLE TEST CHAMBER ASSEM.

ALPHA-M CORPORATION
Dallas, Texas

SCALE	REV	DRAWING NUMBER	FILE
		6080-78	B

CONTENTS

CONTENTS (Continued)

1. INTRODUCTION

1.1 GENERAL

The TC2 and TC4 Temperature Test Chambers were designed to fill the need for economical, portable, high response environmental temperature testing of small components, subassemblies, and systems in the laboratory, on the production line, and in quality control.

The 200 cubic inch Model TC2 features a lift-off thermal cover and will accept a test load up to about 4 x 5 x 4" high.

The 400 cubic inch Model TC4 features a hinged top opening cover and will accept a test load up to about 5 x 9 x 4½" high.

The test load is placed on the tray, or platform within the insulated chamber and its instrumentation connections, pressure lines, etc., are brought out through the access notch provided in the chamber cover. The test items are then subjected to a recirculating high veolicty, low pressure air flow. Into this air flow are metered controlled amounts of heating, or cooling causing the air to attain any desired preset temperature between -100°F and +400°F. Once this process is stabilized, the temperature is maintained within the accuracy of the temperature controller and its sensing system. The controlling system may also be programmed to provide any desired time variation in temperature compatible with the chamber's heating/cooling capacity and the mass of the test load.

Both the TC2 and TC4 chambers consist of two subassemblies. They are the thermal housing and the control module. The housing forms the insulated enclosure and air flow return and encloses the test items. The control module generates the air moving potential and contains all the elements necessary to heat, cool, and control the air temperature.

1.2 AIR CIRCULATION

Air at normal ambient pressure is circulated through the closed chamber by means of a high speed centrifugal blower and a ducting system.

The blower impeller (17) is located within the control module blower compartment. It is driven by a 3000 rpm shaded pole motor (37) located within the control chassis. The motor and impeller are connected by the stainless steel motor shaft which passes through the thermal insulating bulkhead between the chassis and the blower compartment.

In the Model TC2, the air enters the blower compartment through a ventilator on the right side of the test tray and exhausts through a second ventilator at the left side of the tray. It then passes up and over the test item and back into the inlet again.

In the TC 4, the air leaves the control module exhaust, passes through a duct beneath the test platform and rises at the far end of the thermal housing where it reverses direction, passes over the test items and back into the control module inlet again. Wall air deflectors at the duct exit cause portions of the air flow to be directed against the side walls of the housing to effect a more uniform temperature/air distribution.

1.3 HEATING

The recirculating air is heated by its passing over a resistance heater (14) which consists of a high temperature insulating card wound with nichrome ribbon. At one end of the assembly a pure tin wire link is installed in circuit between the end of the nichrome ribbon and the heater connecting wire. This link will melt away at approximately 450°F shutting off the heater and preventing damage to the chamber should the control system malfunction.

Heating of the assembly is obtained by impressing line voltage across the heater terminals. With rated line voltage and normal air velocity created by the blower, the heater will produce 300 watts.

A low heat mode is also provided in which a semiconductor diode is placed in series with the heater allowing only half wave line current to pass. In this mode the heater produces 150 watts.

1.4 COOLING

The recirculating air mass is cooled by injecting a spray of liquid CO_2 through an expansion nozzle into the air stream.

The overall CO_2 system consists of a liquid CO_2 source located external to the chamber, a flexible connection line, the filter (24), the solenoid valve (29), and the spray nozzle (12). Either 900 psi CO_2 or 300 psi refrigerated CO_2 may be used depending on the size of the spray nozzle opening. The nameplate at the back of the chamber specifies the proper choice of CO_2 systems.

The chamber may be converted to the higher or lower pressure systems by replacing the spray nozzle (See overhaul Section 5.5).

NOTE: Overpressure within the chamber caused by the expanding CO_2 is safely relieved through a vent within the control module.

1.5 CONTROL

Both the TC-2 and TC-4 incorporate the AMC Electronics "Type TE Temperature Control". This control is completely solidstate; therefore, it contains no relays to wear out or to generate excessive EMI. Basically, this control system consists of a Wheatstone bridge circuit in which the reference resistance is from the set point potentiometer (4) and is balanced by the "heat variable" precision, nickel-iron wire resistance sensing probe (11) which is located on the chamber air flow. When a temperature deviation occurs within the chamber, or the set point dial is changed by the operator, an unbalance in the bridge is effected which in turn generates a signal voltage. This signal is amplified and compared with a reference voltage. The type "TE" control is a true time proportioning unit in which the percentage of time the heating (or cooling) is on is in direct proportion to the value that the amplified bridge signal is in relation to the reference voltage. A comparator triggers a heating bidirectional thyristor and a cooling (valve) thyristor. One thyristor is on when the other is off. The heating thyristor is synchronously triggered at the "zero crossing" of the sine wave to eliminate EMI.

1.5 CONTROL Continued

The front panel of the test chamber has a main power switch (3), a function indicating pilot lamp (2), a mode (range) selector knob (1), and the temperature set point knob (4). The main switch controls the power to all systems. The function indicating pilot shows "Power On" when lit, and temperature control status, ie., calling for heat (bright) or calling for cold (dim). The 5-position range knob is used to select (a) blower on only (out position), (b) blower and controlled CO_2 (first black band reading clockwise from "out"), (c) blower and controlled CO_2 alternating with low heat (first white band), (d) blower and controlled low heat (second black band), and (e) blower and controlled high heat (second white band). Matching black and white bands on the temperature set point dial correspond generally to the appropriate temperature ranges for these mode selections (see Sections 3.2 and 3.3)

1.6 READOUT

The controlled temperature within the test volume can be measured using glass stem type or bimetallic dial thermometers extending through the front wall or top cover of the thermal housing. In each case the accuracy usually depends upon a minimum immersion of the thermometer stem into the chamber environment of 3 to 4 inches.

A calibrated thermocouple readout represents the most reliable and least obtrusive means for accurate temperature readout. The thermocouple itself is small and easily attached directly to the surface of the item to be tested. The thermocouple connections can be passed through the access wireway and connected to an external calibrated millivolt reading instrument.

1.7 PROGRAMMING

Provisions are available for adapting multiple external set points, cycle time controllers, and curve-following programmers to the TC2 and TC4 Test Chambers.

This provision consists of a receptacle at the rear of the chamber into which may be plugged either of two connectors. With the first (called the dummy plug) the chamber operates normally in all respects. With the second (the program connector) the chamber is controlled remotely from any 200 ohm variable resistor connected to the two shielded wires extending from the connector. With this connector in place, the front set point dial is rendered inactive and the range selector "out" position is altered so that it provides blower and controlled CO_2 alternating with high heat (for rapid rate of change programs requiring both CO_2 and heat).

For example, a series of preset resistances representing preset temperatures could be switched in and out by a timer controlled selector switch, or a curve following programmer could vary a resistance (potentiometer) between 0 and 200 ohms to obtain continuous programming between -100 and 400°F. (-65 to+200°C)

2. INSPECTION & INSTALLATION

2.1 PHYSICAL CHECKOUT

Remove the chamber from its packing case and carefully inspect for visible damage due to improper handling during shipment, ie, broken switches, pilot-lamps, knobs, latches, fuse holders, sprung covers, dents, scratches, etc.

Visual inspection and operation of the cover will show damage to the seals which can affect performance.

2.2. CONNECTIONS

Electrical: Check the nameplate line voltage rating. Plug the line cord into an appropriate receptacle or receptacle adapter. The third line provides a ground connection to relieve the slight leakage which may occur when the resistance heater becomes wet with condensation. The ground also prevents outside elctro-magnetic interference from effecting the sensitive temperature control circuit.

