Chapter Eight
Model-TEA System Control Wiring

The collector captures sunlight and converts it to heat, the air-handling system delivers that heat to the proper place, and the rock bin stores surplus heat for later use. But the electrical control system is the vital link which makes the three parts work together as a whole.

Chapters 5 and 6 give step-by-step instructions for constructing the MODEL-TEA roof or wall collector, and Chapter 7 gives the same detailed instructions for constructing the rock bin. This Chapter presents the control wiring for the entire system.

Because the air-handling arrangement is particularly site and system dependent, step-by-step instructions are not given. However, Sections 1.3, 3.3, and 4.3 contain all the necessary information on the air-handling components and their relationships within a system. Tables 4.1, 4.2 and 4.3 supply data on the components that should be ordered for a given sized system. An alternative to site-building the air-handling system from components is to buy a commercially manufactured pre-packaged unit. This option is discussed in Section 9.1

The information supplied in Chapters 3 and 4 is to be used by an experienced heating contractor in planning the system. Not enough information is supplied to enable the inexperienced layman to do the work. The ductwork layout is site dependent, and its arrangement has many effects on the air-handling system.

The air-handling work should be subcontracted to a skilled heating contractor who can properly plan and install this system. Early in the planning stages, advice should be obtained on placement of duct runs and ordering of components. The same person who installs the ductwork should have access to the equipment to pre-fabricate the manifold pans, and the backdraft and slide dampers. The return and supply ductwork should be connected to the collector prior to the smoke test (Sections 5.7 and 6.7) so that they too can be tested for leaks. After the test, the remainder of the ductwork, the blowers, motors, dampers, and filter can be installed. Once all the connections between the air-handling equipment and the ductwork are complete, the control wiring can begin.

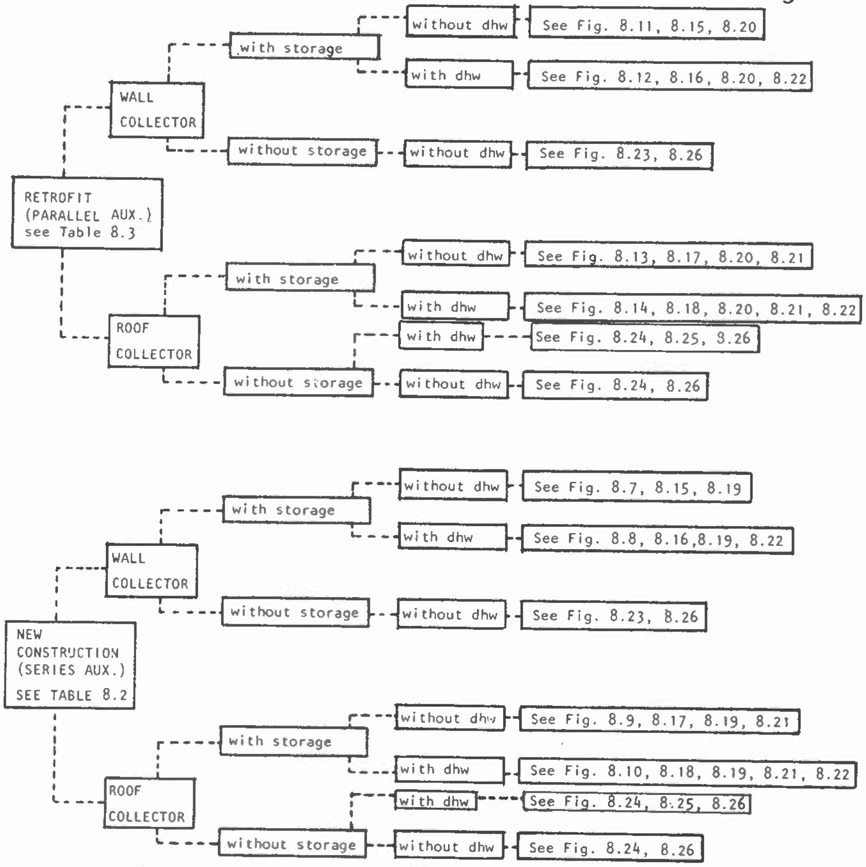


Table 8.1 MODEL-TEA System Options

Control wiring information is presented with sufficiently detailed schematics so that an electrical engineer or skilled mechanical contractor familiar with control systems can wire the controls. This information would be inadequate for the layman, and might not be sufficient for an electrician to do the work.

This Chapter is subdivided into six parts. The first is a description of the various system options available, with a table that will direct the installer to the correct diagrams. The second section is a description of the modes of operation, providing information on the signalling of the various modes. The third section presents a "ladder diagram," or wiring schematic, for each of the options that incorporate remote storage. Sections four and five are the actual diagrams needed to wire the controls, beginning with the general field wiring in the fourth section, and continuing with the control wiring in the fifth section. Section Six discusses those systems without storage, and includes wiring schematics and field and control wiring.

An alternative to wiring the system on site is to buy a pre-packaged control unit. There are commercially manufactured units available on the market, but they will not perform exactly the same as the system presented in this Chapter. Many firms will modify their units to specifications, but this will add to the cost of the unit. It would be less expensive in the long run to buy a pre-packaged air handling system that is supplied with its own controls.

Once the control wiring is finished, the system is ready to be started up and tested through all the modes. Make sure that the contract with the professional doing the wiring includes this process, as well as the de-bugging of any problems that might be encountered.

8.1 System Options

Table 8.1 shows the different options available when planning the MODEL-TEA system. Running through the choices of roof or wall collector, remote storage or direct daytime heating, and DHW or no DHW, leads the reader to the appropriate wiring diagrams that should be followed when wiring that particular system and its options.

There are many site, performance, economic, and personal criteria effecting the final choices made. For example, if a roof collector is chosen over the wall collector, an investment in power-venting equipment must be made. This includes one additional sensor in the collector, one additional switch, and two manually operated slide dampers, each with two separate housings and two interchangable blades. Also required are two duct runs to the outside, with grilles.

If the collector is large enough (greater than 150-200 square feet) to cause over-heating of the living space, then a remote storage rock bin must be constructed. This choice involves not just the cost of the rock bin, but the extra ductwork to carry the heat to it, an additional fan to retrieve the heat, two to three additional motorized dampers to direct the air, one extra backdraft damper, one differential controller (with one sensor on the collector and one sensor in storage), and one additional sensor in the rock bin.

Another decision is whether or not to include DHW. On a large roof collector the only reason not to use it is if there is an existing DHW system. The only time DHW should be included with a wall collector would be if the collector were large enough to make the option cost-effective. A decision to include the DHW mode will add the cost of another differential controller (with an extra sensor in the collector, and one on the preheat DHW tank), one extra switch and one extra relay, a 60 gallon preheat tank, a circulating pump, a heat exchanger to go in the ductwork, and miscellaneous piping, valves and flanges. On the wall collector, it would also mean the addition of one pair of slide dampers and extra ductwork.

The addition of these costs should be considered each time a choice is made. If the cost of the DHW mode seems out of the question now, the additional sensor could be included in the collector during construction and the wires run to the control panel. The DHW system could then be added later, without taking the collector apart to add the sensor.

8.2 Modes of Operation

Before beginning work on the control wiring, it is important to understand the operation of the modes. There is one basic mode common to systems with or without storage, and that is "Collector to House." This is the only mode available on a wall collector system with no storage. The systems with storage share two additional modes: "Collector to Storage" and "Storage to House." Roof collectors must have the mode called "Power Venting" whether they have remote storage or not. Adding DHW to the system adds the "Domestic Hot Water" mode, and in the summer this combines with the "Power Venting" mode for the roof collector, resulting in the "DHW and Power Vent Mode." In all, there are six different possibilities.

There are three parts to a mode. The signals, or inputs, are sent to the system. The controls interpret these signals as a certain mode, and then in turn send their own signals, or outputs, to different parts of the system to make that mode happen.

There are two mode schedules to follow in this section, found in Tables 8.2 and 8.3. One is for Retrofit and one is for New Construction. The only difference between a New Construction System and a Retrofit System is that the auxiliary heating system is in parallel with the solar air handling system in Retrofit, and in series in New Construction.

Table 8.2 Mode Schedule for New Construction

MODE	M.D.1	M.D.2	M.D.3	C.FAN	H.FAN	B.D.1	B.D.2	DHW	S.D.1	S.D.2	AUX.	SIGNALS
WINTER												
COLLECTOR TO HOUSE	O	O	C	ON	ON	O	O	OFF	W.P.	W.P.	OFF	$\Delta T, W_1,$
											ON	$\Delta T, W_1, W_2$
COLLECTOR TO STORAGE	O	C	O	ON	OFF	O	C	OFF	W.P.	W.P.	OFF	ΔT
								ON				$\Delta T, \Delta T_{HW}$
STORAGE TO HOUSE	C	O	O	OFF	ON	C	O	OFF	W.P.	W.P.	OFF	W_1, $RB_T > 85°F$
											ON	W_1, W_2 OR
											ON	W_1, $RB_T < 85°F$, W_2
SUMMER												
POWER VENT	O	C	–	ON	OFF	–	–	–	S.P.	S.P.	OFF	$T_{COL} > 190°F$
DHW	O	C	–	ON	OFF	–	–	ON	S.P.	S.P.	OFF	ΔT_{HW} OR $T_{COL} > 190°F$

KEY

O	OPEN	C	CLOSED
M.D.	MOTORIZED DAMPER	C.FAN	COLLECTOR FAN
M.D.1	COLLECTOR	H.FAN	HOUSE FAN
M.D.2	HOUSE	D.H.W.	DOMESTIC HOT WATER
M.D.3	STORAGE	ΔT	20°F ΔT COLL./STOR.
B.D.	BACKDRAFT DAMPER	W_1	1ST CALL FOR HEAT
S.D.	SLIDE DAMPER	W_2	2ND CALL FOR HEAT
S.D.1	POWER VENT EXHAUST	RB_T	ROCK BIN TEMPERATURE
S.D.2	POWER VENT INTAKE	ΔT_{HW}	40°F ΔT PRE-HEAT TANK/COLL.
AUX	AUXILIARY HEATING	T_{COL}	TEMPERATURE OF COLLECTOR
W.P.	WINTER POSITION	S.P.	SUMMER POSITION

Table 8.3 Mode Schedule for Retrofit

MODE	M.D.1	M.D.2	M.D.3	C.FAN	H.FAN	B.D.1	B.D.2	DHW	S.D.1	S.D.2	AUX.	SIGNALS
WINTER												
COLLECTOR TO HOUSE	O	O	C	ON	ON	O	O	OFF	W.P.	W.P.	OFF	$\Delta T, W_1,$
											ON	$\Delta T, W_1, W_2$, $RB_T > 85°F$
COLLECTOR TO STORAGE	O	C	O	ON	OFF	O	C	OFF	W.P.	W.P.	OFF	ΔT
								ON				$\Delta T, \Delta T_{HW}$
								–			ON	W_2
STORAGE TO HOUSE	C	O	O	OFF	ON	C	O	OFF	W.P.	W.P.	OFF	W_1, $RB_T > 85°F$
											ON	W_1, W_2, $RB_T > 85°F$
AUXILIARY ONLY	C	O	–	OFF	OFF	C	C	OFF	W.P.	W.P.	ON	W_1, W_2, $RB_T < 85°F$
SUMMER												
POWER VENT	O	C	–	ON	OFF	–	–	–	S.P.	S.P.	OFF	$T_{COL} > 190°F$
D H W	O	C	–	ON	OFF	–	–	ON	S.P.	S.P.	OFF	ΔT_{HW} OR $T_{COL} > 190°F$

