Tenney

O P E R A T I N G I N S T R U C T I O N S

F O R

TENNEY TEST CHAMBER MODEL #BTC BENCHMASTER

Basic Manual

SCOPE

This manual covers use and functioning of a Tenney Model BTC Benchmaster, designed to perform environmental testing at controlled high and low temperatures.

SPECIFICATION SUMMARY

Temperature Range:	-100°F to +350°F.
Refrigeration:	Two stage cascade system using R-502 high stage and R-503 low stage, with two Copeland 1 horsepower compressors. Compressor starting is sequential, and rating is 208/230 volt, single phase, 60 Hz.
Heating:	1,000 watt low watt density heater bank.
Power:	220 V.A.C., single phase, 60 Hz., 17 amps at maximum operation, 25 amp fuse recommended. Power connection is by 12 ft. cord and plug.
Temperature Controller:	Waynco electronic controller with controlled rectifier output, potentiometer set point and resistance temperature sensor.

ADDITIONAL MATERIAL FURNISHED

General maintenance, upkeep and installation suggestions together with trouble-shooting hints are found in the Tenney General Manual accompanying these instructions. Testing technique applying to the equipment is reviewed in the accompanying booklet "Get the Most From Your Environmental Test Equipment," prepared by Tenney's Engineering and Service Departments.

UNPACKING

The chamber is commercially packed and requires no special unpacking technique. The unpacker pulls staples from the top of the carton and removes the top. He then carefully strips away the remainder of the carton, freeing the cabinet. The BTC may then be lifted by hand or fork lift truck and taken to its location.

Caution: The chamber should be handled and transported in a reasonably upright position. It must not be carried on its back, front, or any side. To do so would strain the refrigeration compressor mounts.

INSTALLATION

The BTC is a benchtop chamber requiring no special installation procedures. The chamber should be set up and made level. It should be placed where its air-cooled refrigeration condenser will receive adequate fresh air, and should be attached to a power source as specified in the accompanying electrical drawings. The installer should read the section of this manual entitled "Watch That Line Voltage."

WATCH THAT LINE VOLTAGE

One of the most common causes of chamber malfunction is low line voltage at the chamber terminals. The user should be careful that his facility is connected to a circuit with adequate ampacity to handle the load. Tenney chambers are designed to operate on the following voltages with the noted maximums and minimums applying to nameplate nominal:

115 volts nominal:	104v. minimum	127v maximum
230 volts nominal:	208v. minimum	253v maximum
208-230v. nominal:	200 v. minimum	242v maximum

Chambers rated 208-230 should never be operated below 200 volts as a bare minimum. If voltage falls to that level, or close to it, at maximum operation, it is strongly suggested that the chamber be fitted with a suitable boosting transformer. Tenney can recommend and quote on the correct transformer.

OPERATE THE CHAMBER AS SOON AS IT IS RECEIVED

We suggest that when this chamber is first set up and ready to run, that you operate it in various modes before using it as a test facility.

Pull the chamber down to its lowest rated temperature and allow it to stabilize for a half hour. Then heat it to its highest rated temperature, again allowing it to stabilize. Operating the chamber as described will assure that it is operable and that it was not damaged in transit.

At several chamber temperatures, observe the relationship between the set-point dial and measured workspace temperature. The dial is adjusted at Tenney and should be within about ±1% of span. However, if calibration has changed and you desire to make an adjustment, do as follows:

Loosen the two set screws on the dial. Rotate the dial to actual chamber temperature as measured on a read-out instrument. Do this without rotating the potentiometer shaft, then re-tighten the dial set screws.

OPERATION

The Circuit Breaker

Circuit breaker CB1 must be closed in order for the chamber to operate in any mode. Closing of the circuit breaker arms the refrigeration system, and the push button switch, readying the facility for operation.

Safety Note: Opening of the circuit breaker removes voltage from portions of the control circuitry, but leaves other conductors hot. Service personnel must keep this in mind when working in the power box. Circuits energized by the 230/115 volt transformer are not de-energized when the circuit breaker is opened either manually or on overload trip.

