DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-161480

INSTALLATION GUIDELINES FOR SOLAR HEATING SYSTEM, SINGLE-FAMILY RESIDENCE AT WILLIAM O'BRIEN STATE PARK, STILLWATER, MINNESOTA

Prepared from documents furnished by

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Solar Energy

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16. ABSTRACT

This document provides the Solar Heating System installer guidelines for each subsystem and includes testing and filling the system. This single-family residential heating system is a solar-assisted, hydronic-to-warm-air system with solar-assisted domestic water heating. It is composed of the following major components:

- o Liquid cooled flat plate collectors
- o Water storage tank
- o Passive solar-fired domestic water preheater
- o Electric hot water heater
- o Heat pump with electric backup
- o Solar hot water coil unit
- o Tube-and-shell heat exchanger, three pumps, and associated pipes and valving in an energy transport module
- o Control system
- o Air-cooled heat purge unit

This document also provides information on the operating procedures, controls, caution requirements, and routine and schedule maintenance. Information consists of written procedures, schematics, detail drawings, pictures and manufacturer's component data.

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SECTION I

INTRODUCTION

A) SCOPE

This document provides the Solar Heating System installer guidelines for the installation of each subsystem as well as the testing and filling of the system, operation and maintenance instructions.

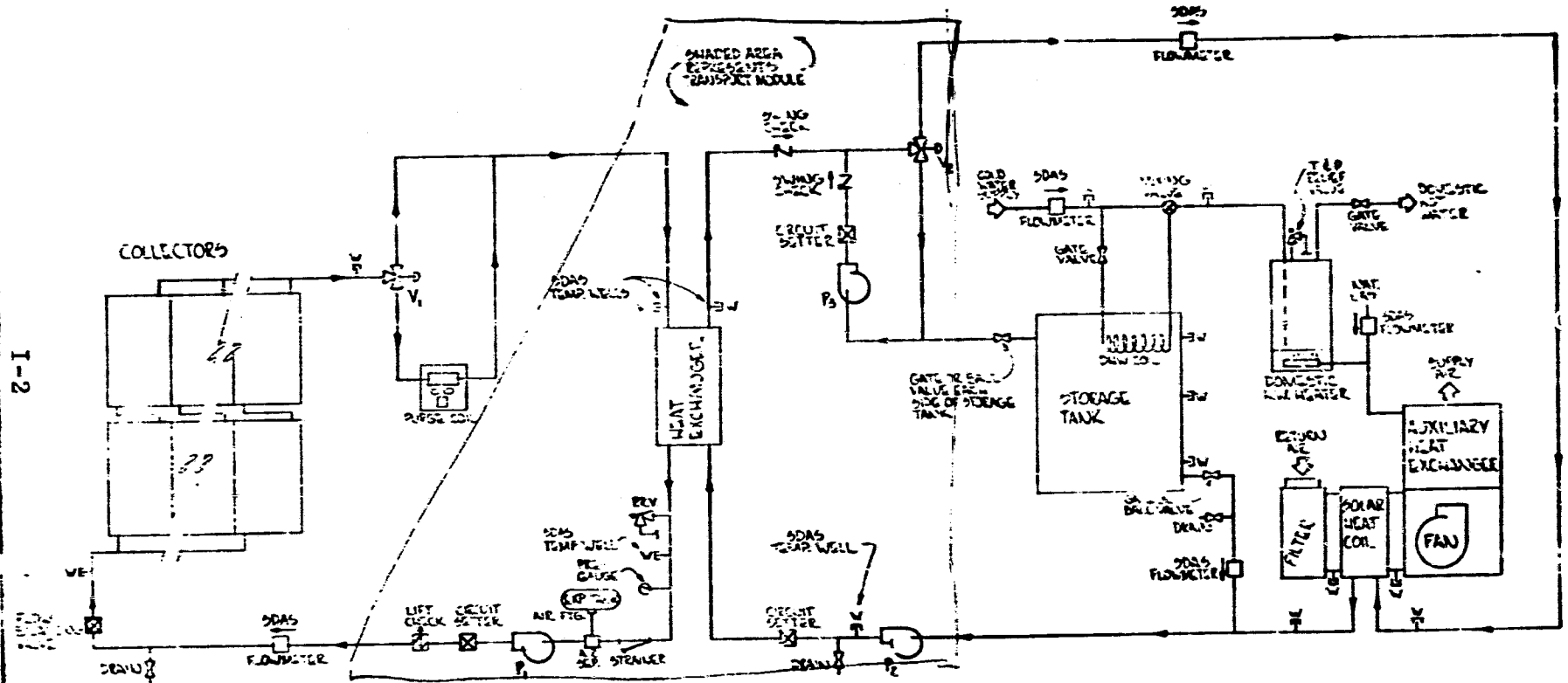
B) SINGLE-FAMILY RESIDENTIAL HEATING SYSTEM DESCRIPTION

The single-family residential heating system is a single-loop, solar-assisted, hydronic-to-warm air heating system with solar-assisted domestic water heating. The system is composed of the following major components:

- Liquid cooled flat plate collectors
- A water storage tank
- A passive solar-fired domestic water preheater
- A gas-fired hot water heater
- A gas-fired warm air furnace with hot-water coil unit
- A tube-and-shell heat exchanger, three pumps, and associated pipes and valving in an energy transport module.
- A control system
- An air-cooled heat purge unit

The arrangements of components within the system is as shown on Sheet 2 of SK 142057. The system consists of a glycol/water collector loop which interfaces with a water storage loop, through a tube-and-shell heat exchanger. A domestic hot water preheat coil is located in the storage tank.

The glycol/water collector loop consists of the solar collectors, the shell side of the heat exchanger, the purge coil and pump P_1, and a control valve as required for the different modes of operation.



SOLAR HEATING SYSTEM SCHEMATIC

NO SCALE

HONEYWELL INC.	ENERGY RESOURCES CENTER
SINGLE FAMILY RESIDENCE SYSTEM INTEGRATION	
SIZE C	CODE IDENT NO. 55513
DRAWING NO. 5K-142057	
SCALE NONE	SHEET 2 OF 4
CONTROL A	

The water side of the heat exchanger is a direct heating/storage loop consisting of the storage tank, control valve, pumps P_2 and P_3, the tube side of the heat exchanger and the solar heating coil.

The system provides six modes of operation:

- Direct heating from collectors
- Direct heating from storage
- Auxiliary heating (insufficient solar)
- Storage charging
- Continuous domestic hot water preheating
- Purging excess energy

C) SYSTEM OPERATION

When space heating is required and solar energy from the collectors is available, the collectors supply heat to the furnace. Energy transfer is through the heat exchanger then via the solar hot water coil in the return air duct. Pumps P_1 in the solar collector loop and P_2 in the water loop provide movement of the heat transport through valve V_2 to the heating coil. The blower moves the building air across this heating coil. When the heating demand is satisfied, valve V_2 diverts the water fluid to the top of the storage tank. Pumps P_1 and P_2 provide movement of the heat transport fluids to charge the storage tank. Storage charging occurs by circulating water from the tank bottom through the heat exchanger and returning the heated water to the top of the storage tank, thus taking advantage of stratification. During high solar insolation and low heating and storage demands, if surplus energy is collected, then valve V_1 diverts collector loop flow to the purge coil. The purge coil operates to maintain the system fluid temperatures below preselected values.

When space heating is required and direct solar energy is not available, thermal storage supplies heat to the furnace. Pump P_3 circulates the water from the top of the tank through the solar hot

water coil and returns the cooler water to the bottom of the storage tank, again taking advantage of tank stratification. If the storage tank temperature is not high enough to provide space heating, the second stage thermostat activates the auxiliary furnace to maintain a comfortable building temperature.

D) LIMITATIONS

These installation guidelines are intended as a general guide and do not supersede local codes in any way. Authorities having jurisdiction should be consulted before installation to comply with all applicable building codes.

SECTION II

SOLAR HEATING SUBSYSTEMS AND COMPONENTS

The Solar Heating system consists of the following subsystems:

- Collector
- Storage
- Auxiliary Energy and Space Heating
- Hot water
- Energy transport
- Control

A description of each subsystem is given in the following sections. Information on the major components within each subsystem is provided in the Appendices under the same alphabetical tab.

A. Collector Subsystem

The collector subsystem consists of 33 Lennox LSC 18-1 solar collectors, a purge coil unit Lennox HRW-1-30, a diverting valve (V2), Honeywell Part Y534A, headers, supply/returns lines and isolation and balancing valves.

The solar collectors should operate without any special attention. However, excessive temperatures can be achieved if pumps P_1 and P_2 are in the off position and direct solar energy is available. Pump P_2 can be turned off and pump P_1 can be operated during daylight hours if flow is directed through the purge unit. Caution should be taken if pump P_1 is left running at night during below freezing conditions as the water in the tube side of the heat exchanger can be frozen and rupture the unit.

A-1. Solar Collectors

The LSC 18-1 is double glass cover, flat plate collector. The tempered, low-iron glass has an acid etched surface to reduce reflection. The steel absorber plate has a special black chrome coating for high solar absorptivity. The absorber plate is formed around the copper fluid tubes and is all incased in an insulated, formed, galvanized steel box.

A-2. Purge Coil Unit

The purge coil unit is a fin and tube coil and blower unit that is mounted outside the dwelling. It is used to get rid of excess heat energy the collectors may be collecting.

A-3. Diverting Valve

The diverting valve is a dual unit consisting of two valve bodies which are plumbed together. These are controlled by two powerheads which move each valve separately. This valve is used to divert the liquid coming from the solar collectors to the purge coil unit as required.

See Appendix A for details on these components.

B. Storage Subsystem

The storage subsystem consists of a 1000 gallon lined steel tank. The tank is designed to operate at ambient pressure and is vented to the space enclosing it. The water in the tank is neutralized with an inhibitor to reduce corrosion of system components.

The storage tank is filled to a level which is 6 inches from the top of the tank. Initial fill level is marked with a red band on the site glass. If the water level is more than 3 inches below this level additional water should be added to the storage tank. This is accomplished by removing manhole cover, using hose connected to domestic water, fill system until level in sight glass is up to red band on sight glass.

Components in the storage subsystem are standard "off-the-shelf" plumbing components. See Appendix B for parts list.

C. Auxiliary Energy and Space Heating Subsystem

This subsystem consists of a Lennox G11Q3-82V gas fired furnace and a Lennox CW3-45 solar heat coil. The furnace is a standard up flow unit with an output rating of 65,600 Btu/hr. The heat coil is a fin and tube unit designed to be inserted in the return air flow.

The furnace functions as an air handling unit when the solar heated water is above 90°F and there is a call for heat in the dwelling. If the solar heated water is not hot enough the furnace gas burner will turn on and provide heat until demand is satisfied.

C. (continued)

Various blower speeds are available on the furnace. However, a new speed which is lower than the initial speed set by the installer should not be used as this can result in less solar energy utilized and consequently higher fossil fuel consumption rates.

The G11Q3 furnace and CW3-45 heat coil maintenance and repair instructions are in Appendix C.

D. Hot Water Subsystem

The domestic hot water subsystem consists of a preheat coil submerged in the 1000 gallon storage tank, a 40 gallon gas fired water heater and a mixing valve. When hot water is utilized, make-up cold water from the domestic water supply flows through the preheat coil and undergoes an increase in temperature. If the storage tank temperature is below 150°-160°F the preheated water will be below 140°. The gas fired water heater will maintain water temperature at 140°. If the storage tank temperature is greater than 160°F then the preheated DH water may be over 140°F. In this case the mixing valve then adds cold water to bring the water temperature down to 140°F before entering the domestic hot water heater.

The temping valve setting should be kept at 140°F.

The hot water subsystem components are shown in Appendix D.

E. Energy Transport Subsystem

This subsystem contains most of the active components of the solar heating system, i.e., the Energy Transport Module (ETM). The pumps to move the fluid, the valve that diverts from storage to the heating coil, the heat exchanger, an expansion tank, the control panel, circuit setters and fill and drain valves are all in the ETM.

ETM Components and Functions (Appendix E)

Pumps 1, 2, and 3, located in the bottom section of the ETM, provides the required flow rates in the collector, heating, and storage loops. DO NOT RUN PUMPS WITHOUT FLUID IN SYSTEM.

The heat exchanger separates the freeze-protected collector loop from and transfers energy to the heating/storage water loop. Integrally plumbed and mounted into the top section of the ETM, it has no moving parts but is equipped with a manual air bleed and drain valve. Cleaning and flushing of the exchanger shell is possible without contaminating the entire collector loop.

E. (continued)

The diaphragm expansion tank absorbs the expansion of the transfer fluid from fill temperature (50-60°F) to purge temperature (210°F). It is mounted in the center of the ETM, with the charging air valve accessible on its bottom (relief pan removal provides additional access to the valve). Tank air pressure should not drop below its initial 20 psi charge; it will increase as the system pressure increases. Removal of expansion tank is through the top panel, after removing the air separator and strainer.

Located in the upper section in the collector line is an air separator. With no moving parts, it separates entrapped air from the collector fluid as it circulates.

The automatic, float-type air vent, attached to the air separator, eliminates the purged air only. Then, fluid fills the chamber and the float closes the vent port. During system start-up, this process may be expedited by removing the protective vent cap and manually depressing the vent system. During operation, leave vent cap 2-1/2 turns open.

Two air bleeds, located in the top section, allow for the manual venting of air from the ETM piping and heat exchanger during system start-up. A catch basin should be used when venting the air/fluid mixture from plumbing.

Located in the top section of the ETM is a pressure relief valve, used to protect the collector loop from overpressure during a system pump failure. When system pressure reaches 45 psig, the valve will begin to open. The discharge is directed through the pressure relief line into the holding pan. DO NOT REMOVE ETM PANELS WHILE RELIEF VALVE IS FUNCTIONING. Fluid (water/ethylene glycol mixture) may be at 210°F.

The dual diverting control valve, located in the lower section, directs the water flow into various storage and heating modes. This electrically driven valve is controlled by the Solar Control Panel, but does have manual override levers, one per powerhead. These levers should be in the unlocked position.

Located in the lower section are three circuit setters, used to reduce flow rates to the correct level in the collector, charge storage, and heat from storage loops (there is no setter in the Direct Heating loop). The reduction is made by turning the large nut, thus adjusting the internal valve body. ETM is shipped with the setters in the "open" position, adjustments should be made during initial system start-up. TURN PUMPS OFF AND SHIELD THEM AND THE ETM BASE FROM FLUID LEAKAGE WHEN CONNECTING OR DISCONNECTING PRESSURE METER FROM SETTER.

E. (continued)

The lift check valve, located in the collector supply line in the top section, is used to prevent thermosyphoning (backward gravity flow) of cold collector fluid into the heat exchanger during cold, cloudy days. It is designed to prevent freezing of the heat exchanger water loop. During operation, the system pump (P_1) pushes liquid through the check valve, lifting the mechanism off the seat. When flow stops (the protect mode), the valve mechanism drops by gravity onto the seat, thus not allowing flow in the reverse direction. DURING OPERATION, THE VALVE MUST BE FIRMLY SCREWED DOWN ONTO THE SEAT.

Located in the bottom section are two swing check valves which, like hinged doors, allow flow in only one direction. Reversed flow causes the valve to seat more firmly. Check valves are a part of the overall flow control in the heating and storage loops.

There are four drain/fill valves, located in the ETM. These are used to flush, clean, and fill the system. These valves are similar to the drain on a residential hot water heater and have a standard garden hose threaded outlet. ANY SPILLED GLYCOL SOLUTION SHOULD BE IMMEDIATELY WIPED UP.

Located in the top section of the ETM (in the collector return line) is a ball valve, used during flushing of collector loop. The valve must be open (handle in-line) during system operation, thus allowing full flow through it. By opening and closing (handle perpendicular to supply line) the valve as stated in the operational instructions, the collector loop and heat exchanger shell can be independently flushed and cleaned.

Located in the top section of the ETM (in the collector loop) is a strainer which removes most of the foreign matter from the fluid as it passes through the metal screen. Foreign material should be occasionally removed from the strainer. STRAINER SHOULD NOT BE OPENED PRIOR TO DRAINING OR ISOLATING THE COLLECTOR LOOP.

The low level indicator consists of an indicator lamp (mounted on the ETM) and the pressure gauge mounted in the top section of ETM. After charging the system to 20 psig, the gauge contact pointer should be adjusted to the proper setting (17 psig). When collector loop looses fluid the pressure will drop from the nominal operating 20-36 psig, to the 17 psig, the lamp will light. This indicates a possible system pressure leak, i.e., loss of fluid.

The lamp may also light if all collector fluid becomes very cold and contracts sufficiently to cause a drop in system pressure. If lamp remains lit when the system pump (P_1) is automatically turned on, check for a leak.

NOTE: The indicator actually detects a pressure loss, and not a liquid level.

c. (continued)

The Solar Control Panel located in the right side of the ETM, senses conditions throughout the system and requirements of the household (thermostat setting) and provides ETM operational control. When opening the Control Panel, care should be taken to avoid damage to the door or cabinet finish. Switches should remain in the "AUTO" position. Secure the door after closing it with the screw provided.

The holding pan, located on rails under the ETM, is provided to catch and hold the overflow from the relief valve. To remove pan, first disengage the relief line by pushing in at its mid-length and pulling the bottom out of the pan. Then grasp the pan handles and pull from under the ETM.

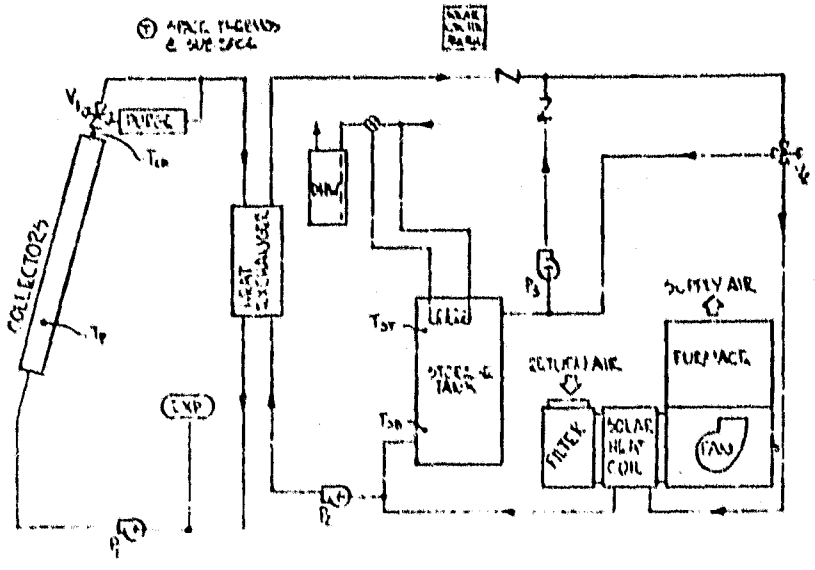
d. Control Subsystem

The control subsystem is composed of the collector plate temperatur sensor, the upper and lower storage tank temperature sensors, the collector outlet temperature sensor and the central panel.

Operation of the control subsystem is as follows: (Refer to Figure 2-1)

Space heating is controlled by the two stage heating thermostat. First stage heting is set to utilize solar energy if available while second stage heating will supply the auxiliary energy if solar is not adequate. The system control logic is as follows:

- Collector solar energy when available
  - store energy under no load conditions
  - provide energy directly to load on demand
- Use direct solar energy before stored energy
- Use stored energy when direct solar energy is not available
- Use direct or stored solar energy before auxiliary energy



SOLAR HEATING SYSTEM CONTROL SCHEMATIC

Figure 2-1

Direct Heating from Collectors

Whenever plate temperature T_p is greater than 105°F (adjustable) and there is a call for heating from the space thermostat pumps P_1 and P_2 are activated. Valve V2 is positioned to direct flow to the heating coil. The furnace fan is activated to provide warm air to the space. A heating coil leaving-air high-limit controller will cause valve V2 to direct flow to the storage tank if the heating coil leaving-air temperature exceeds 140°F (adjustable). Direct heating operation will continue until the space thermostat is satisfied or until the collector plate temperature has dropped to 90°F.

Heating from Storage

Whenever T_p is less than 105°F (adjustable), T_{ST} is greater than 90°F (adjustable), and there is a call for space heat, pump P_3 is activated to discharge the storage tank for space heating. Valve V2 is positioned to direct flow to the heating coil. The furnace fan is activated to provide warm air to the space. Pumps P_1 and P_2 are not allowed to operate during this mode. The heating coil leaving-air high-limit controller functions as described above.

Storage Charging

Storage charging is accomplished whenever T_p is greater than T_{SB} by 18°F (adjustable). Pumps P_1 and P_2 are activated and valve V2 is positioned to direct flow to the storage tank. If the above temperature difference falls to less than 3°F (adjustable), the storage charge mode is terminated.

Heat Rejector Control

Whenever the collector discharge temperature exceeds 210°F (adjustable) as sensed to T_{CD}. Valve V1 is positioned to direct collector loop flow through the heat rejector, and the heat rejector fan is activated.

Auxiliary Heating

Whenever solar heating is being utilized, either direct or stored, auxiliary gas-fired heating will be available as controlled by the second heating stage of the space thermostat. When solar heating is not available, auxiliary gas-fired heating will be available as first stage heating. Auxiliary heating is provided by a conventional gas furnace utilizing conventional controls.

G. Site Data Acquisition Subsystem (SDAS)

To meet the data collection, performance evaluation, and data dissemination goals of the National Program for Solar Heating and Cooling, the solar heating system will include a comprehensive instrumentation subsystem.

Data Collection

The goal of ERDA's data collection activity is to provide the information necessary for evaluation of the performance and operation of solar systems and subsystems under different climatic conditions. The information generated as a result of this data collection activity will be utilized to stimulate industrial and commercial capability, including that of small business, to produce and distribute solar heating and cooling systems, and through widespread applications, to reduce the demand on conventional fuel supplies. This information will also be used to improve the general knowledge and understanding of solar energy systems, to develop defintive solar energy system performance criteria, to provide the basis for component system improvement and to estimate the economics of solar energy systems in reducing the consumption of conventional fuels. Results will be available for use by property owners, the building industry and related sections of the economy to compare costs and benefits of solar heating and cooling systems. This information will also provide the data base for design of new applications in the private sector. ERDA's Technical Information Center at Oak Ridge, Tennessee, will be the National Solar Heating and Cooling Data Bank and will be the focal point for distribution of this information.

Data System Overview

The Data System depicted in Figure 2-2 provides for the automatic gathering, conversion, transfer, reduction, and analysis of demonstration site data. This system is made up of three basic elements: installed sensors, a Site Data Acquisition Subsystem (SDAS), and a Central Data Processing System (CDPS).

The data will be gathered at each operational site at predetermined intervals of time and will be stored for transfer to the Central Processor. The collected data will be transferred via telephone communications upon request from the Central Data Processing Facility. At the Central Data Processing Facility, the collected data will be processed, analyzed, evaluated, and documented as Performance Evaluation Reports.

Locations of all SDAS sensors are shown in Figure 2-3.

Operation and Maintenance

All operation and maintenance work for the Site Data Acquisition Subsystem will be the responsibility of ERDA or its appointed representative.

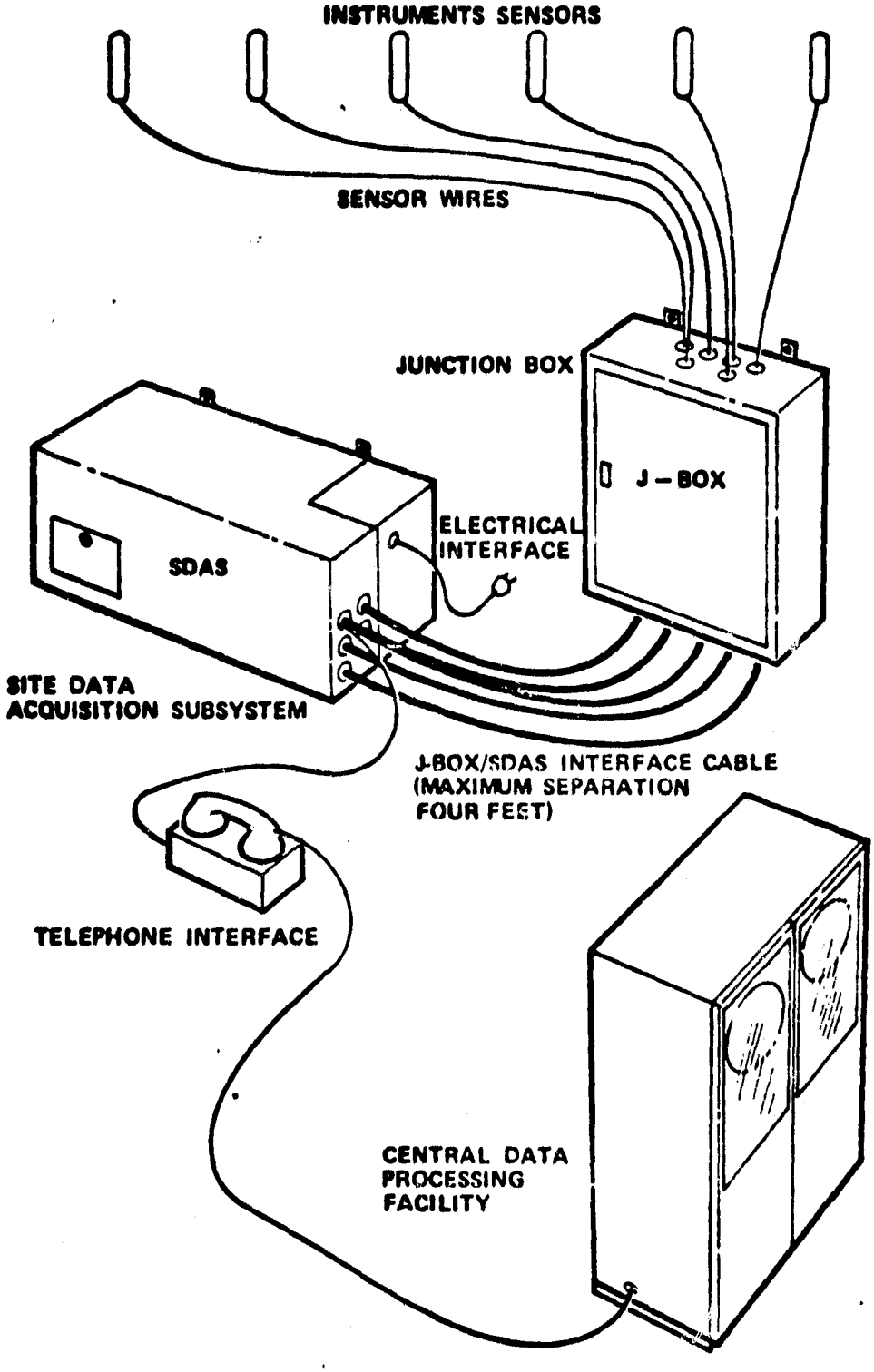


Figure 2–2 *Site Instrumentation Interface Hardware*

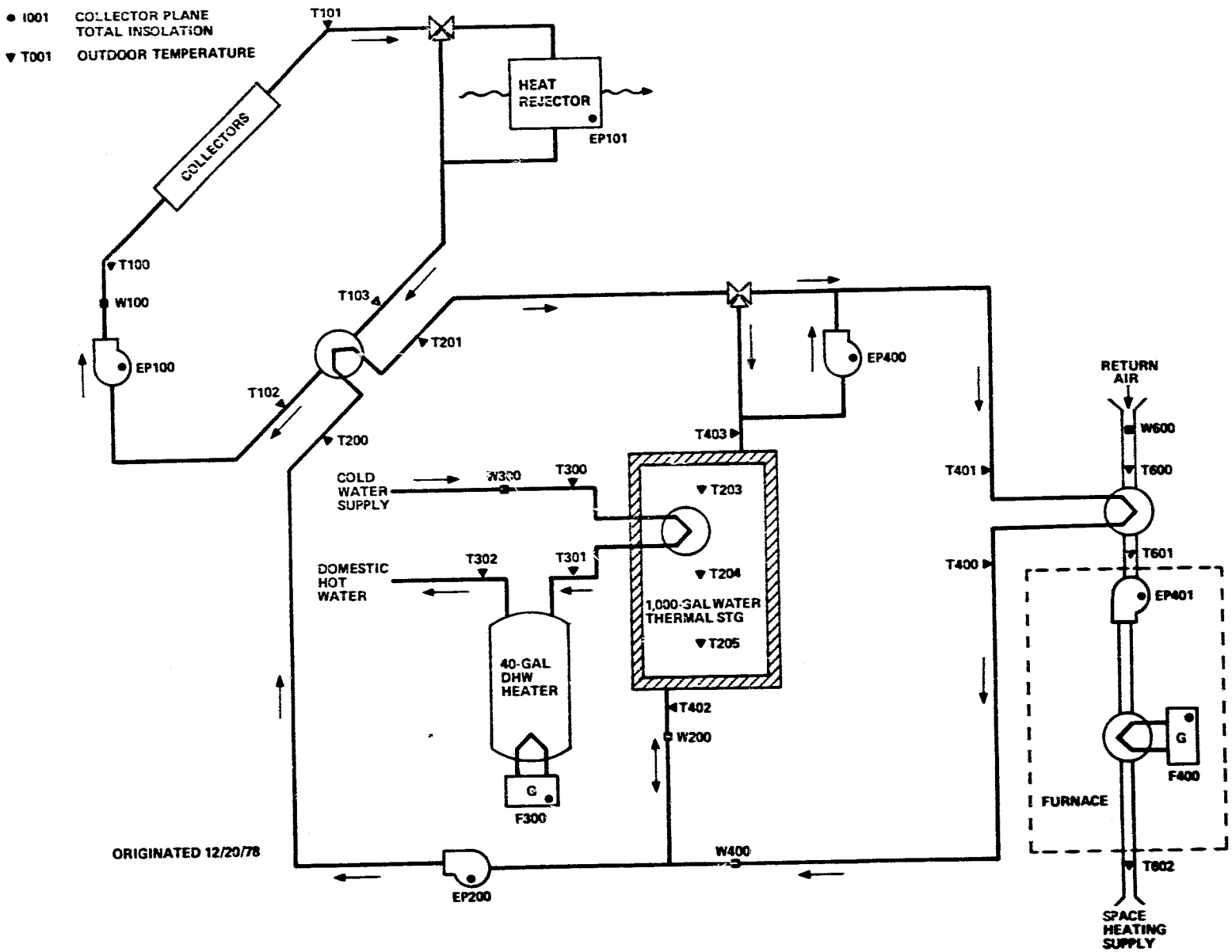


Figure 2-3 *HONEYWELL-STILLWATER SOLAR ENERGY SYSTEM SCHEMATIC*

SECTION III

SUBSYSTEM INSTALLATION GUIDELINES

A) COLLECTOR SUBSYSTEM

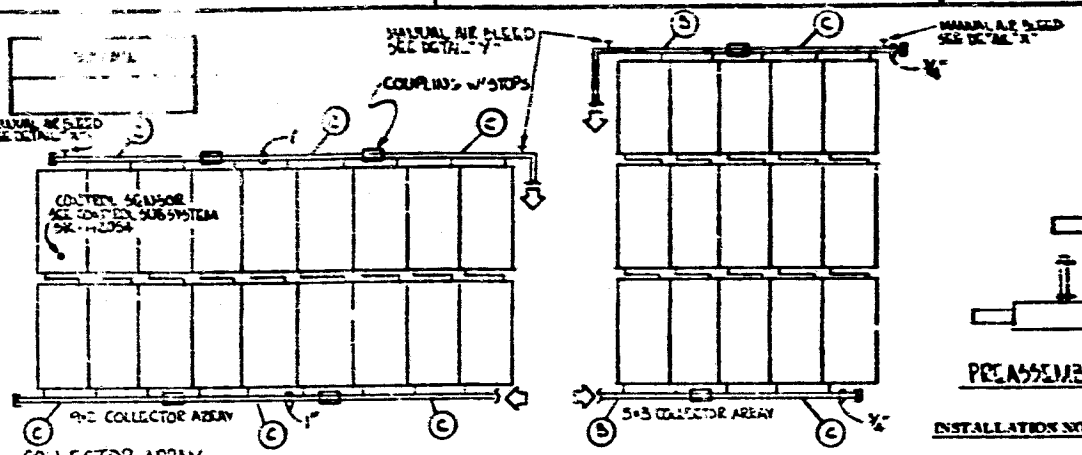
The solar collectors, Lennox LSC18-1, are arranged in typical arrays as shown on sheet 2 of drawing SK 142049. The collectors and headers are interconnected as shown in the lower left of the drawing. Prior to collector placement on the support structure remove inlet and outlet plugs from the collector ends. Do not remove the "red" plastic plugs at each end of the collector. Install straight fittings at the collector inlet of lower-most collectors and collector outlet of upper-most collectors in the collector array (Detail A). Install elbow fittings facing inward at all other collector inlets and outlets (Detail B). Use pipe compounds on all threaded fittings suitable for aqueous ethylene glycol solutions, Rectorseal No. 7 or equivalent.

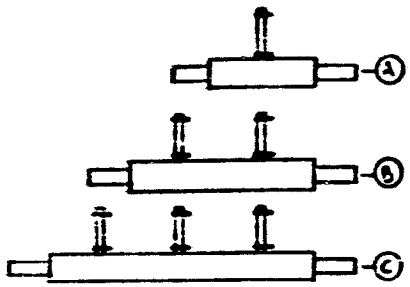
Collector mounting to the support structure is done chronologically by collector stacks one at a time proceeding from one end of the collector array. The lateral spacing between collectors should be approximately 1/8 inch. The mounting procedure is as follows:

1) Place the upper collector(s) of a collector stack approximately 6 inches above its (their) final position and retain by bracing against the support structure. The upper collector(s) may be offset laterally for easier interconnecting to the adjacent lower collector.

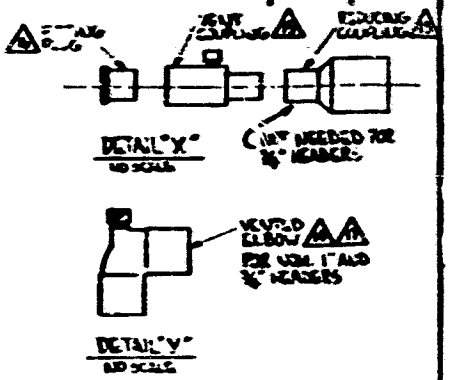
2) Place the first row collector on the support structure and bolt both lower-end mounting brackets to the structure allowing space for the supply header and its interconnecting hose.

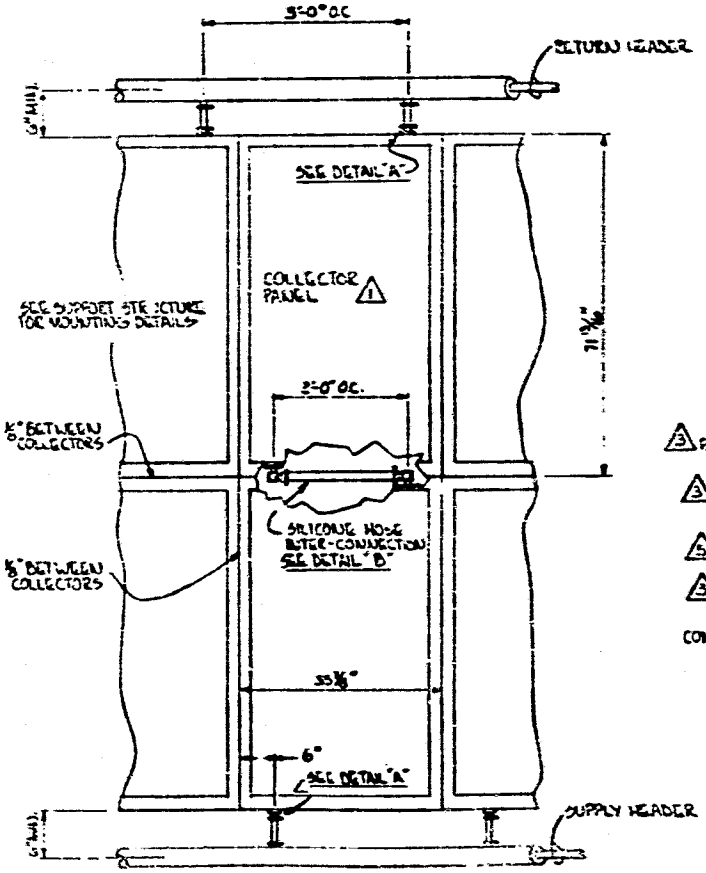
3) At the upper end of the collector attach the tie-down clip to the mounting bracket and bolt to the support structure.





PRE-ASSEMBLED COLLECTOR HEADERS





COLLECTOR ARRANGEMENT

INSTALLATION NOTES

Single-Stack Collector Array

1. Screw header-to-collector coupling into both collector ends, place collector on support structure, and fasten (bolts, etc.) collector to structure. Repeat for all collector modules.
2. Connect pre-assembled return header sections to top of collector array with section-to-section couplings placed at all joints. After proper alignment, tighten header sections together. Insulate and weatherproof uninsulated sections of header. Strap header to support structure.
3. Repeat #2 for pre-assembled supply header sections at bottom of collector array.
4. For second stack collector screw collector-to-collector coupling into bottom end of collector and header-to-collector coupling into top end of collector.
5. Lower collector down structure until it rests against wood stud, and connect fluid lines with 24 in. of/inner hose clamping each end to coupling.
6. Remove 2 x 4 wood stud and lower collector such that mounting brackets slide into clips. Fasten top mounting brackets (bolts) to structure.
7. Repeat #1 - #5 for entire collector array.
8. Connect pre-assembled return header sections same as #2 for single-stack array.
9. Connect pre-assembled supply header sections same as #2 for single-stack array.

Double-Stack Collector Array

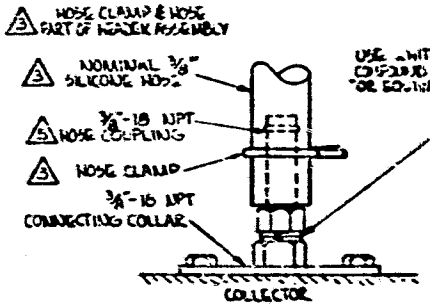
1. For bottom row collector screw header-to-collector coupling into bottom end of collector and collector-to-collector coupling into top end of collector. Place collector on support structure and fasten to structure (bolts at bottom end and insert clips at top end).
2. Place 2 x 4 wood stud at top end of collector with wide face flat against support structure.

Triple-Stack Collector Array

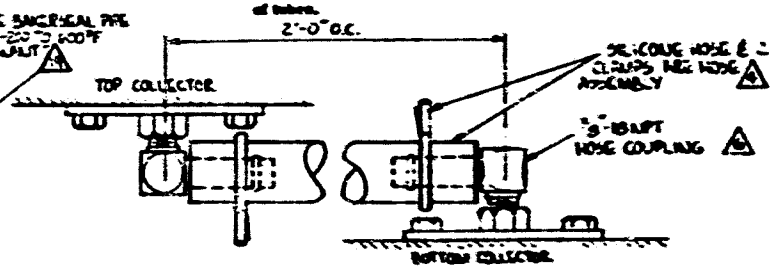
The procedure is an extension of the double-stack collector array installation notes.

INSULATION NOTES

Put insulation tube around header. Apply insulation adhesive to longitudinal slit of insulation tube and between seams at ends of tubes.



DETAIL "A"



DETAIL "B"

			ENERGY RESOURCES CENTER
			SINGLE FAMILY RESIDENCE COLLECTOR SUBSYSTEM
			SIZE C; CODE IDENT NO. 53513; DRAWING NO. 5K-142049
			SCALE 3/4; WEIGHT; SHEET 2 OF 4
			CONTROL A

4) Connect adjacent ends of collectors by installing the 23-inch interconnecting hose using two clamps per end as shown on sheet 2 of drawing SK 142049 (Detail B).

5) Bring the upper collector into place by sliding its lower mounting bracket under the tie-down clip attached to the lower collector and support structure.

6) For a three-high collector stack repeat steps 3 through 5.

7) Bolt both upper-end mounting brackets of the highest collector to the support structure.

8) Repeat steps 1 through 7 for all remaining collector stacks in the array.

Header sections are placed into position and connected to the bottom and top collectors' fittings by the 6-inch long interconnecting hose using two clamps per end as shown on sheet 2 of drawing SK 142049 (Detail A). Header sections are connected to each other by means of a copper coupling. After all such interconnections have been made, the header sections are soldered together. During soldering the support structure should be shielded from the flame used to heat the copper headers and coupling. Also, it may be necessary to provide a heat block between the soldering flame and the insulated portion of the headers. Headers should be anchored securely only at ends where connected to supply and return lines. At other locations the headers should be supported or strapped but done in such a manner as to allow expansion and contraction movement.

Air bleed valves must be installed at both ends of the return header in each collector array as shown in drawing SK 142049 (Detail X and Y). Also air bleed valves are needed at the high points in the supply and

return lines, if such locations exist. All collector subsystem piping should be insulated with 3/4 inch thick armaflex insulation or equivalent and outdoor piping weatherproofed. A flow balancing valve should be installed in the return line for each collector array and a shut-off valve in the supply line to each array.

The purge unit, Lennox HRW-1-30, is located outside the dwelling on a concrete slab as shown on sheet 4 of drawing SK142049. Check sections E and F for control valve installation guidelines.

B) STORAGE SUBSYSTEM

The storage tank depicted on SK142050 Sheet 2 is to be installed above ground (i.e., not buried) and enclosed within a partition which allows the tank to be engulfed in blown fiberglass insulation. The tank should rest evenly on four 1-inch redwood boards. The tank should be leveled with a bubble level. All plumbing connections, control and SDAS sensors should be installed prior to engulfing Tank in insulation. See sections F and G for sensor information. Inlet and outlet lines should be insulated with 3/4" thick armaflex insulation or equivalent.

C) AUXILIARY ENERGY AND SPACE HEATING SUBSYSTEMS

The auxiliary energy unit is a Lennox gas fired furnace type G11Q3-82V. It is to be combined with a space heating coil Lennox type CW3-45. The installation of the furnace is outlined in Figures C-1 and C-2. Do not connect return air plenum or filter to furnace.

CAUTION: See SK 142054 Sheet 3 (Pg. III-21) for changes to furnace wiring.

The general dimensional information on the furnace is shown on drawing SK 142051 sheet 1. The installation information for the CW3-45 is shown on drawing SK 142051 sheet 3. This information is supplemented with detail cut out information shown in Figure C-3.

PART NO.

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III-5

PURGE COIL DESCRIPTION

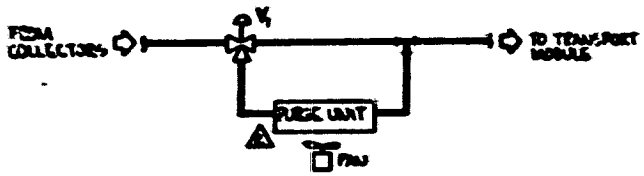
Heat Capacity and Pressure Drop

Height of the coil	• 25"
Length of the coil	• 25"
No. of rows	• 2
No. of fins/inch	• 15
Outer dia. of tubes	• 1/2"
No. of circuits	• 10
Air flow rate	• 2000 CFM
HP of the motor	• 1/3
Assumed air temp. at the suction side of the fan	• 60-125°F
Calculated heat dissipated/hr	• 101,600-158,600 Btu/hr. (Inlet Fluid Temp. • 235°F 50% glycol solution)
Pressure drop (calculated) in the Purge coil	• 9.0 ft. = 3.9 PSI

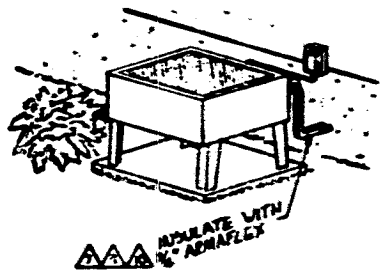
INSTALLATION NOTES

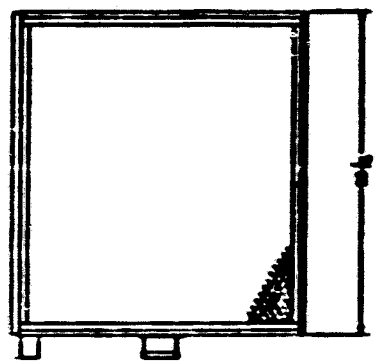
PLUMBING: Connect the inlet and outlet manifolds (1 5/8", O.D., copper tube) of the purge coil to the desired pipes in the collector loop.

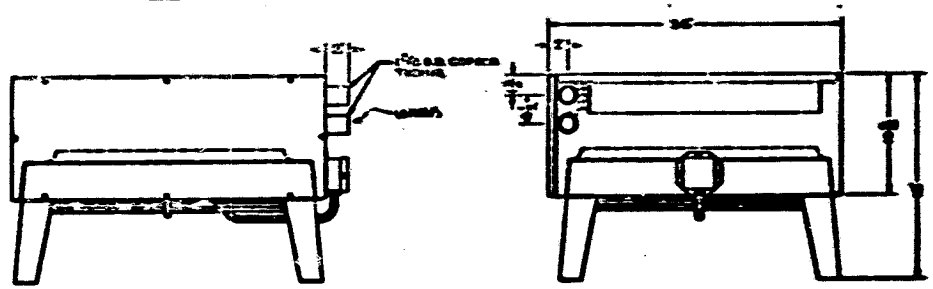
ELECTRICAL: Connect the motor of the purge coil fan to the control panel.



SCHEMATIC - PURGE
NO SCALE

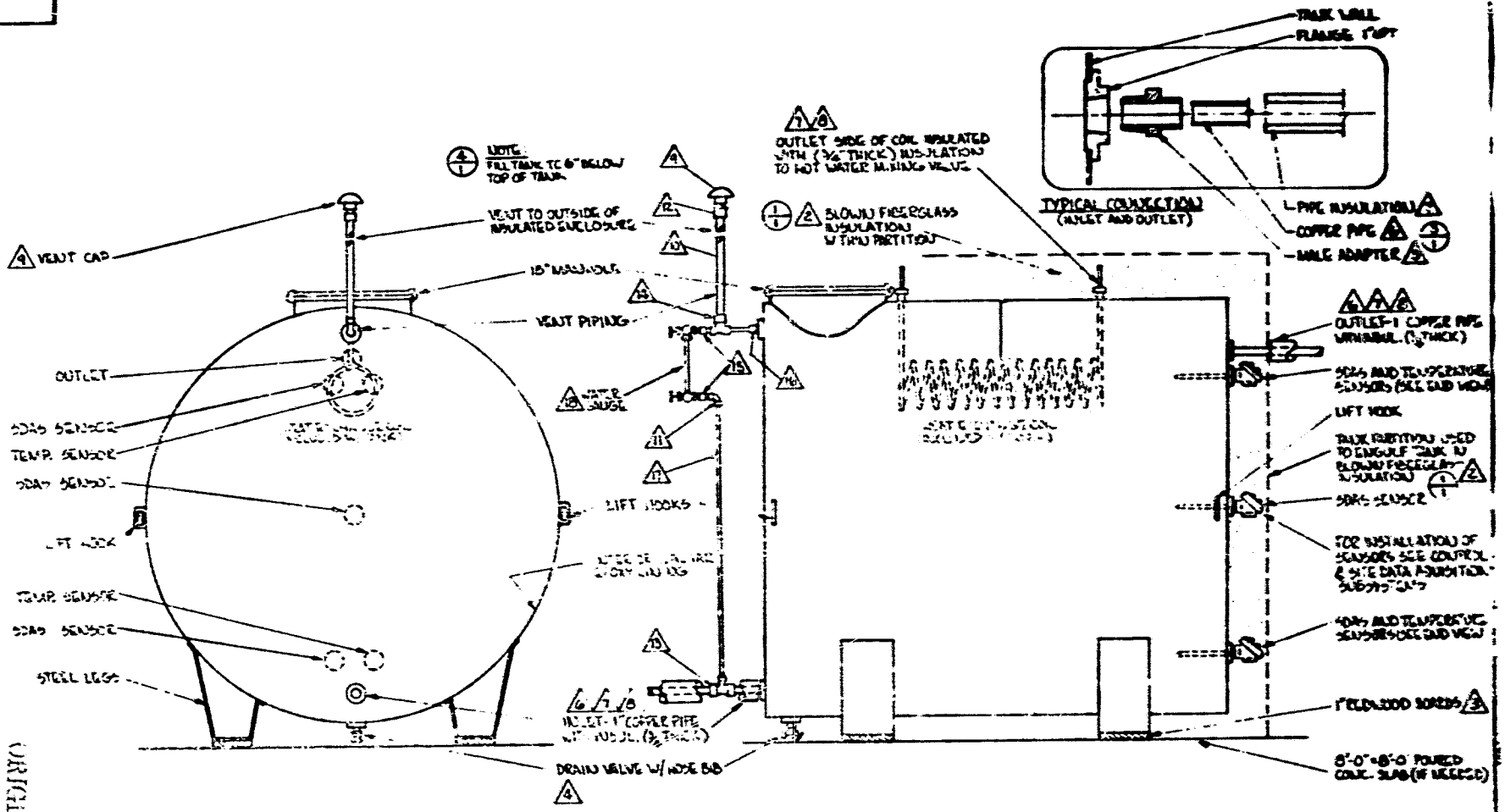






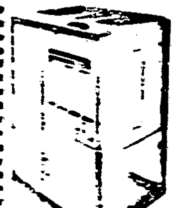
PURGE COIL UNIT (HEAT REJECTOR)
½" = 1'-0"

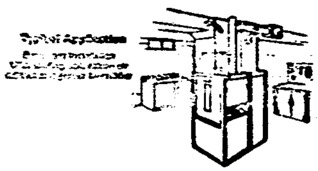
				HONEYWELL INC.	ENERGY RESOURCES CENTER
				SINGLE FAMILY RESIDENCE COLLECTOR SUBSYSTEM	
			WILLIAM O'BRIEN	SIZE C	CODE IDENT. NO. 53513	DRAWING NO. SK-142049
				SCALE 12 = 1'-0"	SHEET 4 OF 4
				CONTROL	A



PART NO.

FORCED AIR GAS FURNACES—UP-FLO
G11Q SERIES
DIRECT DRIVE BLOWERS
32,000 Btuh Input



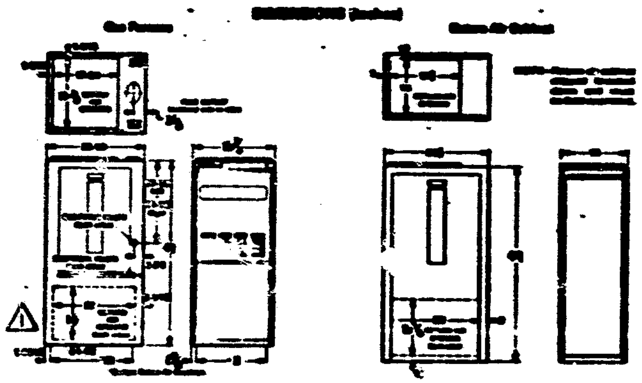


A.G.A. INSTALLATION CLEARANCES

HIGH ALTITUDE DERATE

SPECIFICATIONS

BLOWER DATA
WITHOUT SPACE HEAT COIL



MATERIAL SCHEDULE				
ITEM #	ITEM	MANUFACTURER	TYPE/PART NO	QUANTITY
1	FURNACE	LENNOX IND	G11Q3-32V	1
2	HEAT COIL	LENNOX IND.	CW3-45	1

BLOWER DATA
WITH CW3-45 SPACE HEAT COIL
G11Q3-32V BLOWER PERFORMANCE

EXTERNAL STATIC PRESSURE (IN. H_2O)	AIR VOLUME (CFM) @ VARIOUS SPEEDS HIGH	MEDIUM HIGH	MEDIUM LOW	LOW
0.00	1291	1185	995	888
0.05	1270	1166	977	850
0.10	1245	1144	960	819
0.15	1219	1121	940	807
0.20	1190	1096	920	796
0.25	1160	1070	898	780
0.30	1128	1043	875	765
0.40	1060	984	827	721
0.50	993	915	770	666
0.60	[illegible]	833	705	547
0.70	825	750	640	525
0.80	740	668	515	440

NOTE – ALL CFM MEASURED EXTERNAL TO THE UNITS W/ THE AIR FILTER IN PLACE.

HONEYWELL INC.	ENERGY RESOURCES CENTER
S.F.R. AUXILIARY ENERGY AND SPACE HEATING SUBSYSTEMS	
DRAFTSMAN	WILLIAM O'BRIEN
SIZE C	CODE IDENT NO. 55513
DRAWING NO.	SK-142051
SCALE NONE	SHEET 1 OF 3
CONTROL	A

REQUIREMENTS — APPLICATION — INSTALLATION

I - SHIPPING AND PACKING LIST
A - Units with Direct Drive Blowers
Package 1 of 1 Contains
1 - Leveling bolt package
1 - Thermostat (if ordered)
1 - Rubber grommet (for electrical make-up)
B - Units with Belt Drive Blowers
Package 1 of 1 Contains
1 - Leveling bolt package
1 - Thermostat (if ordered)
1 - Rubber grommet (for electrical make-up)
Package 1 of 1 Contains
1 - Blower Motor
1 - Motor Pulley
1 - Belt
Motor mounting clamps

II - SHIPPING DAMAGE
Check unit for shipping damage. The receiving party should contact the last carrier immediately if any shipping damage is found.

III - GENERAL
These instructions are only intended as a general guide, and do not supersede local codes in any way. Authorities having jurisdiction should be consulted before installation.

IV - REQUIREMENTS
Installation of Lennox gas central furnaces must conform with American National Standard (ANSI-Z223. 1-1974) National Fuel Gas Code, manufacturers installation instructions and local municipal codes. Authorities having jurisdiction should be consulted before installation. Air for combustion and ventilation must conform to the methods outlined in ANSI-Z223. 1-1974.
Unit design, certified by American Gas Association (AGA) and Canadian Gas Association (CGA).
Central furnace is certified for installation clearances to combustible material as listed on A.G.A. rating plate.
Accessibility and service clearances must take precedence over fire protection clearances.
Unit must be adjusted to obtain a temperature rise within the range specified on A.G.A. rating plate.
When this furnace is used in conjunction with cooling units, it shall be installed in parallel with or on the upstream side of cooling units to avoid condensation in the heating element. With a parallel flow arrangement, the damper (or other means to control the flow of air) shall be adequate to prevent chilled air from entering the furnace and, if manually operated, must be equipped with means to prevent operation of either unit, unless damper is in the full "heat" or "cool" position.
All electrical wiring and grounding for unit must be in accordance with the regulations of the National Electrical Code (NFPA No. 70-1975/ANSI C1-1975).

V - CUT OUT RETURN AIR OPENINGS
1 - The return air can be brought in either side or at the bottom of the unit. Scribe lines are provided on each side and bottom showing the outline for the return air opening. Remove blower access door and cut out desired opening.

VI - LEVELING THE UNIT
Holes are provided in the corners of the base for leveling the unit. Install leveling bolts provided in leveling bolt package as shown in Figure 1.
CAUTION - Be sure that the plastic nuts are installed as shown and screwed down snug before setting unit.
2 - Set unit in desired location keeping in mind the clearances listed on the A.G.A. rating plate. Also keep in mind, gas supply connections, electrical supply, flue connections and sufficient clearance for installing and servicing unit.

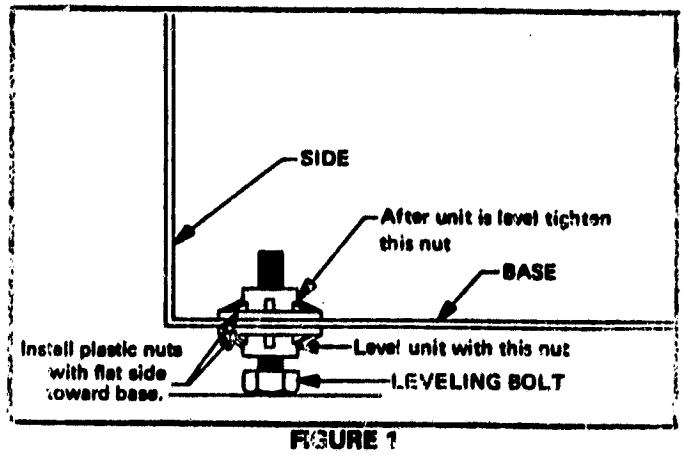


FIGURE 1

VII - INSTALL RETURN AIR PLENUM
Install return air plenum and secure to return air opening with sheet metal screws. (Do not screw into filter.)
If a return air cabinet is used, install according to the installation instructions furnished with the return air cabinet.

VIII - INSTALL WARM AIR PLENUM
NOTE - The following are suggested procedures that should be followed when installing the warm air plenum.
1 - Sealing strips of asbestos or fiberglass may be used.
2 - In all cases, the plenum should be secured to the furnace or evaporator cabinet with sheet metal screws. In closet installations, it may be impossible to install sheet metal screws from the outside. If this is the case, install screws from the inside. Cut an access panel in plenum if necessary.
3 - Install conventional plenum as illustrated in Figure 2. Secure to furnace top with sheet metal screws.
4 - Install cooling plenum according to the instruction furnished with the C4 Evaporator Coil or the C4-00 Empty Cabinet.

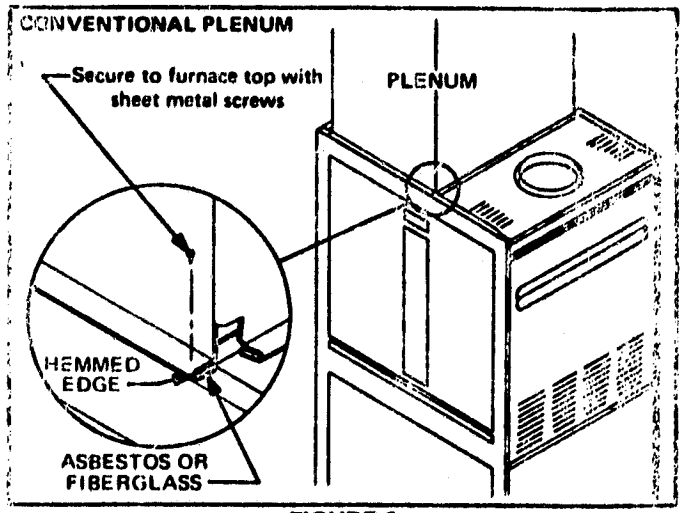


FIGURE 2

IX - CONNECT DUCT WORK
Install supply and return ductwork as desired.

X - CONNECT FLUE
1 - Install flue pipe over the collar on the cabinet top and connect to the chimney using least number of elbows and angles possible. See Figure 3.
2 - The flue pipe should have a slight upward slope toward the chimney on all horizontal runs. Approximately 1/4 inch for each 1 foot of horizontal run. The flue pipe or vent connector must be

Figure C-1

inserted into, but not beyond, the outside wall of the chimney flue. Where two or more appliances vent into a common flue, the area of the common flue should be at least equal to the area of the largest flue or vent connector plus 50% of the combined area of the additional flues or vent connectors.

XI - HIGH ALTITUDE

Unit may be fired at full input up to 2000 feet above sea level. If unit is installed at an altitude higher than 2000 feet, unit must be de-rated 4% for each 1000 feet above sea level.

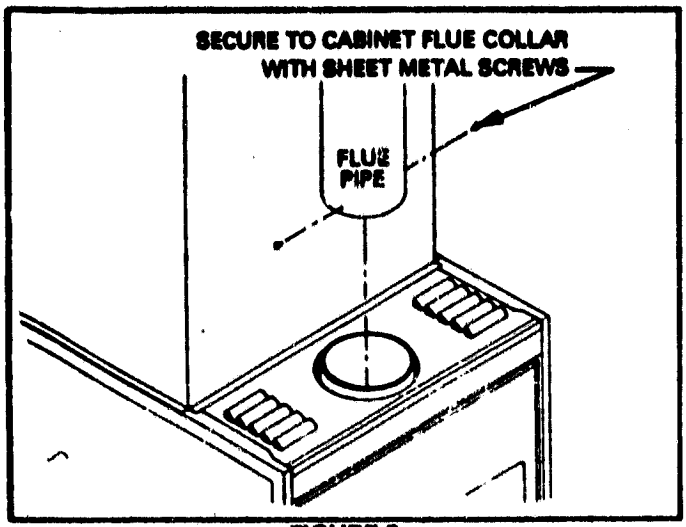


FIGURE 3

XII - CONNECT GAS SUPPLY

1 - This unit is shipped standard for the piping to be installed through the left side of the unit. See Figure 4. All that is necessary for the installer to do is connect gas supply to the piping assembly.

2 - If it is necessary to bring piping through the right side of the unit, a piping hole is furnished on the right side. See Figure 4 for connection.

3 - When connecting the gas supply, the length of run from the meter must be considered in determinining the pipe size so as to avoid excessive pressure drop. For correct sizing of gas delivering piping consult booklet "Specifications for Installations of Gas Piping and Gas Appliances" issued by the utility having jurisdiction. A drip leg should be installed in the vertical pipe run to the unit. See Figure 4.

In some localities, codes may require a manual main shut off valve and union (furnished by installer) be installed external to unit. Union must be of the ground joint type.

NOTE - Compounds used on threaded joints of gas piping must be resistant to the actions of liquefied petroleum gases.

XIII - LEAK CHECK PIPING

After gas piping is completed, carefully check all piping connections (factory and field) for gas leaks. Use a soap solution or other preferred means.

CAUTION: DO NOT USE MATCHES, CANDLES, FLAME OR OTHER SOURCES OF IGNITION TO CHECK FOR GAS LEAKS.

XIV - INSTALL BLOWER MOTOR AND DRIVES (BELT DRIVE MODELS ONLY)

1 - Mount motor on motor frame and secure with motor clamps, machine bolts and nuts provided. Be sure motor is rotated so oiling holes are accessible.

2 - Install the motor pulley making sure it is aligned with the blower pulley.

3 - Install blower belt. Refer to page 2 for correct motor pulley adjustment and belt tension.

4 - Use wiring strain relief at motor and connect wiring leads at motor according to wiring make-up diagram on motor cover.

5 - Connect the loose end of the green ground provided on blower housing to motor.

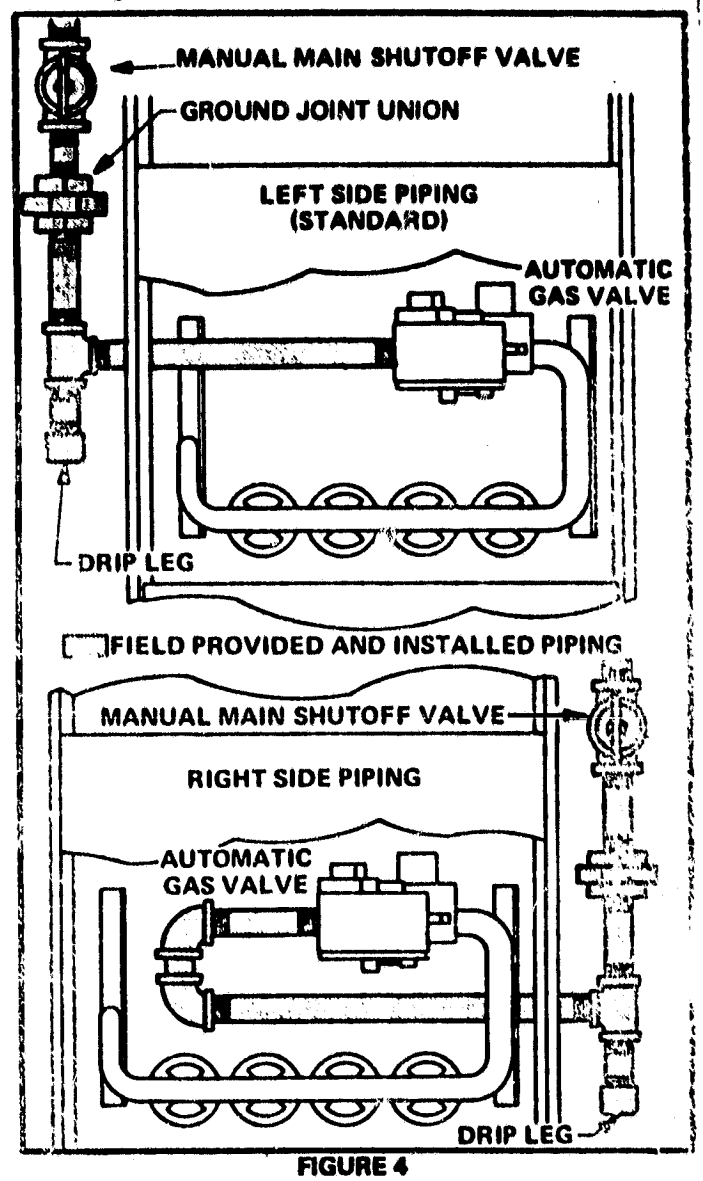


FIGURE 4

XV - COMPLETE WIRING – Caution. See SK 14 2054 Sh3

The unit is equipped with terminal strips where all field wiring connections are made. Line voltage connects at terminals L1 and N. Thermostat connections are made at R and W (heating only) or at R, Y, W and G for additive cooling. For cooling, condensing unit low voltage connections are made at terminals T and Y. An indoor blower relay is mounted standard in the unit. Blower motor speed connections are made at terminals 2 (red) and 6 (black) of indoor blower relay.

6 - Cooling Blower Speed
2 - Heating Blower Speed

Unused motor leads must be taped separately. Refer closely to unit diagram for correct terminal connections.

1 - Refer to blower motor nameplate to select proper fuse and wire size.

2 - Snaphole plugs are provided on both sides of cabinet to facilitate wiring.

3 - Install room thermostat (avoid installing on an outside wall or where radiant heat will effect thermostat) and wire to unit terminal board. Set adjustable heat anticipator on thermostat accord-

Figure C-2

ing to the setting stamped on the unit gas valve.

4 - Install a separate fused disconnect switch near the unit so power supply can be turned off for servicing.

5 - Complete line voltage from disconnect switch to unit terminal strip in make-up box.

6 - Multi-tap direct drive motors are wired for different heating and cooling speeds. Speed may be changed by simply interchanging motor connections at indoor blower relay. Refer to speed selection chart on unit wiring diagram.

CAUTION - To prevent motor burnout, never connect more than (1) motor lead to any one connection. Tape unused motor leads separately.

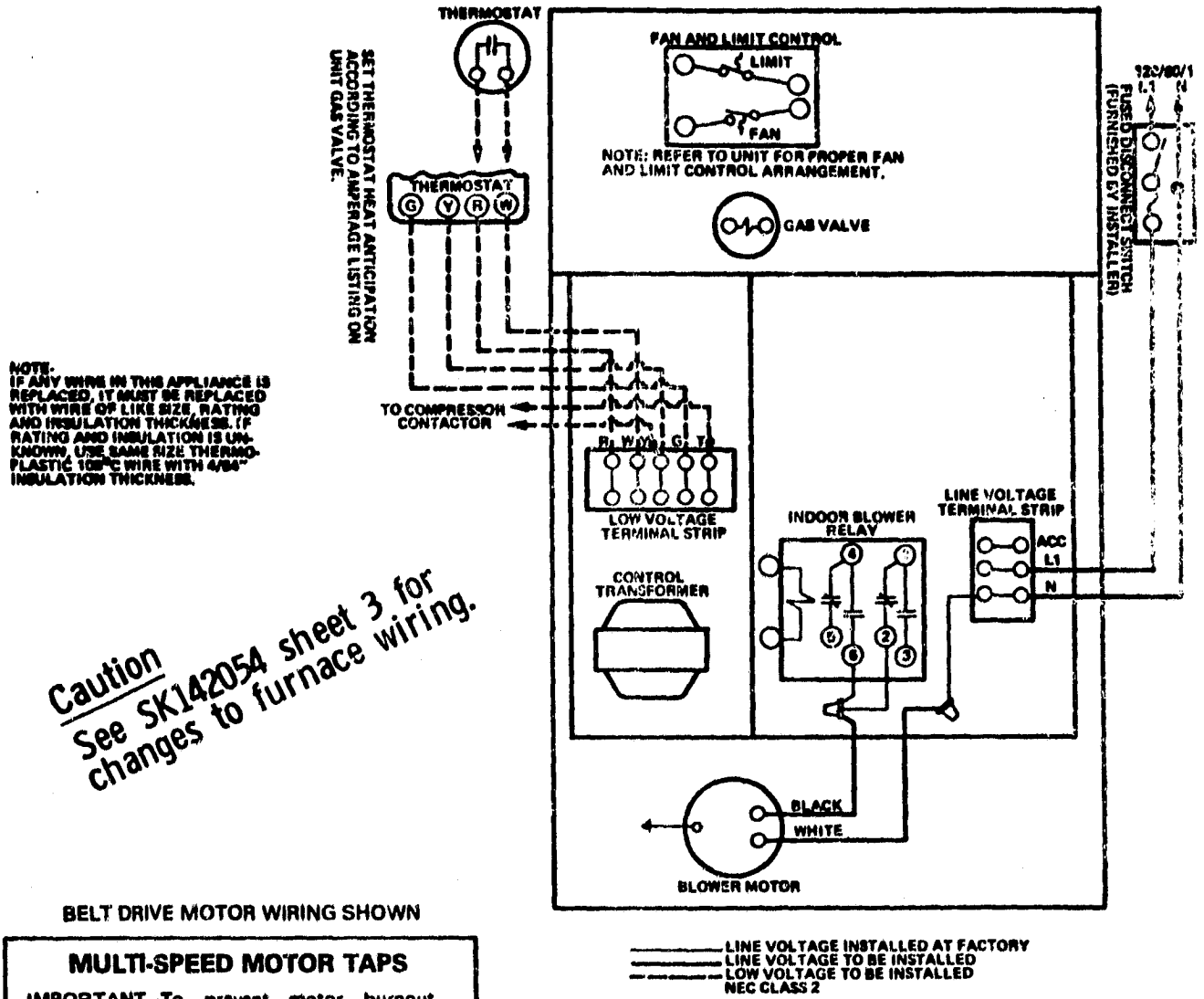
XVI - CLEAN-UP

After unit is operating properly:

1 - Set room thermostat at desired setting.

2 - Leave this instruction with the unit.

3 - Pick up all shipping cartons, metal scraps, extra insulation and generally clean-up the installation.



BELT DRIVE MOTOR WIRING SHOWN

LINE VOLTAGE INSTALLED AT FACTORY
LINE VOLTAGE TO BE INSTALLED
LOW VOLTAGE TO BE INSTALLED
NEC CLASS 2

MULTI-SPEED MOTOR TAPS

IMPORTANT—To prevent motor burnout, never connect more than one motor lead to any one connection. Tape unused motor leads separately.

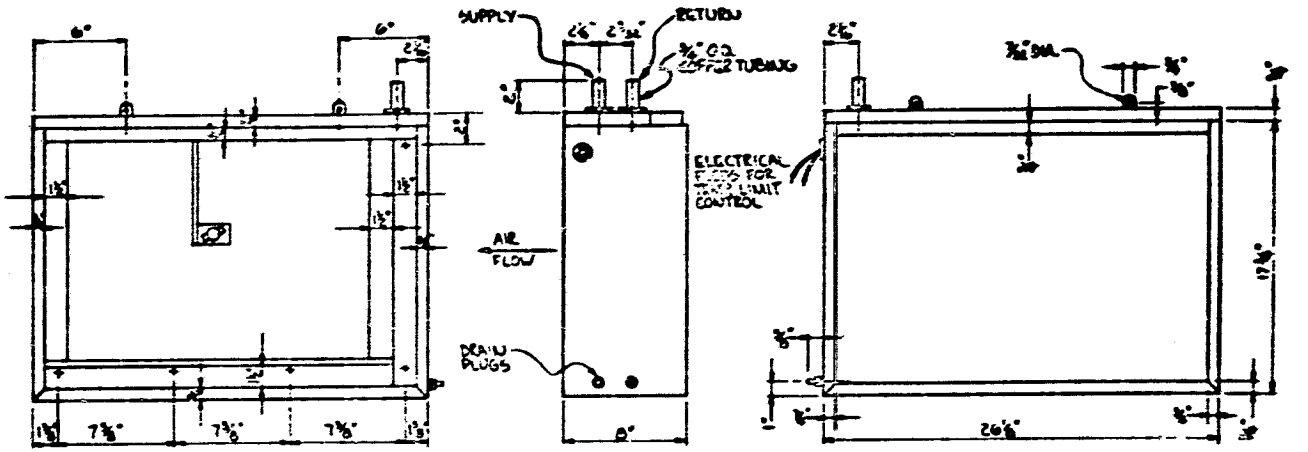
SPEED	BLOWER MOTOR LEAD		
	D2 and Q4	Q3	Q5
	RED	RED	RED
[illegible] LO	—	YELLOW	YELLOW
MEDIUM	YELLOW	—	BLUE
MEDIUM HI	—	BROWN	BROWN
HIGH	BLACK	BLACK	BLACK

If single speed blower operation is desired, wire nut leads from terminal 3 of indoor blower relay and lead from fan control together with desired motor lead.

G11 FIELD WIRING DIAGRAM

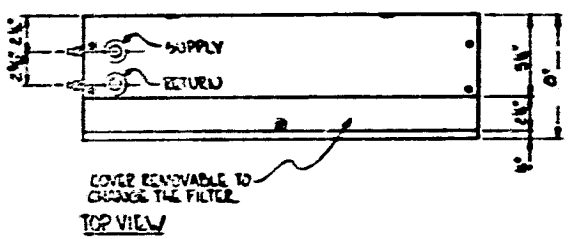
Figure C-3

PART NO.



+ HOLES TO BE DRILLED IN THE FIELD
(SEE INSTALLATION NOTES BELOW)

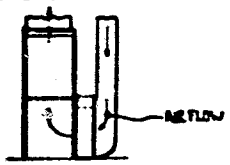
RESIDENTIAL SPACE HEATING COIL (2)



Space Heating Coil - Residential Units

Installation Notes

1) **Cut out the return air openings as explained in installation instructions for furnaces.**
2) **Remove bottom four screws on the cut outside.**
3) **Align the coil with return air opening.**
4) **Mark the location of the four holes on the front of the space heating coil (indicated by + marks on front view this sheet).**
5) **Mark the location of the two holes to be drilled in the furnace cabinet.**



UP-FLO, SIDE INSTALLATION

6) **Drill the various holes and fasten the coil to the furnace cabinet with sheet metal screws.**
7) **Drill one more hole on the side of the coil (indicated by + marks on front view this sheet) and the furnace cabinet at the same time. Fasten with a sheet metal screw.**

Electrical

For wiring information see control subsystem.

			DRAFTSMAN		HONEYWELL INC.
			CHECKED		ENERGY RESOURCES CEN
			DEV ENGR		
			ENGRG MGT		5FR. AUXILIARY ENERGY AND SPACE HEATING SUBSYSTEMS
			SYSTEMS ENGR		
QUANTITY	SYMBOL		WILLIAM O'BRIEN		SIZE C · CODE IDENT NO. 55513 · DRAWING NO. 5K-142051
					SCALE · SHEET 3 OF 3
					CONTROL A

INSTALLATION INSTRUCTION

I. SHIPPING AND PACKING LIST
Package 1 of 1 contains:
1 - Indoor coil in cabinet with slab filter
1 - Roll gasket material
Screws

II. SHIPPING DAMAGE
Check unit for shipping damage. If damage is found, receiving party should contact last carrier immediately.

III. GENERAL
These instructions are intended as a general guide only and do not supersede local codes. Authorities having jurisdiction should be consulted before installation.

IV. APPLICATION
CW3-45 indoor water coils provide a field installed space heating/cooling subsystem. Used in conjunction with an auxiliary gas or electric furnace unit, the CW3-45 coil will provide solar space heating. When connected with a water chiller, space cooling is available.

V. INSTALLATION (G11 or G12 Series Auxiliary Unit Installed)

A. Cabinet Installation

1. Remove return air plenum or cabinet. (If installed.)
2. Remove filter hammock and media from G11 or G12 blower compartment. The air filter will now be in the CW3-45 cabinet, upstream from the water coil.
3. Cut out return air opening on desired side of G11 or G12 cabinet. See Figure 3.

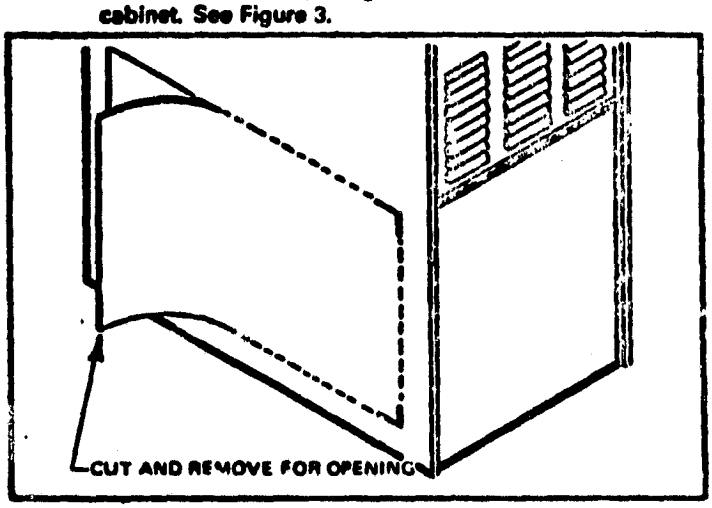


FIGURE 3

4. Remove bottom (4) screws from base of G11 or G12 unit on the return air cutout side. See Figure 4.
5. Install gasket material around cutout opening.
6. Align CW3-45 unit with return air opening.
7. From inside blower compartment drill and fasten CW3-45 cabinet to G11 or G12 cabinet with (4) sheet metal screws (use existing holes in G11 or G12 cabinet). Drill and screw the two cabinets together at (1) other accessible location.
8. Drill and fasten with (2) screws at tabs on top of CW3-45 cabinet. See Figure 5.
9. Attach return air plenum to CW3-45 coil cabinet being careful not to screw into filter.

B. Electrical
Two leads from CW3-45 high limit switch are to be connected into the total system controls. Refer to total system control wiring instructions.

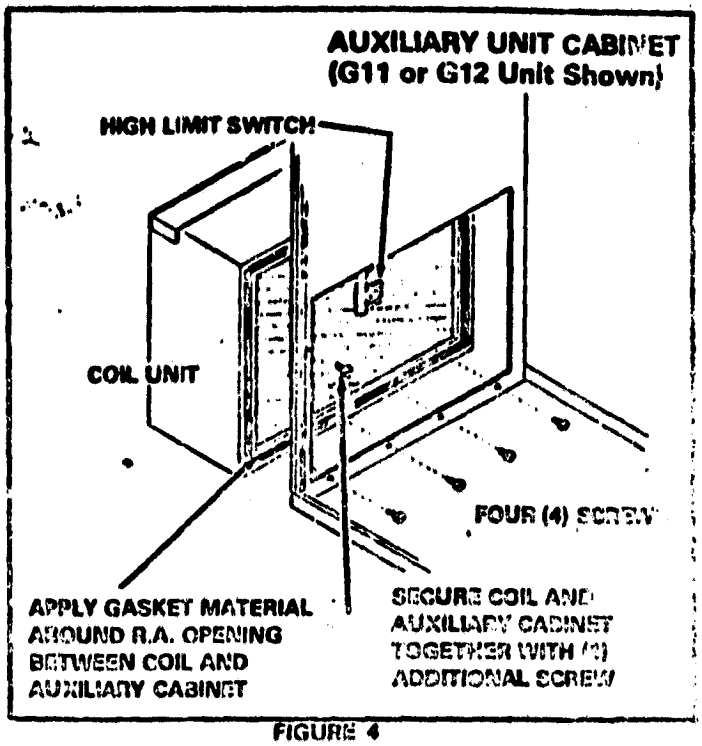


FIGURE 4

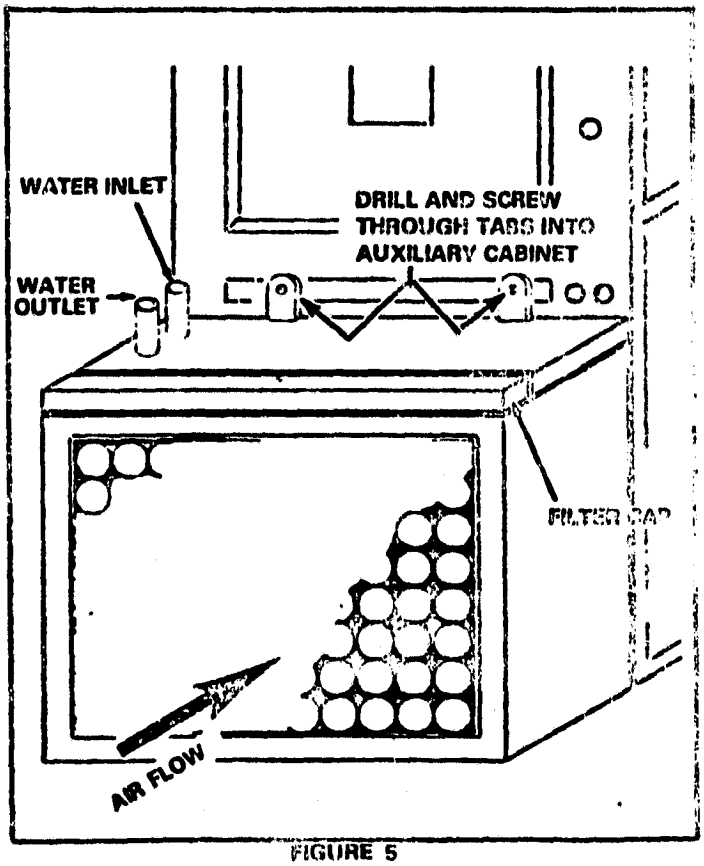


FIGURE 5

C. Plumbing Connection
Refer to the total system instructions for proper plumbing requirements and procedures.

D. Auxiliary Energy Components
Refer to the particular Operation, Maintenance, and Installation Instructions that apply to mating components.

Figure C-4

Insulate piping with 3/4" thick armaflex insulation or equivalent. Connect temperature limit control wiring to control panel on ETM unit as shown on SK142054 Sheet 3 in Section F.

D) DOMESTIC HOT WATER SUBSYSTEM

The domestic hot water subsystem installation consists of installing a conventional hot water heater (either gas or electric) connecting its outlet (hot) to the dwelling hot water line, connecting the inlet (cold) to the preheat coil in the storage tank. This line should have installed in it a tempering valve, see Figure D-1 for installation guidelines. The supply water (cold) is run to the preheat coil and to the mixing valve. The DHW piping is shown on SK 142052.

The hot water heater should be installed as shown in Figure D-2. Install pressure and temperature relief valve in water heater and discharge line to within 2-feet of floor.

CAUTION: Be sure to remove thermostatic assembly from tempering valve before sweating connections. Otherwise it will become damaged. Tempering valve should be set at 140^{O}F.

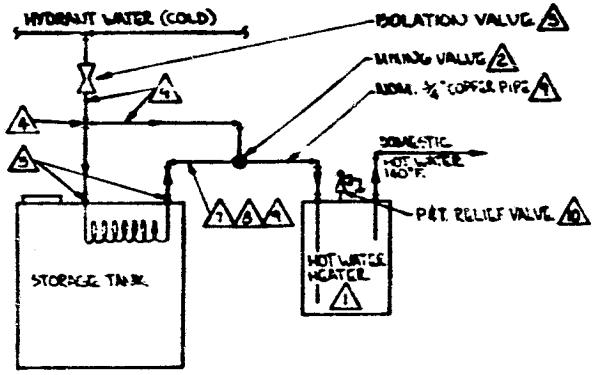
E) ENERGY TRANSPORT SUBSYSTEM

The Energy Transport Subsystem consists of the Energy Transport Module (ETM) and the piping between it and the collectors, storage and heating subsystems. The ETM should be installed as outlined on SK 142053 Sheets 1 and 2. The piping installation should conform the Section 15.050 Basic Materials and Methods and Section 15.100 Valves on SK 142057 Sheet 3. Check Section F for control valve installation. It should be located in collector outlet piping where purge unit is to be piped in.

PART NO.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED INSTALLATION & INSULATION INFO	7-19-77	
B	CHANGED PART NO. ON ITEM # 1	8-19-77	

CHANGED HEADER ITEMS 4,5,&6



SCHEMATIC H.W. SUBSYSTEM
NO SCALE

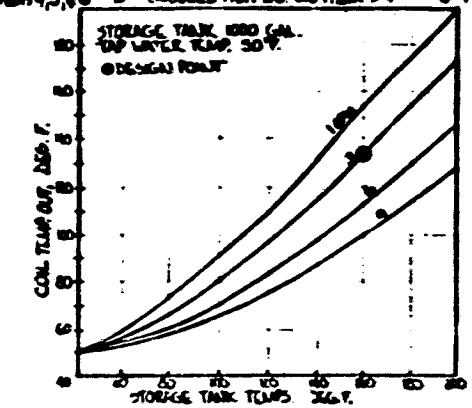


FIGURE 1. HEATING COIL PERFORMANCE

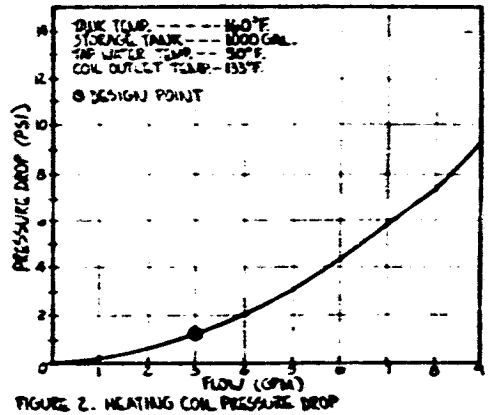


FIGURE 2. HEATING COIL PRESSURE DROP

INSTALLATION INFORMATION

1) DHW preheat coil will be previously installed in storage tank and has ends protruding from top of tank.

2) Tighten adapter on compression fitting.

3) Solder coil ends to copper tubing using coupling.

INSULATION INFORMATION

1) Insulate copper tubing from storage tank outlet to hot water mixing valve.

ORIGINAL PAGE IS OF POOR QUALITY

ALL ITEMS LISTED "OR EQUIVALANT"

MATERIAL SCHEDULE

ITEM	ITEM	MANUFACTURER	TYPE / PART NO	QUAN.
1	HOT WATER HEATER	LOCHINVAR	52 KP-10	1
2	3-WAY MIXING VALVE	WATTS REGULATOR CO.	70A - 3/4"	1
3	BALL VALVE	NIBCO	S-580 - 3/4"	1
4	COPPER TEE NOM. ¾" x ¾" x ¾"	GOULD-IMPERIAL EASTMAN	111 - 7/8	1
5	COPPER COUPLING w/ STOP NOM ¾"	GOULD-IMPERIAL EASTMAN	100 - 7/8	2
6	COPPER ELBOW NOM. ¾" - ¾"	GOULD - I.E.	107 - C - 7/8	AS REQ'D
7	INSULATION (¾" THICK)	ARMSTRONG CORK CO.	ARMAFLEX STANDARD	AS REQ'D
8	INSULATION ADHESIVE	ARMSTRONG	520	AS REQ'D
9	COPPER PIPE ¾" NOM	REVERE	M	AS REQ'D
10	PRESSURE & TEMP RELIEF VALVE	WATTS PLUMBING SPEC.	40 XL	1

DOMESTIC HOT WATER (DHW) Subsystem

The DHW subsystem consists of two hot water heaters in series. The 1st heater is the coil immersed in the storage tank, and the 2nd heater is a conventional domestic hot water heater. The storage tank is heated with the surplus solar energy not required for space heating. This stored heat is transferred to city water via a coil which preheating the water before it goes to the conventional hot water heater. When the storage tank is at it's maximum temperature 200°F no additional heat will be required from the conventional heater at flow rates of 7 gpm or less. The capacity of preheat coil is shown in Figure 1 and 2. To limit the output of the heaters to 140° a self contained 3 way mixing valve tempers the hot water to the user with city water.

TOLERANCES UNLESS NOTED OTHERWISE		DRAFTSMAN		HONEYWELL IRC.	ENERGY RESOURCES CENTER
		CHECKED			
		DES ENGR		SINGLE FAMILY RESIDENCE HOT WATER SUBSYSTEM	
		ENGR MGT			
APPLICATION	FINISH	WILLIAM O'BRIEN		SIZE C	CODE IDENT NO. 55513
		NEW CASTLE		SCALE NONE	DRAWING NO. SK-142052
					SHEET 1 OF 2
				CONTROL A	

INSTALLATION AND OPERATING INSTRUCTIONS

INSTALLATION

WARNING: The water heater must not be installed in small enclosure unless amply ventilated. In tightly constructed homes or basements, openings must be cut based on 1 sq. inch per 1,000 BTU/HR input. The heater must not be installed in bathroom, bedroom or any other occupied rooms normally kept closed. The water heater must be vented to the proper flue. Be sure your water heater is equipped to burn the particular type of gas you intended to use.

LOCAL CODES: Water heater installation must be in accordance with these instructions and all applicable local codes and gas utility requirements.

SAFETY: This heater is equipped with an automatic gas shutoff system actuated by high water temperature. A listed temperature and pressure relief valve shall be installed at the time of the installation of the heater. Local codes shall govern installation of relief devices.

A ¾" tapping has been provided in the top of the heater for installing the relief valve. The pressure setting of the relief valve must not exceed the working pressure shown on the rating plate.

Pipe discharge outlet of relief valve to a suitable drain using pipe full size of relief valve outlet (see typical installation). Failure to install a properly rated ASME and A.G.A. certified temperature and pressure relief valve at the time of installation of this heater will release the manufacturer from any claim due to damages caused by excessive pressure or high temperature.

LOCATION

Install the water heater as close as possible to existing flues. On long horizontal runs use at least ¼" rise per foot of length.

Locate the heater in such a manner that should the tank or any connections leak, water damage would not result to adjoining areas. Under no circumstances is the manufacturer to be held liable for any water damages in connection with this heater.

Make certain the draft hood, packaged with this heater, is installed properly on top of the heater. The diameter of the flue pipe must match the diameter of the draft hood. Connect the ¾" water lines. Cold water inlet connects to right hand nipple at top of heater (facing heater), and hot water connects to left hand nipple.

Connect ½" gas piping to gas thermostat. The installation should conform with American National Standard Installation of Gas Appliances and Gas Piping, Z 21.30 — 1964, or with the requirements of the authority having jurisdiction. Use a pipe joint compound that is resistant to the action of liquified petroleum (LP) gases. Check for gas leaks with soap suds, not a flame.