CO_2 CONNECTION: Check nameplate CO_2 rating. 900 psi, 50-lb. CO_2 bottles with internal syphon tubes may be directly connected to the rear of the box using the AMC-E CL70 flexible pressure line and a CF17 adaptor fitting. No other hardware is required.

The same flexible line is usable with most low pressure (300 psi) refrigerated systems, although greater efficiency may be realized by using a better insulated connecting hose.

Turn CO_2 source valve on and check flow to chamber by setting range selector to CO_2 and set point to a low temperature. With cover open, observe visual and audible indications of CO_2 injection into air stream, ie., white cloudiness, loud hissing. When unit is first turned on, approximately 30 seconds are required to get liquid up to nozzle.

2.3 OPERATIONAL CHECKOUT

a. Remove or open cover.

b. Turn main switch to "On". Pilot lamp should light. Blower should come on. If not, check fuse at rear of box or refer to trouble shooting (Section 4.1)

c. Set mode (range) selector to "Out".

d. Turn set point dial to 200°F. Pilot light should glow brightly.

e. Move set point to 0°F. Pilot light should go dim.

f. Move selector to the CO_2 band (first black), swing dial between 0 and 200°. There will be a solid thunking sound as the CO_2 solenoid activates.

g. Move selector to the CO_2 and low head band (first white). Again swing dial to get same sound, and notice warm air leaving blower exhaust when set point is on the 200°F mark.

h. Move selector to the low heat band (2nd black). Observe same quality of exhuast air temperature, but without the "thunking" sound of the CO_2 valve.

i. Finally, we move the selector to the high heat mode (2nd white), and notice increased exhaust air temperature.

2.4 ACCESSORIES

Thermometer Ports

TP25 Thermometer Ports installed in either the top or the front of the test chamber will accept the AMC - "DT" Series Dial Thermometers, or standard 1/4" glass stem types.

TP12 Thermometer Ports are specifically designed to accept the standard line of dial thermometers manufactured by Weston Instruments, Inc.

If ordered at the time of chamber purchase, the ports will come installed. If they are to be installed at a later date, the following procedure may be applied:

a. Remove nickel-plated snap covers from inside and outside port openings on chamber.

b. Rout out the foam insulation by forcing a wooden pencil through the hole.

c. Push in the yellow plastic port from the outside of the chamber.

d. Push on the stainless steel retaining ring so that the smooth side contacts the chamber wall. The ring is easily pushed on using the end of a 3/8" pipe nipple or equivalent.

Insert thermometers by pushing firmly into the port until seated.

Readout Provision

If the Type J thermocouple output has been installed in the chamber, connect two wires approximately 22 awg., to pins A and B of the small connector at the rear of the chamber. Connect these wires to a millivolt reading instrument, recorder, or high limit controller.

Programming Provisions

If programming provisions have been supplied, connect a 200 ohm programming potentiometer (or switch sequenced potentiometers) to the red and black wires of the cable and connector assembly supplied. The red wire connects to the wiper and the black to the (-100°F) side of the potentiometer. (See Wiring Diagram 6009).

To operate the test chamber from a programmer, remove the dummy connector from the receptacle at the rear. Plug in the connector supplied for the programmer cable. Set the range selector at a position appropriate to the program desired. For example, a program consisting of a series of progressively rising temperatures above ambient will require high or low heat only, while alternating temperature changes above and below ambient will require CO_2 alternating with heat. (Use "Out" position, or first white band.)

3. OPERATION

3.1 LOADING

TC2 Unlatch and lift off the overhead cover. Place test item, or items up to 4 x 5 x 4" high on the test tray between the two ventilators. Do not block the ventilator openings.

Bring test connections (wires, tubes, etc.) forward on the left side and loop under the wiring retainer supplied. With the left hand hold the connection bundle while lowering the cover in place with the right hand. Check to be sure all connections are within the cover wireway notch. Latch the cover.

Note: Excess leakage of air or CO_2 through the wireway notch can be effectively blocked using a small piece of foam plastic. (Use silicone rubber foam above 200°F)

TC4 Unlatch and open hinged cover. Cover may be opened back 180° to a rest position. Place test item, or items up to 5 x 9 x 4½" high on test platform (floor) of chamber. Do not block blower inlet ventilator on right end, or blower exhaust openings on left.

Place test item(s) midway between forward and rear walls to allow equal air flow along both sides.

Bring test connections (wires, tubes, etc.) up and out of the chamber through the notch provided in the top of the left end wall. Place a small pad of silicone rubber foam (or equivalent) in the notch with the wiring to eliminate leakage of air or CO_2.

Close and latch the cover.

3.2 SELECTING TEMPERATURE

Turn on the main control switch. Turn CO_2 main valve (tank). Select the temperature by turning the "Degrees" dial to the desired set point.

Select the control mode by turning the "Range" switch to the appropriate band (Note matching range bands on degrees and range scales.)

In general, temperatures below ambient will require CO_2 only (first black band reading clockwise from "Out), while temperatures between ambient and 250°F will require low heat only (second black band), and temperatures from 250 to 400°F will require high heat (second white band.)

The high heat mode may be used at any temperature above ambient and will result in a faster rise and stabilization at the expense of having slightly less accuracy at the set point.

Functional use of the alternating (CO_2 and low heat) band (first white band) is discussed in the following section.

Once the "Degrees" and "Range" knobs have been adjusted accordingly, the control will take over and cause the chamber temperature to adjust to meet the set point. As the temperature approaches this point, cycling of the control occurs (blinking light) causing the temperature to settle and hold without overshoot. Normal settling time after cycling begins is 5 to 10 minutes for a lightly loaded chamber.

3.3 ALTERNATING CONTROL BAND

Operation of the closed temperature chamber in an average laboratory with the blower only (range selector "Out" position) will result in a stabilized temperature somewhere between 80° and 120°F. This means that operation above 120° will always require addition of heat, while temperatures below 80° will require CO_2 injection. Operation at temperatures between 80 and 120°F may require use of the alternating band which provides for low heat alternating with CO_2 (first white band), especially under conditions of laboratory ambient temperature variation such as on tests running overnight.

In general, the most economical and accurate control will be obtained in the modes using heat or CO_2 only. Whether or not one of these modes may be used at your desired set point near ambient and in your laboratory ambient conditions will be determined only by experiment.

For example, set the control at 95°F and allow to stabilize using the "Alternating" mode. Now switch to the low heat mode. If the pilot lamp goes dim and fails to cycle it means that normal control at this point is going to require CO_2 injection, and the selector may now be switched to the CO_2 only mode.

The alternating band is also useful for obtaining rapid, unattended stabilization at new set points below or above previous hot or cold points respectively. For example, suppose we have completed a test at -65°F and must now rise to a new set point at 10°F. Normal operation at 10°F will require CO_2 only, but the heat is to be used to rise in a minimum period of time. If we switch to a heat band, we will have to watch the ascent and return the selector to CO_2 after the heat cycles off. Using the alternating band, this will take place automatically and we can return and switch to CO_2 at our convenience.

3.4 READING TEMPERATURE

Since the "Degrees" dial is accurate only to the nearest $10^{o}F$, it will be necessary to obtain actual temperature readings from the interior of the chamber to get accurate temperature settings.

Since any day to day setting of the "Degrees" dial will be repeatable well within the readability of the dial (about $\pm 2^{o}F$) it will be advantageous to perform a dial calibration. Dial setting may be plotted or tabulated against actual chamber temperature (^{o}C or ^{o}F). A blank calibration table providing spaces for 52 calibrated set points is provided. This adhesive-backed label can be filled in using a typewriter, sprayed with a clear acrylic resin (Krylon) and placed on the front of the TC2 case or the top of the TC4 control module.