The Push Button Switch

Push button switch SW1, when closed, energizes the conditioner fan, arms the switching terminals on the temperature controller, arms the heater bank, the LogiTenn, and the refrigeration system. When this push button switch is closed, the conditioning systems are ready to operate in all their modes. The operator need make no other mode selections such as were required on older models. In order to simulate a temperature, the operator merely selects the desired temperature on the controller, then presses the push button. Automatic controls do the rest.

The Pilot Lights

This facility has several pilot lights telling the operator what circuits are armed or operating. The following describes what is indicated as each light glows:

PL1 Power: The chamber is connected to a source of power, and the control circuits are "hot."

PL2 Heat: The temperature controller is energizing the air heater bank.

PL4 Over Temperature: The high heat cutout (heat limiter) has open-circuited, tripping open the circuit breaker and shutting down the facility.

AUTOMATIC FUNCTIONS

Temperature Controller

In a bridge circuit, the temperature controller compares the effects of platinum temperature sensor resistance against the resistance of the setpoint potentionmeter. When the sensor determines that workspace temperature is lower than setpoint, the controller conducts, energizing the air heater bank. When the heat requirement is satisfied, the controller de-energizes the heater. Refrigeration is not modulated by the temperature controller. Correct temperature is maintained by bucking modulated heat against fixed refrigeration.

LogiTenn

Responding to signals transmitted from its associated temperature controller, LogiTenn automatically selects the following:

1. Start up and shut down of the refrigeration compressor(s) (LGT-1).
2. Full or restricted capacity refrigeration (LGT-V).

Responding to a milliamp error signal from the temperature controller LogiTenn energizes the refrigeration system upon detecting that workspace temperature is slightly higher than controller setpoint. It keeps the system operating until workspace temperature is substantially lower than setpoint, having a differential of about two times the trip point setting.

The instrument selects full capacity refrigeration mode when detecting via a millivolt signal that workspace is below a given temperature. To prevent hunting, this function is provided with a differential, typically 5°F. When workspace temperature rises above selected transfer temperature, plus differential, LogiTenn automatically selects restricted refrigeration.

Note that refrigeration capacity selection is determined by workspace temperature deviating from a certain fixed temperature. By contrast, refrigeration arming and disarming is determined by workspace temperature deviation from setpoint, which can be steady or changing depending upon the program being run.

LogiTenn performs two additional functions. When disabling refrigeration via its LGT-1 function, it simultaneously increases heat capacity by increasing temperature controller output power to the heater bank. In addition, when the refrigeration system is activated, LogiTenn's LGT-V function increases heating power when selecting high capacity refrigeration. When selecting restricted refrigeration, LogiTenn reduces heating power.

Artificial Loading

Opening of the artificial loading valve reduces refrigeration capacity. This valve is opened by LogiTenn (LGT-V) when workspace is above a given temperature.

Heat Limiter

On detecting workspace temperature above its rating, the heat limiter opens the circuit to a relay. A normally-closed contact in this relay is in series with a trip coil in the main circuit breaker, and when the heat limiter closes the relay contact, voltage is applied to the trip coil, the circuit breaker trips open, and the facility is disabled. In order to restore conditioning, the heat limiter element must be replaced.

RESET AFTER POWER INTERRUPTION

The heat limiter circuit is fail-safe in that it de-energizes its control relay, closing the relay's normally-closed contact which energizes the circuit breaker trip coil. Because of this, after a power interruption, it is possible that the limiter circuit could trip the breaker before the relay had time to transfer to safe configuration. To prevent unwanted trip out of the breaker, a time delay capsule is provided. The capsule provides delay of a few seconds before voltage is applied to the relay contact. The delay assures that the contact is open before voltage appears across the circuit.

OPERATING WITH AN ACTIVE HEAT LOAD

Remember that when testing with an active live load, such as an energized electronic assembly, its generated heat must be removed. If it is not, chamber temperature will rise. Tenney chambers are well insulated: an active heat load in the workspace will raise chamber temperature quickly unless refrigeration is available to remove the heat.

Where you perform tests on a specimen which gives off heat, and where runaway high temperature would damage its components, consider attaching an alarm or automatic over-temperature protector. Wire this device, such as Tenney's TempGard, to shut down both chamber heat and the active specimen in the event that temperature exceeds safe limits. If you do not want automatic shut-down, arrange the device to monitor specimen or workspace temperature and sound an alarm when temperature exceeds the desired limit.