KEY

O	OPEN	C	CLOSED
M.D.	MOTORIZED DAMPER	C.FAN	COLLECTOR FAN
M.D.1	COLLECTOR	H.FAN	HOUSE FAN
M.D.2	HOUSE	D.H.W.	DOMESTIC HOT WATER COIL
M.D.3	STORAGE	ΔT	20°F ΔT COLL./STOR.
B.D.	BACKDRAFT DAMPER	W_1	1ST CALL FOR HEAT
S.D.	SLIDE DAMPER	W_2	2ND CALL FOR HEAT
S.D.1	POWER VENT EXHAUST	RB_T	ROCK BIN TEMPERATURE
S.D.2	POWER VENT INTAKE	ΔT_{HW}	40°F ΔT PRE-HEAT TANK/COLL.
AUX	AUXILIARY HEATING	T_{COL}	TEMPERATURE OF COLLECTOR
W.P.	WINTER POSITION	S.P.	SUMMER POSITION

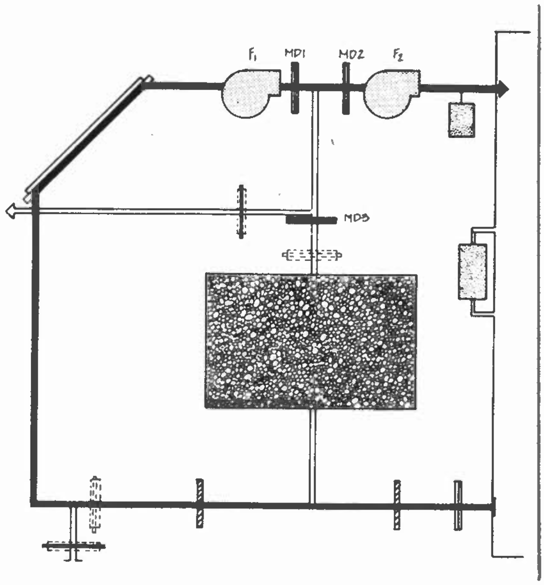


Figure 8.1 Collector to House Mode

FIG. 8.1 COLLECTOR TO HOUSE: Whenever there is a first stage call for heat by the house (W_1), and the collectors are at least 20°F hotter than the storage (ΔT), hot air is drawn directly from the collectors. Motorized Dampers 1 and 2 (M.D. 1 and M.D. 2) open and Motorized Damper (M.D. 3) remains closed. Both the Collector Fan (F_1) and the House Fan (F_2) turn on. Heat is drawn from the collectors and blown into the house, with cool room air being sent to the collector. This is a priority mode and will occur whenever there is a call for heat and the collectors are hot enough to supply it.

FIG 8.2 COLLECTOR TO STORAGE: Whenever the collectors are at least 20° F hotter than storage (ΔT), and this heat is not needed by the house (W_1) the heat is stored in the rock bin. In this mode M.D.1 and M.D.3 open and the Collector Fan (F_1) turns on. Since M.D.2 is closed, the hot air is forced through the rock bin transferring its heat to the rocks. Cool air is then returned to the collector.

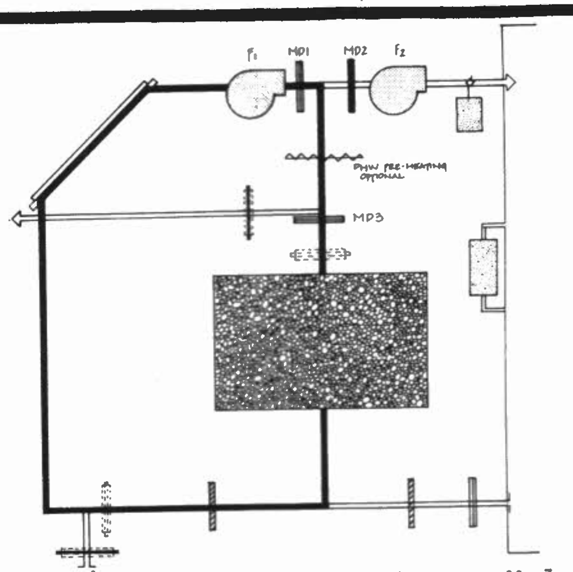


Figure 8.2 Collector to Storage Mode

FIG. 8.3 STORAGE TO HOUSE: This mode occurs whenever there is heat in storage (RB_T > 85°F) and the house calls for heat (W_1), but there isn't enough heat in the collectors (ΔT). In this case, M.D.2 and M.D.3 open and the House Fan (F_2) comes on, drawing hot air from the storage and delivering it to the house. Cool room air is drawn through the rocks to be heated.

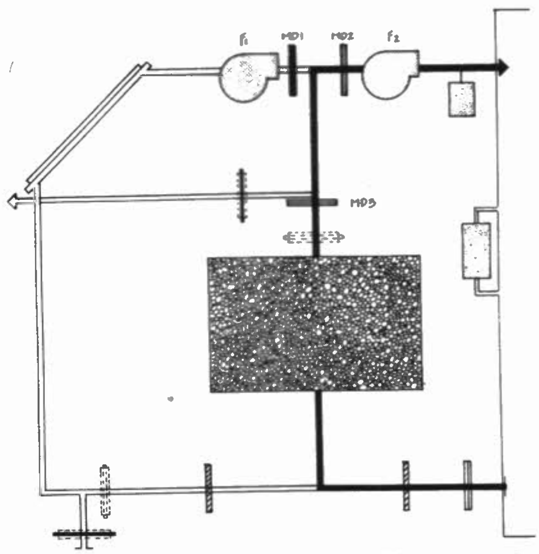


Figure 8.3 Storage to House Mode

The auxiliary system will come on any time there is a second stage call for heat (W_2), which happens when the house temperature drops approximately 2°F below stage one (W_1). This can happen if there is not sufficient heat in the collectors (ΔT) or in the storage ($RB_T <$ 85^oF). But it can also happen if in a very cold spell, the heat delivered from storage is not by itself sufficient to balance the heat loss.

In the Retrofit systems, the second stage call for heat (W_2) turns on the parallel auxiliary, independent of what is happening in the solar air-handling system. If there is not enough heat in the collectors (ΔT) or storage ($RB_T < 85^oF$), the dampers close and the fans shut off. But if there is heat in storage ($RB_T > 85^oF$), the storage to house mode will continue supplying heat to the house at the same time as the auxiliary heating system.

In the New Construction systems, the second stage call for heat (W_2) turns on the series auxiliary. The auxiliary boosts the temperature of the already pre-heated air coming from the collectors or storage.

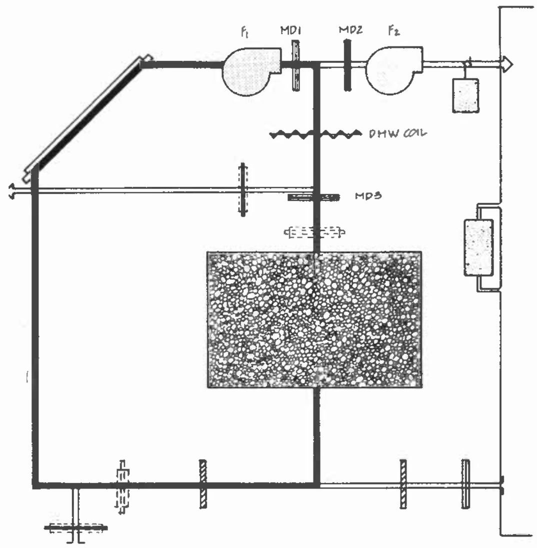


Figure 8.4 Domestic Hot Water Mode

FIG. 8.4 DOMESTIC HOT WATER: When the collector temperature reaches a point 40^oF higher than the water in the pre-heat tank (ΔT_{HW}), the system enters the "Collector to Storage" mode. The pump turns on to circulate the water from the pre-heat tank through the heat exchanger coil that is located in the return duct. The water in the coil picks up the heat from the hot air drawn down from the collector.

FIG. 8.5 POWER-VENTING: The power venting mode is only used with the roof collector, to cool the collector in the summer and extend the life of the collector materials. This mode requires active participation of the home-owner twice a year to throw a switch and move the two slide dampers from winter to summer positions in the spring, and back to the winter positions in the fall. The switch will be located on the control board, and when thrown to the summer position will activate the extra

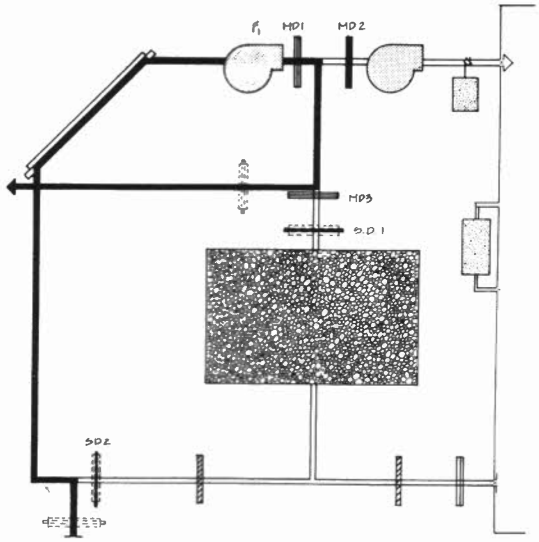


Figure 8.5 Power Venting Mode

sensor in the collector. The slide dampers, when in the summer position, connect the collector supply and return ducts to the outside. When the temperature of the collector exceeds 170°F (T_{COL}), the sensor in the collector closes, and the "Collector to Storage" mode is activated. But with the slide dampers in their summer positions, the hot air from the collector bypasses the rock bin and is vented outside. Air from the outside is returned to the collector.

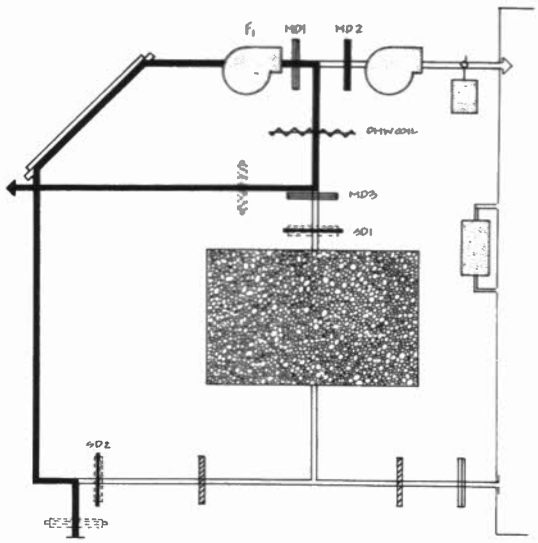


Figure 8.6 DHW and Power Venting Mode

FIG. 8.6 DHW AND POWER VENTING: In the summer, the domestic hot water mode can operate either in its normal mode (ΔT_{HW}), or it may operate during power venting, when the roof collector temperature exceeds 170°F (T_{COL}). When the collector power vents, the pump circulates the water from the pre-heat tank through the heat exchanger coil in the duct, recovering some of the heat from the air before it is dumped outside.

SUMMER OPERATION VS WINTER OPERATION: When spring arrives, the system must be changed from its winter to its summer operation. No matter what options the system has, the first step is to disconnect the differential controller between collector and storage. This will keep the system from operating whenever ΔT occurs, which would result in overheating the rock bin and eventually the house. In systems with power venting and for DHW, the slide dampers must be moved from their winter to their summer positions. In addition, switch S, must be flicked from its summer to winter position. This will activate T_{COL}, and will convert the winter heating system to the summer DHW and/or power venting system.

Exactly when in the spring this process should occur is up to the individual. Once the differential controller is disconnected, solar heating is no longer available to the house, and the auxiliary heating system must carry the load alone. The earlier in the spring this is done, the greater the chance that the house will call for heat and the auxiliary will have to respond. Some individuals might combine disconnecting the differential with turning down the thermostat, and then be willing to endure lower temperatures to save energy. Other individuals might wait until later in the swing season to switch over, often storing more heat than will be needed. This will result in eventual over-heating of the rock bin and the house--a last resort reminder that the collector might be undergoing stagnation conditions.

In the fall, the process must be reversed. The differential controller must be connected, and the Switch and Slide dampers returned to their winter positions. The earlier this is done in the season, the more solar heat might be wasted. The later this is done in the season, the more the auxiliary heating system will have to answer the call for heat.