MAINTENANCE

To assure long life and efficiency, the water heater tank must have a small amount of water drained periodically. Once a month the drain valve should be opened and the water allowed to run until it flows clean. This will help prevent sediment buildup in the tank bottom.

OPERATION

CONDENSATION: When the heater is first lit or during periods of heavy draw-offs, water vapor may condense on the cold tank and drop down on the burner causing a sizzling sound. THIS IS NOT A LEAK and will disappear when the tank warms.

TEMPERATURE REGULATION: For general household usage, the normal setting will be satisfactory. However, the knob may be set to any position which satisfies temperature requirements.

LIGHTING

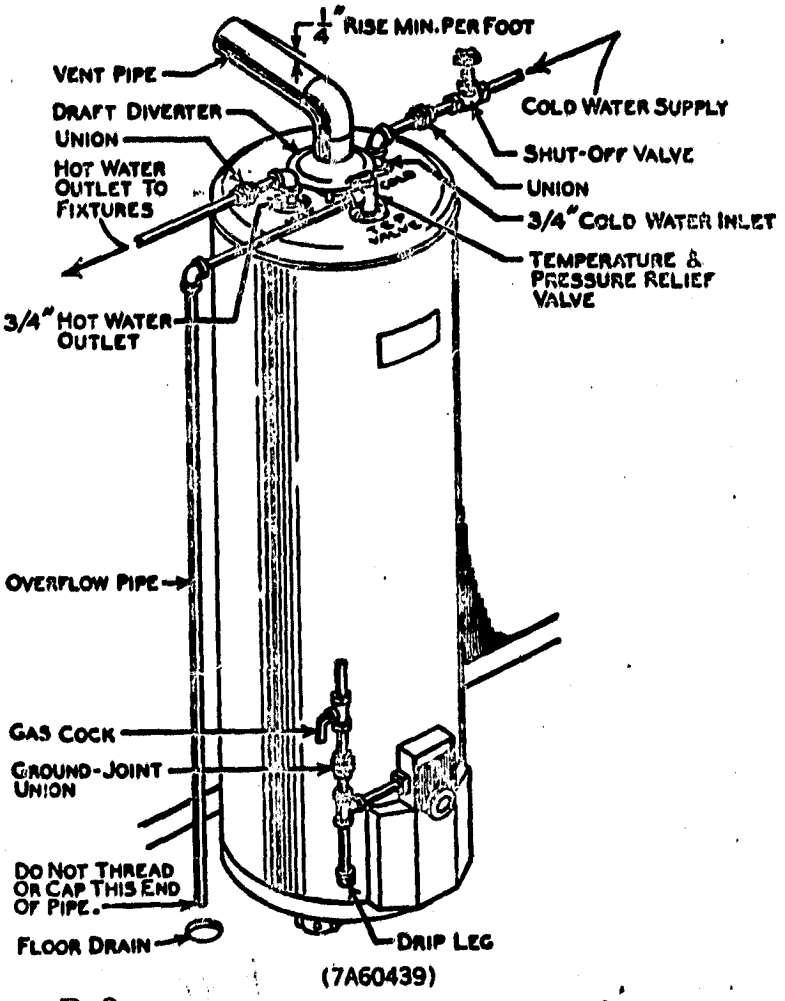
Under no circumstances should the heater be operated unless it is filled with water. Lighting and operating instructions are located on the front of the heater.

TEMPERATURE LIMITING SWITCH

Your heater has a nonadjustable limit switch built into the thermostat that guards against excessive temperatures.

If the limit switch operates, the pilot can not be relit until the water temperature drops to approximately 120° F. To relight, follow instructions on rating plate. If heater shuts down frequently contact your serviceman or local gas utility.

TYPICAL INSTALLATION



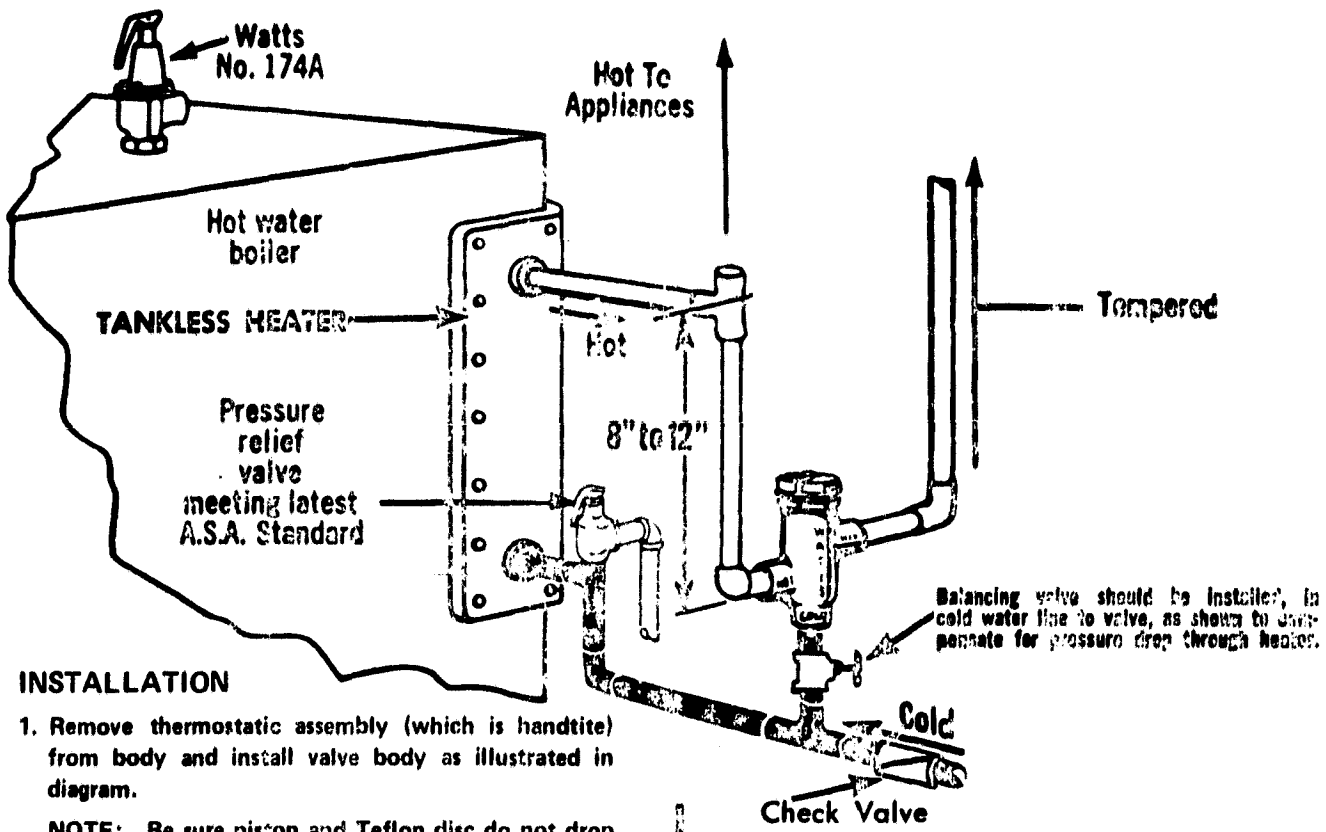
(7A60439)

Figure D-2

WATTS No. 70A SERIES
Adjustable Water Tempering Valves

IMPORTANT

BE SURE TO REMOVE THERMOSTATIC ASSEMBLY from valve before sweating connections. Otherwise it will become damaged.



INSTALLATION

1. Remove thermostatic assembly (which is handtite) from body and install valve body as illustrated in diagram.

   NOTE: Be sure piston and Teflon disc do not drop out of thermostat, when removing thermostatic assembly.

2. Re-insert thermostatic assembly in body and tighten securely.

ADJUSTMENT

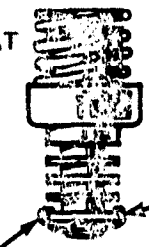
The No. 70A features a new adjustment means which permits you to "dial" a desired temperature, quickly and conveniently. To increase or decrease the water temperature, simply turn the adjusting cap as indicated by the arrow. The adjustment temperature range is 120° to 160°F.

REPLACEMENT PARTS

RENEWABLE THERMOSTAT AND SPRING

FOR 70A–70A-T
Part No. SAN70A3

FOR L70A–L70A-T
Part No. SAN70A3-LT



NOTE: Replacement thermostats are furnished with a plastic protector which serves to hold the piston and Teflon disc. Be sure to discard this plastic protector when installing assembly. See note under installation.

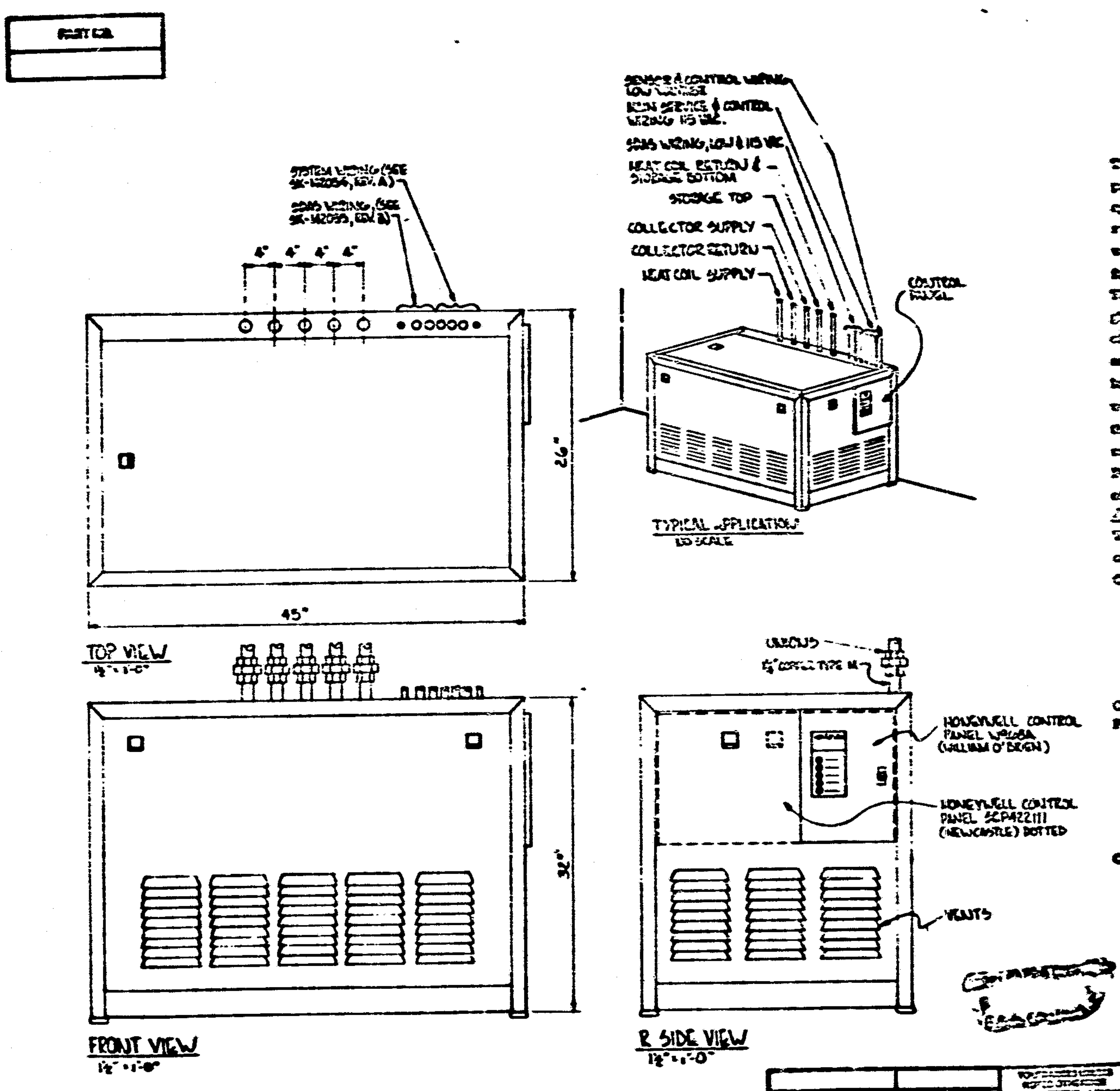
L70A SERIES

NOTE: For lower tempered water requirements at or below 130°F., use low temperature Model L70A Series which provides adjustment temperature range between 100° - 130°F.

WATTS *The name that protects your name*

IS-70A 763 WATTS REGULATOR COMPANY ® LAWRENCE, MASS., U.S.A. PRINTED IN U.S.A.

Figure D-1



A	CHANGED UNIT, CIRCUIT, DIMENSION & CHANGED CIRCUIT PIPING ORDER	7-19-77
B	GEOMETRY & DESC. PANEL, ADDED SHT. 2	

ENERGY TRANSPORT MODULE (ETM) - SOLAR HEATING

The Energy Transport Module is a fully-assembled, pre-wired unit which provides the pumping power, control logic, and interface between subsystems in a residential hydronic solar heating system. It has a sturdy, rolled steel cabinet with an attractive, durable finish for installation within a building. Large, removable vented access panels are provided for system checkout and component servicing.

The main system pump is capable of 13 gpm flow of water/ethylene glycol (mixture percentage is site specific) through collector arrays of [illegible] ft². Two smaller pumps move water through the heating and storage subsystems. Separating the freeze-protected collector loop from the heating/storage water loop is a high efficiency, water-to-water solar heat exchanger. Other hydronic components are included in the ETM, resulting in an efficient, quietly running system which requires minimal maintenance. An integrally mounted Honeywell Solar Control Panel which senses conditions throughout the system and requirements of the household (thermostat setting), provides ETM operational control.

Application

The basic ETM design (for gas furnace auxiliary heating solar systems) can be adapted for use with heat pump auxiliary by replacing the W958A Control Panel with the SCP 422111 controls. See table below:

Auxiliary Heat	ETM Model	Control Panel
Gas Furnace	SK-142053-ETM-1	W958A
Heat Pump	SK-142053-ETM-2	SCP [illegible]

Consult manufacturer for other application assistance.

Pressure drop within ETM (can be increased by adjusting circuit setters):

Collector Loop (50% ethylene glycol) = 3.3 psig

Direct Heating (water) = 4.0 psig

Charge Storage (water) = 4.0 psig

Heat from Storage (water) = 1.0 psig

Conditions

Pressure (pump inlet)	Operating	Maximum	Minimum
Collector Loop	20-25 psig	45 psig	---
Storage/Heating	atmospheric	---	---
Temperature (liquid)			
Collector Loop	[illegible] °F	[illegible] °F	outside ambient
Storage/Heating	[illegible] °F	[illegible] °F	inside ambient

HONEYWELL INC.

ENERGY RESOURCES CENTER

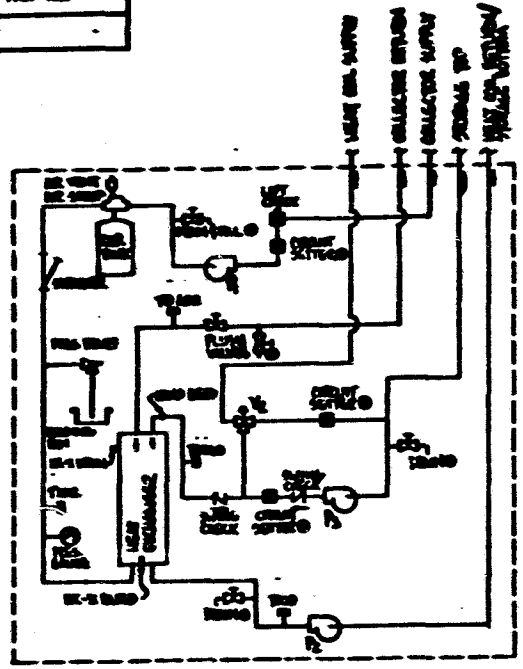
SINGLE FAMILY RESIDENCE ENERGY TRANSFER SUBSYSTEM

WILLIAM O'BRIEN

NEWCASTLE

SIZE C | CODE IDENT NO. 55513 | DRAWING NO. SK-142053

SHEET 1 OF 2



SCHEMATIC - ENERGY TRANSPORT MODULE

NO SCALE

Specifications

Electrical: Power Supply ... 115 VAC, 60 Hz, 1 phase

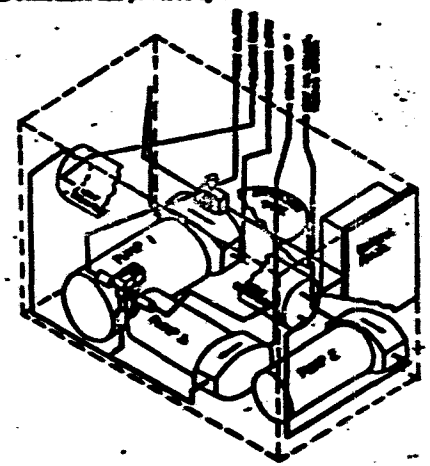
Minimum supply circuit conductor ... 20 ampere

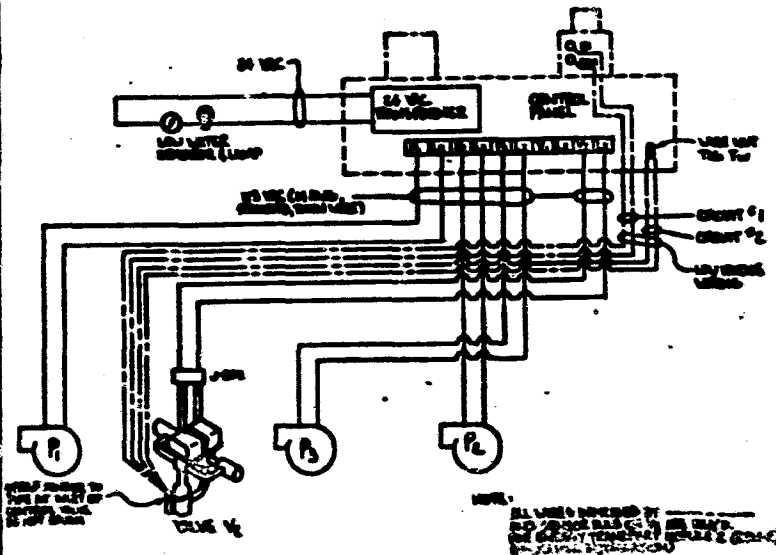
Maximum circuit overcurrent protection ... 30 ampere

Pumps: 1750 rpm, centrifugal impeller, open drip-proof motor, built in thermal overload protection.

Subsystem	Motor	Capacity (flow @ head)	Full Load Current	Starting Current
Collector (P_1)	1/4 Hp	12 gpm @ 34 ft.	4.0 amp	12 amp
Heating (P_2)	1/6 Hp	8 gpm @ 17 ft.	3.3 amp	8 amp
Storage (P_3)	1/6 Hp	8 gpm @ 17 ft.	3.3 amp	8 amp

NOTE: A 1/6 Hp fan, located outside the cabinet in the Purge Bin, is controlled and powered by the ETM Control Panel.





ETM INTERNAL WIRING SCHEMATIC

NO SCALE

Installation

- ETM may be fork-lifted as indicated on shipping crate. Before moving unit when mounted, the two small brass guide and pressure relief bolting pins should be removed. Bolting pin will slide from under the ETM after the pressure relief has been removed from pan. ETM can be carefully fork-lifted after clearance between lift and cabinet underside is checked out. IMPORTANT: Removable guards and Control Panel will be damaged if mounted unit is hand-trucked on the side or top.
- ETM size is 26" x 28" x 48" and weighs 350 lbs. (operating weight is 600 lbs). Position on level surface (adjustable legs provided) near storage and space heating subsystems. Consult manufacturer when ETM is to be located above the collector array or storage tank.
- Orient ETM with its back towards wall. Rear ventilation clearance is required around the unit, two feet minimum in front and at the sides. Adequate clearance for service access through front, top and side panels shall be provided. Panels are removed with a sharp outward pull on the recessed tabs.

Plumbing Connections

- Five 1 1/4 inch sweat copper valves are provided for system piping connections (see drawing). DO NOT APPLY HEAT to ETM piping inlets. Sweat rubber tubing to the removable inlet pieces BEFORE connecting to ETM inlets.
- External plumbing shall conform to applicable codes. Isolation/ flush valves and air bleeds shall be installed, as necessary.

Electrical Connections

- ETM is internally pre-wired.
- External wiring must conform to National Electrical Code and local codes. Line voltage supply to ETM shall be from properly sized branch circuit and overcurrent protection device. Use wire suitable for at least 90°C (194°F). Wiring diagrams are shown on this drawing and on SK-142054, Rev. A (Control Relay Load).
- Three 1/2 inch flexible conduits are provided to the Control Panel terminals for 115 VAC electrical service and for line voltage control wiring. Low voltage sensor wires may be run from the upper right side of the Control Panel through the end hole provided in cabinet top. (Additional openings are provided for the fitted, with wiring diagrams shown on SK-142055, Rev. B.)

				HONEYWELL INC.	
				SINGLE FAMILY RESIDENCE ENERGY TRANSPORT SUBSYSTEM	
			WILLIAM O'BRIEN	SIZE C	CODE IDENT NO. 55513
			NEWCASTLE	SCALE NONE	DRAWING NO. SK-142053
					SHEET 2 OF 2

CONTROL

PART NO.

INSTALLATION CRITERIA

SECTION 15.000 GENERAL PROVISIONS

15.010 STARTUP OF REMOTE SYSTEMS

A. Collector Loop

1) Complete testing of collector loop as called for elsewhere in these specifications.

2) Filling and Cleaning Procedures:

a) Cover collectors before filling or fill at night.
b) Do not operate pumps dry.
c) Do not over-pressurize system on initial fill.

3) Clean system with a minimum of 1 gallon trisodium phosphate per 100 gallon water circulating for four hours. Check strainers periodically and clean as necessary to avoid damage to pump.

4) Drain cleaning solution and measure collector loop fluid volume so that correct amount ethylene glycol can be added.

5) Flush system with clean water for two hours.

6) Collector loop filling procedure:

a) Open vent at top of collectors
b) Fill system with proper amount of ethylene glycol to provide a 50% by volume solution.
c) Add corrosion inhibitor as per manufacturer's recommendations.
d) Operate control valves as necessary to fill all piping and remove all air from system.
e) Close vent and add fluid to provide a nominal 30 psi gauge pressure at module fill point.
f) Operate system and check all vents to eliminate all air from system.
g) Add water to pressurize system to 30 psi gauge pressure.

B. Storage Heating Loop:

1) Complete testing of storage/heating loop as called for elsewhere in these specifications.

2) Filling and cleaning procedures same as above.

3) Flush storage tank with a hose.

4) Flush piping with clean water for two hours.

5) Storage/heating loop filling procedure:

a) Add water to system up to proper level in storage tank.
b) Operate control valves as necessary to fill all piping and remove all air from system.
c) Recheck storage tank level and fill accordingly.
d) Add corrosion inhibitor in quantity specified.

C. System Operation:

Uncover collectors and operate system for several days under automatic control. Check system fluid levels, air vents, and operating pressures periodically.

D. Contractor will be assisted by systems engineer. Submit results of above work to architect.

15.040 TESTING

A. Solar Heating System Piping: (except collector headers, storage tank, and hose connections to collectors).

1) Test after erection and before concealing or covering. Any materials or workmanship found faulty shall be replaced or repaired and sections or systems retested.

2) These systems shall be proven tight under a hydrostatic pressure of 100 psig.

B. Collector Headers and Hose Connections to Collectors:

1) Test after erection and before concealing or covering. Any materials or workmanship found faulty shall be replaced or repaired and sections or systems retested.

2) Cover collectors or conduct test at night.

3) These systems shall be proven tight under a hydrostatic pressure of 50 psig.

C. Test results shall be submitted to architect.

15.050 BALANCING OF SYSTEMS

A. Hydronic Systems:

1) Balance flow rate of each pump to within 5% of specified flow as shown on plans.

2) Balance flow rate through each branch circuit to within 5% of specified flow as shown on plans.

B. Air Systems:

Balance air system so as to provide flow rate at Solar Space Heating Coil within 5% of specified flow rate as shown on plans.

C. Solar Assemblies:

Measure all motor amperages and compare with nameplate ratings.

D. Balancing results shall be submitted to architect.

SECTION 15.050 BASIC MATERIALS AND METHODS

15.080 PIPE AND PIPE FITTINGS

A. Solar Heating System:

Type "M" hard drawn copper tubing with wrought copper or cast bronze fittings. Solder joints made with 95-5 tin-antimony solder.

B. Installation Method:

According to manufacturer's instructions.

C. General Requirements:

1) All piping shall be run parallel to adjoining building surfaces and by the most direct route. Exposed piping shall be run as close to ceiling and/or walls as possible.

2) All piping shall be installed so as to allow for movement due to thermal expansion and contraction.

3) Install manual air vents as shown on plans and at high points in the system.

4) Anchor vertical piping for support as required. Install pipe hangers in horizontal piping at eight foot intervals. Pipe hangers shall be PAH No. 304 or No. 305, or Autogrip, or equal. Provide an eight inch section of rigid insulation for pipe inside within each hanger.

15.100 VALVES

A. Manufacturer

Valves shall be manufactured by Crane, Jenkins, Walworth, Powell, Lunkenheimer, or Stockham.

B. Valves - Solar Heating Systems

1) Gate Valves, 2" and Smaller -- 125 lbs. steam, bronze body, solder end, solid wedge, rising stem.

2) Check Valves, 2" and Smaller -- 125 lbs. steam, bronze body, solder end, bronze disc, swing check.

3) Ball Valves, 2" and Smaller -- 150 lbs. steam, bronze body, screwed end or solder end, glass reinforced Teflon seats and stem seals, balancing stop, brass ball, blow out proof brass stem and vinyl grip on handle.

4) Drain Valves, 2" and Smaller -- 125 lbs. steam, bronze body, globe valve, screwed end or solder end, composition disc.

C. Valve Tags:

Each system valve shall be identified with a stamped numbered brass tag. A schedule of valves including valve size, service, or otherwise and location shall be submitted to architect.

15.105 SOLAR STORAGE TANK

A. Procurement:

The Solar Storage Tank will be supplied by Honeywell EBC.

B. Required Work:

The Mechanical Contractor shall install the Solar Storage Tank as shown on plans.

SECTION 15.100 INSULATION

15.101 GENERAL:

A. Scope:

This section pertains to insulation of all solar heating system piping supplied by the mechanical contractor.

B. Materials

Armstrong Armaflex, 3/4 inch thickness.

C. Installation:

Per manufacturers recommendations.

SECTION 15.400 PLUMBING

15.404 DOMESTIC WATER HEATER:

A. Procurement:

The Domestic Water Heater and Mixing Valve will be supplied by Honeywell EBC.

B. Required Work:

The mechanical contractor shall install the Domestic Water Heater and Mixing Valve as shown on plans.

SECTION 15.500 POWER OR HEAT GENERATION

15.501 SOLAR COLLECTOR SUBSYSTEM:

A. Scope:

The Solar Collector Subsystems consists of the solar collectors, collector header piping, flexible hose connections to each solar collector, and the purge unit.

B. Procurement:

These components of the collector subsystem to be supplied by Honeywell EBC are shown on plans. All other materials required for a complete installation shall be supplied by the Mechanical Contractor.

C. Required Work:

The Mechanical Contractor shall install all above equipment as shown on plans. Header assembly joints shall be made with 95-5 tin-antimony solder. During the joining process a heat sink shall be provided between the coupling and the pre-insulated header sections. The pre-insulated header sections shall not be at temperatures greater than 200°F.

15.505 ENERGY TRANSPORT MEDIA

A. Procurement:

The Energy Transport Module will be supplied by Honeywell EBC.

B. Required Work:

The Mechanical Contractor shall install the Energy Transport Module as shown on plans.

SECTION 15.700 LIQUID HEAT TRANSFER

15.705 SOLAR SPACE HEATING COIL:

A. Procurement:

The Solar Space Heating Coil will be supplied by Honeywell EBC.

B. Required Work:

The Mechanical Contractor shall install the Solar Space Heating Coil as shown on plans.

SECTION 15.800 AIR DISTRIBUTION

15.805 FORCED FLOW FURNACE:

A. Procurement:

The Gas Fired Furnace will be supplied by Honeywell EBC.

B. Required Work:

The Mechanical Contractor shall install the Gas Fired Furnace as shown on plans.

SECTION 15.900 CONTROLS AND INSTRUMENTATION

15.901 GENERAL:

Refer to Solar Control Subsystem, Site Data Acquisition Subsystem (SDAS), and Educational Subsystem plans

15.905 BASIC MATERIALS AND METHODS

Refer to Solar Control Subsystem, Site Data Acquisition Subsystem, and Educational Subsystem plans

15.910 SEQUENCE OF OPERATION

Refer to Solar Control Subsystem plans.

WORKING DRAWING NOT SUBJECT TO E.B.C. CONTROL

				DRAFTING			HONEYWELL INC.
				CHECKED			ENERGY RESOURCES CENTER
				REV DATE			
				ENGRG MGR			SINGLE FAMILY RESIDENCE SYSTEM INTEGRATION
							WILLIAM O'BRIEN
							SIZE C / CODE IDENT NO. 55513 / DRAWING NO. SK-H2057
							SCALE / SHEET 3 OF 4
SHEET ASSY	USED ON						CONTROL A
APPLICATION							

III-19

The piping should be leak tested prior to connecting to the collectors or the ETM unit as specified in Section 15.042 Testing on the same drawing.

Electrical connections to ETM are described on Drawing SK 142054 Sheet 3 and the SDAS connections on SK 142055 Sheet 4.

The Site Data Acquisition System (SDAS) temperature sensor that are located in the ETM are brought up to the top of the insulation under the top cover. These are to be connected to the SDAS J Box as shown on SK 142055 Sheet 1.

The watt transducers for the 3 motors in the ETM and the purge unit fan motor are to be connected to the ETM control panel as shown on SK 142055 Sheet 4.

F) CONTROL SUBSYSTEM

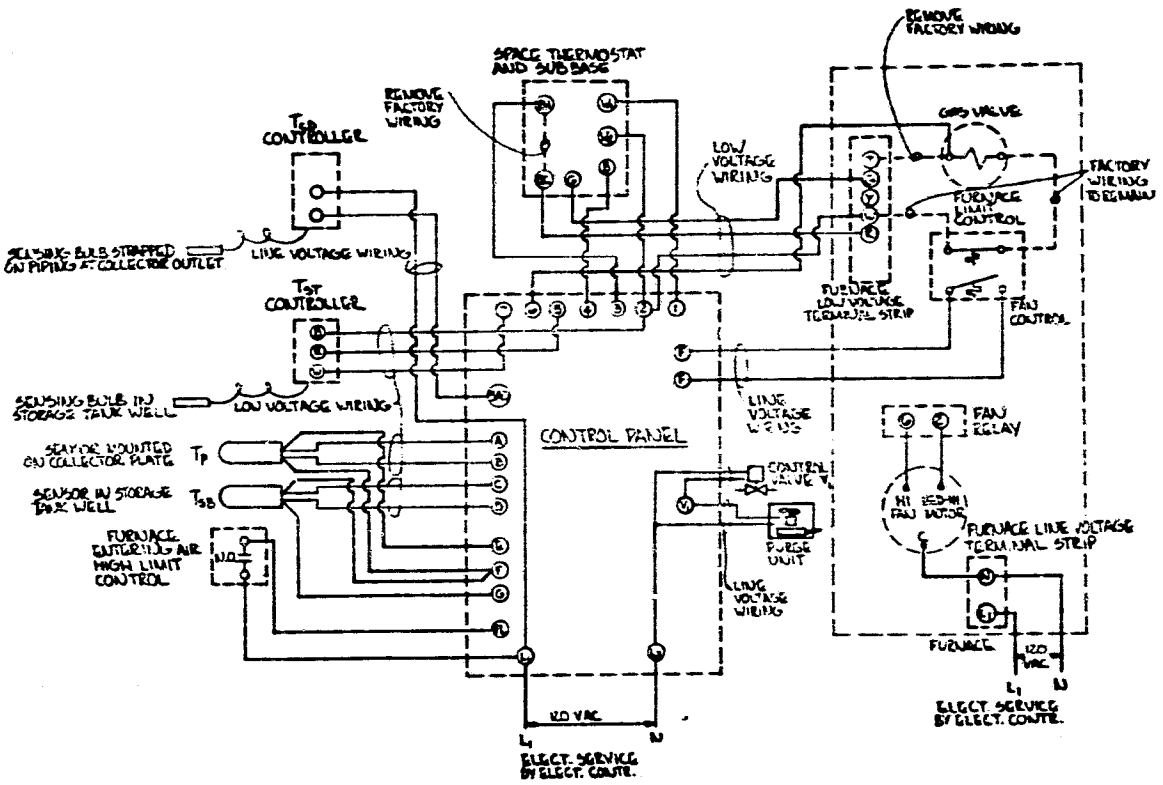
The installation of the control subsystem consists of installing 2 aquastat controllers, the thermostat, a motorized valve, 2 temperature sensors and wells, a shield over the temperature sensor on the collector and connecting these units with the control panel on the ETM unit. The overall control system schematic and sequence of operation is shown on Drawing SK 142054 Sheet 1.

The temperature sensor and shield installed on the collector should be positioned as shown in detail (upper right) on SK 142054 Sheet 2. This requires removal and reinstallation of the collector glass which is shown in Figure F-2 and F-3.

The two aquastats should be installed as shown on SK 142054 Sheet 2 detail for T_{st} and T_{cd}.

PART NO.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



SOLAR HEATING SYSTEM - SINGLE FAMILY RESIDENCE
CONTROL SUBSYSTEM

1.0 GENERAL CONDITIONS

1.1 Scope: The Control Subsystem will include all controls necessary for operation of the solar heating system.

1.2 Required Work: The Mechanical Contractor will install and wire all controls as shown on control subsystem wiring schematic. This will include all line voltage wiring required.

1.3 Procurement of Control Devices: Control devices listed in Material List. (i.e., Solar Control Panel, Aquastats, Thermostat, etc.) will be provided by Honeywell ERC. This will include the control devices only, all materials necessary for a complete installation will be provided by the Mechanical Contractor.

2.0 BASIC MATERIALS AND METHODS

2.1 Basic Materials:

2.1.1 Control sensor wiring (T_P and T_{SB}): Wiring from solar control panel to control sensors T_P and T_{SB} shall be run in conduit in outdoor areas and shall be Belden #8762 or equal.

2.1.2 Power and control wiring: All line and low voltage wiring shall be of size and type required by applicable codes, and supplied by Mechanical Contractor.

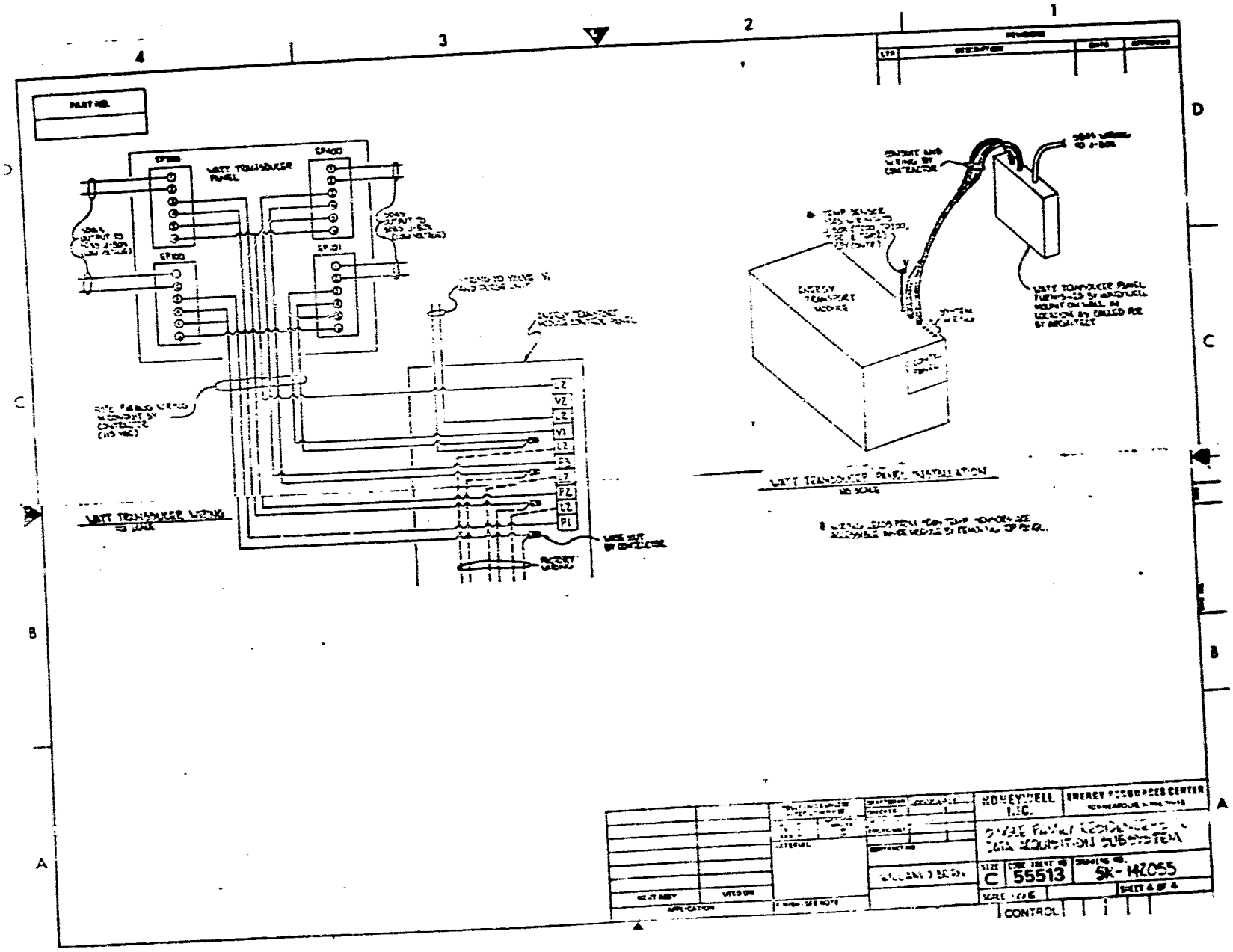
2.1.3 Other Materials: All other materials required for a complete installation of the Control Subsystem shall be supplied by the Mechanical Contractor.

2.2 Basic Methods:

2.2.1 Control device installation methods: As per applicable details and/or instructions included with equipment.

2.2.2 Electrical wiring: As per all applicable codes.

		TOLERANCES UNLESS NOTED OTHERWISE	DRAFTSMAN		HONEYWELL INC.	ENERGY RESOURCES CENTER	
			CHECKER				
			DESIGNER				
			ENGINEER		SOLAR HEATING SYSTEM SINGLE FAMILY RESIDENCE CONTROL SUBSYSTEM		
		MATERIAL	EQUIPMENT NO.				
				WILLIAM O'BRIEN	SIZE C	CODE IDENT NO. 55513	DRAWING NO. SK-1420E9
PROPRIETARY	USED ON				SCALE NONE		SHEET 1 OF 3
APPLICATION		FINISH - SEE NOTE			CONTROL	A	


4
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WATT TRANSDUCER PANEL
WATT TRANSDUCER WIRING
WATT TRANSDUCER PANEL INSTALLATION
HONEYWELL INC.
ENERGY RESOURCES CENTER
SOLAR THERMAL RESIDENCE
DATA ACQUISITION SUBSYSTEM
SIZE C
55513
SK-142055
SHEET 4 OF 6
CONTROL

PART NO.

REVISIONS			
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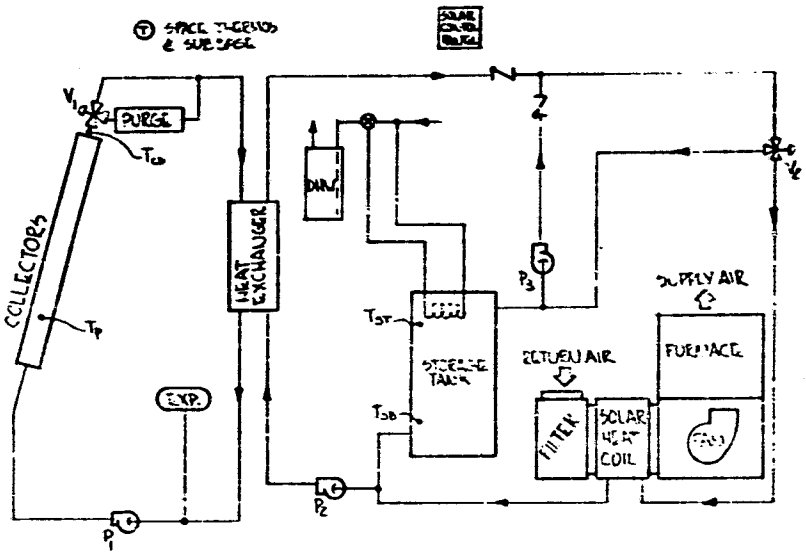


SOLAR HEATING SYSTEM CONTROL SCHEMATIC
NO SCALE

Solar Heating System - Single Family Residence

SEQUENCE OF OPERATION

GENERAL

Space heating is controlled by the two stage heating thermostat. First stage heating is set to utilize solar energy if available while second stage heating will supply the auxiliary energy if solar is not adequate. The system control logic is as follows:

- Collect solar energy when available
  - Store energy under no load conditions
  - Provide energy directly to load on demand
- Use direct solar energy before stored energy
- Use stored energy when direct solar energy is not available
- Use direct or stored solar energy before auxiliary energy

DIRECT HEATING FROM COLLECTORS

Whenever plate temperature T_p is greater than 105°F (adjustable) and there is a call for heating from the space thermostat pumps P_1 and P_2 are activated. Valve V_2 is positioned to direct flow to the heating coil. The furnace fan is activated to provide warm air to the space. A heating coil leaving-air high-limit controller will cause valve V_2 to direct flow to the storage tank if the heating coil leaving-air temperature exceeds 140°F (adjustable). Direct heating operation will continue until the space thermostat is satisfied or until the collector plate temperature has dropped to 90°F.

HEATING FROM STORAGE

Whenever T_p is less than 105°F (adjustable), T_{ST} is greater than 90°F (adjustable), and there is a call for space heat, pump P_3 is activated to discharge the storage tank for space heating. Valve V_2 is positioned to direct flow to the heating coil. The furnace fan is activated to provide warm air to the space. Pumps P_1 and P_2 are not allowed to operate during this mode. The heating coil leaving-air high-limit controller functions as described above.

STORAGE CHARGING

Storage charging is accomplished whenever T_p is greater than T_{SB} by 10°F (adjustable). Pumps P_1 and P_2 are activated and valve V_2 is positioned to direct flow to the storage tank. If the above temperature difference falls to less than 3°F (adjustable), the storage charge mode is terminated.

HEAT REJECTOR CONTROL

Whenever the collector discharge temperature exceeds 210°F (adjustable) as sensed by T_{CD} valve V_1 is positioned to direct collector loop flow through the heat rejector, and the heat rejector fan is activated.

AUXILIARY HEATING

Whenever solar heating is being utilized, either direct or stored, auxiliary gas-fired heating will be available as controlled by the second heating stage of the space thermostat. When solar heating is not available, auxiliary gas-fired heating will be available as first stage heating. Auxiliary heating is provided by a conventional gas furnace utilizing conventional controls.

DOMESTIC HOT WATER HEATING

Whenever domestic hot water is drawn from the water heater it is replaced by preheated water from a coil in the storage tank. A thermostatic mixing valve is used to regulate the hot water supply temperature to 140°F.

MATERIAL LIST

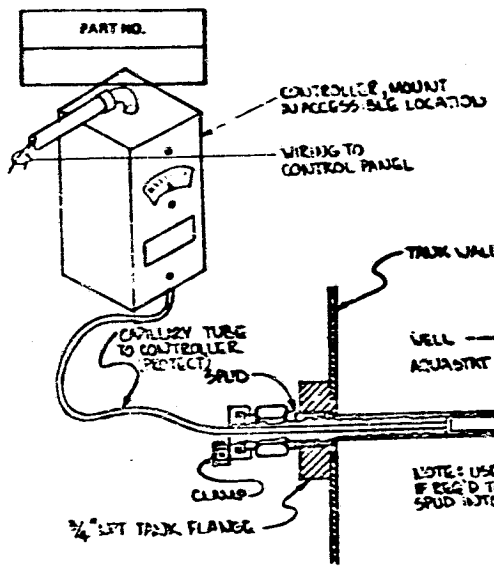
ITEM	QUAN.	DESCRIPTION	HONEYWELL MODEL NO.
	1	SOLAR CONTROL PANEL	W968A1009
T_{ST}	1	AQUASTAT CONTROLLER	L6008C1065
T_{CD}	1	AQUASTAT CONTROLLER	L4008B1083
	1	MULTISTAGE THERMOSTAT	T87C1004
	1	THERMOSTAT SUBBASE	Q674B1004
V_1	1	MOTORIZED VALVE	V4331A1003
V_2	1	MOTORIZED VALVE	V4331A1003
	2	IMMERSION WELL	122555B
	1	CASE ASSEMBLY	112842F
T_p & T_{SB}	2	SENSOR	C773B1005
	1	COLLECTOR SENSOR SHIELD	5K-142067

FOR REFERENCE ONLY PREMOUNTED ON TRANSPORT MODULE - 5K-142053

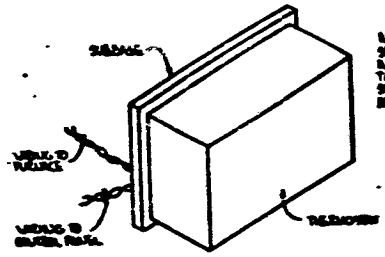
FOR REFERENCE ONLY PREMOUNTED IN TRANSPORT MODULE 5K-142055

		UNLESS NOTED OTHERWISE	DRAFTSMAN	HONEYWELL INC.	ENERGY RESOURCES CENTER
			CHECKER		
		X ±	DEV ENGR		
		.XX ±	ENGR MGT		
		.XXX ±			
		MATERIAL	CONTRACT NO.		
				WILLIAM D'BRIEN	
NEXT ASSY	USED ON			SIZE C	55513 5K-142054
APPLICATION		FINISH-SEE NOTE		SCALE	SHEET 1 OF 2
				CONTROL A	

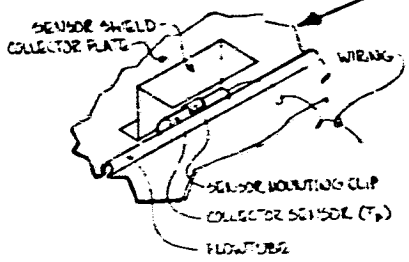
III-23



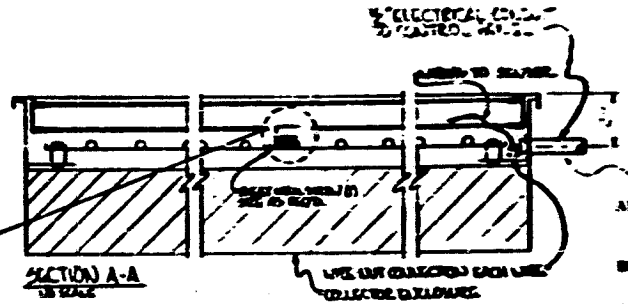
STORAGE TANK AQUASTAT MOUNTING DETAIL INDOOR INSTALLATION (T_{ST})
NO SCALE



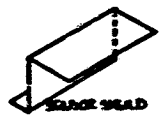
THERMOSTAT AND SENSOR DETAIL
NO SCALE



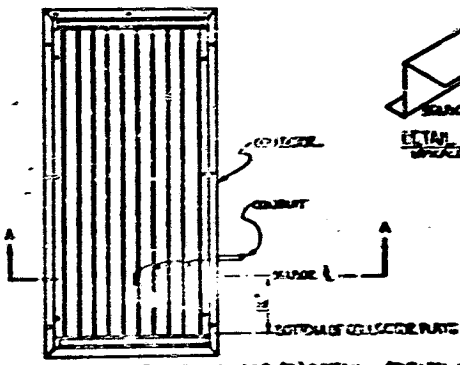
ISOMETRIC DETAIL
NO SCALE



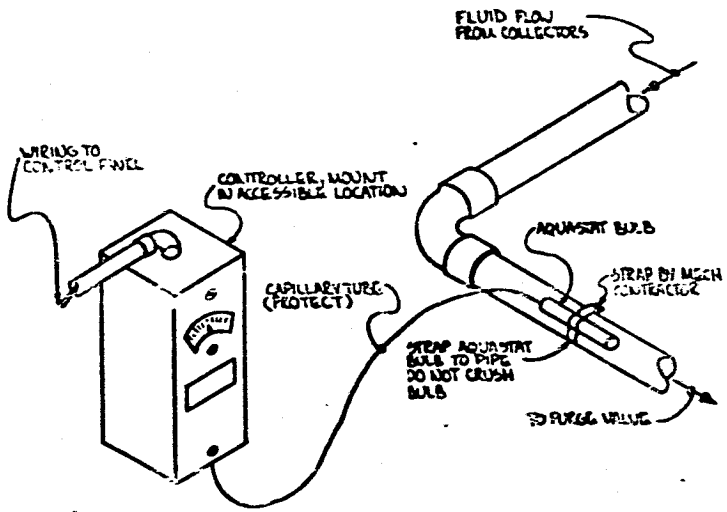
SECTION A-A
NO SCALE



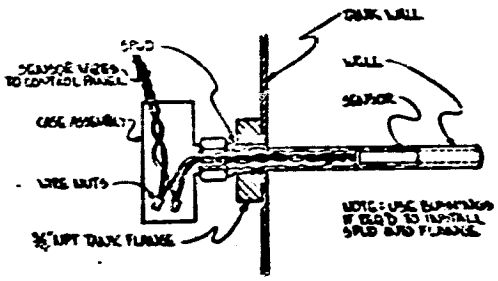
DETAIL X
NO SCALE



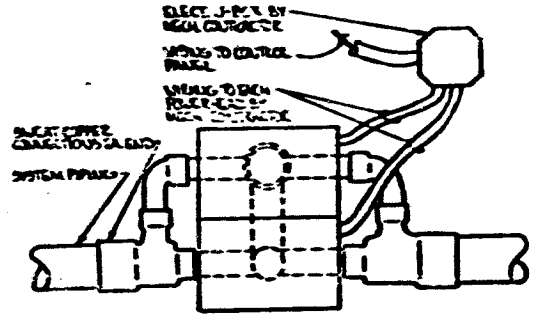
COLLECTOR PLATE SENSOR (T_p) DETAIL (BOTTOM)
NO SCALE



PURGE VALVE AQUASTAT MOUNTING DETAIL (T_{PV})



STORAGE TANK SENSOR MOUNTING DETAIL INDOOR INSTALLATION (T_{SS})
NO SCALE



CONTROL VALVE DETAIL (V_1)
NO SCALE

HONEYWELL INC.	ENERGY RESOURCES CENTER		
SOLAR HEATING SYSTEM SINGLE FAMILY RESIDENCE CONTROL SCHEMATIC			
SIZE C	CODE IDENT NO. 55513	DRAWING NO. SK-142054	
SCALE		SHEET 2 OF	

COLLECTOR COVER REMOVAL & REPLACEMENT

NOTE - The collector surface temperature can burn. Handle solar collector with caution.

1 - **Use rubber gloves when handling solar collector to avoid finger prints on glass.**

2 - **To replace the glass, remove the collector as shown in Figure 19 and dismantle according to Figure 20. To re-assemble frame, insert the glass sheets and new gaskets into side pieces making sure the glass is centered and the ends are even. Next insert the glass into the end pieces and secure with existing screws. Use sealer compound on corner joints.**

3 - **If the glass cover becomes dirty, clean the glass using a soft clean cloth, mild soap or detergent and clean rinse water. Alkalies can stain the glass if allowed to remain in contact too long.**

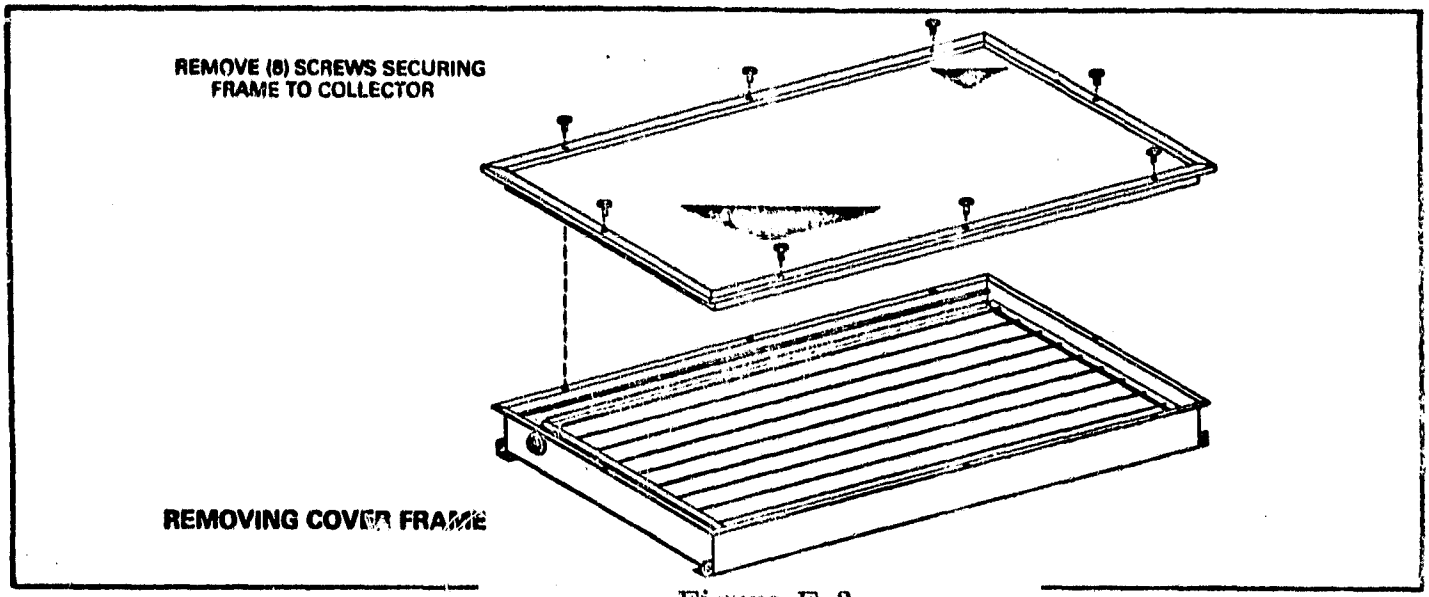


Figure F-2

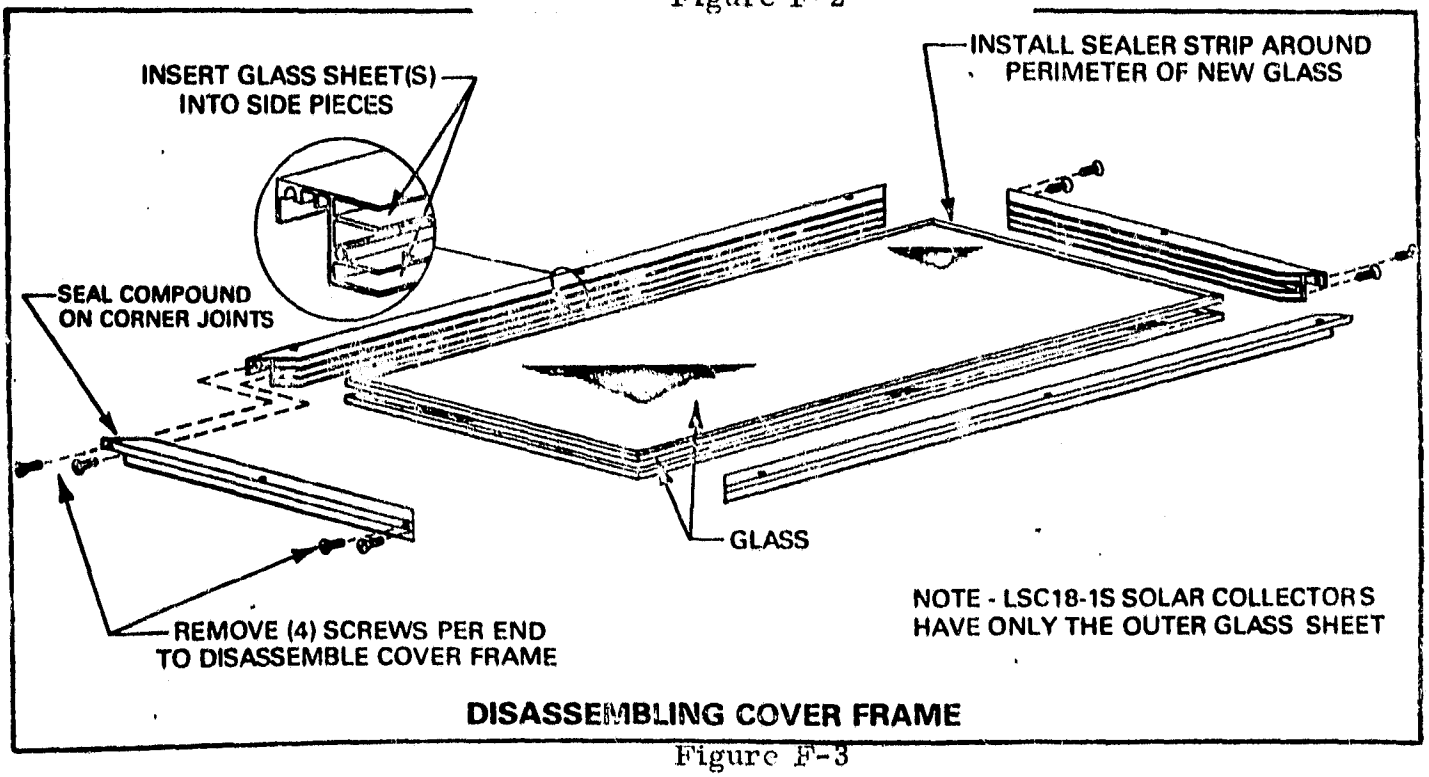


Figure F-3

The Control Valve V_1 should be installed in the collector outlet piping where the purge unit is to be piped in.

The aquastats should be set as follows:

T_{cd} (on collector outlet piping) set at 210°F

T_{st} (top of storage tank) set at 100°F

The collector setpoint potentiometer in Control Panel should be set at 105°F. See Figure F-1.

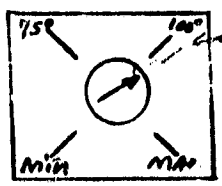


Figure F-1.

G) SITE DATA ACQUISITION SUBSYSTEM (SDAS)

The installation of the SDAS involves the installation of 16 temperature sensors; a total radiation sensor, a watt transducer for the furnace blower and 7 flow rate meters. The list of sensors and system schematic showing their location is shown on SK 142055 Sheet 1. As noted on the list of sensors, some items are already installed but need to be connected to the SDAS Junction Box. The SDAS JB should be installed as shown in Figure G-1.

The return air flow sensor and Temp sensors T600 and TD601 should be installed as shown in Figure G-2 and the terminals wired as shown in detail 6 and 7 on SK 142055.

The storage tank temp sensors should be installed with T203 as the top sensor, T204 as the middle sensor and T205 as the bottom sensor. Sensor T401 is mounted in the inlet line at the bottom of the tank and TD401 is installed in the outlet line at the top of the tank -- opposite end to sight glass. These inline sensors should be installed as depicted in detail #9 and 10 on SK 142055 Sheet 2.

The total Radiation sensor I001 (Pyramoneter) should be installed on the collector support structure as shown in detail on SK 142055 Sheet 3.

The ambient temperature sensor, T001, should be mounted under the eaves on the north side of the residence. See detail 3 on SK 142055 Sheet 3 for mounting instructions.

Three types of flow meters are to be installed. The gas flow meters are the most conventional looking. They are to be installed in the gas line to the furnace and to the hot water heater. The return air flow rate is to be installed in the return air duct as shown in Figure G-2. The liquid flow sensors are to be installed in the hydronic lines as depicted in detail 5 on SK 142055 Sheet 3. Flow sensor W100 can be installed in the collector supply line near where it connects to the ETM. The storage flow sensor W200 should be installed in the outlet line from the storage tank (bottom). The heating coil flow rate sensor should be installed in the return line from the space heating coil attached to the furnace. The DHW flow sensor should be installed where the hydrant line is tapped to provide the feed to the preheat coil in the storage tank.

The wiring connections for each sensor is shown on SK 142055. The sensor wiring is to be brought to the SIDAS J Box. The types of wire connection and conduit requirements are called out on Sheet 1 of SK 142055.

PART NO.

REV	DESCRIPTION	DATE	CHECKED
A	CHANGED SENSOR LOCATION SUBSCRIPT	7-15-77	JPL

Single Family System - Single Family Residence

SITE DATA ACQUISITION SUBSYSTEM

1.0 GENERAL CONDITIONS

1.1 Purpose:

A Site Data Acquisition Subsystem (SDAS) will be installed to evaluate the performance of the solar heating system as well as determine the contribution of collected solar energy to reducing the consumption of conventional energy. The Site Data Acquisition Subsystem components will be furnished by NASA, consisting of instrumentation sensors, junction box, Site Data Acquisition Subsystem Module and a telephone interface, as shown in detail.

1.2 Required Work

1.2.1 Instrumentation Installation - The Mechanical Contractor will install all sensors listed in the instrumentation schedule. The sensor locations are shown on the Site Data Acquisition Subsystem Schematic and the mechanical plans. The Mechanical Contractor shall install the sensors in the locations shown so as to provide for accessibility and ease of servicing.

1.2.2 Instrumentation Wiring - The Mechanical Contractor shall perform all electrical wiring from each sensor back to the Junction Box as shown on details and described below.

1.2.3 Wall Transducer Installation Mechanical Contractor shall install and wire wall transducers on or near equipment served, and system battery wiring as required. See Wall Transducer detail.

1.2.4 Site Data Acquisition Subsystem Module - The Site Data Acquisition Subsystem Module will be furnished by NASA, and installed by the Mechanical Contractor. The installation location will be as shown on mechanical plans.

1.2.5 SDAS Telephone Interface - NASA will provide the telephone installation required for the SDAS.

1.2.6 SDAS Electrical Interface - The SDAS will interface with a standard 110-125v, 60 Hertz, 1 phase, 3 amp service. A standard 3 wire interface (safety ground, power and return) with a standard twist lock outlet, located within approximately six feet of the SDAS, shall be provided by the Mechanical Contractor. NASA shall provide a three pin twist lock connector and cable to interface the SDAS with the power outlet.

1.2.7 Junction Box - NASA shall provide a Junction Box to the Mechanical Contractor for installation in a location as shown on mechanical plans. The Junction Box shall be located so that it is accessible for wiring connections from the sensors into the top and is within four feet of the SDAS location. At the required mounting location, the Junction Box shall be mounted using the four mounting feet located at the top and bottom of the unit. Depending on the characteristics of the mounting surface, molly bolts, wood screws or bolt/nut combinations shall be used to mount the unit. The Junction Box shall be installed in a top-up orientation.

1.2.8 Junction Box/Sensor Interface - NASA will establish the wire run list which identifies where each sensor wire attaches to the Junction Box. The Junction Box will be prewired from the terminal strips to output connectors by NASA prior to delivery to the site. Each applicable sensor detail illustrates the sensor to Junction Box wiring. The Mechanical Contractor shall connect sensor wires to Junction Box terminals according to a wiring diagram to be provided by NASA.

1.2.9 Junction Box/SDAS Module Interface Cables - NASA will install the cables between the Junction Box and the SDAS Module.

1.3 Restrictions on Use of Instrumentation

No monitoring, indicating or readout devices are to be connected to the instrumentation sensors, i.e., paralleled with the Site Data Acquisition Subsystem, without prior approval of NASA.

1.4 Failed Sensor Replacement

Defective sensors will be initially identified by NASA as a part of the performance analysis process.

The improperly operating sensor will be identified to Honeywell ERC. After examination of the sensor for signs of physical damage such as broken wires, loose connectors, loose terminals, etc. If no physical damage is apparent in the inspection, NASA shall be notified for further instructions. If mechanical damage is apparent, the sensor shall be replaced by the Mechanical Contractor with a sensor supplied by NASA. The defective sensor shall then be returned to NASA for failure analysis.

2.0 SDAS MATERIALS

2.1 Instrumentation Wiring

Wiring from the sensors to the Junction Box shall be performed by the Mechanical Contractor utilizing wire supplied by the Mechanical Contractor. The wire size and number of conductors required for each sensor type is specified in list below and each sensor detail. The sensor-to-Junction Box wire shall be UL approved, color-coded, cable and instrumentation grade cable of the following manufacture or equal:

Alpha P/N 5421-18 gauge, 2 conductor
Dearborn P/N 872202-18 gauge, 2 conductor
Alpha P/N 2424-18 gauge, 4 conductor
Dearborn P/N 871804-18 gauge, 4 conductor

All externally exposed wire in the outdoor environment or buried will be in conduit.

Wire nuts will be utilized for terminations at the following sensors:

Temperature Sensors	3 each (single element)
	6 each (dual element)
Flow Meter	6 each
Wall Transducer	2 each

If terminations conflict with local codes, local codes shall be applicable.

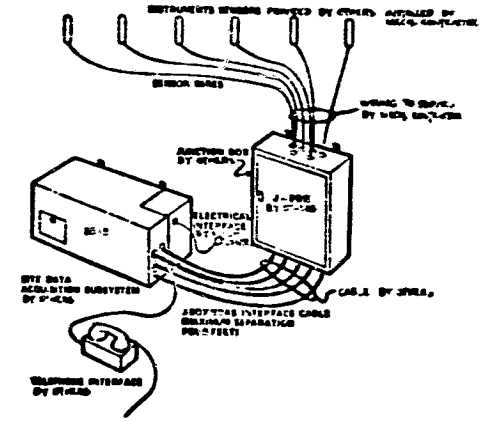
2.2 All other materials necessary for installation of the sensors shall be provided by the Mechanical Contractor. This would include but not be limited to, weld-o-let fittings, pipe flanges, valves, pipe fittings, fasteners, electrical enclosures, terminal blocks, electrical wiring, electrical conduit and any other materials necessary for a complete installation of all sensors.

SITE DATA ACQUISITION SUBSYSTEM

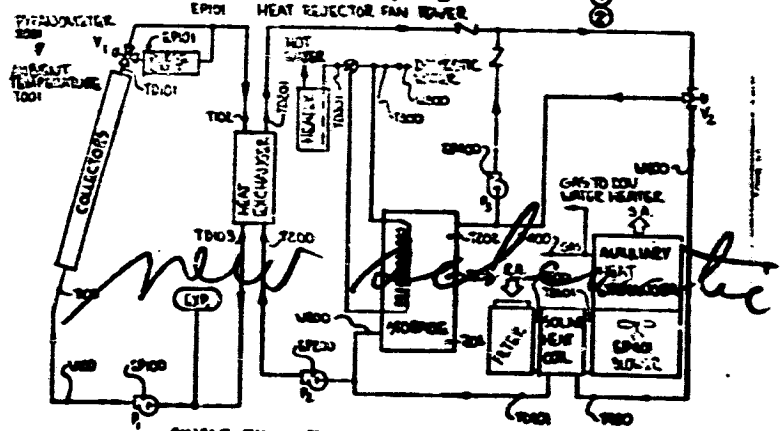
MATERIAL LIST

Site Data Acquisition Subsystem Module
Junction Box and interface cable.
Instrumentation Sensors as follows:

Sensor	Function	Read
[illegible]	Total Radiation	
T001	Outdoor Ambient DB Temperature	
T100	Collector Inlet Temperature	
TD100	Collector Differential Temperature	
T200	HX Solar Inlet Temperature	
TD200	HX Solar Differential Temperature	
T300	HX Hot Water Inlet Temperature	
TD300	HX Hot Water Differential Temperature	
T302	Storage Tank Temperature - Top	
T303	Storage Tank Temperature - Middle	
T304	Storage Tank Temperature - Bottom	
T400	Domestic Cold Water Temperature	
TD301	Solar DHW Preheat Differential Temperature	
T600	Heating Coil HW Inlet Temperature	
TD600	Heating Coil HW Differential Temperature	
T800	Heating Coil Air Inlet Temperature	
TD800	Heating Coil Air Differential Temperature	
T100	Collector Flow Rate	
[illegible]	[illegible] Flow Rate	
[illegible]	[illegible] Rate	
W600	Heating Coil Flow Rate	
EP100	Collector Pump Power	
EP200	Storage Pump Power	
EP600	Heating Pump Power	
EP650	Furnace Fan Power	
F600	Natural Gas Auxiliary Energy	
EP150	HEAT REJECTOR FAN POWER	



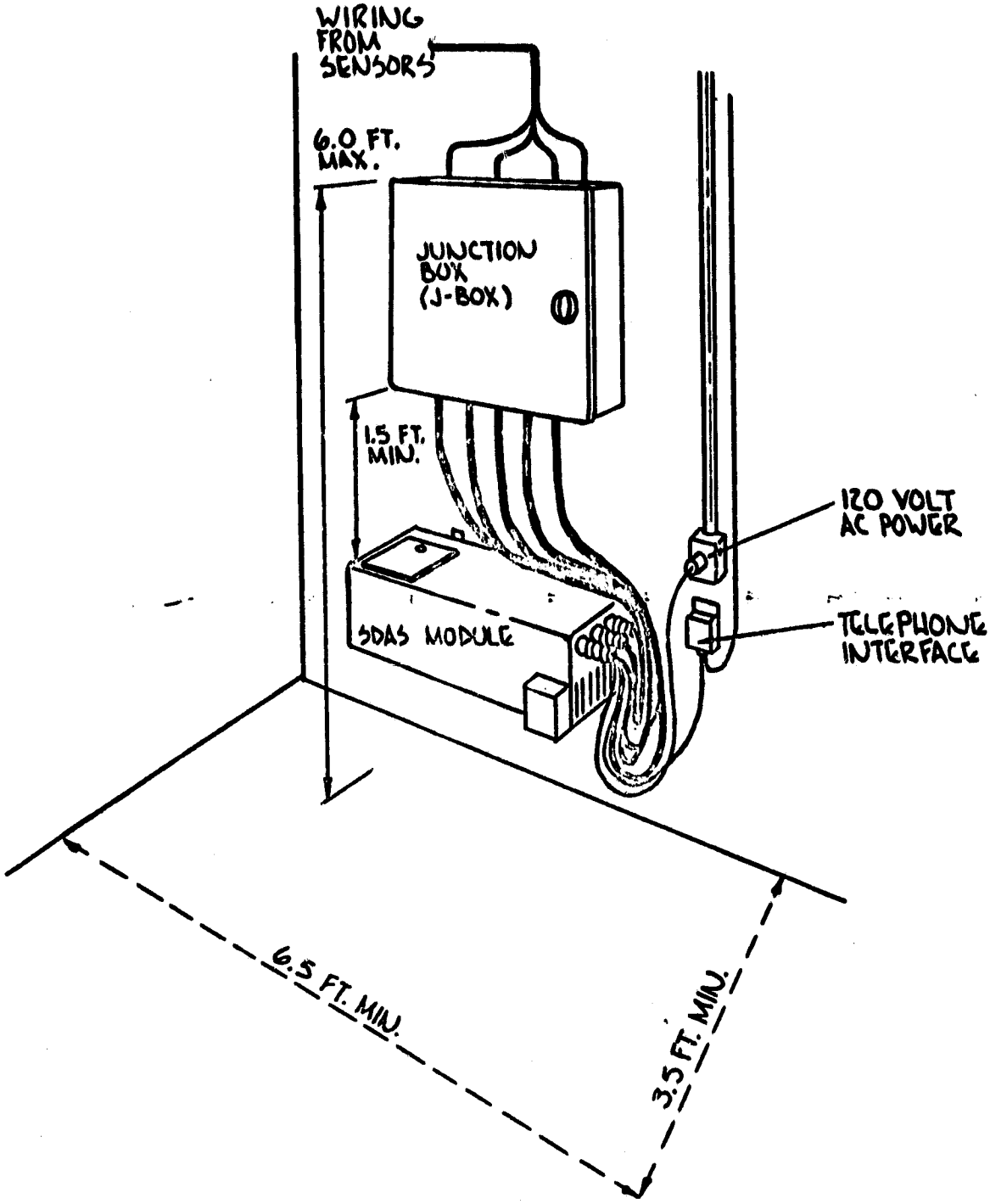
SITE DATA ACQUISITION SUBSYSTEM COMPONENTS
NO SCALE



SINGLE FAMILY RESIDENTIAL SOLAR HEATING SYSTEM
SITE DATA ACQUISITION SUBSYSTEM SCHEMATIC

		TOLERANCES UNLESS NOTED OTHERWISE	DRAWN		HONEYWELL IEC. ENERGY RESOURCE CENTER
		X ±	CHECKED		
		XX ±	DESIGN		SOLAR HEATING SYSTEM - SFR
		XXX ±	ENGR'G APPR		SITE DATA ACQUISITION SUBSYSTEM
		MATERIAL	CONTRACT NO.		
NEXT ASSY	USED ON	FINISH-SEE NOTE	WILLIAM O'BRIEN	SIZE C	CODE IDENT NO. 55513
APPLICATION				SCALE	DRAWING NO. SK-142055
					SHEET 1 OF 5

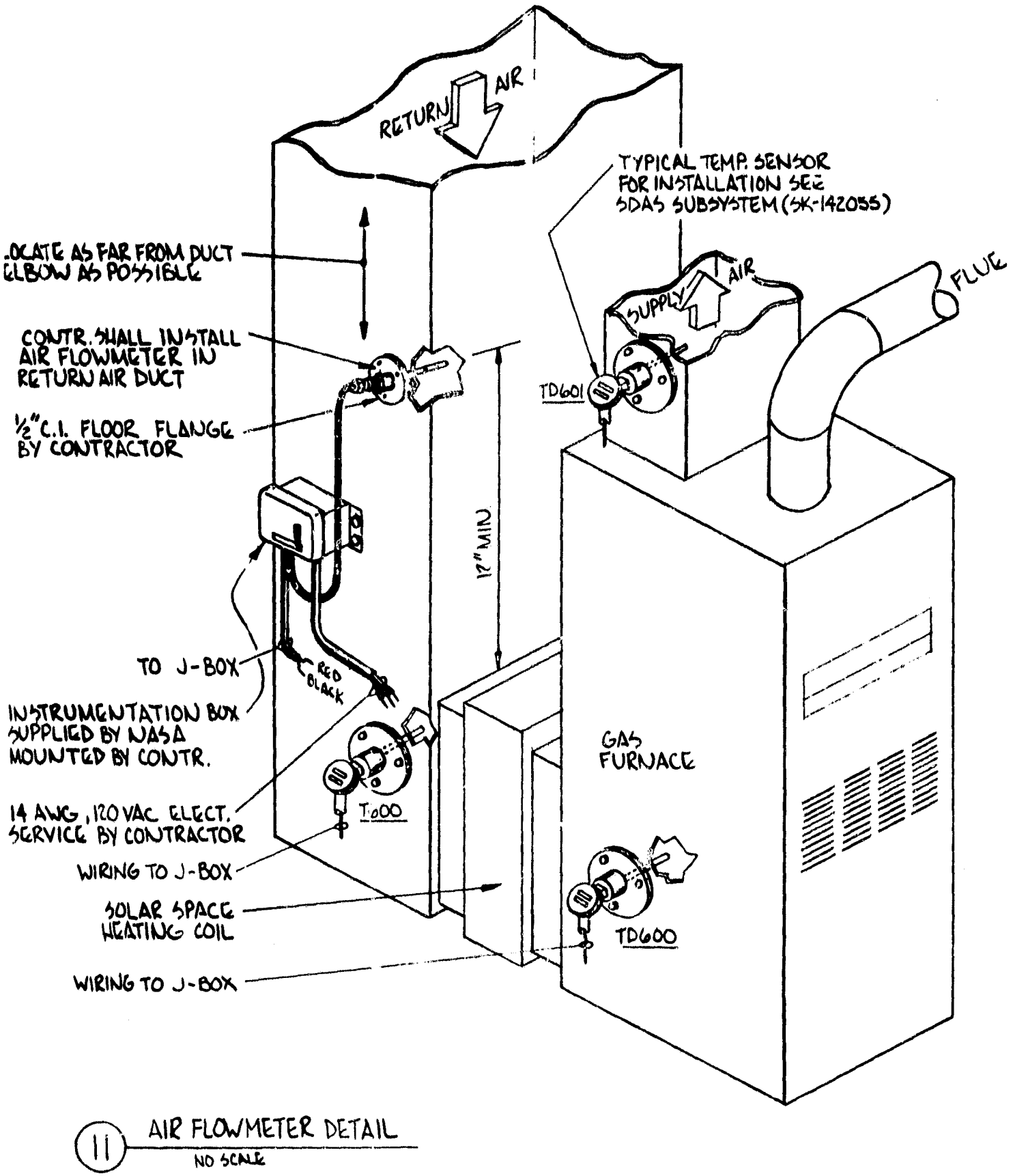
CONTROL A



SDAS MODULE AND J-BOX INSTALLATION

NO SCALE

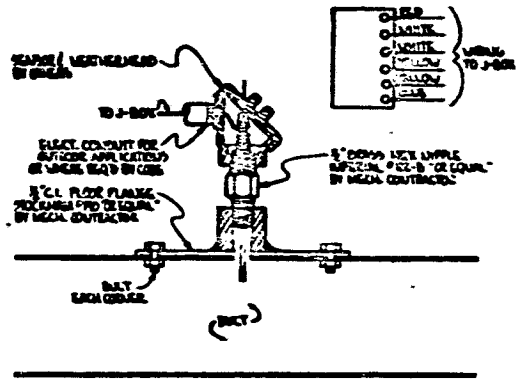
Figure G-1



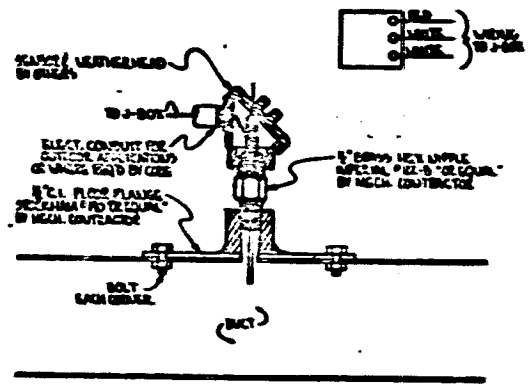
11 AIR FLOWMETER DETAIL
NO SCALE

Figure G-2. Aux. Heat SDAS Sensor Installations

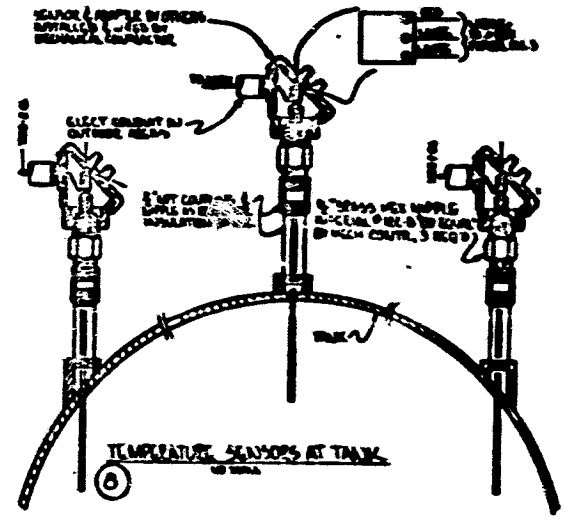
PART NO.



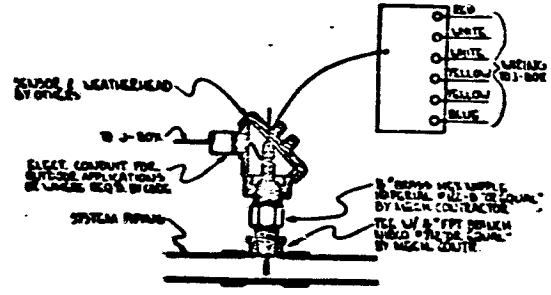
6 DUAL ELEMENT TEMPERATURE SENSOR



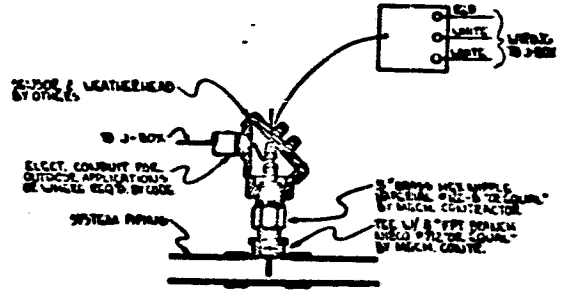
7 SINGLE ELEMENT TEMPERATURE SENSOR



8 TEMPERATURE SENSORS AT TANK



9 DUAL ELEMENT TEMPERATURE SENSOR



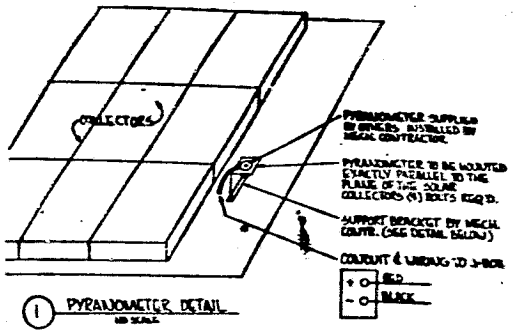
10 SINGLE ELEMENT TEMPERATURE SENSOR

TEMPERATURE SENSOR INSTALLATION

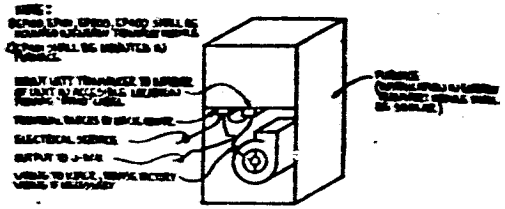
1. All temperature sensors shall be located so as to avoid accidental damage to the sensor head assembly.
2. Dow Corning DC-340 heat transfer grease shall be applied to the bottom of the temperature probe prior to insertion into the thermowell.
3. In areas where there is a risking of flows, the temperature sensor shall be mounted a minimum of twenty (20) pipe diameters downstream of the point of mixing.
4. All temperature sensors shall be identified with a brass tag.

		TOLERANCES UNLESS NOTED OTHERWISE		HONEYWELL INC.	ENERGY RESOURCES CENTER
			DRAFTSMAN		
			CHECKER		
			DEV ENGR		
		MATERIAL	ENGRG MGT	SOLAR HEATING SYSTEM - FER	
			QUALITY MGR	SITE DATA ACQUISITION SUBSYSTEM	
NEXT ASSY	USED ON		WILLIAM O'BRIEN	SIZE C	CODE IDENT NO. 55513
APPLICATION		FINISH-SEE NOTE		SCALE NONE	SHEET 2 OF 3
				CONTROL A	

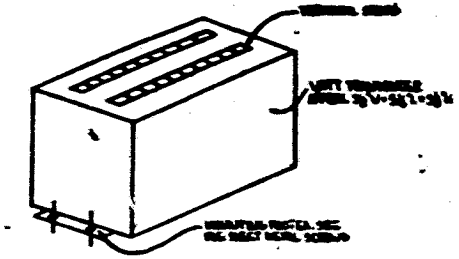
PART NO.



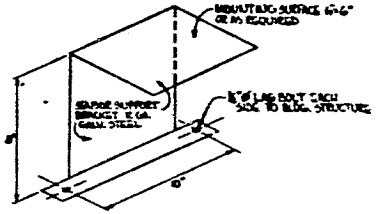
1 PYRANOMETER DETAIL



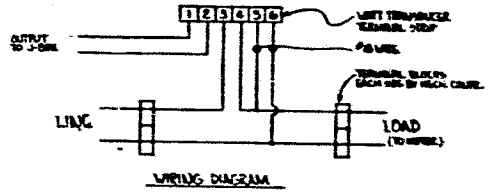
INSTALLATION



WATT TRANSDUCER



SUPPORT BRACKET DETAIL

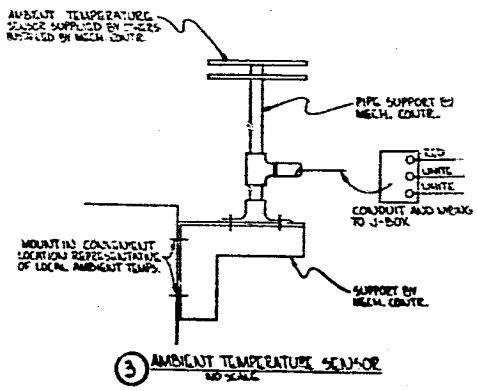


WIRING DIAGRAM

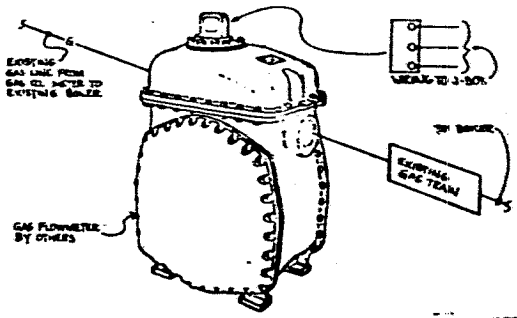
2 WATT TRANSDUCER

FLOWMETER INSTALLATION INSTRUCTIONS

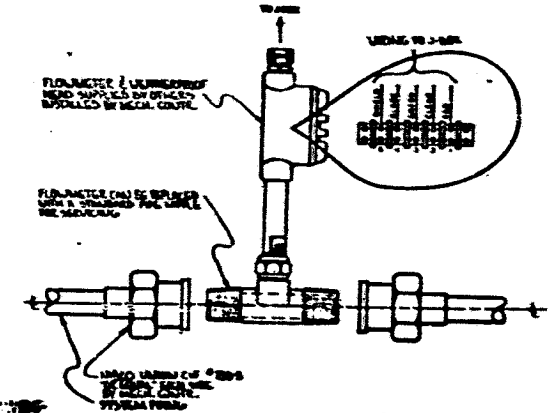
1. Flowmeters shall be preceded by a minimum of twenty (20) pipe diameters of uninterrupted flow line upstream, and followed by a minimum of ten (10) pipe diameters of uninterrupted flow line downstream. These sections shall have no elbows, valves, thermometers or temperature sensors, or other obstructions.
2. Flowmeters shall be located in the horizontal position.
3. All flowmeters shall be identified with a brass tag.



3 AMBIENT TEMPERATURE SENSOR



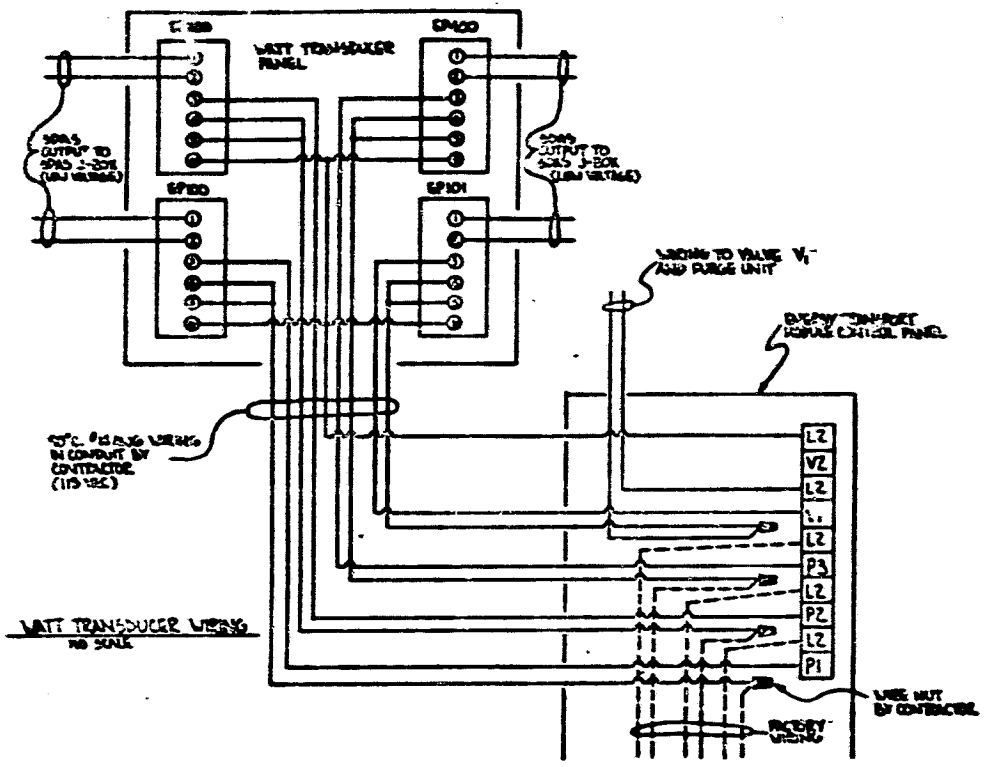
4 GAS METER DETAIL

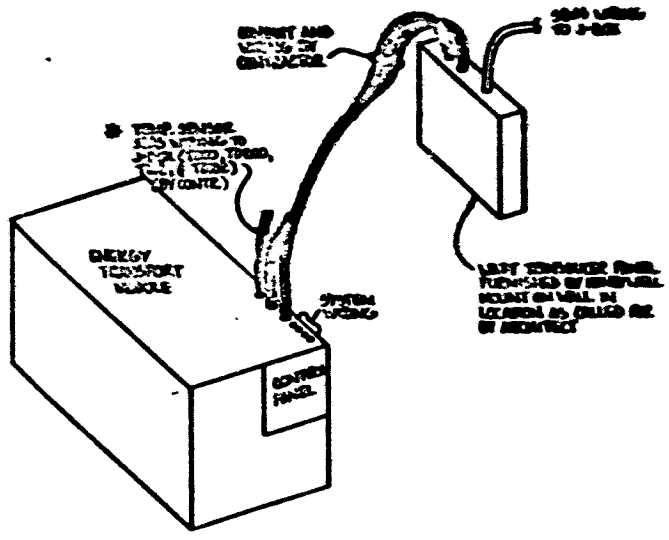


5 FLOWMETER DETAIL

RELEASED FOR CONSTRUCTION
E.C.O. Control

		TOLERANCES UNLESS NOTED OTHERWISE		HONEYWELL INC.	ENERGY RESOURCES CENTER
				SOLAR HEATING SYSTEM - SFR. SITE DATA ACQUISITION SUBSYSTEM	
		MATERIAL	WILLIAM O'BRIEN	SIZE C	CODE IDENT NO. 55513
NEXT ASSY	USED ON			SCALE NONE	SHEET 3 OF 3
APPLICATION		FINISH-SEE NOTE		CONTROL A	





* WIRING LEADS FROM SOLAR TEMP. SENSORS ARE ACCESSIBLE INSIDE MODULE BY REMOVING TOP PANEL.