PREVENTIVE MAINTENANCE

Since the refrigeration is sealed and the temperature controller is solid state, very little maintenance, is required on the temperature chamber. However, the following preventive maintenance steps are suggested once each 3 months:

1. Clean the refrigeration condenser with a vacuum cleaner and brush. (Air-cooled units only.)

2. Inspect and clean the condenser fan. Make sure it spins freely. (Air-cooled units only.)

3. Inspect and clean the conditioner fan. Make sure it spins freely.

4. Clean the inside of the chamber with Tenney's Humiclean.

5. Inspect the door gasket, making sure the door seals well.

6. Adjust the door latch if the door does not seal well. If adjustment of the latch does not make the door close tightly, replace the gasket.

7. About once a month, examine the refrigeration system. Make sure the compressors are secure, that no wires or tubes are chaffed, that the starting components are tight.

8. If your facility has a water-cooled condenser, check water flow occasionally.

9. About once a year, inspect the inside of the power box. Look

for loose connections, frayed wires and lint. If you find lint or dirt, vacuum clean the box - after shutting off all power, naturally.

IN CASE OF TROUBLE

Tenney facilities have conductors carrying dangerous voltage and with heavy current carrying capacity. Be careful when trouble-shooting.

The control switch opens the circuit to most of the controls and mode switches. However, power circuits remain hot and are dangerous unless the main disconnect switch is open.

Don't take chances. Before working on a machine, open the main disconnect switch and tag it with a red tag saying "DANGER - DO NOT CLOSE THIS SWITCH."

Our refrigeration systems are sealed and require little service. If you suspect a malfunction, write or call Tenney's Service Department. Unless you are expert in the refrigeration art, don't tamper.

Insufficient cooling, increasing vibration, compressor overheating and constant compressor loading are signs of trouble.

But Note: This Tenney facility is designed to operate with the compressor locked on continuously whenever cooling mode is selected by LogiTenn. Don't be alarmed about this.

Before writing or phoning Tenney, inspect the system superficially: Be sure the condenser is getting plenty of water or air. Make certain the cooling coils are defrosted and that power supply voltage is nominal when all systems are operating.

Should you have to contact us about your refrigeration system, please jot down all the numbers on the compressor identification plate. Also give us the serial number of the chamber. This will help us give you fast service on spare parts.

Before trouble-shooting the control system, get a copy of the electrical schematic. It is included with these instructions.

Open or short circuits, inoperative relays, blown fuses or open fail safe devices are most common malfunctions.

When shooting trouble, carefully trace one system at a time. Be systematic. Use a trouble light, buzzer or volt ohmmeter. Don't carelessly tinker one circuit or system out of adjustment only to find the trouble somewhere else: Then you'll have double trouble to repair and the job will be twice as difficult.

Use the X1 scale on an ohmmeter when checking circuit continuity. Don't use X10, X100 or higher or you'll sometimes get false readings. Stray capacity, leakage and high resistance connections will falsely appear as a good circuit.

For the same reason, don't use a miniature neon lamp as a continuity tester. Frequently it will glow, indicating a hot circuit: Actually, the circuit may be open but shunted by leakage or a reactive component.

Check all fuses, overloads and manual resets. Inspect the power box. Look for burned wires, loose connections, scorched components. Pay particular attention to relay and contactor coils.

TROUBLE-SHOOTING

This section does not purport to be a complete and comprehensive trouble shooting guide for the service man. However, it attempts to help the operator locate the causes of possible troubles so that he can make simple repairs or adjustments himself. The information here should also help the user in localizing trouble so that he can better describe the malfunction when contacting the us.

Refer to the appropriate electrical and refrigeration drawings when using these trouble-shooting suggestions.

TROUBLE: CONDITIONER FAN DOES NOT RUN.

Possible Causes:

1. Circuit breaker open.
2. No active selection made on push button.
3. Wire disconnected. Inspect all wiring.
4. Fan Motor seized or frozen. Try turning the blade by hand.
5. Defective fan motor. Listen and feel, determining if it is struggling or hot.