8.3 Wiring Schematics

The wiring for the MODEL-TEA Air Handling System has been designed so that all the relays, switches, and damper motors can be wired with low voltage (24v AC) wiring. Only the blowers and the pump have to be wired for high voltage. This means extra savings in time and cost. In this section, there are eight different wiring schematics, or ladder diagrams: four are for the options available to Retrofit Systems with Storage, and four are for the New Construction System options with storage. The options for systems without storage are discussed in Section 8.6. The air-handling and control components and manufacturers are listed in Table 8.4.

The wiring diagrams shown in Figures 8.7 through 8.10 are for New Construction, and those in Figures 8.11 through 8.14 are for Retrofit. Comparing any two analagous diagrams (eg. 8.7 and 8.11, "Wall Collector with Storage:), it can be seen that the only difference between them involves the Control Relay for the auxiliary heating system (CR_{AUX}). The relay in the Retrofit wiring schematic (bottom line) is a single-pole, double-throw (SPDT) relay. But in the New Construction Wiring Schematic, the CR_{AUX} is a double-pole, double-throw (DPDT) relay, with the second contact located between the second and third lines from the bottom. Except for this one difference of putting the auxiliary heating in series with the solar system, the rest of the comparable wiring schematics is the same.

Take Fig. 8.7 as an example. Let us assume that the collector is 20^{o} hotter than storage (ΔT). ΔT would close, allowing power to flow to CR_{F1} (turning on the collector fan), and to M.D.1 (opening motorized damper No. 1). Since CR_{F1} is activated, M.D.3 is powered through the CR_{F1} and CR_{W1} contacts. Since M.D.1 is powered, its micro-switch R-W contacts open, and M.D.2 remains closed. This is the "Collector to Storage" mode.

If there is a first stage call for heat, W_1 closes and powers CR_{W1}. M.D.3 is deactivated, because the normally closed CR_{W1} contact opens. M.D.2 and CR_{F2} are activated through the CR_{F1} and CR_{F2} contacts, opening damper number 2 and turning on the House Fan. This is the "Collector to House" mode.

When there is no longer any heat in the collectors, ΔT opens. But suppose there is still a first stage call for heat and there is heat in storage. RB_T would be closed, and with W_1 already closed, CR_{F2} and M.D.2 would be activated through CR_{F1} and CR_{W1} contacts, and M.D.3 through the normally closed R-W micro-switch. Dampers 2 and 3 would open, the House Fan would turn on, and the "Storage to House" mode would begin.

But what if the house draws from storage until the rock bin temperature on the cold side drops below $85^{o}F$? RB_T would open, and the system would shut down. But if the house still needs heat and the first stage is not being satisfied, the second stage calls for heat. W_2 closes, powering the auxiliary control relay (CR_{AUX}). W_1 is still closed, powering its control relays. The "Storage to House" mode continues, with warm pre-heated air from storage being boosted by the auxiliary.

8.4 Field Wiring

The Field Wiring Diagrams, Figures 8.15 through 8.18, picture the wiring from the different parts of the systems all coming together at a box called controls. This is the first step in actually wiring the system.

The wires to the left of the control box are all Class II (24v AC) #18 A.W.G. control or thermostat wires. However, some sensors may require shielded wire, so check with the manufacturer of the sensor, or a control specialist. The wires to the right of the control box are Class I (115v AC) #14 A.W.G. minimum, and must be installed according to the National Electrical Code. All the wires are brought together in one central location, the control panel, to make the subsequent control steps easier.

The appropriate Field Wiring Diagram for the system being installed should be chosen from Table 8.1. The proper sensor wires should be connected to the differential controllers, and the differential controller wires should be run to the panel. The other wires from the sensors, thermostats, dampers, fans and auxiliary should also be run to the panel, as shown in the diagrams.

8.5 Control Wiring

Wiring the control panel is split into steps. First there are two Basic Control Wiring Diagrams: one for New Construction (Fig. 8.19) and one for Retrofit (Fig. 8.20). Each diagram can be used for either a wall or a roof collector.

Step two for the roof collector is for power venting, shown in Fig. 8.21. The additional switches should be connected to the extra temperature sensor wires from the collector, and to the control relay for the House Fan. The wire to the normally open CR_{F1} contact should be eliminated.

The last step is optional. It is the control wiring for the domestic hot water, as shown in Fig. 8.22. The additional switch should be wired to the differential controller for the domestic hot water and to the pump relay. Note that the wire to the normally open CR_{F1} contact should be eliminated.

The system should now be taken through all its modes. If there is any trouble in the operation of them, the wiring diagrams and the connections should be re-checked.

8.6 Daytime Systems

The Daytime Systems are those systems connected directly to the living space without remote storage.

WALL COLLECTOR DAYTIME SYSTEM: In its most basic form, this system is a simple, one mode operation. If the collector is hotter than the house and the house is not too hot, the collector heat is blown into the house. This type of system is well suited to Retrofit, or even New Construction situations, where it is impossible to have remote storage or install a large collector. Because there is no heat storage, there is a definite limitation on how large the collector can be before a significant amount of surplus heat is wasted.

The air-handling and control parts for this one-mode system are few: a collector sensor, house thermostat, fan, and backdraft damper. Figure 8.23 shows the system schematic, wiring schematic, and control wiring for the system. The components of the system and the manufacturers are called out in Table 8.4. An additional manual slide damper and extra ductwork could be added to the system to divert the hot air from the living space when it begins to overheat--perhaps sending it to a basement utility space. A basement can provide a very inexpensive way to store a large amount of heat.

ROOF COLLECTOR DAYTIME SYSTEM: The roof collector Daytime System expands upon the basic system by adding power venting. This principle is exactly the same as in the roof collector systems with storage. In the spring, the home-owner flicks the switch that activates the extra temperature sensor in the collector, and moves the slide damper from the winter to the summer position. In this case, all that is added to the system is one switch, and one pair of slide dampers. Figure 8.24 shows the system schematic, wiring schematic, and control wiring for the system. Figure 8.25 shows the system schematic, wiring schematic, and control wiring for a roof collector with power venting and DHW. The system components and the manufacturers are listed in Table 8.4.

The systems shown in Figure 8.23, 8.24 and 8.25 are high voltage (115v AC), so they should be wired with a minimum of #14/2 with ground, in accordance with the National Electrical Code and local building codes. Alternate low voltage wiring controls are shown in the Field and Control wiring of Figure 8.26. Both systems are connected to a line-voltage thermostat, and the auxiliary heating system has its own thermostat. The auxiliary thermostat should be set a minimum of 2°F below the solar thermostat. The greater the differential, the longer the time delay between the "first"(solar) and the "second" (auxiliary) stage call for heat.

The auxiliary thermostat should be set at the desired average house temperature. The solar thermostat, however, should be set just below the daytime overheating temperature. The collector should be allowed to run, collecting heat and storing it in the mass of the living space itself. Once the mass has stored as much as it can, the space will begin to overheat. The solar thermostat should be set just below this point, which can be found with experience. The higher the solar thermostat is set, the greater the differential will be between it and the auxiliary thermostat, and the utilization of available solar energy will be maximized.

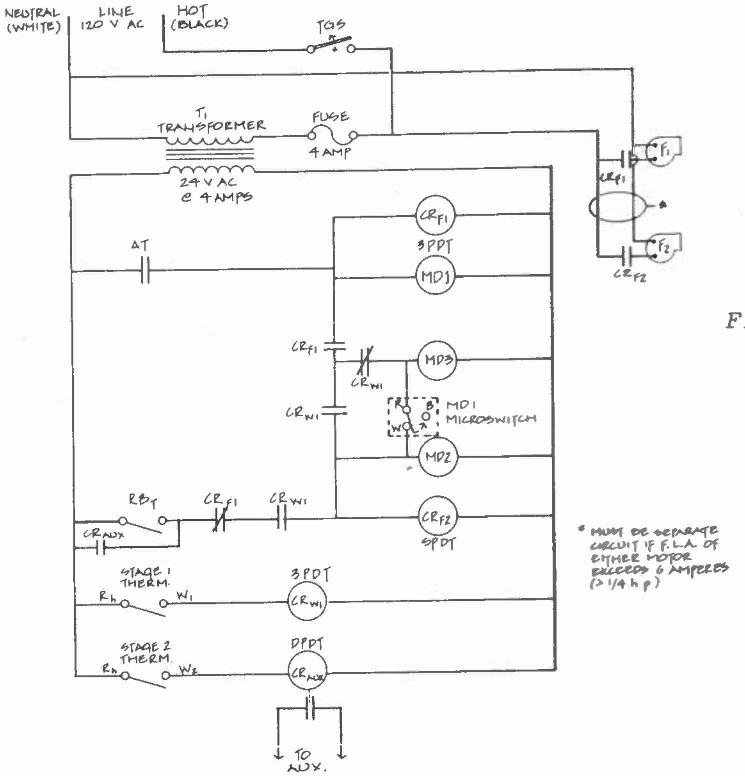


Figure 8.7 New Construction Wiring Schematic: Series Auxiliary Wall Collector With Storage

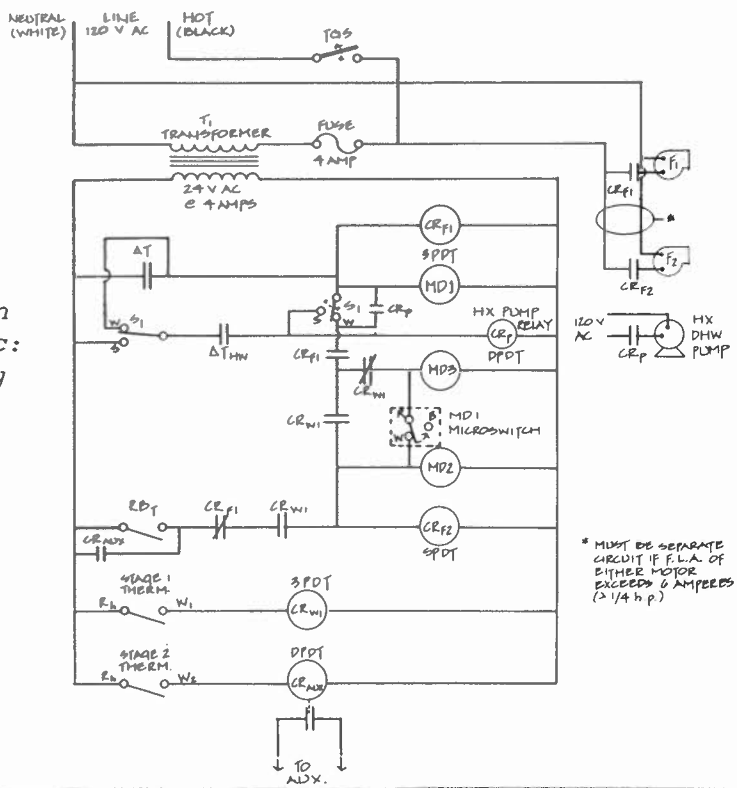


Figure 8.8 New Construction Wiring Schematic: Series Auxiliary Wall Collector With Storage and DHW