SINGLE FAMILY RESIDENCE-SITE DATA ACQUISITION SUBSYSTEM

SK-142055

SECTION IV

SYSTEM TEST AND FILLING

A) TESTING

As the hydronic loops are completed they should be tested to verify their integrity. The System Integration SK 142057 Sheet 3 (Pg. III-19) outlines the testing to be performed under 15.042 Testing.

B) FLUSHING AND CLEANING

After the testing of the hydronic loops is completed the following cleaning procedure should be used.

1) The collector loop and the space heat/storage loop are controlled by the ETM module. See SK 142053 sheet 2. (Pg. III-18)

Access to the various components in the ETM can be gained as described below. These items are shown in Figure 4-1, 4-2 and 4-3.

a) drain/fill valve #4	- remove side panel (opposite control box)
b) ball valve, flush valve #3, and lift check valve	- remove top panel and insulation in front of coll. return inlet
c) HX drain	- remove side panel (opp. control box); then remove galvanized insulation retainer
d) Pressure gauge (part of low level/pressure indicator system) and HX air bleed	- remove top panel and insulation between the Control Panel and HX

Flushing and draining of the collector loop must be done thru flush drain/fill valve #4 and flush valve #3. To clean collector loop:

a) set all switches on control panel to stop

b) close ball valve adjacent to flush valve #3 and open balancing valves in collector supply lines and air vents at collectors

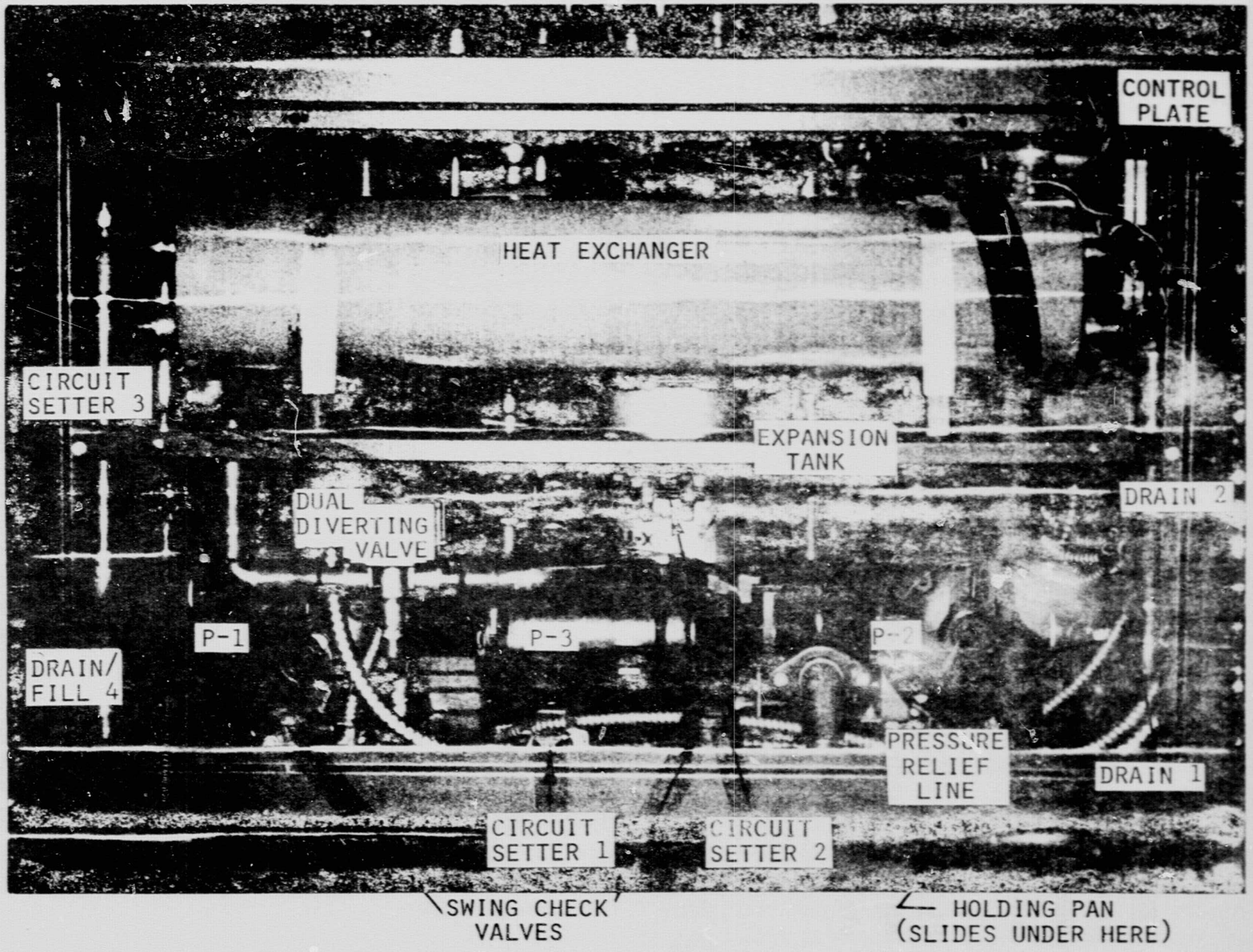


Figure 4-1. ETM Front View

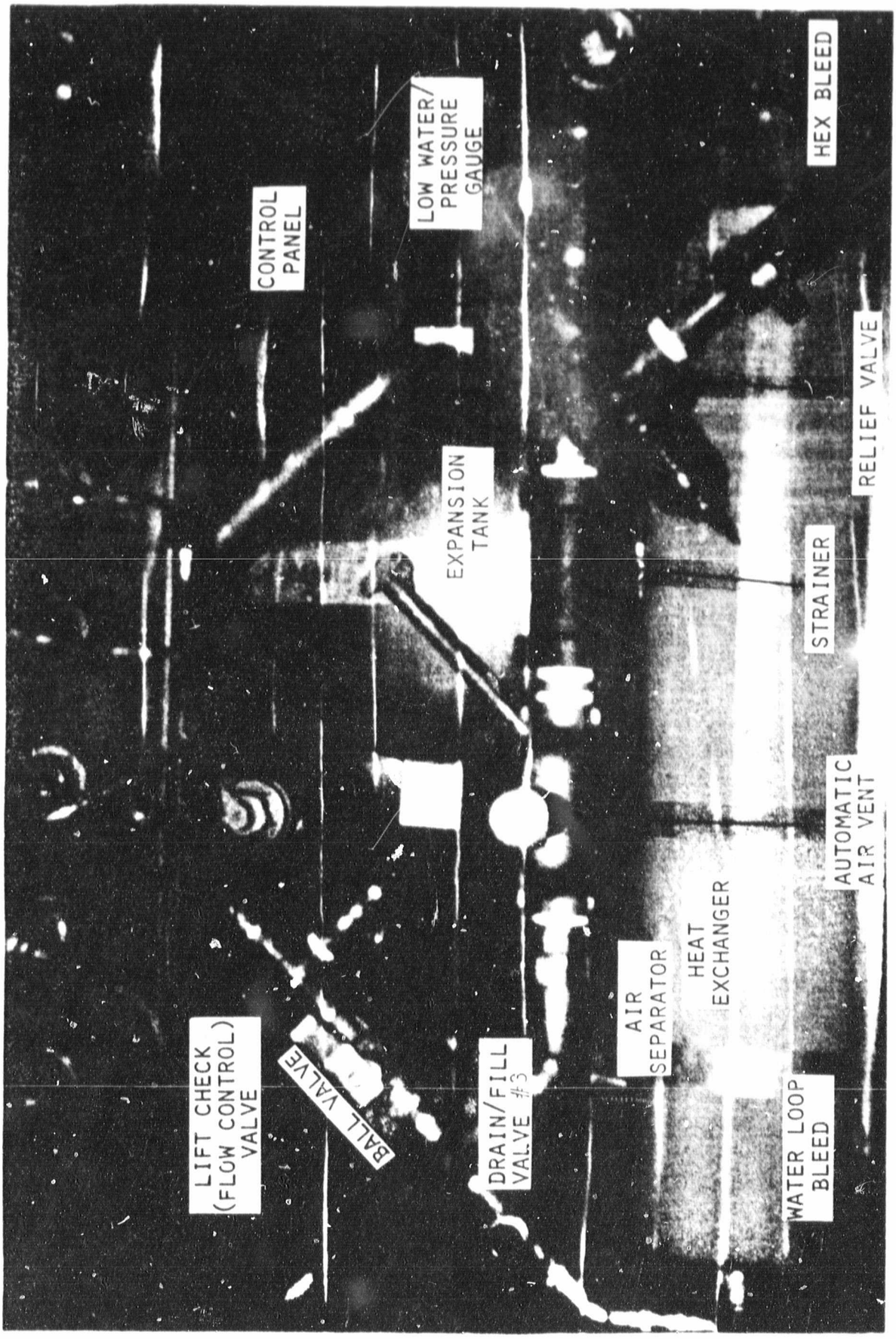


Figure 4-2. ETM Top View

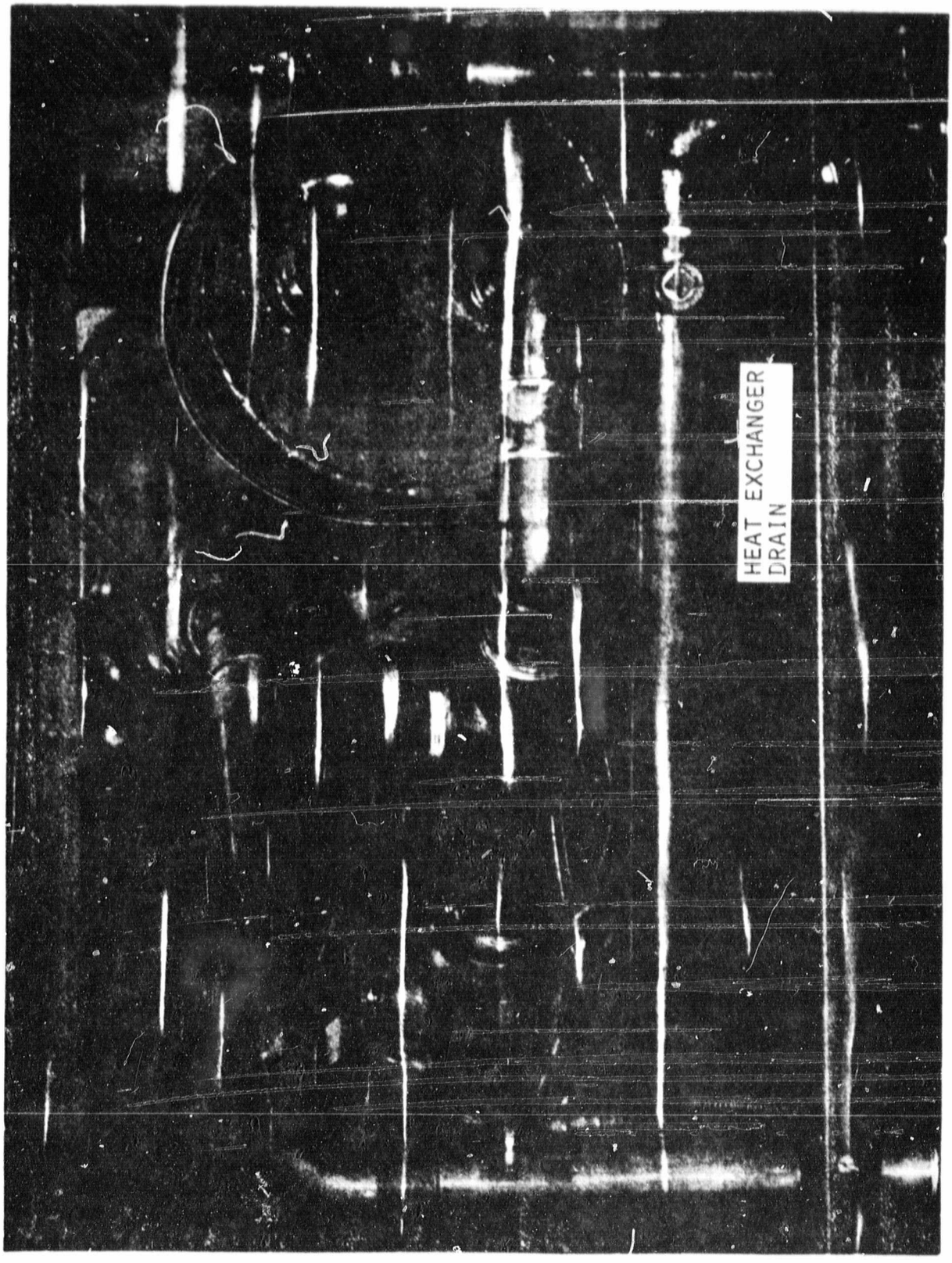


Figure 4-3. ETM End View (Left)

c) Connect fill line from drum with 50 gal. of water mixed with 1/2 gal. trisodium phosphate to drain/fill valve #4

d) open valve #4 and using external pump

e) pump liquid into system.

CAUTION: Pressure should not exceed 40 psig

f) As liquid starts flowing open flush valve #3;

g) a drain hose should be connected to flush valve #3 and run to a large container (55 gal. drum) to catch to flushing fluid;

h) start pump by moving switch ma rked P1 to P1 "ON".

CAUTION: Do not run pump when no liquid is present

i) Continue feeding flushing fluid until it flows freely from drain hose;

j) close air vents at collector when air ceases to flow;

k) energize valve V1 (turn to ON position) and continue to feed fluid until it flows freely from drain hose.

l) open ball valve adjacent to flush valve #3 and close flush valve #3

m) continue to supply fluid until pressure gauge reads 20 psig

n) bleed air from HX bleed valve, then

o) close drain and fill valve #4. Shut external fluid supply and run system for 4 hours.

Monitor pressure gauge periodically to be sure it remains within 20-35 psi operating range.

When cleaning is completed drain total collector loop - HX fluid and measure volume so that correct amount of ethylene glycol can be mixed.

To completely drain collector loop, the Lift Check Valve (rear Circuit Setter (3) must be opened (turn knob counter-clockwise till it stops). *After draining, insure knob is returned to the fully closed position.

After system is totally drained, remove drain plug from HX to empty shell side.

The strainer should be cleaned while system is drained.

The collector loop should now be flushed with clean water for two hours. This may be accomplished using the water system. Caution:- assure supply pressure does not exceed 40 psi. It should be connected to the drain/fill valve No. 4. Pump P_1 need not be energized but ball valve must be closed. A drain hose should be connected to flush valve No. 3 and run outside to an appropriate area.

The HX portion of the system should be flushed and it may be performed as follows:

a) Close ball valve and drain/flush valve 3
b) Open HX drain and connect drain hose to it
c) Pump fluid into drain/fill valve #4 and out of HX drain

2) The storage and heating system loop should be flushed and cleaned prior to filling
   a) The storage tank should be flushed first. Connect hose to drain valve on bottom of tank and open valve. Drain hose should be run to appropriate floor drain. Remove manhole cover and using hose connected to household water supply

*NOTE: Without isolation valves outside ETM, system must be drained before maintenance can be performed.

flush interior of tank.

CAUTION: Do not enter tank with shoes as interior lining could be damaged.

To flush heat coil loop, connect a drain hose to drain valve #1 in ETM, open valve, and connect to drain valve #2 in ETM a hose from household water supply. Close both isolation valves on inlet and outlet of storage tank. Turn water on and let water flow for 30 minutes.

b) When system is thoroughly flushed shut-off drain valve and fill tank to 6" below top of tank. Add inhibitor (1200 mg/l) which is 5 gallons of nitrate base made by Norman Chemical product no. 284, 1630 Carroll Ave, St. Paul, MN.

C) BALANCING

Connect Bell and Gossett Delta Pressure readout kit or equivalent to Bell and Gossett Circuit setter balance valve #1 in ETM (heat from storage loop). Proceed as per instructions included with readout kit. Manually start P3. Adjust flow to 8 GPM.

Repeat procedure with circuit setter blance valve #2 in ETM (storage charge loop). Run P. 2. Adjust flow to 8 GPM.

Repeat procedure with circuit setter balance valve #3 in ETM (total solar collector loop) run P1. Adjust flow to 12 GPM.

Repeat procedure with circuit setter flow balance valve in supply line to 3 high collector array. (Not in ETM) with P-1 operating. Adjust flow to 5.5 GPM.

Repeat procedure with circuit setter flow balance value in supply line to 2 high collector array (not in ETM) with P-1 running. Adjust flow to 6.5 GPM.

D) START-UP

1) Collector Loop

Fill the collector loop with a 50/50 solution of water and Dowtherm SR1 ethylene glycol. Mix the glycol and water in a 55 gallon drum. Connect fill hose to drain/fill valve #4. Connect inlet of external pump to 55 gal. drum, open fill valve #4 and start pump. Open all air bleeds in the system and fill slowly. It is imperative not to fill the system too rapidly. Close air bleeds as they begin to leak. Precautions should be taken to prevent the glycol mixture from spilling onto the building or collector array.

2) System Pressurization

Once the system is full and purged of air, it may be pressurized to 20 psig as shown on low water/pressure gauge using external pump and 50/50 mixed solution. Energize the collector system pump P_1 manually. Air that is trapped will tend to be separated by the air separator as the fluid circulates. This will cause a decrease in the fluid level within the collector loop. It is important to watch this pressure level to see that it does not get too low as the low fluid warning light will come on. If the pressure gets low, then add more fluid to the collector loop to maintain the same charge pressure. Low water/pressure gauge should be set to 15 psig.

E) SYSTEM CHECK-OUT

To verify system operation have both loops of system filled and electrical power to ETM. Position all Auto-Stop-On switches in Auto position. This allows the indicator lights to function correctly. Using system check-out matrix on Figure 4-4 verify each mode operates as shown.

OPERATING MODE	DISCONNECT	ADJUST	ENERGIZE	PUMP 1	PUMP 2	PUMP 3	VALVE 1	VALVE 2	GAS VALVE	FAN	CONTROL PANEL LIGHTS
Collector Heat Heating House	LOW Temperature Sensor on Differential Temperature Terminal C Controller		1st Stage Heat (W_1 energized)	E	E	DE	DE	DE	DE	E Med-Hi	Collector Heat Heating House
Collector Heat Heating House and Auxiliary Heat Heating House	LOW Temperature Sensor on Differential Temperature Terminal C Controller		2nd Stage Heat (W_1 and W_2 energized)	E	E	DE	DE	DE	E	E Med-Hi	Collector Heat Heating House, Auxiliary Heat Heating House
Storage Heat Heating House	HIGH Temperature Sensor on Differential Temperature Terminal A Controller Reconnect Terminal C	Aquastat Tank Sensor Set Point at Minimum (Tst)	1st Stage Heat (W_1 energized)	DE	DE	E	DE	DE	DE	E Med-Hi	Storage Heat Heating House
Storage Heat Heating House and Auxiliary Heat Heating House	HIGH Temperature Sensor on Differential Temperature Terminal A Controller	Aquastat Tank Sensor Set Point at Minimum	2nd Stage Heat (W_1 and W_2 energized)	DE	DE	E	DE	DE	E	E Med-Hi	Storage Heat Heating House, Auxiliary Heat Heating House
Auxiliary Heat Heating House	HIGH Temperature Sensor on Differential Temperature Terminal A Controller	Aquastat Tank Sensor Set Point at Maximum	1st Stage Heat (W_1 energized)	DE	DE	DE	DE	DE	E	E Med-Hi	Auxiliary Heat Heat House
Collector Heat to Storage Tank	LOW Temperature Sensor on Differential Temperature Terminal C Controller		Set Thermostat Down	E	E	DE	DE	E	DE	DE	Collector Heat to Storage Tank
Cooling			G on Space Thermostat	DE	DE	DE	DE	DE	DE	E Hi	
Ventilation			G on Space Thermostat	DE	DE	DE	DE	DE	DE	E Hi	
Purge	LOW Temperature Sensor on Differential Controller Terminal C	Aquastat Collector Pipe Sensor Set Point at Minimum	Set Thermostat Down	E	E	DE	E	E	DE	DE	

Figure 4-4. System Checkout

SECTION V

OPERATION

This section outlines the operation of the single family residence Solar Heating System. The system is automatically controlled by the space thermostat to provide energy to satisfy heating requirements. When no heat is required in the dwelling the system will automatically store the collector solar energy or will dissipate it if the storage is fully charged.

The following sections describe in detail how the system and subsystems operate.

System Operation

General (Refer to Pg. I-2)

Once the solar system has been installed, fluids added to collector and storage loops and system checked out by the installer, the complete system will operate automatically. Lights on the control panel will indicate in which mode the system is operating. For normal operation, set all switches in the control panel to the "Auto" position. The On and Stop positions should only be used for manually controlling the system such as during maintenance or system checkout.

The space thermostat can call for heat in two stages. The first stage will utilize solar energy if it is available. If this is not sufficient to heat the building the thermostat will switch automatically to second stage heating which energizes the gas furnace. Solar heated water is available from the collector if sufficient solar energy is available or from energy stored in the solar storage tank.

When heating directly from the collectors to the heating coil located in the return air section of the furnace, the collectors must be at least $105^{\circ}F$. The energy will continue to be supplied from the collectors as long as there is a call for heat and the collectors are greater than $90^{\circ}F$. In this mode pumps P_1 and P_2 are energized and water is heated by the heat exchanger and circulated around the storage tank to the furnace coil through valve V_2.

If sufficient energy is not available from the collectors and the storage tank is greater than $90^{\circ}F$, then pumps P_1 and P_2 are off, pump P_3 is energized and hot water is supplied to the furnace coil from the top of the storage tank and is returned to the bottom of the tank.

When there is no call for heating and solar energy is available from the collectors the system will charge storage as long as the collectors are greater than $3^{\circ}F$ above the storage tank after intial start.

When the storage is fully charged the system will operate the purge coil whenever the collector outlet is greater than $220^{\circ}F$. The purge will control the collector outlet temperature to prevent over heating of the system.

SECTION VI

MAINTENANCE

This section outlines the maintenance of the single family residence Solar Heating System. The maintenance required is outline in two sections - Section I Routine Maintenance covering ordinary and preventive maintenance; - Section II Maintenance Schedule which provides a chart of maintenance activities for the system and the subsystems.

Repair and parts replacement for the components are provided in the appendices A thru F.

ROUTINE MAINTENANCE

The Solar Heating System requires only a small amount of routine maintenance. The elements requiring maintenance are broken down by subsystems and described below.

A. Collector Subsystem

The components requiring routine maintenance are the:

- **Solar Collectors (LSC 18-1)**
  Normal rainfall will usually suffice for cleaning however, inspect spring and fall for dirty cover glass. Clean glass using a soft clean cloth, mild soap or detergent and clean rinse water. Alkalines can stain the glass if allowed to remain in contact too long.

- **Purge Unit (HRW-1-30)**
  Inspect spring and fall for debris on coil. Clear debris from coil with brush - unit may be flushed with water hose if necessary. Lubricate motor in accordance with guide on motor.

B. Storage Subsystem

The water in the storage tank should have the inhibitor checked and water condition checked annually. If the tank water has a pungent odor, or dark discolorization, drain tank and refill with clean water adding inhibitor as called out in Section V under Start-Up part 2 Storage Loop.

The inhibitor pH level should be between 7.0 and 9.0 Draw a small amount of water from the storage tank drain valve. Using a pH test kit dip a short piece of test paper in the fluid drain off. Observe the color of the moistened portion and compare to color chart with kit. The desired pH is 8.0 or higher. If the pH is less than 8.0 add 5 gallons of Product No. 284 made by Norman Chemical Co., 1630 Carroll Ave., St. Paul, or equivalent to reach a value of 1200 mg/l. (1200 ppm) of nitrite base.

Adding of inhibitor and filling tank may be done thru manhole in top of tank. Tank may be drained by connecting drain hose to tank drain on bottom of tank.

C. Auxiliary Energy and Space Heat Subsystem

- The furnace should have the following checked annually:
  - check and clean blower wheel
  - lubricate blower motor
  *- replace filter media
  - check furnace operation

D. Hot Water Subsystem

To assure long life and efficiency, the water heater tank should have a small amount of water drained periodically. Once every month or two the drain valve should be opened and the water allowed to run until it flows clean. This will help prevent sediment buildup on the bottom of the tank.

E. Energy Transport Subsystem

- The Energy Transport Module (ETM-1) has three pumps that should be lubricated every three months. Proper lubrication is the most important single factor in obtaining long life and trouble free operation. Each oil cup, two on motor and one on the pump should be filled with #20 non-detergent motor oil.

- Transfer Fluid (SR-1) - The ethylene glycol and water mixture contains corrosion inhibitors. An annual test of the fluid is necessary to avoid plumbing decay. "Do not add chromate inhibitors to system". Using a standard pH test kit, dip a short piece of test paper in a small amount of fluid drawn from drain and fill valve #4 in ETM. Observe the color of the moistened portion and compare to color chart with kit. The desired transfer fluid pH is 8 or higher. If the pH is less than 8 acids are forming in the fluid. The dwelling owner should call the solar system service man to add inhibitor to system. Use Figure 6-E-1 to determine the correct quantity of inhibitor to be added. After system operation for 30 minutes recheck pH level for proper value.

- Replenishing Inhibitor - If the pH is less than 8, the inhibitor is becoming depleted, and adding inhibitor to protect the system is recommended. Such inhibitor is readily available from the Dow Checmical Company in five gallon lots. Since the inhibitors are specially designed for Dowtherm SR-1 heat transfer medium, other type inhibitors should never be mixed with this material.

*Filter should be checked monthly during heavy operation and replaced as needed.

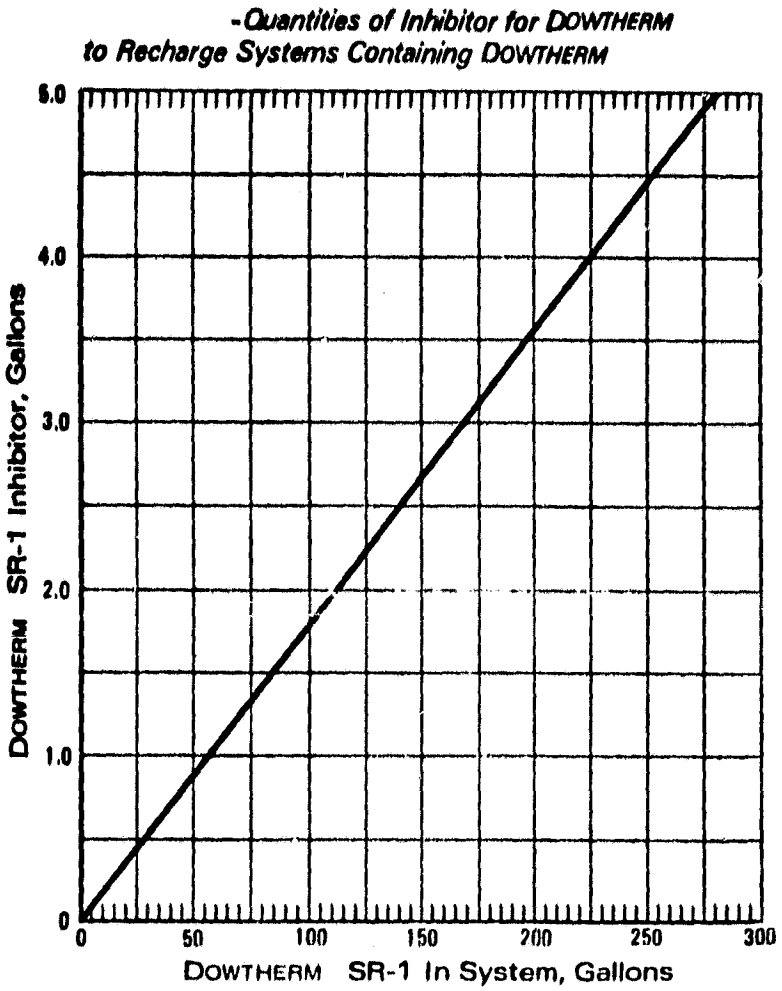


Figure 6-E-1.

F. Control Subsystem

The control subsystem does not require any periodic maintenance. This subsystem can be used to check system operation as shown in Section IV System Test and Filling.

SECTION VII

MAINTENANCE SCHEDULE

Figure 7-1 outlines the routine maintenance required or the single family Solar Heating System.

Frequency	Activity	Reference	
		Section	Appendix
Quarterly every 3 months	Check furnace air filter	3C	C
	Hot Water heater sediment drain	3D	D
	ETM Pump lubrication	3E	E
Semi-Annual or seasonal	Clean Collector Glass	3A	A
	Clean Purge unit	3A	A
Annual	Storage tank fluid check	3B	B
	Service furnace	3C	C
	Solar collector fluid check	3E	

Figure 7-1. Routine Maintenance

APPENDIX A

COLLECTOR SUBSYSTEM

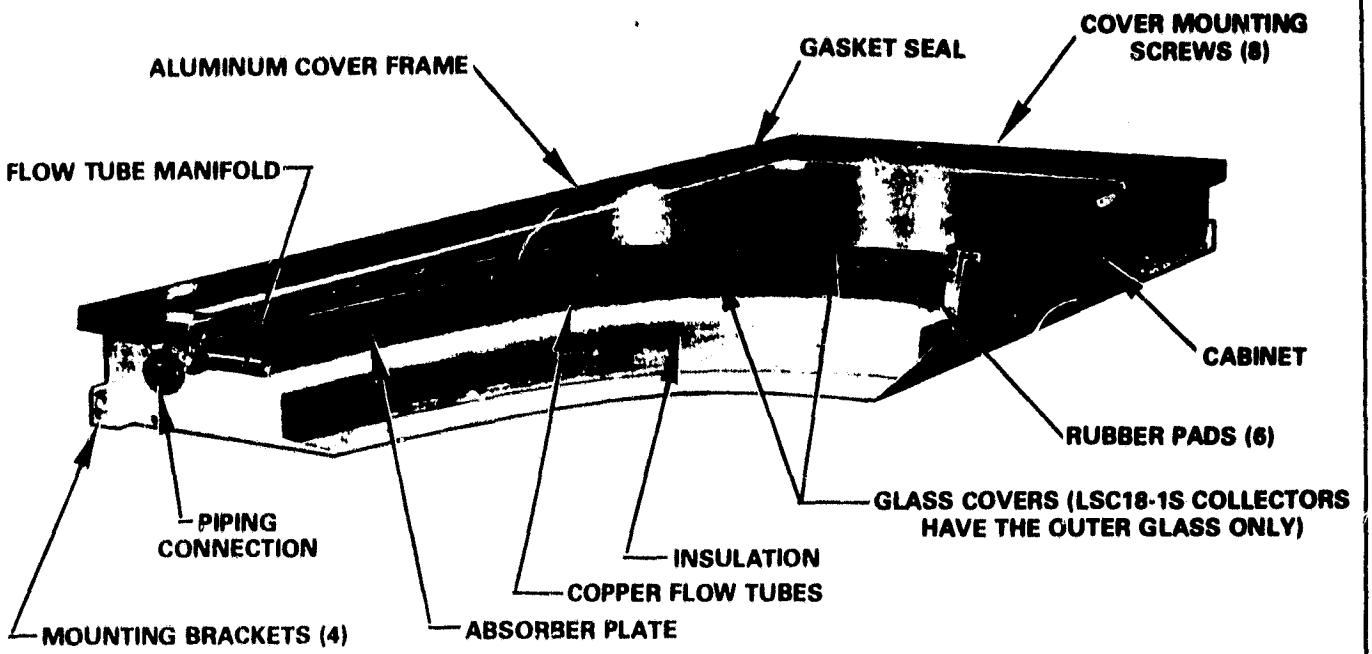
LSC18-1	Solar Collectors
HRW-1-30	Purge Unit
Y534A	Diverting Valve (page E-10)

operation
maintenance
and
installation
instructions

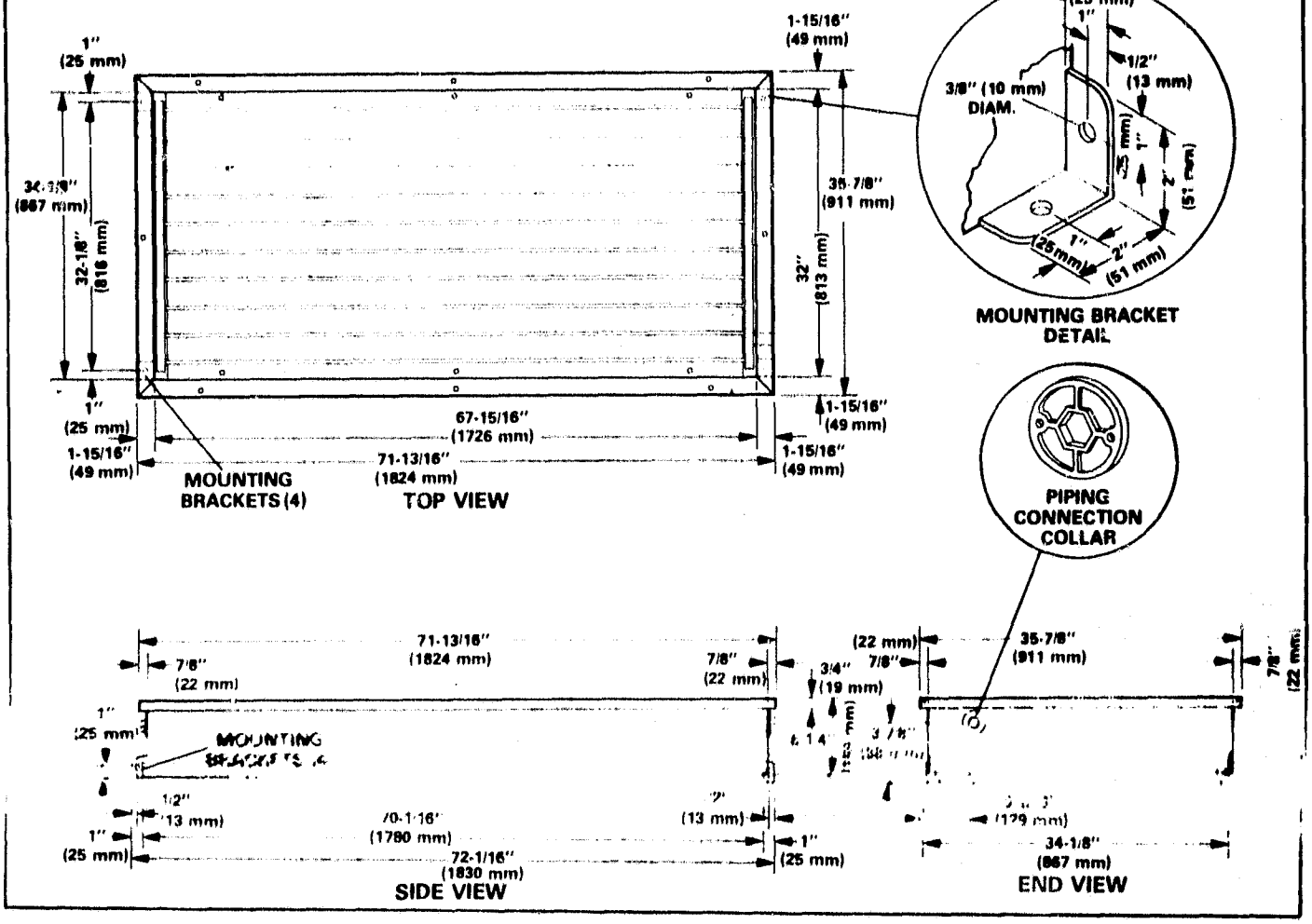
LSC18-1 and LSC18-1S Solar Collectors

SOLAR
501,249M
6/76

PARTS ARRANGEMENT



SOLAR COLLECTOR DIMENSIONS



FRAMING - FLASHING - COLLECTOR MOUNTING

I - SHIPPING AND PACKING LIST
Package 1 of 1 Contains
1 - Assembled solar collector

II - SHIPPING DAMAGE
Check unit for shipping damage. Contact the last carrier immediately if any damage is found.

III - GENERAL
These instructions are intended as a general guide and do not supersede local codes. Authorities having jurisdiction should be consulted before installation.

IV - APPLICATION
The consulting engineer, architect or dealer must determine the solar collector application including number required, placement, mounting angle and piping sequence. This instruction outlines one typical method of framing and installing the solar collectors. Other designs can be substituted if the basic guidelines within the instruction are followed. Figure 1 illustrates a typical residential application.

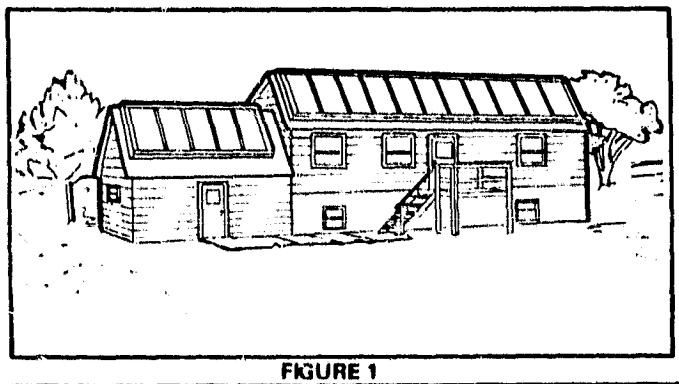


FIGURE 1

V - SOLAR COLLECTOR
The collectors must mount on a watertight roof. Roof construction must be adequate to support the collectors and mounting frame. Solar collectors must be installed with the flow tubes in the vertical

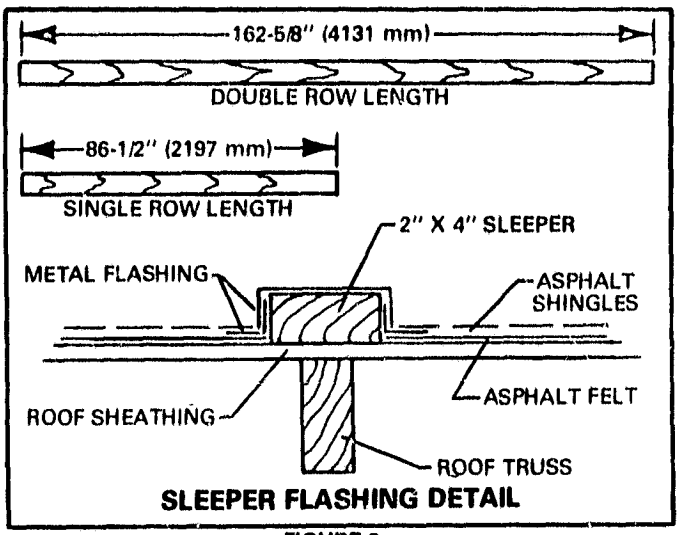


FIGURE 3

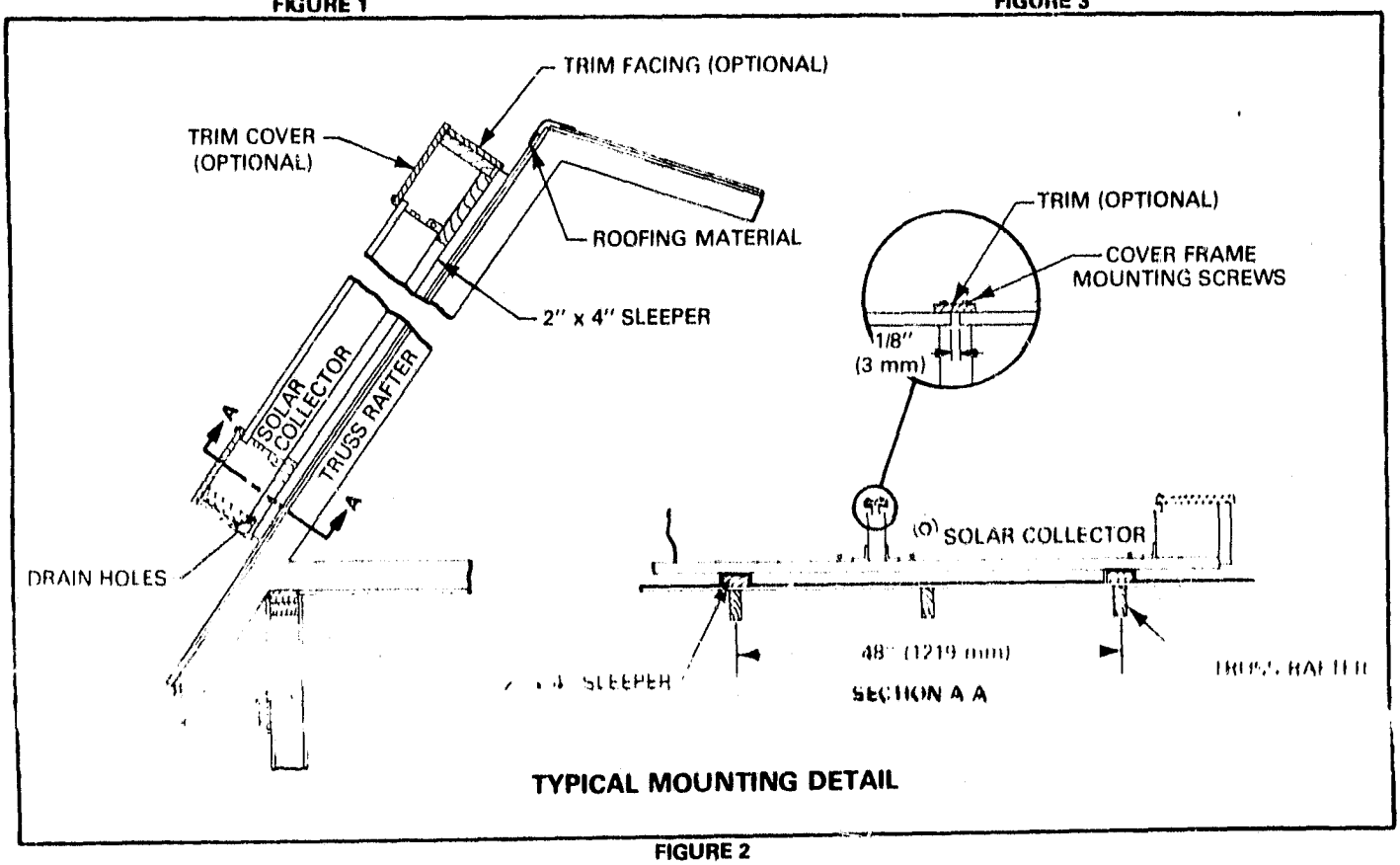
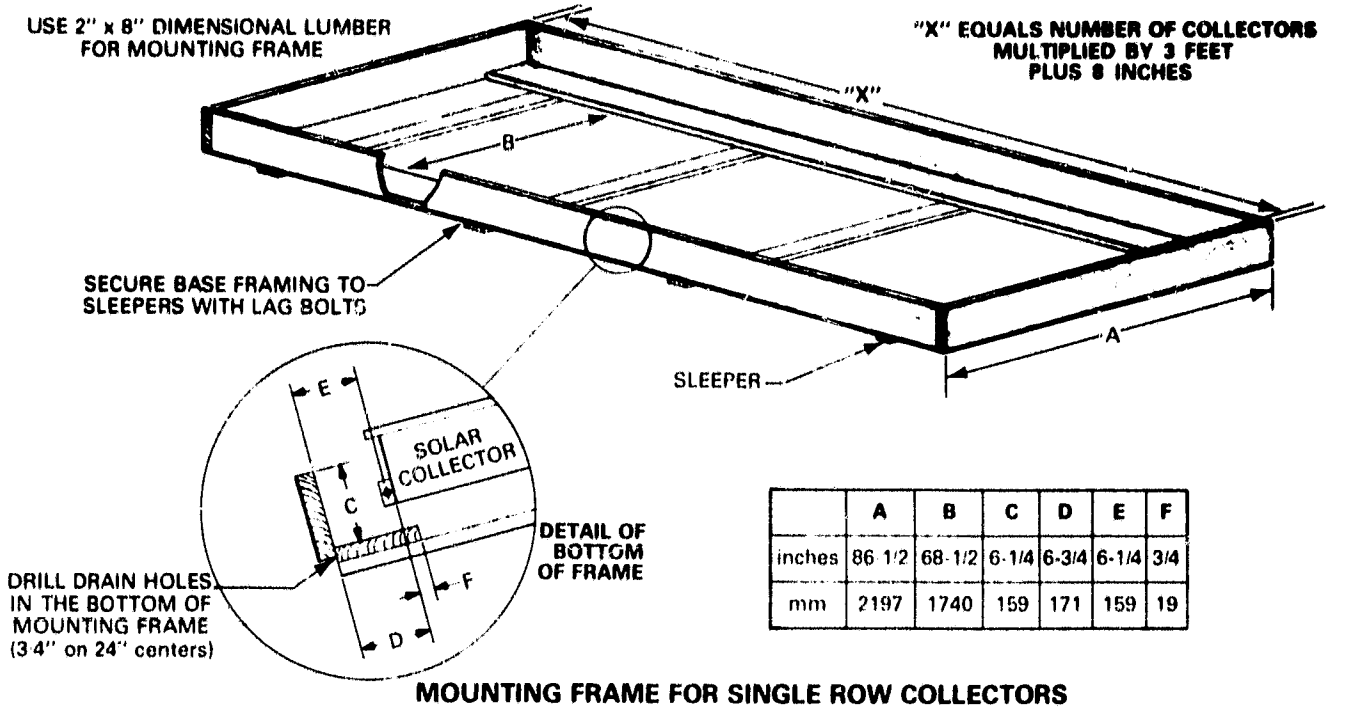


FIGURE 2

position. Figure 2 illustrates details for a typical mounting frame. Install the frame and solar collectors as follows:

1 - Center sleepers over trusses and secure to roof. Figure 3 shows the sleeper flashed into the roof.
   a - Length of sleepers required for a single row of collectors is 86-1/2 inches.
   b - Length of sleepers required for two rows of collectors is 162-5/8 inches.

2 - Figure 4 illustrates typical framing construction for one row of collectors. Figure 5 illustrates construction for two rows of collectors. 2" x 8" dimentional lumber is utilized.

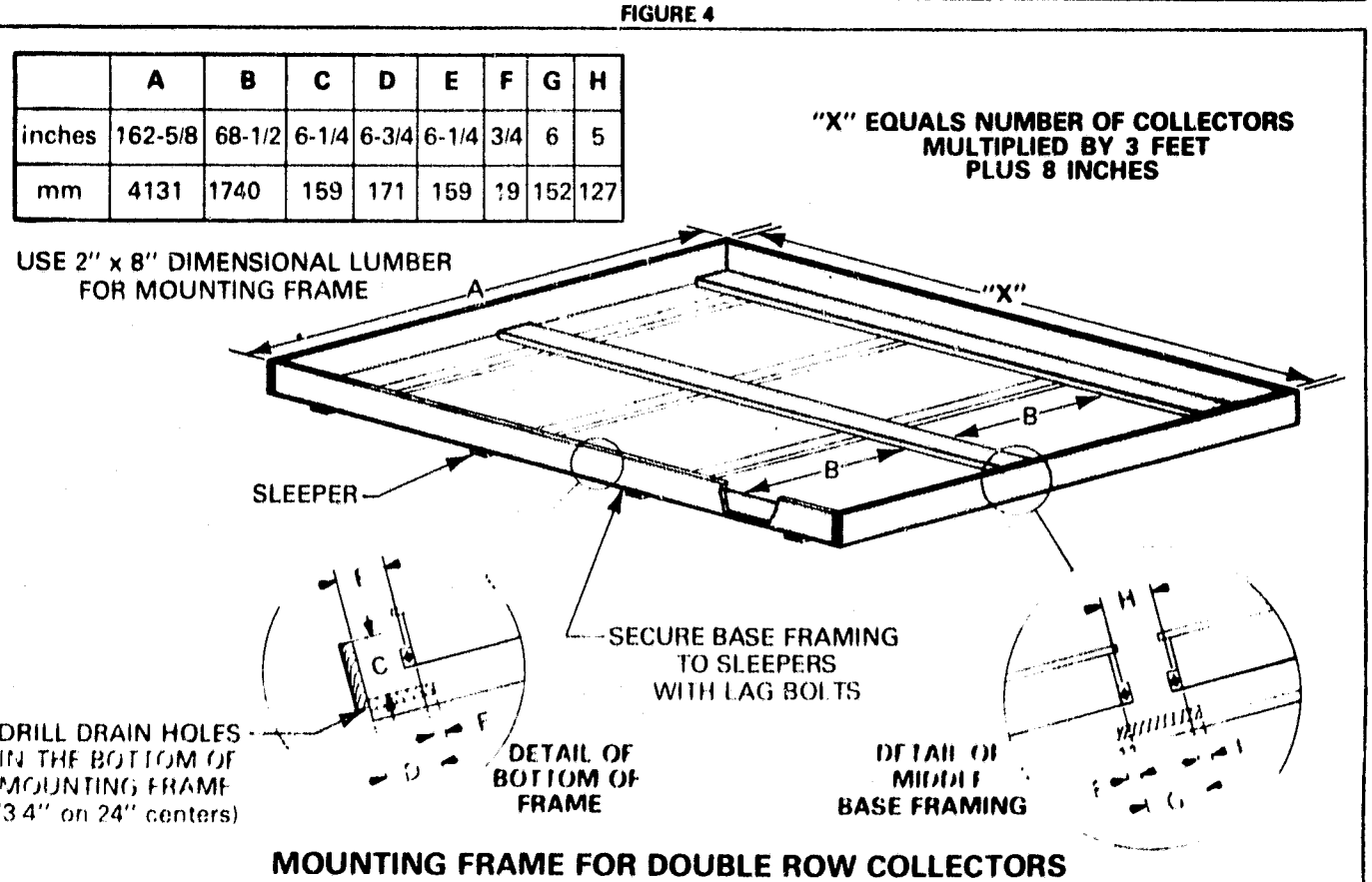


	A	B	C	D	E	F
inches	86 1/2	68-1/2	6-1/4	6-3/4	6-1/4	3/4
mm	2197	1740	159	171	159	19

MOUNTING FRAME FOR SINGLE ROW COLLECTORS

FIGURE 4

	A	B	C	D	E	F	G	H
inches	162-5/8	68-1/2	6-1/4	6-3/4	6-1/4	3/4	6	5
mm	4131	1740	159	171	159	19	152	127



MOUNTING FRAME FOR DOUBLE ROW COLLECTORS

FIGURE 5

3 - Position first collector 4-7/8 inches from end of frame and then maintain 1/8 inch between remainder of collectors. Refer to Figure 6. Secure collectors to frame with lag bolts (4 per collector). If desired the inside spacing could enclose the supply and return header runs where they penetrate through roof.

NOTE - Solar collectors can be piped individually as they are set or if working area permits, piped after all collectors are set.

4 - The temperature control system has a sensor which secures directly to one absorber plate. Remove the collector frame from desired collector and install the sensor in the center of absorber plate. Refer to manufacturer's installation instructions. Drill a hole through collector cabinet and route wiring to sensor.

5 - After the system has been leak tested and the insulation has been installed on outdoor piping, flash the frame and solar collectors as illustrated in Figure 7. This flashing prevents air flow around collectors minimizing convection losses. This trim can bolt directly to the collector frame.

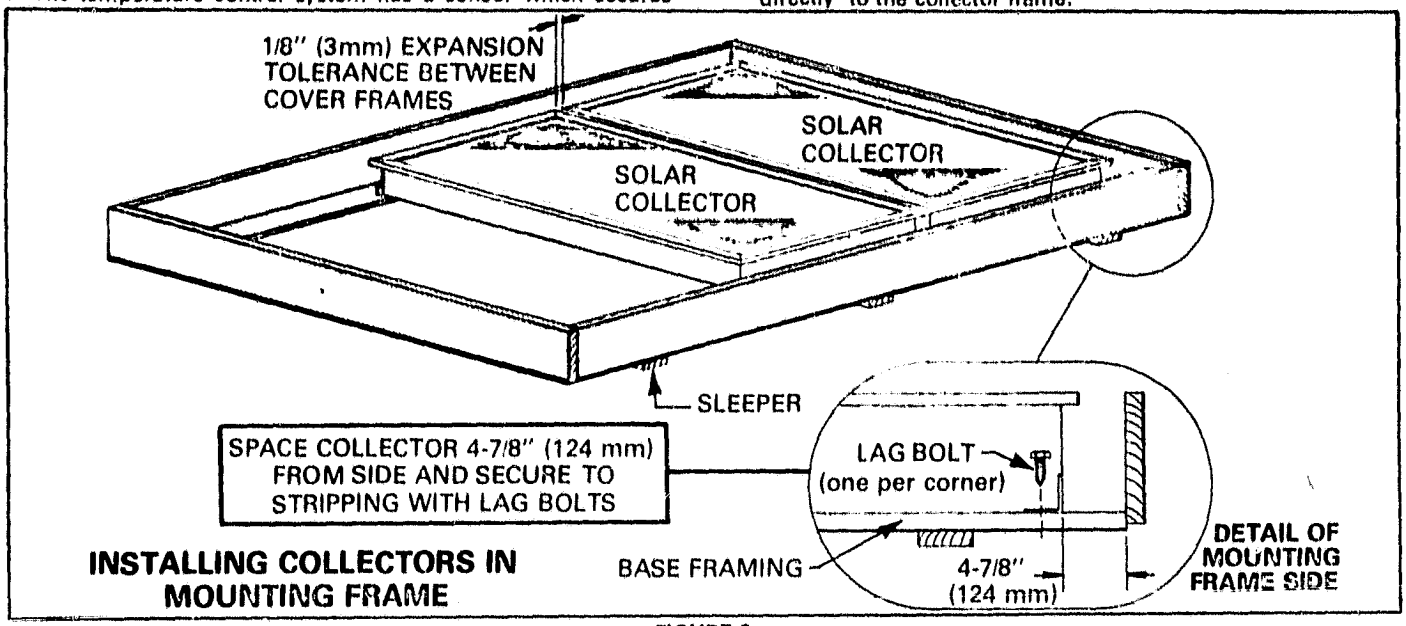


FIGURE 6

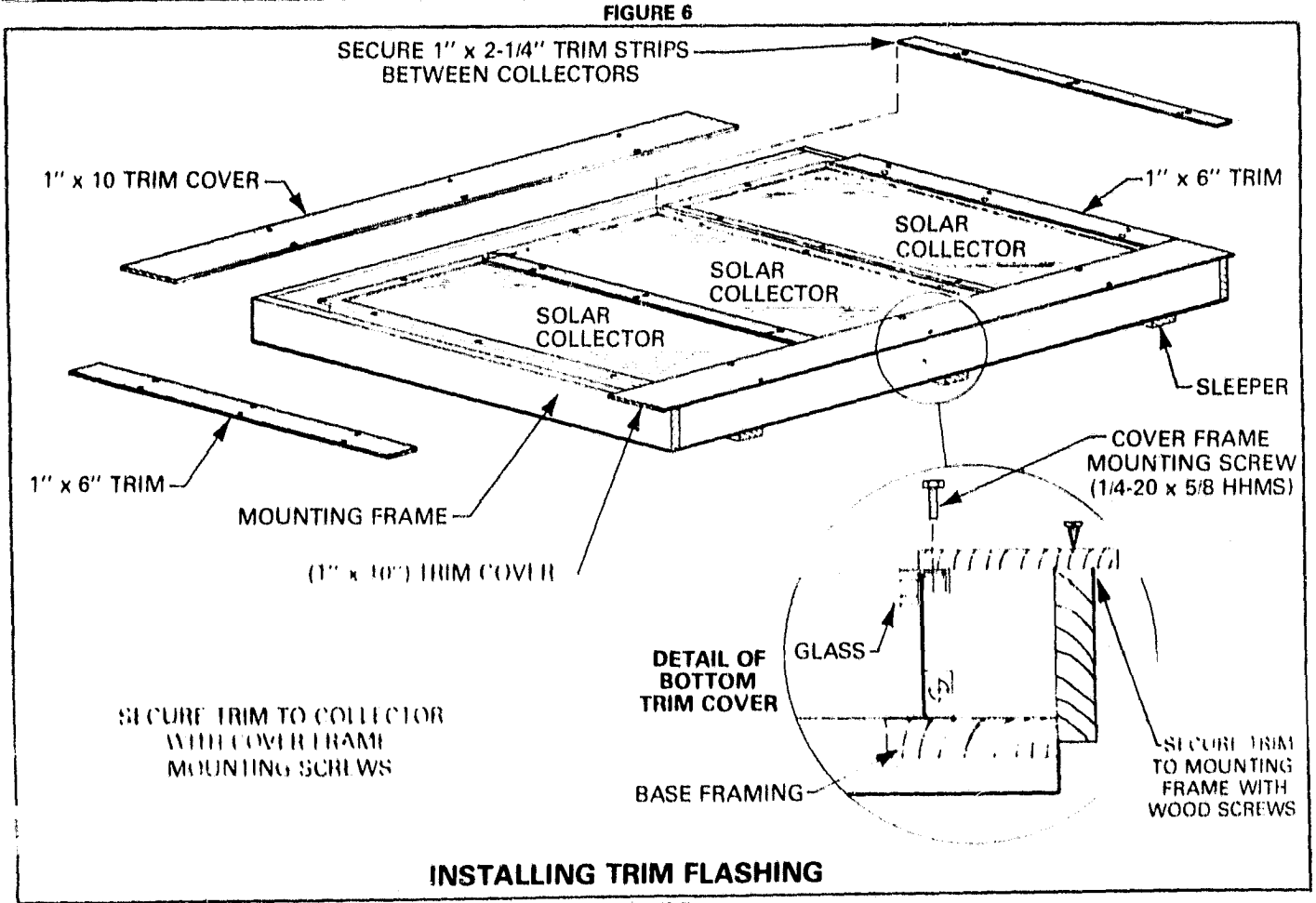


FIGURE 7

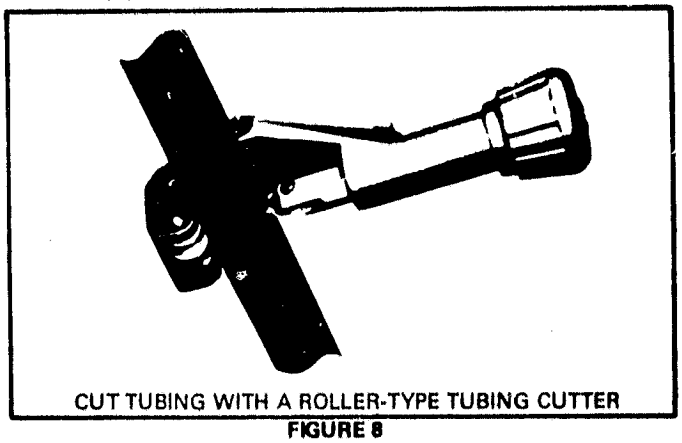
PIPING

VI - PIPING FOR SOLAR COLLECTORS

A - Basic Piping Fundamentals

1 - Flared Connections

a - Cut pipe to size with a roller type tubing cutter. See Figure 8.



CUT TUBING WITH A ROLLER-TYPE TUBING CUTTER

FIGURE 8

b - Remove any burrs with knife or reaming tool as shown in Figure 9.

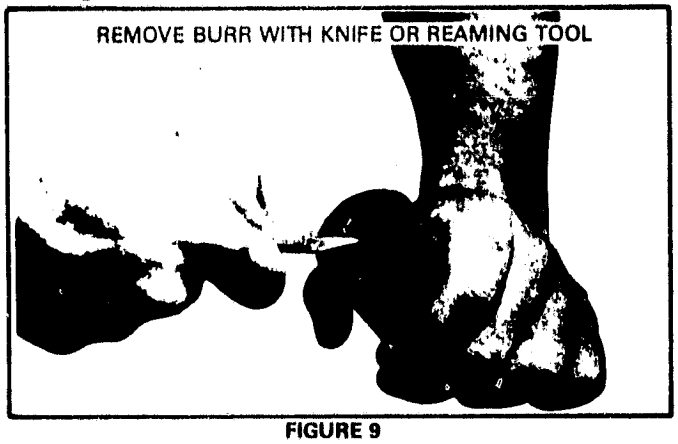
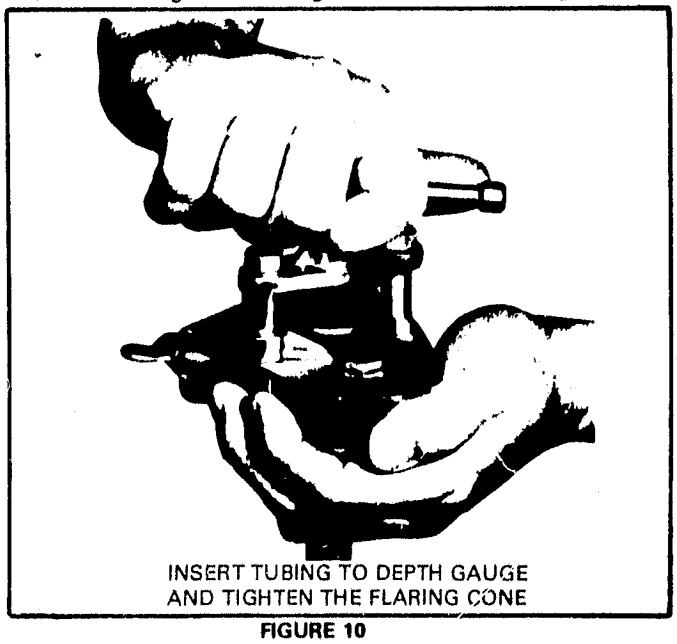


FIGURE 9

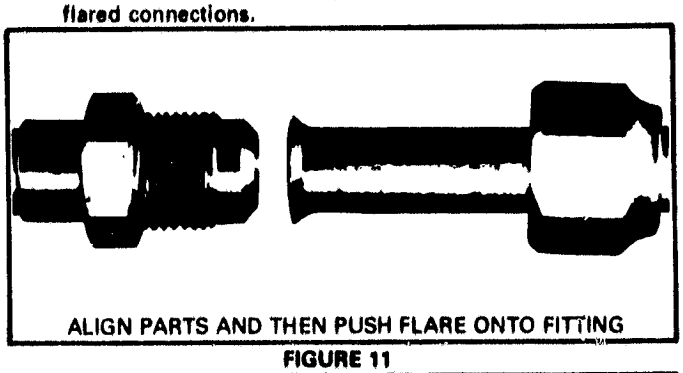
c - Flare tubing with a flaring tool as illustrated in Figure 10.



INSERT TUBING TO DEPTH GAUGE
AND TIGHTEN THE FLARING CONE

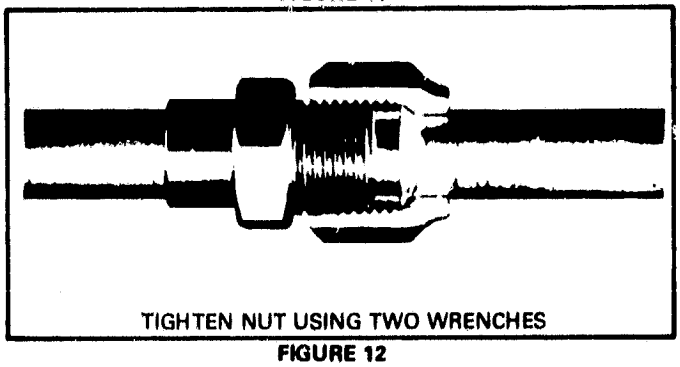
FIGURE 10

d - Align parts as shown in Figure 11 and tighten using two wrenches to prevent twisting lines. Figure 12 shows cutaway of flared connections.



ALIGN PARTS AND THEN PUSH FLARE ONTO FITTING

FIGURE 11



TIGHTEN NUT USING TWO WRENCHES

FIGURE 12

2 - Soldered Connections

a - Cut the pipe to size.

b - Remove burr.

c - Fit tubing into coupling maintaing a tight and proper clearance. See Figure 13.

d - Use *minimum* 95-5 rated solder.

e - Make joint using proper amount of heat to draw solder in joint.

f - Cool and clean the joint with wet cloth.

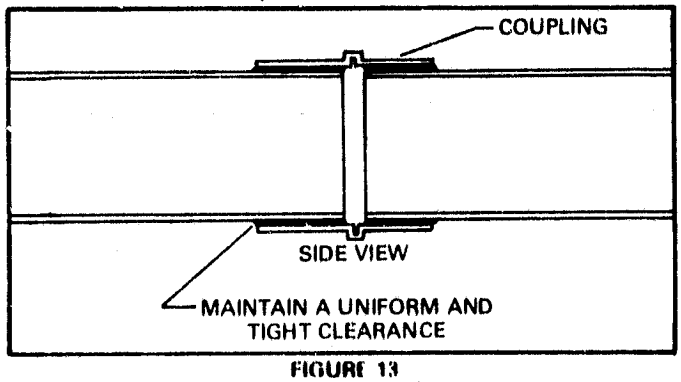


FIGURE 13

B - General Guidelines

1 - The solar collectors can be assembled in parallel, series or series-parallel combinations. Figure 14 illustrates various sequencing arrangements. **The supply header is always positioned at the bottom side of collectors while the return header is on the top.**

NOTE - For residential applications, no more than two collectors should be connected in series.

TABLE 1

APPLICATION	SIZE
Single family heating and heating/cooling	1-1/4" (38 mm)
Multi-family heating and heating/cooling	3" (76 mm)
Commercial heating and heating/cooling	4" (102 mm)

2 - Table 1 lists information for sizing headers.

3 - Avoid dissimilar metals. Where copper piping connects to different piping materials, dielectric insulating couplers should be used to prevent corrosion.

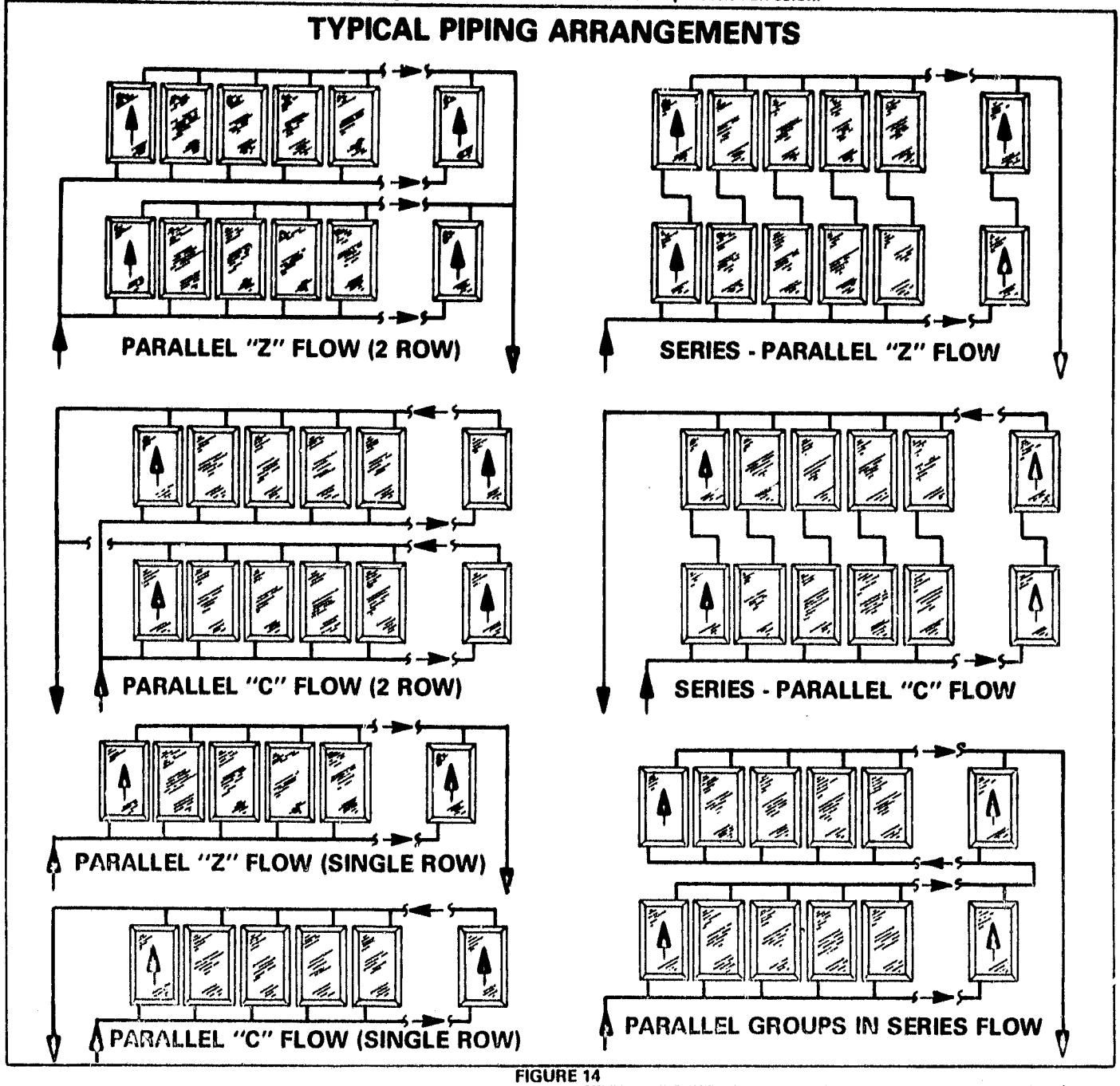


FIGURE 14

C. **Installation of Piping**

1. Remove the plug from each end of solar collector.
2. The collector either pipes to another collector or into a header. The 1/2 inch copper tubing must be field provided.
   a - Figure 15 illustrates two solar collectors piped in series. Install a flare male elbow at the bottom collector and a flare male straight connection at the top collector.
   b - A 1/2 inch sweat to 1/2 flare fitting must be soldered into each header at 36 inch intervals. Install a flare male elbow at the collector and connect piping as shown in Figure 16. In a two row parallel application, the return and supply headers can be piped according to Figure 17 to minimize collector spacing.
3. Route the supply and return headers into the interior of building and then flash completely to waterproof the opening.

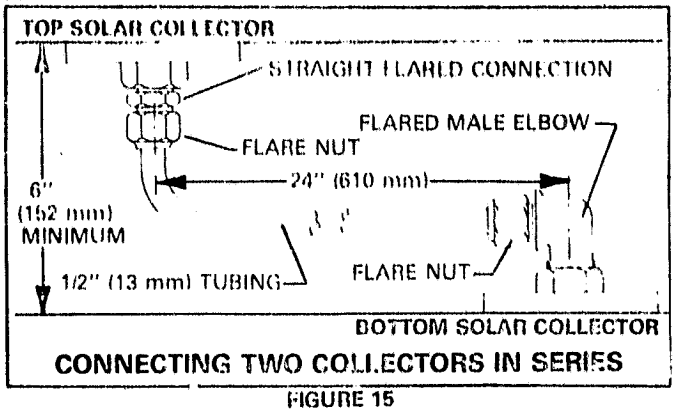


FIGURE 15

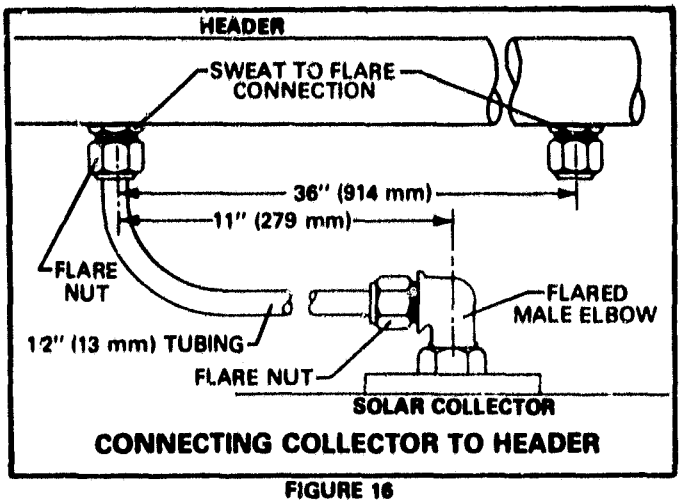


FIGURE 16

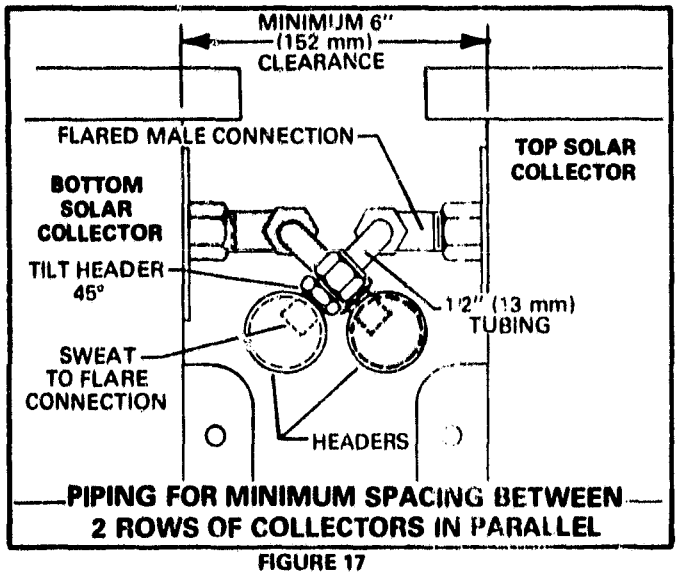


FIGURE 17

4 - An air bleed valve must be installed at each end of the return header for the top row of collector cells. Solder a sweat to flare fitting into the ends of return header. Connect a short length of 3/8 inch tubing to flared connection and then secure to a "B" valve with a nut and ferrule. Refer to Figure 18.

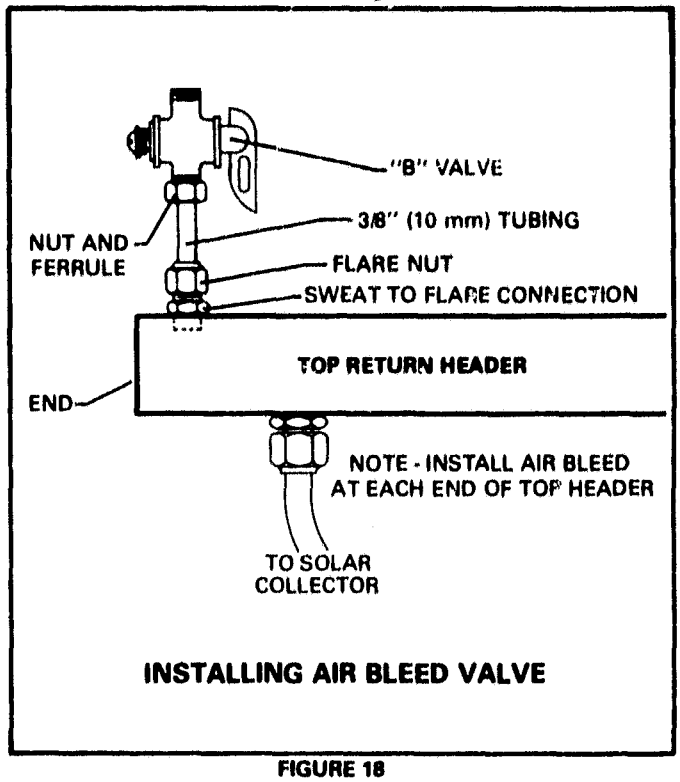


FIGURE 18

5 - Leak test the installation thoroughly and make any needed repairs. Insulate all outdoor piping with 3/4 inch thick foamed plastic insulation. Waterpoof outdoor pipe insulation with two coats of plastic finish reinforced with glass mesh. Install per manufacturer's recommendations.

MAINTENANCE

VII - MAINTENANCE

1 - If the glass cover becomes dirty, clean the glass using a soft clean cloth, mild soap or detergent and clean rinse water. Alkalies can stain the glass if allowed to remain in contact too long.

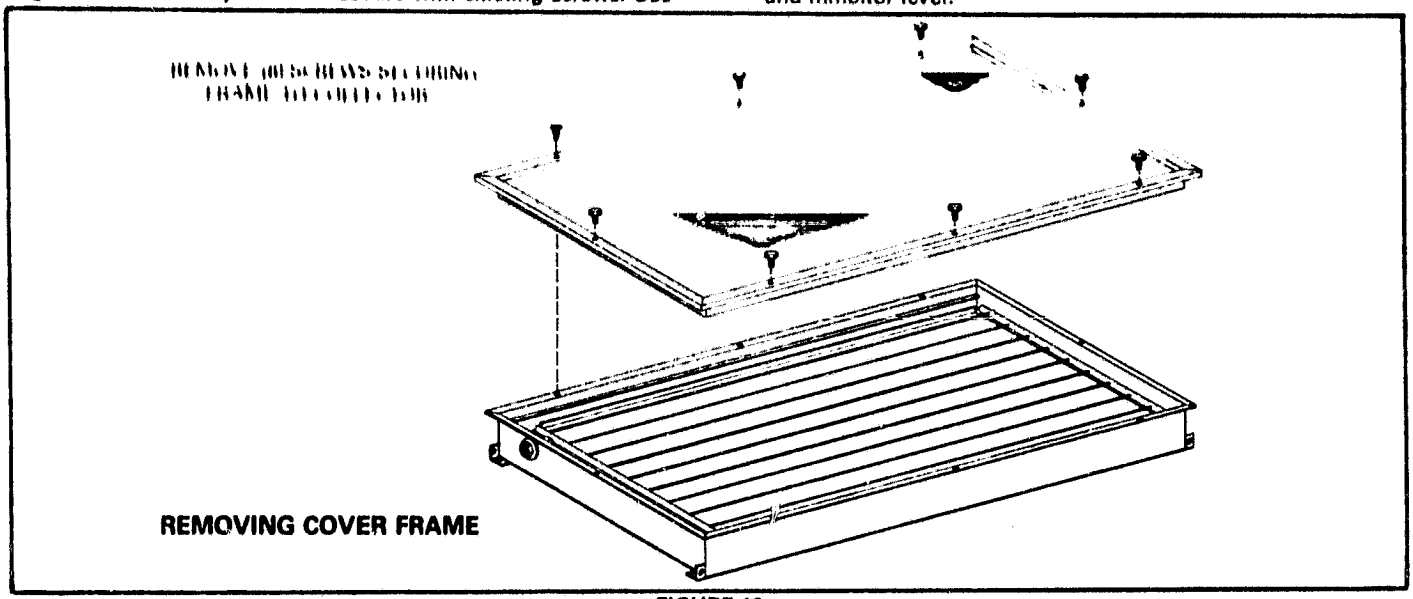
NOTE - The collector surface temperature can burn. Handle solar collector with caution.

2 - Use rubber gloves when handling solar collector to avoid finger prints on glass.

3 - To replace the glass, remove the collector as shown in Figure 19 and dismantle according to Figure 20. To re-assemble frame, insert the glass sheets and new gaskets into side pieces making sure the glass is centered and the ends are even. Next insert the glass into the end pieces and secure with existing screws. Use sealer compound on corner joints.

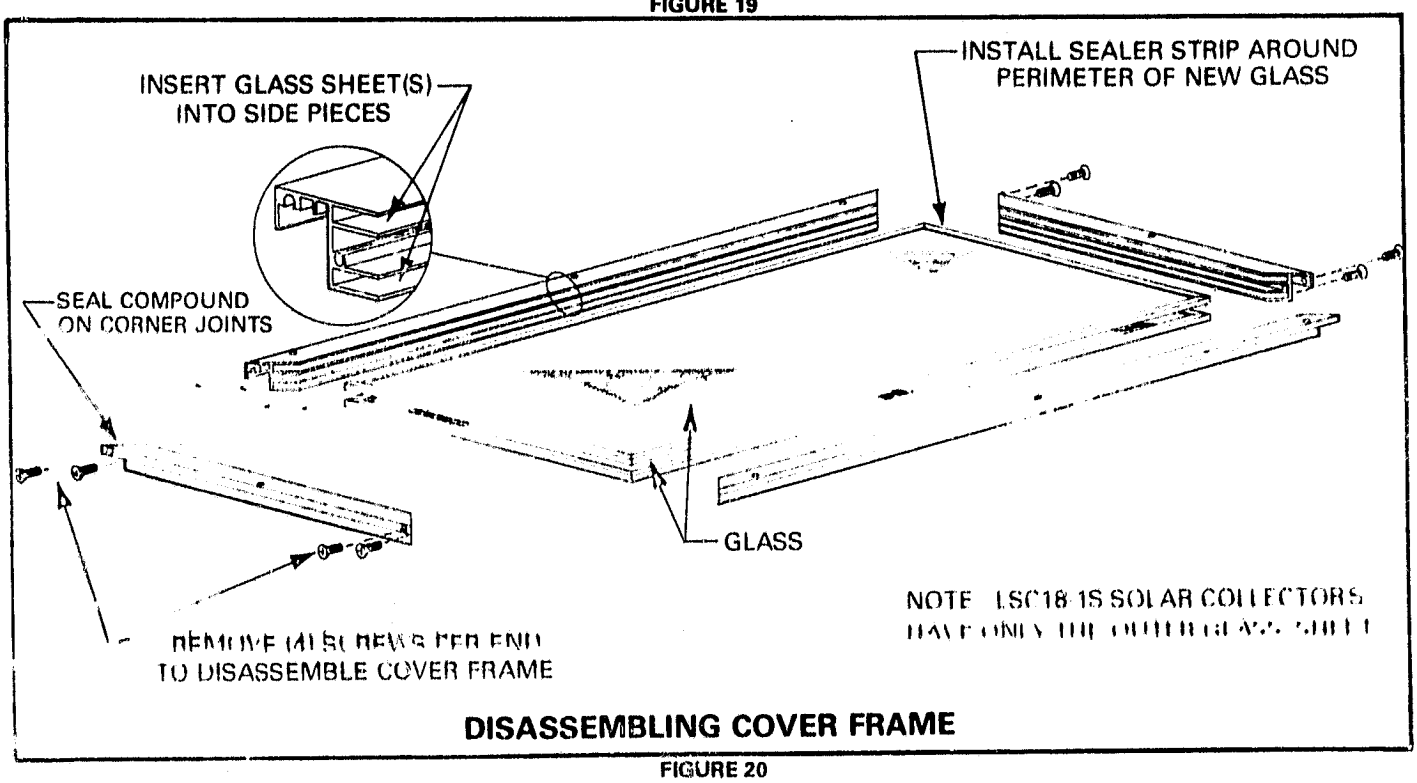
4 - To replace an absorber plate refer to following sequence and Figure 21.
- a - Drain collector.
- b - Remove collector frame.
- c - Remove plate seal and gasket on each end of collector.
- d - Disconnect flare fitting on each end of collector.
- e - Remove 6 screws securing absorber and left plate from cabinet. Avoid touching coating on plate.
- f - When re-assemblying absorber plate, tighten screws between 10 lbs and 15 lbs torque.

5 - The ethylene glycol/water mixture should be checked once a year by your Lennox service organization for proper freeze protection and inhibitor level.



REMOVING COVER FRAME

FIGURE 19



DISASSEMBLING COVER FRAME

FIGURE 20

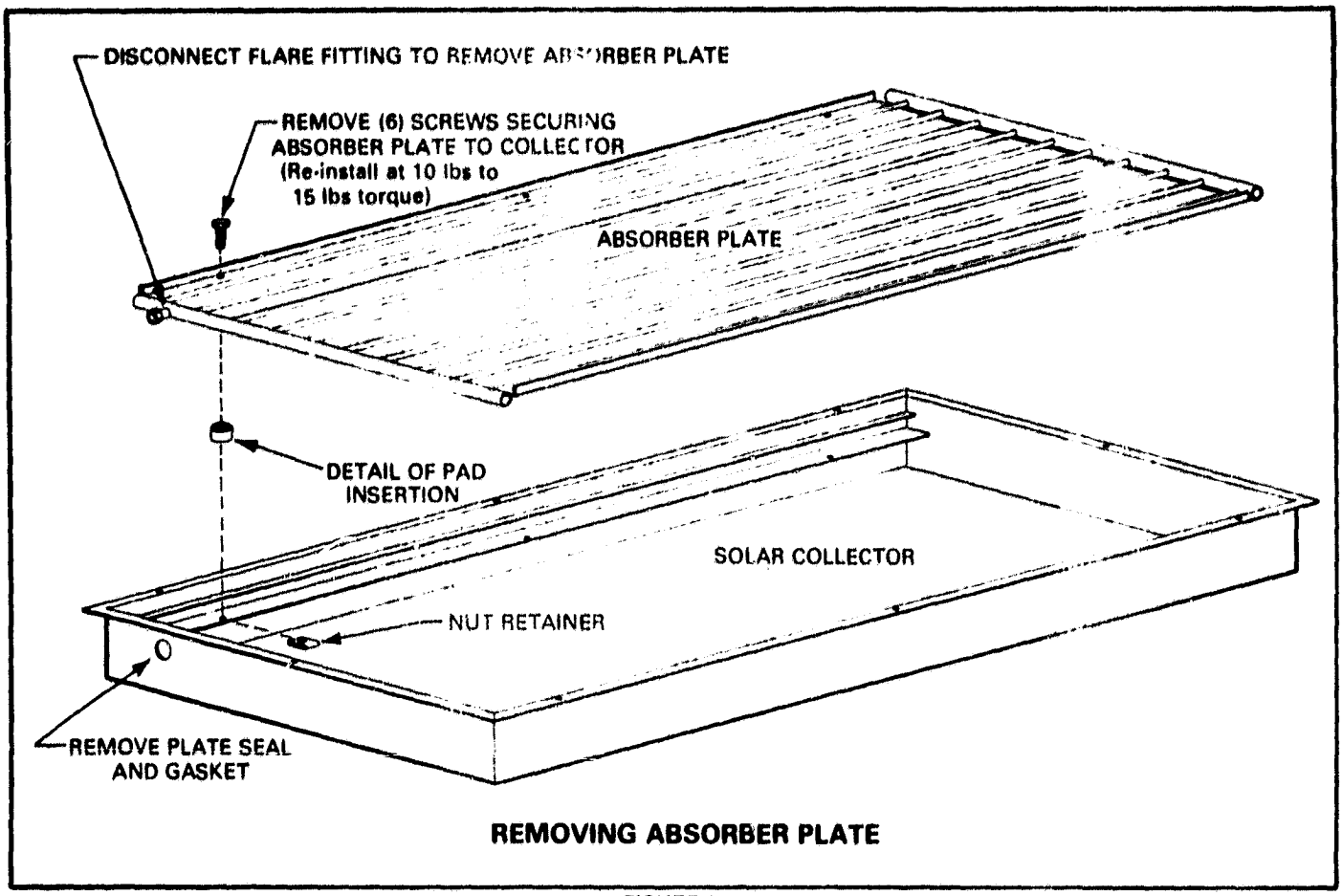

DISCONNECT FLARE FITTING TO REMOVE ABSORBER PLATE
REMOVE (6) SCREWS SECURING ABSORBER PLATE TO COLLECTOR (Re-install at 10 lbs to 15 lbs torque)
ABSORBER PLATE
DETAIL OF PAD INSERTION
SOLAR COLLECTOR
NUT RETAINER
REMOVE PLATE SEAL AND GASKET
REMOVING ABSORBER PLATE

FIGURE 21

PURGE UNIT HRW-1-30

The HRW-1-30 is an air to water heat exchanger. The finned tube coil and the blower are mounted in a cabinet designed for outdoor installation. The air is drawn in through the bottom and exhausted out the top of the unit. When connected to the collector outlet line, the purge unit will lower the fluid temperature. The unit is rated at 2000 CFM and should dissipate 100, 000 Btu's per hour.

Maintenance

At the beginning of each heating or cooling season the system should be cleaned as follows:

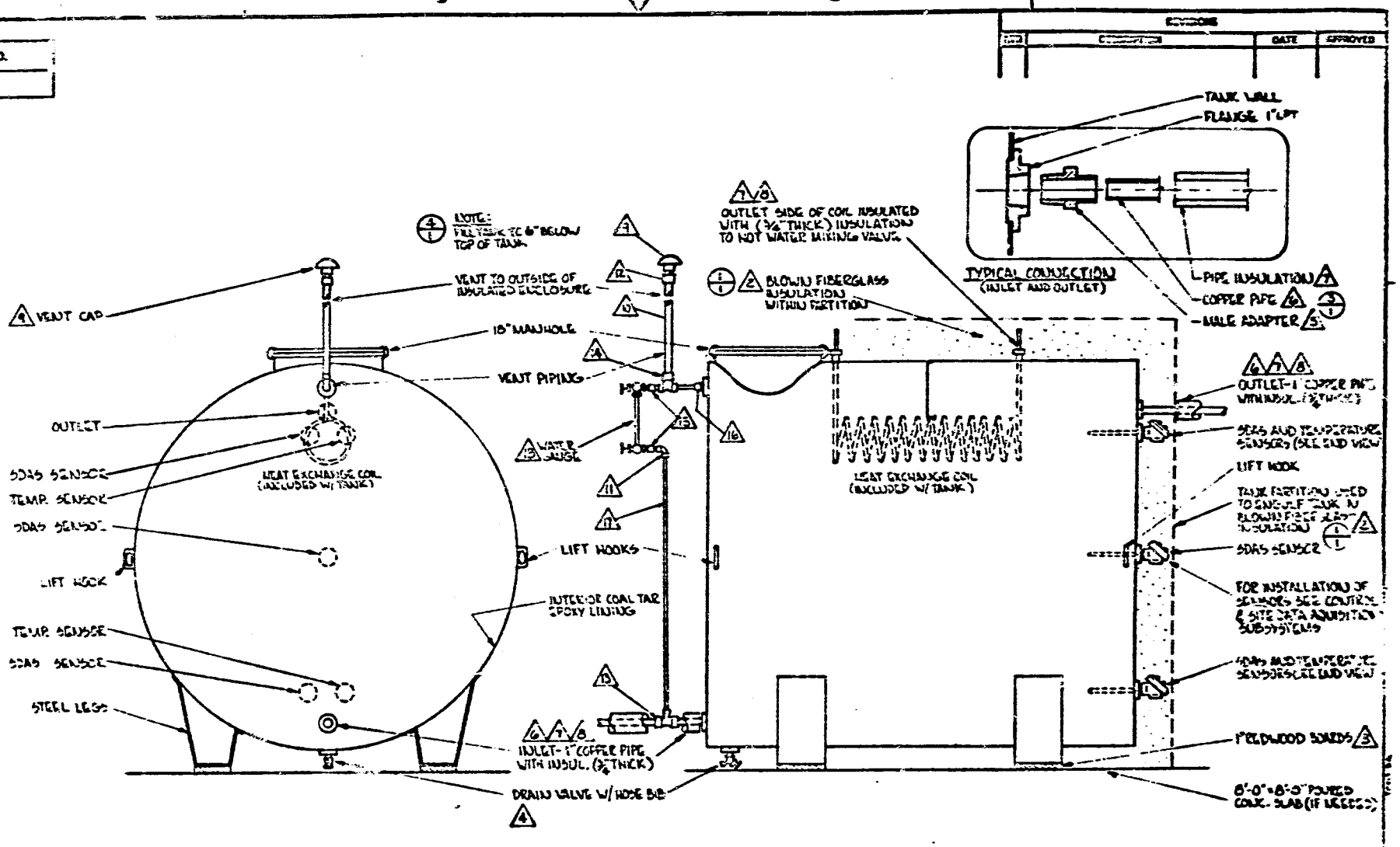
A. HRW-1-30 Unit

1. Clean and inspect both sides of coil. Coil may be flushed with water hose if necessary.
2. Oil outdoor fan motor: always relubricate motor according to manufacturers lubrication instructions on each motor. If no instructions are provided, use the following as a guide.
   a. Motors With Oiling Ports - Prelubricated for an extended period of operation. For extended bearing life, relubricate with a few drops of SAE No. 10 non-detergent oil once every two years.
   b. Motors Without Oiling Ports - Prelubricated and sealed. No further lubrication required.
3. Visually inspect all connecting lines, joints and coils for evidence of fluid leaks.
4. Check all wiring for loose connections.
5. Check for correct voltage at unit (unit operating).