3.5 PROGRAMMING: Temperature

Multiple preset set-points, cycle time controllers, or curve following programmers may be used to remotely command the time-temperature environment within the chamber. If programming provisions have been supplied, refer to Sections 1.7 and 2.4.

4. SERVICE AND PREVENTATIVE MAINTENANCE

4.1 TROUBLE SHOOTING

Following is a list of possible malfunctions showing their symptoms, causes, and the sections of the manual showing remedial procedures. Assume line cord is plugged to active circuit, main switch on, CO_2 source on, and up to pressure.

	Symptom	Cause	Refer To
a.	Switch on, but no pilot or blower	Fuse bad or missing	4.3
b.	Blower on, no pilot	Pilot circuit bad	5.8
c.	Pilot on, blower on, but no control action when degrees knob is rotated	Sensor probe defective	5.2
d.	Range switch set on alternating, low or high heat modes. Pilot bright, but no heat	Heater or overheat fuse defective	4.3 5.4
e.	No heat in alternating and and low heat modes	Diode defective	5.8
f.	Range switch on cold, or alternating modes, pilot dim but no CO_2 injection	CO_2 filter or nozzle plugged	4.5 5.5

	Symptom	Cause	Refer To
g.	CO_2 will not shut off	CO_2 valve seat impaired	4.5 5.5
h.	Inaccurate or intermittent control at low temperatures	Sensor probe iced up	4.2
i.	Blower noisy at temperature extremes	Incorrect impeller installation	5.3
j.	Blower noisy	Motor bearings bad	5.3

4.2 CONDENSATION AND ICING

When the test chamber is initially cooled to temperatures below 32°F, moisture laden atmospheric air which is trapped within the test volume will cause icing of all the interior surfaces. Similarly, then the test chamber is opened while cold, fresh atmospheric air will enter and circulate causing additional icing. When the test volume is returned to ambient temperatures or above, the ice will melt creating excess moisture.

Icing may be reduced by the following:

a. Purge the air from the chamber during the initial pulldown period by leaving the top thermometer port open.

b. Minimize the number of chamber openings at low temperatures.

c. Turn blower off while chamber is open at low temperatures.

Prolonged presence of excess moisture within chamber can cause deterioration of the insulation properties and oxidation of hardware. The best procedure will be to "bake out" the moisture buildup periodically by operating the chamber at 300 to 400°F.

4.3 OVERLOAD, OVERHEAT PROTECTIONS

Overloaded Blower: Two overload features are built into the test chamber. The first is a delayed action (slo-blow) fuse in circuit with the blower motor, CO_2 valve and temperature control. In the event of a motor stall, the fuse should blow preventing overheat by shutting off the motor and control which in turn deactivates the heater switch circuit. "Over-cold" (filling with solid CO_2) is also prevented, since the solenoid valve is in parallel circuit with the control.

The fuse should blow when the load exceeds 90 to 100 volt-amps on 60 cycles, and 110 to 120 volt-amps on 50 cycles. Thus, if the line voltage is 115 volts 60 cycles, the fuse should be rated 0.8 amp. If the line is 125 volts, the fuse should be rated 0.75 amp. If the line is 200 volts, 50 cycles the fuse should be 0.5 amp, etc. See Section 6 for typical fuse replacements.

If the fuse continues to blow under normal operating conditions, install the next highest value, ie., if 0.75 amp fuses are inadequate use 0.8 amp.

Over-Temperature: The second feature is an overheat fuse located on the heater. This is a link of pure tin wire which melts out at approximately 450° cutting off the heater. This can occur in the event of a blower stall at high temperatures, or a stuck heater relay.

In the event of a melt-out, the link may be replaced by crimping a new section of pure tin wire .032" diameter by 0.40 long into the two fork shaped terminals at the top of the heater board.

4.4 LUBRICATION

The sleeve bearings of the blower motor require re-lubrication every 6 months minimum and more often if extensive continuous high temperature testing is being done. Refer to Section 5.1 for instructions on access to the motor.

Two oil holes are provided on the motor. These should be filled with SAE 20 machine oil.

4.5 CO_2 FILTER AND NOZZLE

Filter: A small sintered metal filter cartridge is located inside the CO_2 input connector at the rear of the chamber. It should be checked periodically for clogging due to particles in the liquid CO_2, dirty lines, etc.

Unscrew the hex connector from the brass nipple leading into the solenoid valve. Inspect the interior of the filter or pull out and replace. Use caution to avoid contamination of the line downstream from the filter.

Nozzle: A clogged nozzle must generally be back-flushed to insure proper clearing although it may be possible to clear it while under internal positive CO_2 pressure.

a. Remove blower cover (7).
   Note: On TC4 this requires partial disassembly per Section 5.1.

b. Remove impeller (17).

c. Turn on CO_2 solenoid valve and CO_2 pressure.
   Insert tip of .010" diameter drill or pin (.015" diameter on 300 psi models) several times until uniform positive flow of CO_2 "snow" is restored. When operating properly the visible spray pattern is about 1/8" diameter by 3/4" long.

If this method is unsuccessful, replace the nozzle per Section 5.5.

4.6 SET POINT RECALIBRATION

The "Degrees" scale is accurate to ±2% of full scale, or 10°F. This is achieved initially by a factory calibration procedure and ordinarily will not require readjustment. If the control is replaced, or sent to the factory for repair, it may require recalibration. Proceed as follows:

a. Install an accurate temperature readout in the test area. (See sections 1.6 and 3.4)

b. Rotate "Degrees" knob from stop to stop to observe alignment of pointer with the two dots on the dial face. Readjust if required by loosening knob setscrews.

c. Set "Degrees" dial at 300°F and allow 15 minutes to stabilize.

d. Adjust the "high calibration" potentiometer to obtain 300° within the test area. Turn clockwise to raise the temperature.

e. Set degrees dial to -50°F and allow temperature to stabilize.

f. Adjust "low calibration" potentiometer to obtain -50°F in the test area. Turn counter-clockwise to lower the temperature.

g. Repeat Steps c and d and readjust high calibration if necessary.