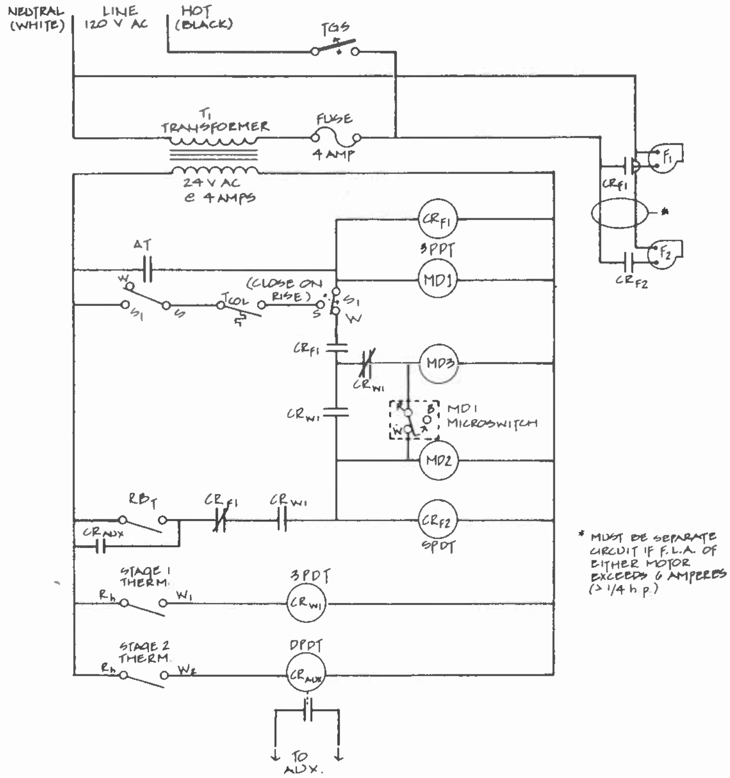


Figure 8.9 *New Construction Wiring Schematic: Series Auxiliary Roof Collector With Storage and Power Venting*

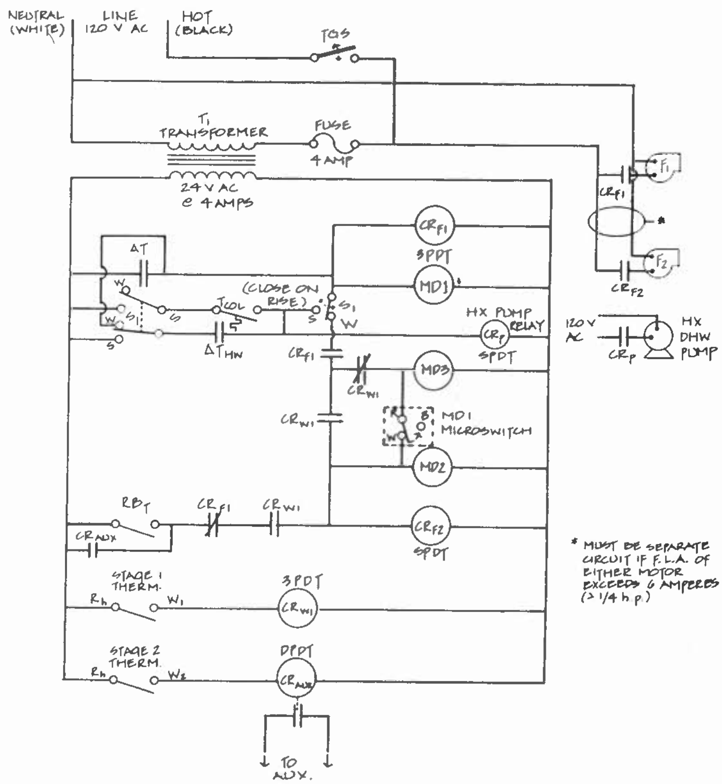


Figure 8.10 *New Construction Wiring Schematic: Series Auxiliary Roof Collector With Storage, DHW and Power Venting*

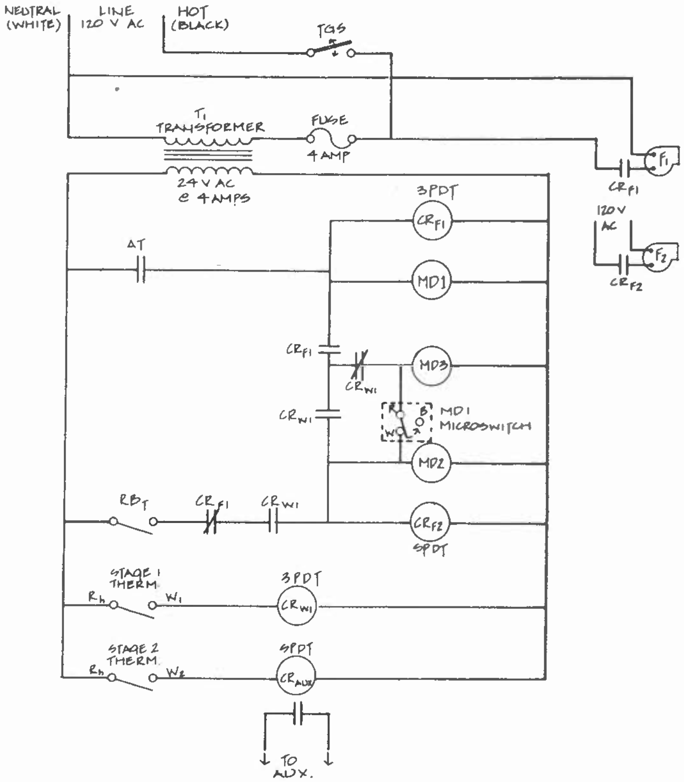


Figure 8.11 Retrofit Wiring Schematic: Parallel Auxiliary Wall Collector With Storage

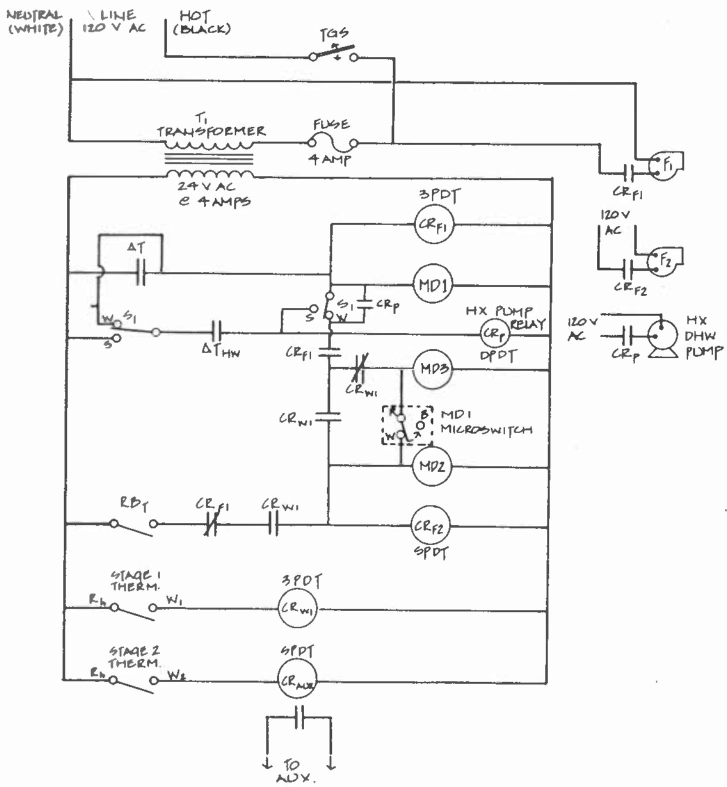


Figure 8.12 Retrofit Wiring Schematic: Parallel Auxiliary Wall Collector With Storage and DHW

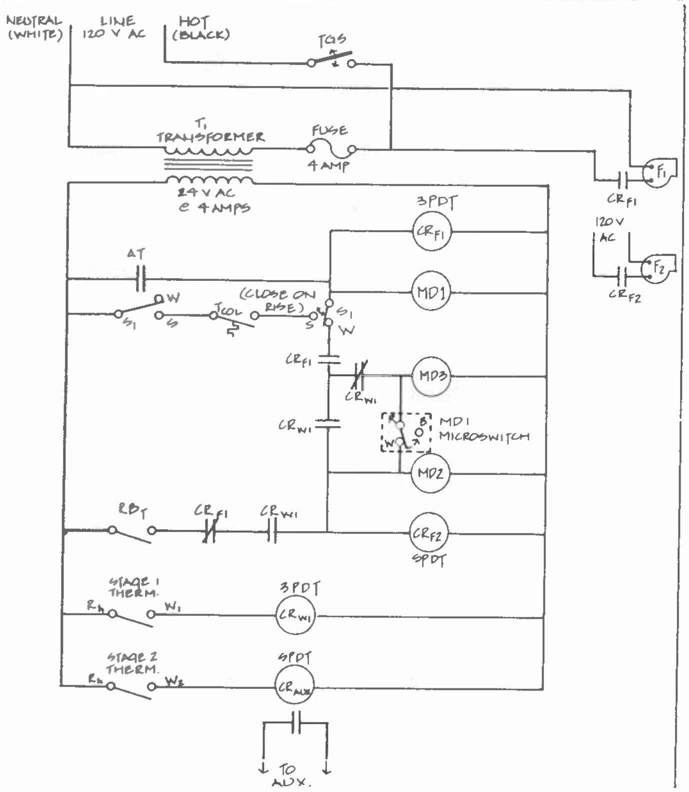


Figure 8.13 Retrofit Wiring Schematic: Parallel Auxiliary Roof Collector With Storage and Power Venting

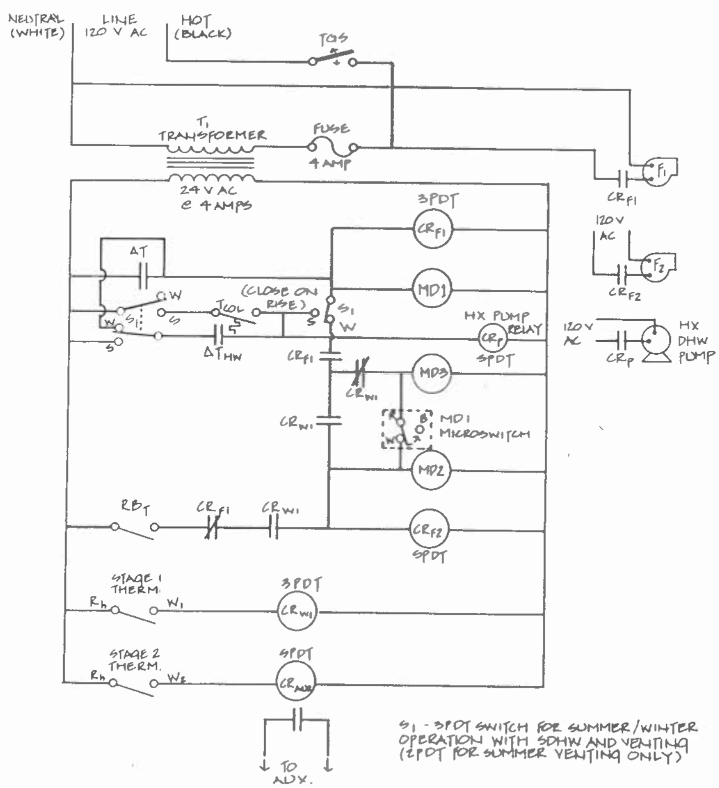


Figure 8.14 Retrofit Wiring Schematic: Parallel Auxiliary Roof Collector With Storage, DHW and Power Venting