APPENDIX B

STORAGE SUBSYSTEM

SK-142050 Storage Tank Installation Drawing
(sheet 2)

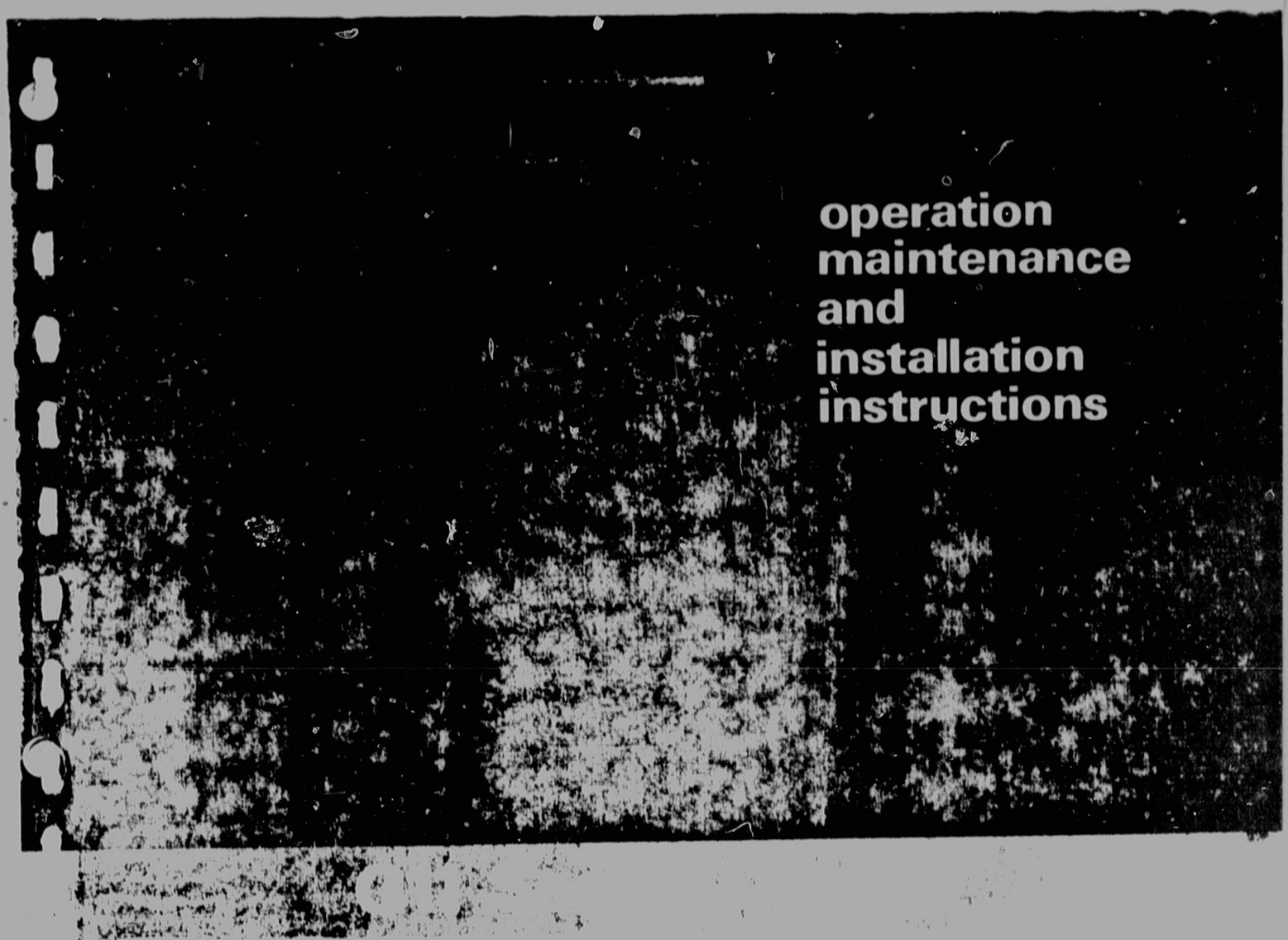

PART NO.
TANK WALL
FLANGE 1" LPT
TYPICAL CONNECTION (INLET AND OUTLET)
PIPE INSULATION
COPPER PIPE
MALE ADAPTER
NOTE: FILL TANK TO 6" BELOW TOP OF TANK.
OUTLET SIDE OF COIL INSULATED WITH (3/8" THICK) INSULATION TO HOT WATER MIXING VALVE
BLOWN FIBERGLASS INSULATION WITHIN PARTITION
VENT CAP
VENT TO OUTSIDE OF INSULATED ENCLOSURE
18" MANHOLE
VENT PIPING
OUTLET
SDAS SENSOR
TEMP. SENSOR
SDAS SENSOR
LIFT HOOK
TEMP. SENSOR
SDAS SENSOR
STEEL LEGS
HEAT EXCHANGE COIL (INCLUDED W/ TANK)
WATER GAUGE
LIFT HOOKS
INTERIOR COAL TAR EPOXY LINING
INLET- 1" COPPER PIPE WITH INSUL. (3/8" THICK)
DRAIN VALVE W/ HOSE BIB
HEAT EXCHANGE COIL (INCLUDED W/ TANK)
OUTLET- 1" COPPER PIPE WITH INSUL. (3/8" THICK)
SDAS AND TEMPERATURE SENSORS (SEE END VIEW
LIFT HOOK
TANK PARTITION LINED TO ENCLOSE TANK W/ BLOWN FIBERGLASS INSULATION
SDAS SENSOR
FOR INSTALLATION OF SENSORS SEE CONTROL & SITE DATA ACQUISITION SUBSYSTEMS
SDAS AND TEMPERATURE SENSORS (SEE END VIEW
PLYWOOD BOARDS
8'-0" x 8'-0" POURED CONC. SLAB (IF NEEDED)
STORAGE TANK
1" = 1'-0"
64" DIA. 72" LONG
1000 GALLONS
HONEYWELL
ENERGY RESOURCES CENTER
SINGLE FAMILY RESIDENCE
STORAGE SUBSYSTEM
WILLIAM O'BRIEN
DRAWING NO. SK-142250

B-1

APPENDIX C

AUXILIARY ENERGY AND SPACE HEATING SUBSYSTEM

G11	Series Furnaces
CW3-45	Series Coils



GAS UNITS

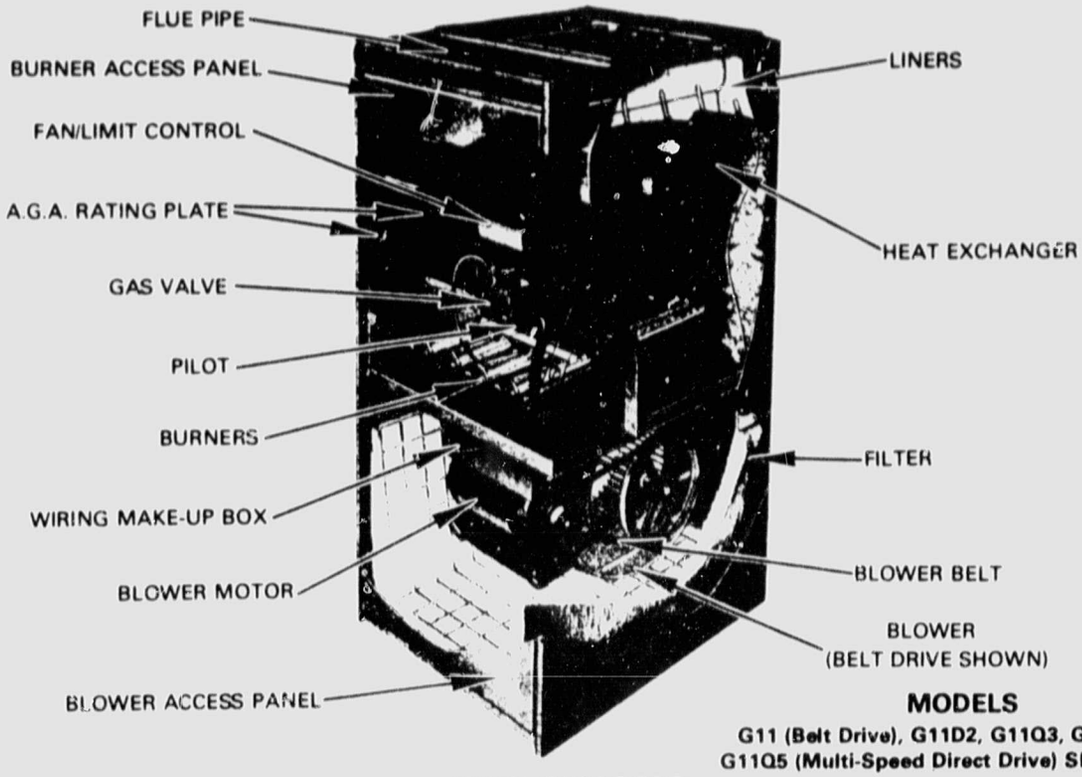
501,172M

12/76

Supersedes 4/76

LENNOX Industries Inc.

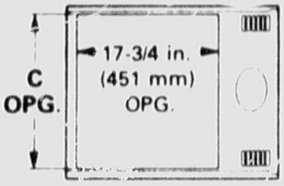
PARTS ARRANGEMENT



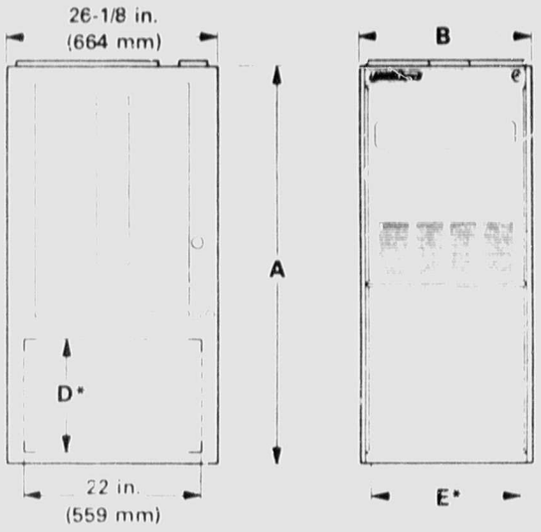
MODELS

G11 (Belt Drive), G11D2, G11Q3, G11Q4 AND G11Q5 (Multi-Speed Direct Drive) SERIES UNITS

DIMENSIONS



TOP VIEW



SIDE VIEW **FRONT VIEW**

DIMENSIONS

Model No.	A	B	C	D	E
G11-82	49 in. (1245 mm)	16-1/4 in. (413 mm)	14-1/8 in. (359 mm)	14 in. (356 mm)	11 in. (279 mm)
G11-110	49 in. (1245 mm)	21-1/4 in. (540 mm)	19-1/8 in. (486 mm)	14 in. (356 mm)	16 in. (406 mm)
G11 137	53 in. (1346 mm)	26-1/4 in. (667 mm)	24-1/8 in. (613 mm)	18 in. (457 mm)	21 in. (533 mm)
G11-165 G11-200	53 in. (1346 mm)	31-1/4 in. (794 mm)	29-1/8 in. (740 mm)	18 in. (457 mm)	26 in. (660 mm)

*OUTLINE OF RETURN AIR OPENING

TABLE OF CONTENTS

START-UP AND PERFORMANCE CHECK LIST

Job Name ______________________ Job No. ______________ Date ________

Job Location ______________ City ______________ State ________

Installer ______________ City ______________ State ________

Unit Model No. ______________ Serial No. ______________ Serviceman ________

HEATING SECTION

Electrical Connections Tight? ☐

Supply Voltage ________ Blower Motor Amps ________

Blower Motor H.P. ________

Blower Motor Lubrication O.K.? ☐

Gas Piping Connections Tight & Leak-Tested ☐

Fuel Type: Natural? ☐ Propane? ☐

Furnace BTU Input ________

[illegible]

Regulator Pressure (3.5 Factory Setting, Nat. Only) ________

Air Shutters Properly Adjusted (Propane Only)? ☐

Flue Connections Tight? ☐ Proper Draft? ☐

Fan Control Setting (90° Factory Setting) ________

Limit Control Cutout ________ Temperature Rise ________

Filters Clean & Secure? ☐

THERMOSTAT

[illegible]

START UP – OPERATION – ADJUSTMENTS – MAINTENANCE

I - START-UP AND OPERATION

CAUTION: Before proceeding with lighting instructions, make sure that the main gas valve and pilot valve at unit have been closed for at least five minutes and that room thermostat is at lowest setting.

A - To Light Unit

Refer to lighting instructions on A.G.A. rating plate.

B - Burner Operation

1 - After pilot is lighted, set thermostat at desired temperature.

2 - If during normal operation pilot goes out relight according to instructions on A.G.A. rating plate.

II - FAILURE TO OPERATE

If unit fails to operate check the following:

1 - Is thermostat calling for heat?

2 - Is main disconnect switch closed?

3 - Is there a blown fuse?

4 - Is filter dirty or plugged? Dirty or plugged filters will cause unit to go off on limit control.

5 - Is gas turned on at meter?

6 - Is pilot lit?

7 - Is manual main shut off valve open?

III - ADJUSTMENTS

A - Fan and Limit Control Settings

1 - *Limit Control* - Do not adjust from factory settings.

2 - *Fan Control* - Refer to Figure 1 to determine the type of control used on this unit and the correct setting.

B - Air Shutters (If Used)

The G11 is not factory equipped with air shutters. If air shutters are desired, the optional G11 Propane Changeover Kit must be ordered. Minor adjustments for flame lifting, burner noise, etc., may be necessary. Refer to Figure 2.

C - Proper Gas Flow

To check for proper gas flow to combustion chamber, determine btu input from the A.G.A. rating plate. Divide this input rating by the btu per cubic foot of available gas. Result is the number of cubic feet per hour required. Determine the flow of gas through gas meter for 2 minutes and multiply by 30 to get the hourly flow of gas to burner. [illegible]

[illegible] 11 w.c. propane

Regulator Pressure 3.5 w.c. natural (Tol. ± 0.3 w.c.)

[illegible] Adjustment

Adjust belt tension so that belt is as loose as possible without allowing slippage. See Figure 3.

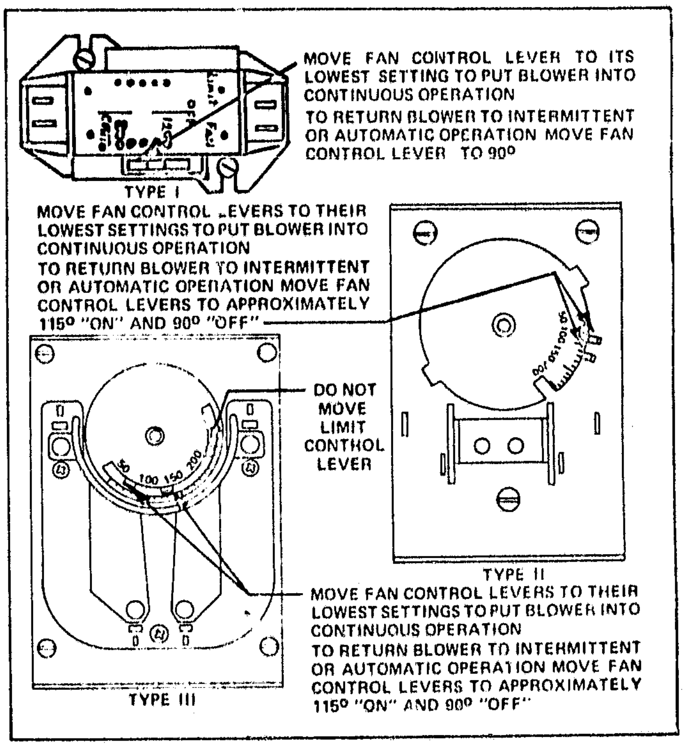


FIGURE 1

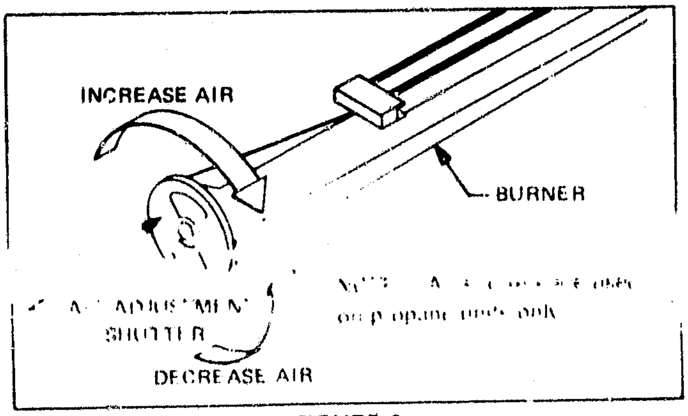


FIGURE 2

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F - Temperature Rise

Adjust blower speed for proper air temperature rise listed on A.G.A. rating plate. To measure this temperature rise, place plenum thermometers in warm air and return air plenums. See Figure 4. Locate thermometer in warm air plenum where thermometer will not "see" heat exchanger, thus picking up radiant heat. Turn up thermostat as high as possible to start unit. After plenum thermometers have reached their highest and steadiest readings, subtract the readings. The difference should be in the range listed on A.G.A. rating plate. If this temperature is low, decrease blower speed; if temperature is high, increase blower speed. Refer to the following for adjustment of belt or direct drive units.

1 - *Belt Drive (G11 units)* - Loosen nut on the blower motor housing and push motor up to relieve belt tension. See Figure 5. Remove belt as shown in Figure 6. Then loosen motor pulley with Allen wrench as illustrated in Figure 7 and open adjustable pulley to decrease blower speed or close to increase speed. Refer to Figure 8.

CAUTION - Be sure that Allen screw is lined up with flat side of motor shaft before retightening. Adjust belt tension as outlined in "E - Belt Adjustment."

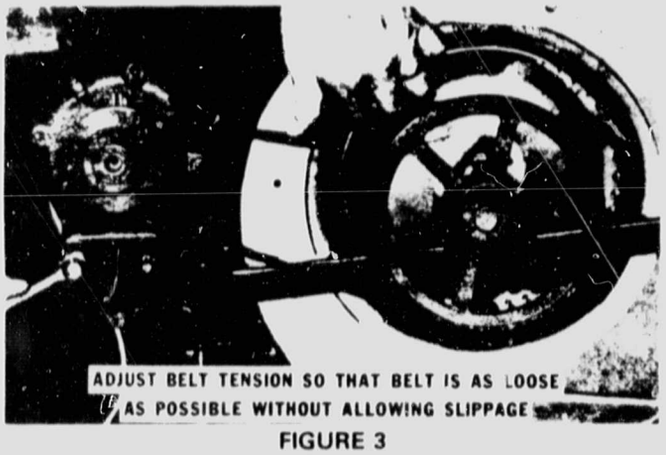
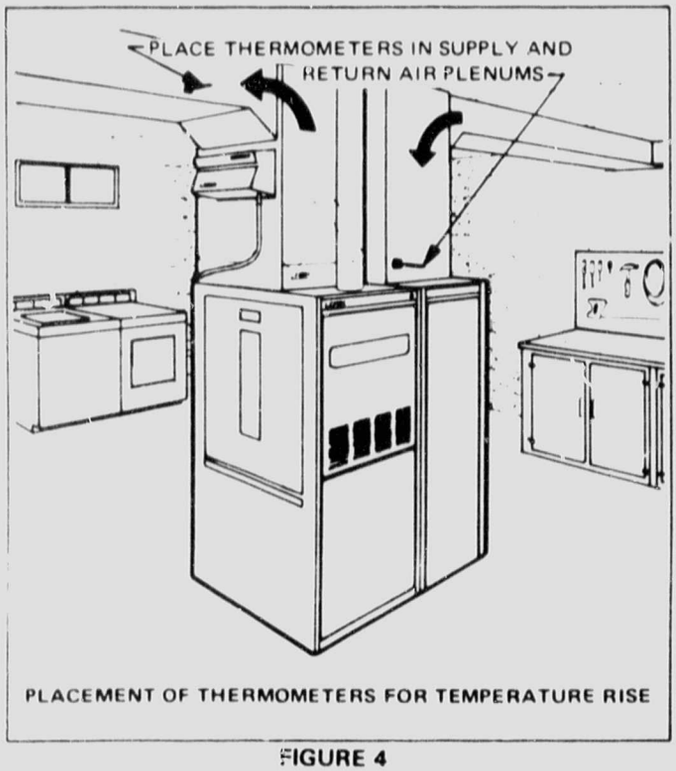


FIGURE 3



PLACEMENT OF THERMOMETERS FOR TEMPERATURE RISE

FIGURE 4

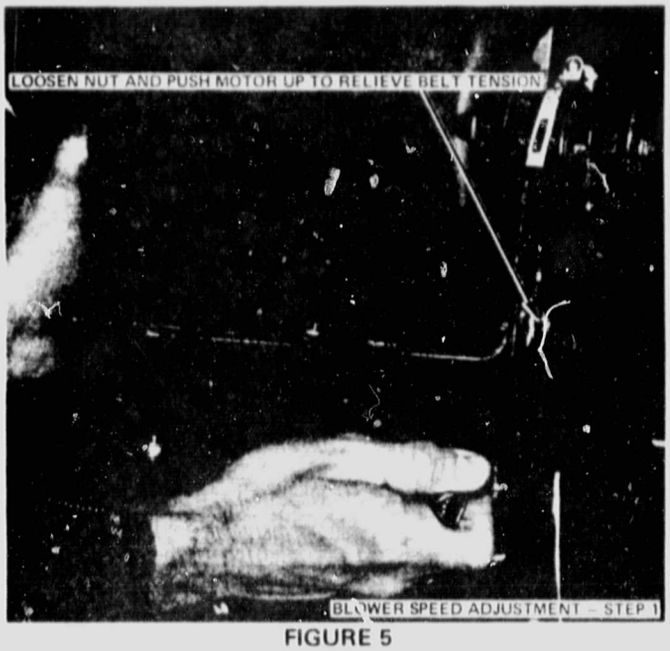


FIGURE 5

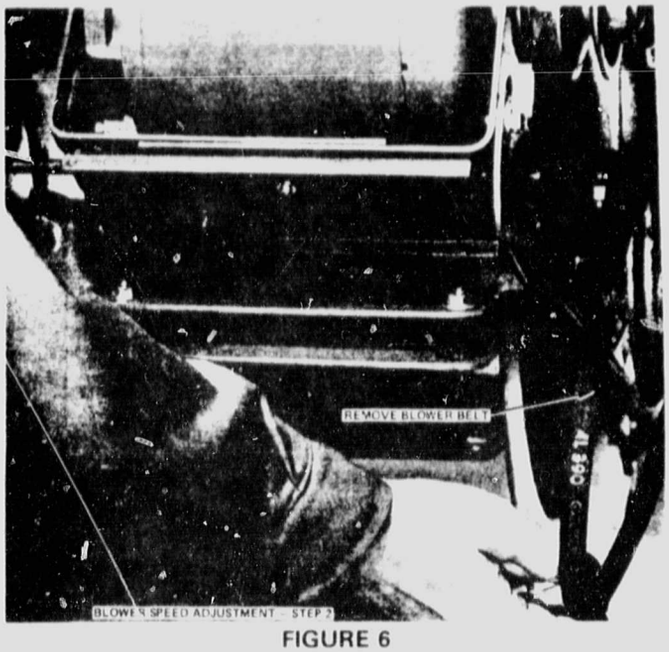


FIGURE 6

2 - *Multi-Speed Direct Drive (G11D2, G11Q3, G11Q4 and G11Q5 units)* - Wire motor to higher or lower speed according to unit wiring diagram.

Repeat either of these procedures until desired setting in this range is obtained.

IV - ANNUAL MAINTENANCE

At the beginning of each heating season, the system should be checked as follows.

A - Blower

1 - Check and clean blower wheel.

2 - Lubricate blower motor.

Always relubricate motor according to the manufacturer's lubrication instructions on each motor. If no instructions are provided, use the following as a guide.

a - *Motors Without Oiling Ports* - Prelubricated and sealed. No further lubrication required.

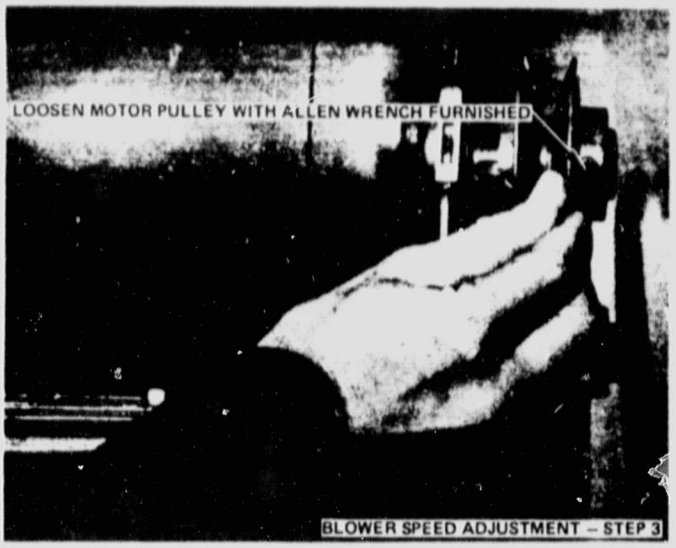


FIGURE 7

FIGURE 8

b - *Belt Drive Motors With Oiling Ports* - Add a few drops of SAE No. 10 non-detergent oil yearly. Refer to Figure 9.

c - *Direct Drive Motors With Oiling Ports* - Prelubricated for an extended period of operation. For extended bearing life, relubricate with a few drops of SAE No. 10 non-detergent oil once every two years. It may be necessary to remove blower assembly for access to oiling ports.

3 - Lubricate Blower Bearings (Belt Drive Models)

a - *Bearings With No Fittings* - These bearings are prelubricated and sealed. No further lubrication required.

b - *Bearings With Grease Cups* - Grease cups are packed with lubricant. Turn grease cups down about one turn yearly to relubricate bearings. Use only special lubricant for refilling grease cups, such as Gulf E or Lennox P-8-2638 (available through Lennox dealers).

4 - Belt Drive Blowers - Check belt for wear and proper tensions.

5 - If blower speed has been altered during the cooling season, the unit should be adjusted for the proper air temperature rise at the beginning of the heating season. Refer to "Temperature Rise" section in this manual.

B - Filter

1 - Replace media in hammock type filter with 1 inch thick fiberglass of the same size. Refer to Figure 10.

C - Fan And Limit Control

Check fan and limit controls for proper operation and settings. For settings, refer to the "Fan and Limit" section in this manual.

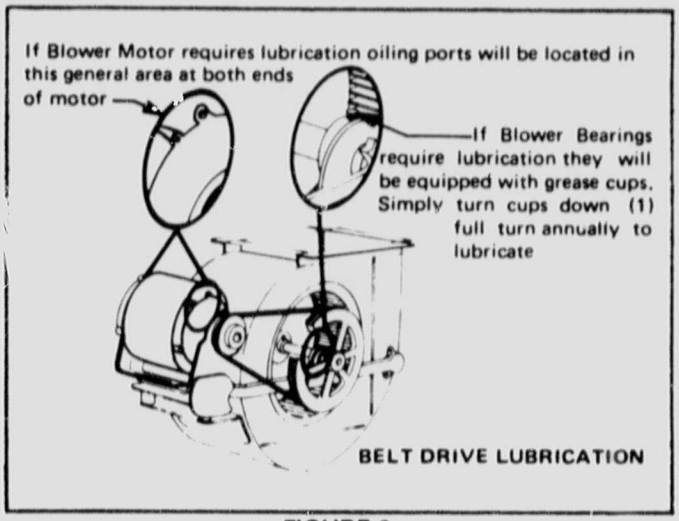


FIGURE 9

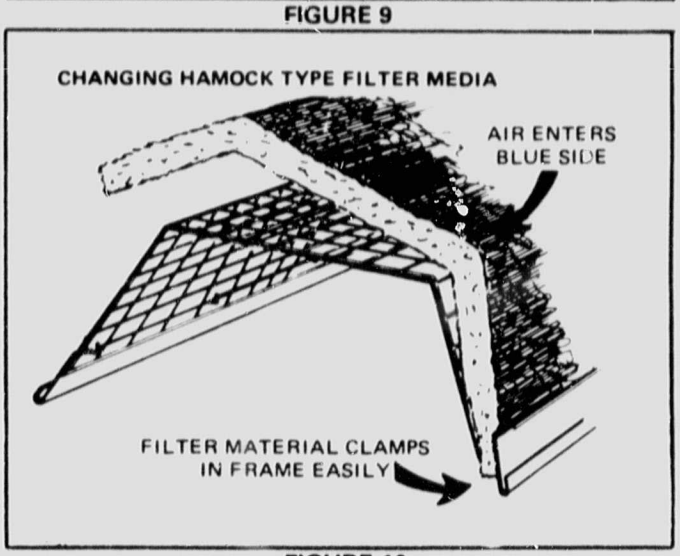


FIGURE 10

D - Burner

1 - Check gas pressure (both inlet and manifold).
2 - Inspect burners and clean, if necessary.
3 - Check gas valve for proper operation.
4 - Adjust pilot and main burner flame.

E - Electrical

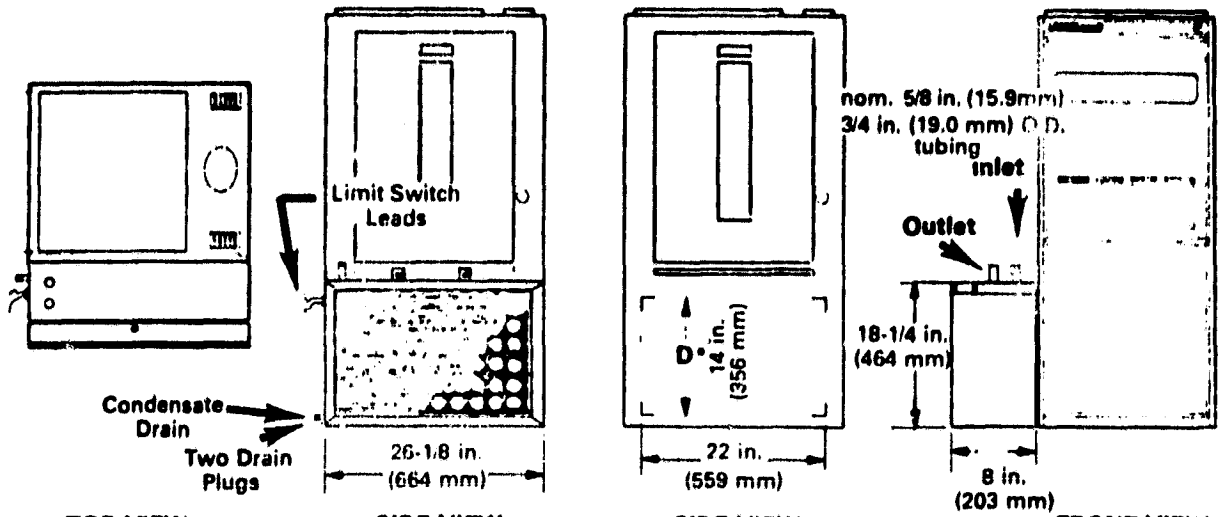
1 - Check all wiring for loose connections.
2 - Check for correct voltage at unit (unit operating).
3 - Check amp-draw on blower motor.
Motor Nameplate _____ Actual _____

F - Flue And Chimney

1 - Check flue pipe, chimney and all connections for tightness and to make sure there is no blockage.
2 - Check unit for proper draft.

NOTE: See page III-8 for additional information.

DIMENSIONS
(G11/G12 Cabinet shown with CW3-45 Coil)



*OUTLINE OF RETURN AIR OPENING

OPERATION/MAINTENANCE

I. OPERATION

A. Water Coil and Auxiliary Energy Subsystem

The CW3-45 coil can be used as either a heating or cooling coil depending on application. In a heating application, solar heated water in the coil serves as the first stage heat source. When the room thermostat demands heat, solar heated water is circulated through the CW3-45 and the blower circulates air. If solar water heat is sufficient the thermostat requirement will be met. If sufficient heat is not available from the coil the thermostat will activate the second stage heat source, the auxiliary gas heat, to meet the heating demand.

The CW3-45 coil is usable alternatively with a chiller system to provide space cooling. Chilled water circulated through the coil cools the system air being drawn through the coil by the blower.

B. High Limit Switch

A high limit switch, located on the downstream side of the coil provides overheating protection for the subsystem blower motor. If the temperature of air discharged form the coil reaches 140°F (60°C) the switch stops the water flow through the coil. No additional heat will be available from the coil and the blower motor will not be subjected to excessive air temperature.

C. Condensate Drain

The condensate run-off drain (3/4 npt) needs to be connected only if the CW3-45 is used for cooling purposes. A condensate line should be run from the stub at CW3-45 coil to an open drain. (Never connect the condensate drain line directly to a waste line.)

D. Drain Plugs

Two drain plugs are provided on the side of the CW3-45 coil for draining of the coil. One plug connects to the inlet water line and the other — the outlet water line.

II. ADJUSTMENTS

A. Air Flow Capacities

Refer to Tables 1 and 2 for flow capacities relating external static pressure and blower air volumes for specific applications.

B. Fluid Pressure Drop

Table 3 is four related tables which provide information to adjust actual pressure drops involved based on temperature and % glycol solution.

C. Heating and Cooling Capacity

Figure 1 provides performance standards which can be traced from supply fluid temperature to air volume to cooling capacity for cooling determination. Figure 2, for heating monitoring, shows resultant Btuh heating capacity based on water flow rate, inlet water temperature, entering air temperature and blower air volume.

Table 1

BLOWER PERFORMANCE
G12Q4-110V FURNACE, CW3-45
COIL AND SLAB FILTER

External Static Pressure (In. H²O)	Air Volume @ Various Speeds					
	High		Medium		Low	
	CFM	M³/SEC	CFM	M³/SEC	CFM	M³/SEC
0.00	1446	.682	1276	.602	1089	.514
0.05	1424	.672	1261	.595	1081	.510
0.10	1396	.659	1243	.587	1070	.505
0.15	1367	.645	1222	.577	1056	.498
0.20	1337	.631	1200	.566	1040	.491
0.25	1305	.616	1175	.554	1022	.482
0.30	1271	.600	1150	.543	1002	.473
0.40	1201	.567	1095	.517	958	.452
0.50	1130	.533	1033	.487	905	.427
0.60	1055	.498	965	.455	846	.399

Table 2

BLOWER PERFORMANCE
G11Q3-82V FURNACE, CW3-45
COIL AND SLAB FILTER

External Static Pressure (In. H²O)	Air Volume (CFM) @ Various Speeds							
	High		Medium High		Medium Low		Low	
	CFM	M³/SEC	CFM	M³/SEC	CFM	M³/SEC	CFM	M³/SEC
0.00	1291	.609	1185	.559	995	.470	838	.395
0.05	1270	.599	1166	.550	977	.461	830	392
0.10	1248	.588	1144	.540	960	.453	819	.386
0.15	1219	.575	1121	.529	940	.444	807	.381
0.20	1190	.562	1096	.517	920	.434	794	.375
0.25	1160	.547	1070	.505	898	.424	780	.368
0.30	1128	.532	1043	.492	875	.413	763	.360
0.40	1060	.500	984	.464	827	.390	721	340
0.50	985	.465	915	.432	770	.363	666	.314
0.60	905	427	835	.394	705	.333	597	.282
0.70	825	.389	750	.354	640	.302	523	.247
0.80	740	.349	668	.315	573	.270	440	.208

Table 3

Table A: Temperature Correction Factor to be Multiplied with Fluid Pressure Drop at 100°F (38.7°C)

Fluid: Water

Temp. °F	Temp. C	Correction Factor
100	37.8	1.000
120	48.9	0.966
140	60.0	0.931
160	71.1	0.897
180	82.2	0.862
200	93.3	0.862

Table B: Calculated Pressure Drop Across the Residential Solar Coil (20" x 15") (508 mm x 381 mm)

Water Temp. = 100°F (38.7°C)

GPM	L/SEC	Head Loss FT. / H²O	Head Loss mm - H²O
5.0	315	3.41	1039
7.5	473	6.00	1829
10.0	631	10.27	313.0
15.0	946	21.27	6483

Table C: Correction Factor to be Multiplied With the Water Pressure Drop at 100 F (38.7 C) to get Pressure Drop for Ethylene Glycol Solution (25% by Weight)

Temp. °F	Temp. C	Correction Factor
40	4.4	1.352
50	10.0	1.296
60	15.6	1.259
70	21.1	1.204
80	26.7	1.167
90	32.2	1.148
100	37.8	1.111
120	48.9	1.067
140	60.0	1.037
160	71.1	1.000
180	82.2	0.981
200	93.3	0.967

Table D: Correction Factors to be Multiplied With the Water Pressure Drop at 100 F (38.7 C) to get Pressure Drop for Ethylene Glycol Solution (50% by weight)

Temp. F	Temp. C	Correction Factor
40	4.4	2.019
50	10.0	1.926
60	15.6	1.828
80	26.7	1.621
100	37.8	1.414
120	48.9	1.310
140	60.0	1.207
160	71.1	1.138
180	82.2	1.069
200	93.3	1.034

III. MAINTENANCE

A. CW3-45 Unit

1. The CW3-45 slab filter, 18" x 25"x 1" (457 x 635 x 25 mm), is a disposable type which should be replaced semi-annually or more frequently if circumstances require. Remove screw from top of filter bracket and lift filter assembly from cabinet. New filter installs with fibrous side away from auxiliary furnace unit.
2. Inspect unit for evidence of coil leaks.
3. Inspect condensate drain to insure free flow. (If used.)
4. Inspect coil. The coil must be clean and free of any obstructions.

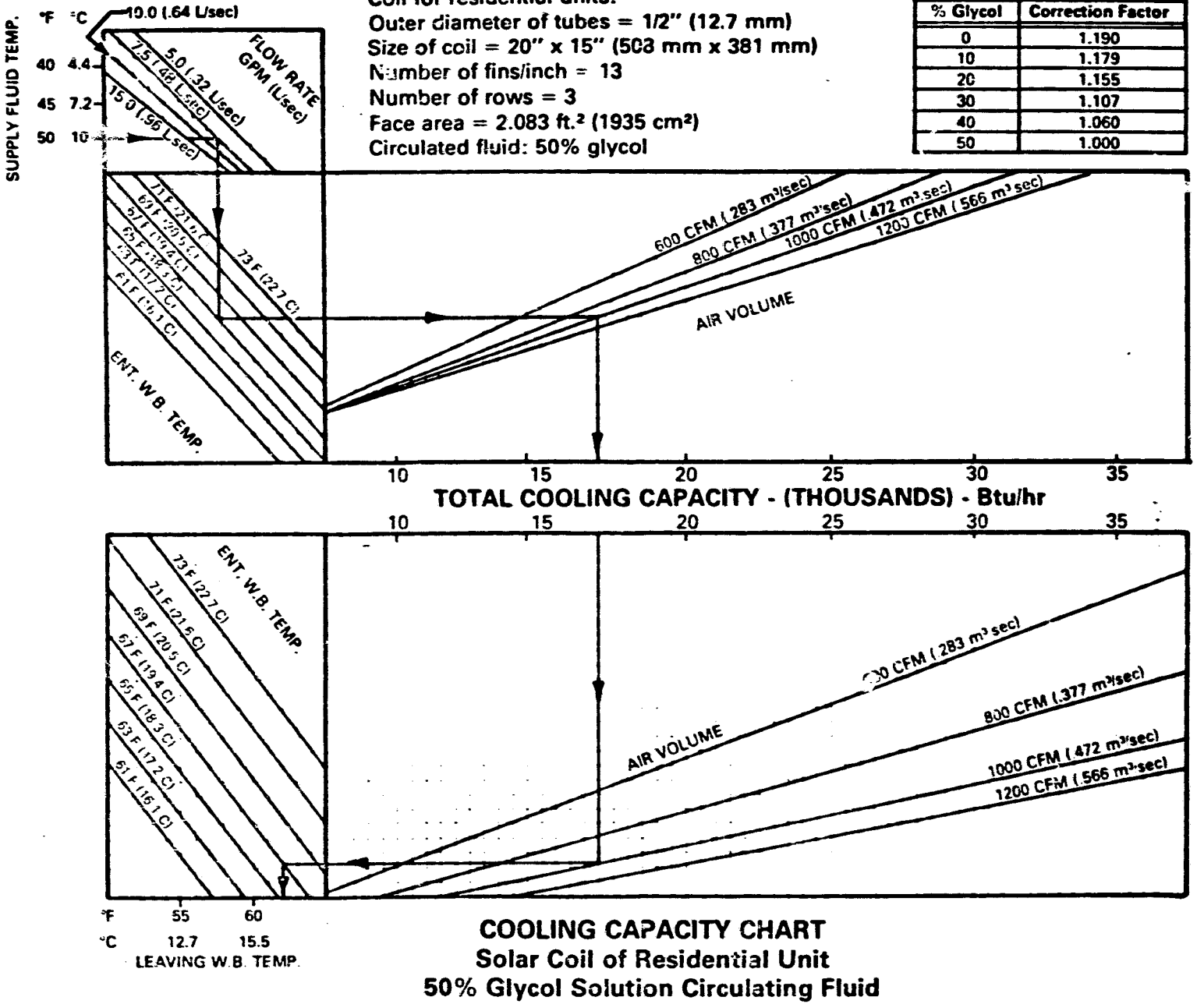
B. Auxiliary Energy Unit

Refer to the Operation and Maintenance book accompanying the auxiliary energy unit for its proper maintenance requirements.

Chilled Water Capacity Correction Chart (To Be Multiplied with the Capacity of 50% Glycol Solution)

% Glycol	Correction Factor
0	1.190
10	1.179
20	1.155
30	1.107
40	1.060
50	1.000

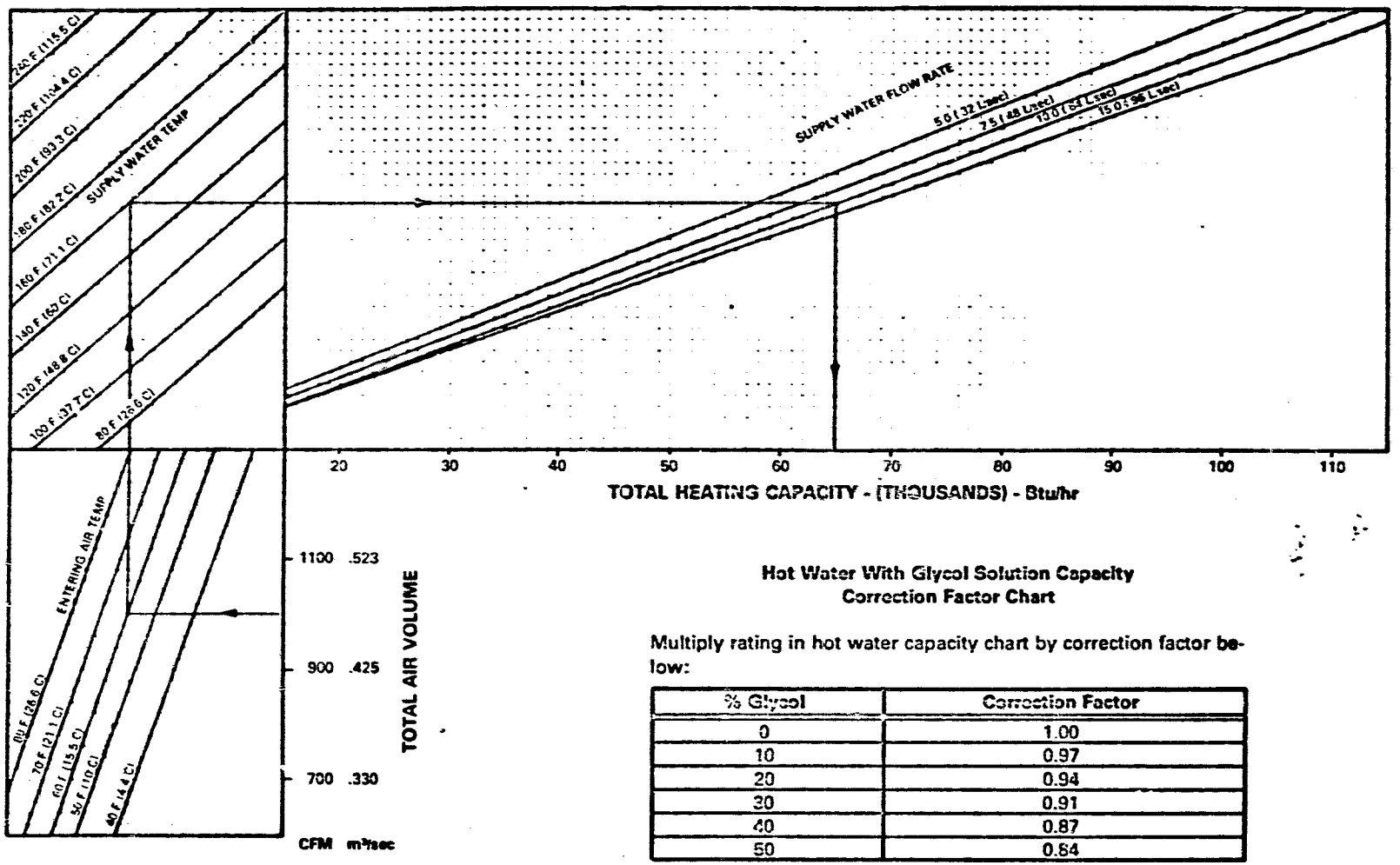
Coil for residential units:
Outer diameter of tubes = 1/2" (12.7 mm)
Size of coil = 20" x 15" (508 mm x 381 mm)
Number of fins/inch = 13
Number of rows = 3
Face area = 2.083 ft.² (1935 cm²)
Circulated fluid: 50% glycol



COOLING CAPACITY CHART
Solar Coil of Residential Unit
50% Glycol Solution Circulating Fluid

FIGURE 1

HEATING CAPACITY CHART
Solar Coil of Residential Units
Water Circulating Fluid



Hot Water With Glycol Solution Capacity Correction Factor Chart

Multiply rating in hot water capacity chart by correction factor below:

% Glycol	Correction Factor
0	1.00
10	0.97
20	0.94
30	0.91
40	0.87
50	0.84

Coil for residential units:
Outer diameter of tubes = 1/2" (12.7 mm)
Size of coil = 20" x 15" (508 mm x 381 mm)
Number of fins/in = 13
Number of rows = 3
Face area = 2.033 ft.² (1035 cm²)
Circulated fluid: water

FIGURE 2

APPENDIX D

INSTALLATION OF DOMESTIC HOT WATER SUBSYSTEM

40 Gal.	Water Heater (page III-15)
SK142047	Preheat Coil
70A	Tempering Valve (page III-15)

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	STRAIGHTENED ENDS OF COIL	8/3/77	

PART NO.

Specifications

Material - copper alloy-ASTM-B359-B111
Length - approx. 33 feet
No. of Coils - 17
Coil I.D. - 5 3/4" (5 1/8")
Tubing Diam. - nom. 3/4"

NOTES

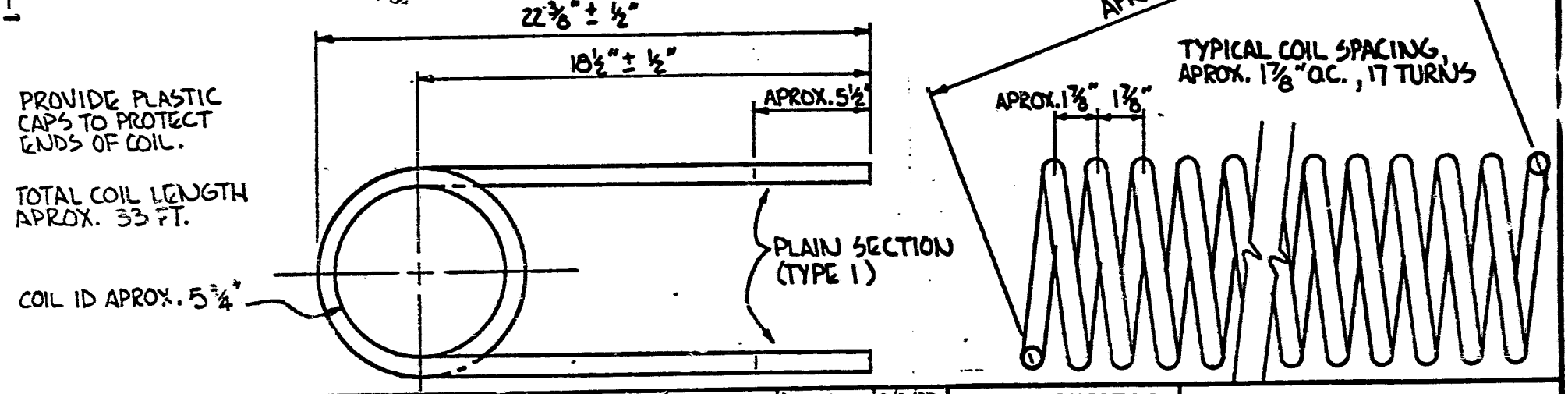
1) The seller will inspect each coil to the requirements of this specification and for evidence of poor workmanship.
2) The heat coils shall be packaged in suitable protective containers that prevent damage to coil when shipped by United Parcel Service.

Approved Source

Vender/PN
Wolverine Tube Division
17200 Southfield Rd.
Allen Park, Michigan 48101

Truffin Type W/H
Catalog No. 66-116038-01
With type 1 ends

D-1



		TOLERANCES UNLESS NOTED OTHERWISE	DRAFTSMAN	Donahue	8/3/77	HONEYWELL INC. — ENERGY RESOURCES CENTER, MINNEAPOLIS, MINN. 55413
		.X ± .XX ± .XXX ±	90° FORMED ANGLES ±2°	CHECKER		
				DEV ENGR		
		MATERIAL		ENGRG MGT		HOT WATER COIL
				CONTRACT NO.		
NEXT ASSY	USED ON			SOURCE CONTROL		SIZE A — CODE IDENT NO. 55513 — DRAWING NO. SK-142047
APPLICATION		FINISH—SEE NOTE				SCALE NONE — SHEET 1 OF 1

9/76

CONTROL A

APPENDIX E

ENERGY TRANSPORT SUBSYSTEM

Energy Transport Module ETM-1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	[illegible]	7-19-77	[illegible]
B	[illegible]	10/28/77	

ENERGY TRANSPORT MODULE (ETM) - SOLAR HEATING

The Energy Transport Module is a fully-assembled, pre-wired unit which provides the pumping power, control logic, and interface between subsystems in a residential hydronic solar heating system. It has a sturdy, rolled steel cabinet with an attractive, durable finish for installation within a building. Large, removable vented access panels are provided for system checkout and component servicing.

The main system pump is capable of 12 gpm flow of water/ethylene glycol (mixture percentage is site specific) through collector arrays of 200-550 ft^2. Two smaller pumps move water through the heating and storage subsystems. Separating the freeze-protected collector loop from the heating/storage water loop is a high efficiency, water-to-water solar heat exchanger. Other hydronic components are included in the ETM, resulting in an efficient, quietly running system which requires minimal maintenance. An integrally mounted Honeywell Solar Control Panel which senses conditions throughout the system and requirements of the household (thermostat setting), provides ETM operational control.

Application

The basic ETM design (for gas furnace auxiliary heating solar systems) can be adapted for use with heat pump auxiliary by replacing the W968A Control Panel with the SCP 422111 controls. See table below:

Auxiliary Heat	ETM Model	Control Panel
Gas Furnace	SK-142065-ETM-1	W968A
Heat Pump	SK-142065-ETM-2	SCP 422111

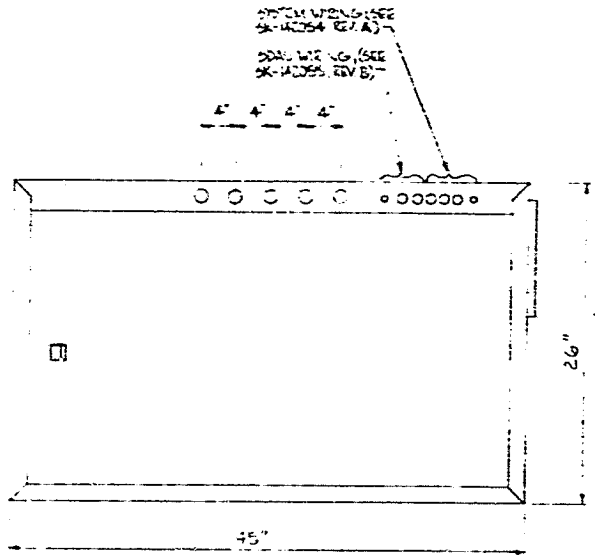
Consult manufacturer for other application assistance.

Pressure drop within ETM (can be increased by adjusting circuit setter):

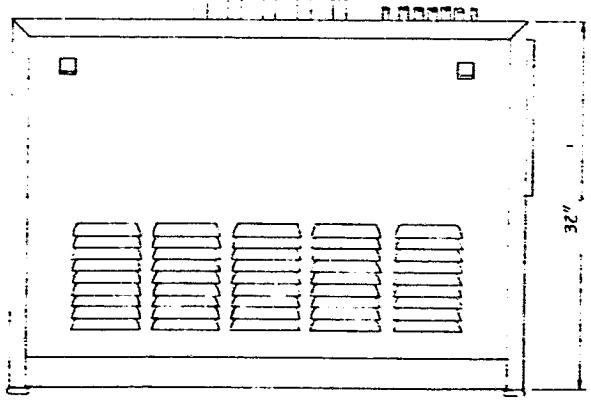
- Collector Loop (50% ethelene glycol) = 3.3 psig
- Direct Heating (water) = 4.0 psig
- Charge Storage (water) = 4.0 psig
- Heat from Storage (water) = 1.0 psig

Conditions:

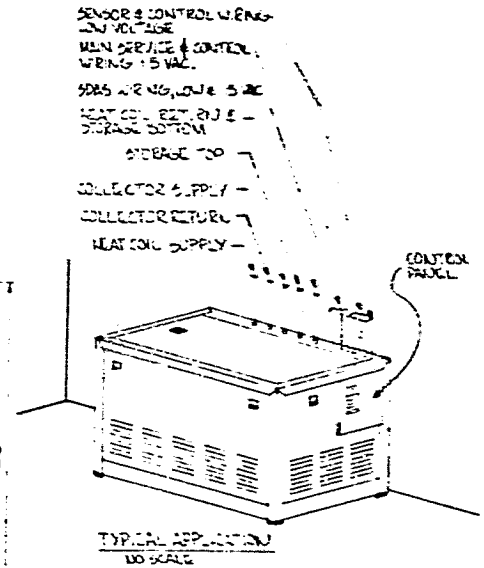
Pressure (pump inlet)	Operating	Maximum	Minimum
Collector Loop	20-35 psig	45 psig	---
Storage/Heating	atmospheric	---	---
Temperature (liquid)			
Collector Loop	50-210°F	210°F	outside ambient
Storage/Heating	50-200°F	210°F	inside ambient



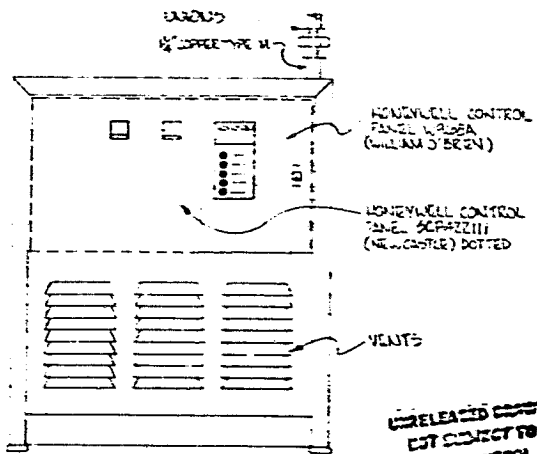
TOP VIEW
1/2" = 1'-0"



FRONT VIEW
1/2" = 1'-0"



TYPICAL APPLICATION
NO SCALE



R SIDE VIEW
1/2" = 1'-0"

UNRELEASED
NOT SUBJECT TO E.C.O. CONTROL

		TOLERANCES UNLESS NOTED OTHERWISE	DRAFTSMAN	HONEYWELL INC.	ENERGY RESOURCES CENTER MINNEAPOLIS, MINN. 55413
		X ±	CHECKER		
		XX ±	DEV ENGR		
		XXX ±	ENGR'G MGT		
		ANGLES ±			
		MATERIAL	CONTRACT NO.		
				WILLIAMSBURG	SIZE C
				NEWCASTLE	SCALE
EDIT ACTY	USED ON	FINISH-SEE NOTE			
APPLICATION					

SINGLE FAMILY RESIDENCE ENERGY TRANSPORT SUBSYSTEM

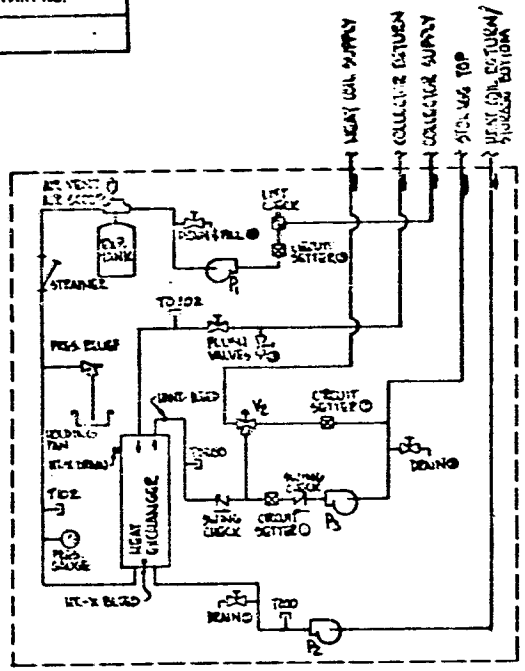
CODE IDENT NO. 55513 | DRAWING NO. SK-142053

SHEET 1 OF 2

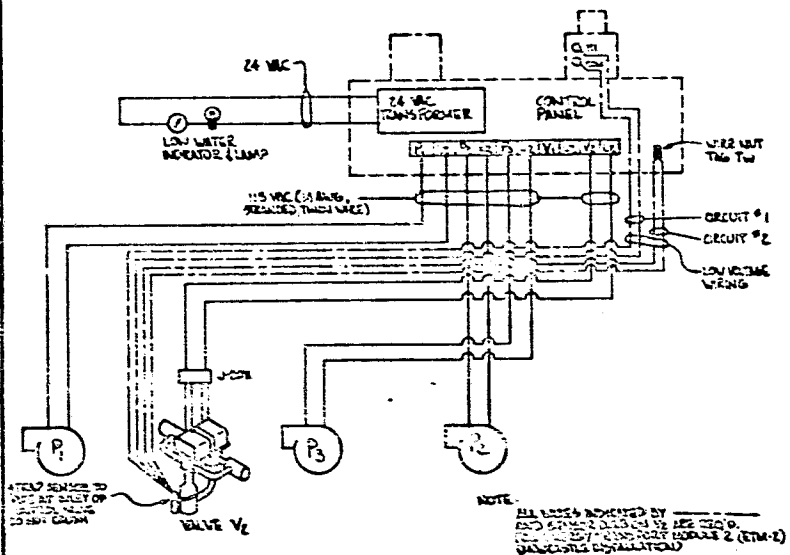
CONTROL A

PAINT NO.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



SCHEMATIC - ENERGY TRANSPORT MODULE
NO SCALE



ETM INTERNAL WIRING SCHEMATIC
NO SCALE

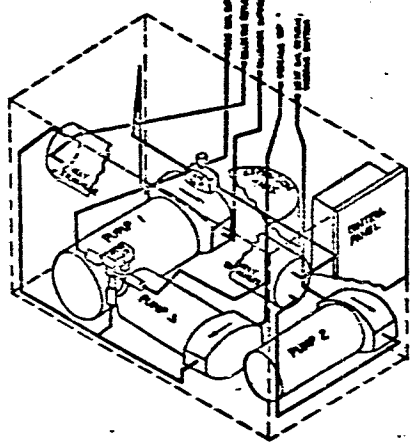
Specifications

Electrical: Power Supply ... 115 VAC, 60 Hz, 1 phase
Minimum supply circuit conductor ... 25 amperes
Maximum circuit overcurrent protection ... 25 amperes

Pumps: 1750 rpm, centrifugal impeller, open drip-proof motor, built in thermal overload protection.

Subsystem	Motor	Capacity (flow @ head)	Full Load Current	Starting Current
Collector (P_1)	1/4 Hp	12 gpm @ 24 ft.	4.9 amp	12 amp
Heating (P_2)	1/6 Hp	8 gpm @ 17 ft.	3.2 amp	8 amp
Storage (P_3)	1/6 Hp	8 gpm @ 17 ft.	3.2 amp	8 amp

NOTE: A 1/5 Hp fan, located outside the cabinet in the Purge Unit, is controlled and powered by the ETM Control Panel.



Installation

- ETM may be fork-lifted as indicated on shipping crate. Before moving unit when uncrated, the two small lower panels and pressure relief holding pan should be removed. Holding pan will slide from under the ETM after the pressure relief line is removed from pan. ETM can be carefully fork-lifted after interference between lift and cabinet underside is checked out. IMPORTANT: Removable panels and Control Panel will be damaged if uncrated unit is hand-trucked on its side or top.
- ETM size is 28" x 32" x 45" and weighs 550 lbs. (operating weight is 600 lbs). Position on level surface (adjustable legs provided) near storage and space heating subsystems. Consult manufacturer when ETM is to be located above the collector array or storage tank.
- Orient ETM with its back towards wall. Heat ventilation clearance is required around the unit, two feet minimum in front and at the sides. Adequate clearance for service access through front, top and side panels shall be provided. Panels are removed with a sharp outward pull on the recessed tabs.

Plumbing Connections

- Five 1 1/4 inch sweat copper unions are provided for system piping connections (see drawing). DO NOT APPLY HEAT to ETM piping inlets. Sweat solder tubing to the removable union pieces BEFORE connecting to ETM inlets.
- External plumbing shall conform to applicable codes. Isolation/Shutoff valves and air bleeds shall be installed, as necessary.

Electrical Connections

- ETM is internally pre-wired.
- External wiring must conform to National Electrical Code and local codes. Line voltage supply to ETM shall be from properly sized branch circuit and overcurrent protection device. Use wire suitable for at least 90°C (194°F). Wiring diagrams are shown on this drawing and on SK-142054, Rev. A (Control Subsystem).
- Three 1/2 inch flexible conduits are provided to the Control Panel terminals for 115 VAC electrical service and the line voltage control wiring. Low voltage sensor wires may be run from the upper right side of the Control Panel through the end hole provided in cabinet top. (Additional openings are provided for the SDAS, with wiring diagrams shown on SK-142055, Rev. B.)

RELEASED DRAWING
NOT SUBJECT TO
E.C.O. CONTROL

		TOLERANCES UNLESS NOTED OTHERWISE	DRAFTSMAN	HONEYWELL INC.	ENERGY RESOURCES CENTER MINNEAPOLIS, MINN. 55413
		X ±	CHECKER		
		XX ±	DES ENGR		
		XXX ±	ENGINEER		
		MATERIAL	CONTRACT NO.	SINGLE FAMILY RESIDENCE ENERGY TRANSPORT SUBSYSTEM	
NEXT ASSY	USED ON		WILLIAM O'BRIEN	SIZE C	CODE IDENT NO. 55513
APPLICATION		FINISH-SEE NOTE	NEW DATE	SCALE	SHEET 2 OF 2

CONTROL

ETM-1. Energy Transport Replacement Parts

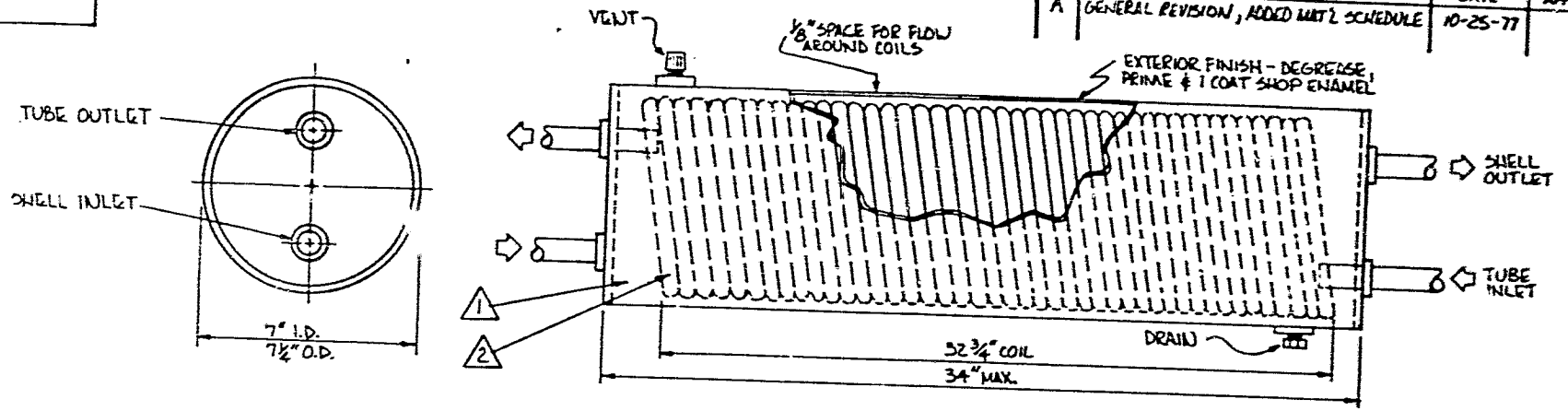
No.	Item	Manufacturer	Type/Part	Quantity
1	Pump 1	Bell & Gossett	60-11S, 1 1/4AA, 1/4hp	1
2	Pump 2 & 3	Bell & Gossett	PR-1 1/4, 1/6 hp	2
3	Heat Exchanger	Honeywell	SK-140184	1
4	Expansion Tank	Amtrol	30, Diaphragm	1
5	Air Separator	Amtrol	444-1 1/4	1
6	Air Vent	Amtrol	690	1
7	Air Bleed	Hammond	1/8 Radiator	2
8	Relief Valve	Bell & Gossett	480-45 psi	1
9	Control Valve, Dual Diverting	Honeywell	V4331-A1003, (115 VAC)	1
10	Circuit Setter Balancing Valve	Bell & Gossett	CB-1 1/4	3
11	SDA Sensor Wells	Mueller	Bronze, 1 1/4	4
12	Lift Check Valve	Bell & Gossett	BA- 1 1/4	1
13	Swing Check Valve	Stockham	B-309-1 1/4	2
14	Drain/Fill Valve	Hammond	710-3/4	1
15	Ball Valve	Hammond	Sweat-1 1/4	1
16	Strainer	Strong	S-1 1/4	1
17	Low Level Indicator w/Lamp	F.W. Murphy	20-PC, 50 psi, 24 VAC	1
18	Solar Control Panel	Honeywell	W968A	1

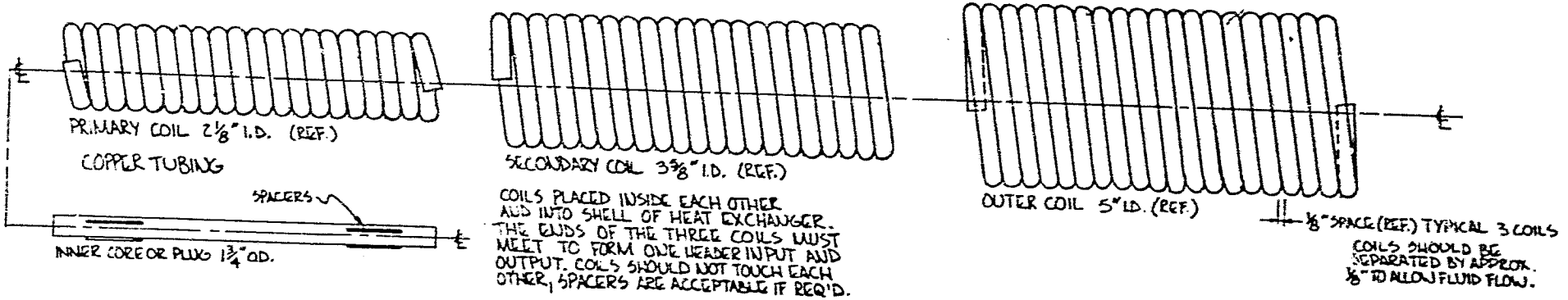
NOTE: See page IV-2, IV-3 and IV-4 for photograph on ETM system

This page has been removed because of copyright information. For information on the PD Boosters and Series "60" In-Line Centrifugal Pumps, contact Bell and Gossett, 8200 N. Austin Ave., Morton Grove, Ill. 60053.

PART NO.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	GENERAL REVISION, ADDED MAT'L SCHEDULE	10-25-77	





COILS PLACED INSIDE EACH OTHER AND INTO SHELL OF HEAT EXCHANGER. THE ENDS OF THE THREE COILS MUST MEET TO FORM ONE HEADER INPUT AND OUTPUT. COILS SHOULD NOT TOUCH EACH OTHER, SPACERS ARE ACCEPTABLE IF REQ'D.

COILS SHOULD BE SEPARATED BY APPROX. 1/8" TO ALLOW FLUID FLOW.

MATERIAL SCHEDULE

ITEM	ITEM	MANUFACTURER	TYPE/PART NO.	QUAN.
1	SHELL	GERBER IND. DIV.	SK-142178	1
2	HEAT EXCHANGE COIL	HONEYWELL INC.	SK-142179	1
3	WROUGHT 90° ST. ELBOW 3/4 x 3/4	REF. & IND. SUPPLY CO.	607-S-3/4	2
4	WROUGHT 90° ST. ELBOW 5/8 x 5/8	REF. & IND. SUPPLY CO.	607-S-5/8	2
5	WROUGHT 90° ST. ELBOW 1/2 x 1/2	REF. & IND. SUPPLY CO.	607-S-1/2	2

NEXT ASSY	USED ON
APPLICATION	

TOLERANCES UNLESS NOTED OTHERWISE
X ±
XX ±
XXX ±
SOFT DECIMAL ANGLES ±

MATERIAL

FINISH—SEE NOTE

DRAFTSMAN L. Doyle
CHECKER
DES ENGR
ENGRG MGT
CONTRACT NO.

HONEYWELL INC. — ENERGY RESOURCES CENTER, MINNEAPOLIS, MINN. 55413

HEAT EXCHANGER FOR SOLAR HEATING SYSTEM

SIZE	CODE IDENT NO.	DRAWING NO.
B	55513	SK-140184

SCALE NONE — SHEET 1 OF 3

CONTROL

Selection Data

EXTROL SIZING TABLE

BOILER NET OUTPUT IN 1000's OF BTU/HR	TYPE OF RADIATION							
	Finned Tube Baseboard or Radiant Panel		Convectors or Unit Heaters		Radiators—Cast Iron		Baseboard Cast Iron	
	SW	CS	SW	CS	SW	CS	SW	CS
25	15	15	15	15	15	15	15	15
50	15	15	15	15	15	30	15	30
75	15	30	15	30	30	30	30	60
100	15	30	15	30	30	60	30	60
125	15	30	30	60	30	60	30	90
150	30	30	30	60	30	90	60	90
175	30	60	30	60	60	SX-30	60	SX-30
200	30	60	60	60	60	SX-30	60	SX-30
250	30	60	60	90	60	SX-30	90	SX-40
300	60	90	60	SX-30	90	SX-30	90	SX-40
350	60	SX-30	60	SX-30	90	SX-40	SX-30	SX-60
400	60	SX-30	90	SX-40	SX-30	SX-40	SX-30	SX-60

EXTROL SIZING TABLE

Average System Temp. °F	SYSTEM CONTENT IN GALLONS									
	Extrol Mo. 15		Extrol Model 30		Extrol Model 60		Extrol Model 90		Extrol Model SX-30	
	SW	CS	SW	CS	SW	CS	SW	CS	SW	CS
100		133		305		500		734		1102
110		101		232		380		557		835
120		80		183		300		440		660
130		65		149		244		358		537
140		54		125		204		298		447
150	62	47	141	106	230	174	338	256	473	384
160	58	40	134	92	219	150	321	220	449	330
170	55	34	127	78	208	128	306	187	428	280
180	53	30	121	68	198	111	291	163	407	245
190	51	26	116	60	190	98	278	144	389	216
200	49	23	111	52	182	86	266	126	372	189
210	47	21	106	48	174	78	256	114	358	171
220	45	19	102	43	167	71	246	103	344	155
230	43	17	98	39	161	64	236	94	330	141
240	41	16	95	35	155	58	228	86	316	129

SW indicates Summer—Winter hook up where boiler is used for heating, and supplying domestic hot water. Minimum boiler water temp. of 150 F. is required.
CS indicates cold start hook up where boiler is used for heating only. MAXIMUM WORKING PRESSURE 75 PSI — OPERATING TEMP. 40°-240°F

#15 EX-TROL = 109 FILL-TROL #30 EX-TROL = 110 FILL-TROL #60 EX-TROL = 111 FILL-TROL #90 EX-TROL = 112 FILL-TROL

Dimensional Data

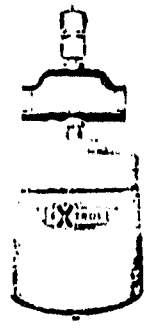
EX-TROL TANKS

Model No.	Diameter Inches	Length Inches	Shipping Wt. Lbs.
15	8	11½	5
30	11	14	9
60	11	23	14
90	15	21	23

EX-TROL COMBINATION PACKAGES

Model No.	INCLUDES			Shipping Wt. Lbs.
	EXTROL	Purger *	Vent	
1500	15	1"		9
3000	30	or	#700	13
6000	60	1¼"		19

Specify type and size required



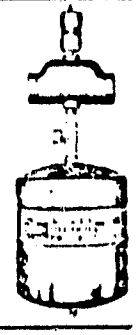
EX-TROL WITH FILL-TROL

Model No.	Diameter Inches	Length Inches	Shipping Wt. Lbs.
109	8	14½	6
110	11	17	10
111	11	26	15
112	15	23½	24

FILL-TROL COMBINATION PACKAGE

Model No.	INCLUDES			Shipping Wt. Lbs.
	FILL-TROL	Purger *	Vent	
109-P	109	1" or 1¼"		11
110-P	110	1" or 1¼"	#700	14
111-P	111	1¼"		18

Specify type and size required



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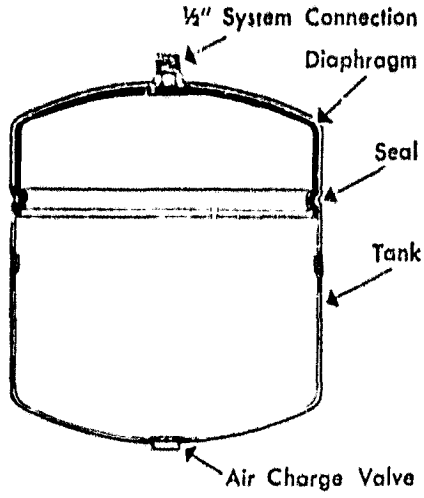


Fig. 2 Extrol tank construction

The EX-TROL Tank is a modern, pressurized diaphragm-type expansion tank for all hot water heating systems.

It is of welded steel construction; compact and neat in appearance. A rugged, flexible diaphragm of a material specially compounded for long life in hydronic service is the heart of the EX-TROL tank.

This diaphragm separates system water from the (standard 12-lb.) air charge, assuring a permanent air cushion. Because the diaphragm permits the tank to be pressurized, the EX-TROL tank can be smaller than conventional units.

The EX-TROL Tank may be installed into a tee or any other suitable tapping anywhere on a hot water heating system.

It may also be remotely located and piped to convenient point on the system.

An ideal EX-TROL installation is to screw it into the bottom of an American Air Purger. A single ½" nipple serves as both pipe connection and mounting.

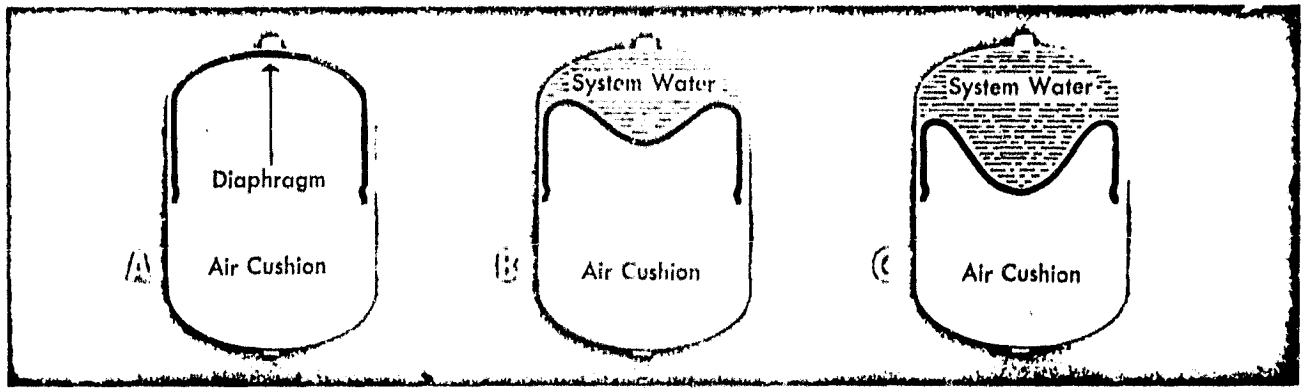


Fig. 3 Extrol tank operation

The EX-TROL Tank controls expansion of heating system water. *See Figure 3*

A. When the system is first filled to the setting of the automatic fill valve, no water enters the EX-TROL Tank because of the charge pressure behind the diaphragm.

B. When the system comes up to temperature, the EX-TROL tank receives the expanded volume of water.

C. When the boiler water temperature rises to its maximum, the EX-TROL diaphragm simply flexes against the air cushion.

The American Air Purger continuously separates air from heating system water.

It is a one-piece cast iron chamber with two passages through which boiler water flows. Internal contours and baffles are designed for low flow resistance characteristics and efficient separation of the air from the water.

The Air Purger should be installed horizontally on the main as close to the boiler as possible. It must be installed so that water flows through it in the direction indicated by the arrow.

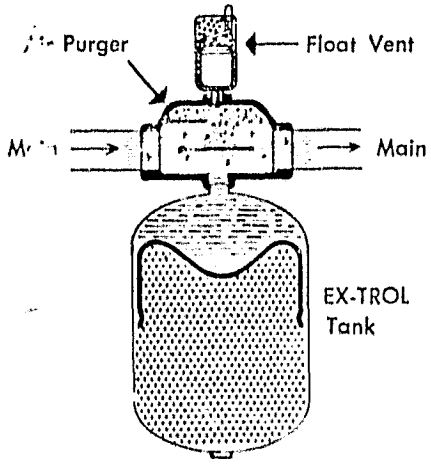


Fig 4 System view illustrating contin-

All models have tappings for installation of #700 Float Vents to provide complete continuous purging and venting. Spare tappings are also provided for easy mounting of an EX-TROL for expansion control or FILL-TROL for combining automatic fill valve and expansion control.

EX-TROL system venting

After initial purging and venting of air from the system more air will be released from the water as it is heated. The American #700 Float Vent is an advanced type valve designed for venting all hydronic heating and cooling systems. It has a unique construction which insures: Fastest Venting — Positive shut off — Venting through the complete pressure range (0-45) — Long continuous operation — Trouble free performance — No spitting or unsightly stains from leaking. No separate air chamber is required.

Even with Air Purger and Float Vent installed on the main or mains, it is recommended the American #700 Float Vent to be installed on each return at the elbow that drops to the circulator.

While seldom required, it is also recommended that manual (key or coin type) air vents be installed at high points on the radiation.

This page has been removed because of copyright information. For information on the Installation Instructions Ex-Trol Expansion Tanks contact Amtrol, 1400 Division Road, West Warwick, R. I. 02893.

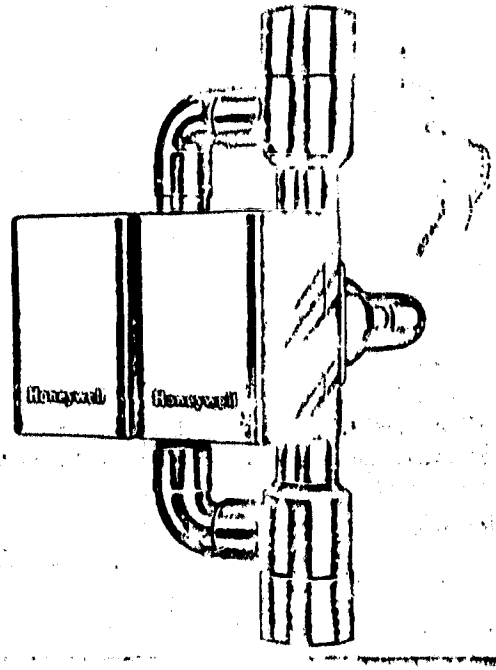
This page has been removed because of copyright information. For information on the Relief Valves-ASME Valves and Fittings contact Bell and Gossett, 8200 N. Austin Ave., Morton Grove Ill. 60053.

Honeywell

DUAL DIVERTING VALVES

THE Y534A DUAL DIVERTING VALVE ASSEMBLY CONSISTS OF TWO VALVE BODIES WHICH ARE SWEATED TOGETHER AND TWO POWERHEADS WHICH CONTROL EACH VALVE BODY SEPARATELY. WHEN ASSEMBLED, THE Y534A OFFERS FLOW CHARACTERISTICS WHICH ARE COMPATIBLE WITH SOLAR ENERGY SYSTEMS.

- ☐ Available for line or low voltage applications (specify when ordering).
- ☐ Assembly provides a flow capacity of 14 Cv [12 kv].
- ☐ Sweat copper end connections may be installed without disassembling the valve.
- ☐ Manual opener for valve operation on power failure. Valve returns to automatic position when power is restored.
- ☐ Complete powerhead may be removed without breaking the line connections.
- ☐ Motor actuator may be replaced without removing the valve body or draining the system.



Y534A

R.L.
9-77 (.05)

SPECIFICATIONS

IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

MODEL:

Y534A–2-position dual diverting valve. The two powerheads must be assembled to the two valve bodies which are shipped sweated together. Available for line or low voltage applications.

TEMPERATURE AND FLOW RATINGS:

Capacity Rating–14 Cv [12 kv].
Maximum Closeoff Pressure–10 psi [69 kPa].
Static Pressure Rating–125 psi [862 kPa].
Maximum Fluid Temperature–
Line voltage model–200 F [93 C].
Low voltage model–240 F [115 C].
Maximum Ambient Temperature–125 F [52 C].

ELECTRICAL RATINGS:

Line voltage models–
0.16 amps at 120V ac, 60 Hz.
0.08 amps at 220/240V ac, 50 Hz.
Low voltage model–
0.64 amps at 24V ac, 50/60 Hz.

WIRING PROVISIONS: 18 in. [457.2 mm] leadwires and 1/2 in. conduit openings.

LINE FITTINGS: 1-1/4 in. sweat (1-3/8 in. O.D.).

DE-ENERGIZED POSITION: Port A normally closed.

TIMING: Diverts flow in 30 seconds.

MANUAL OPENER: Allows valve to be opened in case of power failure. Valve returns to automatic position when power is restored.

DIMENSIONS: See Fig. 1.

UNDERWRITERS LABORATORIES INC. LISTING APPLIED FOR.

REPLACEMENT PARTS:

O-ring–Part No. 802344.
Powerhead–
Line voltage model–Part No. 130441ARG.
Low voltage model–Part No. 130441ARA.

DETERMINATION OF WATER FLOW CHARACTERISTICS: The pressure drop in psi [kPa], equivalent feet [metres] of pipe, or feet of water [kPa] may be determined by calculating the flow rate, referring to Fig. 2, and using the following procedures.

Pressure drop in psi [kPa]–

1. Locate the flow rate at the bottom of the graph in Fig. 2.
2. Draw a line upward from the flow rate until it intersects the curve on the graph.
3. Draw a line from the intersection to the left-hand edge of the graph and read the pressure drop in psi [kPa].

Pressure drop in equivalent feet [metres] of pipe–

1. Locate the flow rate at the bottom of the graph in Fig. 2.
2. Draw a line vertically to the top of the graph. Read the pressure drop in equivalent feet [metres] of pipe on the 3/4 in. pipe scale.

Pressure drop in feet of water [kPa]–

1. Locate the flow rate at the bottom of the graph in Fig. 2.
2. Draw a line upward from the flow rate until it intersects the curve on the graph.
3. Draw a line from the intersection to the right-hand edge of the graph and read the pressure drop in feet of water [kPa].

continued on page 3

MODIFICATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY–

1. **Order number (specify line voltage or low voltage model).**
2. **Replacement part, if required.**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

   (IN CANADA–HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
   INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

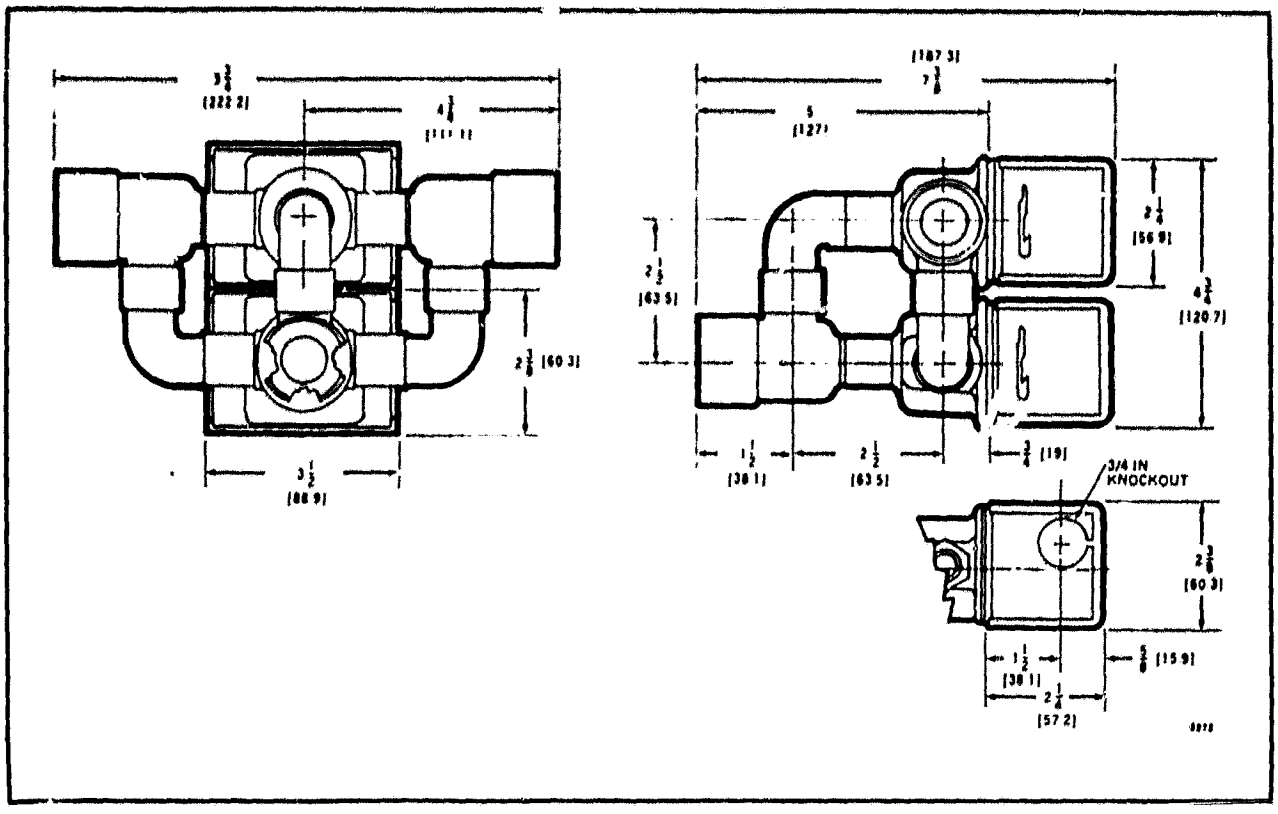


FIG. 1–Y534A DIMENSIONS IN INCHES [MILLIMETRES IN BRACKETS].