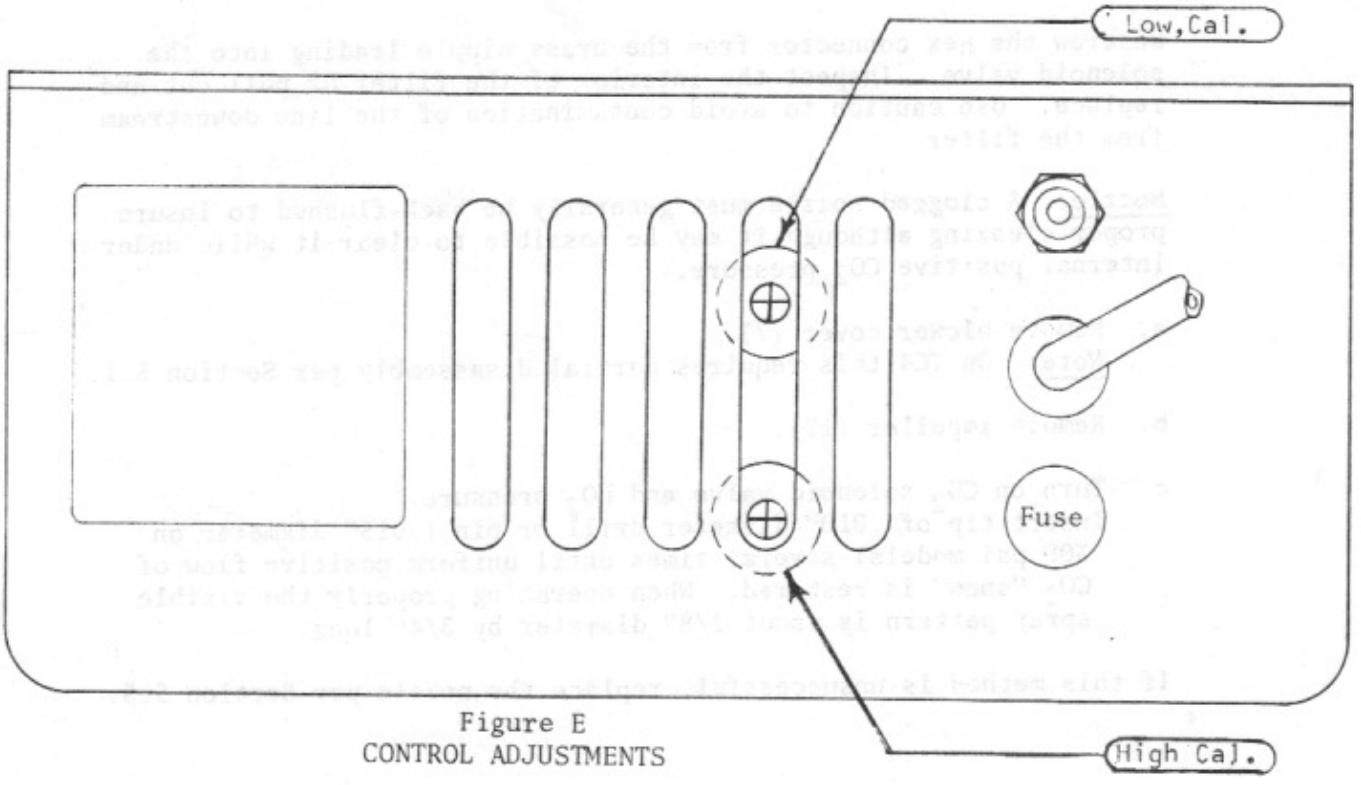


Figure E
CONTROL ADJUSTMENTS

5. OVERHAUL INSTRUCTIONS

5.1 DISASSEMBLY: For Inspection or Service

TC2 Refer to Figures A and C. Disassemble control module as follows:
Remove 2 screws (9) from wiring retainer (8).
Pry out blower cover assembly (7).
Remove 6 screws (19).
Grasp black component board and lift up and out of lower control case.

TC4 Refer to Figures B and C. Disassemble as follows:
Remove 3 screws (10) holding housing to control module, separate housing from control.
Lift out blower cover assembly.
Remove 6 screws (19) including the 3 which hold the mounting clips (13).
Grasp black component board and lift up and out of lower control case.

Refer to Figure D for the Following:

5.2 CONTROL

The temperature control assembly (22) includes the set point potentiometer to which it has been calibrated. Although the instrument should give you long service with little maintenance, the following simple trouble-shooting procedure will assist you to determine any part which might be defective:

a. If the instrument does not operate, remove one sensing element lead from the control. (From terminals #1 or #2). Using a small piece of insulated wire, short the two sensing element lead terminals on the instrument (not the shielded lead terminal). If the following conditions, exist, the problem is in the sensing element.

   Terminals 1 & 2 shorted - Heater voltage/ Valve open/ Indicator bright.
   Terminals 1 & 2 open - No heater voltage/ Valve closed/ Indicator dim.

   If the above conditions do not exist, the problem is not in the element. Skip step b if element is found to be good.

b. Check the sensing element. Remove the sensing element and using a standard volt-ohm-milliampmeter, read the resistance between the two leads. This should be approximately 100 ohms. Then, read the resistance between the shield and one of the leads. This should be greater than 1 megohm. If either of these readings is not obtained, the sensing element is defective.

c. With power on, measure voltage between terminals 11 & 12. Value should read line voltage. If not, check chamber wiring.

d. Remove wire from terminal 9. With mode switch in "high heat" position, read voltage between wire and terminal 11. Value should read line voltage. If not, check chamber wiring.

e. Remove wire from terminal 7. With mode switch in "cooling" position, read voltage between wire and terminal 11. Value should read line voltage. If not, check chamber wiring.

f. Should none of the above checks correct the controller malfunction, it is recommended that the control be returned to the factory for repair. Remove as follows:

Remove the set point knob and potentiometer from the chassis.
Disconnect terminal connections 7 thru 14 from control board. (Label each wire for each of reconnection, or refer to Circuit Diagram).
Remove 4 screws holding control board to control mounting standoffs.
Remove control.

(See Warranty Service)

g. Reinstall the control by reversing the above procedure. When replacing the set point (Degrees) knob, observe the two small dots located beside the word "Degrees". These mark the end point of the knob's pointer travel, attach the knob to the potentiometer shaft accordingly.

When replacing the sensing element, observe the orientation of the airflow "windows" at the end of the probe. These are aligned to receive the maximum vertical air flow. (Fig. C)

Recalibrate the set point if necessary by the procedure of Section 4.6.

5.3 BLOWER

Should the blower motor become defective, it may be removed as follows:

a. Remove the impeller (17) from the motor shaft.

b. Remove the fan blade (38) from the rear motor shaft.

c. Disconnect the motor wiring from the main terminal board.

d. Remove 3 screws (32) and lift motor and adapter assembly off component board.

e. Remove adapter assembly (34) from motor.

When installing replacement motor, reverse the above procedure. When replacing fane blade (38) place the hub toward the motor. When replacing the impeller (17) allow 1/8" clearance between back of impeller and floor of blower housing.

Note: Scraping sounds at temperature extremes can indicate that this clearance was incorrect.

5.4 HEATER

To check the heater, turn off power, remove blower cover and measure resistance between fuse link and terminal at opposite end of heater.

115 volt heaters should measure 35 ohms
230 volt heaters should measure 115 ohms

If the heater is open it should be replaced. Proceed as follows:

Disconnect white heater leads at main terminal board and at selector switch.
Remove 4 screws (15) holding heater assembly (14) and standoffs (16), lift out heater, pulling wires out through insulating wall.

When installing new heater, first remove impeller (17) for ease of access.

See Section 4.3 for replacement of fuse link (18).

5.5 CO_2 SYSTEM

See Section 4.5 for service and replacement of the CO_2 filter.

To service or replace the CO_2 valve or nozzle, proceed as follows:

a. Pry up and remove the red snap cover on the solenoid valve (29).

b. Pull the coil assembly off the center post (wires need not be disconnected).

c. Remove 4 screws (31) holding valve mounting flange to component board.

d. Lift out valve and nozzle assembly.

Return this assembly to the factory for service, or proceed as follows:

Valve Seat: To check valve seat remove valve stem center post from valve body using spanner wrench. Check for wear and/or debris lodged in valve seat. When reassmbling, use caution to insure that the valve spring is properly seated.

Nozzle: Section 4.5 describes procedure for clearing a clogged nozzle. If this is not effective the nozzle should be replaced. Proceed as shown in AMC-E Drawing No. 6067 "CO_2 Valve Assembly". (Appendix)

5.6 LATCHES

The unique polypropylene latches used in the Models TC2 and TC4 are guaranteed by the manufacturer for more than one-half million operations. Nevertheless, should one fail, the hinged portion is easily replaceable. Simply remove the screw (6) holding this portion to the lower section of the chamber and replace with a new part.

5.7 SEALS

The silicone rubber sealing strips on the TC2 and TC4 are replaceable should they become worn or damaged. See replaceable parts (Appendix) for part numbers of replacement seals.