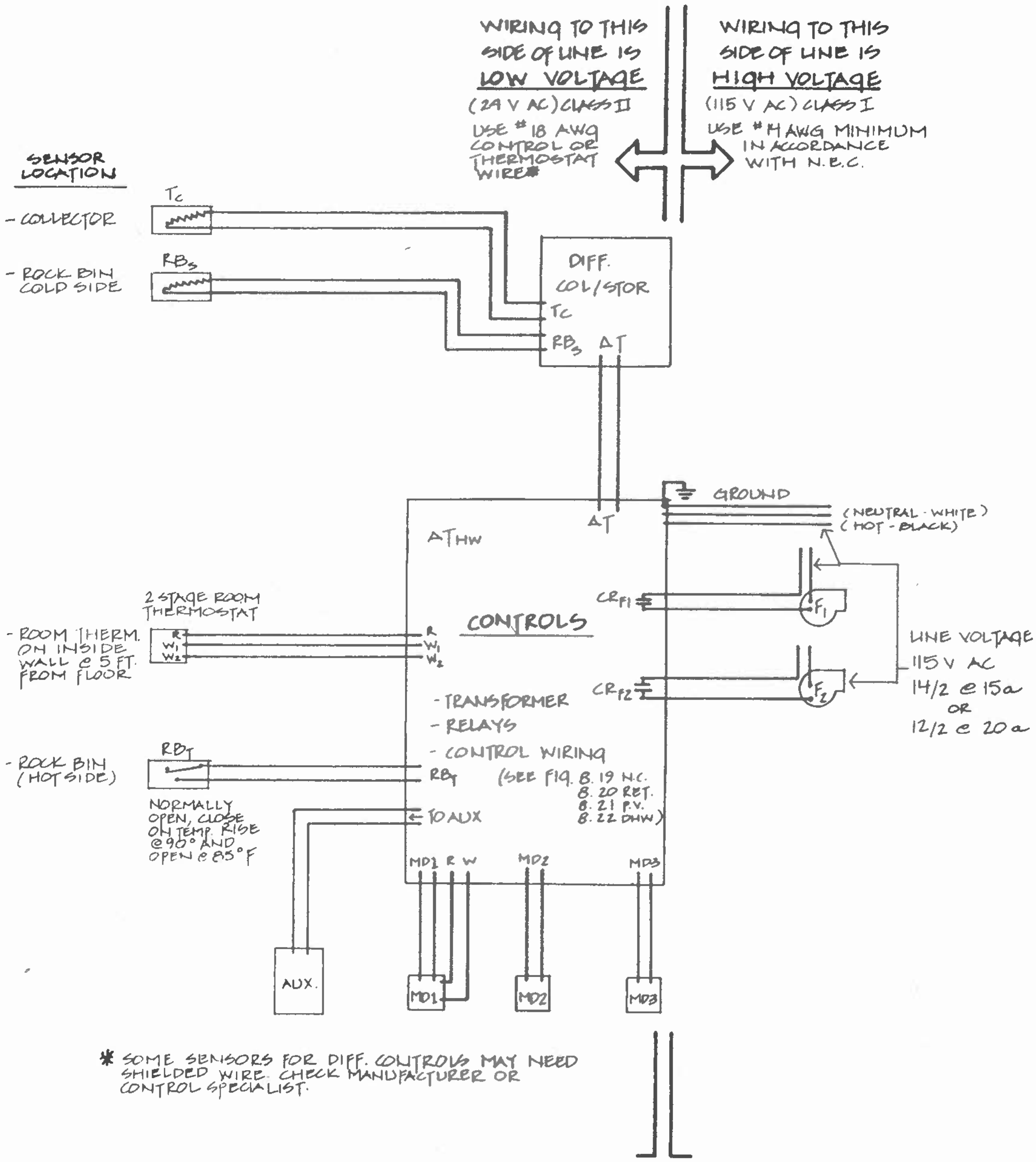


Figure 8.15 Field Wiring for Wall Collector With Storage

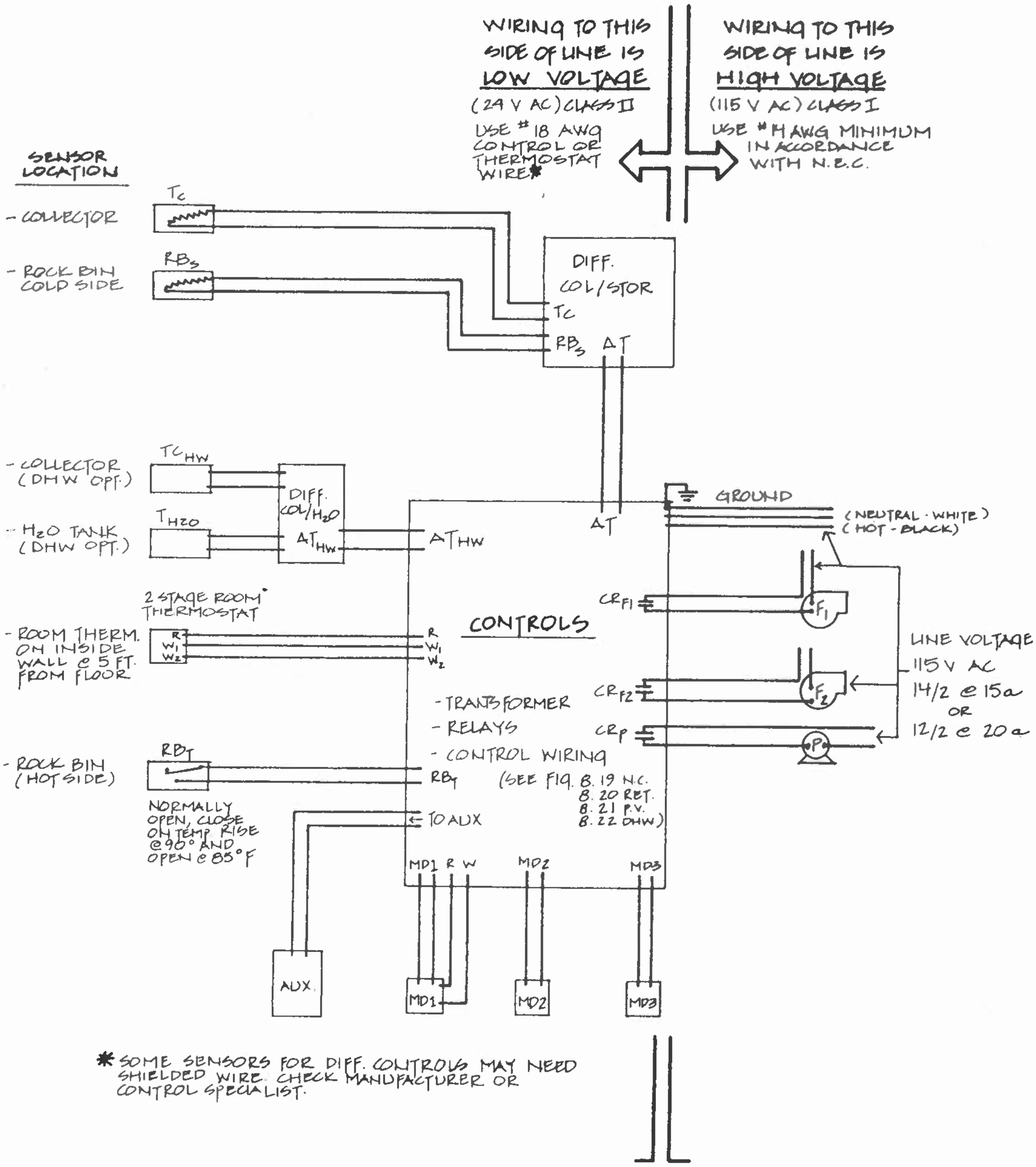


Figure 8.16 Field Wiring for Wall Collector With Storage and DHW

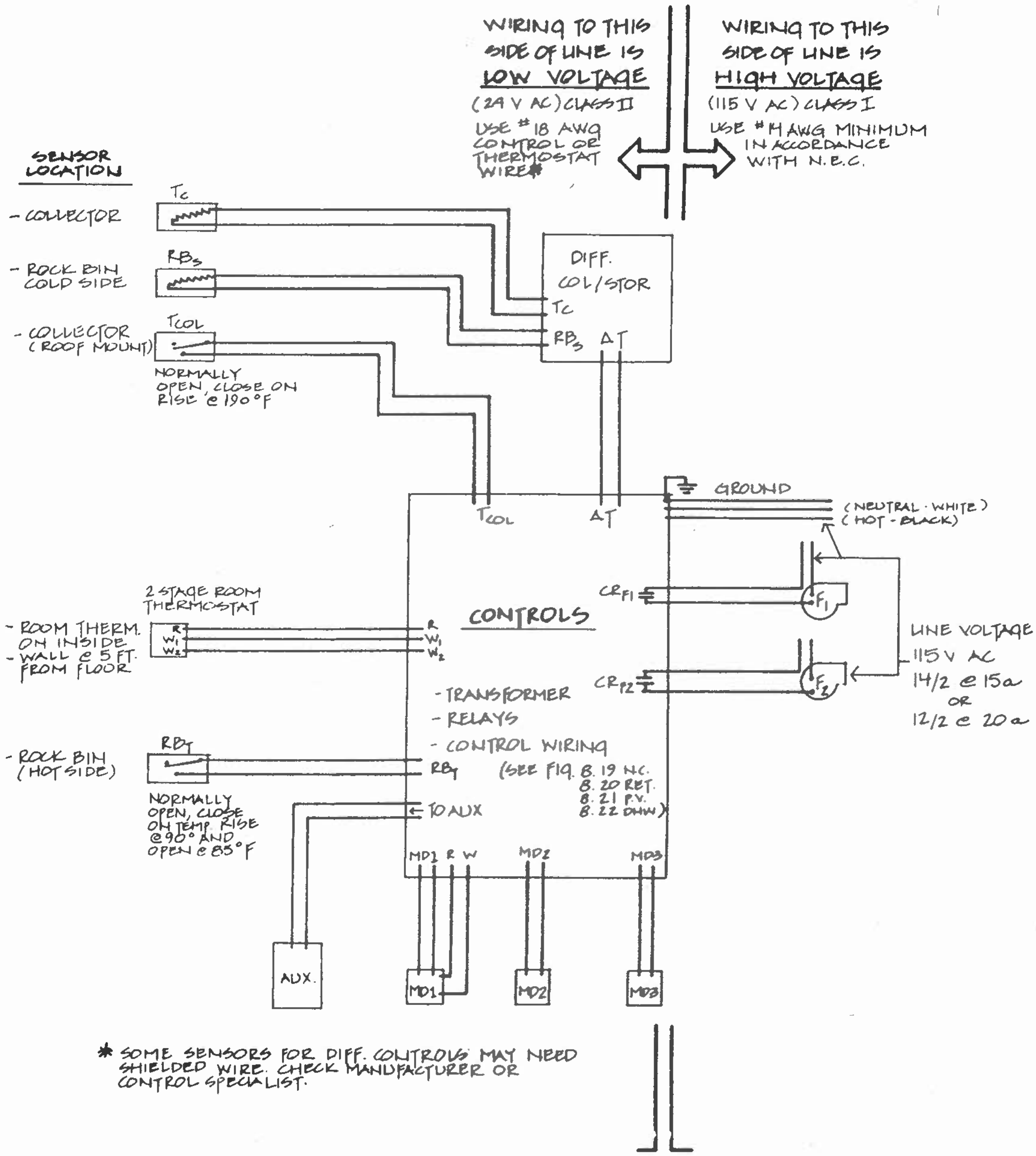
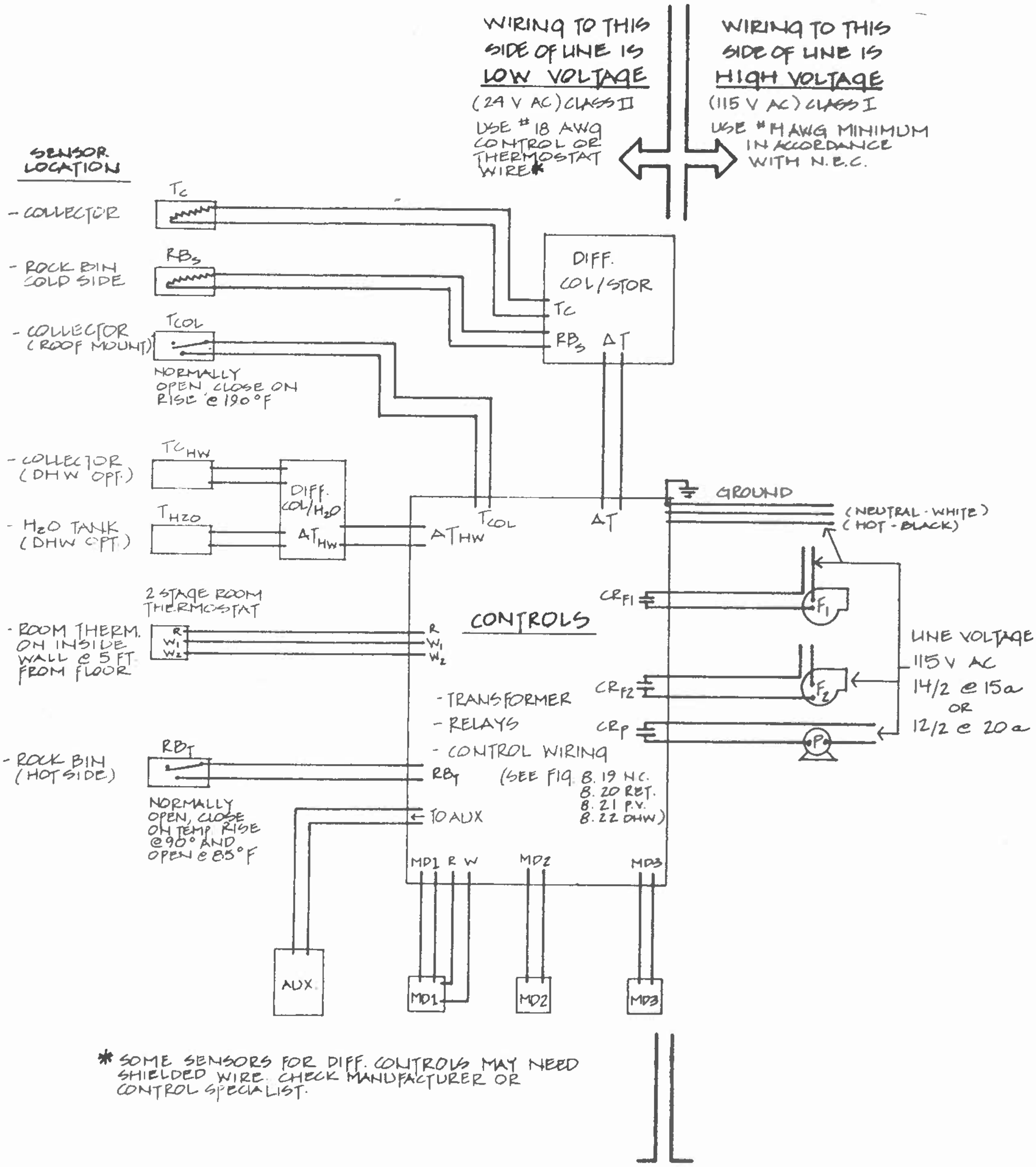