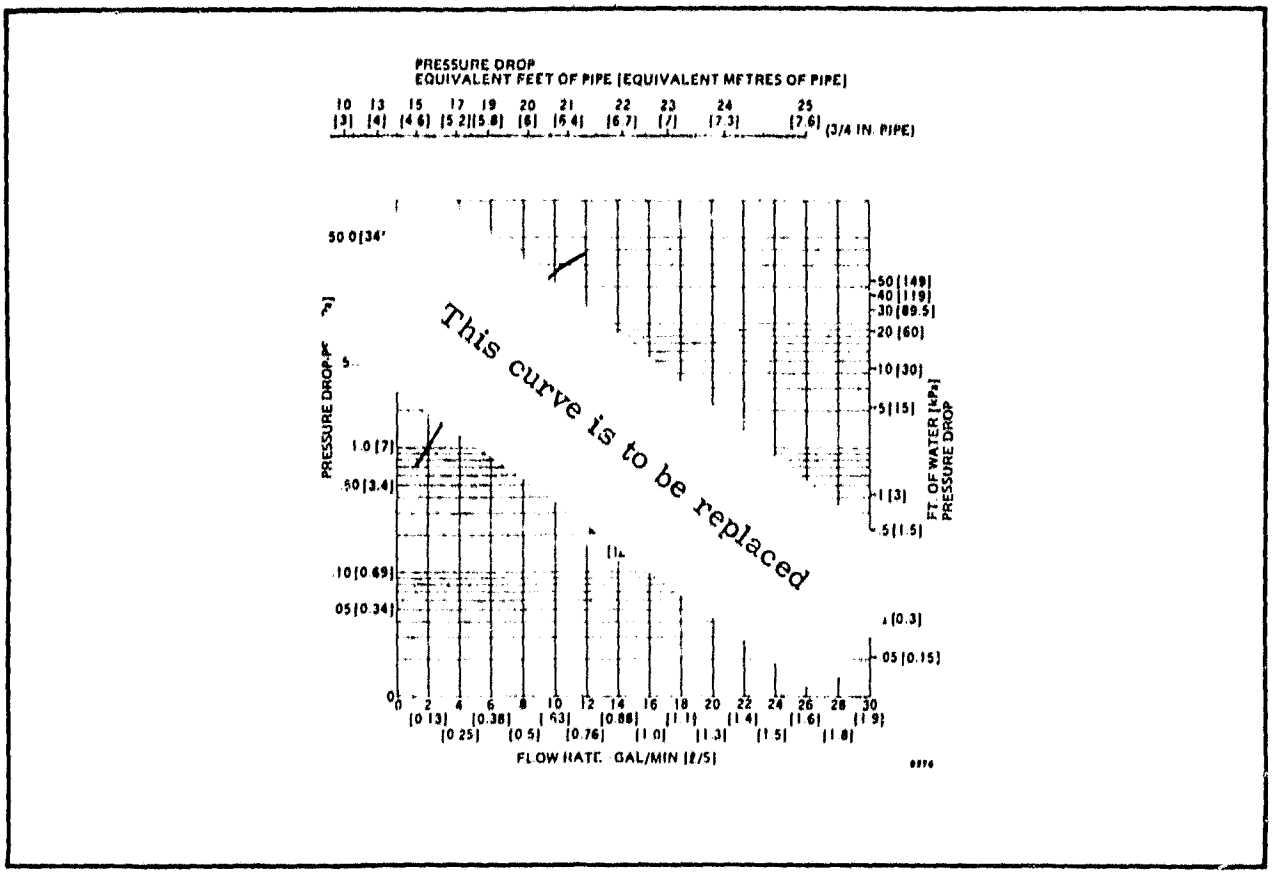


FIG. 2–FLOW CHARACTERISTICS OF Y534A DUAL DIVERTING VALVES.

INSTALLATION

CAUTION

1. Installer must be a trained, experienced service technician.
2. Disconnect power supply before connecting wiring to prevent electrical shock and equipment damage.
3. Always conduct a thorough checkout when installation is complete.

ASSEMBLY

Each powerhead controls each valve body separately. To assemble a powerhead to a valve body, place an O-ring in the circular slot on the top of the valve body (Fig. 3). Assemble the powerhead to the valve body by placing the manual opening lever on the powerhead in the MAN. OPEN position.

Align the powerhead by fitting the hex head screw on the bottom of the powerhead into the hole on the top of the valve body. The guide pins and the positioning pin in the powerhead should fit the holes in the valve body. Tighten securely and repeat this procedure for the other powerhead and valve body.

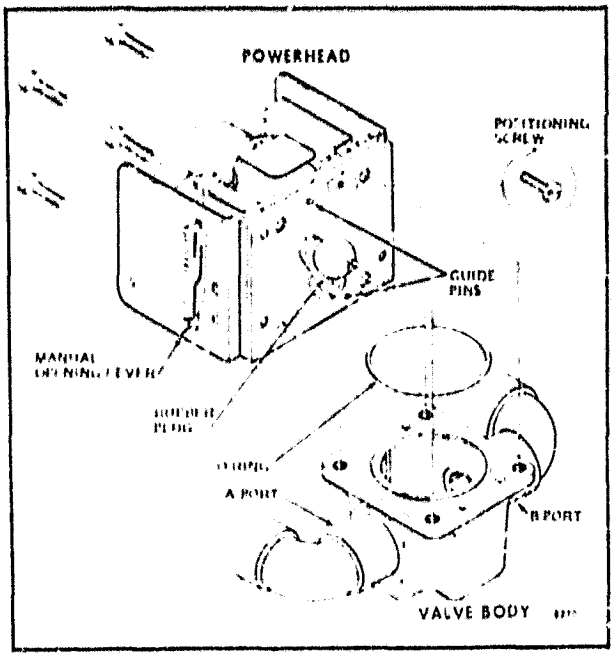


FIG. 3–POWERHEAD MUST BE ALIGNED SO THAT THE GUIDE PINS AND THE POSITIONING PIN IN THE POWERHEAD FIT THE HOLES IN THE VALVE BODY.

MOUNTING

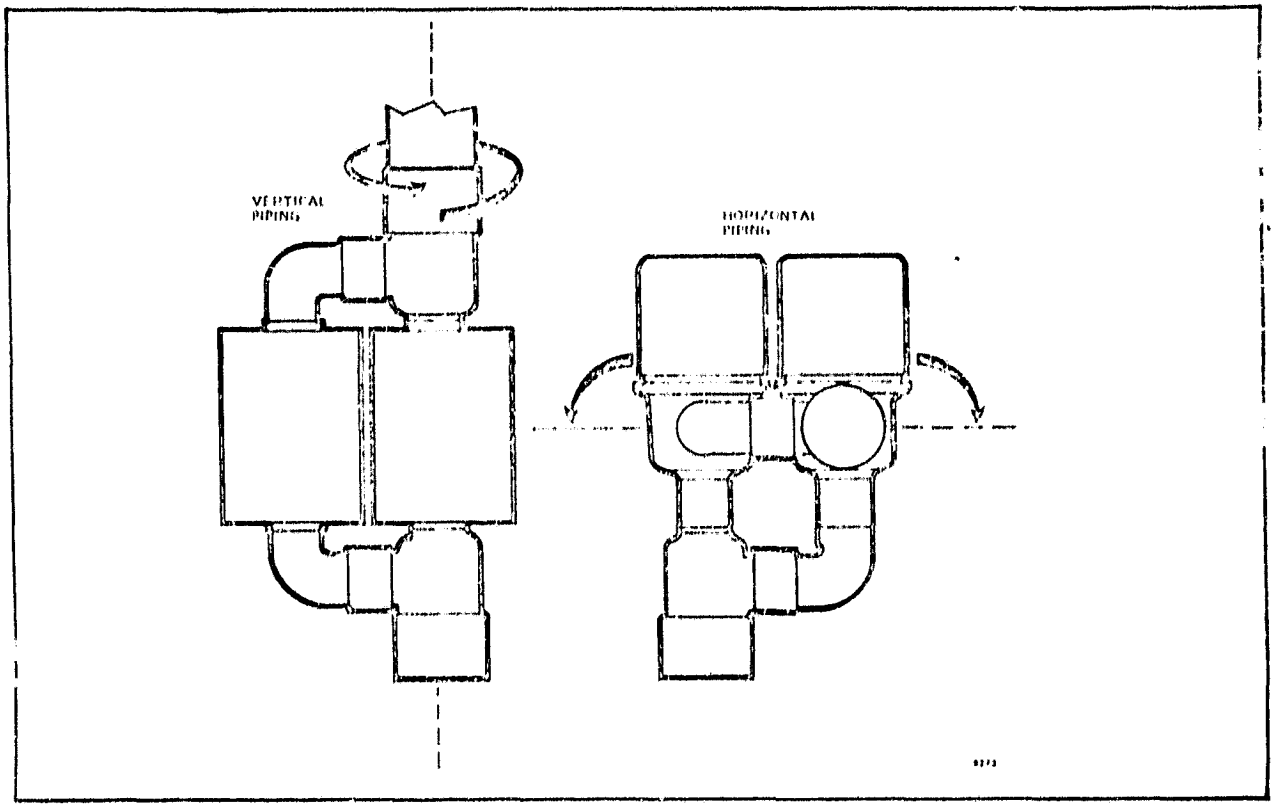


FIG. 4–MOUNTING POSITIONS.

The valve may be mounted in any position on a vertical line. If valve is mounted horizontally, the powerhead must be even with or above the center line of the piping. Make sure that enough room is provided above the powerhead to remove the cover for servicing. See Fig. 4.

The 3 fittings or ports of the dual diverting valves are labeled on the bottom of the valve body castings. Port A is connected to the purge coil piping and is closed when the valve is de-energized. Port B is connected to the system bypass and is open when the valve is de-energized. Port AB is the inlet and is open at all times. See Fig. 4.

SWEAT COPPER MODELS

1. Use new, properly reamed pipe, free from dents or corrosion.
2. Place valve onto the pipe. Set the manual opener lever to MAN. OPEN before applying heat. This will protect the plug inside the valve by removing it from the heat.
3. Sweat joints keeping the outer surface free from solder. DO NOT use silver solder because of the high melting temperatures required.

TO INSTALL REPLACEMENT POWERHEAD

IMPORTANT

Installation of new powerhead does not require the removal of the valve body from the pipe line. It is, however, necessary to drain the water from the system before beginning the installation.

1. Disconnect the valve from the electrical power source and remove the conduit connections if fitted.
2. Place the manual opening lever on the old powerhead in the MAN. OPEN position.
3. With the cover off, remove the 4 screws securing the powerhead to the valve body. Remove the old O-ring from the valve body.
4. Place the new O-ring in the circular slot on the top of the valve body.
5. Install the new powerhead–
   - –Place the manual opening lever on the new powerhead in the MAN. OPEN position.
   - –Align the powerhead by fitting the hex head screw on bottom of powerhead into the hole on top of valve body (see Fig. 3).
6. Reconnect electrical connections.

Inspect the powerhead installation and the valve body to insure that all connections and adjustments have been correctly made. Adjust the thermostat or controller connected to the valve so the valve runs through its cycle. Make sure the valve runs smoothly and positively from closed to open to closed again.

WIRING

All wiring must agree with local codes and ordinances. See Fig. 5 for a typical wiring hookup.

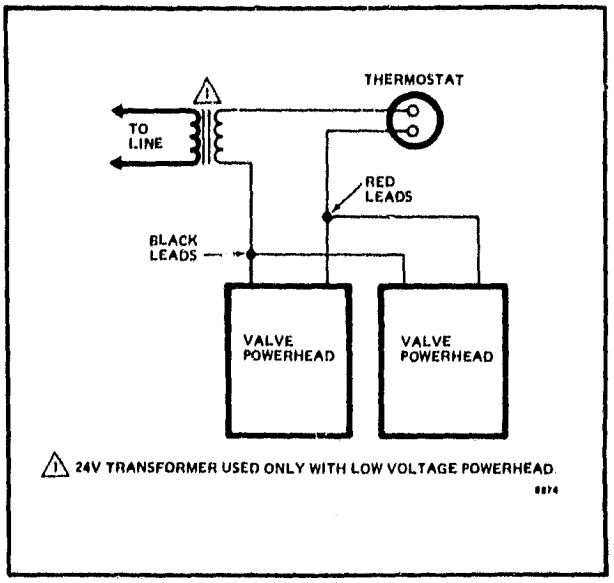


FIG. 5–TYPICAL WIRING FOR Y534 DUAL DIVERTING VALVES.

OPERATION AND CHECKOUT

CAUTION

On 24 volt systems, never jumper the valve coil terminals, even temporarily. This may burn out the heat anticipator in the thermostat.

OPERATION

AUTOMATIC OPERATION

When the valve is energized, port B, the bypass, closes and port A opens. Port A closes by integral spring return when the valve is de-energized.

MANUAL OPERATION

The motorized dual diverting valves (two with each assembly) can be opened manually by lifting the manual opener lever over the stop and pushing slowly and firmly to the MAN. OPEN position. The stop permits the valve to be locked in the open position. The valve will return to automatic position when the valve is energized.

CHECKOUT

1. Lower the set point of the high limit controller below the temperature of the collector fluid.
2. Observe that port A of the valve should be open and port B of the valve should be closed.
3. Raise the set point of the high limit controller above the collector fluid temperature.
4. Observe that port A of the valve should close and port B of the valve should be open.

SERVICE

This valve should be serviced by a trained, experienced service technician.

1. If the valve is leaking, check to see if the O-rings need to be replaced.
2. If the gear train is damaged or the motor is burned out, it is necessary to replace the entire powerhead assembly. See INSTALLATION.

NOTE: Honeywell zone valves are designed and tested for silent operation in properly designed and installed systems. However, water noises may occur as a result of excessive water velocity or piping noises may occur in high temperature (over 212 F [100 C]) systems with insufficient water pressure.

HONEYWELL MINNEAPOLIS, MINN. 55408 INTERNATIONAL: Sales Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

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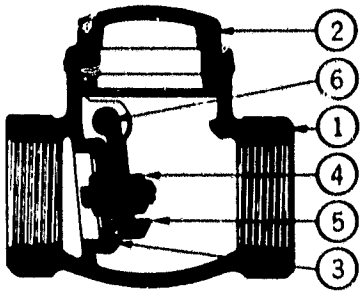
Additional pages have been removed because of copyright information. For information on the Circuit Setter Balance Valves contact Bell and Gossett, 8200 N. Austin Ave., Morton Grove, Ill. 60053.

SEE PAGE 36 FOR PRESSURE-TEMPERATURE RATING.

SERVICE FEATURES

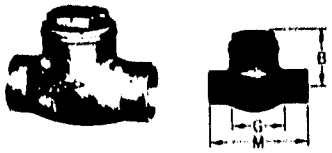
Recommended for prevention of backflow in general services. • Solder ends recommended for non-flammable liquids or gases with Types K, L, and M copper tubing.



B-319

NO.	DESCRIPTION	MATERIAL	ASTM SPEC.
1	BODY	BRONZE	B-62
2	CAP	BRONZE	B-62
3	DISC	BRASS (¼-½)	B-16
		BRONZE (¼-3)	B-62
4	DISC NUT	BRASS	B-16
5	HINGE	BRONZE	B-62
6	HINGE PIN	BRASS	B-16
* 7	SIDE PLUG	BRASS	B-16

*Not Shown



†B-309, SOLDER ENDS

SIZE	WGT.	B	G*	M
⅜	.4	1 13/32	1 5/16	2 1/16
½	.5	1 19/32	1 7/16	2 7/16
¾	.9	1 57/64	1 ¾	3 ¼
1	1.4	2 ¼	2	3 13/16
1¼	2.0	2 19/32	2 5/16	4 ¼
1½	3.4	3 1/32	2 11/16	4 ⅞
2	4.8	3 ½	3 5/16	6

†Saturated Steam Pressure for Solder End Valves Should Not Exceed 15 PSI.
*Piping Make-Up Dimension

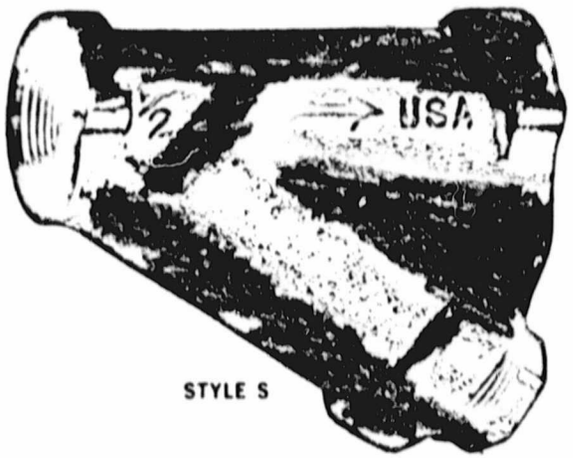
B-319, THREADED

SIZE	WGT.	B	M
¼	.5	1 13/32	2 1/16
⅜	.5	1 13/32	2 1/16
½	.7	1 19/32	2 7/16
¾	1.1	1 29/32	2 11/16
1	1.7	2 ¼	3 3/16
1¼	2.7	2 19/32	3 ¾
1½	3.9	3 1/32	4 5/16
2	6.1	3 ½	5 ⅛
2½	11	4 5/32	6 3/16
3	17	4 13/16	7 ⅛

STRONG

Semi-Steel Y-Type Strainers

High Tensile Semi-Steel Body ASTM A126 Class B.



STYLE S

STYLE SG

SIZES ¼" thru 3"

OPERATING PRESSURES AND TEMPERATURES:

Steam	250 psi at 406°F.
Water, Oil, Gas	400 psi at 150°F.

STANDARD SCREENS:

Service	Connections & Sizes	Screen Openings	Screen Material
Liquid	Screwed ¼" thru 2" 2½" thru 3"	20 mesh .045 perf.	Stainless Steel
Steam	Screwed ¼" thru 2" 2½" thru 3"	20 mesh .045 perf.	Stainless Steel

BLOW-OFF OUTLETS:

N.P.T. tapped in sizes specified on dimension table. Not normally furnished plugged.

CONSTRUCTION:

Constructed of high tensile ASTM A126 Class B semi-steel with blow-off connections and easily removable cylindrical screens. A tapered seat allows the screen to be self aligning and assures a perfect fit. 2½" and 3" sizes have a flanged blow-off cover. Strainer with gasketed blow-off plug and straight thread available in ¼" thru 2" size. 18-8 stainless steel screens.

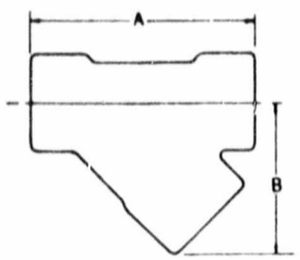
MILITARY SPECIFICATIONS:

Model with gasketed blow-off plug conforms to MIL-S-16293E, Type 1, Style Y, Class 250 when equipped with a brass plug in the blow-off connection. State service when ordering.

PACKAGING:

Screwed strainers in sizes thru 2" can be packaged in multiple unit cartons for certain industries. Write for specific information.

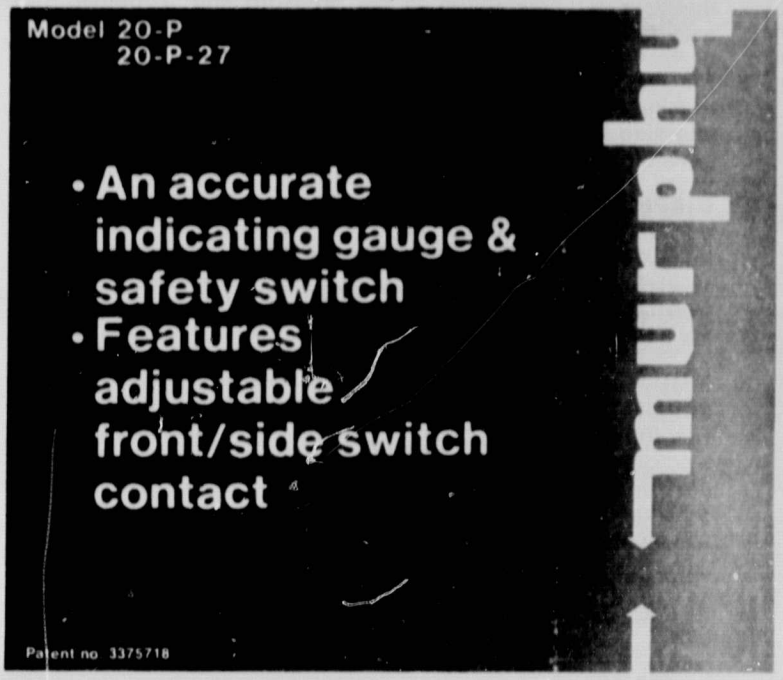
DIMENSIONS:



Size	A	B	Size Blowoff NPT	Ship Weight lbs.	Screen Area In²
¼	2⅝	1¾	¼	1¼	3.0
⅜	2⅝	1¾	¼	1¼	3.0
½	3 13/32	2⅜	⅜	1¾	5.4
¾	4	2¾	⅜	2½	7.4
1	4⅝	3¼	½	4	12.7
1¼	5⅜	3½	¾	6¼	18.1
1½	6 1/16	4	¾	8¼	25.3
2	7½	5	1	14½	39.2
2½	9	6¾	1¼	22½	49.3
3	10	7⅞	1¼	35¼	64.8

Bulletin 0-6701
Revised 6-1-76
Catalog Section 5
Class R

Pressure Monitoring SWICHGAGES®



These rugged, pressure monitoring SWICHGAGES® are designed for any critical pressure control function.

Recommended specifically for safety shutdown on oil field, irrigation and industrial engines or as alarm systems on construction equipment, trucks and marine engines.

Offers constant visual indication.

These instruments offer a constant visual indication of the condition of your lubrication system, or any other vital pressures on your equipment. Their precision construction meets the specifications of those applications which require a higher degree of accuracy and dependability than is available in most standard 2" diameter instruments.

A SWICHGAGE® performs the job of two ordinary instruments (a gauge and a switch), thus this instrument greatly reduces necessary inventory and installation time.

In addition, each instrument is available with a lockout feature to hold the indicating pointer away from the shut-down contact for start-up. When the oil pressure reaches the normal operating level, the lockout is automatically disengaged.

Durability

The entire working mechanism of the SWICHGAGE® is assembled completely independent from the case and therefore is not affected by case damage or abuse in normal operation. Also, all moving parts are machined to close tollerence and many parts are interlocking to retard damage from vibration or shock. The unique design of the diaphragm and bearing plate prevent normal overpressures from harming the accuracy of the instrument.

Model 20-P-7

This model features a "tamperproof" front adjustable contact which can be set with an Allen-Head wrench (also available with standard screwdriver adjustment — specify), and a pushbutton for lockout.

Model 20-P-27

A side mounted micrometer — adjustment type contact screw and convenient side lockout are features of this model. It also has a stand-off ring which holds the instrument away from the panel to give access to the contact adjustment and lockout pushbutton.

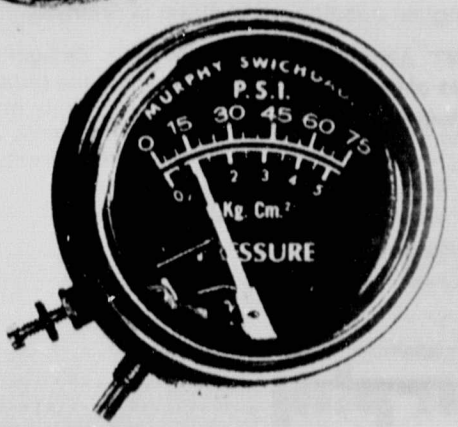
Warranty

Like all Murphy instruments, Pressure SWICHGAGES carry a full one year warranty against defective materials and workmanship. Consult the Murphy Service department for product repairs.

CONTACT RATINGS: 2 amp. @ 30 v.a.c., 2 amp. @ 30 v.d.c.

SHIPPING WEIGHTS: 20-P-7 7.8 Oz.--20-P-27 13 Oz.

20-P



20-P-27

COMPATIBILITY: These simple one-wire to ground SWICHGAGES are compatible with all Murphymatic Controls and can be used with any Murphy "Nerve Center."

- To interrupt ignition circuit — Section 25
- To start and start stop engines — Section 40
- To start and stop elec. tric. motors — Section 45
- For fuel shut-off — Section 55

SPECIFICATIONS

A. PORT: Machined from brass bar stock. It is accurately threaded for connection to the pressure line. Together with the diaphragm, it forms the pressure chamber.

B. PULSATION DAMPENER: A restricting orifice designed to minimize hydraulic shock within the pressure transmitting fluid, preventing undesirable pointer chatter. It is accessible for cleaning, or removal.

C. DIAPHRAGM: Beryllium copper, procured to very close physical and metallurgical specs. The material is die formed and close control heat treated to insure consistent reliability. Each pressure range is designed to operate well below its maximum capability in order to maintain long life and consistent reliability.

D. MOUNTING PLATE: Machined from brass bar stock. The mounting plate performs threefold function. First, together with the port, clamps back diaphragm in position. Second, it provides a strong back stop for the diaphragm, thereby preventing damage should the gauge experience high over pressure. Lastly, it also provides a stable platform upon which to mount the pointer post and the mechanism which amplifies the diaphragm movement into pointer travel.

E. RECAL SCREW: Provides a measure of adjustment to compensate for wear or disturbances that may result if gauge is operated in unusually severe environment.

F. BRIDGE PLATE: Tempered nickel silver provides corrosion resistance and dimensional stability.

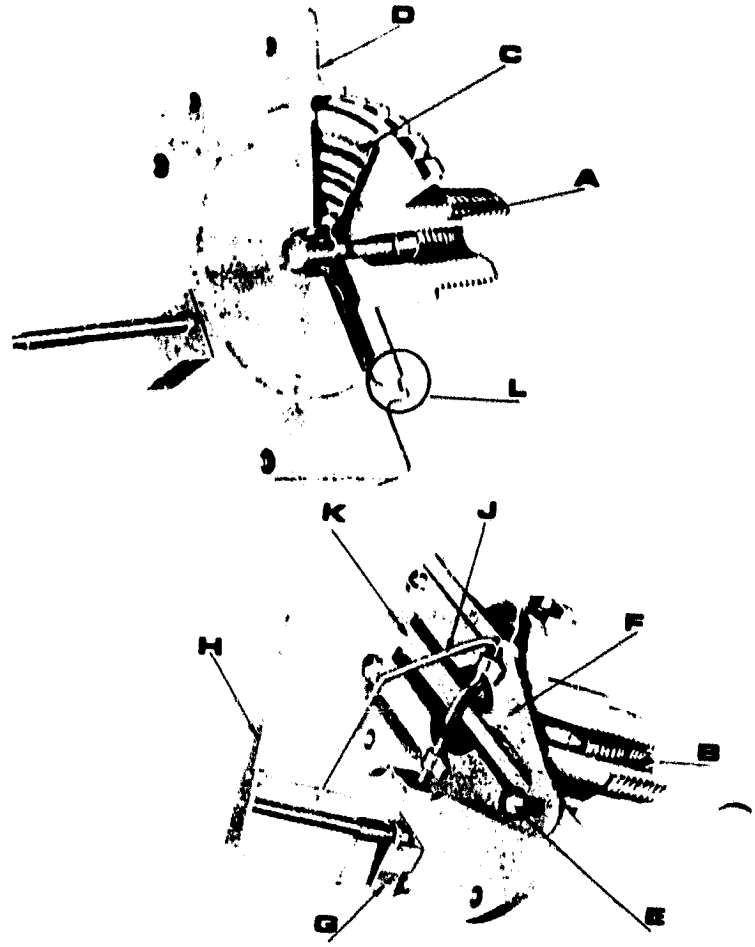
G. SPRING ANCHOR & POINTER ZERO STOP: Stainless Steel.

H. POINTER: Tempered nickel silver for strength and corrosion resistance. It is mounted on a machined brass post. The return spring is helically wound of spring temper stainless steel.

J. CRANK ARM: K-Monel. Senses and amplifies diaphragm movement and transmits it to the pointer.

K. BEARING PLATE: Beryllium copper. Provides fulcrum for crank arm. It is free to lift off the bridge plate should the pointer be restrained by stationary contacts, etc. It returns to original position when strain is relieved.

L. JOINT AND SEAL: The carefully designed peripheral edges of the diaphragm and port, and the radiused channel in the mounting plate provide consistently accurate parts alignment. The annular solder channel provides optimum conditions for producing a combination structural joint, and seal, with maximum integrity.

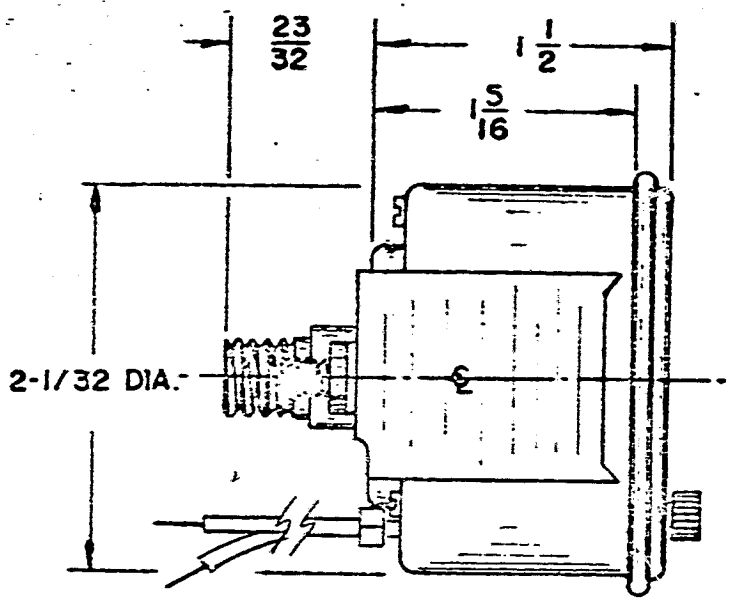


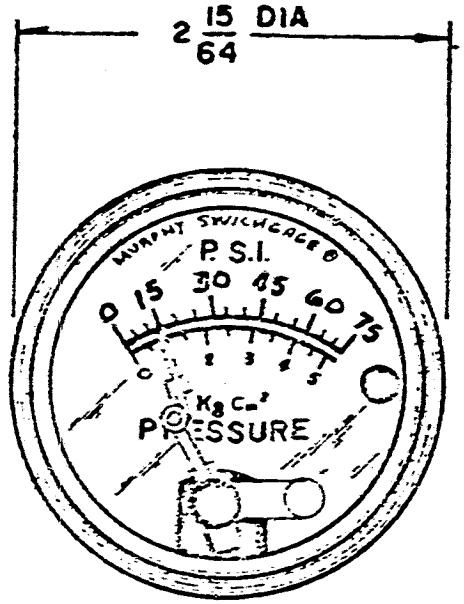
DESCRIPTION	MODEL NO.	RANGES
2" Dia. Pressure SWICHGAGE' Front Contact — No Lockout	20-P	0-30, 0-75, 0-100 p.s.i. 0-150, 0-200, 0-300 p.s.i.
20-P w/Front Lockout	20-P-7	All Ranges
2" Dia. Pressure SWICHGAGE Side Contact — No Lockout	20-P-75	0-30, 0-75, 0-100 p.s.i. 0-200, 0-300 p.s.i.
20-P-75 w/side Lockout	20-P-27	All Ranges
2" Dia. Vacuum SWICHGAGE' HI-Lo Contacts — No Lockout	20-V-2 20-V-3	0-20 inches Vacuum 0-30 inches Vacuum

OPTIONAL EXTRAS

Additional Contact (except 20-V)	add-HL	All Ranges
"C" Contacts — 2 wire ungrounded (Not avail. w/Lockout) Circuit (rated 1 amp @ 125V A.C.)	add-C	All Ranges
Illumination slots. (Front contact only)	add-1	All Ranges

Also available in explosion proof case — see bulletin No. EX-5828. Available on front contact models only.

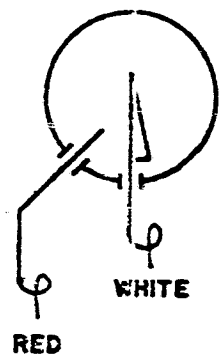




RANGES AVAILABLE	CONTACT SETTING
■ 0-15 PSI	3 PSI
■ 0-30 "	7 "
■ 0-50 "	10 "
*■ 0-75 "	15 "
■ 0-100 "	20 "
▲ 0-150 "	30 "
▲ 0-200 "	50 "
▲ 0-300 "	75 "

*STANDARD

WIRING DIAGRAM



RATING- 1 AMP 120VAC - 2 AMP 30V AC/DC
WIRE - (1) RED, (1) WHITE, 12" X 18 GA
CONTACT SETTING - SEE ABOVE
TYPE ADJUSTMENT - NYLON KNOB
DIAL - WHITE ON BLACK
CLAMP - LONG P/N 05 05-789
MOUNTING HOLE - 2-1/16 DIA
MAX PANEL THICKNESS - 1/4"
PORT - BRASS 1/8-27 NPT
MAX PRESSURE - (■ = 300PSI) (▲ = 500PSI)
PULSATION DAMPENER - BUILT IN (REMOVABLE)
BEZEL - STAINLESS STEEL
CASE - STEEL, CAD & IRIDITE
CRYSTAL - LEXAN
STUDS - 10-24 NC

CALIBRATION CONFORMS TO USAS CLASS B - FIRST & LAST 1/3 OF SCALE ±3%, MIDDLE OF SCALE ±2%

NOTE: NO CUSTOMER REPLACABLE PARTS

NO	REVISION

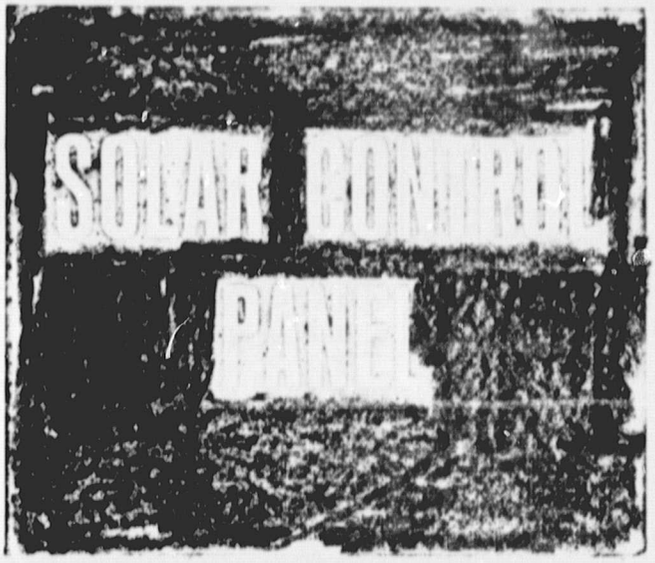
FRANK W. MURPHY MFR., INC
MURPHY SAFETY SWITCH
TULSA, OKLAHOMA

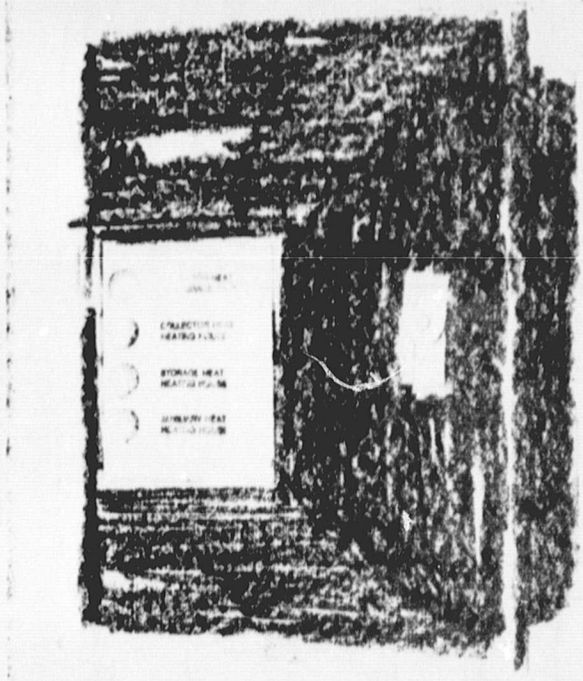
DRN BY	APPD BY
DATE 11-1-72	CHKD BY

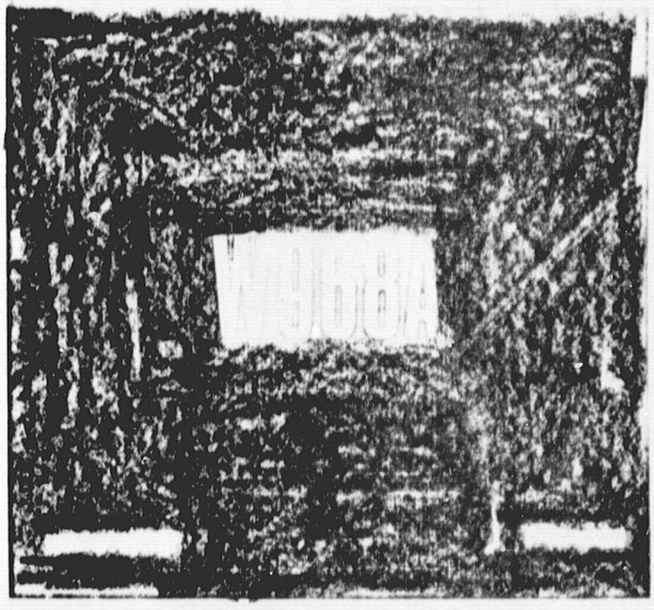
MODEL 20 PC SWICHGAGE®

DWG. NO. 05 02-108

Honeywell







W968A SOLAR CONTROL PANEL CONTAINS A DIFFERENTIAL TEMPERATURE CONTROLLER, TRANSFORMER, AND SWITCHING RELAYS WHICH CONTROL EITHER A 3-PUMP, 2-VALVE OR A 2-PUMP, 4-VALVE SOLAR HYDRONIC HEATING SYSTEM.

- Manual AUTO-STOP-ON switches aid in installation and provide emergency control of the heating system.
- Available with lights that indicate the operating mode of the system when manual switches are in the AUTO position.
- Plug-in type switching relays are easily replaceable.
- Ample terminal connections make wiring hookup convenient.
- Collector set point potentiometer adjustable from 75 to 125 F [24 to 52 C].
- Complies with the requirements of the HUD Interim Performance Criteria for Solar Heating.

R.L.
10-77 (.07)

SPECIFICATIONS

IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

MODEL: W968A Solar Control Panel contains a differential temperature controller, transformer, switching relays, manual switches and field wiring terminals for use in controlling either a 3-pump, 2-valve or a 2-pump, 4-valve solar hydronic system.

ELECTRICAL RATINGS:

Input and Output Voltage and Frequency 120V ac, 60 Hz.

Load Relay Contacts—
1 N.O. Pole—12 AFL/60 ALR at 120V ac.
1 N.C. Pole—125 VA at 120V ac.
Maximum Power Consumption—25 watts.

DIFFERENTIAL TEMPERATURE CONTROLLER: Adjustable ON and OFF differentials from minus 10 to plus 40 F [minus 5.6 to plus 22.2 C]. Factory set for 18 F [10 C] temperature difference ON and 3 F [1.7 C] temperature difference OFF. Plug-in resistors vary settings.

COLLECTOR SET POINT POTENTIOMETER RANGE: 75 to 125 F [24 to 52 C]. Indicates minimum temperature at which energy is used from the collector.

SHIPPING TEMPERATURE RANGE: Minus 30 to plus 150 F [minus 34 to plus 56 C].

AMBIENT TEMPERATURE RANGE: Plus 30 to plus 115 F [minus 1 to plus 46 C].

MOUNTING: 4 holes in back of case.

WIRING CONNECTIONS: Pressure-type terminals.

DIMENSIONS: See Fig. 1.

UNDERWRITERS LABORATORIES INC. LISTING APPLIED FOR.

ADDITIONAL EQUIPMENT REQUIRED:

L6031B Solar Aquastat Controller. High limit controller that prevents excessive temperatures in the collector system is combined with tankstat which controls first stage heating from storage.

Y534A Dual Diverting Valve. Provides flow characteristics which are compatible with solar energy systems.

C773 Electronic Temperature Sensor (2). Used with R7412 Differential Temperature Controller.
C773A is a single sensor for storage tank or solar collector mounting.
C773B contains a double sensor for storage tank or solar collector mounting.
C773C contains a single sensor with a flattened end and mounting hole for solar collectors.
C773D is a double sensor with flattened end and mounting hole for collector installation.

Immersion Well. For mounting C773 Electronic Temperature Sensor in storage tank. See Fig. 2 and Table 1.

T872 Thermostat. Provides low voltage control of multistage heating and cooling systems.

Q672 Subbase. Required for operation of T872 Thermostat.

(continued on page 3)

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. **Order number.**
2. **Additional equipment required and optional specifications.**
3. **Replacement parts, if needed (see back cover).**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

(IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

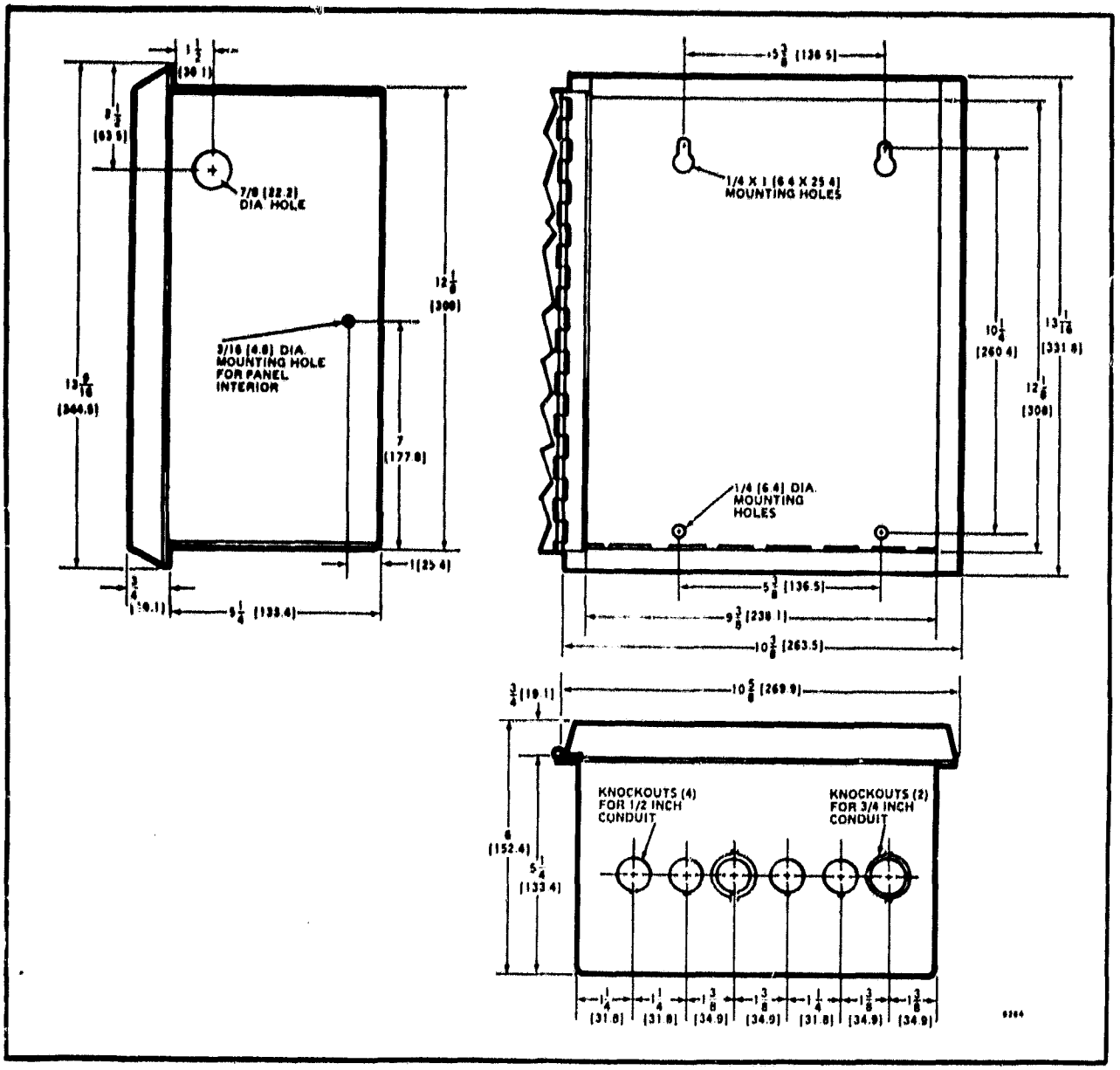


FIG. 1–W988A CASE DIMENSIONS IN INCHES [MILLIMETRES IN BRACKETS].

TABLE 1–IMMERSION WELL TABLE

IMMERSION LENGTH		INSULATION LENGTH		SELECT WELL MATERIAL AND ORDER NUMBER BELOW			
				COPPER		STAINLESS STEEL	
in.	mm	in.	mm	1/2 NPT	3/4 NPT	1/2 NPT	3/4 NPT
3-3/8	85.7	1-1/2	38.1	121731A	121371B	121371E	121371F
3-3/8	85.7	1-1/2	38.1	–	121371K[a]	–	–
3-3/8	85.7	3	76.2	121371L	121371M	–	–
3-3/8	85.7	4	101.6	122554A[a]	122555A[a]	–	–
5-3/8	136.5	4	101.6	122554B[a]	122555B[a]	–	–
6	152.4	1-1/4	31.8	112620BB	–	–	–

[a]Has plastic sleeve on insertion well.

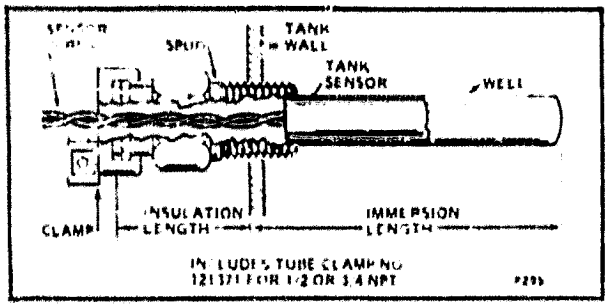


FIG. 2–TANK SENSOR INSERTED INTO IMMERSION WELL.

OPTIONAL SPECIFICATIONS

111892F Remote Sensor Wiring Compartment. For wiring C773 Electronic Temperature Sensor to storage tank.

INSTALLATION

WARNING

1. Installer must be a trained, experienced service technician.
2. Disconnect power supply before connecting wiring.
3. Conduct thorough checkout when installation is complete.
4. Shield the sensor against possible overtemperature conditions prior to system operation.
5. On unglazed collectors mount the sensor with leadwires down to keep sensor from accumulating water.
6. Wire additions to the leadwires must be capable of withstanding a temperature of 450 F [232 C].

MOUNTING CONTROL CABINET

The panel should be mounted on a convenient wall. Make certain that the desired location does not exceed the ambient temperature rating of 30 to 115 F [minus 1 to plus 46 C].

Remove the two chassis screws which are located on each side of the cabinet. Allow the chassis to rest at the bottom of the cabinet.

Fasten the cabinet to the wall using the two mounting holes at the top of the cabinet and two mounting screws (not provided). Replace the chassis and chassis screws.

Secure the cabinet to the wall using the two mounting holes at the bottom of the cabinet and two mounting screws (not provided).

MOUNTING ELECTRONIC TEMPERATURE SENSORS

Follow the system manufacturer's recommendations for the best location of the sensor. Each sensor should be located so that it experiences the most useful temperature for proper system operation.

Mount C773A,B as a storage tank sensor using an immersion well as follows:

1. Drain system fluid to a point below the sensor fitting.
2. Screw the well into the threaded fitting. Use an approved pipe dope or Teflon tape to seal the threads.
3. Refill system and check for leaks.
4. Insert the sensor probe into the immersion well until it bottoms. See Fig. 2.
5. Attach retainer clamp over groove on well spud. Fit wires in clamp groove and lightly tighten screw. Do not overtighten. If a remote sensor wiring compartment is used, secure the sensor with the spring clip instead of the retainer clamp.

Install C773A,B as a collector sensor using the mounting clip provided and No. 8 screw. Mount C773C,D as a collector sensor using the flattened end with mounting hole and a No. 8 or 10 screw. On unglazed collectors mount the sensor with leadwires down to keep sensor from accumulating water.

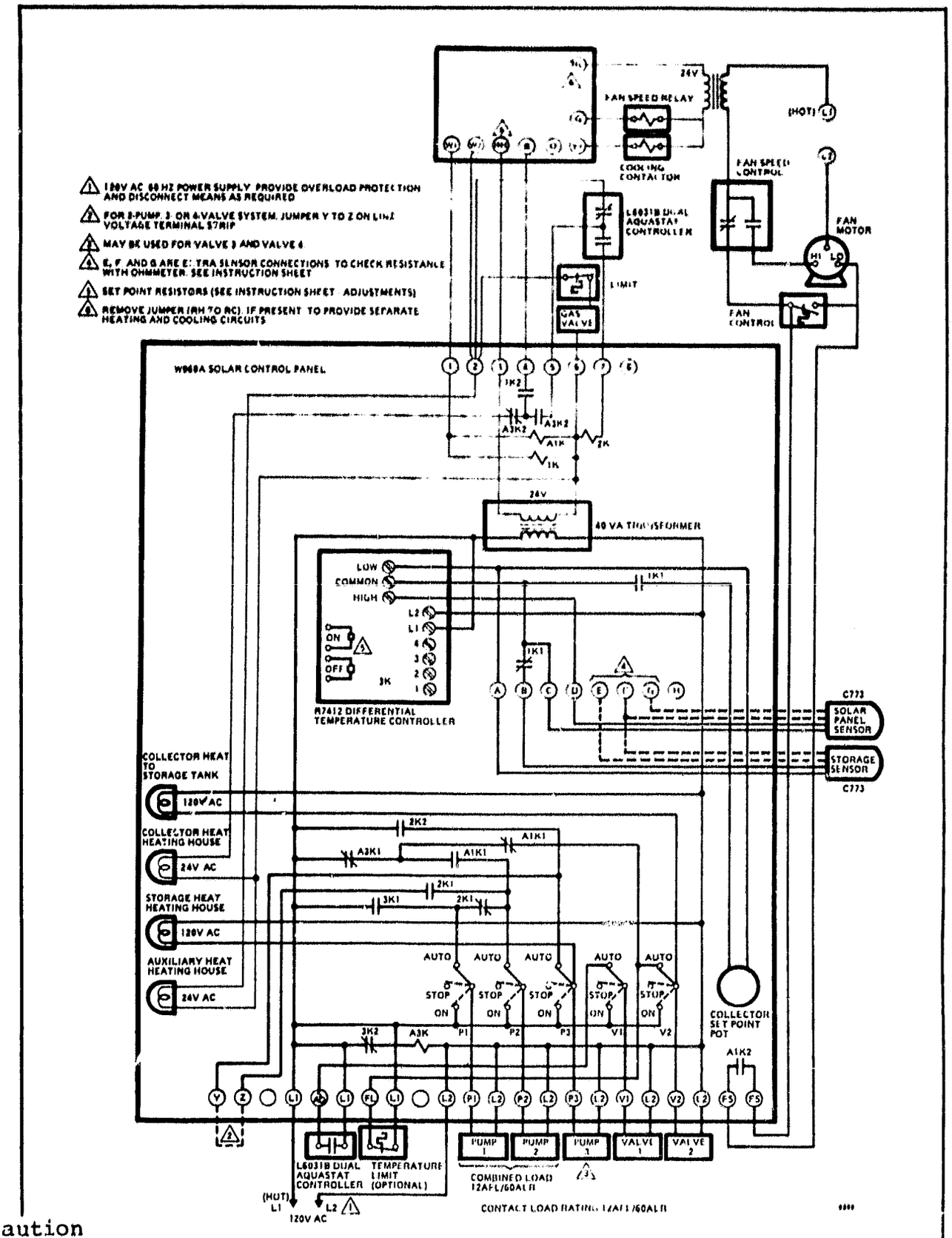
Temperatures in excess of 450 F [232 C] will damage the sensor. Shield the sensor against possible overtemperature conditions prior to system operation. *Do not mount collector sensor to collector fluid channels.*

WIRING

All wiring must comply with applicable codes and ordinances. The panel has four 1/2 inch conduit knockouts and two 3/4 inch conduit knockouts on the bottom of the case. It has one 7/8 inch [22.2 mm] opening for conduit on the right side of the case.

Pressure terminal connections are used for the wiring hookup. Refer to Fig. 3 for a wiring diagram.

If the amount of electronic temperature sensor cable used exceeds 100 feet [30.5 m], use No. 14 wire and grounded metallic conduit or shielded cable. Connect the shield to ground at the panel. Grounded metallic conduit and shielded cable (such as Belden 8762 or equivalent) minimize possible radio frequency signal interference. Wire additions to the leadwires must be capable of withstanding maximum collector stagnation temperatures if installed within the collector.



Caution

See SK142054 sheet 3 for changes to control wiring.

FIG. 3–WIRING THE W968A SOLAR CONTROL PANEL.

ADJUSTMENTS AND CHECKOUT

ADJUSTMENTS

AUTO-STOP-ON SWITCHES

For normal operation, the panel switches should remain in the AUTO position. The ON and STOP positions of these switches are useful during installation and calibration of the heating system. They may also be used for manually operating the system if the differential temperature controller fails.

COLLECTOR SET POINT POTENTIOMETER

The collector set point potentiometer establishes the minimum fluid temperature which the heating system will accept from the collector for direct heating of the house. Set the collector set point potentiometer to the desired setting; 90 F [32 C] is the recommended setting. This set point may be readjusted in accordance with individual preferences. Lower settings will generally result in the solar system carrying a higher percentage of the total heating load.

DIFFERENTIAL TEMPERATURE SELECTION

The control settings may be adjusted by changing the ON and OFF plug-in resistors and sensor connections (Fig. 4). The standard R7412 is factory-set for pull-in at 18 F [10 C] temperature difference with a 4750 ohm ON resistor. Dropout is set for 3 F [1.7 C] temperature difference with a 9760 ohm OFF resistor.

To change the setting refer to Table 3 to select the resistors needed. See Fig. 5 to prepare resistor for installation. Remove the old ON resistor and plug in the replacement. Repeat for the OFF resistor. Be sure the correct resistor is inserted in the proper position. Use 1/8 watt, 1 percent resistors, available locally.

CHECKOUT

One by one, set the AUTO-STOP-ON switches in the ON position to check that the valves and pumps have been wired correctly and that they are operating properly.

TABLE 2--W968A WIRING CHECKOUT

OPERATING MODE	DIS-CONNECT	ADJUST	ENERGIZE	SYSTEM RESPONSE (E = ENERGIZED, DE = DE-ENERGIZED)							W968A PANEL LIGHTS
				PUMP 1	PUMP 2	PUMP 3[a]	VALVE 1	VALVE 2	GAS VALVE	FAN	
Collector Heat Heating House	HIGH Temperature Sensor on Differential Temperature Controller		W_1 and B on Space Thermostat	E	E	DE	DE	DE	DE	E	Collector Heat Heating House
Collector Heat Heating House and Auxiliary Heat Heating House	HIGH Temperature Sensor on Differential Temperature Controller		W_1, W_2, and B on Space Thermostat	E	E	DE	DE	DE	E	E	Collector Heat Heating House, Auxiliary Heat Heating House
Storage Heat Heating House	LOW Temperature Sensor on Differential Temperature Controller	Dual Aquastat Tank Sensor Set Point at Minimum	W_1 and B on Space Thermostat	DE	DE	E	DE	DE	DE	E	Storage Heat Heating House
Storage Heat Heating House and Auxiliary Heat Heating House	LOW Temperature Sensor on Differential Temperature Controller	Dual Aquastat Tank Sensor Set Point at Minimum	W_1, W_2, and B on Space Thermostat	DE	DE	E	DE	DE	E	E	Storage Heat Heating House, Auxiliary Heat Heating House
Auxiliary Heat Heating House	LOW Temperature Sensor on Differential Temperature Controller	Dual Aquastat Tank Sensor Set Point at Maximum	W_1 and B on Space Thermostat	DE	DE	DE	DE	DE	E	E	Auxiliary Heat Heating House
Collector Heat to Storage Tank	HIGH Temperature Sensor on Differential Temperature Controller			E	E	DE	DE	E	DE	DE	Collector Heat to Storage Tank
Cooling			Y and O on Space Thermostat							E	
Ventilation			G on Space Thermostat							E	

[a]May be used for valve 3 and 4.

Next, set all W968A AUTO-STOP-ON switches in the AUTO position. *The indicator lights function correctly only if the panel switches are in the AUTO position.*

Check differential temperature controller operation as follows:

1. Disconnect wire to high temperature terminal C (see Fig. 3). Relay should pull in.

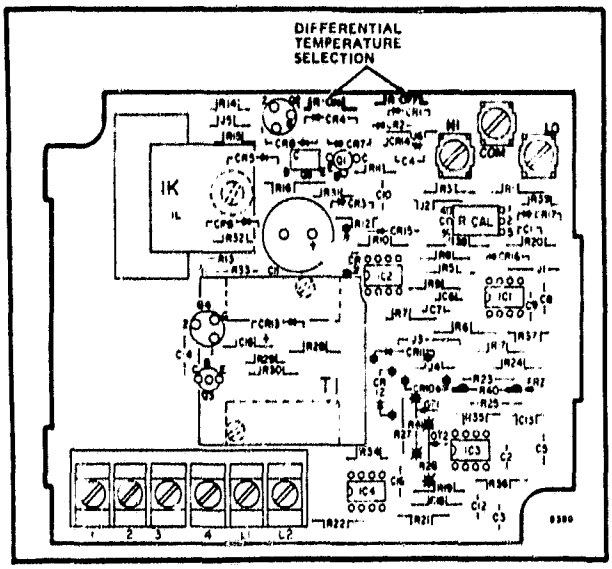


FIG. 4–ADJUSTING THE DIFFERENTIAL TEMPERATURE CONTROL.

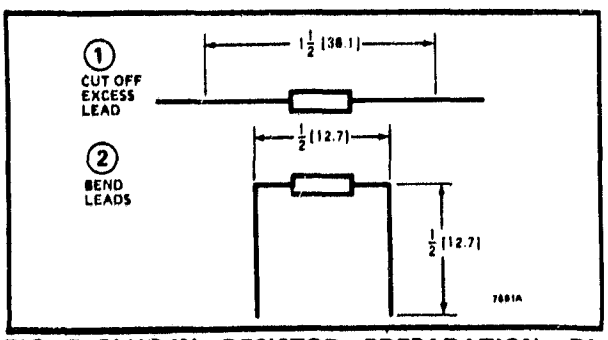


FIG. 5–PLUG-IN RESISTOR PREPARATION. DIMENSIONS IN INCHES [MILLIMETRES IN BRACKETS].

2. Reconnect sensor wire to high temperature terminal C and disconnect wire to low temperature terminal A. Relay should drop out. Reconnect sensor wire.

Check out the wiring of the W968A to a 3-pump, 2-valve solar heating system according to the procedures in Table 2.

TABLE 3–DIFFERENTIAL TEMPERATURE CONTROL

FOR TEMP. DIFFERENCE OF:		USE RESISTANCES BELOW FOR BOTH ON AND OFF RESISTORS
F	C	(IN OHMS)
0	0	11500
1	.6	11000
2	1.1	10500
3	1.7	9760
4	2.2	9310
5	2.8	8870
6	3.3	8250
7	3.9	7870
8	4.4	7500
9	5.0	7150
10	5.6	6810
12	6.7	6340
14	7.8	5760
16	8.9	5230
18	10.0	4750
20	11	4320
25[a]	14[a]	3480
30	17	2430
35	19	1740
40	22	1210
45	25	750
50	28	330

[a]Do not exceed 25 F [14 C] for OFF setting.

OPERATION

To trace the relay operation of the W968A, refer to the internal wiring of the panel given in Fig. 3. The following information describes how the W968A operates within a 3-pump, 2-valve solar heating system (Fig. 6). Fig. 7 depicts a 2-pump, 4-valve solar heating system.

COLLECTOR HEAT TO STORAGE TANK

Collector heat begins to be transferred to the storage tank whenever the collector plate temperature is 18 F warmer than the storage tank temperature and there is no call for heat from the space thermostat. Pumps 1 and 2 conduct heated water to the storage tank through valve 2. Pumps 1 and 2 are controlled by the differential temperature controller within the W968A and they will run as long as the collector temperature is at least 3 F [1.7 C] hotter than the storage tank temperature.

COLLECTOR HEAT HEATING THE HOUSE

On a call for heat from the space thermostat, 2 control relays direct valve 2 to allow flow of heated water to the solar coil.

If the collector plate temperature is greater than 90 F [32 C] (adjustable), then pump 1 will operate through the appropriate relays (Fig. 3). Pump 2 operates only when pump 1 is operating and they are both controlled by the differential temperature controller.

When the call for heat is satisfied, valve 2 diverts flow to the storage tank.

STORAGE HEAT HEATING HOUSE

Heating from storage is accomplished on a call for heat when sufficient energy is not present on the collector plate, but energy is available from storage.

On a call for heat, pump 3 brings heat from storage if the storage temperature at the top of the tank is greater than 90 F [32 C] (adjustable). Pumps 2 and 3 can not operate at the same time.

AUXILIARY HEAT HEATING HOUSE

On a call for heat, if none is available from the collector panels or the storage tank, relay contacts energize the gas furnace.

Also, if the "collector heat heating the house" or the "storage heat heating the house" cannot satisy a call for heat from the thermostat, relay contacts will start the gas furnace. Collector or storage heating may continue during auxiliary heating.

If heat is available from the collectors or storage tank, auxiliary heating operates when the thermostat senses a space temperature 2 F [1.1 C] below the set point.

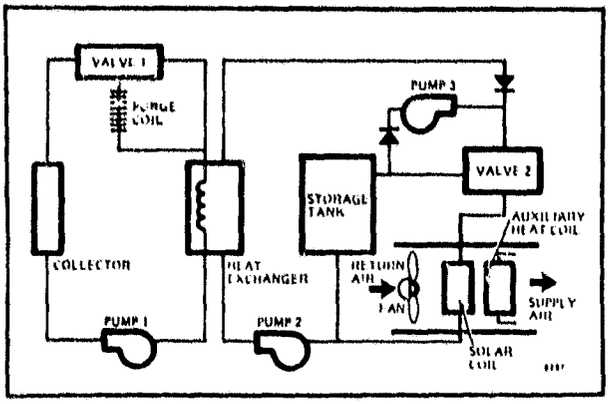


FIG. 6–3-PUMP, 2-VALVE HYDRONIC SOLAR HEATING SYSTEM WHICH USES THE W968A SOLAR CONTROL PANEL.

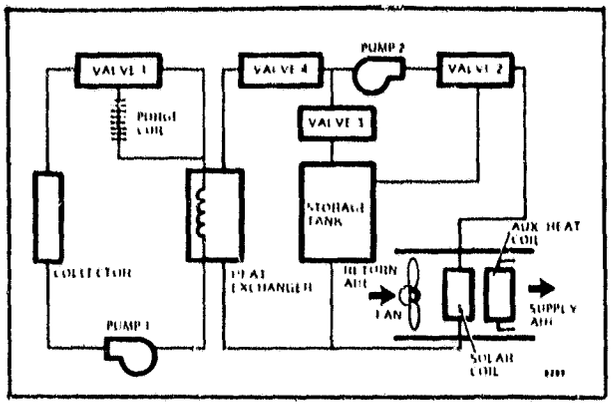


FIG. 7–2-PUMP, 4-VALVE HYDRONIC SOLAR HEATING SYSTEM WHICH USES THE W968A SOLAR CONTROL PANEL.

TROUBLESHOOTING

When the W968A Solar Control Panel does not appear to be operating properly, the following steps may be taken to troubleshoot system problems:

1. Determine the temperatures at the differential temperature controller and solar aquastat controller sensors. For the differential temperature controller, use a high resistance ohmmeter to measure the resistance across terminals E-F (storage sensor) and F-G (solar panel sensor) located in the W968A panel (Fig. 3). Refer to Fig. 8 to convert the resistance measurement to a temperature reading.

Determine the temperature which the solar aquastat is experiencing by adjusting the set points with a screwdriver and listening for the relays to operate. Aquastat may not cause a relay to operate when the relay in the aquastat changes state. Observe temperature scale for temperature reading.

2. Read the OPERATION section to determine which mode(s) the heating system should be operating in based on the sensor temperatures and the space temperature.

3. Check the location of the sensors for the differential temperature controller and solar aquastat controller. Make certain that each sensor is located so as to measure the most appropriate temperature for proper system operation. If the sensors are not providing correct temperature readings, change the location and mount properly.

4. Check that the solar aquastat is operating properly by adjusting the control points of the tankstat and high limit controller and listening for the relays to operate. Reset to the proper temperature.

5. Check that the differential temperature controller relay is operating properly by disconnecting the wire to high temperature terminal C (Fig. 3). Relay should pull in. Reconnect sensor wire to high temperature terminal C and disconnect wire to low temperature terminal A. Relay should drop out. Reconnect sensor wire to low temperature terminal A.

6. Check that the four W968A switching relays are operating properly by plugging in a new R8222 dpdt relay in place of the low voltage relays in the panel and a new R4222 dpdt relay in place of the line voltage relay in the panel. If the substituted relay causes the system to change modes, the original panel relay is faulty. *Do not install a low voltage relay in a line voltage receptacle.*

7. Check system operation on a mode by mode basis using the procedures of Table 2.

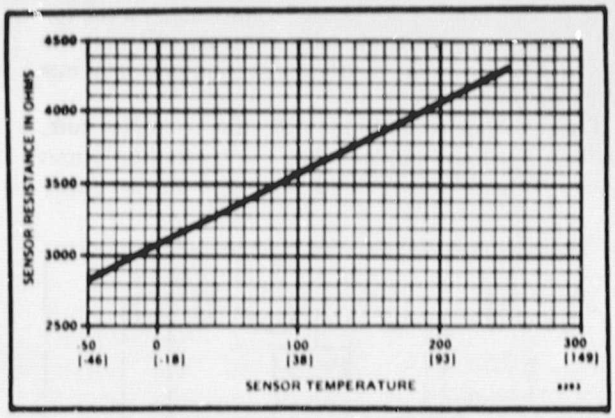
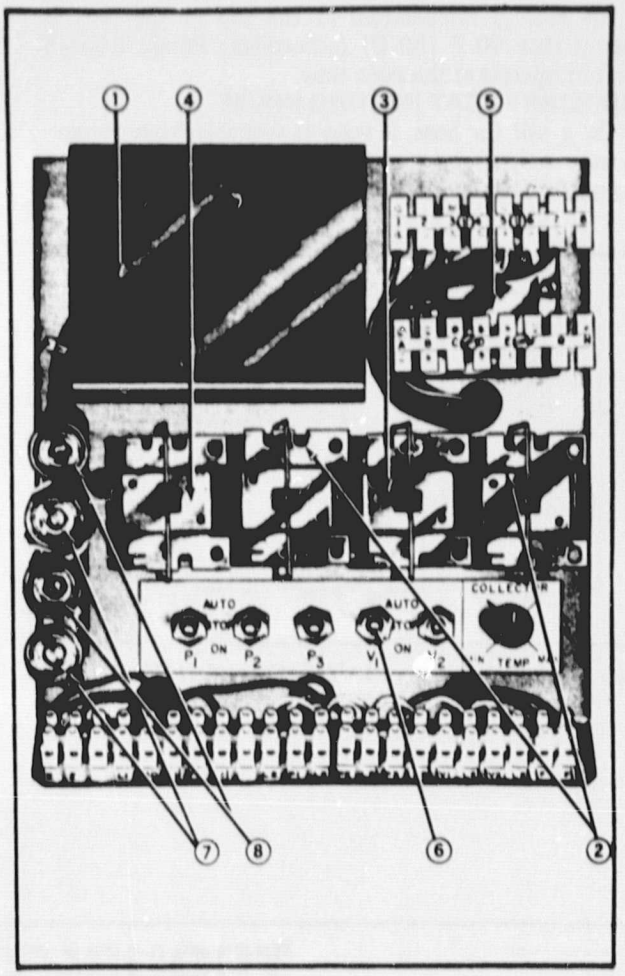


FIG. 8–CONVERTING SENSOR RESISTANCE INTO DEGREES F [C].



REPLACEMENT PARTS LIST

LOCATION	DESCRIPTION	ORDER NUMBER
1	Differential Temp. Controller	R7412A1012
2	Switching Relay (2)	R8222H1007
3	Switching Relay (1)	R8222S1000
4	Switching Relay (1)	R4222V1044
5	Transformer	AT40A1121
6	Manual AUTO-STOP-ON Switch	113700
7	Indicator Lamp (2)	192061
8	Indicator Lamp (2)	118543A

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APPENDIX F

CONTROL SUBSYSTEM

Parts List

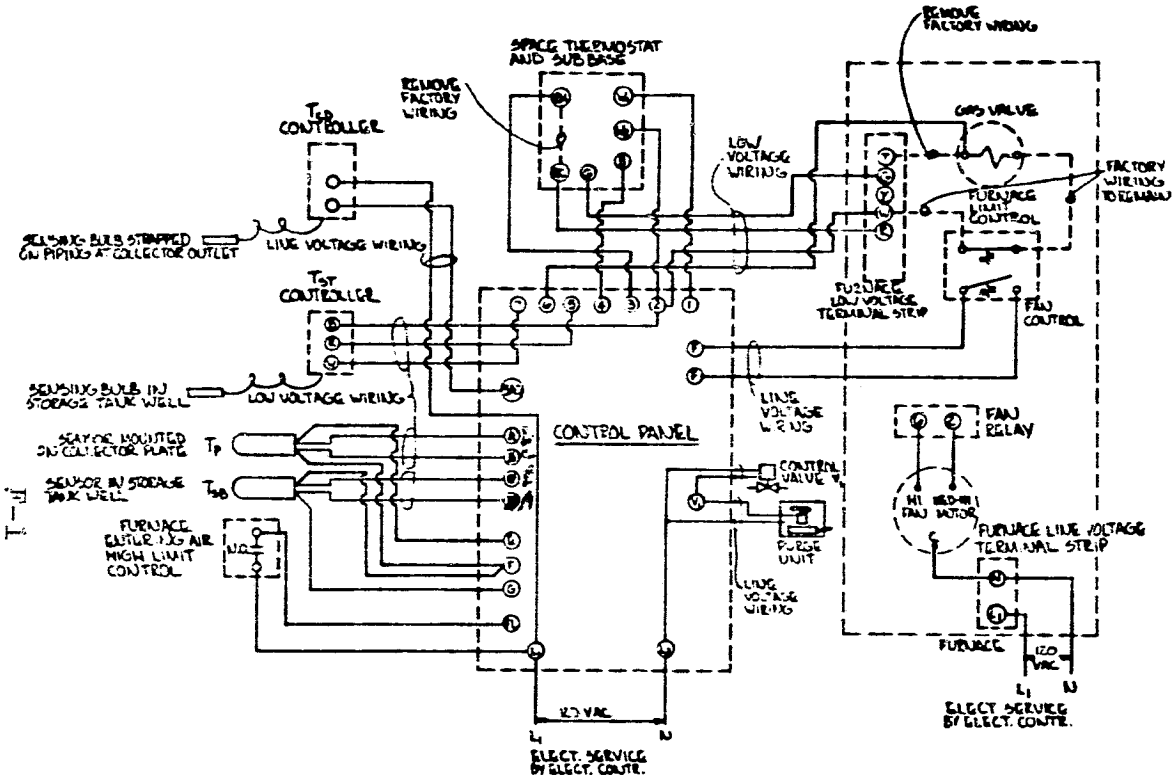
Item	Quantity	Description	Honeywell Model No.	Component Data
	1	Solar Control Panel*	W968A1009	Appendix E
T_{st}	1	Aquastat Controller	L6008C1065	Appendix F
T_{cd}	1	Aquastat Controller	L4008B1013	Appendix F
	1	Multistage Thermostat	T872C1004	Appendix F
	1	Thermostat Subbase	Q672B1004	Appendix F
V_1	1	Motorized Valve	V4331A1003	Appendix A & E
V_2	1	Motorized Valve*	V4331A1003	Appendix A & E
	2	Immersion Well	122555B	
	1	Case Assembly	112892F	
T_p & T_{sb}	2	Sensor	C773B1005	
	1	Collector Sensor Shield	SK-142067	

SK142054 (sheet 3) - Control System Wiring Diagram

*For reference only, premounted on transport module SK142053.

PART NO.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



SOLAR HEATING SYSTEM - SINGLE FAMILY RESIDENCE CONTROL SUBSYSTEM

1.0 GENERAL CONDITIONS

1.1 **Scope:** The Control Subsystem will include all controls necessary for operation of the solar heating system.

1.2 **Required Work:** The Mechanical Contractor will install and wire all controls as shown on control subsystem wiring schematic. This will include all line voltage wiring required.

1.3 **Procurement of Control Devices:** Control devices listed in Material List, (i.e., Solar Control Panel, Aquastats, Thermostat, etc.) will be provided by Honeywell ERC. This will include the control devices only, all materials necessary for a complete installation will be provided by the Mechanical Contractor.

2.0 BASIC MATERIALS AND METHODS

2.1 **Basic Materials:**

2.1.1 **Control sensor wiring (T_p and T_{sb}):** Wiring from solar control panel to control sensors T_p and T_{sb} shall be run in conduit in outdoor areas and shall be Belden #8762 or equal.

2.1.2 **Power and control wiring:** All line and low voltage wiring shall be of size and type required by applicable codes, and supplied by Mechanical Contractor.

2.1.3 **Other Materials:** All other materials required for a complete installation of the Control Subsystem shall be supplied by the Mechanical Contractor.

2.2 **Basic Methods:**

2.2.1 **Control device installation methods:** As per applicable details and/or instructions included with equipment.

2.2.2 **Electrical wiring:** As per all applicable codes.

		TOLERANCES UNLESS NOTED OTHERWISE	DRAFTSMAN		HONEYWELL INC. ENERGY RESOURCES CENTER
		X ± SURFACES ANGLES ±	CHECKER		
		XX ±	DEV ENGR		
		XXX ±	ENGR MGT	6/5/75	SOLAR HEATING SYSTEM SINGLE FAMILY RESIDENCE CONTROL SUBSYSTEM
		MATERIAL	CONTRACT NO.		
NEXT ASSY	USED ON		WILLIAM O'BRIEN		SIZE C | CODE IDENT NO. 55513 | DRAWING NO. SK-1420 A
APPLICATION		FINISH - SEE NOTE			SCALE NONE | SHEET 1 OF 1

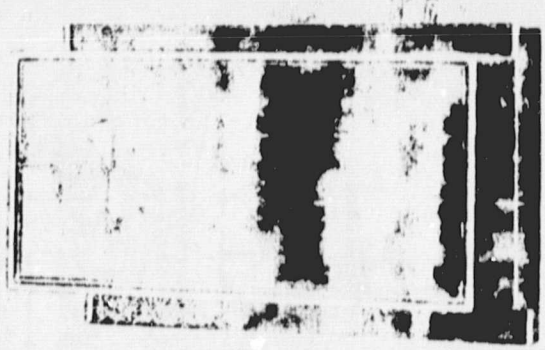
CONTROL | A

Honeywell

MULTISTAGE THERMOSTAT AND SUBBASE

THESE THERMOSTATS AND SUBBASES PROVIDE LOW VOLTAGE CONTROL OF MULTISTAGE HEATING AND COOLING SYSTEMS INCLUDING HEAT PUMP SYSTEMS.

- T872 Thermostat requires a Q672 Subbase.
- Q672 Subbase provides system and fan switching, wiring terminals, and mounting base for T872 Thermostat.
- T872 Thermostat has silent dust-free mercury switches operated by coiled bimetal elements.
- Q672 Subbase mounts on wall or horizontal outlet box.
- Adapter plate available for mounting Q672 Subbase on vertical outlet box.
- Heat anticipator(s) are adjustable or fixed; cooling anticipator(s) are fixed.
- External levers and scale for temperature setting located on top of thermostat case.
- Cover thermometer on most T872 Thermostat models.
- Locking cover and locking lever screws available for T872 Thermostats.
- Plastic thermostat guards available for T872 Thermostats.
- Key lock cover with tumbler lock available for T872 Thermostats.



N.J.
REV. 11-76 (.259)

SPECIFICATIONS

SUPER TRADELINE / TRADELINE MODELS

Super Tradeline controls offer features not available on Tradeline or standard models, and are designed to replace a wide range of Honeywell and competitive controls.

Tradeline models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Specifications of Super Tradeline and Tradeline controls are the same as those of standard models except as noted below.

SUPER TRADELINE MODELS

T872 THERMOSTAT

T872D1300 Thermostat. Provides 2 stages of heating and 2 stages of cooling.

SUPER TRADELINE FEATURES:

- Includes 130821 Adapter Plate Assembly for mounting T872-Q672 on a vertical outlet box.
- Super Tradeline package with cross reference label and special instruction sheet.
- Super Tradeline thermostat is compatible with all Tradeline switching subbases.
- Super Tradeline model supplied with locking lever and locking cover accessories.
- Includes adjustable temperature locking stops.
- Super Tradeline model with 4 switches replaces T872A-F Tradeline or standard models.

TRADELINE MODELS

T872 THERMOSTAT

T872 Thermostat Tradeline models provide 1- or 2-stage heat and/or cool operation as shown in the chart below.

T872	A	B	C	D	E	F
HEATING STAGES	1	1	2	2	—	2
COOLING STAGES	1	2	1	2	2	—

TRADELINE FEATURES:

- Tradeline package with cross reference label and special instruction sheet.
- T872A model with adjustable temperature locking stops.
- All Tradeline T872 models are supplied with locking lever and locking cover accessories.
- All Tradeline thermostat models are compatible with all Tradeline switching subbase models.

Q672 SUBBASE

Q672 switching subbases provide system and fan switching as listed.

Q672	SYSTEM	FAN
A	Heat-Auto-Cool	Auto-On
B	Heat-Off-Cool	Auto-On
E	Off-Heat-Auto-Cool	Auto-On

TRADELINE FEATURE:

- Tradeline package with cross reference label and special instruction sheet.

(continued on page 3)

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY–

1. **Order number:**
   - **–T872 Thermostat, Tradeline, or Super Tradeline, if desired.**
   - **–Q672 Subbase, Tradeline, if desired.**
2. **Optional T872 specifications, as required.**
3. **Optional Q672 specifications, if desired.**
4. **Accessories, as required.**
5. **Optional temperature scale range, if desired.**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

(IN CANADA–HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

T872 THERMOSTATS

MODELS: See Table 1.

ELECTRICAL RATING: 24 to 30V ac.

SWITCHING: Coiled bimetal elements operate mercury switches.

TEMPERATURE ADJUSTMENT: Heating and cooling setting levers, with common scale located on top of thermostat base. Common lever for heating and cooling on T872R, 1 cooling lever on T872E, and 1 heating lever on T872F.

TEMPERATURE SCALE RANGE: 44 to 86 F [7 to 30 C], standard; optional ranges available.

THERMOMETER RANGE: 52 to 98 F [11 to 36 C].

CHANGEOVER DIFFERENTIAL: 3 F [2 C] minimum between heating and cooling. Levers may be set apart for greater separation.

INTERSTAGE DIFFERENTIAL:

Standard Models--mechanical differential is 1 F [0.6 C] between heating or cooling stages; operating differential is approximately 1.9 F [1 C] between stages in heating or cooling.

Special Models--have other differential requirements.

FINISH: Silver bronze.

MOUNTING MEANS: T872 Thermostat mounts on Q672 Subbase. Subbase mounts horizontally on wall or outlet box. Mounts on vertical outlet box with optional 130821A Adapter Plate Assembly.

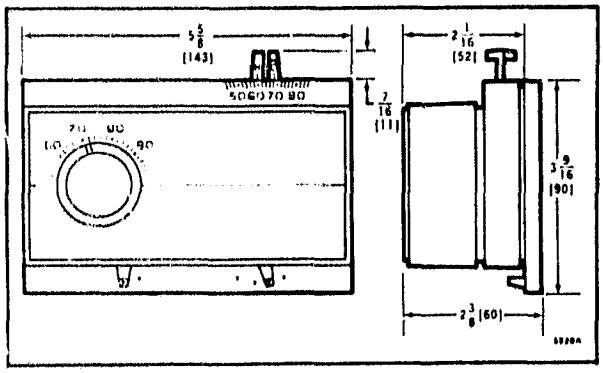


FIG. 1--DIMENSIONS OF T872 THERMOSTAT MOUNTED ON Q672 SUBBASE.

OPTIONAL SPECIFICATIONS (T872 only):

1. Temperature Scale Ranges: 40-75 F [5-24 C] and 75-90 F [24-32 C] with stop; 44-68 F [7-20 C] heating, 80-86 F [27-30 C] cooling; 6-29 C (43-85 F) Celsius scale.
2. Nonadjustable factory added stop. Limits heating set point to 75 F [24 C] maximum, cooling set point to 75 F [24 C] minimum.
3. Celsius scale; 6 to 29 C (43 to 85 F).
4. Customer personalization.
5. Locking cover and locking lever (see Accessories).
6. Thermostat cover less thermometer.
7. Adjustable locking temperature stops.
8. Voltage heat anticipation - first or second stage heat or both (Table I).
9. Fast cycling on heating stage(s) for electric heat applications.

ACCESSORIES:

1. Locking cover and locking lever assembly--Part No. 133627AA with thermometer, 133627AC without thermometer. Includes cover, two screws and Allen wrench for locking cover, plus two No. 4 X 1/4 inch (6.4 millimetre) panhead screws to lock set point levers.
2. Universal thermostat guard
   - --Part No. 133722A, clear plastic cover and beige plastic mounting base.
   - --Part No. 133722D, clear plastic cover and clear plastic "ring type" mounting base. Thermostat need not be removed from wall to install guard.
   - --Part No. 133723A, beige plastic cover and beige plastic mounting base.
   - --Part No. 133723B, beige plastic cover and clear plastic "ring type" mounting base.
3. Key lock cover with tumbler lock--mounts on T872 base and covers thermostat set levers and subbase switches. Two keys included. Should not be used with 130821A or B adapter plate.

- 190103C blank face, internal thermometer.
- 190903D external thermometer.

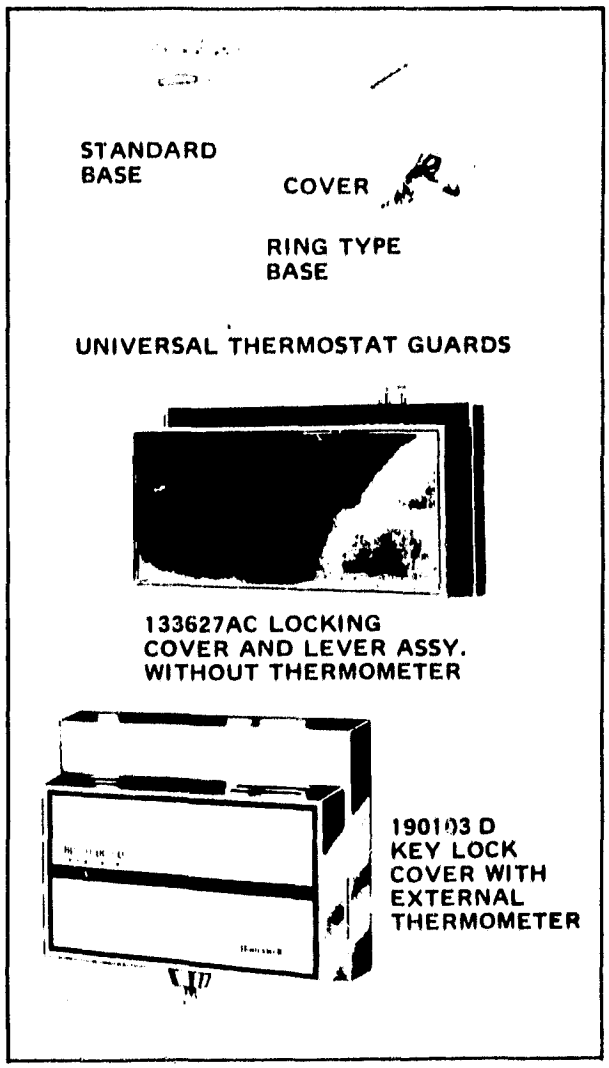


FIG. 2--T872 THERMOSTAT ACCESSORIES.

TABLE 1 T872 THERMOSTAT SPECIFICATIONS

MODELS AND OPTIONS	REPLACES	APPLICATION	SYSTEM STAGES			ANTICIPATION			
						HTG (ADJ)		COOLING (FIXED)	
			HEAT	COOL	OTHER	STAGE 1	STAGE 2	STAGE 1	STAGE 2
T872A –Standard and Tradeline	T870A	STD	1	1	–	0.1-1.2A	–	0-1.5A	–
–75 F scaleplate stop w/locking cover		STD	1	1	–	0.1-1.2A	–	0-1.5A	–
–Adj anticipator set .4 amp		STD	1	1	–	0.1-1.2A	–	0-1.5A	–
–Adjustable locking temperature stops (T/L)		STD	1	1	–	0.1-1.2A	–	0-1.5A	–
–75 F scaleplate stop w/locking cover, no thermometer (for DOD[i]).		STD	1	1	–	0.1-1.2A	–	0-1.5A	
T872B –Standard and Tradeline	T870B	STD	1	2	–	0.1-1.2A	–	0-1.2A	0-1.0A
–Adj anticipator set .4 amp		STD	1	2	–	0.1-1.2A	–	0-1.2A	0-1.0A
T872C –Standard and Tradeline	T870C	STD	2	1	–	0.1-1.2A	0.1-1.2A	0-1.5A	–
–75 F scaleplate stop w/locking cover		STD	2	1	–	0.1-1.2A	0.1-1.2A	0-1.5A	–
–Fast cycling		Elec Heat	2	1	–	0.12-0.6A	0.12-0.6A	0-1.5A	–
–75 F scaleplate stop w/locking cover, no thermometer (for DOD[i]).		STD	2		–	0.1-1.2A	0.1-1.2A	0.1-1.5A	–
–12 F differential between H1 and H2 stages (T872C1368)		STD	2	1	–	0.1-1.2A	0.1-1.2A	0.1-1.5A	–
T872D –Standard and Tradeline	T870D	STD	2	2	–	0.1-1.2A	0.1-1.2A	0-1.2A	0-1.0A
–Adjustable locking temperature stops (T/L)		STD	2	2	–	0.1-1.2A	0.1-1.2A	0-1.2A	0-1.0A
T872E –Standard and Tradeline	T870E	2-Stage Cool	–	2	–		–	0-1.2A	0-1.0A
T872F –Standard and Tradeline	T870F	2-Stage Heat	2	–	–	0.1-1.2A	0.1-1.2A	–	–
–Locking cover		2-Stage Heat	2	–	–	0.1-1.2A	0.1-1.2A	–	–
–Fast cycling		Elec Heat	2	–	–	0.12-0.6A	0.12-0.6A	–	–
T872G –Heat pump, cool changeover, with fast cycling	T870G	Ht Pump	2	1	1[a]	0-1.0A[b]	0.1-1.2A[h]	–	0-1.0A
T872H –Use with Q672C	New	Ht Pump	1	1	1[a]	0-0.8A[b]	–	–	0-0.8A
T872M –Motel heating-cooling application (requires manual changeover remote switching)	T870M	Remote Panel Switching	1	1	[c]	0.1-1.2A	–	0-1.5A	–
T872N –Heat pump, heat changeover	New	Ht Pump	2	1	1[f]	0.1-1.2A	–	0-1.0A	–
T872Q –Night setback heating	T870Q	STD	1[f]	–	–	0.1-1.2A	–	–	–
T872R –Standard	T870R	Ht Pump[e]	2	1	–	0-1.5A[b]	–	0-1.5A	–
T872S –Heat pump, heat changeover	New	Ht Pump	2	1	–	0.1-1.2A	0.1-1.2A	0-1.0A	–
T872T –Representative model	New	STD–Vent Stage	1	2	1[g]	0.1-1.2A	–	0-1.0A	0-1.0A

[a] Changeover stage operates with cooling.

[b] Fixed voltage type anticipation.

[c] Nonadjustable heating changeover stage set at 60 F [16 C].

[d] Manual changeover stage--use Q672B,L subbase.

[e] Provides night setback used with standard T872 and timer operated remote switching.

[f] Ventilating stage (See Fig. 31.)

[g] Second stage. Also available with fast cycle anticipation (0.12-0.6A) with voltage heater, or without anticipation.

[h] Changeover stage operates with heating.

[i] Department of Defense.

Q672 SUBBASES

MODELS: See table in form 70-6208.
ELECTRICAL RATING:
Switch contacts--2.5 amp at 30V ac (7.5 amp inrush).
Malfunction light (optional)--24 to 30V ac.
SWITCHES: Two snap-acting switches (one switch, Q672G and K, no switches on Q672D), operated by levers. Switch position is shown on scaleplate.
MOUNTING: Designed to mount horizontally on an outlet box or wall. Adapter plate assembly available for mounting on a vertical outlet box (see Accessories).
FINISH: Silver bronze.
DIMENSIONS in inches [millimetres]: 3-9/16 [90] high; 5-5/8 [142] wide; 5/16 [8] deep (Fig. 1).
OPTIONAL SPECIFICATIONS (Q672 only):

1. Malfunction indicator light with replaceable bulb available on all models. Indicator can show FILTER, CHECK, EM. HT. (emergency heat), or LK. OUT (lockout). Specify indication when ordering.
2. External jumper between R_C-R_H for common heating-cooling transformer. Jumper is field removable.
3. System switching marked HEAT-OFF/RESET-COOL for systems requiring impedance relay reset. Available on Q672B only.
4. "G" terminal isolated on heating to provide fan relay operation from external low voltage fan switch (Q672B only).
5. Auto fan operation on both heat and cool (Q672B only).
6. Common R terminal for heating/cooling.
7. External O and B terminal jumper (Q672G only).
8. Jumper between W2-X2 terminals (Q672F only).
9. Jumper between E-X2 terminals (Q672F only).
10. Changeover in cool or heat made for heat pumps.
11. Auto fan in EM. HT. for heat pumps.

ACCESSORIES:

1. Adapter plate assembly, Part No. 130821A, for mounting on vertical outlet box. Assembly includes adapter ring and cover plate.
2. Adapter plate assembly, Part No. 130821B, for covering old thermostat marks on wall. Cover plate only.
3. Indicator replacement bulb, Part No. 129571.
4. Field addable indicator light assembly, Part No. 135734A. Assembly includes retainer plate, 2 self-tapping screws, light bulb with 2-3/4 inch [70 millimetres] leadwires with spade terminals and lenses. The Q672 lenses indicate FILTER, CHECK or EM. HT.