TROUBLE: NO HEAT

Possible Causes:

1. Heat limiter open. Test it with a trouble light or ohmmeter.

2. Heater element open. Test it with light or ohmmeter. Resistance of the heater element is approximately 50 ohms. Also, look for a break in the resistance element.

3. Open connection in heater wiring to controller or the common connection. Trace through with test instrument.

4. No output from temperature controller. When the controller

signals for heat, full line voltage should appear between load connection LD on the controller and wiring point 22.

5. Setpoint dial is set to lower temperature than that in workspace. Select "High" and turn the temperature selector as high as it will go.

6. Defective setpoint potentiometer. If the potentiometer circuit is shorted, the controller will never call for heat.

7. Open temperature sensor. If the sensor circuit is open circuited, the controller will never call for heat.

TROUBLE: INSUFFICIENT HEAT, SLOW HEAT-UP RATE. (THE HEAT PILOT LIGHT GLOWS WEAKLY OR FAILS TO RESPOND.)

Possible Causes:

1. Extremely low line voltage.

2. Defective Triac in the temperature controller results in the instrument applying half voltage to the heater. Measure voltage across the heater. If it is 115 rather than 230, the Triac is probably defective. Replace the controller.

3. Contact LC1 on controller failing to close.

4. Chamber door not tightly closed.

TROUBLE: HEATER ENERGIZED CONSTANTLY

Possible Causes:

1. Defective (shorted) Triac in the controller. Controller calls constantly for heat regardless of workspace temperature.

2. Short circuit between terminals 18 and 21 on controller.

3. Defective setpoint potentiometer. If the potentiometer circuit is open, the controller will call for heat constantly.

4. Short circuited temperature sensor. If the sensor circuit is short circuited, the controller will call for heat constantly.

TROUBLE: INSUFFICIENT COOLING AND SLOW TEMPERATURE PULL-DOWN.

Possible Causes:

1. Chamber door not sealing tightly. Tighten the latch.

2. Dirty air cooled condenser. Clean the fins with a vacuum cleaner.

3. Malfunctioning of the artificial loading valve. (Valve open.)

4. Heater energized constantly. (See causes.)

TROUBLE: NO COOLING

Possible Causes:

1. Very low line voltage, causing compressors to shut off.

2. Open circuit breaker connections 36 or 32. Compressors dead.

3. Defective line contactor LC1 or LC2 or both.

4. Defective LogiTenn.

5. Setpoint potentiometer set above workspace temperature. Turn the temperature selector dial lower.

Notes: If the high stage compressor fails to operate, due to electrical or mechanical problems, the low stage will be stopped by its pressure switches. Should the high stage function, but the low stage compressor fail to operate, the high stage will frost heavily, but there will be no cooling in the workspace.

When site ambient temperature is about 75°F, if the chamber does not pull down substantially in temperature within an hour, something is wrong. Turn the chamber off. Let it normalize and defrost. Then try it again. If it still does not pull down to low temperature, shut it off and get technical help. A refrigeration system which does not cool properly should not be run for prolonged periods. It may have a leak and be low on refrigerant. Since the compressor depends upon cool returning refrigerant for cooling, it can be overheated when operated in an undercharged system.

Remember that the compressors have internal overloads (Klixons) with automatic reset; these are in addition to circuit breakers. Therefore, when a compressor cuts out, it must be given time to cool so that its internal protector has time to reset.

PARTS IDENTIFICATION

Component parts are shown and identified on the drawings accompanying this manual. The bills of material indicate nomenclature and parts numbers to be used in ordering replacement or spare parts.

DANGER

THE MACHINERY COMPARTMENT HAS EXPOSED ELECTRICAL CONNECTIONS.

CAUTION

THIS IS NOT AN EXPLOSION PROOF CHAMBER. It has modern, low mass, open wire heating elements to provide close temperature control. Due to their low mass, the heater wires can reach temperatures of 1,500° F, sufficient to ignite explosive mixtures of gases or vapors in the chamber. Because of this danger, DO NOT test any product in your chamber which is capable of generating combustible mixtures.

WARNING

DISCONNECT ALL ELECTRICAL POWER FROM THE FACILITY BEFORE SERVICING OR CLEANING THE CHAMBER INTERIOR.