Figure 8.17 Field Wiring for Roof Collector With Storage and Power Venting



* SOME SENSORS FOR DIFF. CONTROLS MAY NEED SHIELDED WIRE. CHECK MANUFACTURER OR CONTROL SPECIALIST.

Figure 8.18 Field Wiring for Roof Collector With Storage, DHW and Power Venting

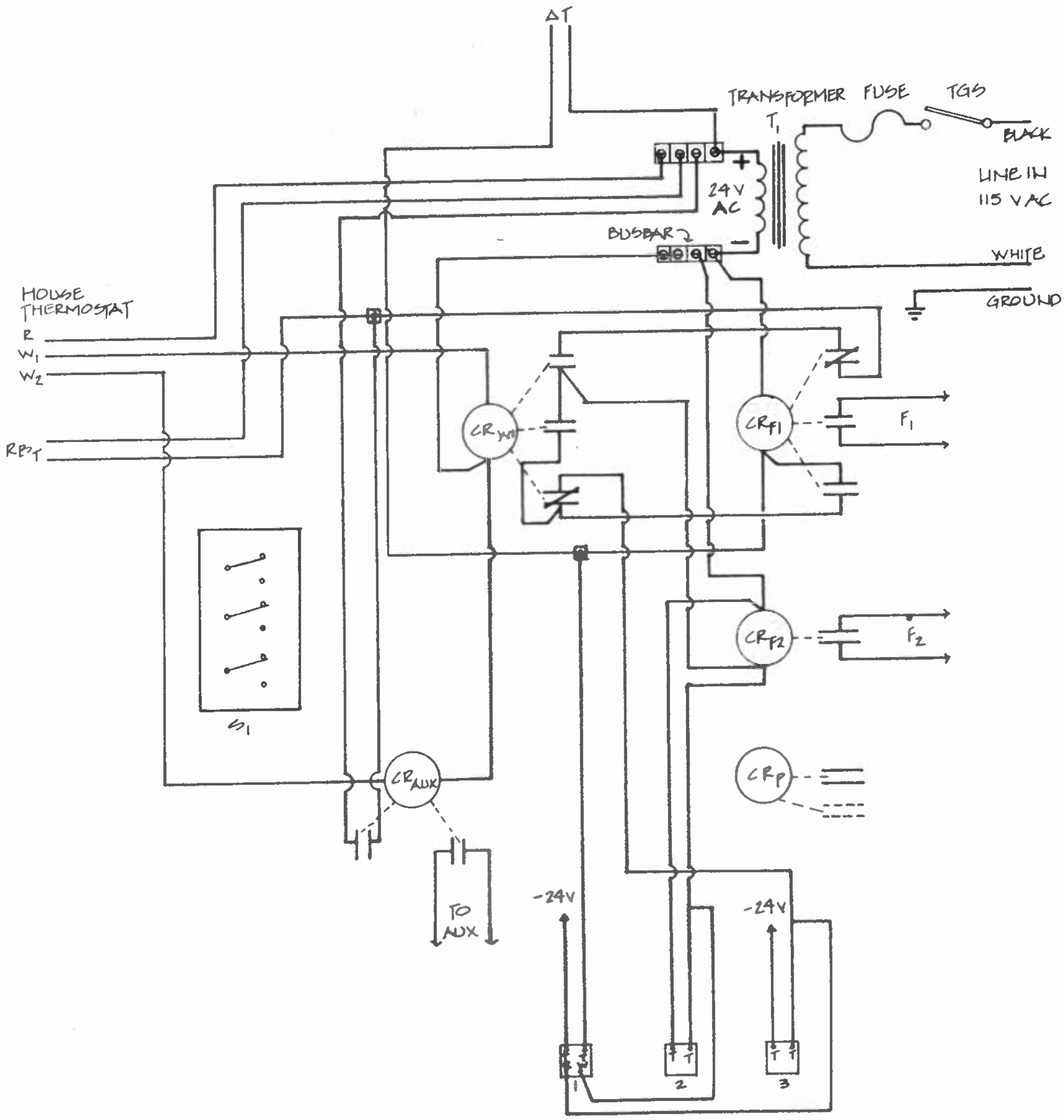


Figure 8.19 New Construction Basic Control Wiring: For Systems With Storage and Series Auxiliary Heating

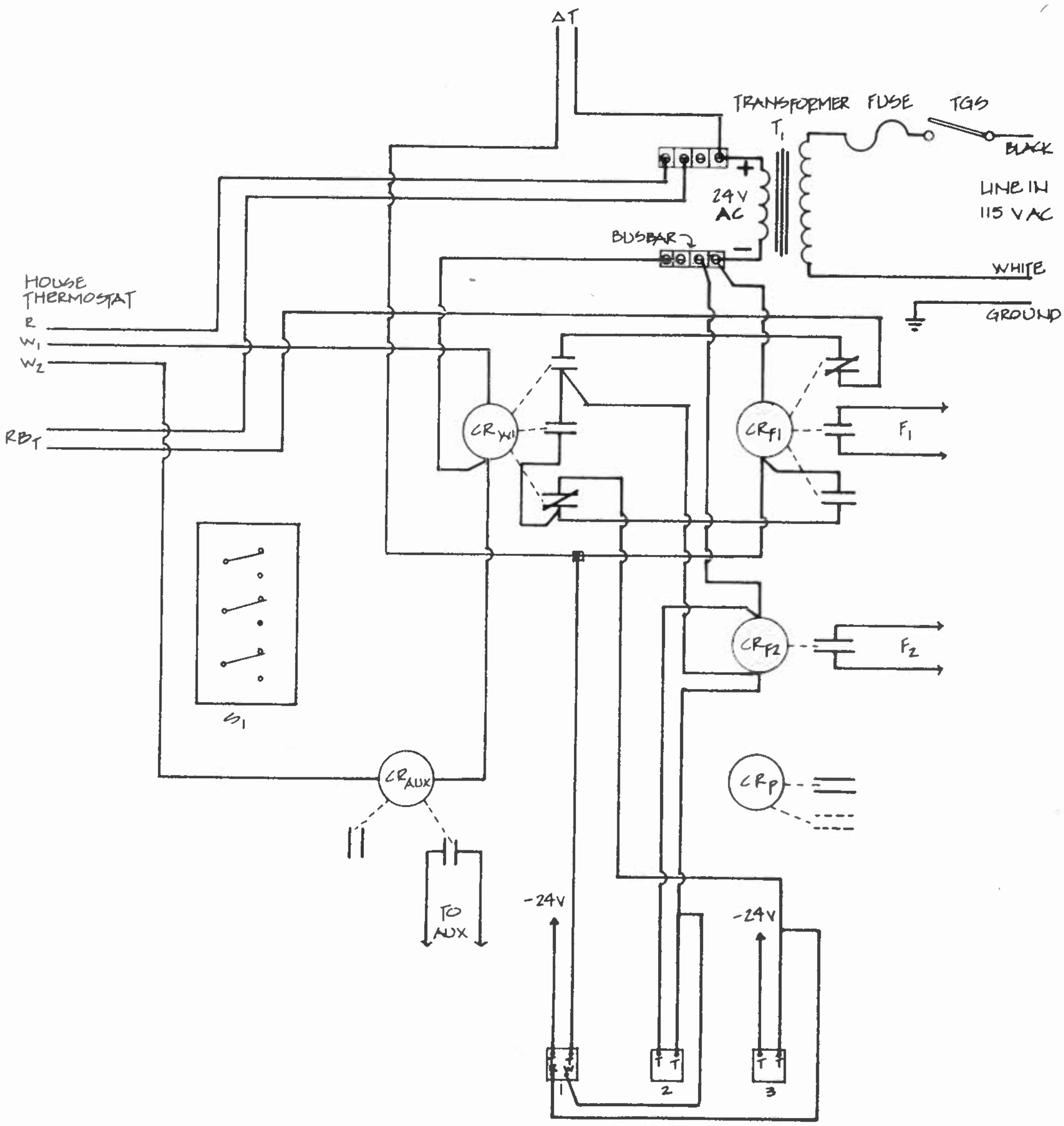


Figure 8.20 Retrofit Basic Control Wiring: For Systems With Storage and Parallel Auxiliary Heating