INSTALLATION

CAUTION

1. Installer must be a trained, experienced serviceman.
2. Disconnect power supply to prevent electrical shock and equipment damage.
3. Do NOT short across coil terminals on relay. This may burn out the heat anticipator.
4. Run wires as close to the subbase as possible. To prevent interference with the thermostat linkage, keep wire length to a minimum, and make certain wires do NOT protrude outward beyond standoffs (Fig. 5). Push excess wire back into the hole, and plug hole to prevent drafts from affecting thermostat operation.
5. Do NOT overtighten thermostat captive mounting screws. This may damage the threads in the subbase.
6. Always conduct a thorough checkout when installation is complete.

IMPORTANT

Thermostats are calibrated at the factory using subbases mounted at true level. Inaccurate subbase leveling will cause thermostat control deviation.

LOCATION

Locate the thermostat about 5 feet [1.5 metre] above the floor in an area with good air circulation at average temperature.

Do not mount the thermostat where it may be affected by

- drafts, or dead spots behind doors and in corners.
- hot or cold air from ducts.
- radiant heat from the sun or appliances.
- concealed pipes and chimneys.
- unheated (uncooled) areas behind the thermostat.

SUBBASE MOUNTING

The subbase is designed for mounting on a wall or horizontal outlet box. (Adapter assembly, Part No. 130821B, with cover plate only is available for covering wall marks from old thermostat.) An adapter assembly, Part No. 130821A, with adapter ring and cover plate is available for mounting on a vertical outlet box. To mount subbase, proceed as follows:

1. At the location selected, prepare an opening for the thermostat wires.
2. Run low voltage thermostat wires to the location, and pull about 4 inches [100 millimetres] through the wall opening.

NOTE: Use color-coded thermostat cable for proper wiring.

3. If mounting the subbase on a vertical outlet box (Fig. 3), install the adapter ring with the 2 screws provided.

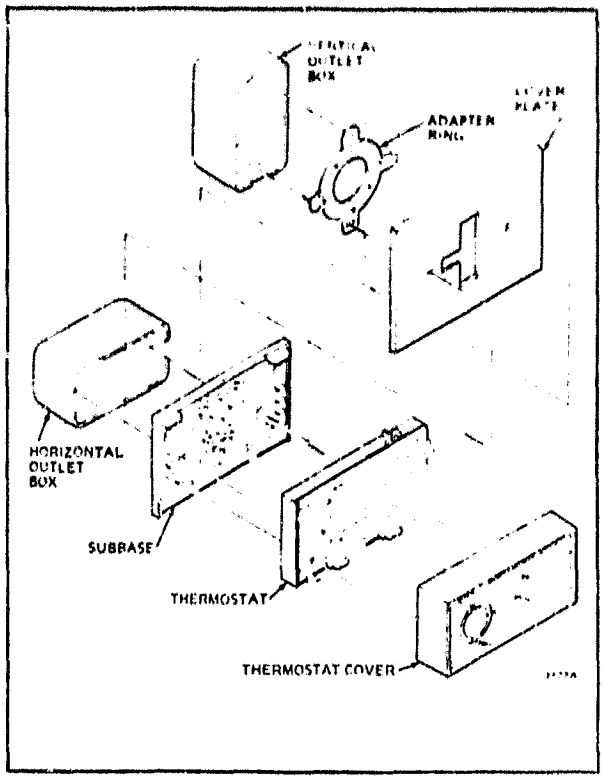


FIG. 3—INSTALLATION OF Q672 SUBBASE ON OUTLET BOX.

4. Pull thermostat cable through cover plate (if used) and subbase opening. Secure the cover plate and subbase with the 2 screws provided, but do not tighten.

Thermostats are calibrated at the factory using subbases mounted at true level. Inaccurate subbase leveling will cause thermostat control deviation.

5. The subbase mounting slots provide for minor out of level adjustments. Level the subbase using a spirit level, as shown in Fig. 4 and tighten subbase mounting screws.

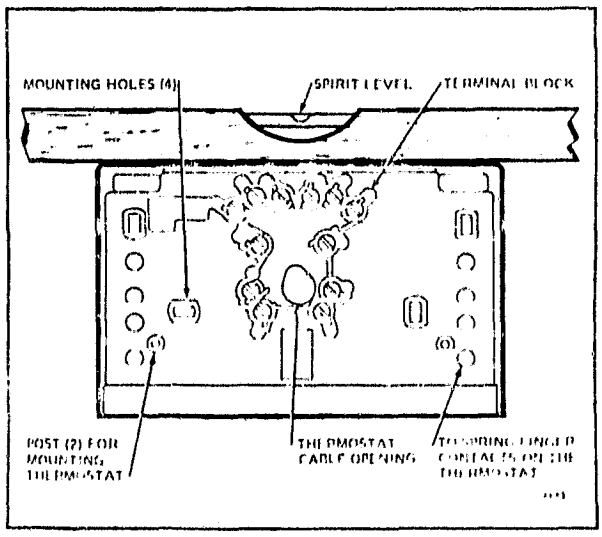


FIG. 4—LEVELING THE SUBBASE.

WIRING

All wiring must comply with local electrical codes and ordinances

A letter code is near each terminal for easy identification. Typical terminal designation and wiring connections are listed in Tables 2 and 3.

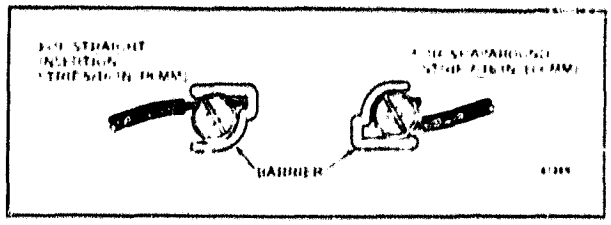


FIG. 5—BARRIER CONFIGURATION.

TABLE 2 TERMINAL DESIGNATIONS

TERMINAL	TYPICAL CONNECTION
B	Heating damper motor, changeover valve (if used).
E	Emergency heat relay.
G	Fan relay coil.
O	Cooling damper motor, changeover valve (if used).
R	Power connection to transformer (internally connected for cooling and heating).
R_C	Power connection to cooling transformer.
R_H	Power connection to heating transformer.
W_1	Stage 1 heating control.
W_2	Stage 2 heating control.
Y_1	Stage 1 cooling control.
Y_2	Stage 2 cooling control.
X-X_1-X_2 C	Clogged filter switch.

TABLE 3 ALTERNATE CONTROL CIRCUIT TERMINAL DESIGNATIONS

ALTERNATE DESIGNATIONS		STANDARD DESIGNATION	TYPICAL CONNECTION
V	V	R	24 volt power supply
H1	-	W1	First stage heating
H2	Y	W2	Second stage heating
C1	M	Y1	First stage cooling
C2		Y2	Second stage cooling
F	F	G	Fan
-	-	B	Heating changeover
-	B	O	Cooling changeover

The shape of the terminal barrier permits insertion of straight or conventional wrap-around (Fig. 5) wiring connections. Either method is acceptable. When making connections, strip wire to the length specified in Fig. 5.

Follow the equipment manufacturer's wiring instructions, if available, when wiring the subbase. If not available, Figs. 15 and up show typical T872-Q672 system hookups.

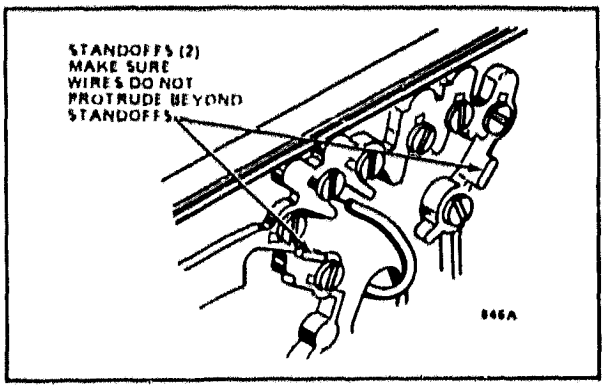


FIG. 6—INDIVIDUAL SCREW WIRING FOR Q672 SUBBASE.

Run wires as close to the subbase as possible. To prevent interference with the thermostat linkage, keep wire length to a minimum, and make certain wires do NOT protrude outward beyond standoffs, (Fig. 6). Push excess wire back into the hole, and plug hole to prevent drafts from affecting thermostat operation.

HEAT ANTICIPATOR SETTING

Set the heat anticipator scale to match the primary control rating. When using a T872 Thermostat with 2 stages of heating, set both heat anticipators to match their respective primary control rating. If the primary control nameplate has no rating or if further adjustment is necessary, use the following procedure to determine the current draw of each stage.

The current draw of each heating stage must be measured with the thermostat removed.

1. Connect an ac ammeter of appropriate range between the heating terminals of the subbase–
   Stage 1–between W1 and RH or R;
   Stage 2–between W2 and RH or R.
2. Move the system switch to HEAT or AUTO.
3. After 1 minute, read the ammeter and *record* the reading.
   Stage 1– amp;
   Stage 2– amp.
4. After mounting the thermostat (see Thermostat Mounting, next paragraph), set the adjustable heat anticipator to match the respective reading measured in step 3.

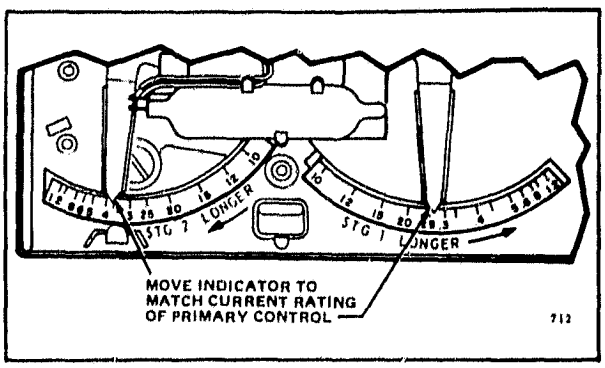


FIG. 7—ADJUSTABLE HEAT ANTICIPATOR SCALES.

If equipment cycles too fast, set the anticipator to a higher current rating, not more than 1/2 division at a time, and recheck cycle rate. Most conventional 2-stage heating equipment is designed to operate at 3 cycles per hour, and 1-stage heating equipment at 6 cycles per hour, at 50 percent load conditions. When using a T872 Thermostat in heat pump systems, set the heat anticipator at 140% of the actual primary control current draw to reduce the cycling rate.

Most heat pump systems should cycle 2-1/2 to 3 times per hour.

THERMOSTAT MOUNTING

1. Remove the thermostat from the polystyrene shipping container.
2. Remove the thermostat cover by pulling the bottom edge of the cover upward until it snaps free of the locking springs.

NOTE: The cover is hinged at the top and must be removed by pulling up at the bottom.

3. Carefully remove and discard the polystyrene packing insert which protects the mercury switches during shipment.
4. Turn the thermostat base over and note the spring fingers which engage the subbase contacts. Make sure the spring fingers are NOT bent preventing proper electrical contact with the subbase.

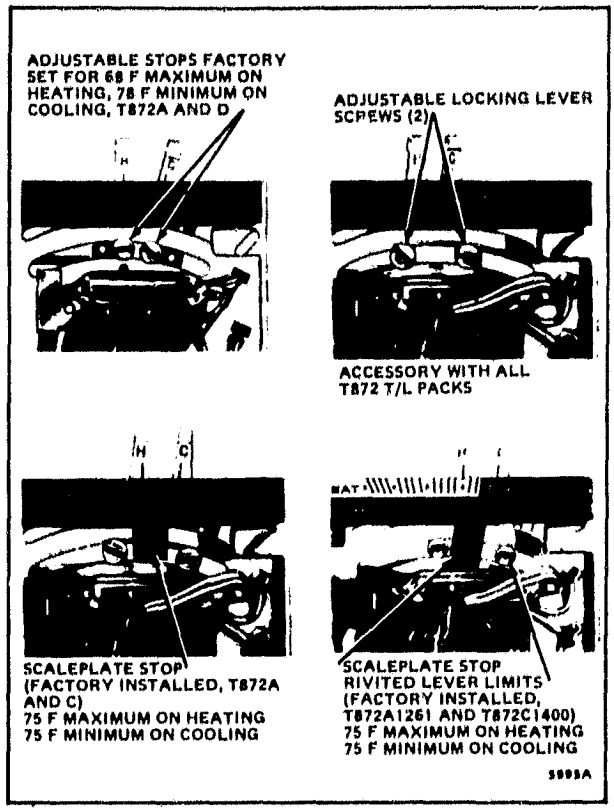


FIG. 8—RANGE LIMITING AND LEVER LOCKING METHODS.

5. Set the heat anticipator indicator(s), Fig. 7, to the respective current setting of each stage. See Heat Anticipator Setting.

6. If the thermostat provides the optional locking lever assembly, install the 2 self-tapping screws (Fig. 8) in the lever arms, if desired.

7. If the thermostat provides optional locking cover assembly, start the 2 Allen locking screws in the cover with the wrench provided (Fig. 9).

8. Note the tabs along the top inside edge of the thermostat base. The tabs fit the subbase sockets. Hang the thermostat on the subbase and tighten the captive mounting screws (Figs. 3-4) on the thermostat base. Do NOT overtighten thermostat captive mounting screws. This may damage the threads in the subbase.

9. Hang the upper edge of the thermostat cover on the base and swing cover downward until it engages with spring clips on base. Tighten the locking cover screws, if assembly is provided.

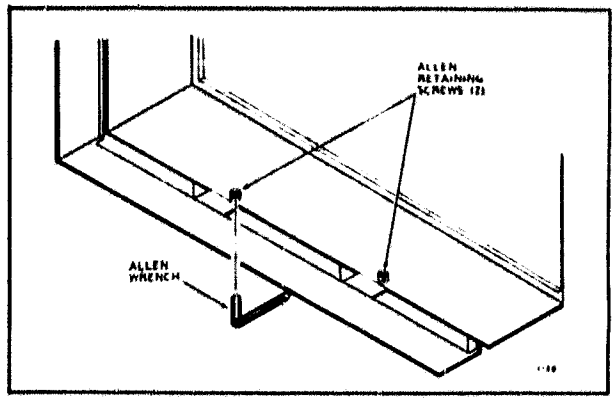


FIG. 9—INSTALLATION LOCKING COVER SCREWS ASSEMBLY.

SETTING AND CHECKOUT

CAUTION

On systems using a gas valve, never apply a jumper across the valve coil terminals, even temporarily. This may burn out thermostat heat anticipator(s).

SETTING

TEMPERATURE SETTING

Move the H (heating) and C (cooling) levers (see Fig. 10) to the desired positions. On models with 2 stages of heating or cooling, the same lever controls both stages. The minimum differential between heating and cooling set points is 3°F [2 C] at midscale.

If model has optional screws to lock temperature control levers, loosen these screws before making temperature adjustment; tighten when levers are set at desired position.

SUBBASE SETTING

SYSTEM SWITCHING positions control thermostat operation as follows (see listing of models for positions applicable to model being installed):

OFF—both the heating and cooling systems are off. If the fan switch is at AUTO position, the cooling fan is also off.

HEAT—heating system is controlled by the thermostat. Cooling system is off.

AUTO—completely automatic -heating or cooling controlled by the thermostat.

COOL—thermostat controls the cooling system. Heating system is off.

EM. HT.—emergency heat relay is energized. Cooling system is off.

FAN SWITCHING positions control fan operation as follows:

ON—fan operates continuously.

AUTO—fan operates with cooling equipment as controlled by the thermostat or with the heating equipment as controlled by the plenum switch.

CHECKOUT

HEATING

Move the system switch on the Q672 Subbase to HEAT or AUTO. Move the H lever on the T872 (Fig. 10) about 10 F [6 C] above room temperature. Both stages of heating system should start and the fan should run after a short delay. Move the H lever about 10 F [6 C] below room temperature. The heating equipment should shut off, and the fan should run for a short time, then shut off.

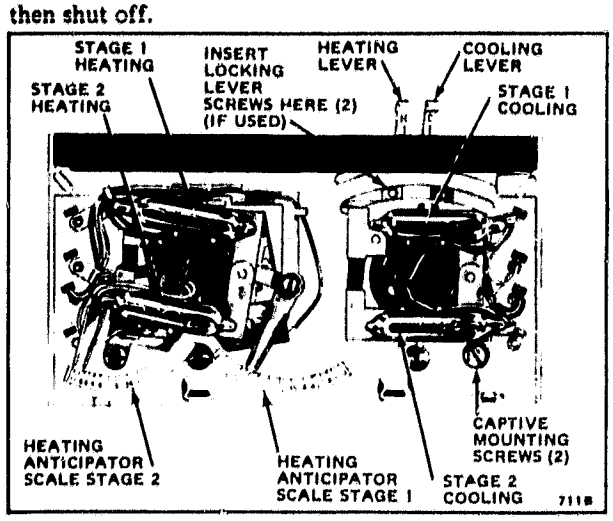


FIG. 10—INTERNAL VIEW OF T872D (WITH 2 STAGES OF HEATING AND COOLING).

COOLING

Move the system switch on the Q672 Subbase to COOL or AUTO. Move the C setting lever on the T872 Thermostat (Fig. 10) about 10 F [6 C] below room temperature. The cooling equipment and fan should start. If the system has 2 stages of cooling, both stages should start. Move the C lever about 10 F [6 C] above room temperature. The cooling equipment and fan should stop.

FAN

Move the system switch to COOL, OFF, or AUTO. If necessary, position both temperature setting levers near midscale so that the heating and cooling equipment are off. Move the fan switch to ON. The fan should run continuously. When the fan switch is in the AUTO position, fan operation is controlled by the heating or cooling system.

SERVICE

CAUTION

Before servicing, disconnect power supply to prevent electrical shock or equipment damage.

THERMOSTAT

T872 Thermostats are accurately calibrated at the factory; THEY DO NOT HAVE PROVISION FOR FIELD CALIBRATION.

THERMOMETER

To calibrate the thermometer:

1. Remove thermostat cover by pulling up from the bottom until it clears the locking springs. If cover has optional locking screws, these must be backed out before cover can be removed.
2. Set the cover on a table near an accurate thermometer.
3. After allowing 5 or 10 minutes for stabilization, compare the readings. If they are the same, replace cover and put system into operation. If they are different, recalibrate the thermostat thermometer, step 4.
4. Insert a small screwdriver in the thermometer shaft (Fig. 11) and turn it until the thermometers read the same. When thermometer is calibrated, replace cover and place system and fan switches for desired operation.

NOTE: Hand heat will offset the thermometer reading. After making each adjustment, wait 5 or 10 minutes for the thermometer to stabilize before comparing.

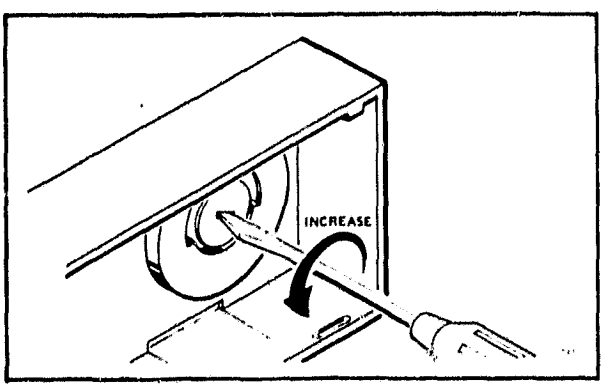


FIG. 11—THERMOMETER CALIBRATION.

BULB REPLACEMENT

Before replacing bulb, shut off the power supply to prevent shorting out the transformer at the bulb terminals, or move subbase system switch to "OFF."

Replace bulb in subbases with optional malfunction light as follows.

1. Remove the thermostat from the subbase.
2. Remove the snap-on shield that covers the light.
3. Disconnect the field wire from the "X" terminal to prevent shorting out the transformer at the bulb terminals.
4. Snap out the old bulb and replace it with a new bulb, Part No. 129571. The bulb contact should seat in the depression in the socket base. The bulb may be screwed in farther, if necessary, for a better electrical connection. When installing bulb, use needlenose pliers.
5. Reconnect the field wire to terminal "X."
6. Replace the shield and mount the thermostat.

INDICATOR LIGHT ASSEMBLY INSTALLATION

The 135734A Indicator Light Assembly may be field added to most Q672 Subbases. The assembly mounts directly on the subbase and may be installed before or after the subbase is mounted. To install the indicator light assembly, use the following procedure.

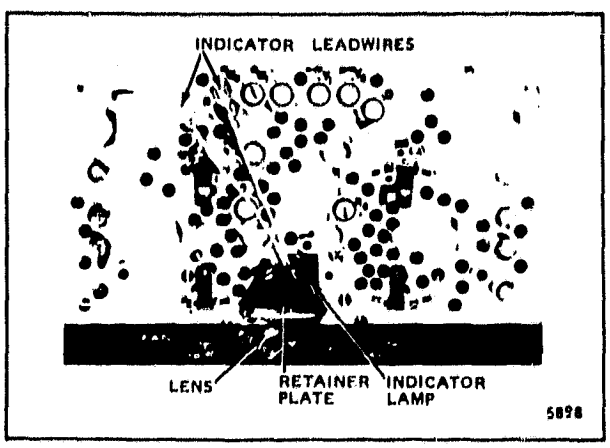


FIG. 12—INSTALLATION OF INDICATOR LIGHT ASSEMBLY.

1. If the thermostat is mounted on the Q672 Subbase, remove the thermostat cover. NOTE: If the cover has optional locking screws, these must be backed out before cover can be removed.
2. Loosen 2 captive screws and remove thermostat.
3. Select either FILTER, CHECK, or EM. HT. lens.
4. Place the lens over the recess cavity on the subbase, and place the black retainer plate over the lens.
5. Start 1 self-tapping screw through the left-hand hole of the retainer plate and lens.
6. Pivot lens and plate out of way as shown in Fig. 12. Insert bulb into recessed cavity, and route wires toward left-hand side of subbase.
7. Pivot lens and retainer plate into position, and start second self-tapping screw in right-hand retainer hole.

To wire indicator light assembly, use the following procedure.

1. Route 1 indicator light leadwire to the R or RH subbase terminal, and fasten beneath the terminal screw (Fig. 13).

2. Route second indicator light leadwire to right retainer screw.

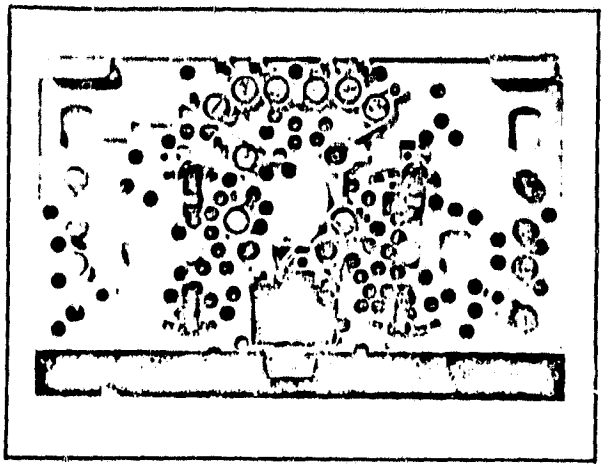


FIG. 13–CONNECTING 135734A LEADWIRES.

3. Route wire from indicator light control switch to right retainer screw. Attach both indicator switch wire and indicator light leadwire to right retainer screw.

4. Connect remaining indicator light control switch wire to common secondary leg of heating transformer (Fig. 14).

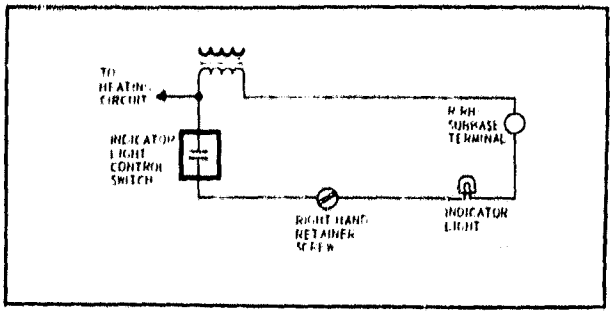


FIG. 14–WIRING HOOKUP FOR INDICATOR LIGHT AND CONTROL SWITCH.

Remount the thermostat, and restore the power supply. To check indicator light operation, jumper the indicator light control. The indicator lamp should light. After removing the jumper, the lamp should go out.

THERMOSTAT-SUBBASE APPLICATION

The schematics on the following pages are divided into four groups:

1. Standard circuits with AUTO heat-cool changeover, page 11.
2. Standard circuits with MANUAL heat-cool changeover, page 17.
3. Heat Pump circuits with changeover in cooling–
   AUTO, page 21.
   MANUAL, page 28.
4. Heat Pump circuits with changeover in heating–
   AUTO, page 32.

Within groups, schematics are generally arranged alphabetically by subbase model, then thermostat model. For additional information on Q672 Subbase/T872 Thermostat combinations, see form 70-6208.

Circuit descriptions and terminology is defined as follows.

For standard heating-cooling circuits:

AUTO CHANGEOVER–refers to the presence of an AUTO position in the system switching (EXAMPLE: Q672E with OFF-HEAT-AUTO-COOL switching); does not require switch movement to change mode.

MANUAL CHANGEOVER–requires a system switch movement to change mode. (EXAMPLE: Q672B with HEAT-OFF-COOL switching).

T872D thermostats with 2 heat and 2 cool switches are shown on most standard circuits. Most standard or Tradeline subbases (Q672 A-E, G) can be used with T872A-F standard Tradeline thermostats. The schematics can be field-modified as required.

For heat pump circuits:

CHANGEOVER VALVE–operates on Cooling. The reversing valve or relay is activated either by moving the system switch to COOL (manual changeover) or by a mercury switch which makes on a temperature rise (auto changeover).

CHANGEOVER VALVE–operates on heating. The reversing valve or relay is activated either by moving the system switch to HEAT (manual changeover) or by a mercury switch which makes on a temperature fall (auto changeover.)

For all circuit components:

Each mercury switch is identified by function, as follows:

H1–Stage 1 heating
H2–Stage 2 heating
C1–Stage 1 cooling
C2–Stage 2 cooling
C/O–Changeover (heat pumps)

Each anticipator is identified as adjustable or fixed, as well as naming which switch it affects. FOR EXAMPLE: H1 adjustable anticipator, C1 fixed anticipator.

All T872 thermostats use mercury switches. Each schematic will indicate switch operation by being drawn in the open position with an arrow indicating operation with a temperature RISE or FALL.

STANDARD CIRCUITS WITH AUTO HEAT-COOL CHANGEOVER

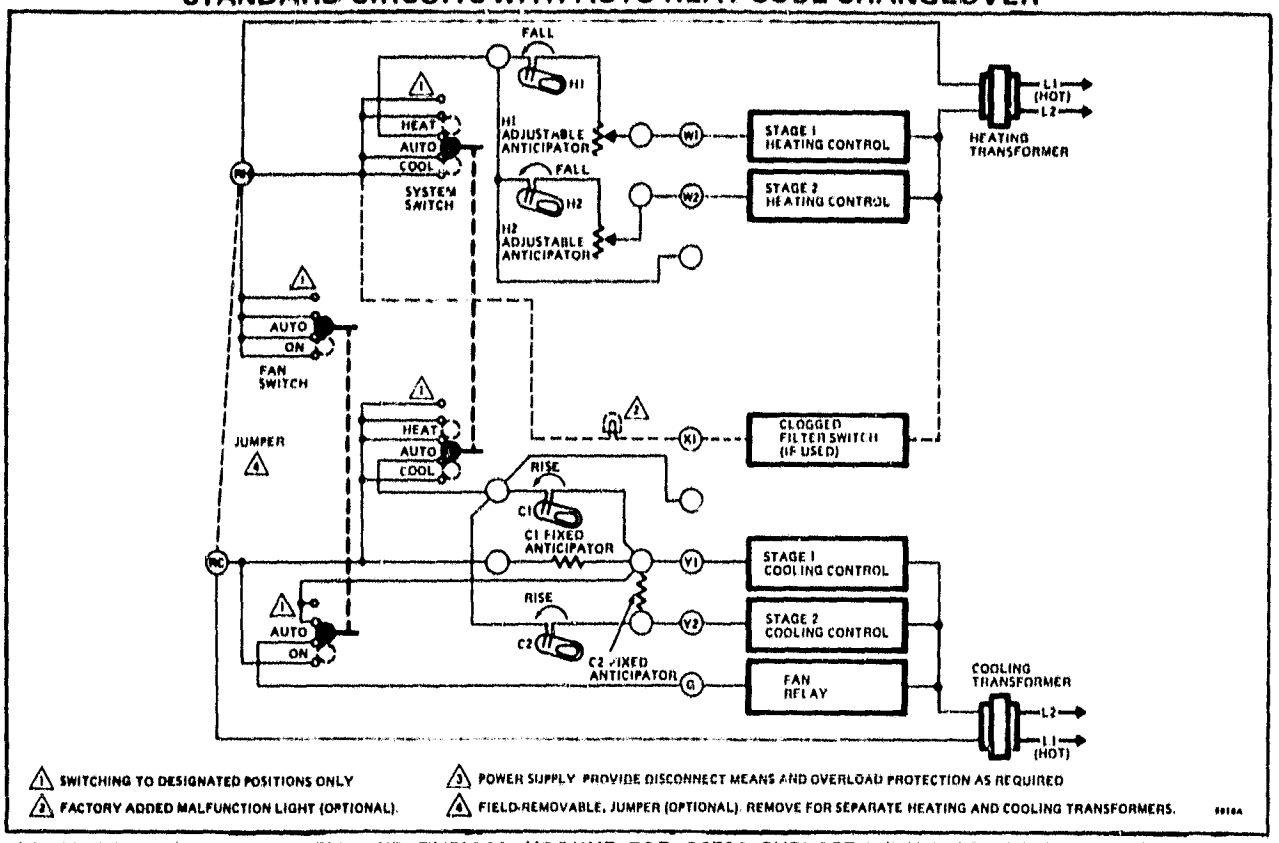


FIG. 15—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672A SUBBASE WITH T872D THERMOSTAT. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

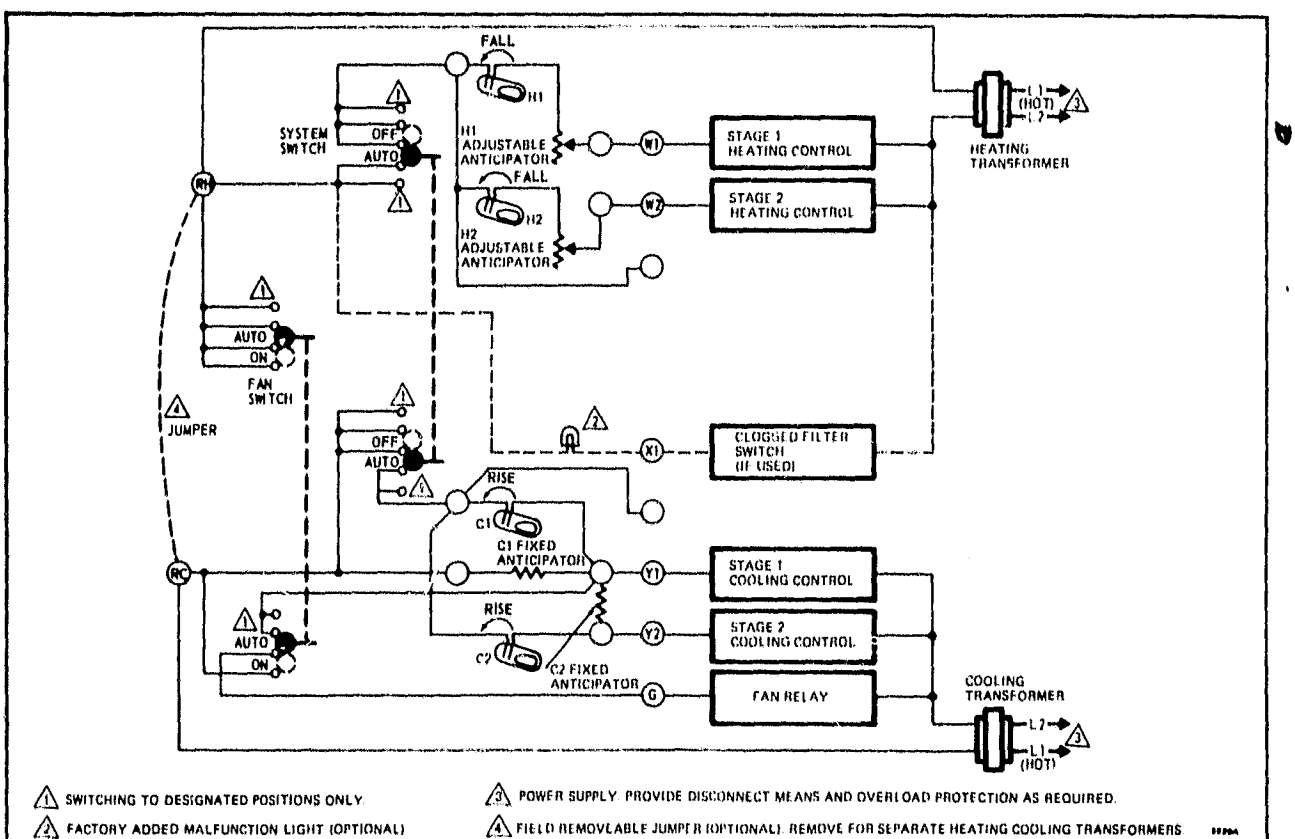


FIG. 16—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672C SUBBASE WITH T872D THERMOSTAT. SUBBASE PROVIDES OFF-AUTO SYSTEM AND AUTO-ON FAN SWITCHING.

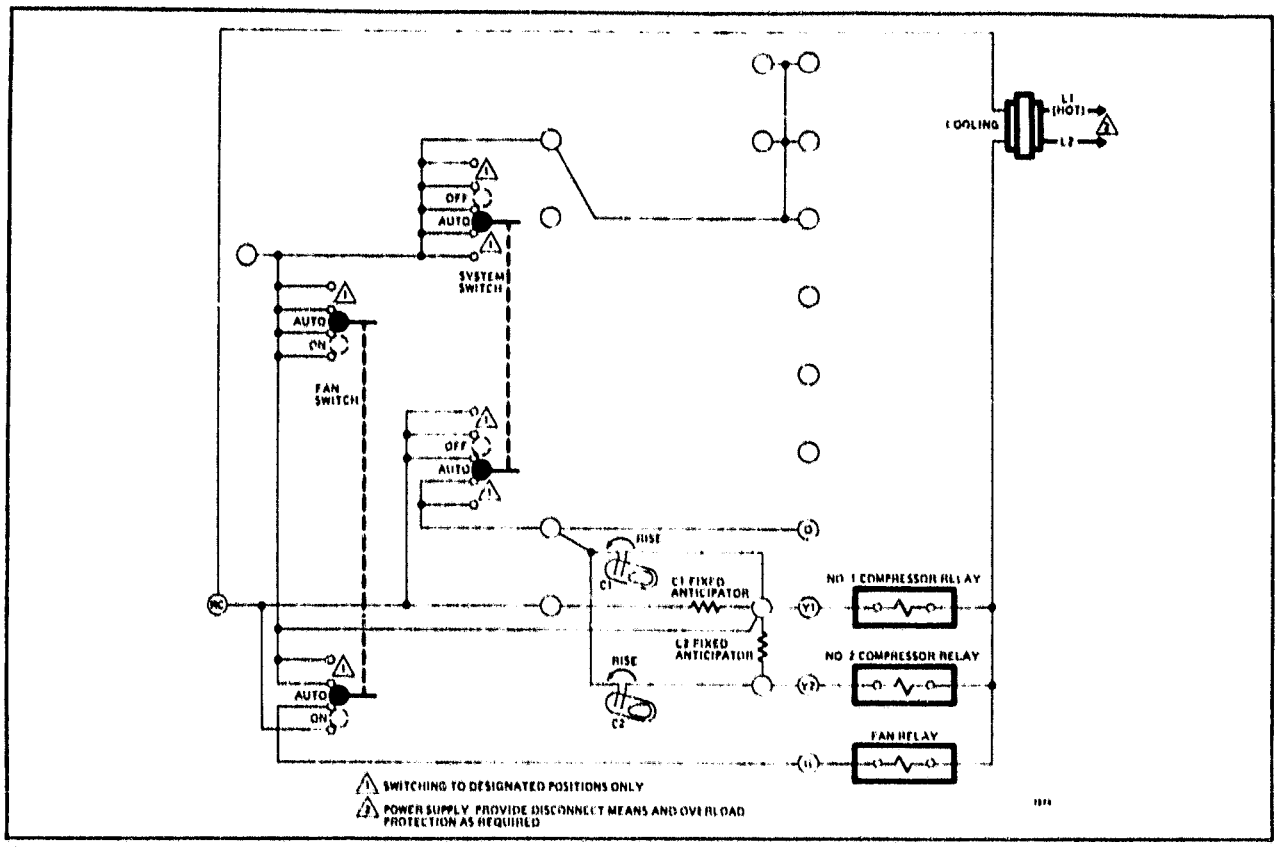


FIG. 17—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672C SUBBASE WITH T872E THERMOSTAT. SUBBASE PROVIDES OFF-AUTO AND AUTO-ON FAN SWITCHING. RC TERMINAL FOR COOLING ONLY.

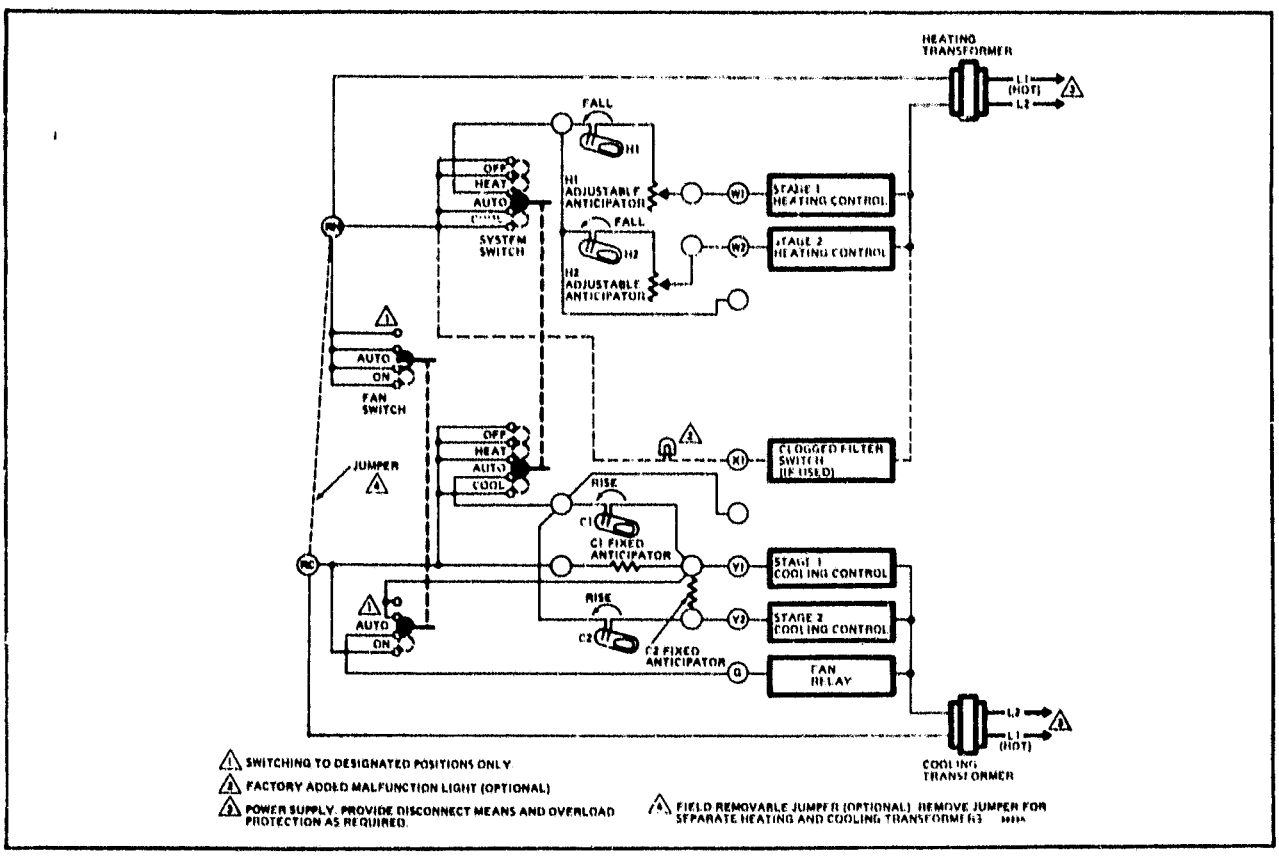


FIG. 18—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672E SUBBASE WITH T872D THERMOSTAT. SUBBASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING. RC-RH TERMINALS FOR SEPARATE HEATING AND COOLING CIRCUITS.

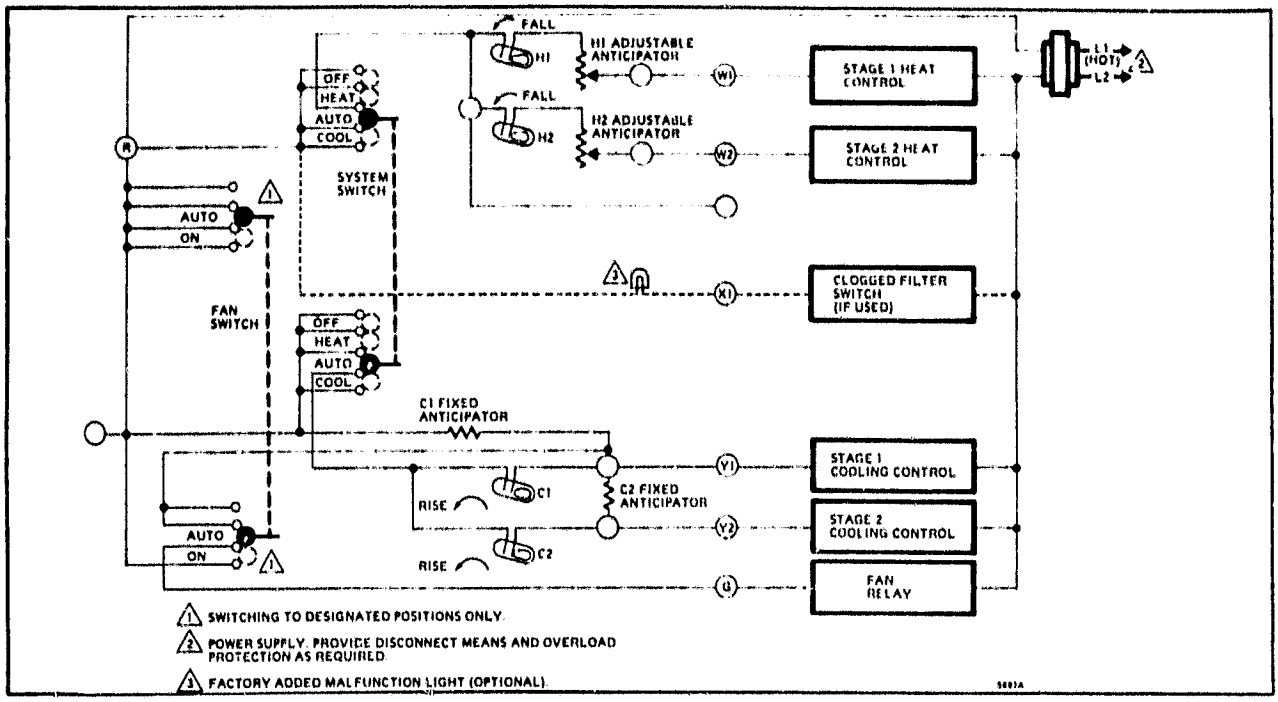


FIG. 19—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672E SUBBASE WITH T872D THERMOSTAT. SUBBASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING. R TERMINAL FOR COMMON HEATING AND COOLING CIRCUIT.

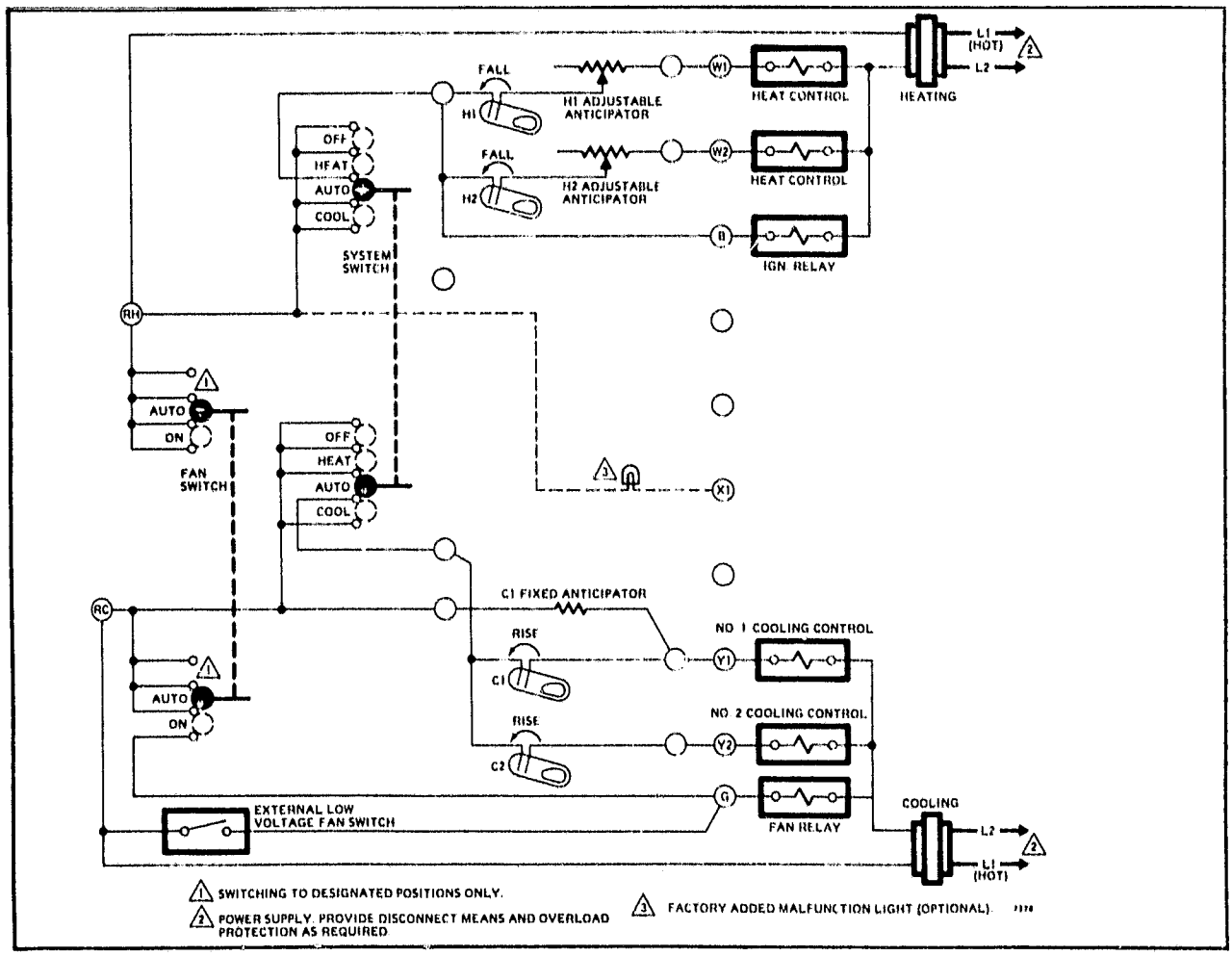


FIG. 20—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672E SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING. RC-RH TERMINALS FOR SEPARATE HEATING AND COOLING CIRCUITS.

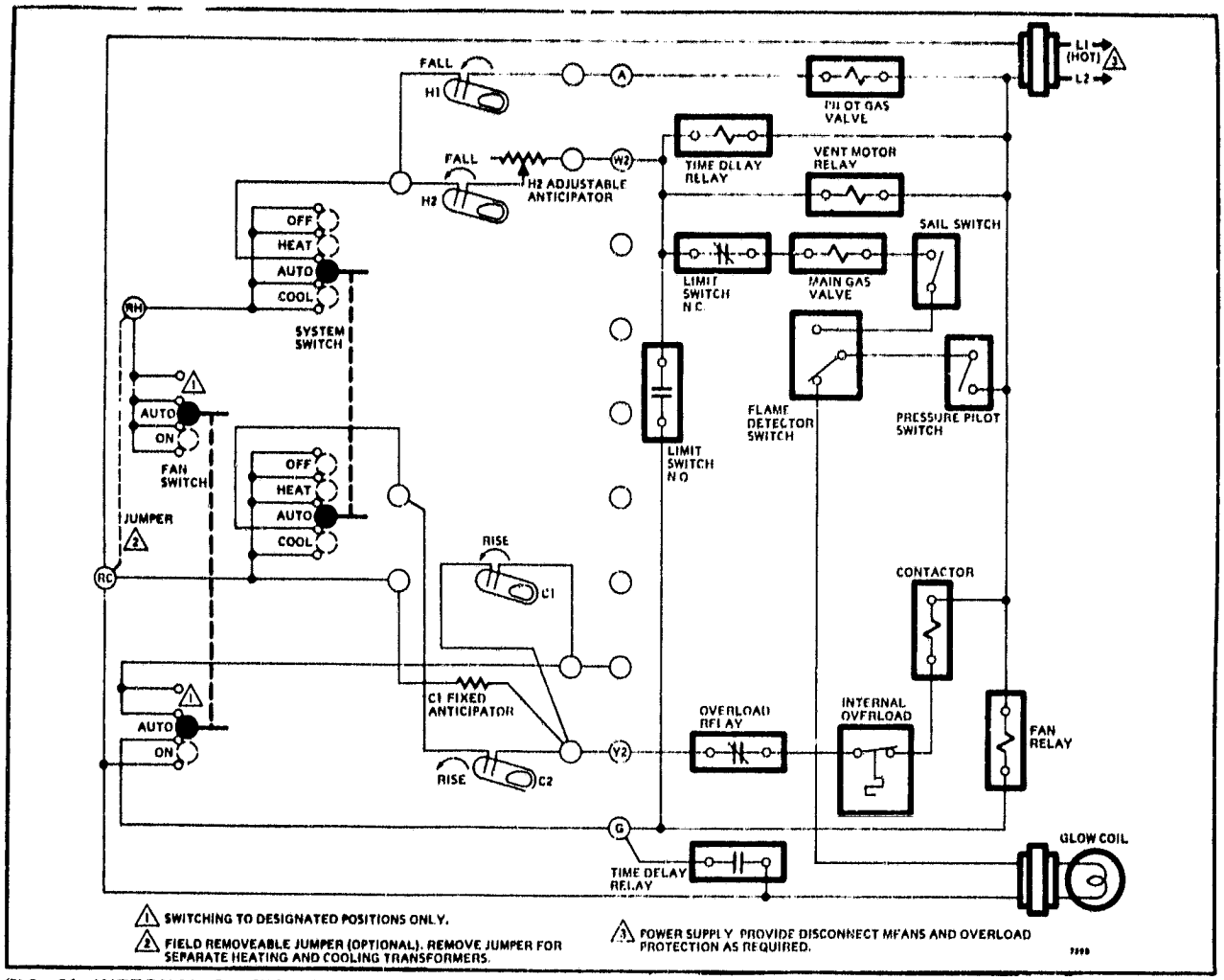


FIG. 21—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672E SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

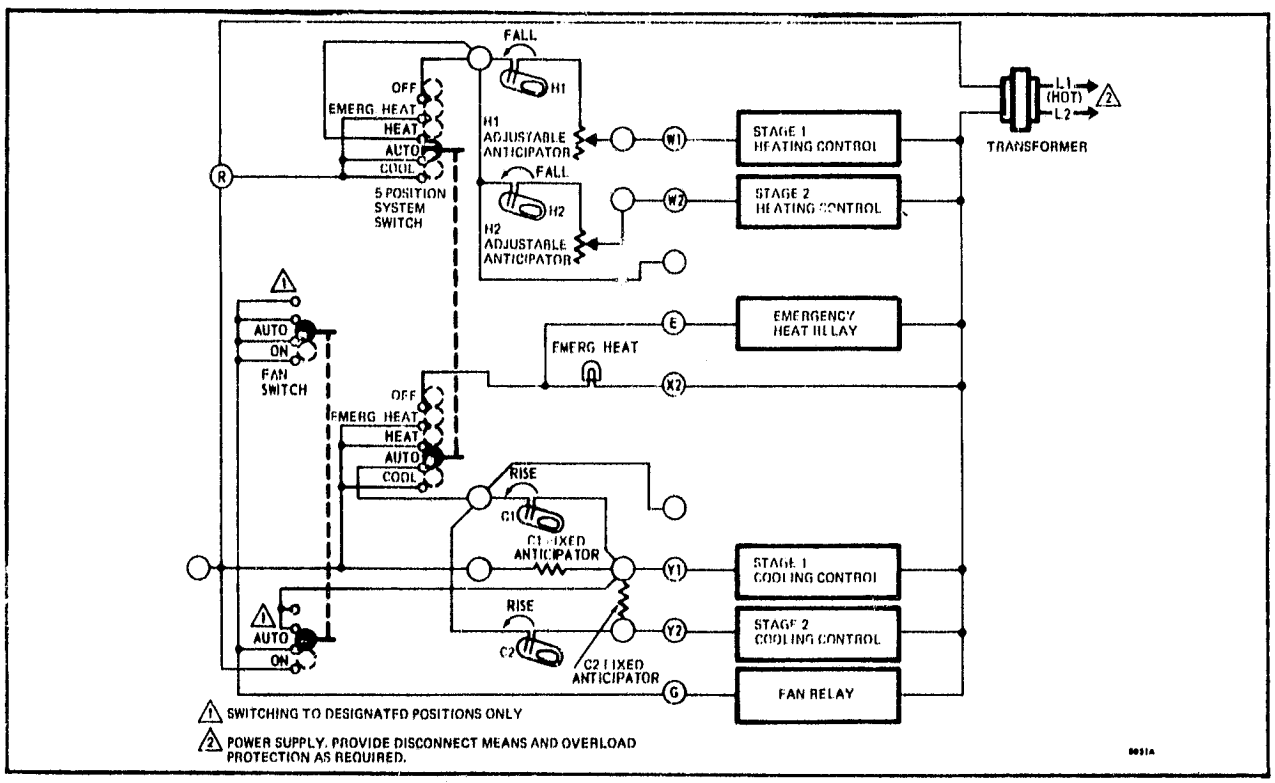


FIG. 22—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES OFF-EM. HT.-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING. EMERGENCY HEAT RELAY AND LIGHT ARE ENERGIZED WHEN SWITCH IS IN EM. HT. POSITION.

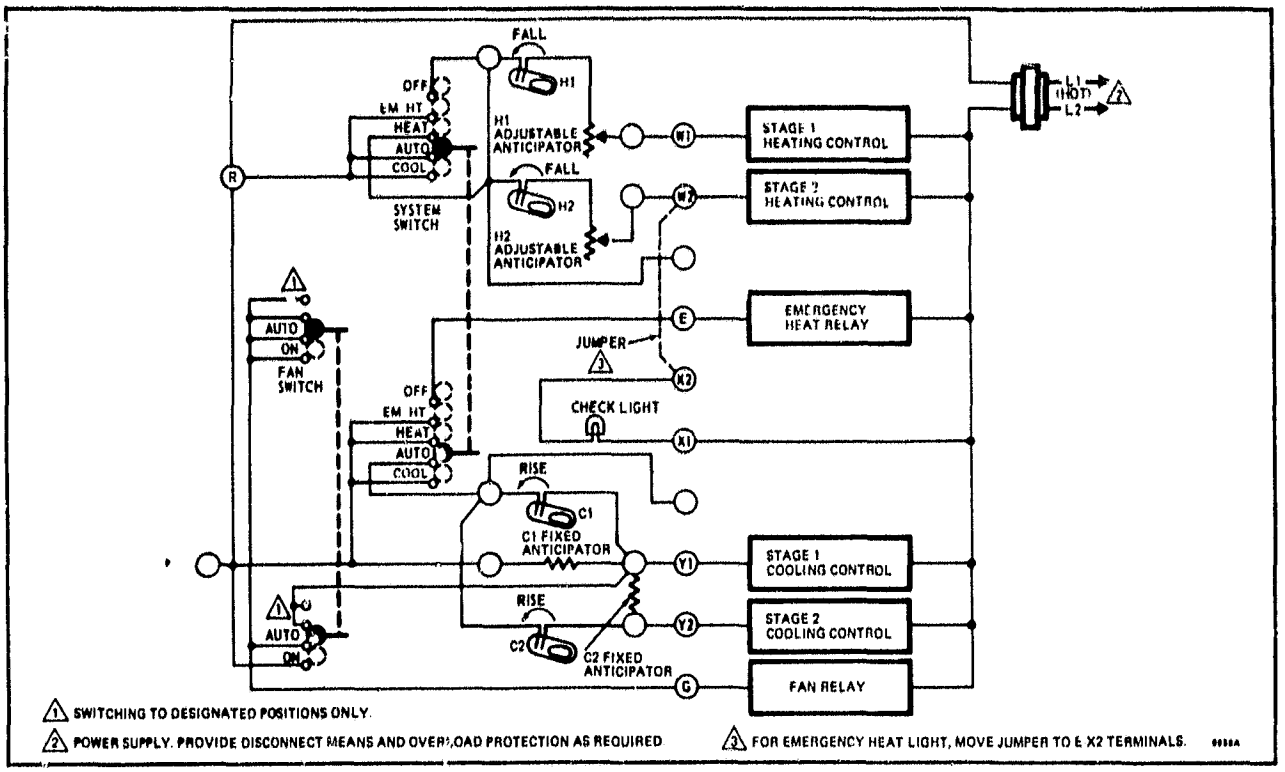


FIG. 23—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES OFF-EM. HT.-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING. EMERGENCY HEAT RELAY IS ENERGIZED WHEN SYSTEM SWITCH IS IN EM. HT. POSITION; LIGHT OPERATES WITH SECOND STAGE OF HEATING.

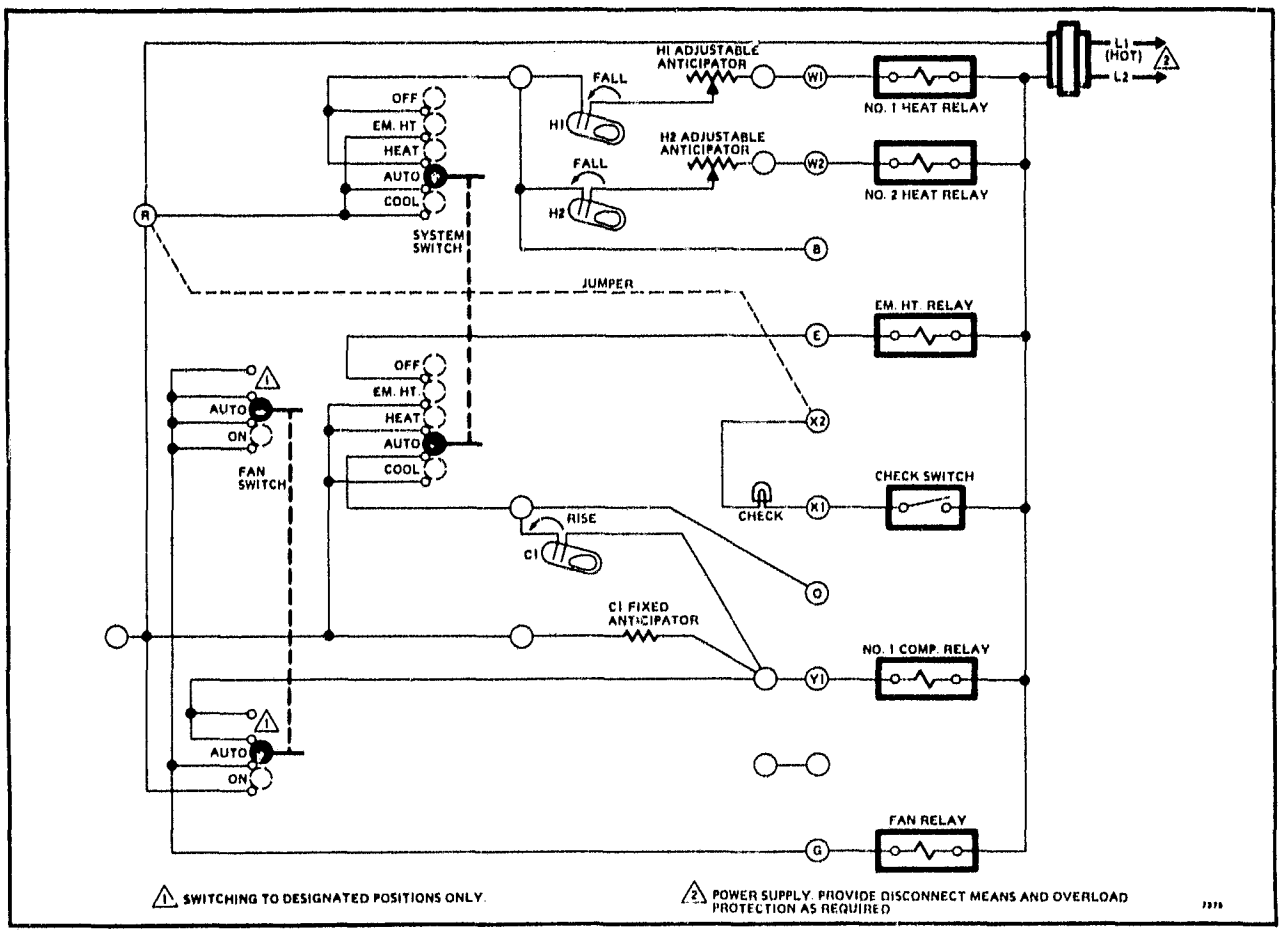


FIG. 24—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F SUBBASE WITH T872C THERMOSTAT. SUBBASE PROVIDES OFF-EM. HT.-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING. EMERGENCY HEAT RELAY ENERGIZED WHEN SWITCH IS IN EM. HT. POSITION; LIGHT OPERATES WITH SECOND STAGE HEATING.

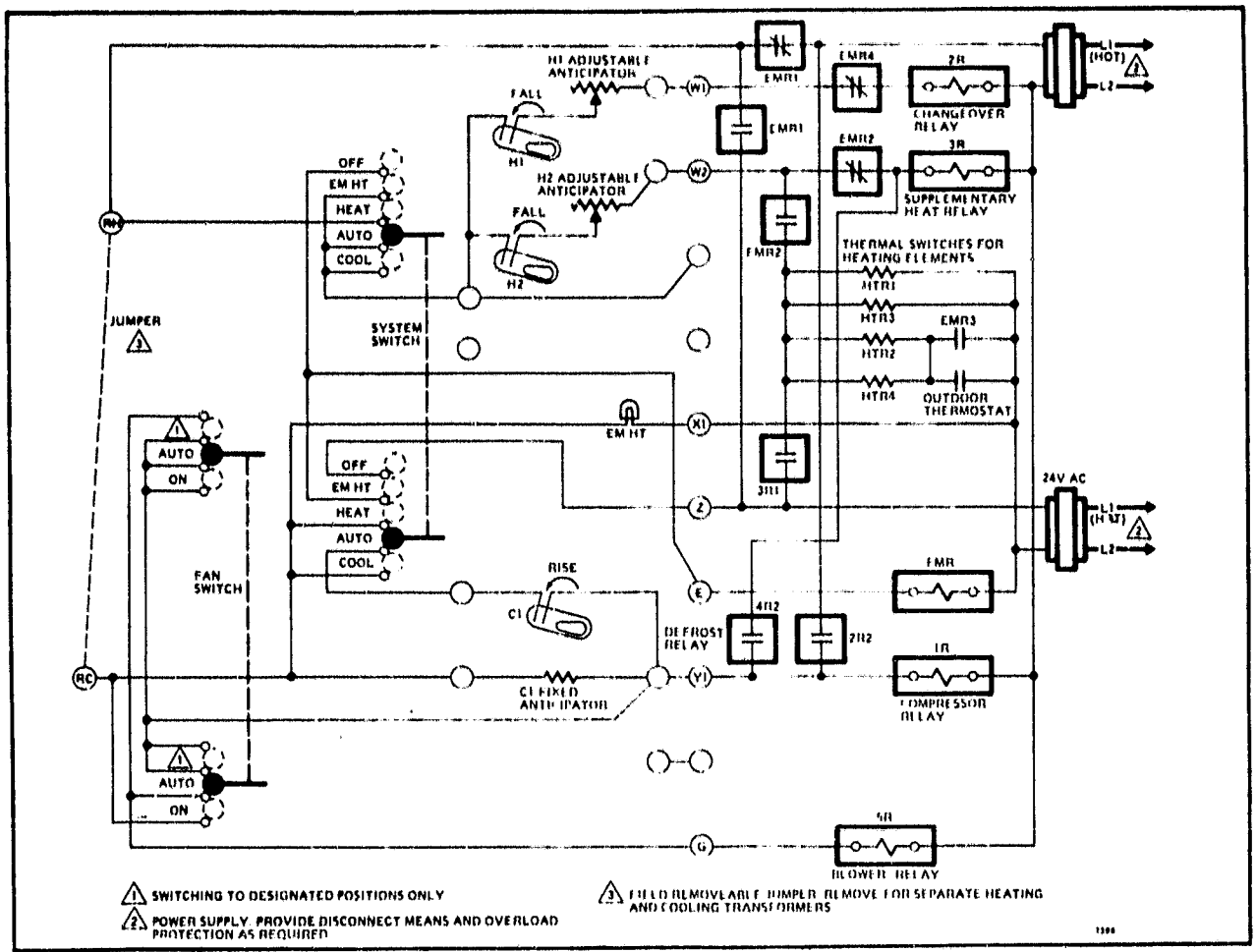


FIG. 25—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F SUBBASE AND T872C THERMOSTAT. SUBBASE PROVIDES OFF-EM. HT.-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

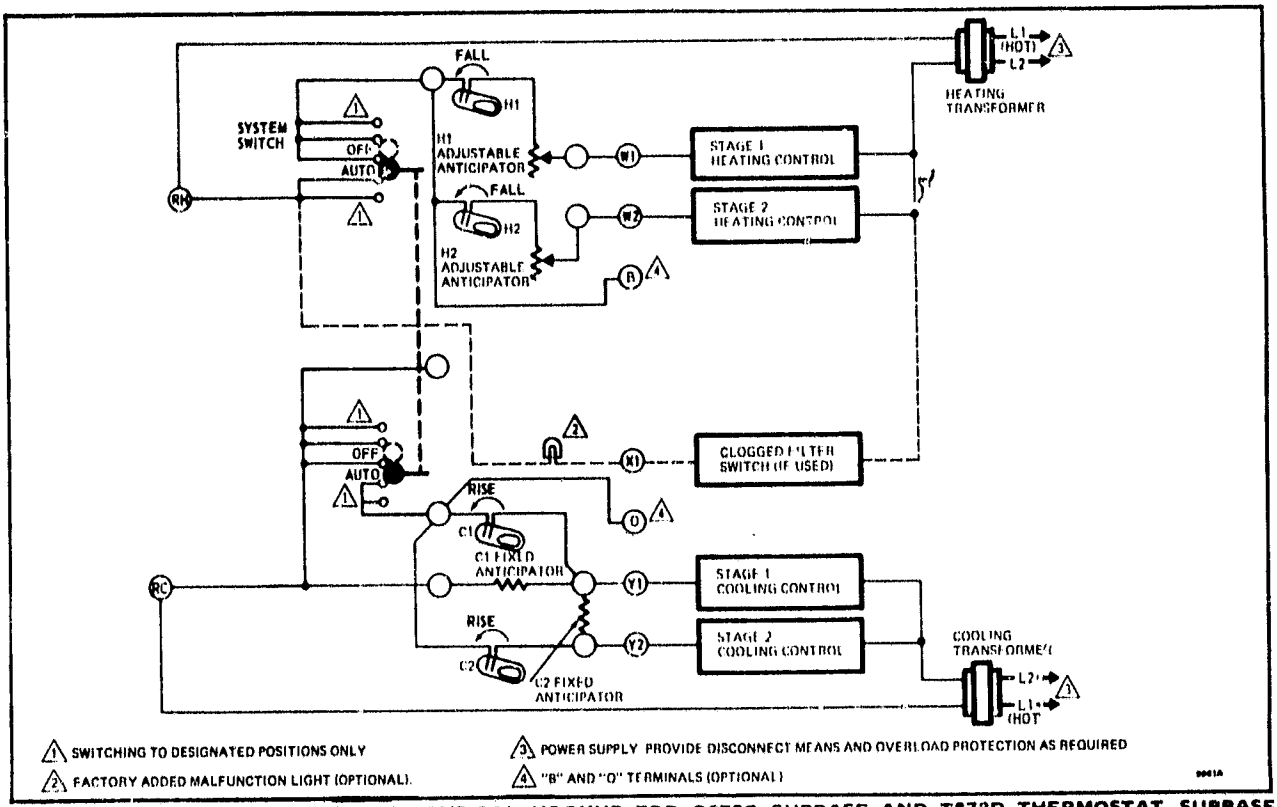


FIG. 26—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672G SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES OFF-AUTO SYSTEM SWITCHING ONLY.

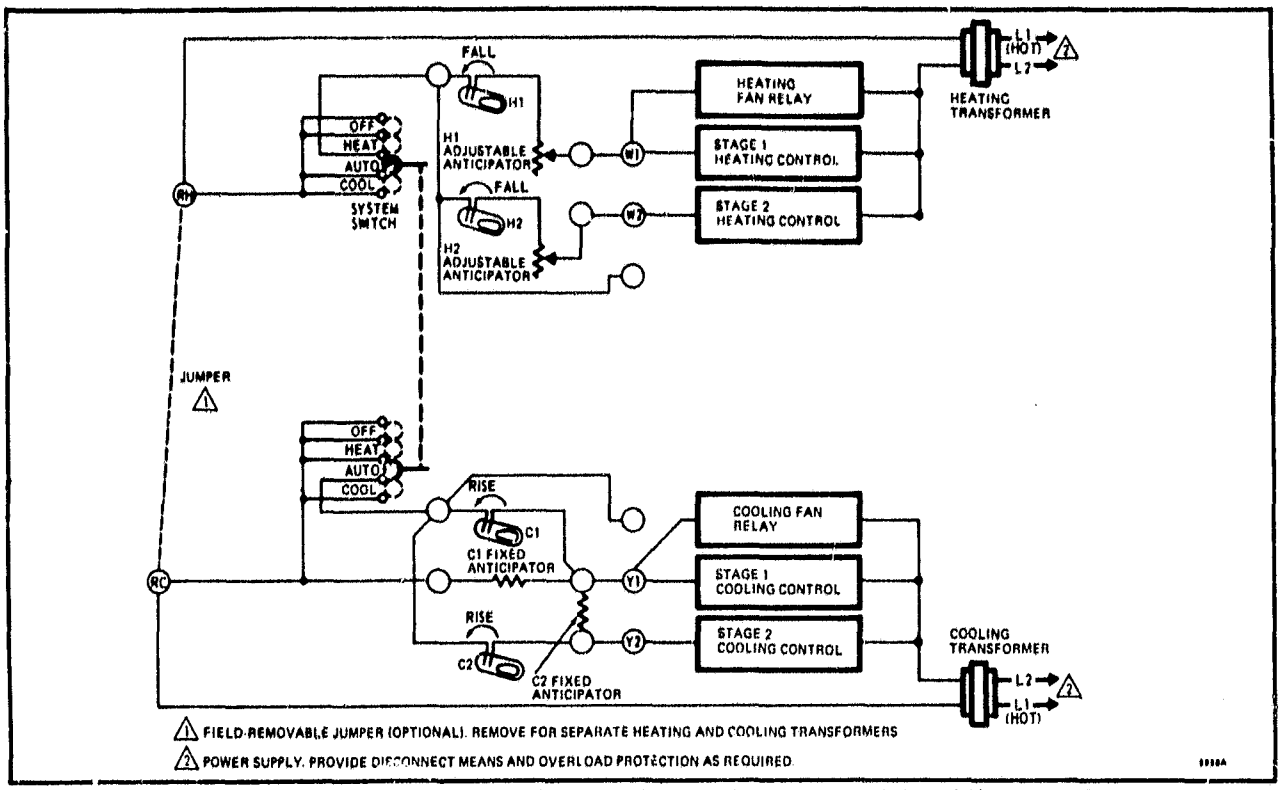


FIG. 27—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672K SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM SWITCHING ONLY.

STANDARD CIRCUITS WITH MANUAL HEAT-COOL CHANGEOVER

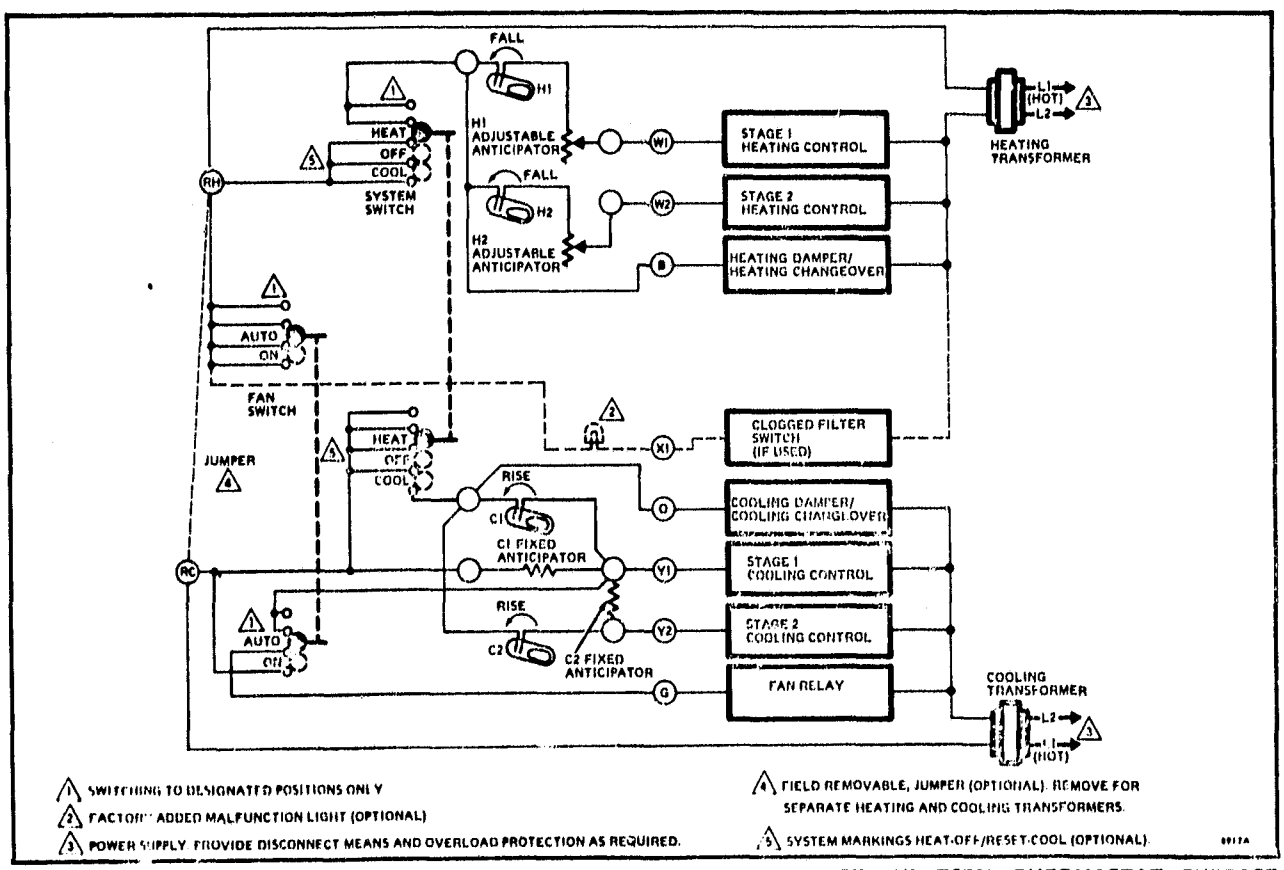


FIG. 28—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672B SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

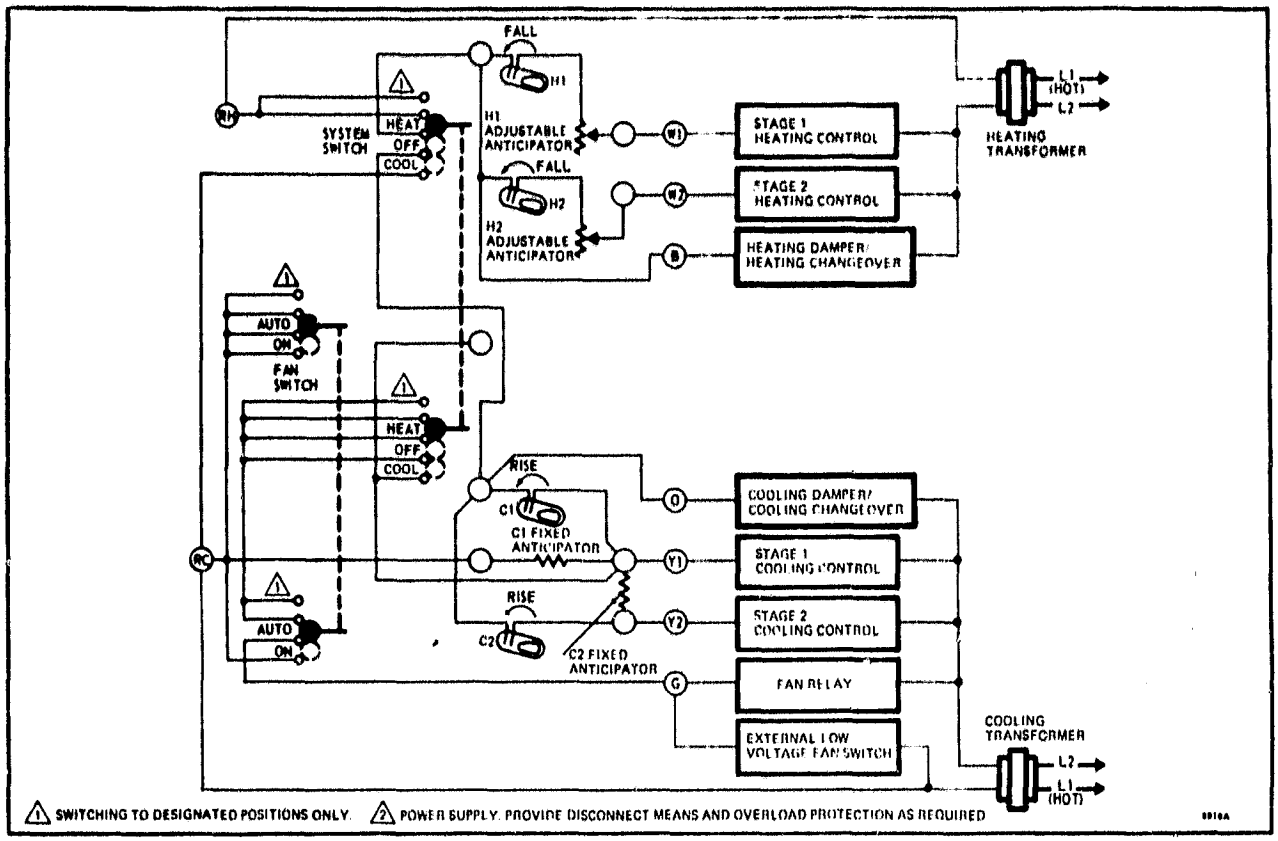


FIG. 29—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672B SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING. G TERMINAL IS ISOLATED ON HEATING TO PROVIDE FAN RELAY OPERATION FROM EXTERNAL LOW VOLTAGE FAN SWITCH.

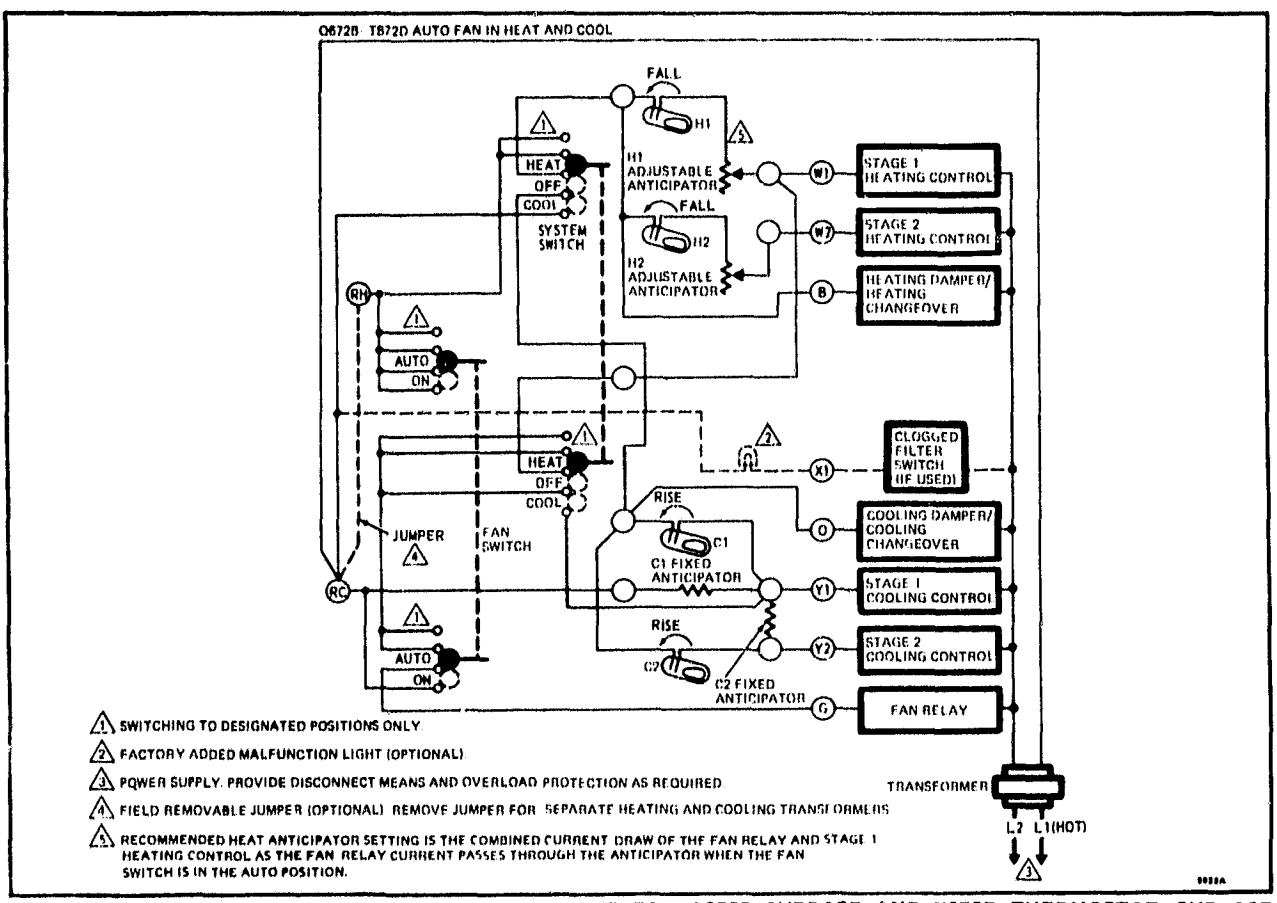


FIG. 30—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672B SUBBASE AND T872D THERMOSTAT. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING, AND AUTOMATIC FAN OPERATION IN HEATING AND COOLING FOR ELECTRIC FURNACE.

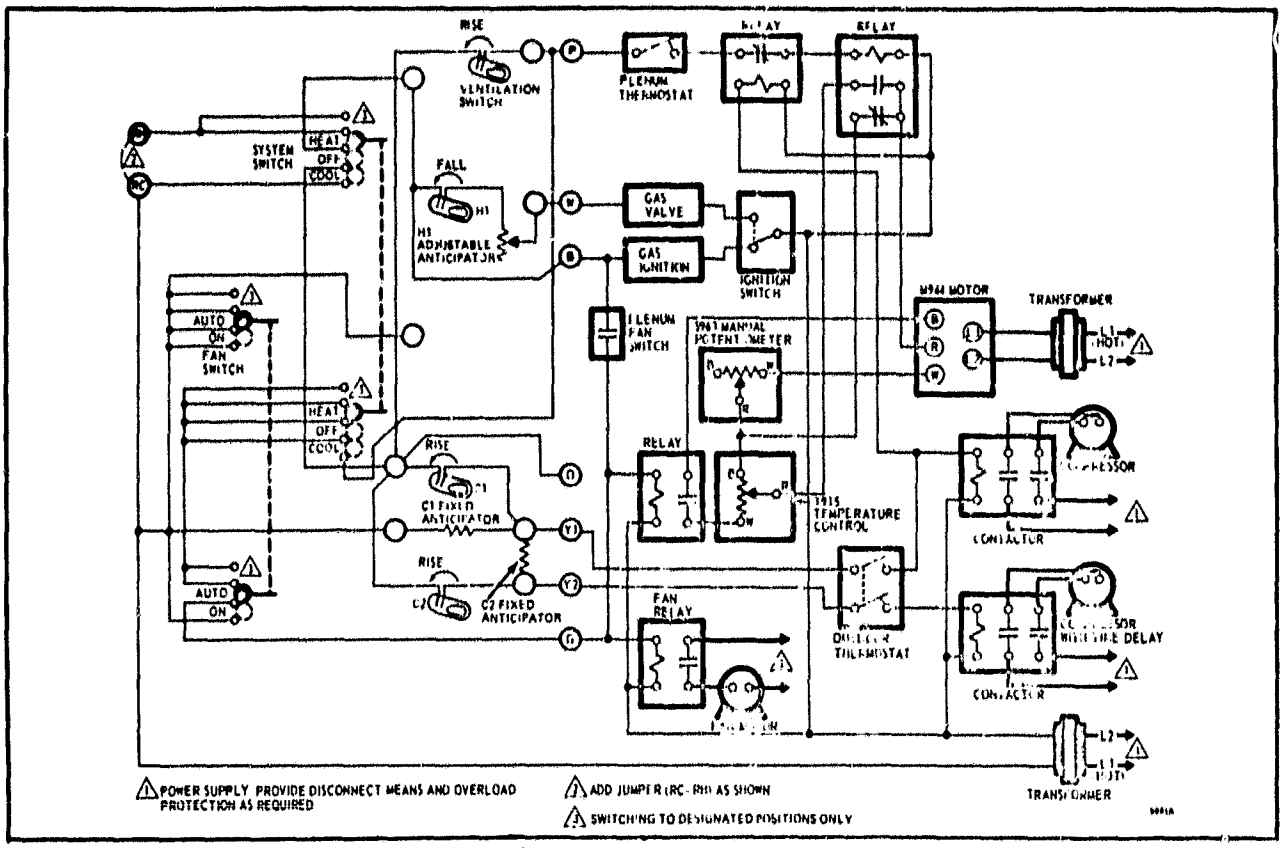


FIG. 31—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672D SUBBASE AND T872T THERMOSTAT. THERMOSTAT PROVIDES 1-STAGE HEATING, 1-STAGE VENTILATION, AND 2-STAGE COOLING. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

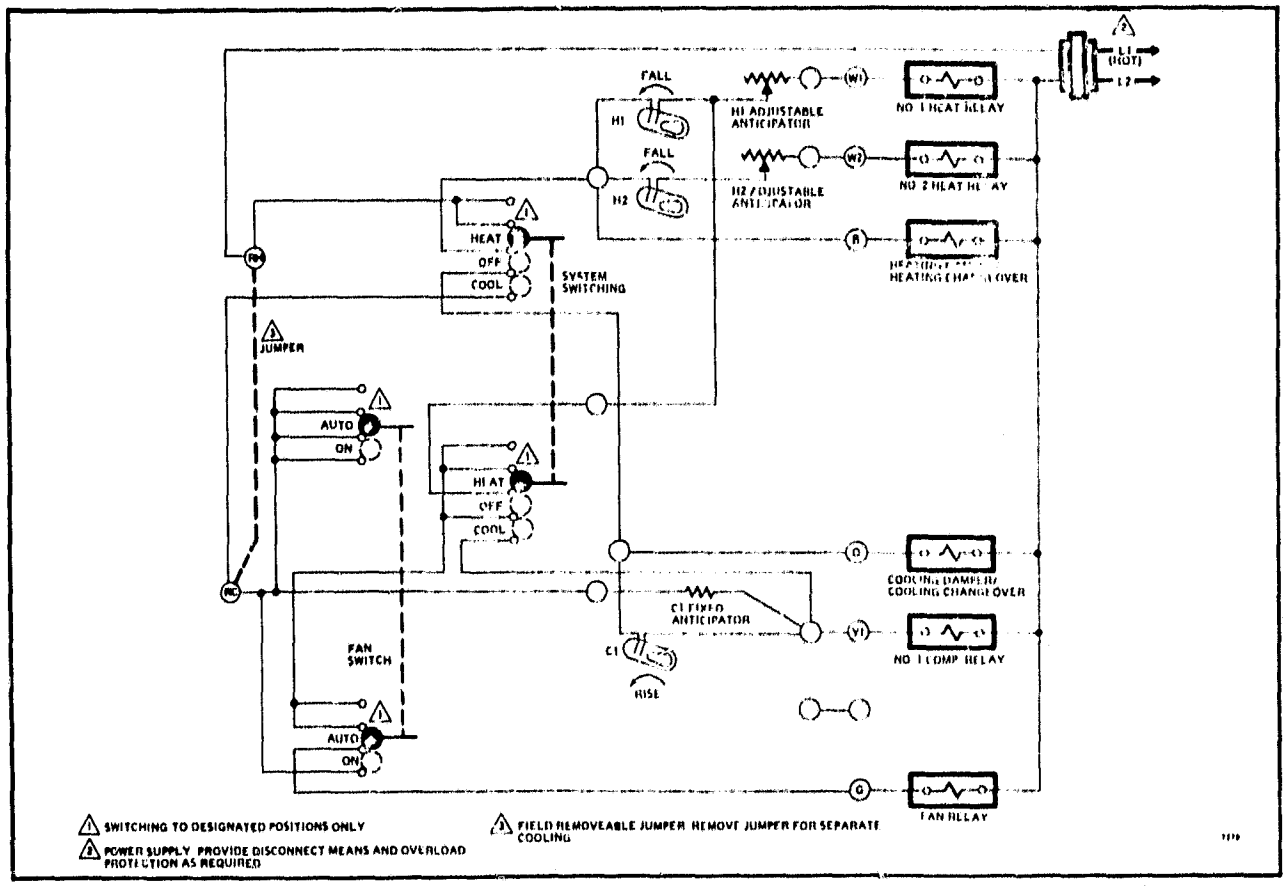


FIG. 32—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672B SUBBASE AND T872C THERMOSTAT. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

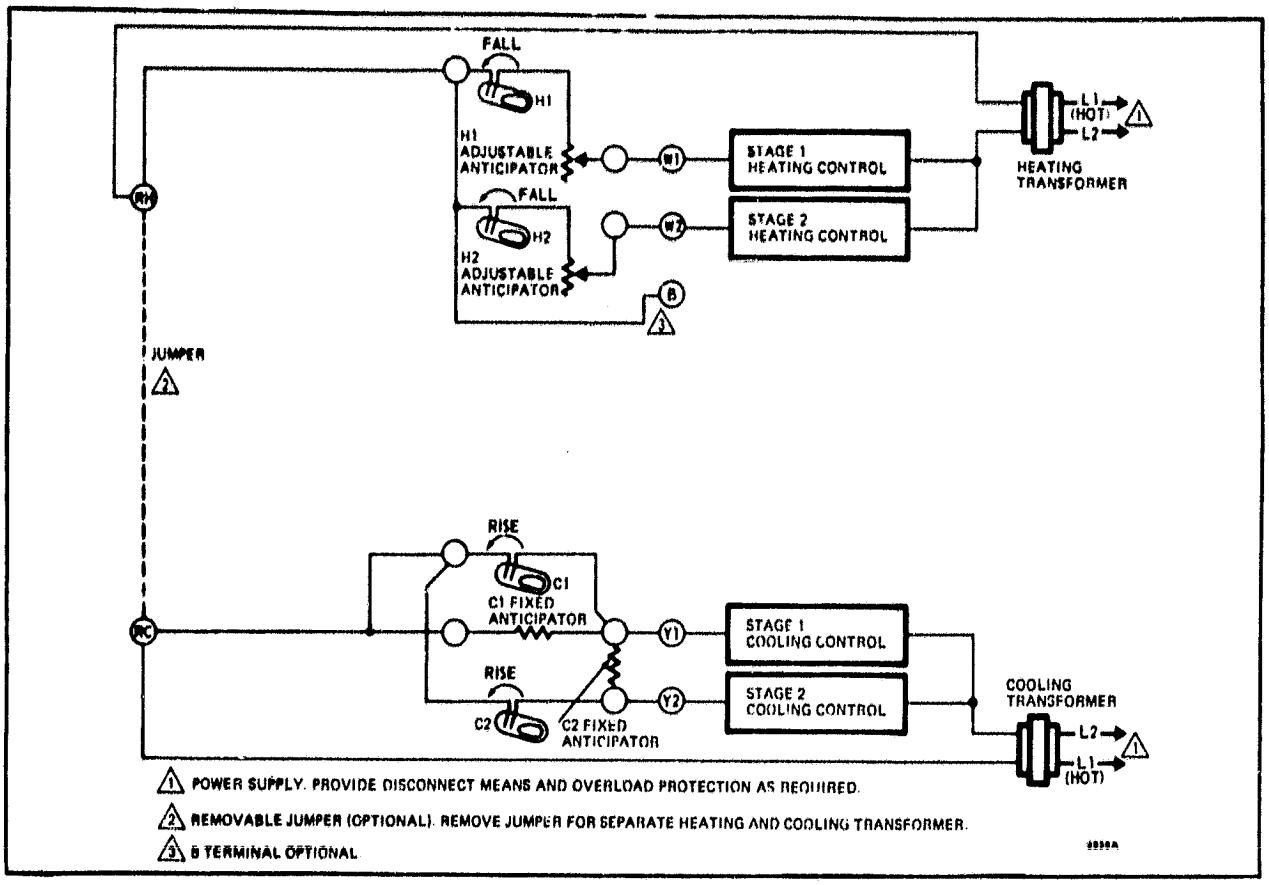


FIG. 33—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672D SUBBASE AND T872D THERMOSTAT. NO SUBBASE SWITCHING IS PROVIDED.