To remove old seal, lift off using a knife. Remove old adhesive with knife end and/or acetone solvent.

Cut new seal strip to fit and apply using Dow Corning "Silastic" Adhesive #732 (clear).

5.8 SWITCHES & INDICATORS

The main toggle switch, pilot lamp, or range selector assembly may be replaced should they become defective. Refer to Replaceable Parts (Appendix) for part numbers.

Disassemble the chamber per instrucitons in Section 5.1. Unsolder old parts and replace.
Re-tie all leads securely to avoid entanglement with fan blade.

5.9 Inlet Air Bracket #6092

Some Models are supplied with a bracket which may be attached to the blower cover Assembly to provide a longer air path whenever the Temperature Conditioning Module is used independently of the chamber module.

5.0 Transformer 230/120 VAC

Some models may be equipped with a **step-down** transformer so that the chamber may be operated from 230VAC ,50/60 Hz, 1Phase power.

SPECIFICATIONS

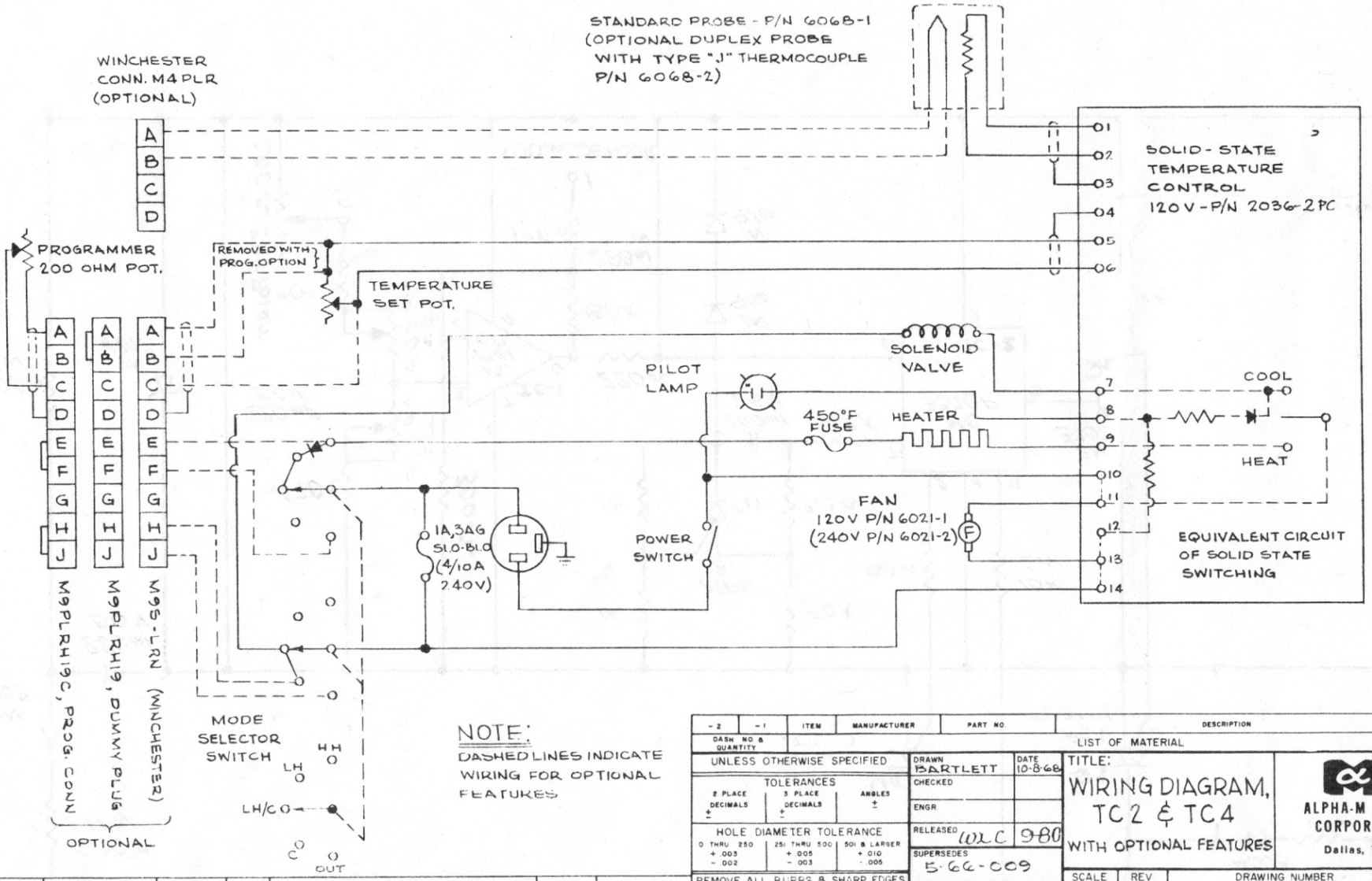
Models TC2, TC4

AMC-E Miniature Temperature Chambers

Temperature Range:	-100°F to +400°F
Controller:	Proportional electronic
Sensor:	Resistance bulb
Control Stability:	± ¼°F
Set Point:	5°F. dial divisions, infinitely adjustable
Heating:	Dual range heating element
Heating Rate:	25°F per minute average
Cooling:	Liquid CO_2 filtered and metered through solenoid valve
Cooling Rate:	25°F per minute average
Air Circulation:	Ducted centrifugal blower
Feedthru:	Wireway opens with cover: ¼ x 1¼" (TC2) ½ x 1¼" (TC4)
Power Cord:	7 ft. Molded 3-wire grounded
Interior:	Stainless steel
Insulation:	Low density foam
Cabinet:	Aluminum
Finish:	Light grey enamel
Access:	TC2: Lift-off top; TC4: Hinged cover
Cabinet Dimensions:	TC2: 8½ x 8½ x 12-7/8" high TC4: 8½ x 19-3/4 x 8½" high
Test Volume:	TC2: 6½ x 6½ x 4-3/4" high (200 cu. in.) TC4: 6½ x 11½ x 5-3/8" high (400 cu. in.)
Weight:	TC2: 14 lbs.; TC4: 17½ lbs.
Inputs:	Power: 115V, 1 phase, 60 cycle, 400 watt (230 volt 50/60 cycle available) Coolant: Liquid carbon dioxide 900 psi or 300 psi (customer to specify)
Thermometer Ports.	Plugged holes top and front of cabinet ready for ports (see accessories) TP-25, ¼" D.
Dial Thermometers:	DT51: -100°F./+400°F. (with °C scale)
CO_2 Hose ASsem.	CL-70, 8'Hose assem. Rated at 1000 psi
CO_2 Bottle Adapter	CF-17, Bottle Adapter, 900 psi.
Programmer Jack:	Rear Panel connector and wiring to adapt the controller to external programmers.