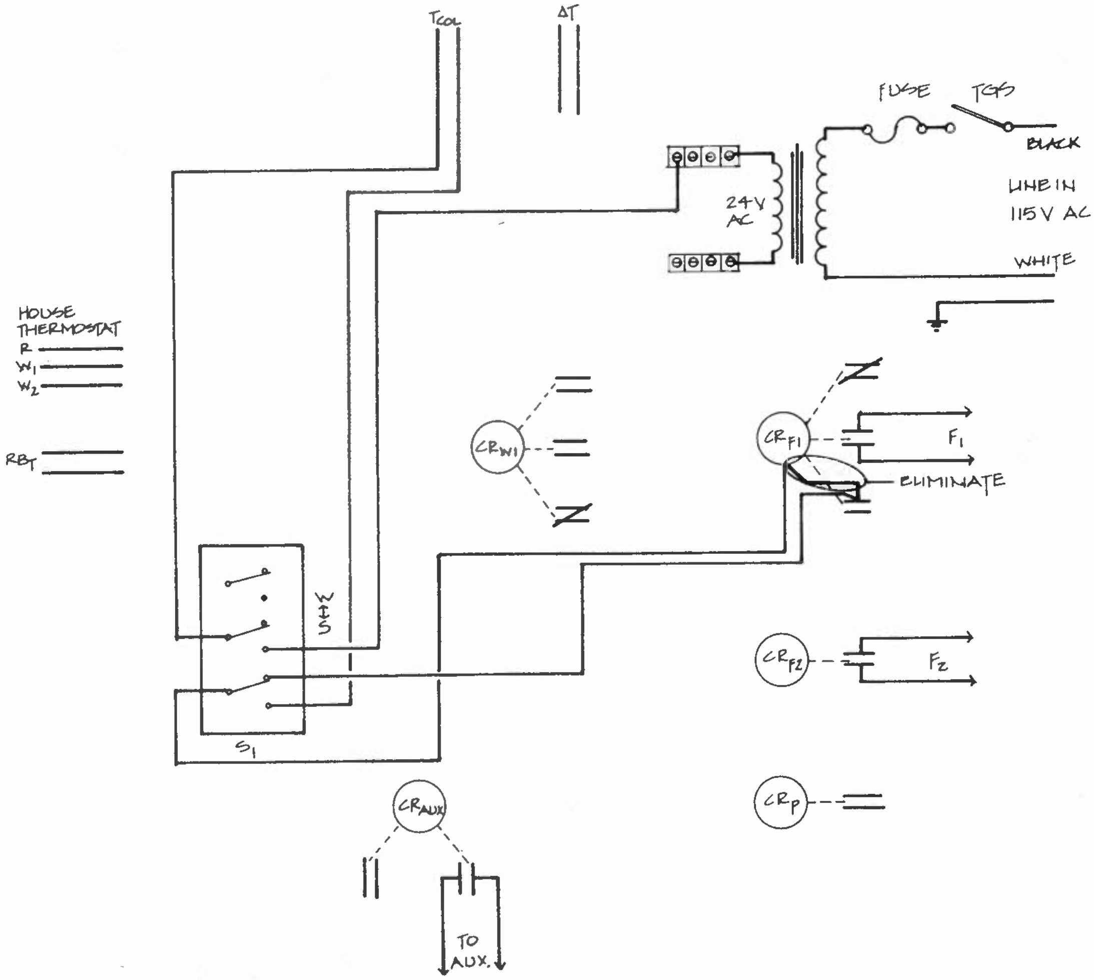


Figure 8.21 Step Two for Roof Collectors: Control Wiring for Power Venting

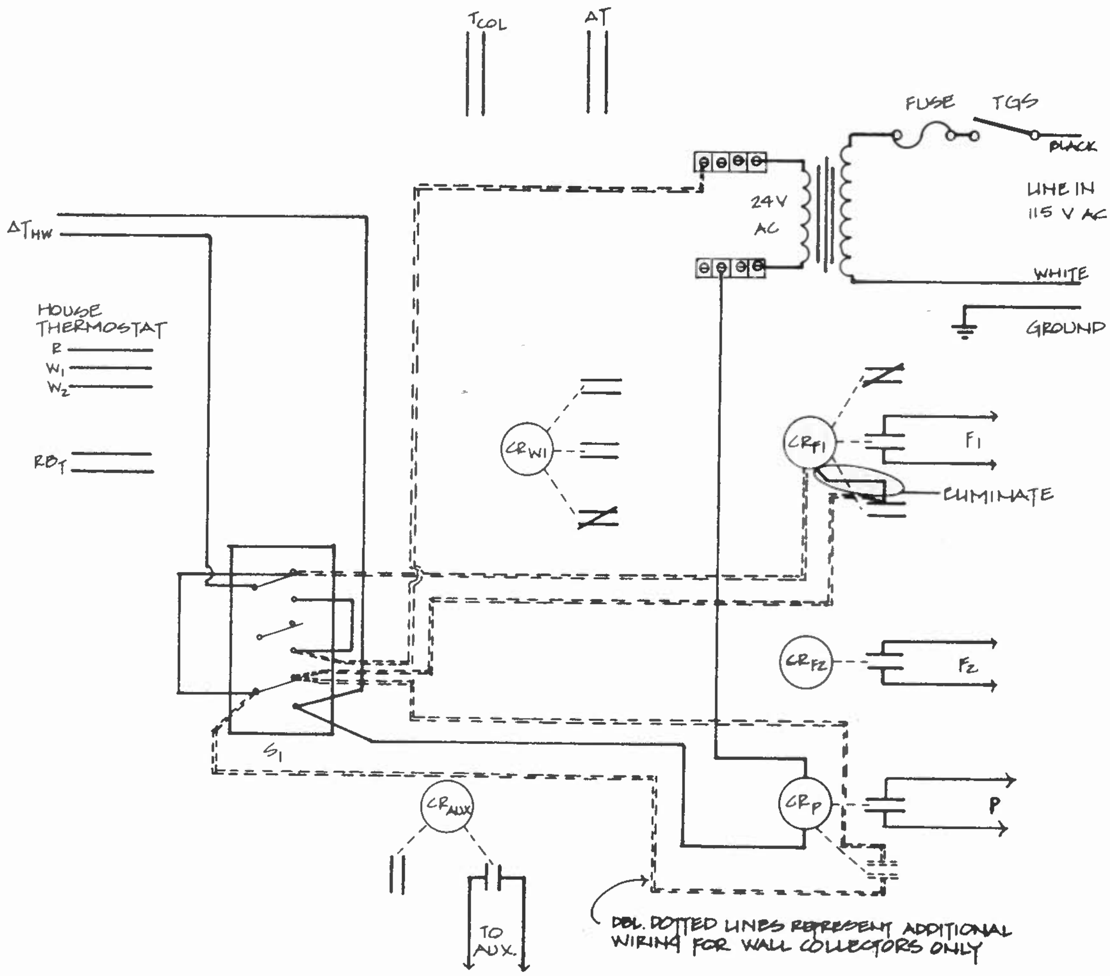


Figure 8.22 Control Wiring for DHW

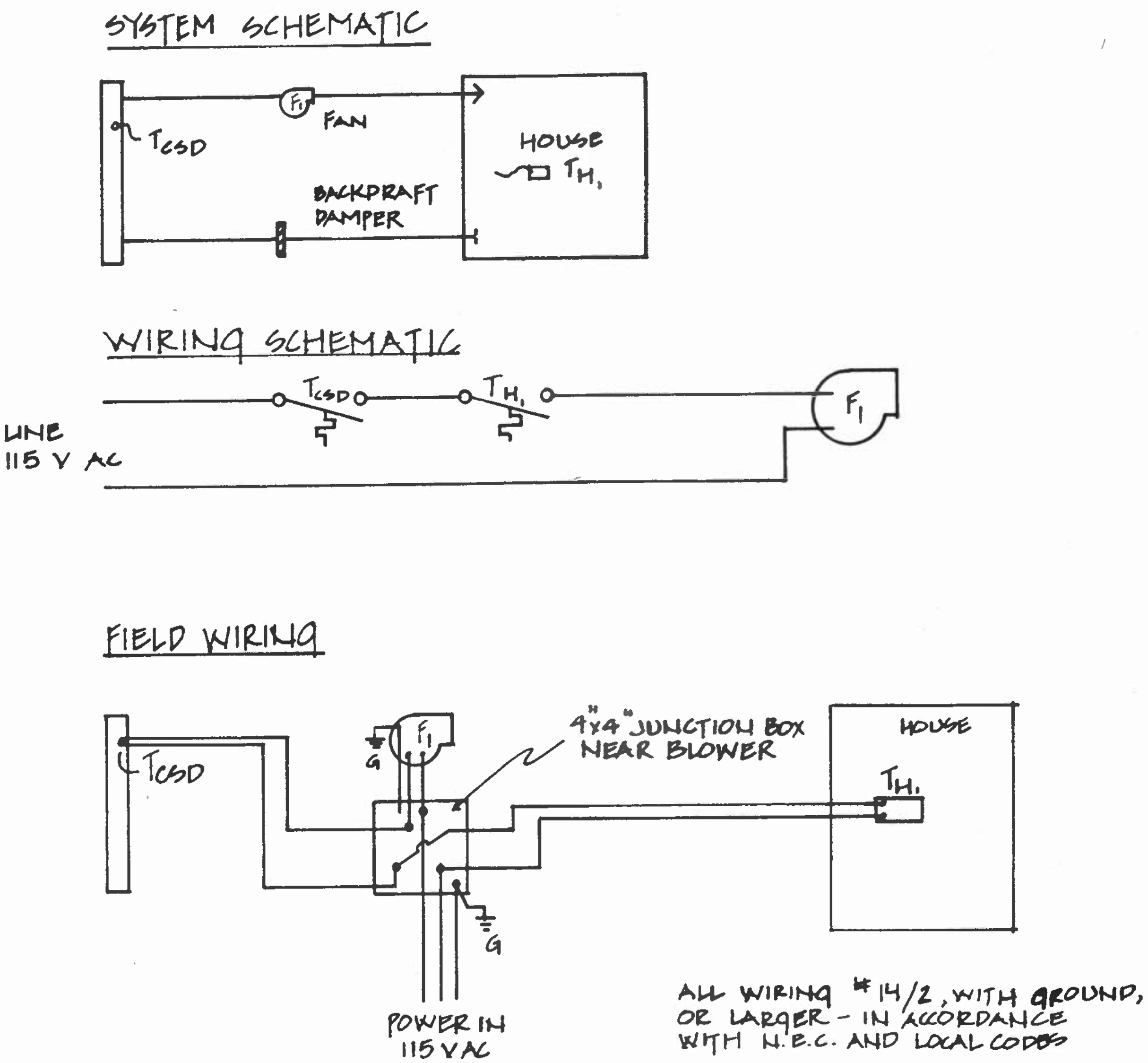
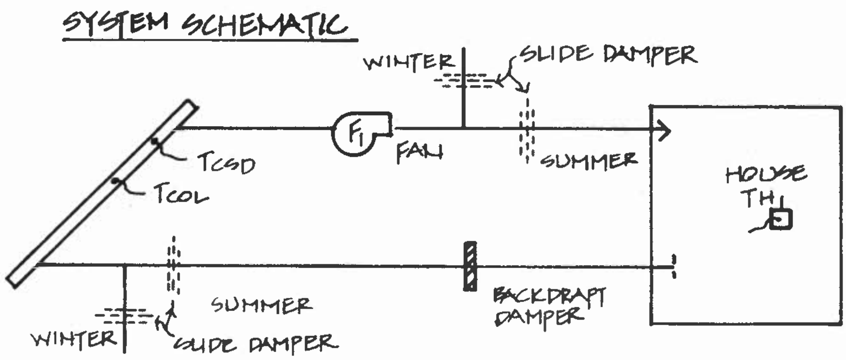
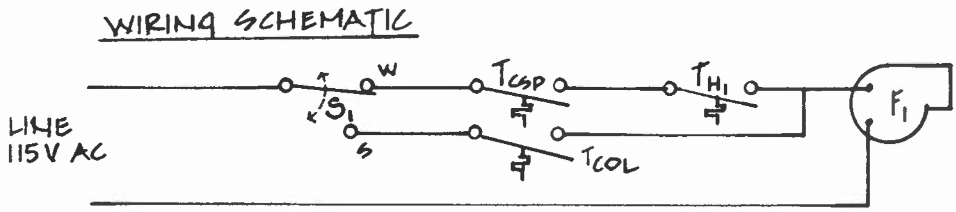