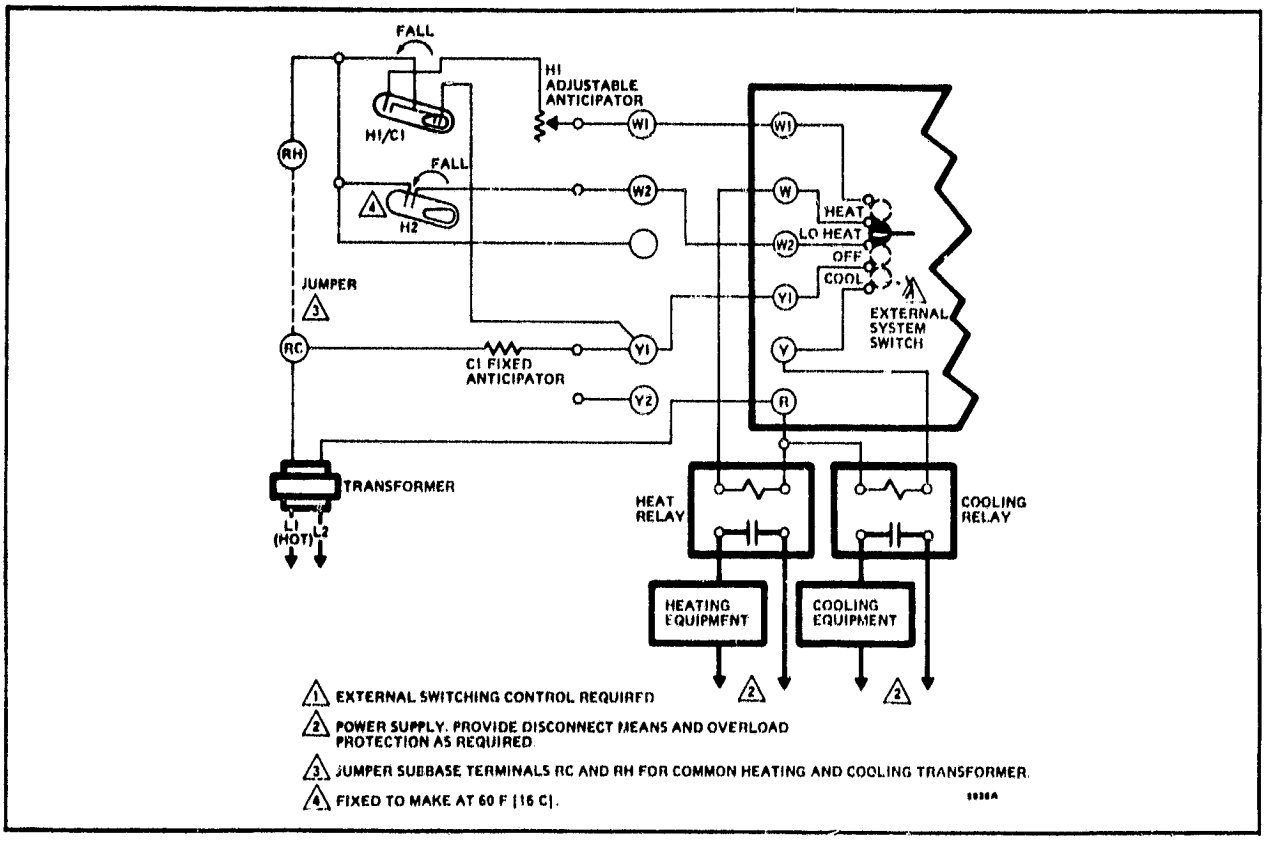


FIG. 34—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672D SUBBASE AND T872M THERMOSTAT. SYSTEM SWITCHING TO BE PROVIDED EXTERNALLY, SECOND-STAGE HEAT IS FIXED TO MAKE AT 60 F [16 C].

HEAT PUMP CIRCUITS WITH AUTOMATIC CHANGEOVER ON COOLING

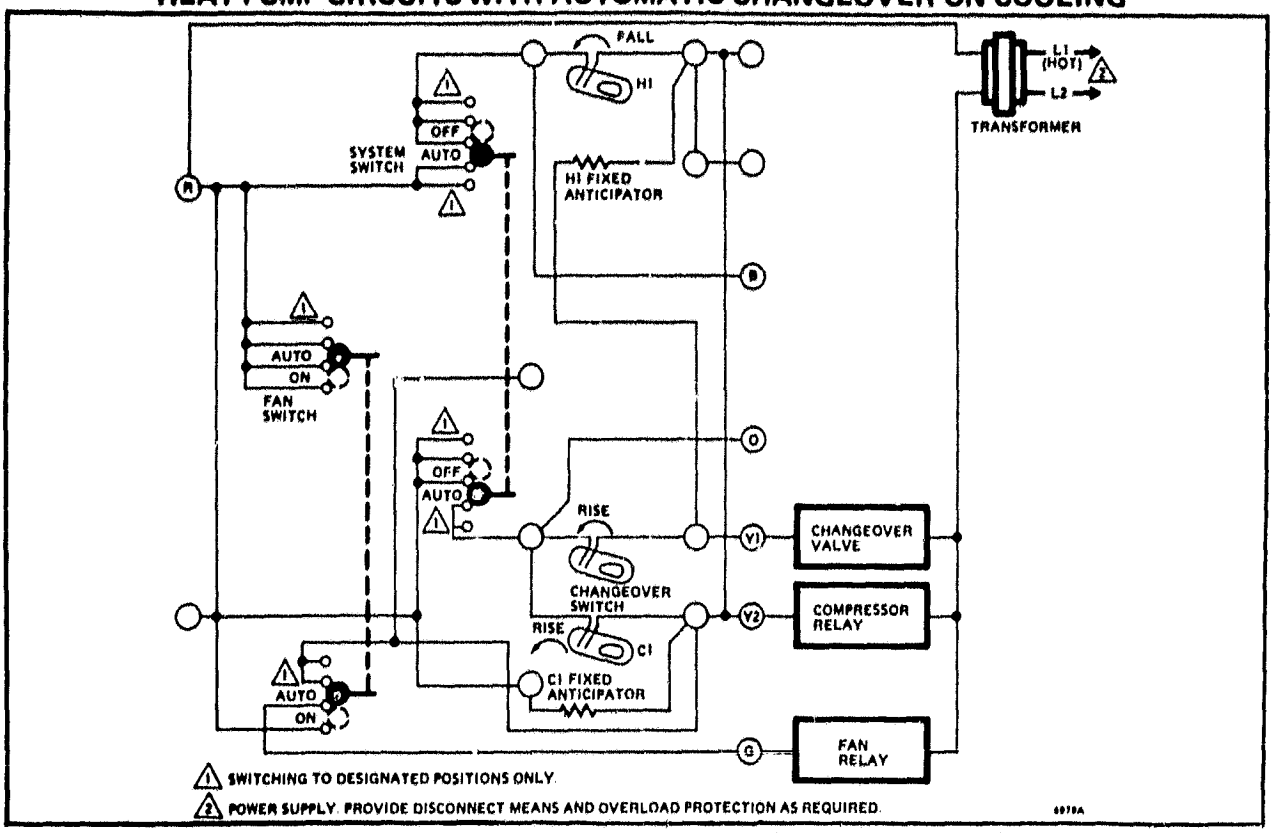


FIG. 35—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672C/T872H IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 1-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES OFF-AUTO SYSTEM AND AUTO-ON FAN SWITCHING.

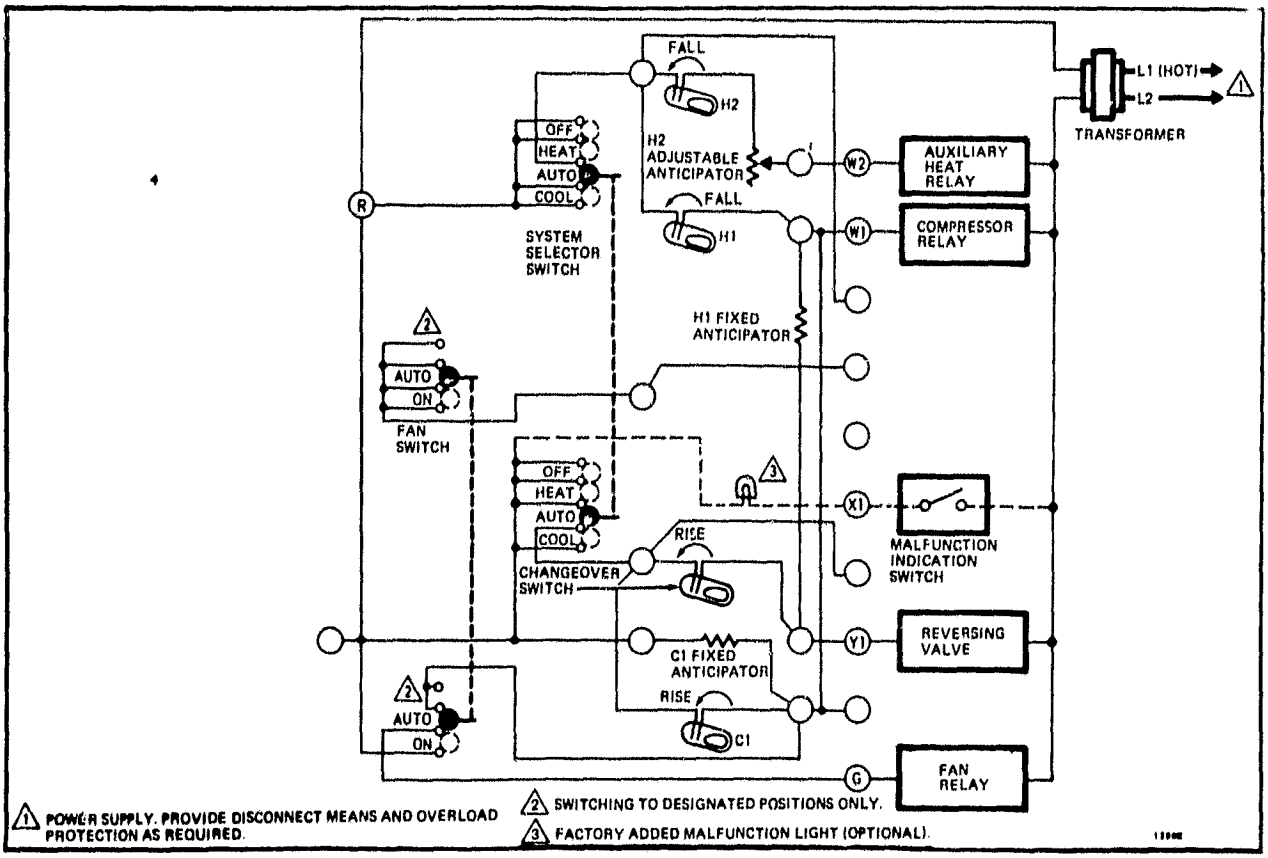


FIG. 36—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672E/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

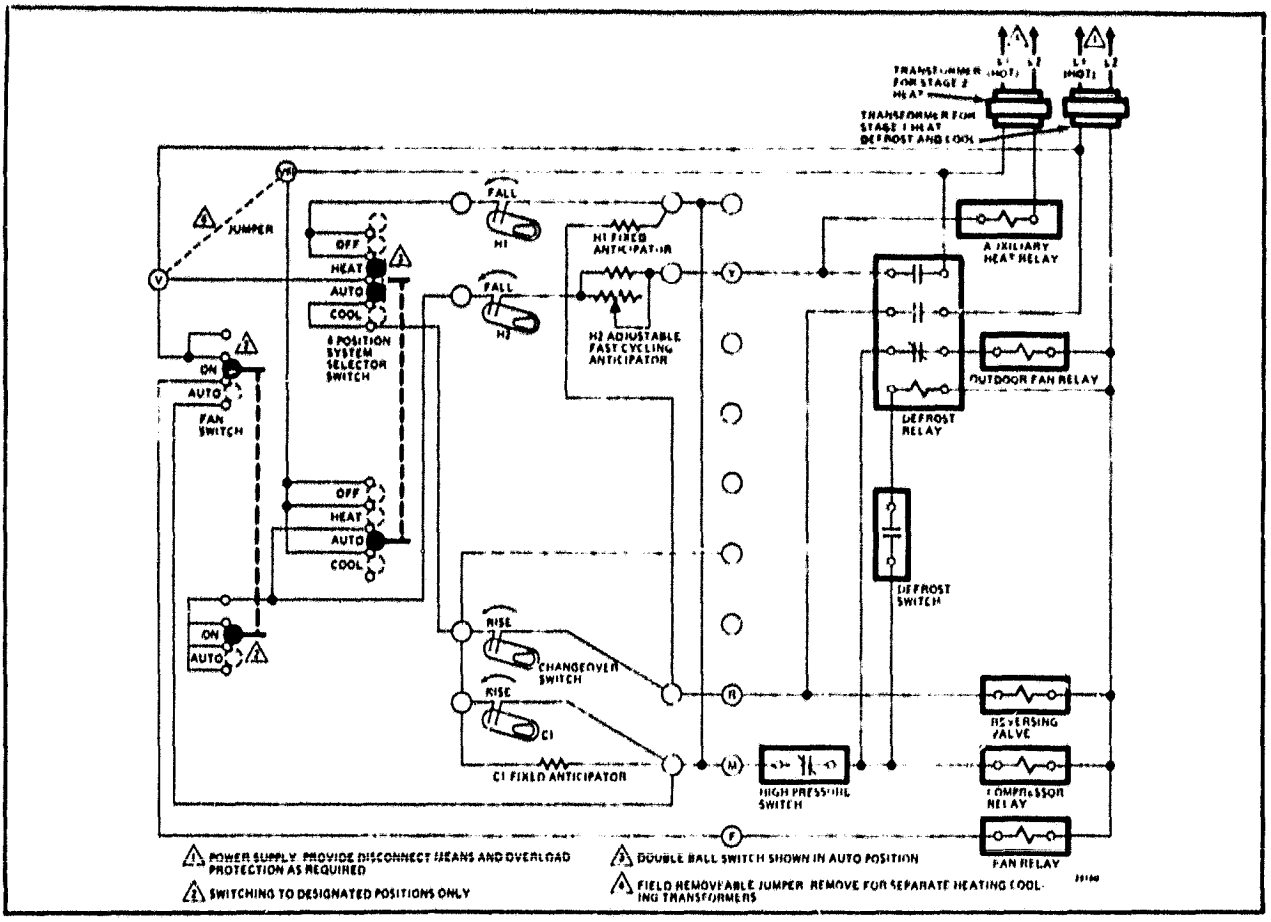


FIG. 37—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672E/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING (SECOND-STAGE HEAT IS FAST CYCLING) AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUBBASE PROVIDES OFF-EM. HT.-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

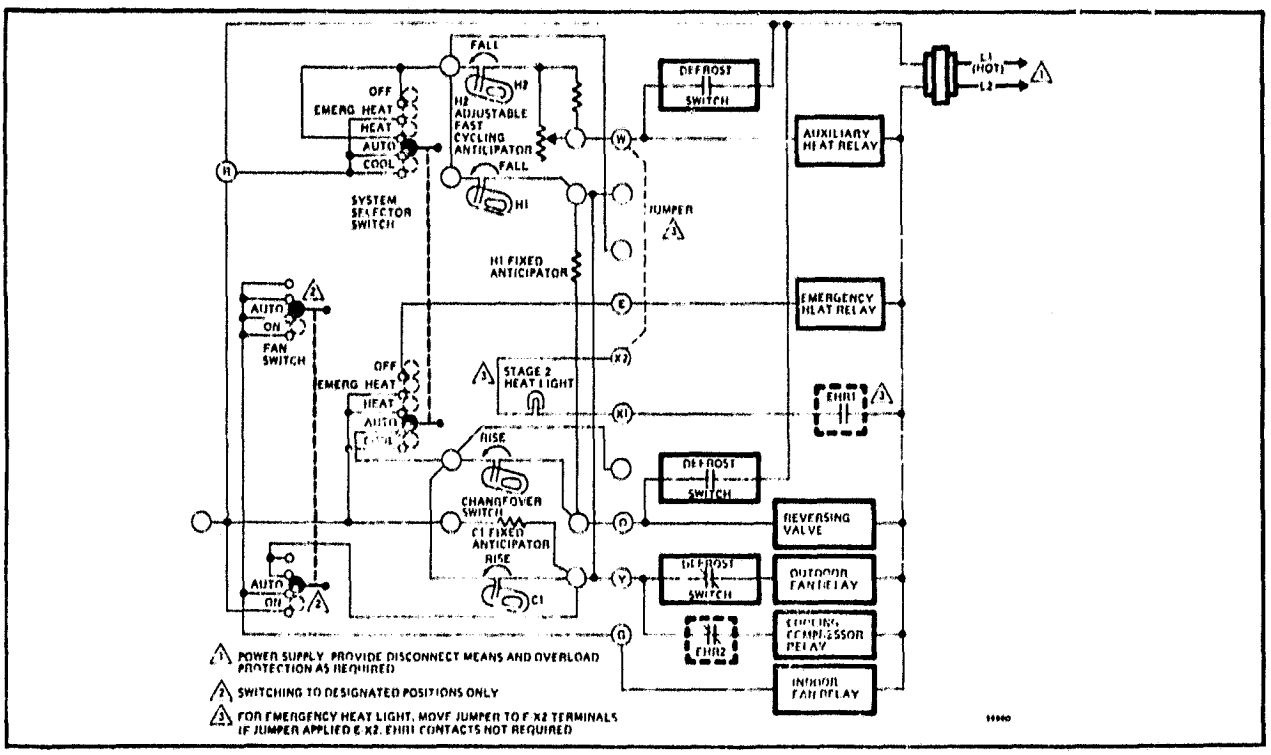
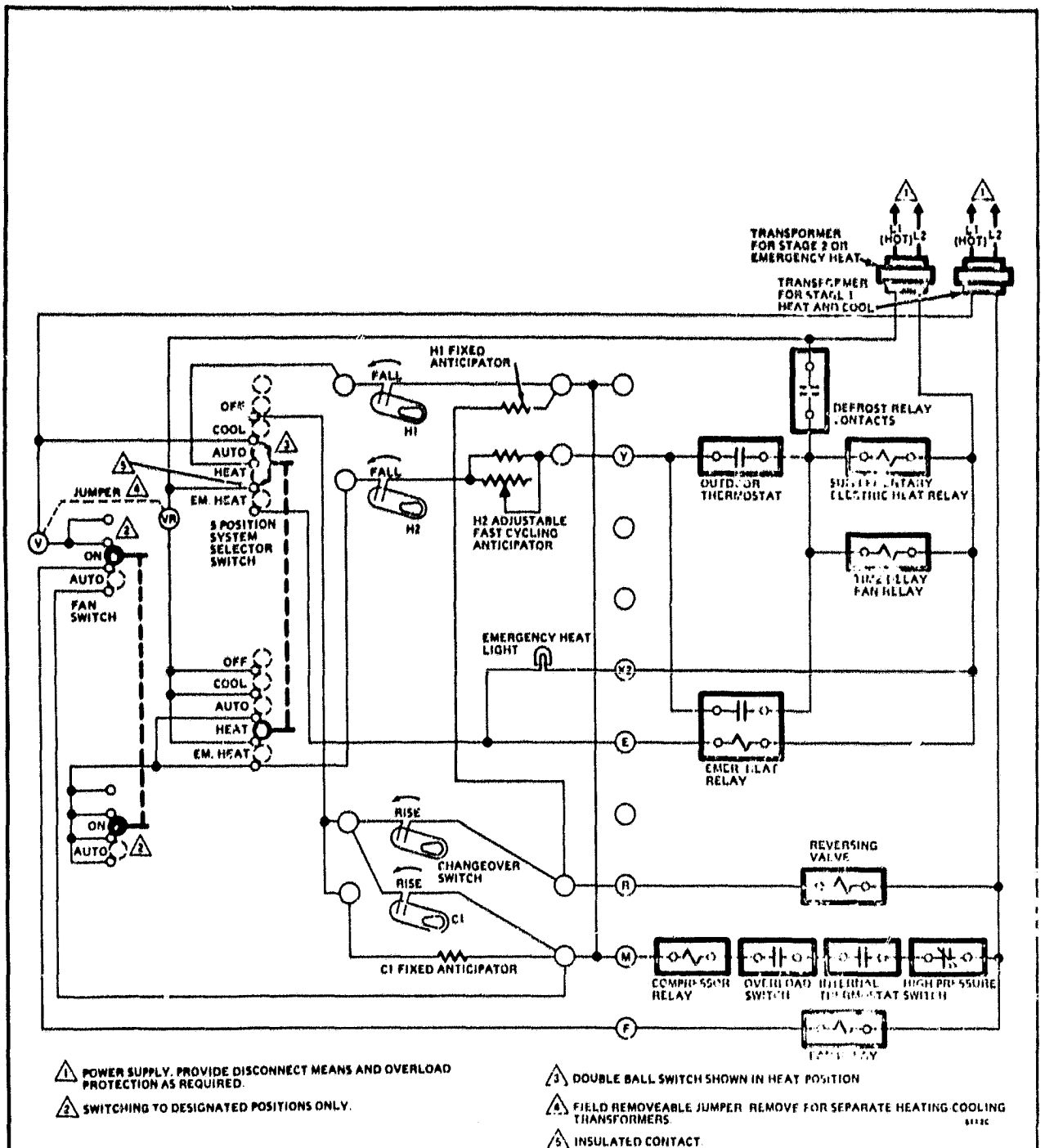
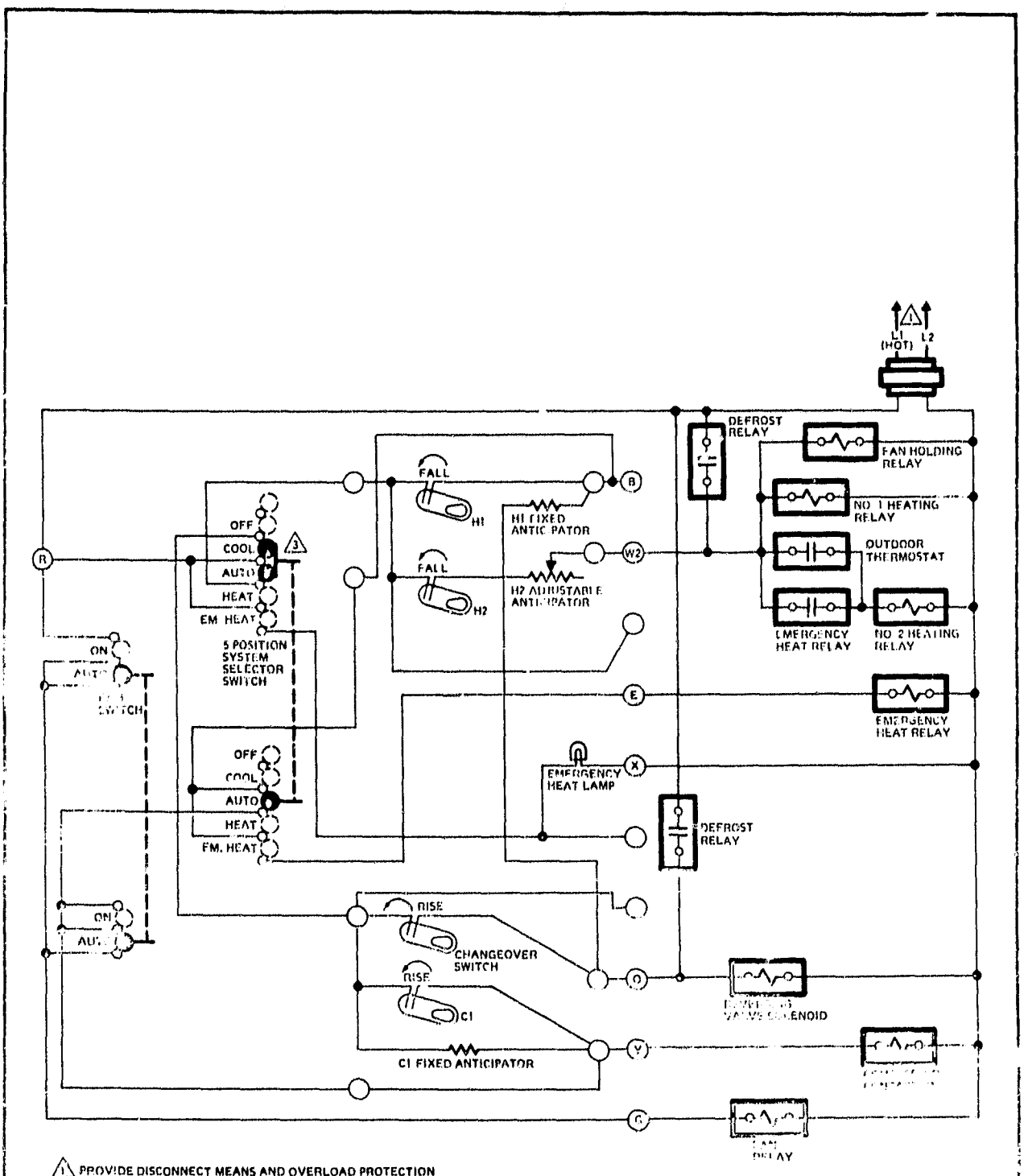


FIG. 38—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING (SECOND-STAGE HEAT IS FAST CYCLING) AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUBBASE PROVIDES OFF-EM. HT.-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. SWITCHING TO DESIGNATED POSITIONS ONLY.
3. DOUBLE BALL SWITCH SHOWN IN HEAT POSITION
4. FIELD REMOVEABLE JUMPER. REMOVE FOR SEPARATE HEATING-COOLING TRANSFORMERS.
5. INSULATED CONTACT.

FIG. 39—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING (SECOND-STAGE HEAT IS FAST CYCLING) AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUBBASE PROVIDES OFF-COOL-AUTO-HEAT-EM. HT. SYSTEM AND AUTO-ON FAN SWITCHING.



1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 FAN HOLDING RELAY MUST BE USED TO ENERGIZE FAN IN EMERGENCY HEAT MODE.

3 DOUBLE BALL SWITCH SHOWN IN AUTO POSITION

FIG. 40—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUBBASE PROVIDES OFF-COOL-AUTO-HEAT-EM.HT. SYSTEM AND AUTO-ON FAN SWITCHING.

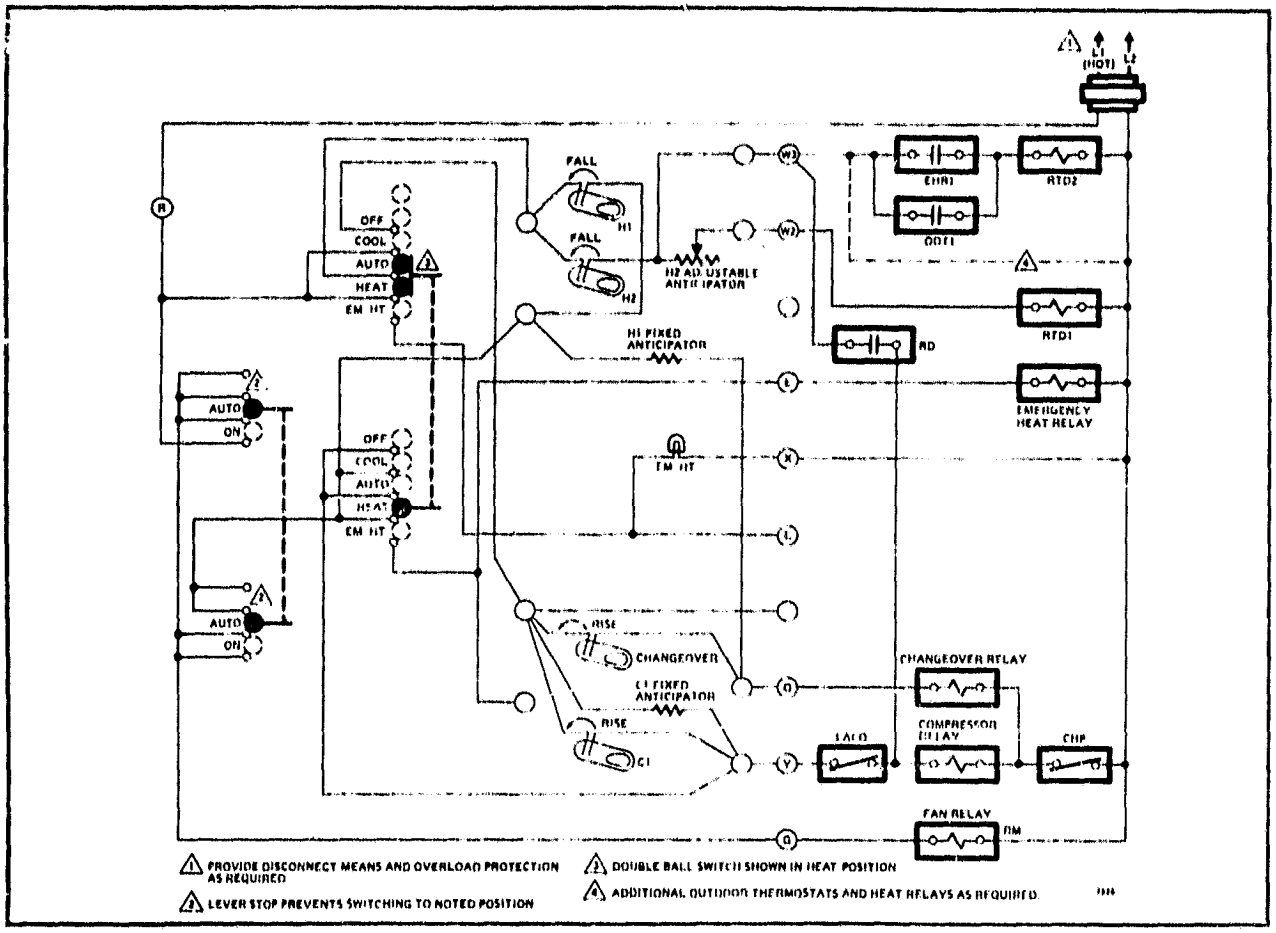


FIG. 41—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES OFF-COOL-AUTO-HEAT-EM.HT. SYSTEM AND AUTO-ON FAN SWITCHING.

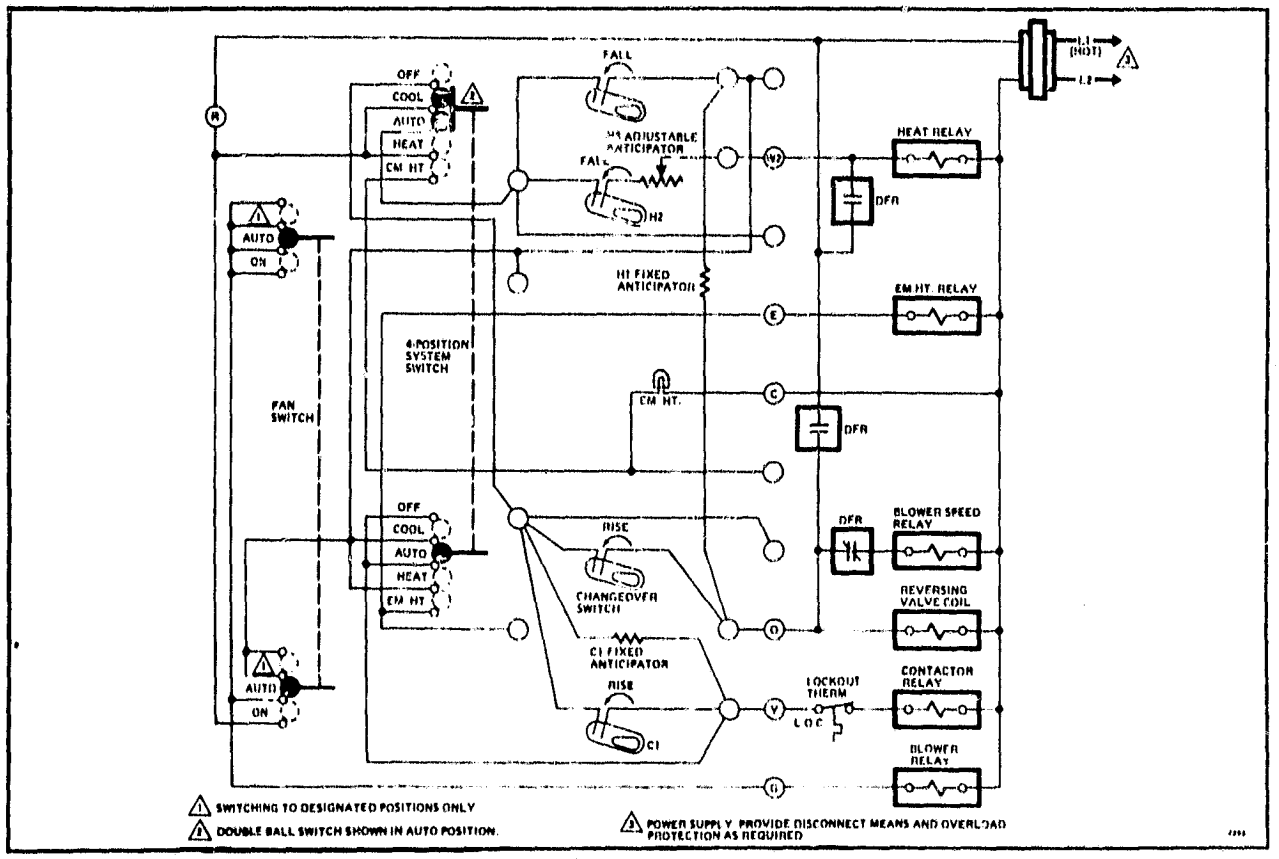


FIG. 42—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672F/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES OFF-COOL-AUTO-HEAT-EM.HT. SYSTEM AND AUTO-ON FAN SWITCHING.

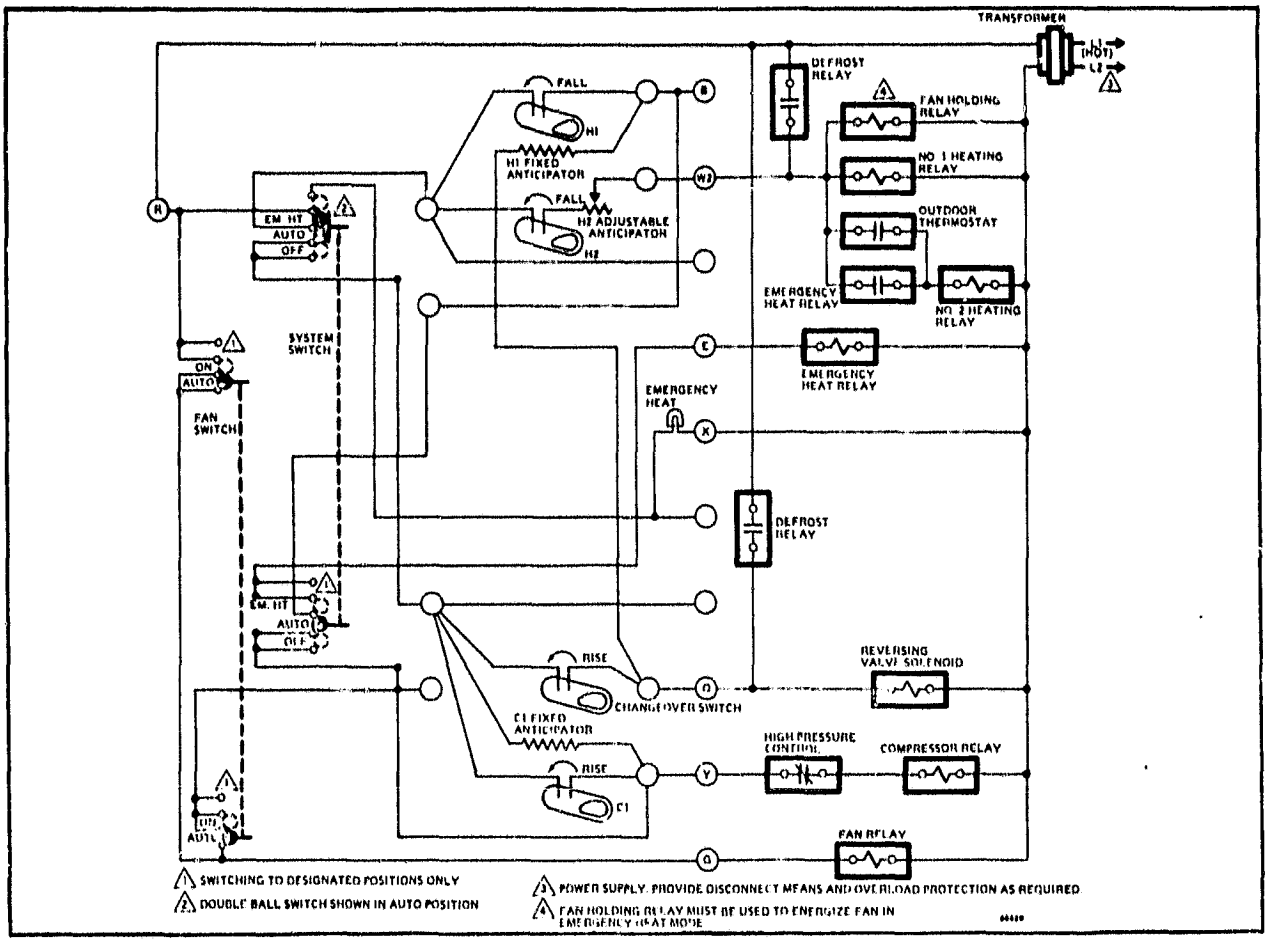


FIG. 43—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672J/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES OFF-COOL-AUTO-HEAT SYSTEM AND AUTO-ON FAN SWITCHING.

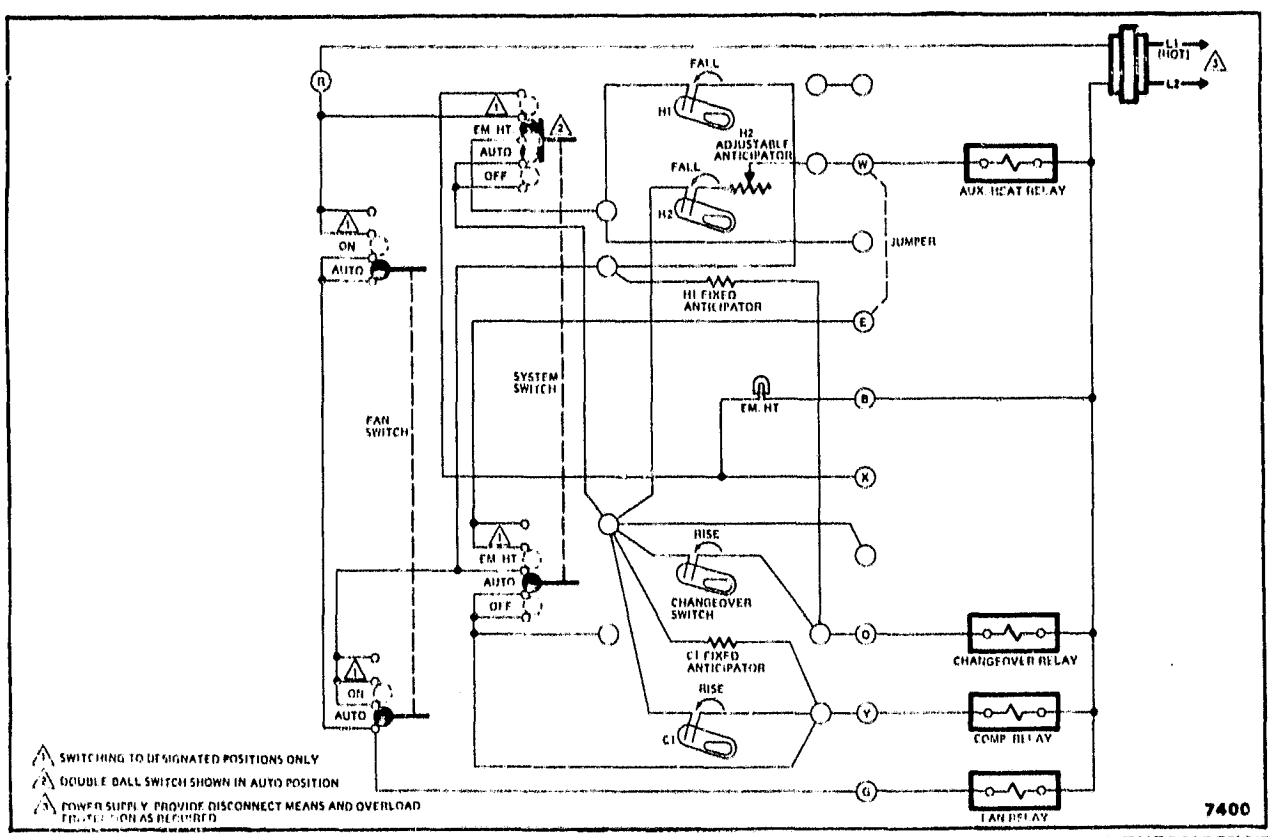


FIG. 44—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672J/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES EM.HT.-AUTO-OFF SYSTEM AND AUTO-ON FAN SWITCHING.

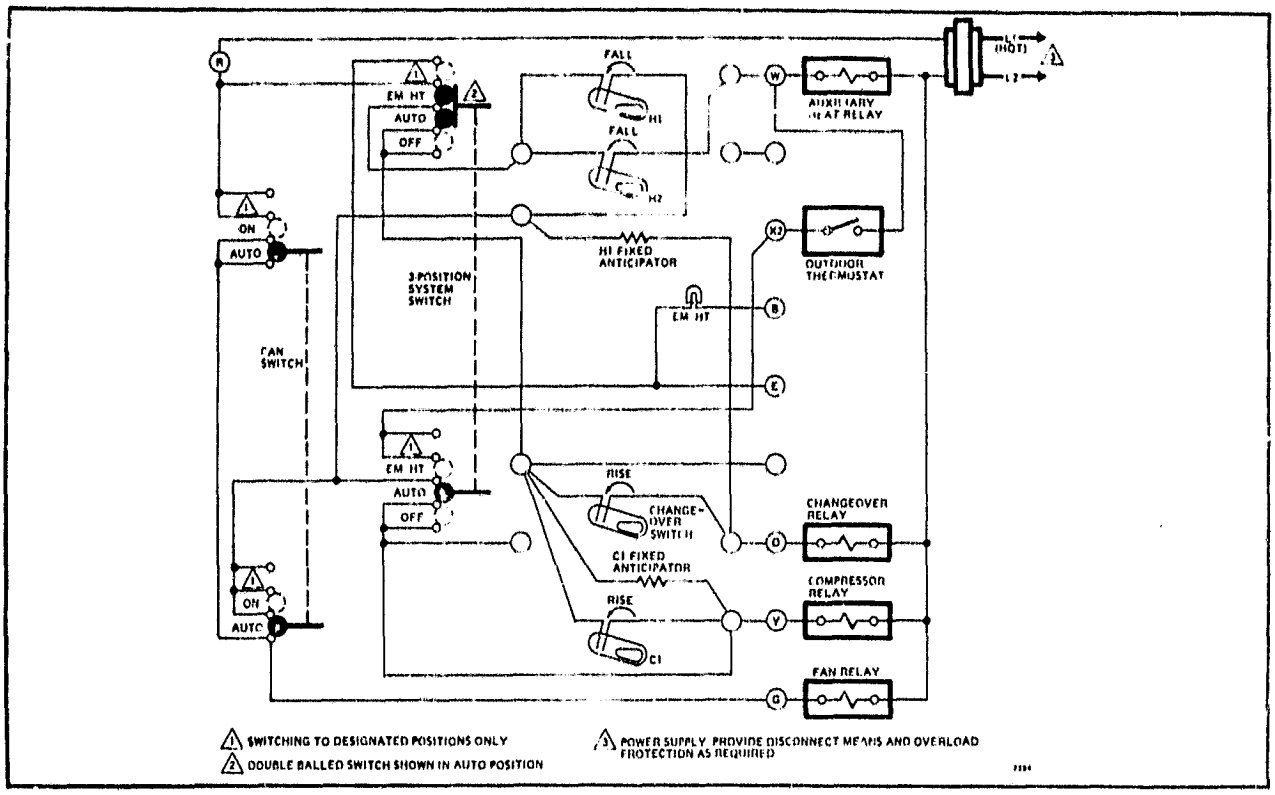


FIG. 45—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672J/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES EM.HT.-AUTO-OFF SYSTEM AND AUTO-ON FAN SWITCHING.

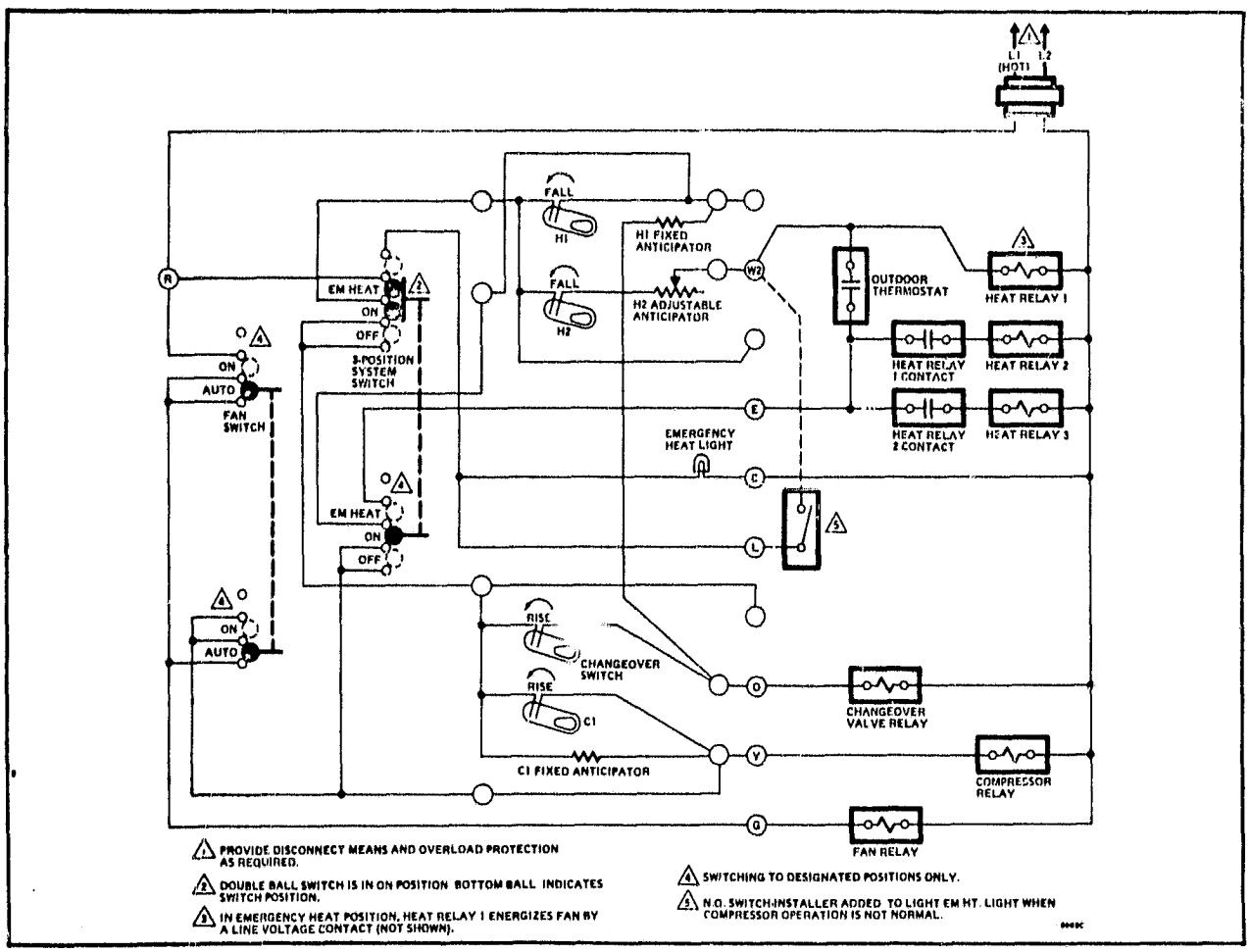


FIG. 46—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672J/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH COOLING. SUB-BASE PROVIDES EM.HT.-ON-OFF SYSTEM AND AUTO-ON FAN SWITCHING.

HEAT PUMP CIRCUITS WITH MANUAL CHANGEOVER ON COOLING

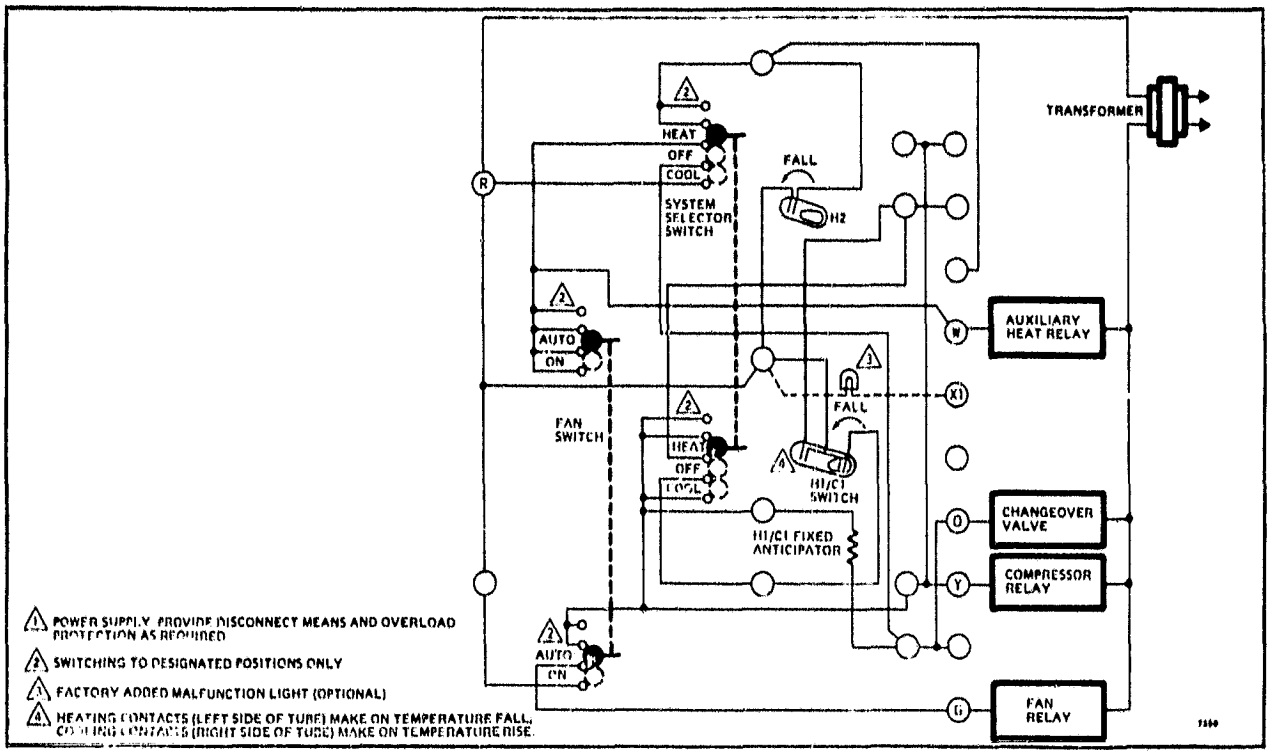


FIG. 47—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672B/T872R IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

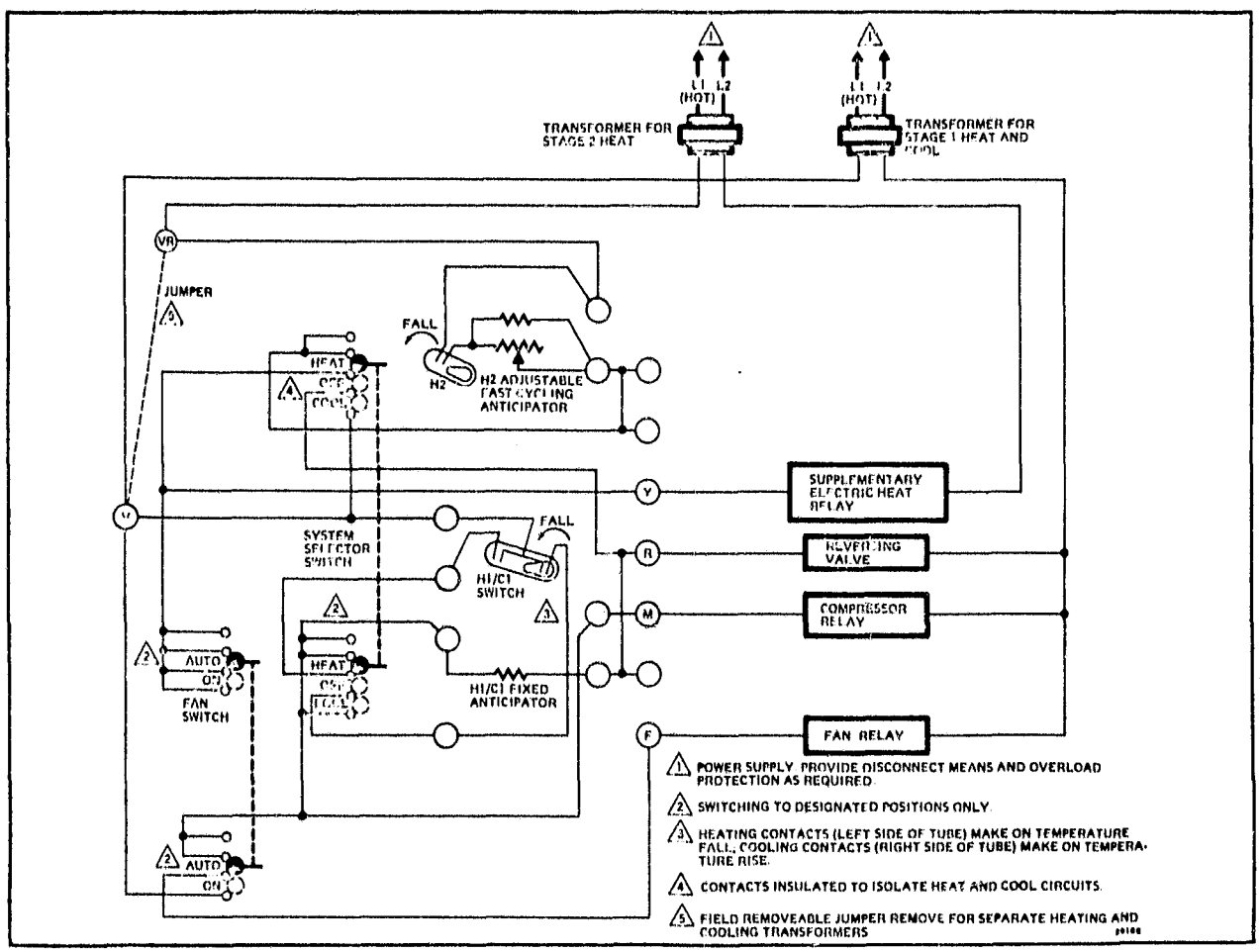


FIG. 48—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672B/T872R IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. FAST CYCLING STAGE 2 HEAT HAS ISOLATED CIRCUIT AND SEPARATE TRANSFORMER. SUBBASE PROVIDES HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

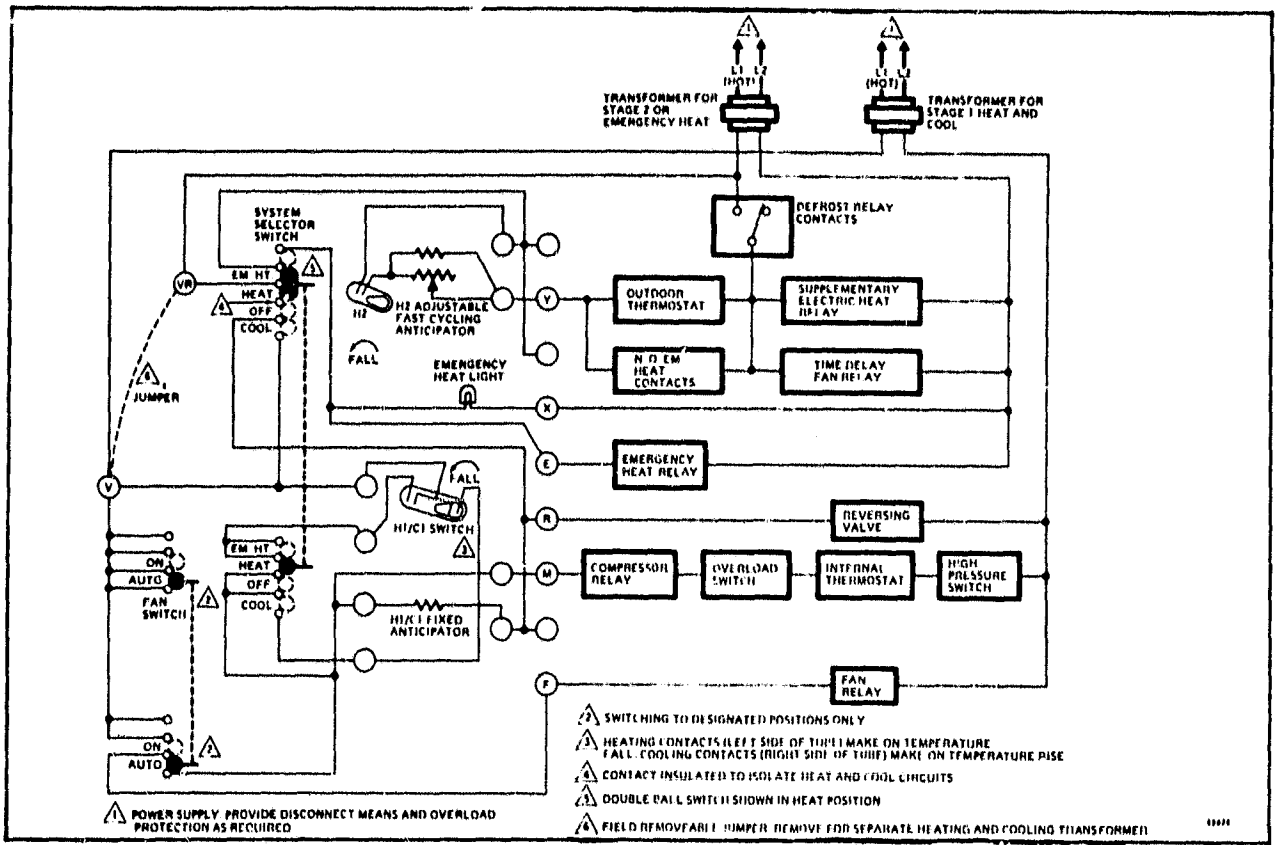


FIG. 49—INTERNAL SCHEMATIC AND TYPICAL HOOKUP FOR Q672L/T872R IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. FAST CYCLING STAGE 2 HEAT HAS ISOLATED CIRCUIT AND SEPARATE TRANSFORMER. EMERGENCY HEAT RELAY AND LIGHT ARE ENERGIZED IN EM.HT. SWITCH POSITION. SUBBASE PROVIDES EM.HT.-HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

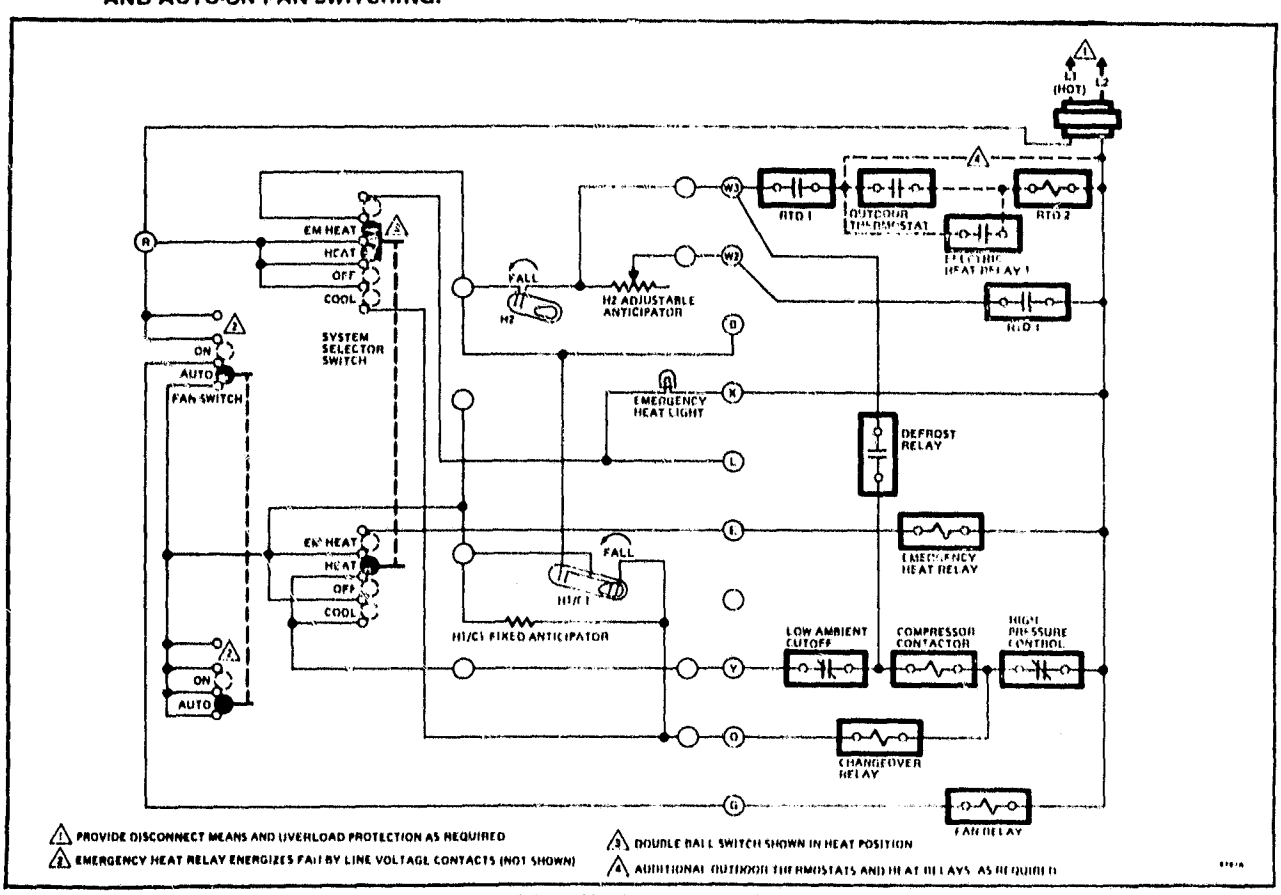


FIG. 50—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672L/T872R IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. FAST CYCLING STAGE 2 HEAT HAS ISOLATED CIRCUIT AND SEPARATE TRANSFORMER. EMERGENCY HEAT RELAY AND LIGHT ARE ENERGIZED IN EM.HT. SWITCH POSITION. SUBBASE PROVIDES EM.HT.-HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

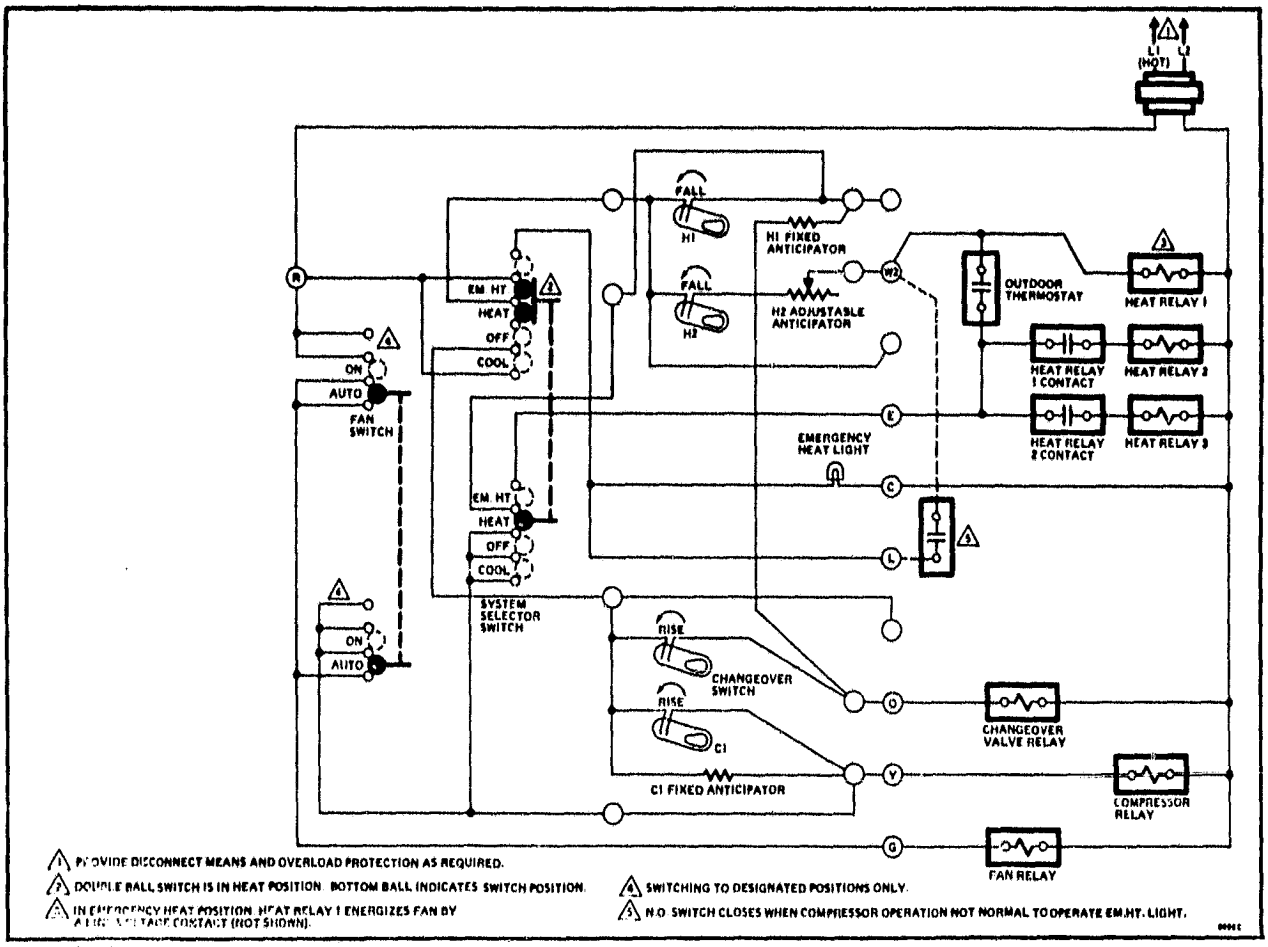


FIG. 51—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672L/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. SUB-BASE PROVIDES EM.HT.-HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

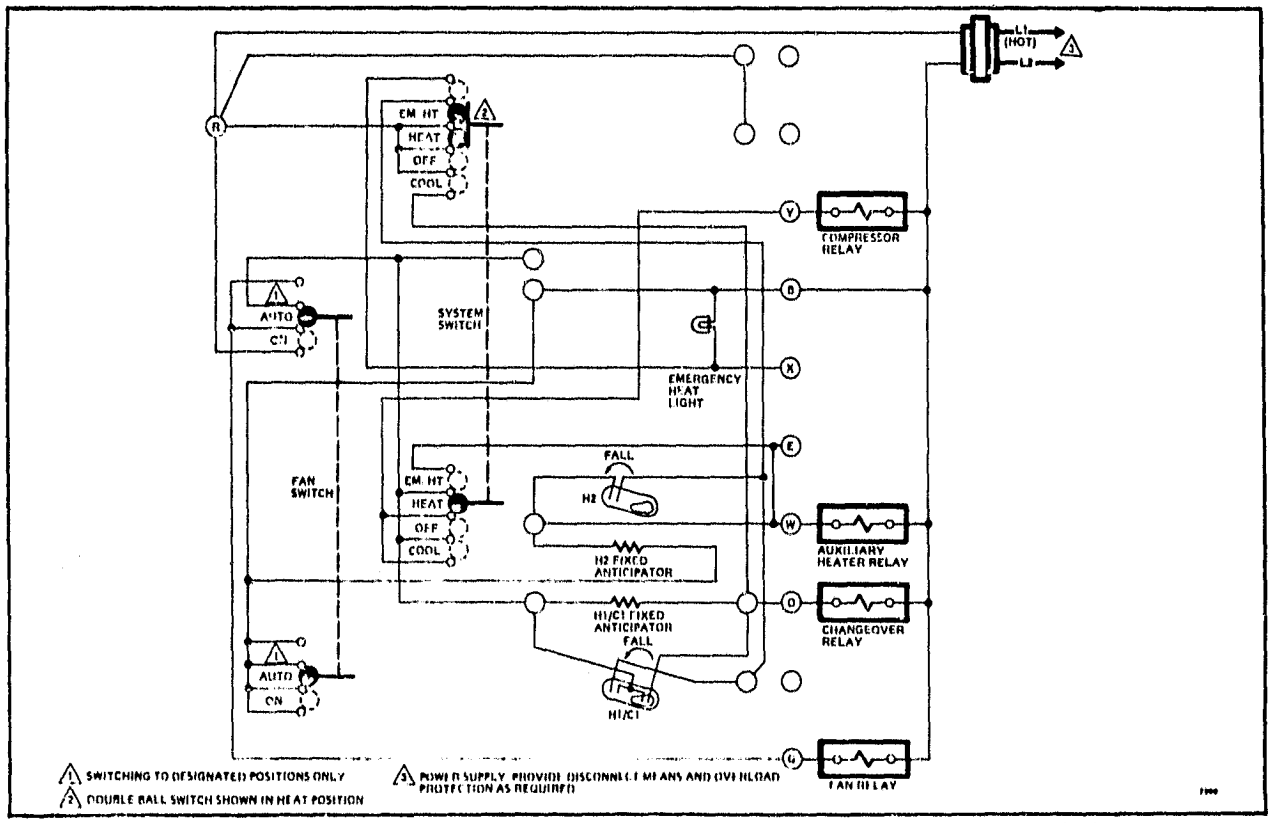


FIG. 52—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672L/T872R IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. SUB-BASE PROVIDES EM.HT.-HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

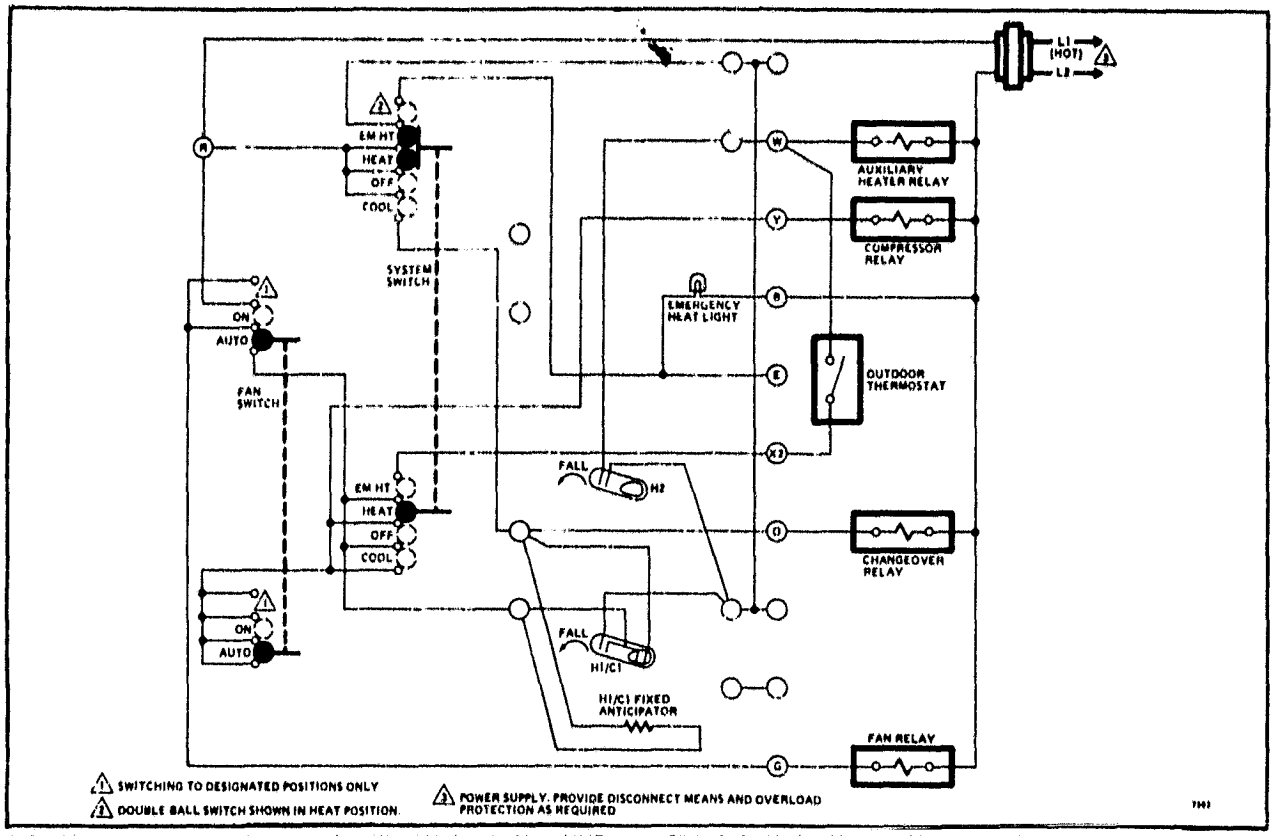


FIG. 53—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672L/T872R IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; MANUAL CHANGEOVER OPERATES ON COOLING. SUBBASE PROVIDES EM. HT.-HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

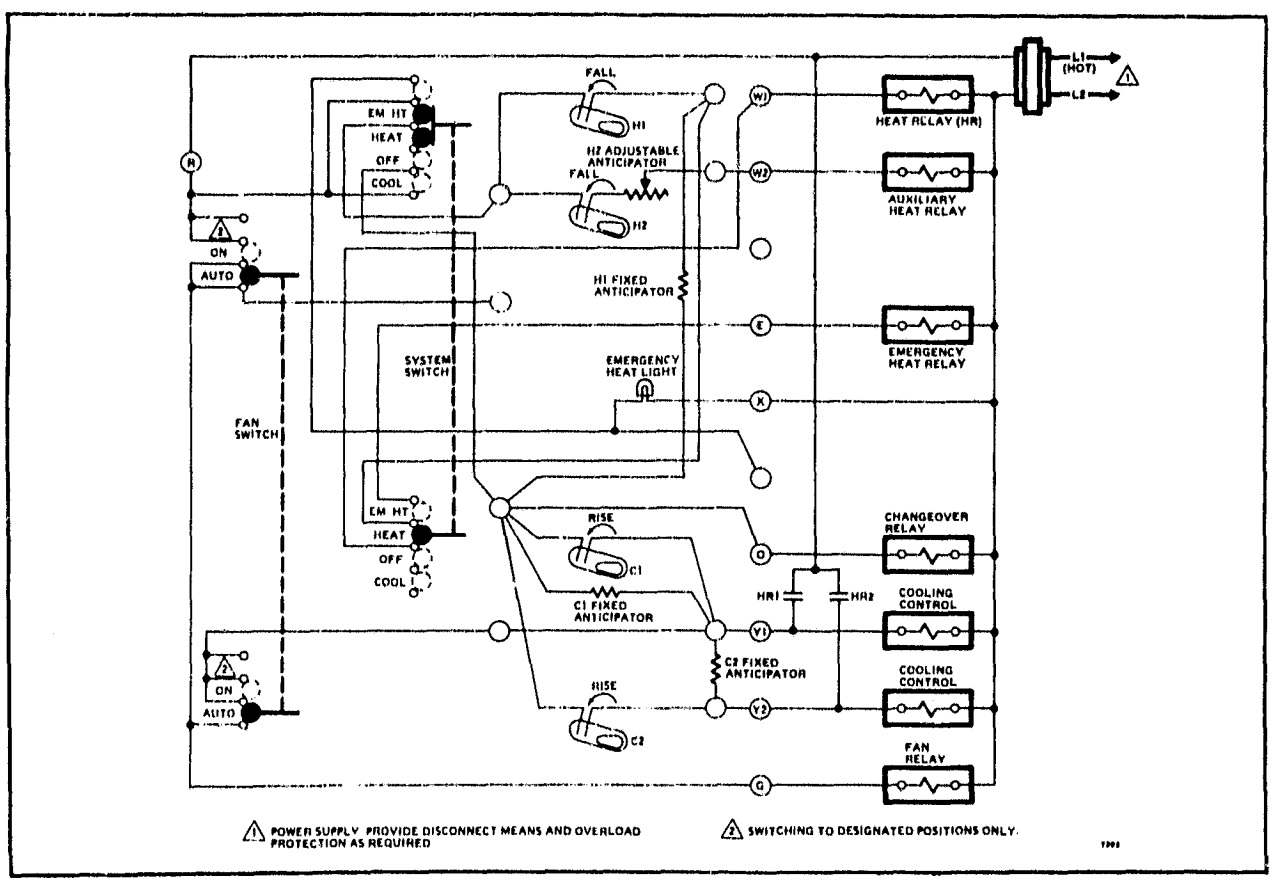


FIG. 54—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672L/T872G IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 2-STAGE COOLING. SUBBASE PROVIDES EM. HT.-HEAT-OFF-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

HEAT PUMP CIRCUITS WITH AUTOMATIC CHANGEOVER ON HEATING

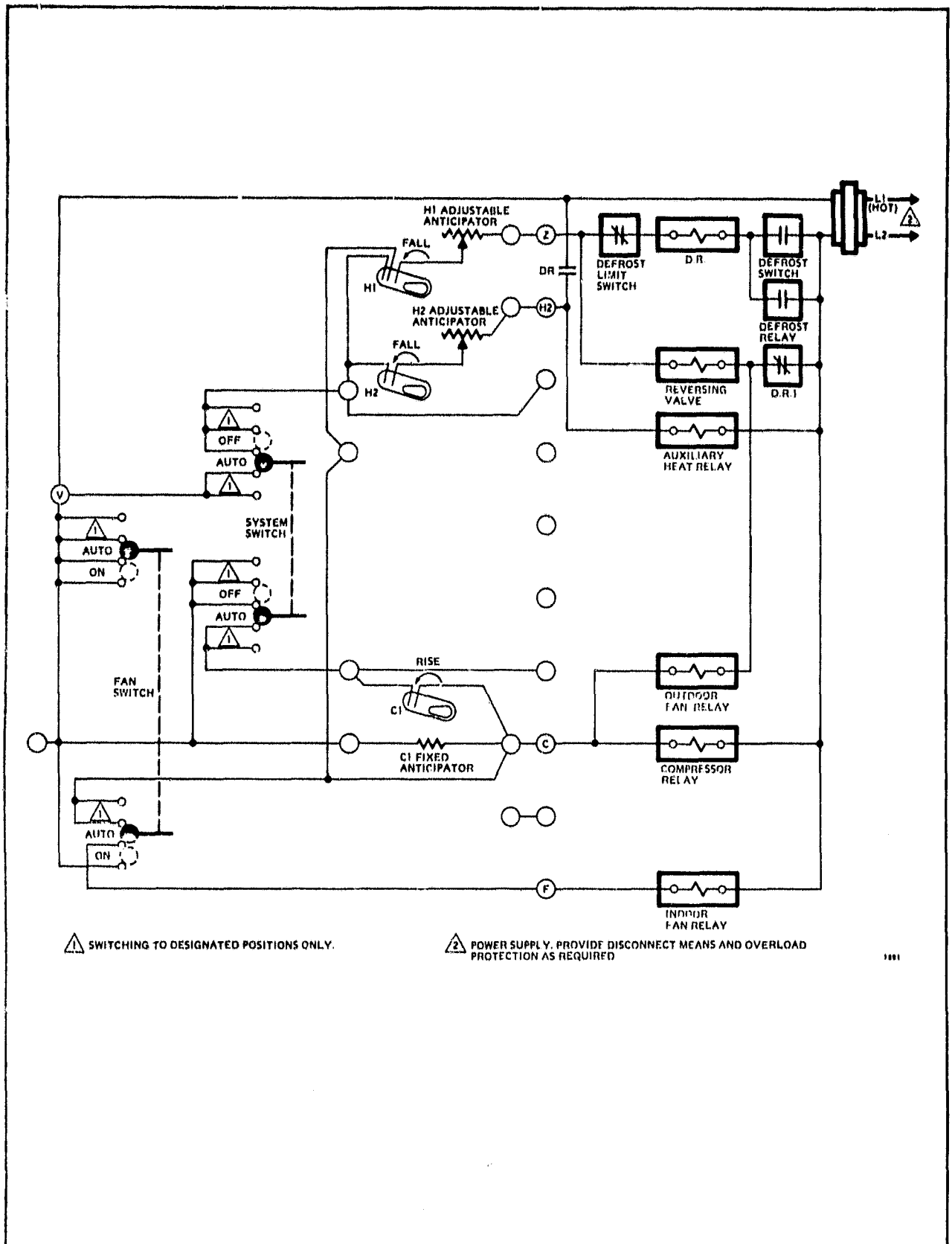


FIG. 55—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672C/T8725 IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH HEATING. SUB-BASE PROVIDES OFF-AUTO SYSTEM AND AUTO-ON FAN SWITCHING.

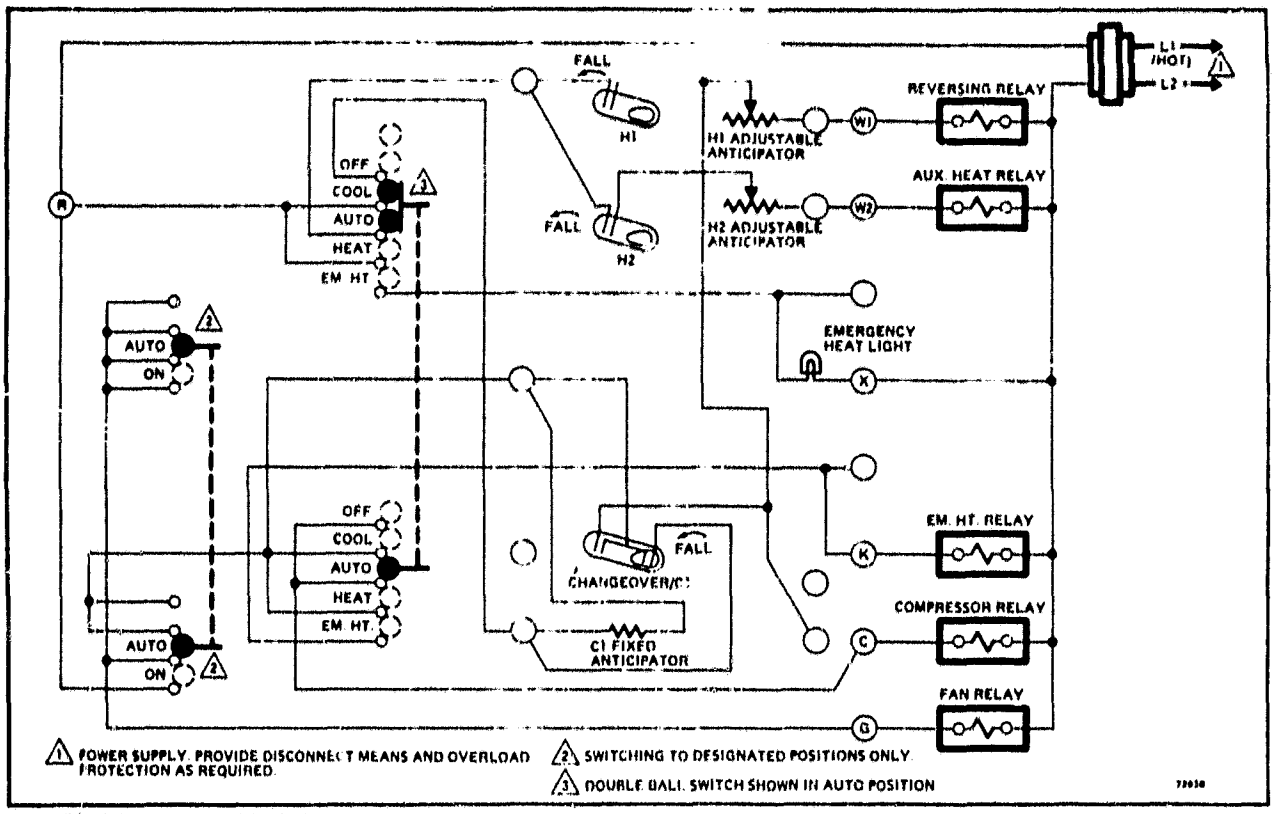


FIG. 56—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672F/T872N IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH HEATING. SUB-BASE PROVIDES OFF-COOL-AUTO-HEAT-EM.HT. SYSTEM AND AUTO-ON FAN SWITCHING.