SPARE PARTS Models TC-2, TC-4

ITEM	Part No.	Part Name	TC-2	TC-4
1	6037-1	Knob, plain	1	1
2	1050 S13	Pilot Lamp	1	1
3.	83001	Toggle Switch	1	1
4.	6037-2	Knob, skirted	1	1
5.	07-10-201-12	Latch Assem.	2	2
6.	17409 S	Line cord	1	1
7.	6011-1	Blower Cover, TC-2	1	
7.	6048-1	Blower Cover, TC-4		1
8.	6039-1	Wiring, Retainer	1	
9.	6021-1	Motor, Blower, 120V, 60H	1	1
9a.	6021-2	Motor, Blower, 230V, 50/60H	-	-
10	2C 952	Fan Blade	1	1
11.	2033-2P	Sensor, Platinum	1	1
12.	6067-1	Nozzle, CO_2, 900 psi	1	1
12a.	6067-2	Nozzle, CO_2, 300 psi	-	--
12b.	6067-3	Nozzle, LN_2	-	--
13	6034-1	Mounting Clip, [illegible] Chamber		3
14.	6051-1	Heater Assem., 120V	1	1
15	6018-2	Motor mount plate	1	1
16.	242 014	Fuse Post	1	1
17	6022-1	Impeller, Blower	1	1
18	313 001	Fuse, 1 amp., 120 VAC	1	1
19	6069-1	Selector Switch Assem. 120 V	1	1
20	6041-1	Sensor Clamp	1	1
21	6121-52	Filter, Cartridge, S-3	1	1
22.	2036-2PC	Temp. Control, Platinum, 120V. 60 Hz. -66 to +200°C	1	1
23	6027-1	CO_2 Nipple	1	1
23a	6027-2	LN_2 Nipple	-	--
24	862409-1	Valve, 120 V. CO_2	1	1
25	7551	Valve, 120 V LN_2	1	1



NOTE:
DASHED LINES INDICATE WIRING FOR OPTIONAL FEATURES

-2	-1	ITEM	MANUFACTURER	PART NO.	DESCRIPTION
DASH NO & QUANTITY					LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED

TOLERANCES: 2 PLACE DECIMALS ±; 3 PLACE DECIMALS ±; ANGLES ±

HOLE DIAMETER TOLERANCE: 0 THRU .250 +.003 -.002; 251 THRU 500 +.005 -.003; 501 & LARGER +.010 -.005

REMOVE ALL BURRS & SHARP EDGES

DO NOT SCALE THIS DRAWING

ALL DIM. IN INCHES

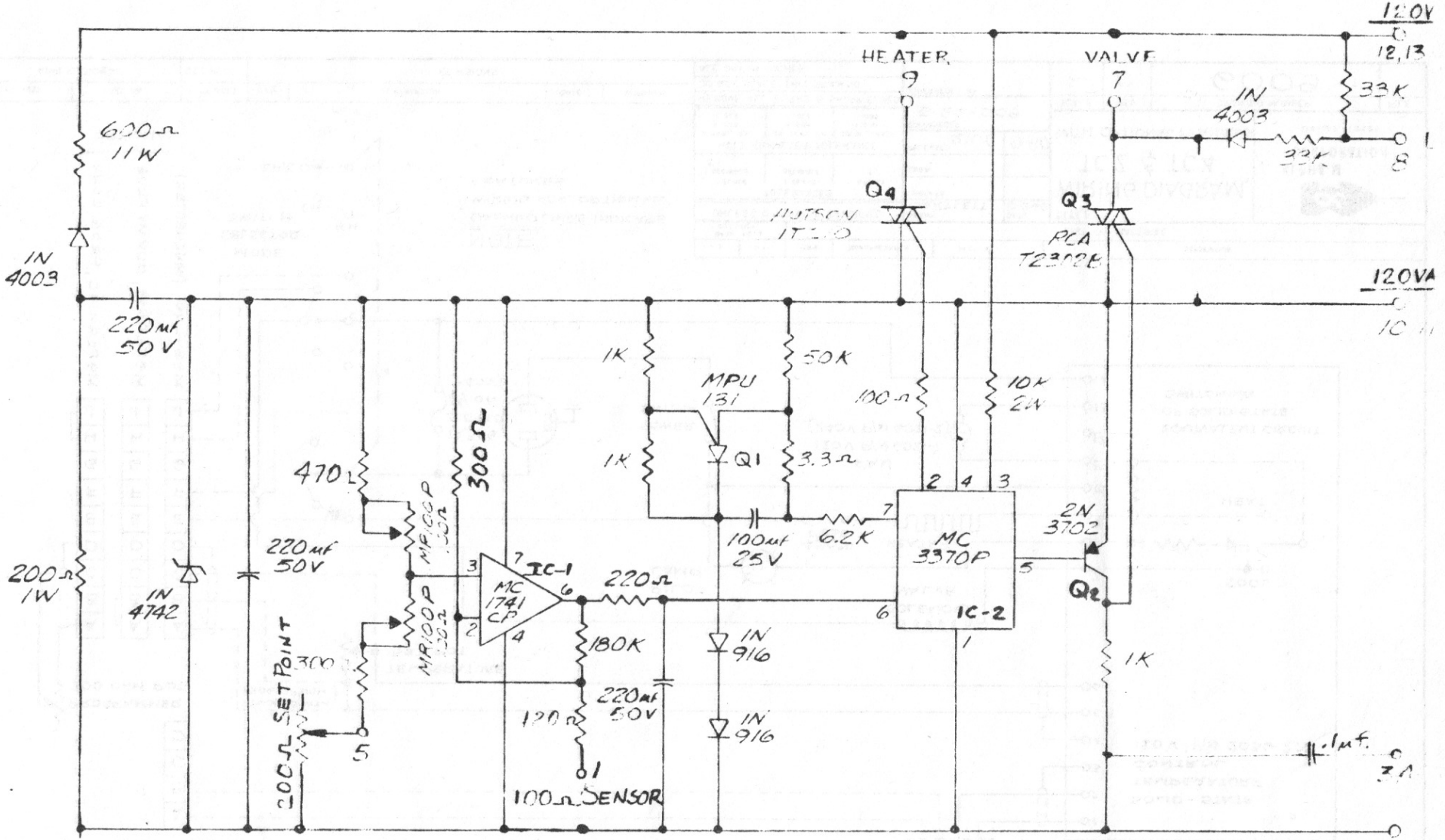
DRAWN	DATE
BARTLETT	10-8-68
CHECKED	
ENGR	
RELEASED WLC 980	
SUPERSEDES 5-66-009	
SUPERSEDED BY	

TITLE: WIRING DIAGRAM, TC2 & TC4 WITH OPTIONAL FEATURES

ALPHA-M CORPORATION
Dallas, Texas

SCALE	REV	DRAWING NUMBER	FILE
~	C	6009	

NEXT ASSY	USED ON	NEXT ASSY	SYM	DESCRIPTION	DATE	APPROVAL
APPLICATION		QTY REQD		REVISIONS		



ALPHA-M CORP.

SCHEMATIC - TC2, TC4 TEMP CONTROL

6-30-80 DWG 2309 REV A S/N 314 & SUB.

ALPHA - M CORPORATION
3009 Wildflower Drive
Dallas, Texas 75229

WARRANTY

ALPHA-M warrants its products to be free of defects in materials and workmanship for a period of one year after shipment from its plant. This warranty does not cover the ALPHA-M product unless it is properly installed in accordance with current instructions and manuals of ALPHA-M and maintained by Purchaser in accordance with the provisions of such instructions and manuals, and unless it is used under normal operating conditions.

WARRANTY is limited to supplying a replacement part or parts or repairing any part or parts which in ALPHA-M's opinion are defective. Commercial parts purchased by ALPHA-M and installed in the equipment will carry original manufacturer's warranty only. In the case of defective components or products. ALPHA-M reserves the right to request the prepaid return to the factory or to inspect them at the customer's installation and also reserves the sole right to determine whether defective componenets and products will be repaired or replaced.

WARRANTY does not cover any customer labor charges for replacement of parts, adjustments or repairs, or any other work. Services performed by ALPHA-M due to defects in workmanship or material, other than commercial parts purchased by ALPHA-M shall be supplied free of charge except that all transportation incurred during such service will be charged to the customers account.

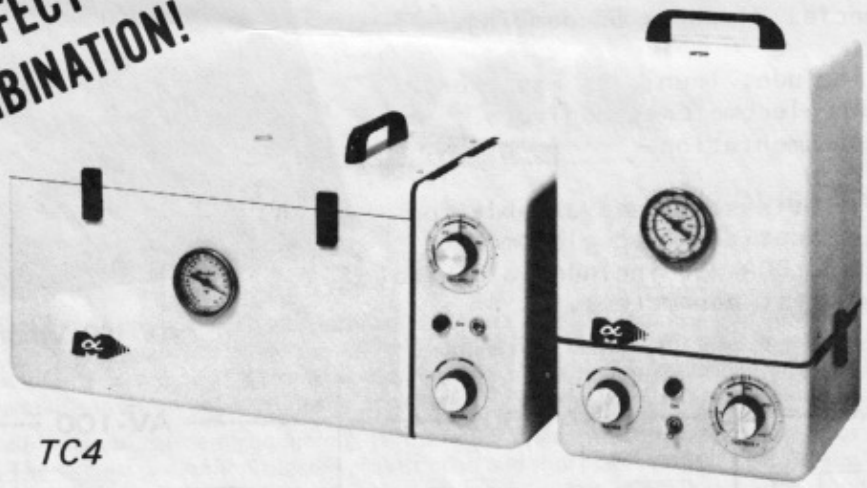
WARRANTY is expressly in lieu of any and all other warranties or representations, expressed or implied, and of any other obligations or liabilities of ALPHA-M to the Buyer arising out of the use of said product, and no agreement or understanding varying or extending the same will be binding upon ALPHA-M unless in writing.

WARRANTY shall not apply to any product which in the judgement of ALPHA-M shall have been subject to misuse or neglect, repaired or altered in any way which may have impaired its safety, operating efficiency, nor to any product which has been subject to accident. Warranty shall not apply if any part not manufactured or supplied by ALPHA-M shall have been substituted which might impair the product's performance.

ALPHA-M reserves the right to make changes in design or additions to or improvements in its product at any time without imposing any liability on itself to install the same in any product manufactured prior thereto.

TEMPERATURE TEST CHAMBERS

THE PERFECT COMBINATION!



TC4 TC2

A remarkably low price combined with control simplicity, rapid cycling, portability, and low operating costs create unequaled economy for laboratory, production, and quality control testing of small components and systems.

VIBRATION TEST SYSTEMS

The AV series of vibration systems covers the range from 2.5 force pounds to 100 force pounds. These systems come complete with wide-range sine wave oscillators, power amplifiers and vibrators.

Each major portion of the system is built to insure ease of operation and reliability.

Calibration Kit

ALPHA-M CORPORATION

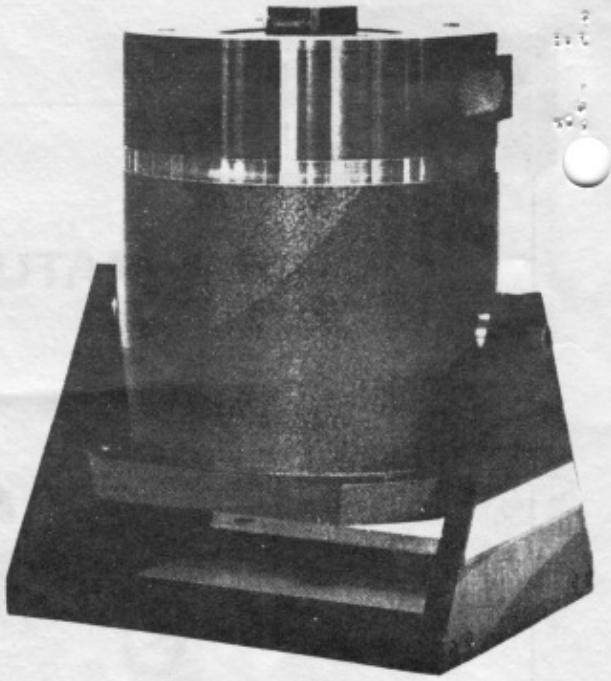
3009 WILDFLOWER DALLAS, TEXAS 75229 214 620-0021

ADVANCED DYNAMIC INSTRUMENTS DIVISION

The AV series Vibration Test Systems are ideally suited for many structural response, fatigue and Military environmental quality test. The whole suspension assembly is easily removable for ease of maintenance or replacement of the coil or installation of special flexures or damping.

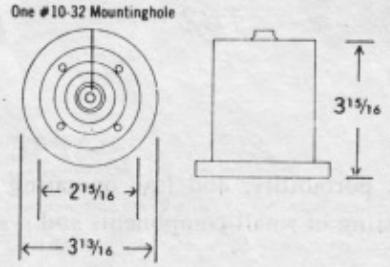
Available options include, Trunions, Fixtures, cooling packages, accelerometers, Monitors , Sine and Random Instrumentation.

A compact portable test system is available for calibration or qualification of accelerometers or other sensors. The DOA-25C includes a Digital indicator to monitor test parameters.

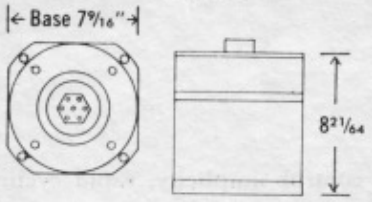


AV-100 Vibrator

AV-2

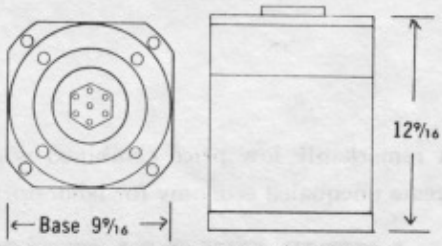


AV-50



Seven #10-32 holes
6 equally spaced on 1.50 in.BC

AV-100



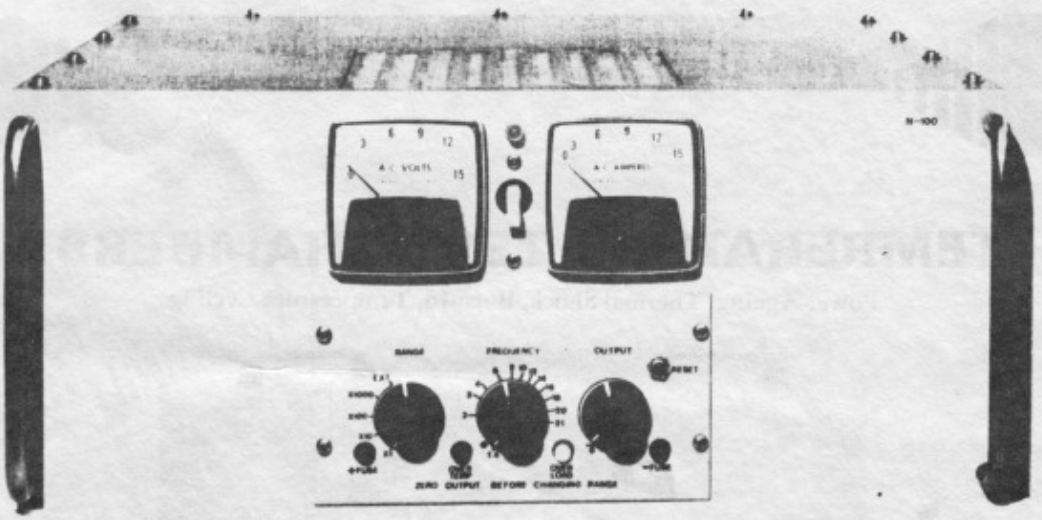
Seven #10-32 holes — 6 equally spaced on 2.250 in.BC