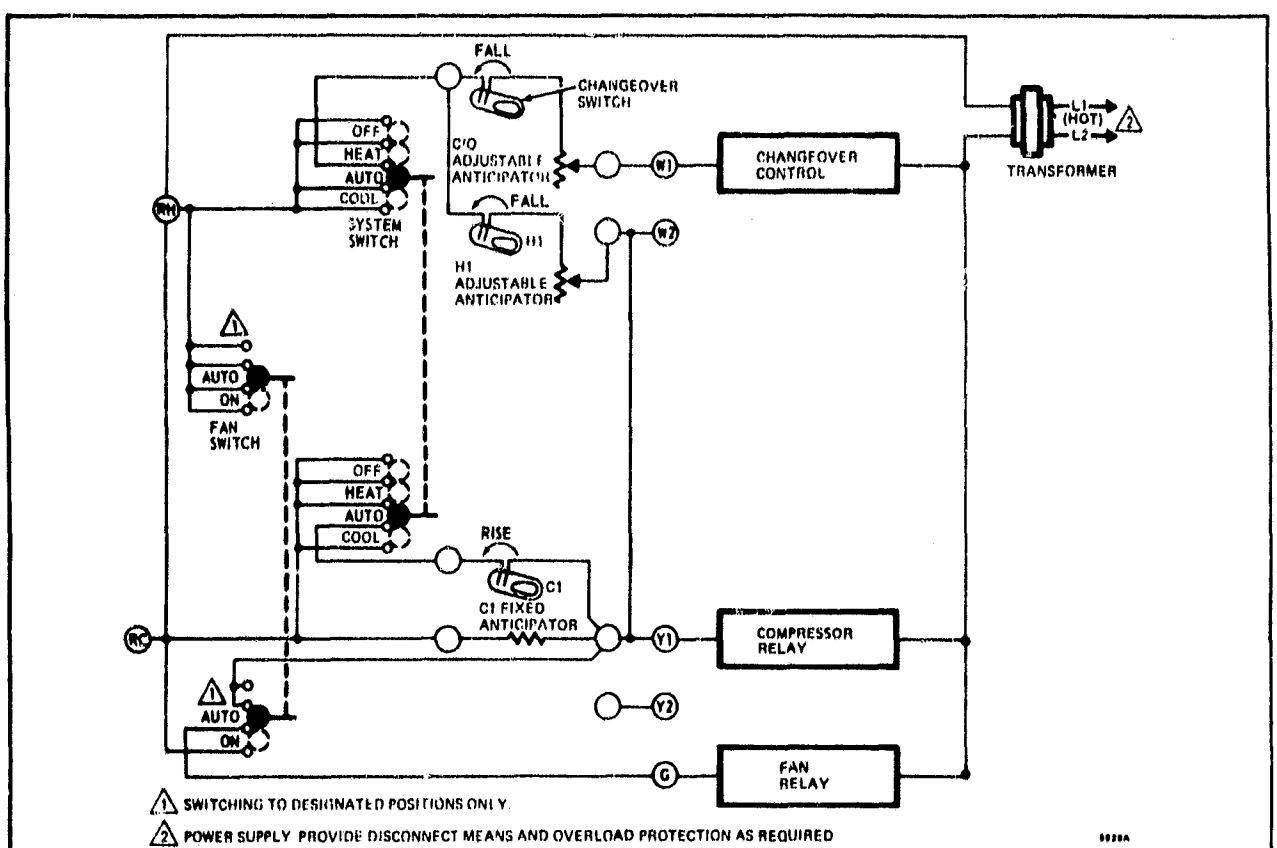


FIG. 57—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672E/T872C IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 1-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH HEATING. SUB-BASE PROVIDES OFF-HEAT-AUTO-COOL SYSTEM AND AUTO-ON FAN SWITCHING.

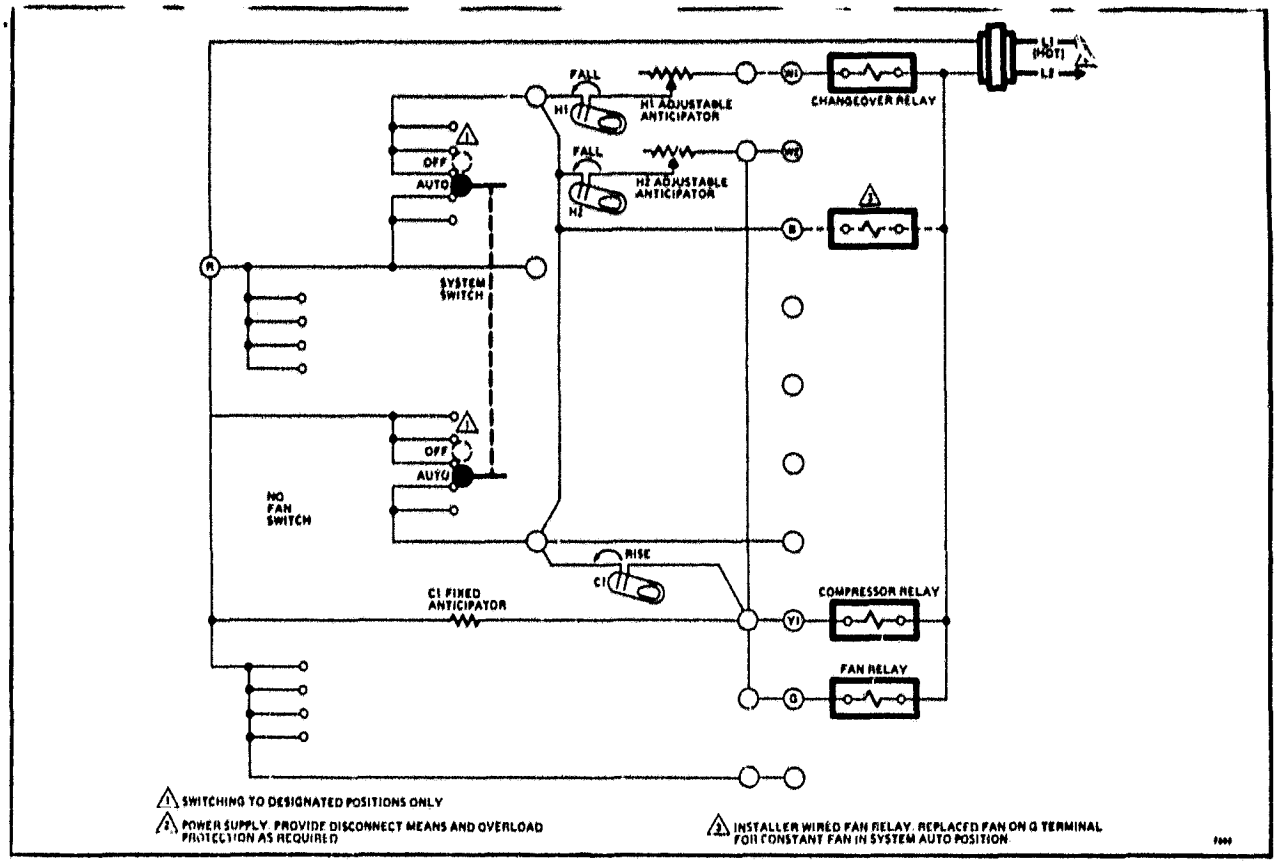


FIG. 58—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672G/T872C IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 1-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH HEATING. SUB-BASE PROVIDES OFF-AUTO SYSTEM SWITCHING AND NO FAN SWITCHING FOR FAN CIRCUIT.

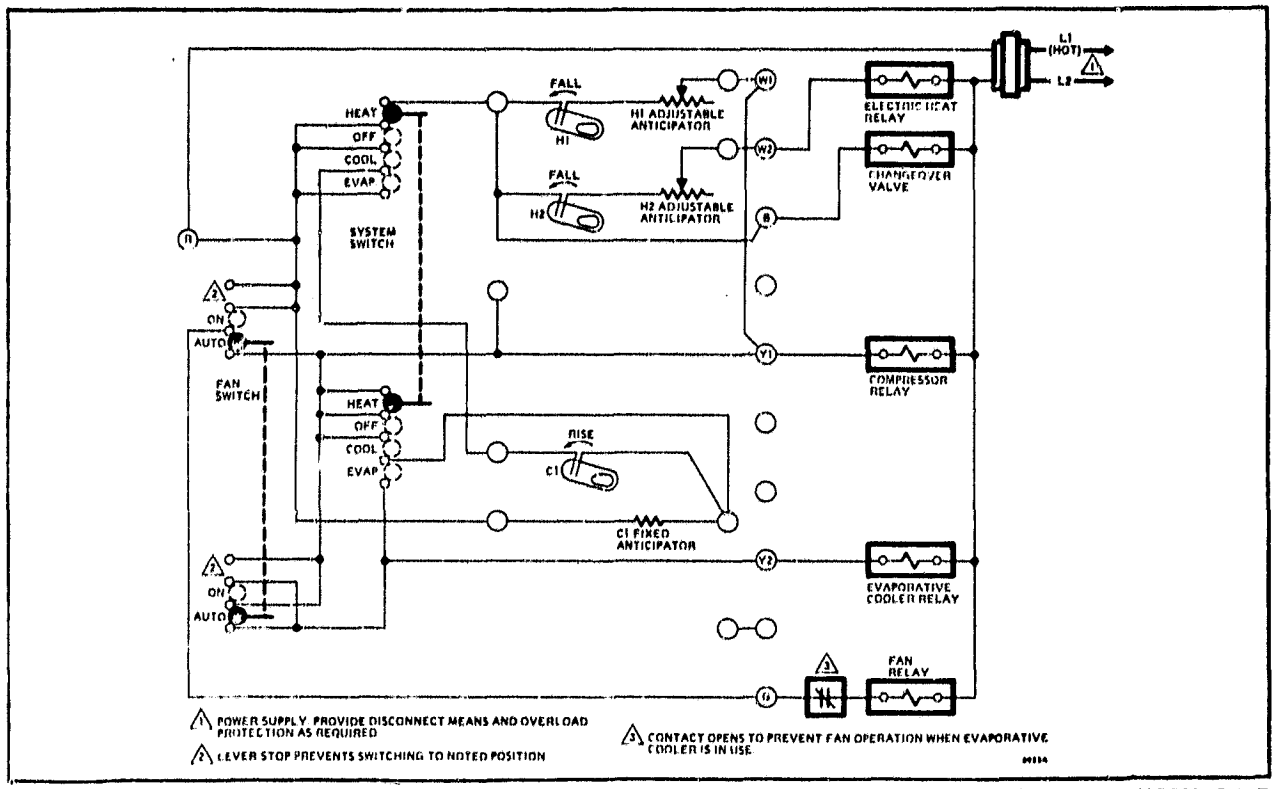


FIG. 59—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672N/T872C IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 1-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH HEATING. SUB-BASE PROVIDES HEAT-OFF-COOL-EVAP. SYSTEM AND ON-AUTO FAN SWITCHING.

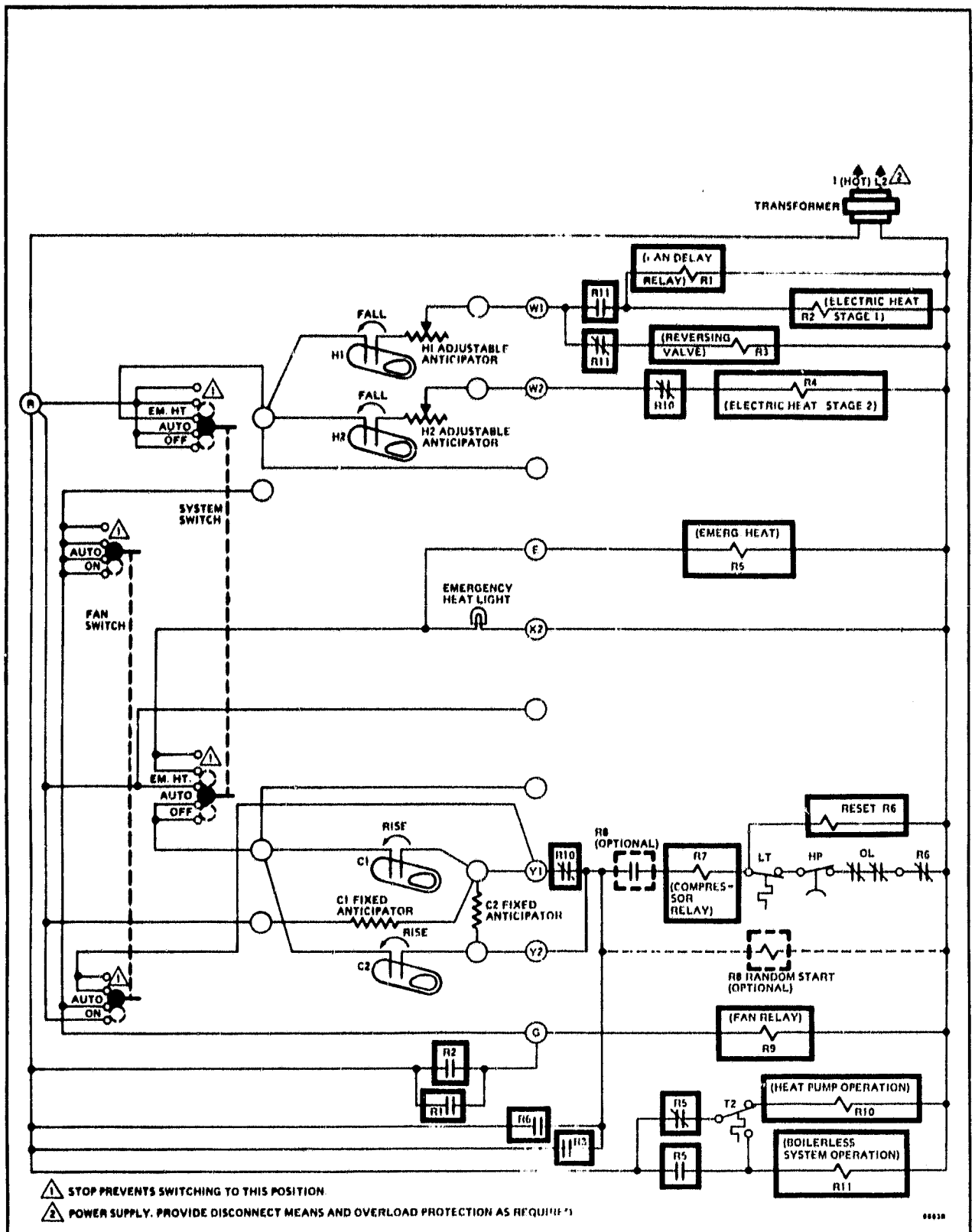


FIG. 60—INTERNAL SCHEMATIC AND TYPICAL HOOKUP OF Q672J/T872A OR D IN HEAT PUMP APPLICATION. THERMOSTAT PROVIDES 2-STAGE HEATING AND 2-STAGE COOLING; CHANGEOVER VALVE OPERATES WITH HEATING. SUBBASE PROVIDES EM.HT-AUTO-OFF SYSTEM AND AUTO-ON FAN SWITCHING.

Honeywell

AQUASTAT CONTROLLERS ARE IMMERSION TYPE DEVICES FOR LIMITING OR REGULATING THE TEMPERATURE OF LIQUIDS IN BOILERS, STORAGE TANKS, AND OTHER APPLICATIONS WHERE TEMPERATURE CONTROL OF LIQUIDS IS REQUIRED. AS THE TEMPERATURE OF THE CONTROLLED MEDIUM RISES TO THE SET POINT, EXPANSION OF THE FLUID IN THE SENSING ELEMENT OPERATES THE INTERNAL SWITCH OR SWITCHES.

☐ The L4006, 7, and 8 provide spst switching for high or low limit control of a burner.

☐ The L4006G model has two spst switches that make and break in sequence to provide boiler sequencing.

☐ The L6006 and 8 provide spdt switching for low limit and circulator control.

☐ Models which break contact on a temperature rise to the set point are calibrated for high limit use. They are also suitable for low limit control if a separate high limit control is used.

☐ Ambient compensated models are available to prevent control-point shift caused by temperature fluctuation at the case.

☐ Visible control point scale and external adjustment screw permit easy setting.

☐ Models are available for either horizontal or vertical insertion of the sensing element. The sensing element may be directly immersed or placed in an immersion well.

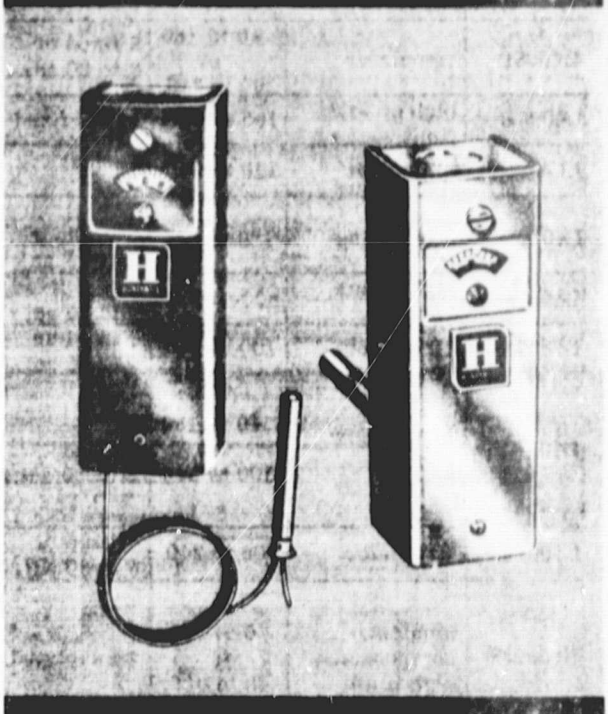
☐ Remote bulb models are available if the controller must be mounted at a location away from the sensing element.

☐ Remote bulb models may also be used to sense air temperature in ducts and in outside air sensing applications.

☐ Totally enclosed Micro Switch snap-acting switches are used in all models.

S.K.
7-75

AQUASTAT CONTROLLERS



L4006,7,8; L6006,8

Residential Div. Form Number 60-2104-1

TABLES

SPST MODELS:

MODEL	APPLICATION	RANGE (F)	MIDSCALE DIFFERENTIAL (F)	INSERTION[a]	SWITCHING ON TEMP. RISE	AVAILABLE OPTIONS
L4006A	high or low limit	40 to 180 100 to 240	2 or 5 fixed or 5 to 30 adj.	horizontal	breaks	Tradeline models which include well and tube of heat conductive compound. Plastic shield for covering well in water heater applications. 3/4 in. NPT brass spud. Centigrade scale markings. Factory set stops at 160 F, 185 F, 190 F, 200 F, or 220 F. Dial marked WARM, NORMAL, HOT. Insulation depths of 1-1/2, 3, or 5 inches.
L4006B	circulator	40 to 180 or 100 to 240	5 fixed or 5 to 30 adj.	horizontal	makes	3 inch insulation depth. 3/4 inch NPT brass spud.
L4006C	high or low limit	100 to 240	2 or 5 fixed	horizontal direct	breaks	10 in. element. Factory set stop at 205 F.
L4006E[b]	high limit	110 to 250	manual reset	horizontal or vertical	breaks	3/4 in. NPT brass spud. 3 in. insulation depth.
L4006G	sequencing	100 to 240	5 fixed interstage 3-10 F adj.	horizontal or vertical	breaks two switches	———
L4007A	high or low limit	100 to 240	2 or 5 fixed, 5 to 30 adj.	vertical	breaks	Centigrade scale markings.
L4007B	circulator	100 to 240	5 fixed or 5 to 30 adj.	vertical	makes	———
L4008A[a]	high or low limit	40 to 180 or 100 to 240	2 or 5 fixed, 5 to 30 adj.	remote bulb	breaks	5 ft.6 in., 8 ft.6 in. or 10 ft. remote capillary. Factory set scale stop at 120 or 200 F. External adjusting knob. Centigrade scale markings.
L4008B[a]	circulator	100 to 240	5 fixed or 5 to 30 adj.	remote bulb	makes	8 ft.6 in. capillary.
L4008C[a]	ambient compensated high limit	0 to 70 or 40 to 180	2 or 5 fixed	remote bulb	breaks	7 ft.6 in., 20 ft.capillary or fast response element. External adj. knob. 150 va rating at 120, 240v ac. High limit stamped on case scale lock.

L4008 models continued on page 3

[a]Copper well or fitting is supplied with all models except remote bulb type. When ordering, specify boiler tapping size (1/2 or 3/4 inch) and insulation depth.

[b]Manual reset (trip-free)—Switch breaks circuit and locks out when controlled medium reaches set point. Controlled temperature must drop 20 degrees below set point before contacts can be manually reset.

ORDERING INFORMATION

REFER TO THE TRADELINE CATALOG OR PRICE SHEET FOR COMPLETE ORDERING SPECIFICATION

SPECIFY –
1. MODEL NUMBER.
2. OPERATING MODE.
3. DIFFERENTIAL – ADJUSTABLE OR NONADJUSTABLE, OR MS.
4. CAPILLARY LENGTH.
5. WELL TAPPING AND INSULATION DEPTH.
6. ACCESSORIES.

ORDER FROM –
1. YOUR USUAL SOURCE, OR
2. HONEYWELL
   1985 DOUGLAS DRIVE, NORTH
   MINNEAPOLIS, MINNESOTA 55422
   (IN CANADA – HONEYWELL CONTROLS LIMITED
   740 ELLESMERE ROAD
   SCARBOROUGH, ONTARIO)

SPST MODELS CONTINUED:

MODEL	APPLICATION	RANGE (F)	MIDSCALE DIFFERENTIAL (F)	INSERTION[a]	SWITCHING ON TEMP. RISE	AVAILABLE OPTIONS
L4008D[a]	ambient compensated circulator	0 to 70 or 40 to 180	2 or 5 fixed	remote bulb	makes	Tradeline model available. Centigrade scale markings. Hot tinned 8 ft.capillary. Electrical rating: 2.3 amp at 120-240v ac, full load. Fast response, 10 ft.armored capillary with 3 ft. bulb. External adjustment knob. Factory set scale stops at 120, 220, or 250 F. Plastic shield for covering well in water heater applications.
L4008E[ab]	high limit	40 to 80 or 110 to 290	manual reset	remote bulb	breaks	Factory set scale stop at 250 F. 8 ft.6 in. capillary.
L4008J[a]	high limit	100 to 240	5 fixed	remote bulb	breaks	All models less case and cover. 18 in. capillary and 1/2 in. well assy. Factory set scale stop at 220 F.
L4008K[a]	circulator	40 to 180	5 fixed	remote bulb	makes	All models less cover.

SPDT MODELS:

MODEL	APPLICATION	RANGE (F)	MIDSCALE DIFFERENTIAL (F)	INSERTION[a]	AVAILABLE OPTIONS
L6006A[a]	circulator and low limit or high limit	100 to 240 or 110 to 290	5 fixed or 5 to 30 adj.	horizontal	Tradeline model which includes well adaptor and tube of heat conductive compound. 3/4 in. NPT brass spud, 3 in. insulation depth. Horizontal or vertical mount available on same models.
L6006B	circulator and low limit or high limit	100 to 240	5 fixed or 5 to 30 adj.	horizontal	3/4 in. brass bulb compression fitting.
L6008A[a]	circulator and low limit cooling	100 to 240 -30 to 70	5 fixed or 5 or 30 adj.	remote bulb	Tradeline model with 5 ft.capillary. Range of -30 to 70 F. Centigrade scale markings. Without cover.
L6008C[a]	dual fuel changeover	0 to 70 40 to 180	2 or 5 fixed	remote bulb. May be duct mounted.	Tradeline model. 150 va switch rating. Centigrade scale markings. 7 ft.6 in. armored capillary. External adjustment knob. Lock type cover. 20 ft. element. Averaging element.
L6008E[a]	ambient compensated	40 to 180	5 fixed	remote bulb	All models less enclosure. Front mounted.

[a]Copper well or fitting is supplied with all models except remote bulb type. When ordering, specify boiler tapping size (1/2 or 3/4 inch) and insulation depth.

[b]Manual reset (trip-free)—Switch breaks circuit and locks out when controlled medium reaches set point. Controlled temperature must drop 20 degrees below set point before contacts can be manually reset.

NOTE: The following specifications are standard. Variances, available as options, are noted in the preceding table.

ELECTRICAL RATING (AMPS):

Models with 2 F fixed differential—

	120v ac	240v ac
FULL LOAD	2.6	1.3
LOCKED ROTOR	15.6	7.8

Models with 5 F differential—

	120v ac	240v ac
FULL LOAD	8	5.1
LOCKED ROTOR	48	30.6
INDUCTIVE CURRENT	.25 at 1/4 to 12v dc	

PRESSURE RATING:
Capillary bulb (direct immersion)—200 psi.
Immersion well—255 psi.

SENSING BULB MATERIAL: Copper.

SENSING BULB FULL: Liquid. Toluene or Silicone.

CAPILLARY LENGTH (including bulb): Remote bulb models—60 inches.

SENSING BULB DIMENSIONS (inches): 2-7/8 long, 3/8 diameter.

INSERTION DEPTH: 3-3/8 inches.

INSULATION: Brass. 1-1/2 or 3 inches. Specify when ordering.

PROVISION FOR WIRING: Screw terminals.

MOUNTING: Horizontal and vertical models mount directly to an immersion well installed in a boiler fitting. Remote bulb models have 3 mounting holes rear of case for screw mounting to a vertical surface.

FINISH: Gray.

INSTALLATION DIMENSIONS: See Figs. 1 and 2.

IMMERSION WELL DIMENSIONS: See Fig. 3.

BOILER FITTING AND BULB DIMENSIONS: See Fig. 4.

ACCESSORIES:
Weatherproof enclosure—Q615.
Immersion wells—
Copper, 1/2 NPT, 1-1/2 inch insulation—Part No. 121371A.
Copper, 1/2 NPT, 3 inch insulation—Part No. 121371L.
Copper, 3/4 NPT, 1-1/2 inch insulation—Part No. 121371B.
Copper, 3/4 NPT, 3 inch insulation—Part No. 121371M.
Copper, 3/4 NPT, 1-1/2 inch insulation, plastic sleeve—Part No. 12131K.
Copper, 3/4 NPT, 3 inch insulation, plastic sleeve—Part No. 121371N.
Stainless steel, 1/2 NPT, 1-1/2 inch insulation—Part No. 121371E.
Stainless steel, 3/4 NPT, 1-1/2 inch insulation—Part No. 121371F.
Bulb Compression Fittings (see Fig. 6)—
Brass, 1/2 NPT plug, 1-1/2 inch insulation—Part No. 104486B.
Brass, 3/4 NPT plug, 1-1/2 inch insulation—Part No. 104486C.
Capillary Compression Fittings (see Fig. 7)—
Copper, 1/2 NPT plug, 1-1/2 inch insulation—Part No. 104484C.
Copper, 3/4 NPT plug, 1-1/2 inch insulation—Part No. 104484B.

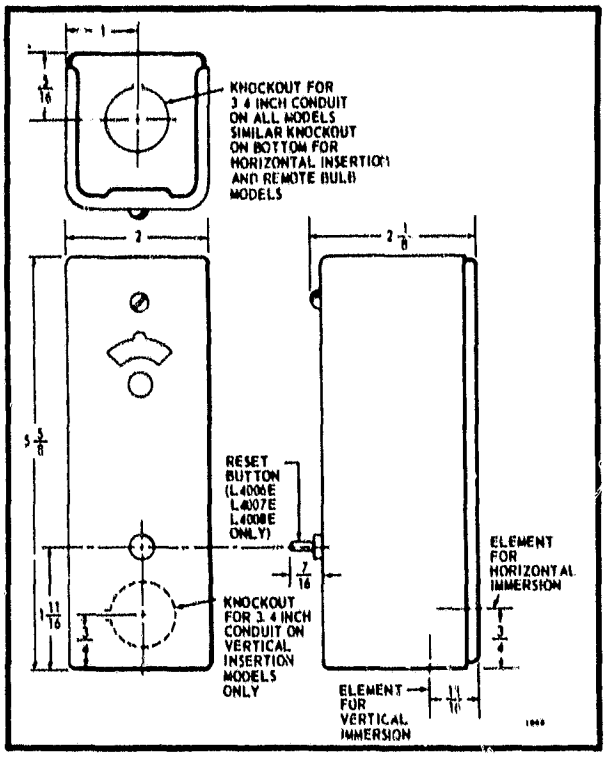


FIG. 1—INSTALLATION DIMENSIONS.

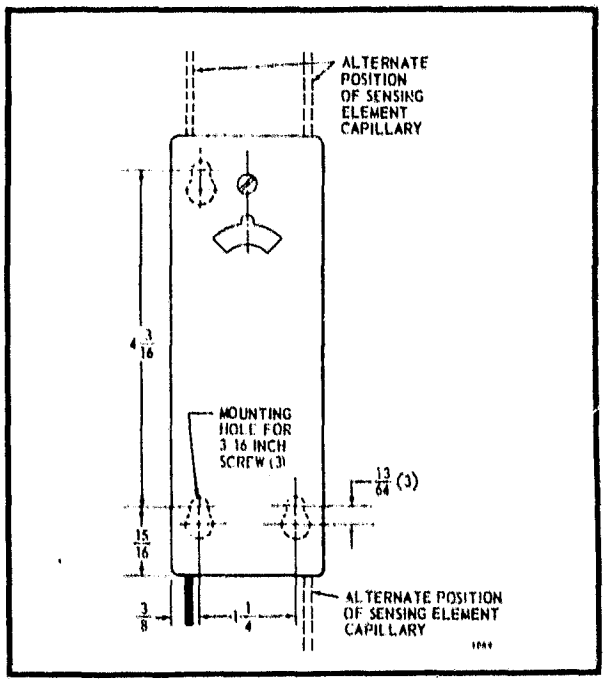


FIG. 2—INSTALLATION DIMENSIONS FOR REMOTE BULB MODELS. OTHER DIMENSIONS SAME AS FIG. 1.

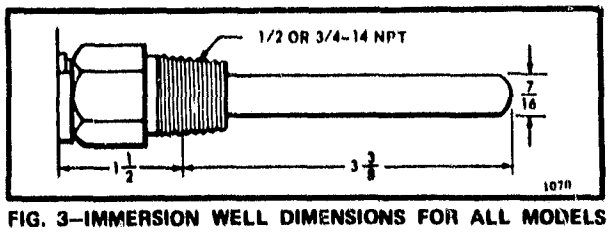


FIG. 3—IMMERSION WELL DIMENSIONS FOR ALL MODELS EXCEPT L4006C, L4007D, AND L6006B.

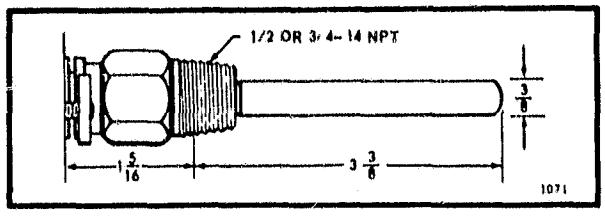


FIG. 4—BOILER FITTING AND BULB DIMENSIONS FOR L4006C, L4007D, AND L6006B.

INSTALLATION

The manufacturer usually provides a tapping for insertion of the controller's sensing element. This tapping is located at a point where typical water temperature can be measured. Depending on model, the element is inserted in an immersion well, through a boiler fitting, or directly immersed.

Installation should be made by a qualified serviceman. Follow the instructions furnished by the system manufacturer, if available. Otherwise, refer to appropriate procedure listed below.

IMPORTANT

Controller may be used with or without immersion well. Well, if used, must fit sensing bulb snugly for good thermal response. Insert bulb until it rests against bottom of well, then hold it there while tightening the tubing clamp.

MOUNTING REMOTE BULB MODELS

The remote temperature-sensing bulb can either be installed in an immersion well (Fig. 5) that extends into the boiler or tank, or it can be directly immersed in the liquid. For installations not using a well, secure the remote bulb with a bulb compression fitting (Fig. 6), or capillary compression fitting (Fig. 7).

Well, bulb compression fitting or capillary compression fitting must be ordered separately. Sizes available: 1/2 in., 3/4 in. NPT spud. Well, if used, must fit sensing bulb snugly for good thermal response. Insert bulb until it rests against bottom of well, then hold it there while tightening the tubing clamp. (See Fig. 5.)

The boiler manufacturer generally provides a tapping for the insertion of the Aquastat controller's sensing element. This tapping should be located at a point where typical water temperature can be measured. The bulb or protecting immersion well must never be located close to a hot or cold water inlet or a steam coil.

If the system is filled, drain system to a point below the boiler tapping, or wherever the sensing bulb is to be installed.

The bulb can also be installed in the supply line of an indirect water heater, in the direct water heater itself, or in the feed riser, about 6 in. above the boiler. If the riser is valved, the bulb can be installed between the boiler and the valve.

NOTE: Avoid making sharp bends or kinks in the capillary. Bends should be no sharper than 1 inch radius.

After installing, carefully coil excess capillary at the bottom of the controller case.

IMMERSION WELL MOUNTING

1. Screw the well into the boiler, tank, or pipe tapping.

2. Insert bulb in well, pushing tubing until bulb bottoms in well.

3. Attach retainer clamp to end of well spud. Loosen draw nut and spread jaws of clamp with screwdriver if necessary.

4. With retainer clamp attached to well spud (be sure jaws of clamp hook over ridge at end of spud, as shown at points "A"), adjust tubing to fit through retainer clamp groove, as shown at point "B."

5. Tighten draw nut so that retainer clamp is firmly attached to well spud and tubing is held securely in place.

CAUTION:
Do not secure draw nut so tightly that retainer clamp could collapse tubing.

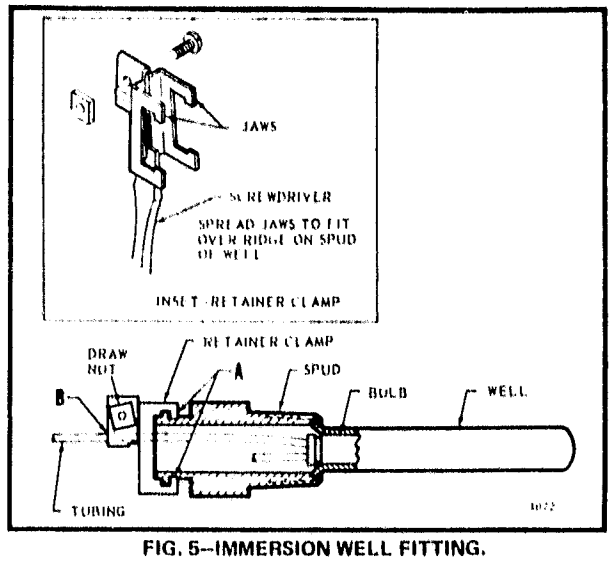


FIG. 5--IMMERSION WELL FITTING.

MOUNTING WITH BULB COMPRESSION FITTING

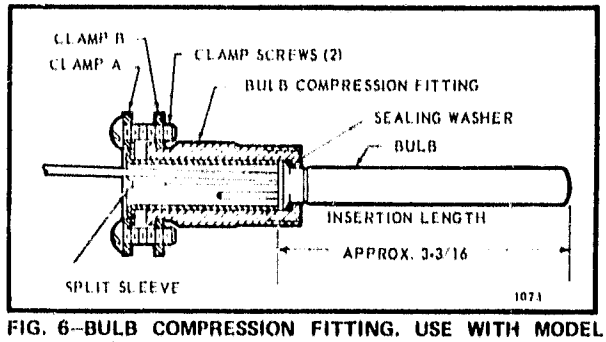


FIG. 6--BULB COMPRESSION FITTING. USE WITH MODEL L4008A,B,E,J, OR L6008A.

1. Screw the fitting into boiler or pipe tapping.

2. Slide sealing washer onto bulb.

3. Insert bulb into boiler fitting until bulb bottoms.

4. Slide split sleeve into fitting.

5. Place clamps A and B on assembly so that sleeve is drawn into fitting when screws are tightened. Note: make sure that nub on clamp A engages space between sleeve and clamp.

6. Tighten clamp screws evenly.

MOUNTING WITH CAPILLARY COMPRESSION FITTING

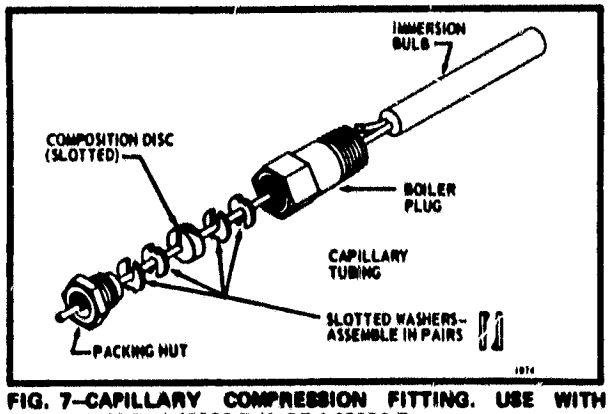


FIG. 7–CAPILLARY COMPRESSION FITTING. USE WITH MODEL L4008C,D,K, OR L6008C,E.

1. Screw fitting into boiler or pipe tapping.
2. Place packing nut on tubing.
3. Slide bulb completely through fitting.
4. Place composition disc and 4 slotted brass washers on tubing in the order shown in Fig. 7. Turn brass washers so that slots are 180 degrees apart.
5. Slide seal assembly into fitting and tighten packing nut.

DUCT MOUNTING

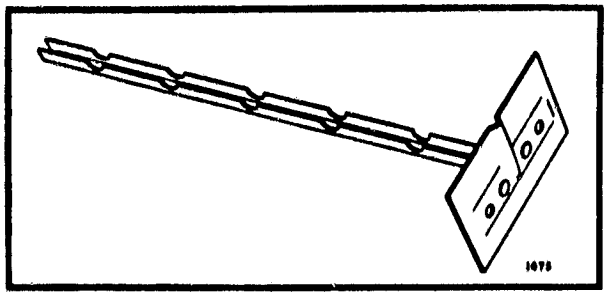


FIG. 8–BULB SUPPORT.

1. Drill a 3/4 inch hole in the duct wall large enough to admit the sensing bulb into the holder.
2. Using the holder as a template, mark and drill holes for bulb holder mounting screws.
3. Break holder to desired length (Fig. 9).

NOTE: Holder must be long enough to hold sensing bulb in freely circulating air away from duct wall. Neatly coil excess capillary at controller case or at bulb holder.

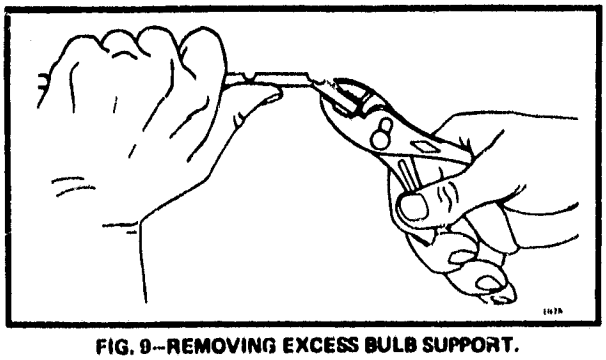


FIG. 9–REMOVING EXCESS BULB SUPPORT.

4. Place capillary in bulb holder channel. Pinch top edges of holder together at each segment (Fig. 10).

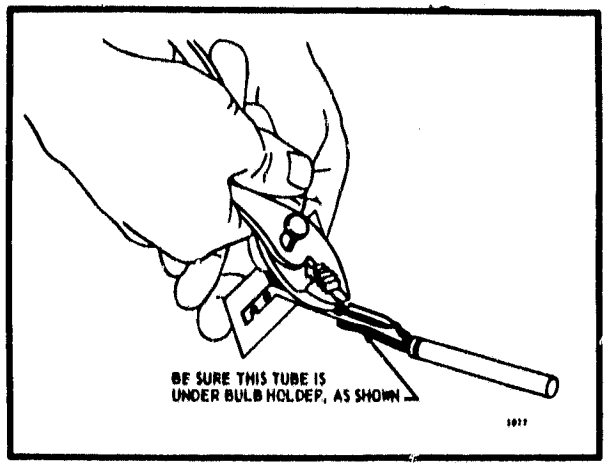


FIG. 10–SECURING CAPILLARY IN BULB HOLDER.

5. Insert bulb holder into controlled area through hole prepared in step 1 above.
6. Fasten bulb holder to duct wall with screws furnished.

MOUNTING DIRECT IMMERSION MODELS

FOR MODELS USING AN IMMERSION WELL

The well of the Aquastat controller must always be exposed to circulation of the medium under control, but must never be located close to a hot or cold inlet or steam coil. Where the tapping is on the side of the boiler, use an Aquastat controller with horizontal well. Where the tapping is on top of the boiler, use a model with a vertical well.

INSTALLING THE IMMERSION WELL

On existing installations, shut off the power and remove the old control. If the old immersion well appears suitable, and if the adapter clamp on the Aquastat controller fits the old well spud, the well need not be replaced.

1. If the system is filled, drain system to a point below the boiler tapping.
2. Remove plug (or old well) from boiler tapping.
3. Install the No. 121371 Immersion Well furnished with the controller. If boiler tapping is greater than 1/2 inch a reduction fitting must be used to adapt the boiler opening to the 1/2 inch threads that are standard with the well or fitting. Fittings with 3/4 inch threads are also available.
4. Fill the system. Make sure that the well is screwed in tightly enough to prevent leakage. Do NOT tighten or apply force to case after controller is secured to well.

INSTALLATION OF SENSING BULB IN IMMERSION WELL

a. Loosen screw (at top of case, above scale-setting), and remove cover. Loosen two screws that secure adapter clamp. See Fig. 11.

b. Insert the sensing element into the immersion well.

c. Fasten the case of the Aquastat controller to the well with the adapter clamp. Make certain that the clamp is properly positioned over the groove of the well spud. Also be sure the flange at the opening of the well fits snugly into the opening of the case. The sensing element bulb must bottom in the well.

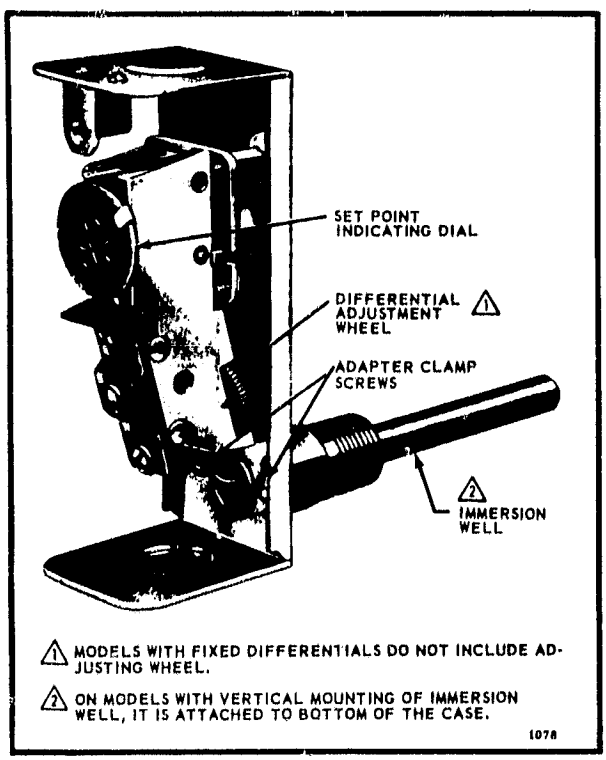


FIG. 11–INTERNAL VIEW OF L6006A.

MODELS DESIGNED FOR DIRECT IMMERSION (WITHOUT WELL)

Some models, which provide direct immersion of the sensing element into the boiler, include a No. 104486 bulb compression fitting assembly instead of an immersion well. Install fitting in boiler tapping. Be sure sealing washer is in place as shown in Fig. 12. Make sure that spud of bulb compression fitting is screwed in tightly enough to prevent leaking. Insert immersion bulb (sensing element) through bulb compression fitting. Adjust the adapter clamp so that it fits over the groove at the opening of the bulb compression fitting. Tighten adapter clamp screws so that Aquastat controller is firmly attached to bulb compression fitting.

MOUNTING DUAL FUEL CHANGEOVER MODELS

These models have a five foot capillary. This capillary establishes the maximum distance between the case and the outdoor mounting.

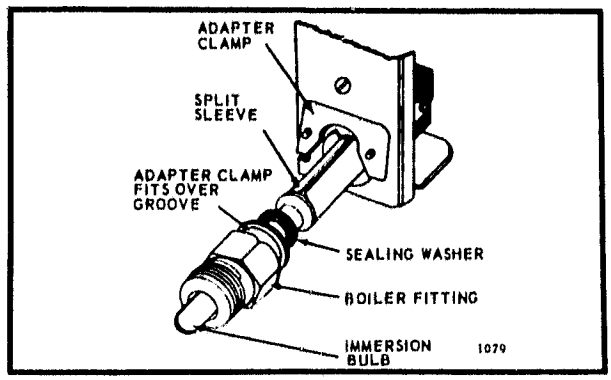


FIG. 12–DIRECT IMMERSION MODEL WITH BULB COMPRESSION FITTING PARTIALLY REMOVED.

The bulb should be installed on the outside of the building in the shield provided (see Fig. 13) where it will be exposed to representative air temperature, but not to direct sunlight. It should be mounted high enough so that accumulated snow, leaves, or other debris cannot obstruct circulation of air around it, and where children cannot reach it. Avoid vents from the building.

Install the case at the indoor location selected, fastening with screws through holes in back of the case. Bring the bulb and tubing out through a 3/4 inch hole in the outside wall. In uncoiling the tubing, carefully avoid sharp bends or kinks. Excess tubing should be left coiled near the case. Do not make sharp bends near the case or bulb.

Slip the bulb through the supports in the shield. Pinch the split supporting clip until it holds the bulb firmly in position. If the seal-off tube protrudes from under the shield, it may be bent under as shown in Fig. 13.

Hold the shield over the mounting position and form a small-radius bend in the tubing. Place the split plug around the tubing and move the shield into mounting location as a unit. Push the split plug into the hole until it is wedged securely in place. Fasten the shield in place on the wall with the screws provided.

NOTE: If the tubing is properly shaped and the split plug installed as directed, the shield will cover the split plug, and the hole in the wall will be hidden from sight.

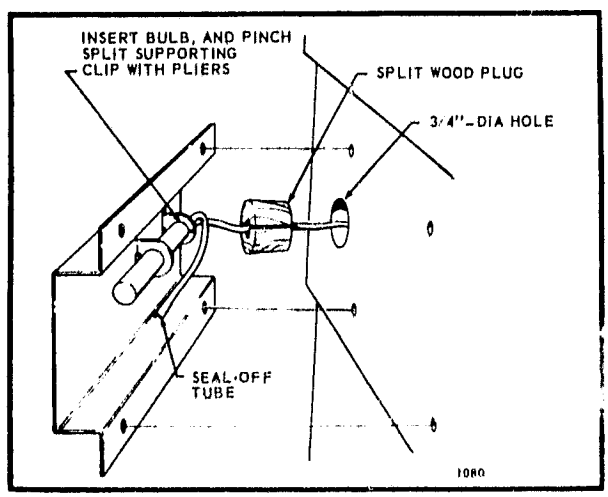


FIG. 13–MOUNTING BULB IN SHIELD OUTSIDE BUILDING.

MOUNTING THE L6008A REMOTE BULB COOLING THERMOSTAT

MOUNTING WITH GUARD BRACKET

Mount the bulb in the guard bracket as shown in Fig. 14. Locate the bulb and bracket combination in freely circulating air in the controlled area. With screws provided, fasten the bracket in place.

MOUNTING ON SUCTION LINE

1. In cooling units with more than one suction line, sensing bulb should be placed on the common line.

2. Make certain the bulb is at least 2 feet from the point at which the suction line leaves the cooler. This will prevent the outside temperature from being transmitted to the remote bulb through the copper tubing of the suction line.

3. Place the remote sensing bulb on the side of the horizontal suction line between the coil and trap (not on the trap).

4. Attach the sensing bulb to the suction line with clips or straps.

5. Coil the excess length of capillary tubing near the L6008A case.

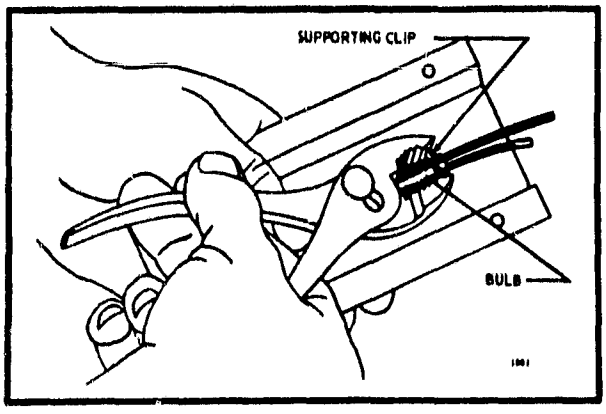


FIG. 14—SECURING REMOTE BULB IN CLIP.

WIRING

All wiring must comply with local codes and ordinances regarding wire size, type of insulation, enclosure, etc. Figures 16 through 23 show typical hook-up diagrams.

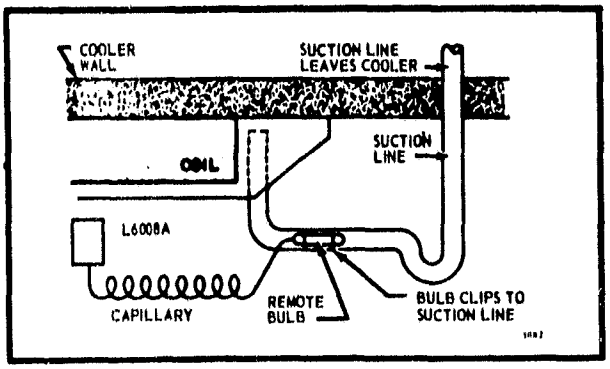


FIG. 15—ATTACHING REMOTE BULB TO HORIZONTAL SUCTION LINE.

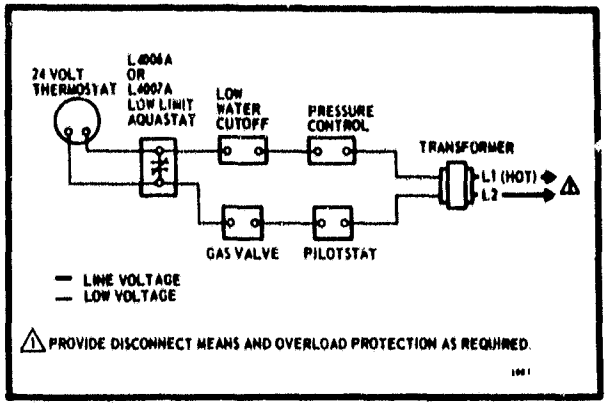


FIG. 16—TYPICAL GAS-FIRED SYSTEM WITH DOMESTIC HOT WATER.

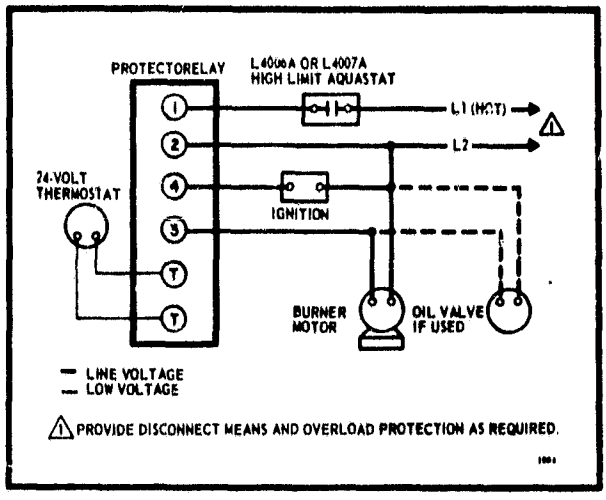


FIG. 17—TYPICAL OIL-FIRED GRAVITY SYSTEM.

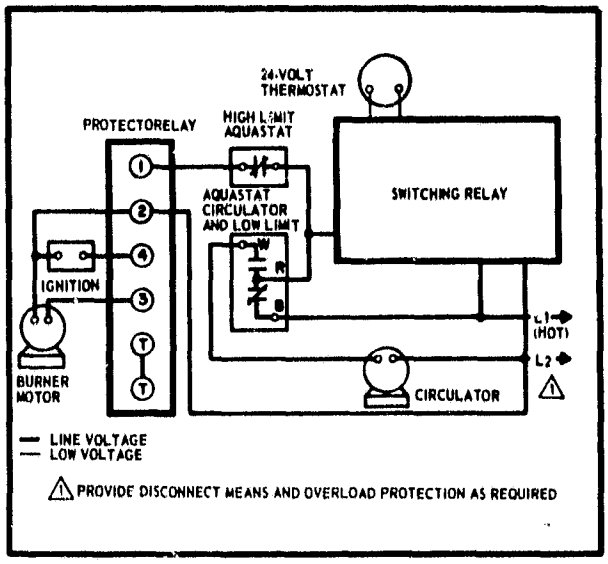


FIG. 18—TYPICAL OIL-FIRED HYDRONIC SYSTEM WITH DOMESTIC HOT WATER.

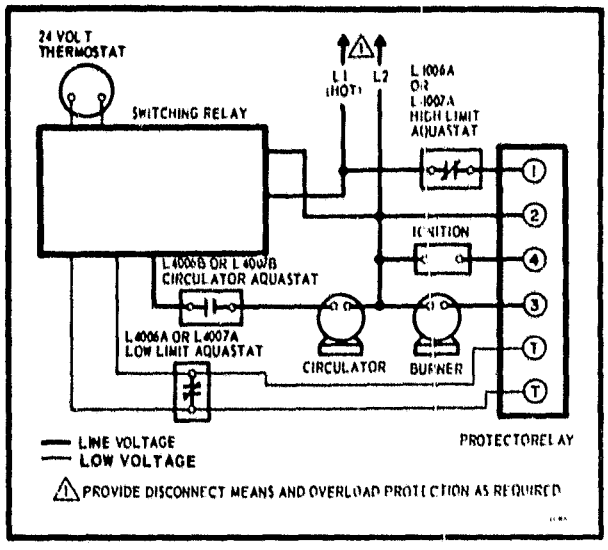


FIG. 19–OIL-FIRED SUMMER-WINTER HYDRONIC SYSTEM WITH DOMESTIC HOT WATER.

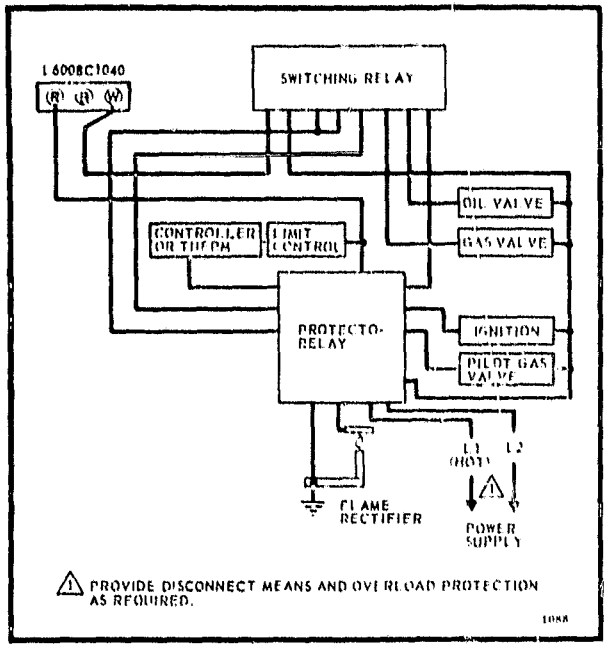


FIG. 20–TYPICAL WIRING DIAGRAM FOR L6008C1040 USED TO SWITCH FROM GAS TO OIL ON TEMPERATURE DROP.

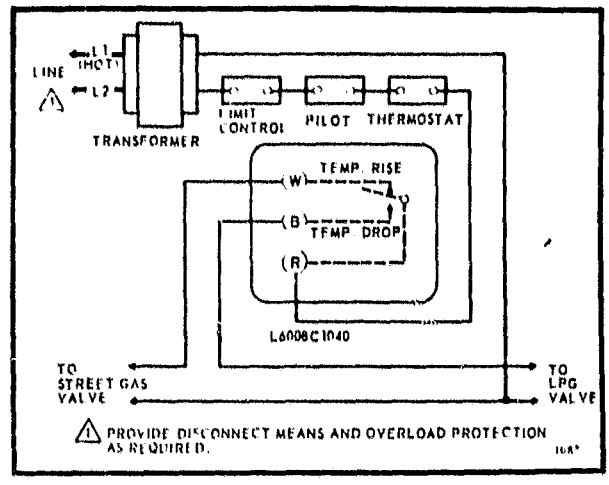


FIG. 21–TYPICAL WIRING DIAGRAM FOR L6008C1040 USED TO SWITCH STREET GAS TO LPG ON TEMPERATURE DROP.

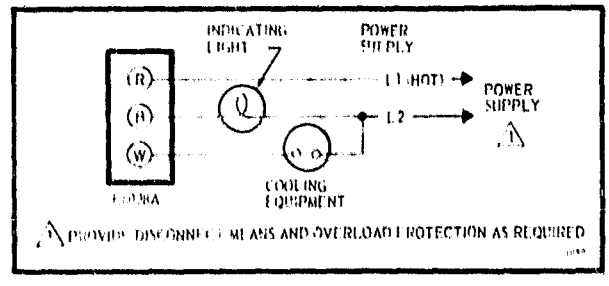


FIG. 22–L6008A USED TO CONTROL COOLING EQUIPMENT AND INDICATING LIGHT.

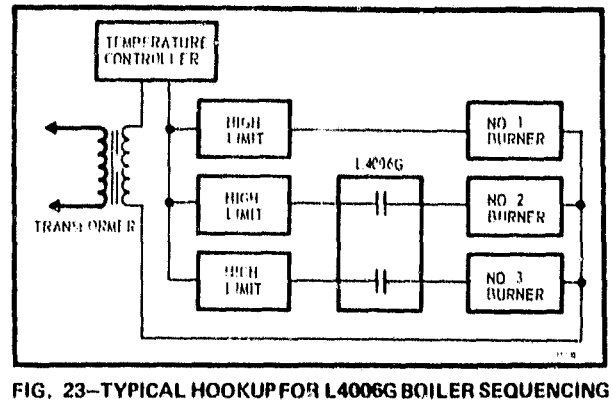


FIG. 23–TYPICAL HOOKUP FOR L4006G BOILER SEQUENCING AQUASTAT.

For proper selection of settings, follow the boiler manufacturer's recommendations.

HIGH LIMIT CONTROLLER

Shuts off burner if water temperature exceeds high limit setting. Burner restarts when temperature drops to high limit setting, less differential.

NOTE: On manual reset models, the reset button on the front of the case must be pushed in to allow the burner to operate after a high limit shutdown.

LOW LIMIT CONTROLLER

Maintains minimum boiler temperature for domestic hot water. Turns on boiler at temperature setting, minus differential.

CIRCULATOR CONTROLLER

Prevents circulation of water that is below the desired heating temperature. Breaks circulator circuit on temperature drop below setting minus differential, remakes on rise to setting.

ADJUSTING

Set the differential to correspond with the boiler manufacturer's recommendations. To adjust models with adjustable differential, rotate the wheel on the back of the snap switch until the desired reading is aligned with the "V" notch in the frame. The wheel provides an adjustment from 5 to 30 F. Replace the cover on the Aquastat controller.

Adjust the control point to correspond with the boiler manufacturer's recommendations. To adjust, insert a screwdriver in the slotted screw-type head located beneath the window in the cover. Turn the scale to the desired control point.

L6008A LOCATION DIFFERENTIAL CALIBRATION

The L6008A1093 is calibrated for applications with both the bulb and case located in the room in which the temperature is being controlled. A correction will be necessary if the temperature of the case is different from the desired dial setting.

1. If the case is at a higher temperature than the desired dial setting, raise the desired dial setting by the correction determined from the table at right.

2. If the case is at a lower temperature than the desired dial setting, lower the desired dial setting by the correction determined from the table below.

Temperature difference between desired room temperature and case temperature (F)	Correction (Degrees F)
0	0
5	3/4
10	1-1/2
15	2
20	2-3/4
25	3-1/2
30	4-1/4
35	5
40	5-3/4
45	6-1/2
50	7
55	8
60	8-1/2
70	10
80	11-1/2

CHECKOUT

Check to make certain that the Aquastat controller has been installed and adjusted properly. Put the system into operation and observe the action of the device through several cycles to make certain that it provides proper control of the system as described under OPERATION. Further adjustments then can be made to meet more exact comfort requirements.

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APPENDIX G

GENERAL SDAS INSTALLATION

INSTRUMENTATION INTERFACE REQUIREMENTS

To transmit data from each sensor to the Central Data Processing System, the hardware components shown in Figure 1 are utilized at each site. A typical layout of the work space required around the SDAS mounting area is shown in Figure 2.

NOTE: All ERDA responsibilities will be performed by NASA.

Hardware Components

1. Sensor wire (supplied and installed by site contractor)
2. Junction box (supplied by ERDA and installed by site contractor)
3. Junction box/SDAS interface cables (supplied and installed by ERDA)
4. Site Data Acquisition Subsystem (SDAS) (supplied by ERDA and installed by site contractor)
5. SDAS telephone interface (supplied by ERDA)
6. SDAS and telephone electrical power interface (supplied by site contractor)

Sensor to Junction Box Wiring

All wiring from sensors to junction box (J-box) terminal block connections shall be performed by the site contractor in accordance with these guidelines utilizing wire procured by the site contractor and prepared for each sensor according to instructions in Figure 3. The wire size and number of conductors required for each sensor is specified in Table 1. The sensor-to-junction-box wire shall be color-coded, audio and instrumentation grade cable to minimize noise problems. Conduit shall be used only in accordance with local codes.

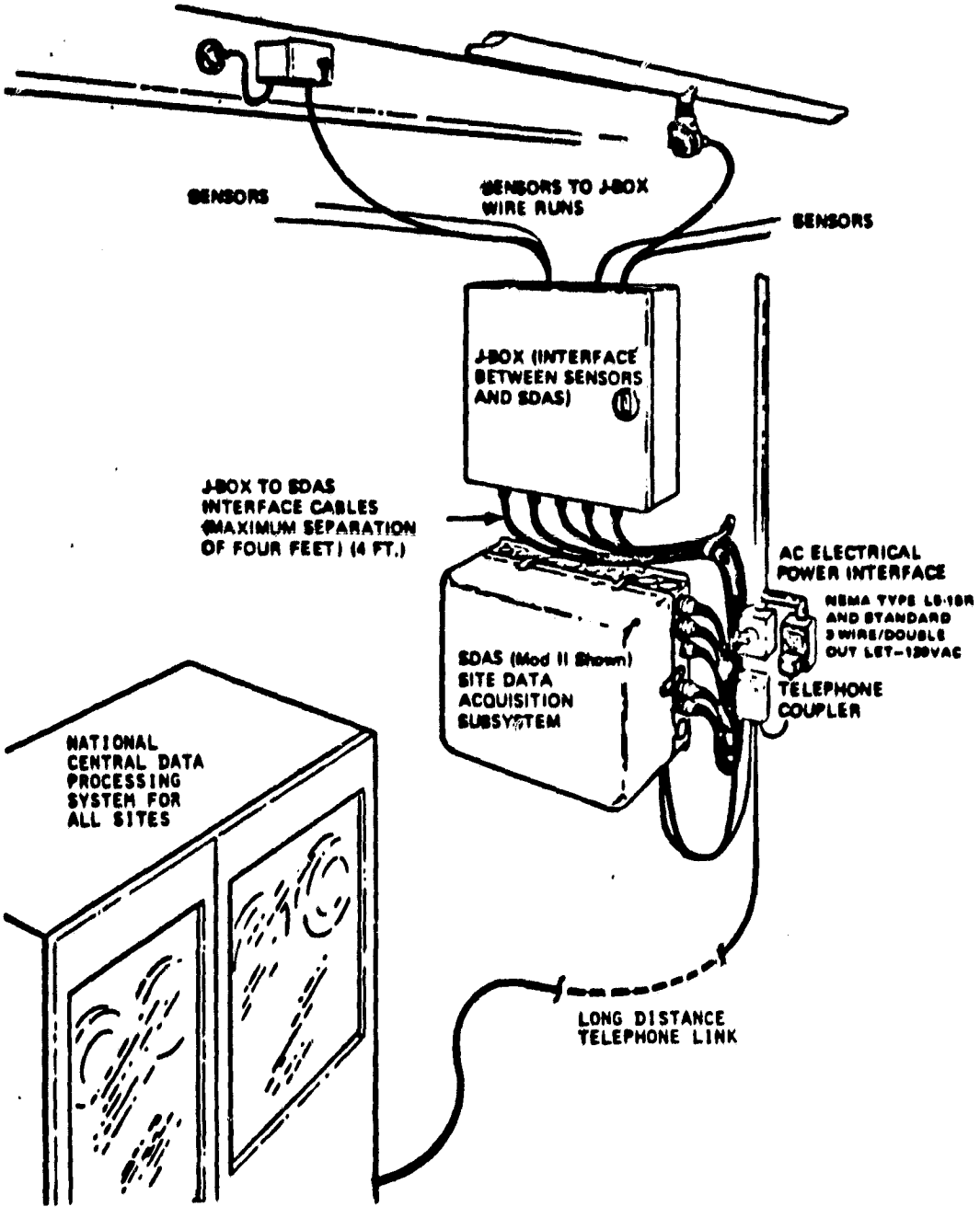
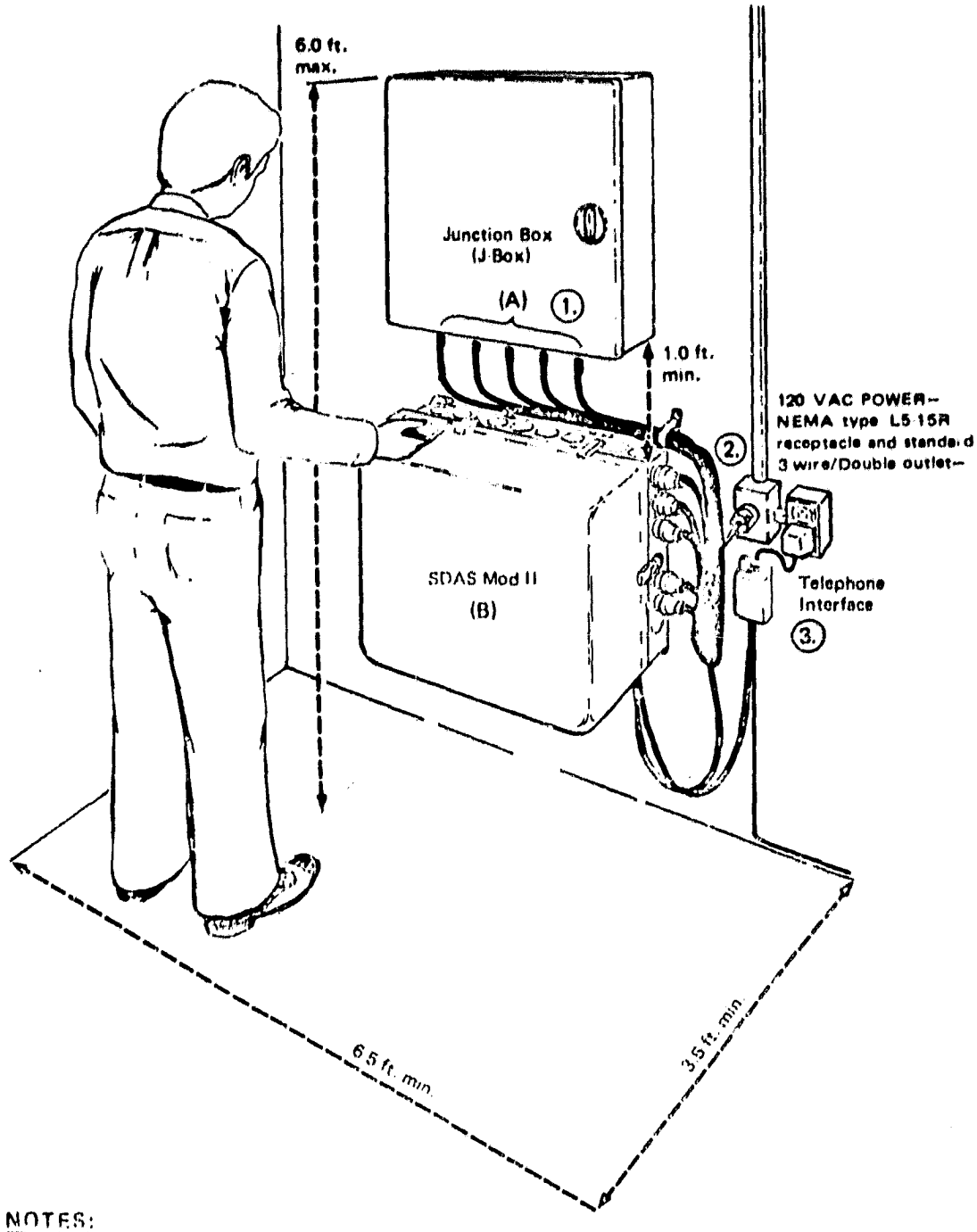


Figure 1. Site Instrumentation Interface Hardware



NOTES:

(1.) J-Box (A) is to be located within a cable run of 4 ft. of the SDAS (B)

(2.) NEMA type L5-15R receptacle to be within 6 ft. of SDAS (B)

(3) Telephone Interface (Coupler) is located within 3 ft. of SDAS (B)

Figure 2. Typical SDAS Installation Layout Profile

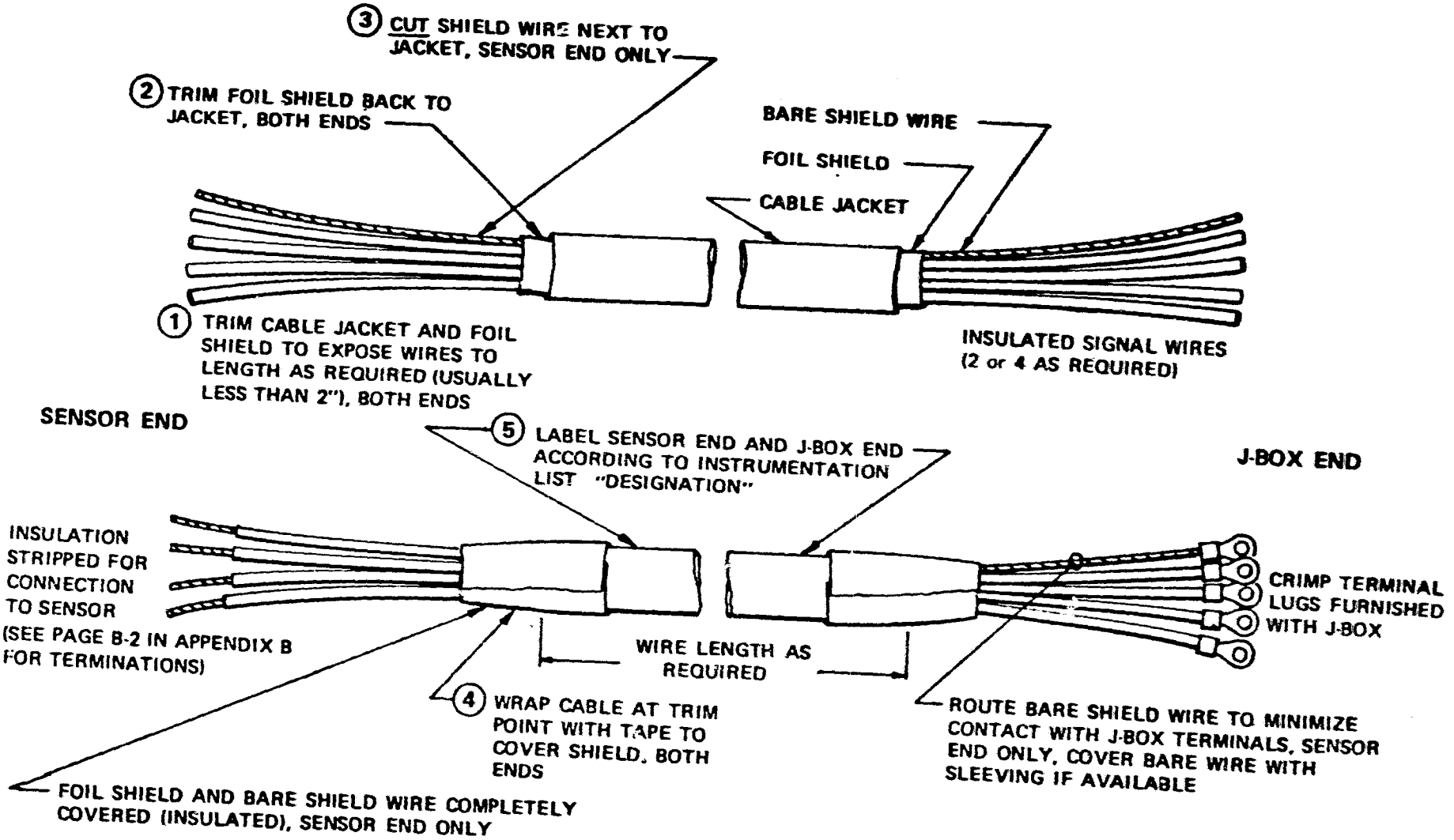


Figure 3. Sensor Wire Preparation Procedure

Table 1. Sensor Wire Requirements

SENSOR TYPE	CONDUCTORS	AMERICAN WIRE GAUGE
Temperature		
- Single element RTD	3 + shield	#18-3
- Dual element RTD	3 + shield (2)	#18-3
Flow rate (liquid)	4 + shield	#18-4
Air velocity	2 + shield	#18-2
Solar radiation	2 + shield	#18-2
Electric power	2 + shield	#18-2

NOTE: 1. Typical wire part numbers include:

- Alpha P/N 2422-18 gauge, 2 conductor or equivalent
- Alpha P/N 2423-18 gauge, 3 conductor or equivalent
- Alpha P/N 2424-18 gauge, 4 conductor or equivalent
- Dearborn P/N 971804-18 gauge, 4 conductor or equivalent
- Dearborn P/N 971803-18 gauge, 3 conductor or equivalent
- Dearborn P/N 971802-18 gauge, 2 conductor or equivalent
- Manhattan P/N M3242-18 gauge, 2 conductor or equivalent
- Manhattan P/N M3243-18 gauge, 3 conductor or equivalent
- Manhattan P/N M3244-18 gauge, 4 conductor or equivalent

2. Two (2) cables required for dual element RTDs.

3. Wire exposed to the outdoor environment or buried shall be in conduit.

4. Rigid conduit runs to all sensors shall be terminated with flexible conduit. All connections shall be made watertight.

CAUTION

AC POWER LINES AND OTHER POTENTIAL NOISE INDUCING LINES SHOULD NOT BE PLACED IN THE SENSOR WIRING CONDUIT OR ROUTED NEAR THE INSTRUMENTATION CABLES. ALSO, THE INSTRUMENTATION CABLES SHOULD NOT BE ROUTED NEAR NOISE GENERATING EQUIPMENT.

Junction Box

ERDA will provide a junction box (Figure 4) to the site contractor for installation in a central location with respect to the solar energy system. The installation location shall be selected by the site contractor and shall be specified in the ISPI.

As defined by ERDA, noise suppression may be required at the sensor, J-Box or both to provide acceptable data. Remote signal conditioning may be required to improve the signal-to-noise ratio that would improve data accuracy.

Junction Box Location -- The junction box, Figure 4, shall be mounted by the site contractor so that it is accessible for wiring connections from the sensors and is within four feet of the SDAS location on the same side of the wall.

Junction Box Mounting -- At the predefined mounting location, the junction box shall be mounted by the site contractor using the four mounting holes located at the back of the unit. Figure 4 provides the dimensional information for mounting. Depending on the characteristics of the mounting surface, Molly bolts, wood screws, or bolt/nut combinations shall be used to mount the unit. The junction box shall be installed in a top-up orientation.

Junction Box Interfaces -- ERDA will establish the wire run list which identifies where each sensor wire attaches to the junction box terminal strips. This wire run list will be a part of the AIP which the site contractor will implement. A typical example of a wire run list and the connection of typical measurements

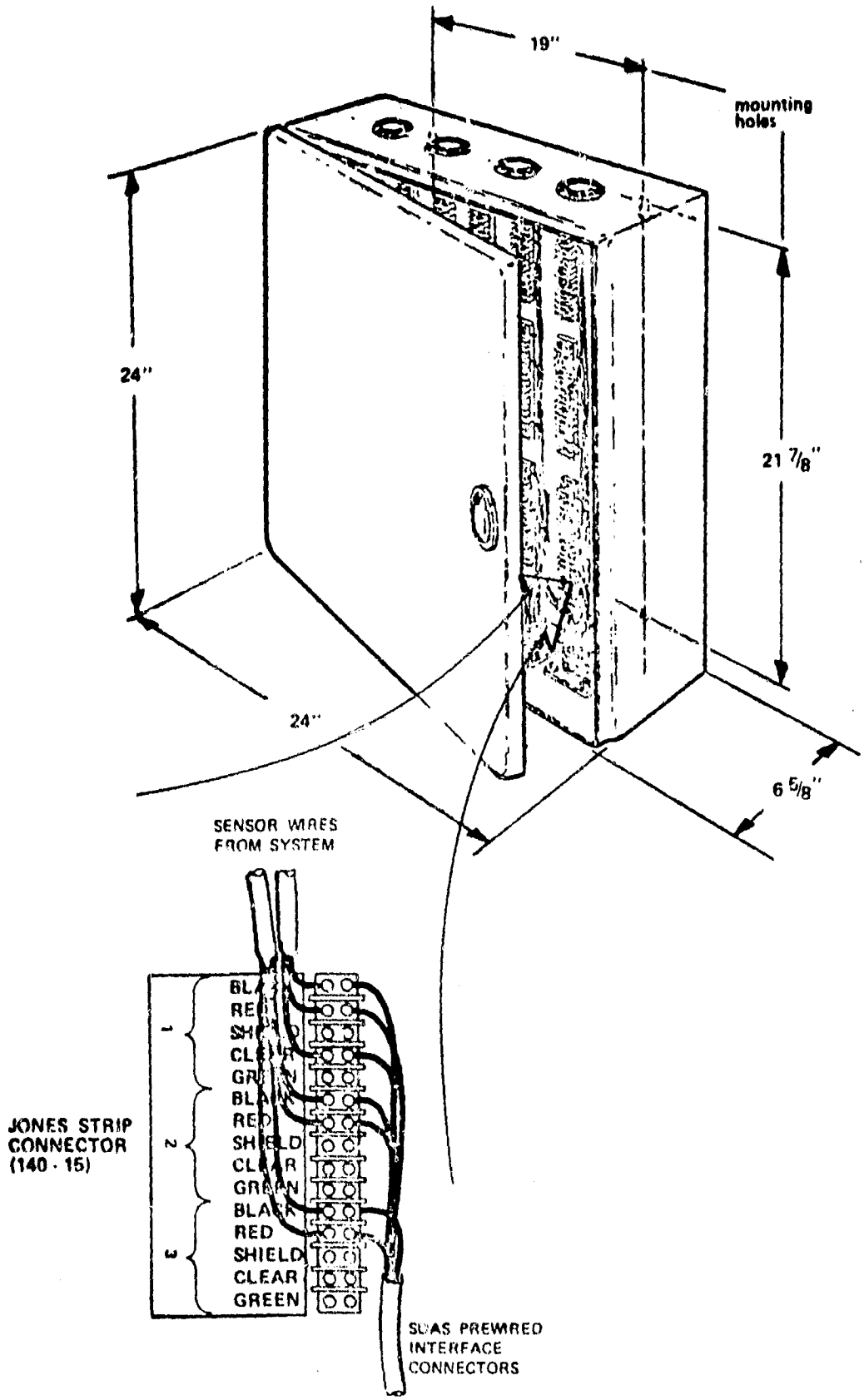


Figure 4. Junction Box/SDAS Interface with typical Sensor connection

is shown in Table 2. The junction box will be prewired from the terminal strips to the output connectors of the SDAS prior to delivery to the site. Five conductor terminals will be provided for each sensor input. Either two, three, or four conductor (18 gauge) and shield will be connected between the sensors and the junction box depending on the interface characteristics of the sensors. Figure 5 illustrates the sensor-to-junction-box interconnections for each of the approved sensors.

Junction Box/SDAS Interface Cables

ERDA will provide and install the junction box/SDAS interface cables.

Site Data Acquisition Subsystem

The Site Data Acquisition Subsystem (SDAS) location at each demonstration project will be selected by the site contractor and shall be specified in the ISPI for approval.

SDAS Location -- The SDAS, Figure 5, shall be mounted by the site contractor in a central position with respect to the solar energy system sensors. It shall be located in an indoor environment having temperature limits between $32^{\circ}F$ and $100^{\circ}F$ and relative humidity limits of 5-80% without condensation. The SDAS shall be located to minimize contamination by elements such as dust or other pollutants. To the extent possible, the SDAS shall be located in an area that minimizes the variations in temperature, relative humidity, and vibration to the SDAS. The SDAS shall be located in an area easily accessible for installation and maintenance.

SDAS Mounting -- The SDAS shall be mounted in accordance with the installation drawings supplied by ERDA. The mounting space required for the SDAS is dependent on the model as shown in Figure 6. Either unit will weigh approximately 70 pounds. The SDAS shall be wall mounted using dimensions in Figure 6 both top and bottom. Either Molly bolts, wood screws, or bolt/nut combination shall be used

Table 2. Typical Wire Run List for J-Box Terminal Connection

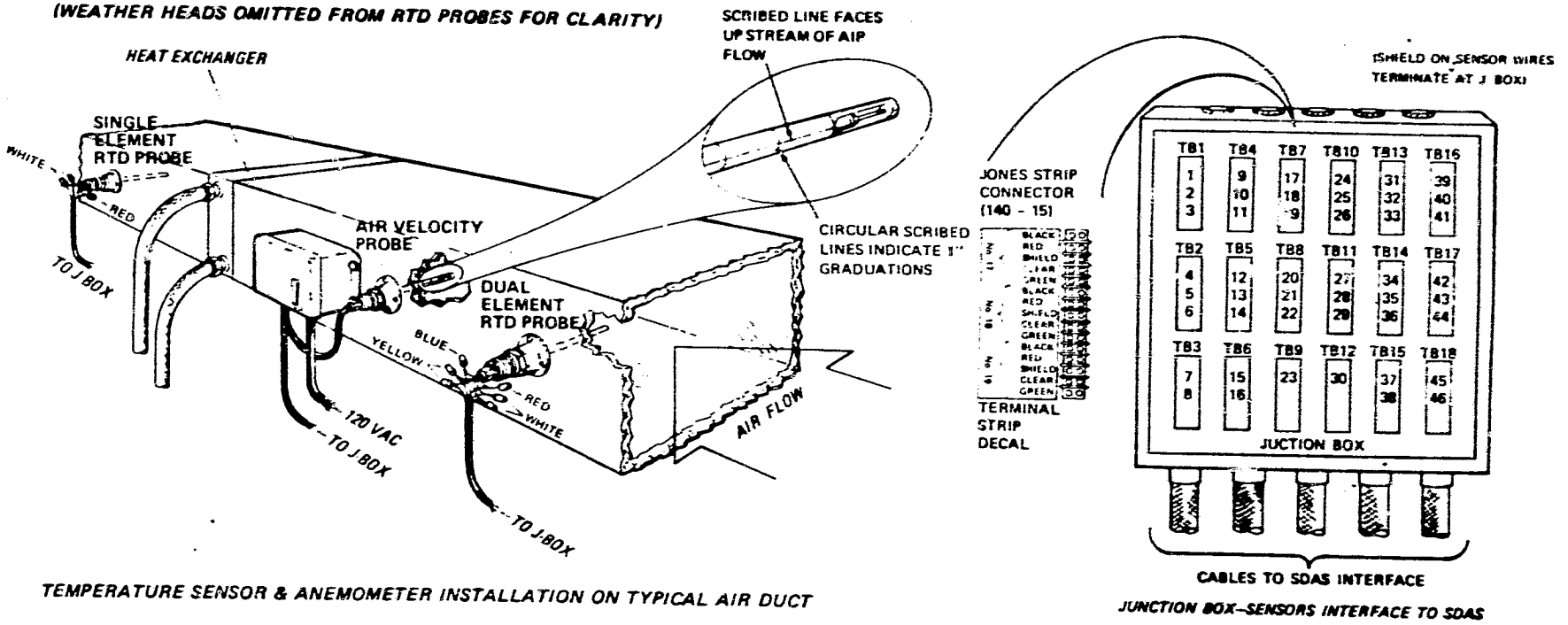
DATE _____

SITE IIG WIRE LIST XXXXXXX SHEET X OF XX

SENSOR NUMBER	REF. MEAS. NUMBER	SENSOR CONNECTION	SENSOR/J-BOX WIRE COLOR	TERMINAL STRIP NO.	INTERNAL FROM	JUMPER TO	SDAS CHANNEL	LEVEL
T100	T100	RED	RED	TB1-6			2	LO
		WHITE*	CLEAR	TB1-7			2	HI
		WHITE*	BLACK	TB1-9			2	3RD
			SHIELD	TB1-8S				SHIELD
	TD100L	YELLOW*	BLACK	TB2-4			4	3RD
		YELLOW*	CLEAR	TB2-4			4	3RD
		BLUE	RED	TB2-1			4	LO
			SHIELD	TB2-3S				SHIELD
TD100	TD100H	RED	RED	TB2-2			4	HI
		WHITE*	BLACK	TB2-5			4	3RD
		WHITE*	CLEAR	TB2-5			4	3RD
			SHIELD	TB2-3S				SHIELD
W100	W100	1	RED	TB1-15			3	+5 VDC
		2	CLEAR	TB1-12			3	HI
		3	GREEN	TB1-11			3	LO
		4	BLACK	TB1-14			3	GND
			SHIELD	TBL-13S				SHIELD
I001	I001	B	RED	TB3-2			7	HI
		A	BLACK	TB3-1			7	LO
			SHIELD	TB3-3S				SHIELD
D001	D001	G	RED	TB11-5			31	+5 VDC
		E	CLEAR	TB11-2			31	HI
		F	BLACK	TB11-1			31	LO/GND
			SHIELD	TB11-3S				SHIELD
EP101	EP101	2	RED	TB13-2			34	HI
		1	BLACK	TB13-1			34	LO
			SHIELD	TB13-3S				SHIELD
F300	F300	1	RED	TB2-10			8	+5 VDC
		2	CLEAR	TB3-7			8	HI
		3	BLACK	TB3-6	TB3-6**	TB2-9**	8	LO/GND
			SHIELD	TB3-8S				
V001	V001	A	RED	TB9-2			25	HI
		B	BLACK	TB9-1			25	LO
			SHIELD	TB9-3S				SHIELD
W400	W400	1	RED	TB11-2			31	HI
		2	BLACK	TB11-1			31	LO
			SHIELD	TB11-3S				SHIELD
RH001	RH001	BROWN	RED	TB14-15			39	+3.6 VDC
		PURPLE	BLACK	TB14-14			39	GND
		YELLOW	CLEAR	TB14-12			39	HI
		GREEN	GREEN	TB14-11			39	LO
			SHIELD	TB14-13S				SHIELD
D101	D101	RED 1	RED	TB5-15			15	5 VDC
		BLACK 3	BLACK	TB5-14			15	GND
								LO/GND
		YELLOW 2	CLEAR	TB5-12			15	HI

*EITHER WIRE

**JUMPER ADDED PRIOR TO SHIPMENT



TEMPERATURE SENSOR & ANEMOMETER INSTALLATION ON TYPICAL AIR DUCT

JUNCTION BOX–SENSORS INTERFACE TO SDAS

Figure 5. Typical Sensor to J-Box Interconnection

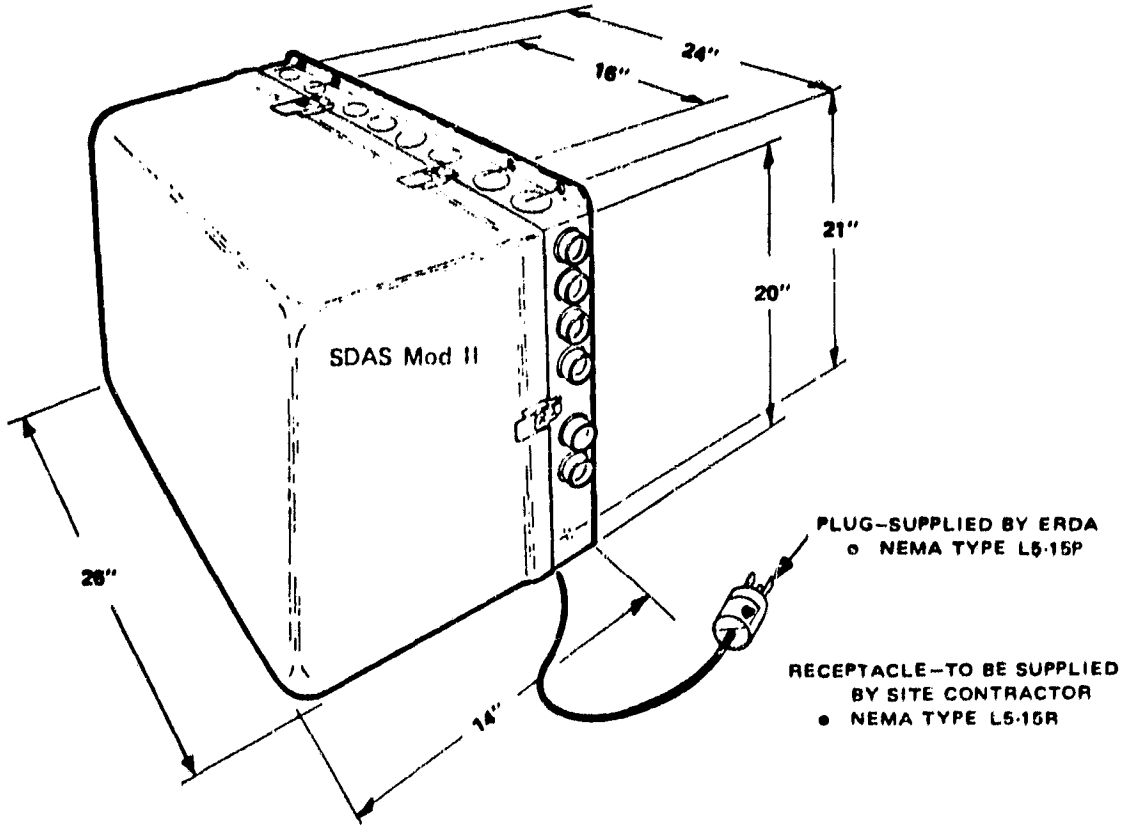


Figure 6. Site Data Acquisition Subsystem

to mount the unit depending on the characteristics of the mounting surface. The SDAS shall be mounted between two feet and four feet above floor level measured from the bottom of the SDAS.

SDAS Telephone Interface

ERDA will arrange for the telephone installation required for the SDAS. The SDAS shall interface with a standard Bell System CBS Data Access Arrangement (DAA), Series 5 or later, or equivalent. The DAA shall be located within three feet of the SDAS on the same side of wall. The DAA connection with the SDAS shall be performed by ERDA. The site contractor shall provide a standard 120 VAC three (3) wire receptacle for power to the coupler.

SDAS Electrical Interface

The SDAS interfaces with 110-125V, 60 Hertz, 1 phase, 3 amp service. A standard 3 wire interface (safety ground, power and return) with a standard power cord and twist lock connector shall be provided on the SDAS. A 120 VAC three pin twist lock outlet (actual receptacle should be NEMA Part Numbers L6-15R, 250V, 15 amps for Mod I and L5-15R, 120V, 15 amps for Mod II) shall be provided by the site contractor and located within six feet of the SDAS.

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