■ **Outputs — 2.5 to 100 force lb.** ■ **Efficient table diameter to weight design** ■ **Rugged suspension system**

VIBRATION TEST SYSTEMS SUMMARY

System Sine Performance Pounds Force Vector	Vibrator Model	Amplifier Model	Moving Element Mass (lbs.)	Maximum Bare Table Accelerating	Useful Frequency Range	Maximum Stroke in d.a.
2.5	AV-2	OC-25	.03	82 g	1.5 - 20,000 Hz	.2
4	AV-6	OC-25	.04	100 g	1.5 - 20,000 Hz	.2
35	AV-50	N-100	.5	70 g	1.5 - 10,000 Hz	.5
50	AV-50	N-300	.5	100 g	1.5 - 10,000 Hz	.5
70	AV-100	N-300	1.0	70 g	1.5 - 10,000 Hz	.75
100	AV-100	N-750	1.0	100 g	1.5 - 10,000 Hz	.75

The mark of quality



N-100 Amplifier

AMPLIFIERS

Our amplifiers have been designed primarily to drive small electromagnetic vibrators, and include a wide range sine wave oscillator. They are entirely suitable for driving any load of the correct impedance, and because of the low output distortion, may be used in conjunction with suitable output transformers for music amplification, variable frequency power supplies, and other similar applications.

All circuits use silicon semiconductors, permitting the amplifiers to be operated over a wide temperature range. The circuits are fully protected against open and short circuiting of the load and incorporate thermal compensation and thermostats to prevent dangerous overheating under such conditions. Front panel indicators show the fault condition.

The internal oscillator signal is available at the rear of the amplifier chassis. The signal is of constant amplitude regardless of the amplifier output potentiometer setting. It can be used for driving auxiliary equipment such as counters, and strobe lights. Normally open interlock connections are provided on the N-100, N-300, and N-750 amplifiers for use with external circuits such as vibrator cooling or overtravel.

VIBRATION MONITORS

The Vibration Monitor (VM) series of voltage amplifiers provides an economical and convenient means of standardizing the various acceleromater outputs to a calibrated 10 mv/g. This 10 mv/g can be used to calibrate automatic vibration servo control systems or for easy readouts on a VTVM or oscilloscope. The high input impedance (FET) ensures good low-frequency response and no loading of the acceleroveter output. These instruments consist of an FET input, continuously variable gain amplifier (0.1 to 10) and a complementary emitter follower output. The system is calibrated by merely dialing in the accelerometer sensitivity.

Vibration monitors are available with and without meters. In addition a vibration safety/Monitor version is available with adjustable high and low limits. This instrument is ideally suited for long unattended tests.

Metered Precision Stroboscope

.....with high intensity daylight lamp

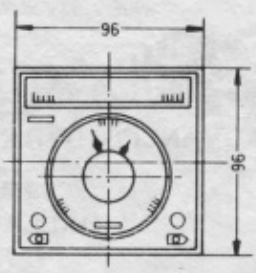
MODEL 165

110/25,000 Flashes per Minute

PRECISION STROBOSCOPE TACHOMETER INSTANT STARTING . . HIGH INTENSITY WHITE LIGHT. . . OPERATES FROM EXTERNAL CONTACTS OR INTERNAL OSCILLATOR. . EASILY SYNCHRONIZED. OUTPUT JACKS TO COUPLE SCOPE, ETC....

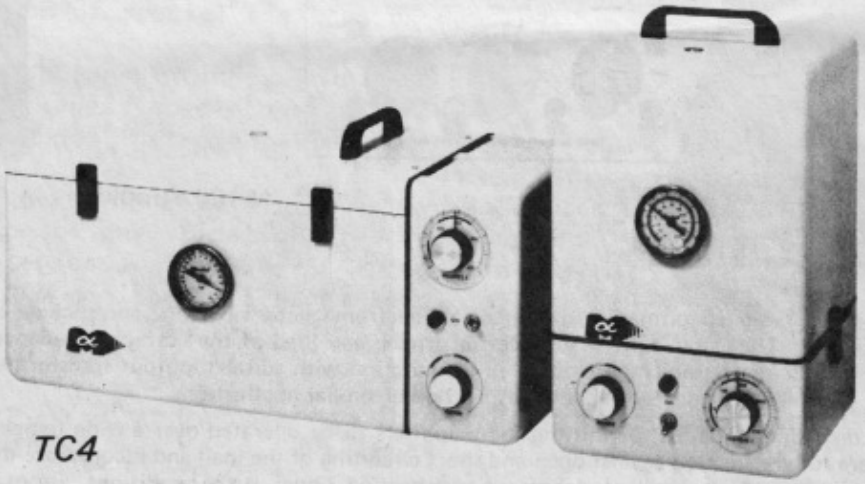
TEMPERATURE CONTROLS

Scale Range	Scale Div.	Thermocouple
0–200°C	2°C	CRC
0–300°C	5°C	IC, CA
0–400°C	5°C	IC, CA
0–600°C	10°C	CA
0–800°C	10°C	CA
0–1000°C	10°C	CA
0–1200°C	20°C	CA
600–1200°C	10°C	CA
0–1400°C	20°C	PR13
0–1600°C	20°C	PR13



TEMPERATURE TEST CHAMBERS

Power Ageing, Thermal Shock, Burn-In, Temperature Cycling



TC4 TC2

SPECIFICATIONS

Temperature Range:	−100°F. to +400°F.
Controller:	Proportional electronic
Sensor:	Resistance bulb
Control Accuracy:	±¼°F.
Set Point:	5°F. dial divisions, infinitely adjustable
Heating:	Dual range heating element
Heating Rate:	20°F. per minute, average
Cooling:	Liquid CO_2 filtered and metered through solenoid valve
Cooling Rate:	20°F. per minute, average
Air Circulation:	Ducted centrifugal blower
Feedthru:	Wireway opens with cover. ¼" × 1¼" (TC2); ½" × 1¼" (TC4)
Access:	TC2: Lift-off top; TC4: Hinged cover
Cabinet Dimensions:	TC2: 8½" × 8½" × 12⅞" high; TC4: 8½" × 19¾" × 8½" high
Test Volume:	TC2: 6½" × 6½" × 4¾" high (200 cu. in.); TC4: 6½" × 11½" × 5⅜" high (400 cu. in.)

ACCESSORIES

Dial Thermometers:	DT51: −100°F./+400°F. (with °C scale) DT52: −100°F./+100°F. DT53: 50°F./250°F. DT54: 50°F./400°F.
Thermometer Ports:	Provide insulated grip for both glass and dial type thermometers. Installation hardware included. TP12: 3/32" dia.; TP25: ¼" dia.
CO_2 Line:	#CL70: 5/16 O.D. × 7 ft. long flexible hose with swivel connectors. Rated 1000 psi (teflon liner, brass braid)
Adapter Fitting:	#CF17: connects CL70 flex line to CB15 or larger pressure bottles.
Miniature CO_2 Bottle:	#CB15: 7" dia. × 27" high steel bottle rated 1000 psi. Holds 15 lbs. liquid CO_2. Valve and siphon included. Total weight with CO_2 is only 39 lbs.
Programming Provisions:	#PC-1: provide circuit for adapting multiple external set points, cycle-time controllers, and programmers.
Programmer:	Available on custom order.

Inquiries are invited for products which call for creative design, state of the art performance and early delivery. An experienced management team is available for consultation and assistance.

ALPHA – M CORPORATION
ADVANCED DYNAMIC INSTRUMENTS
3009 WILDFLOWER
DALLAS, TEXAS 75229
(214) 620-0021

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