Figure 8.23 Daytime System: Wall Collector Without Storage





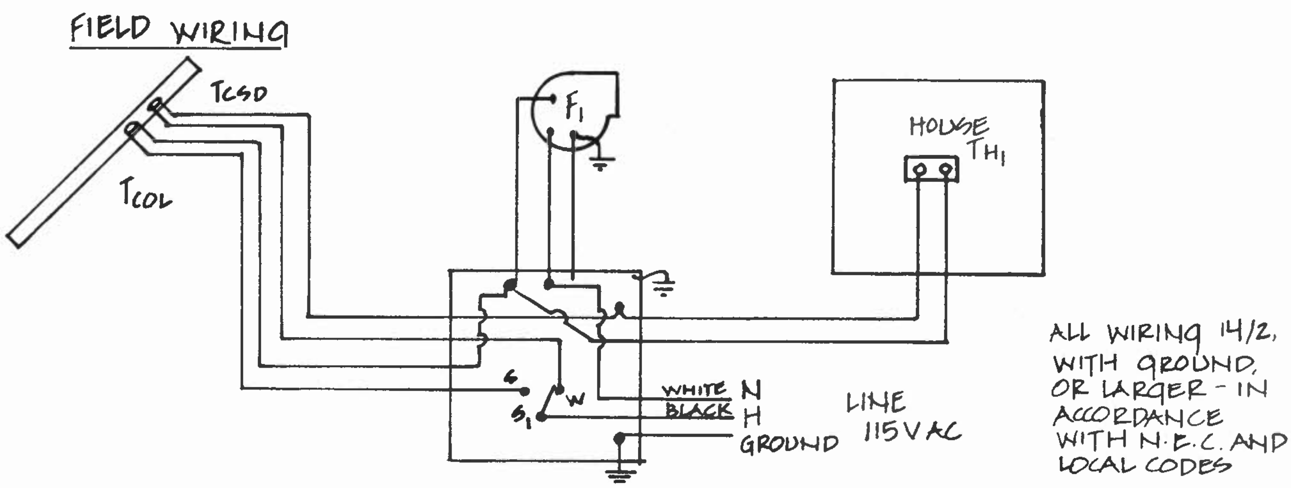


Figure 8.24 Daytime System: Roof Collector Without Storage With Power Venting

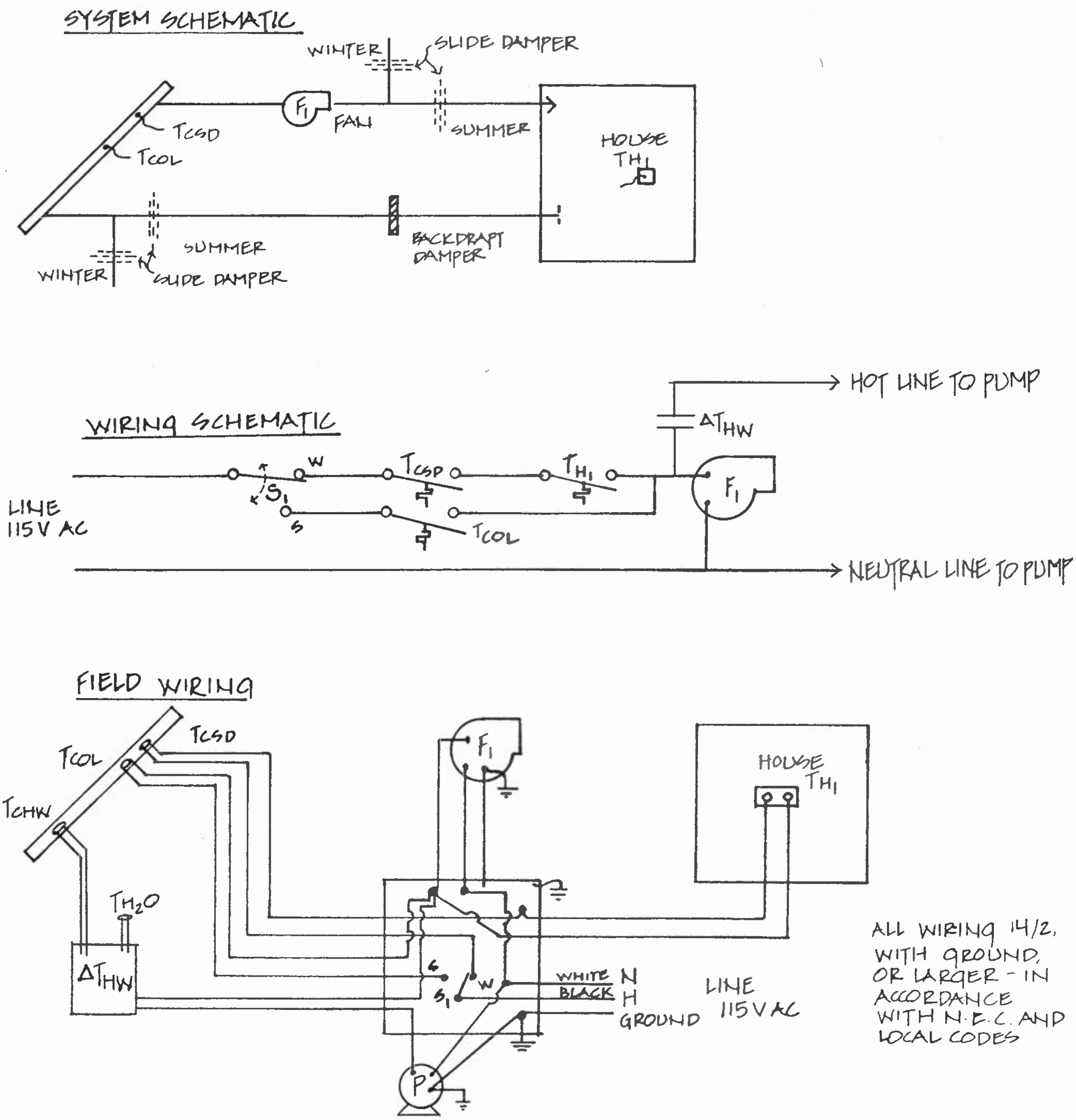
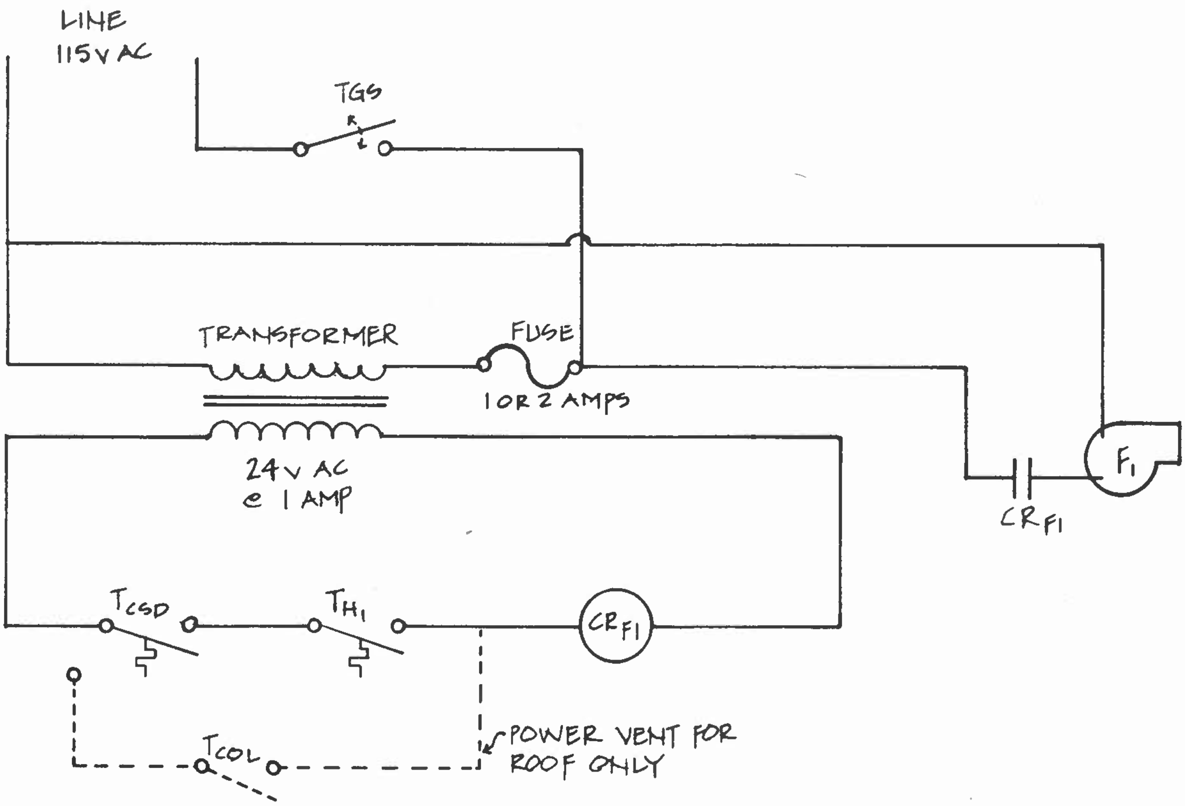


Figure 8.25 Daytime System: Roof Collector Without Storage With Power Venting and DHW



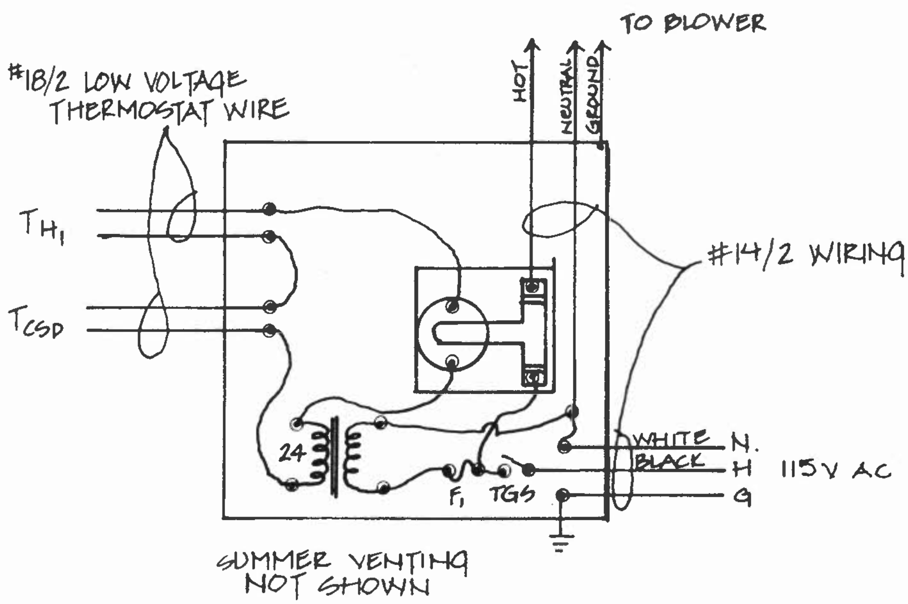


Figure 8.26 Daytime System: Low Voltage Control Alternative

SYMBOL	DESCRIPTION	MANUFACTURER	MANUFACTURER #
T_1	Transformer 120 v to 24 v	Electrical Supply	–
TGS	Toggle Switch or Disconnect Fuse	Electrical supply	
F_1	Fuse	Electrical supply	
S_1	3PDT Switch	Electrical supply	
CR_{F1}	3PDT Relay-Collector Fan	Magnecraft	Class 388, 93 or 199
CR_{F2}	SPDT Relay- House fan	Magnecraft	Class 388,93 or 199
CR_P	SPDT Relay- Pump	Magnecraft	Class 388,93 or 199
CR_{W1}	3 PDT Relay	Magnecraft	Class 388 or 78
CR_{AUX}	DPDT Relay (new construction) SPDT Relay (retrofit)	Magnecraft	Class 388 or 78
THERM or T_{H2}	2 Stage Thermostat	Honeywell	T872F1019
	Thermostat with subbase	Honeywell	Q672C or D
M.D.1,2,3	Low leakage dampers	Honeywell	Series D640
	Low voltage motors	Honeywell	24V M836A
ΔT (DIFF. COL/STORAGE)	Differential controller with T_C collector sensor RB_S coldside rockbin sensor	Honeywell	R7412A1004
ΔT_{HW} CONT. (DIFF. COL/H_2O)	Differential controller with T_{CHW} collector sensor for dhw T_{H_2O} dhw preheat tank sensor	Honeywell	C773A-1014
T_{COL}	High Limit Control	Dayton	Grainger 2E050
RB_T	Remote Bulb SPDT Thermostat	Dayton	Grainger 2E399
T_{CSD}	Snap Disk Thermostat Close 110, Open 90	Dayton	Grainger 2E245
T_{H_1}	Line Voltage Thermostat	Dayton or Honeywell	Grainger 2E158 Grainger 2E516
F_1	Collector Blower	Bayley or	Series BC
F_2	House Blower	Lau	Series FGP or BD
P	Heat Exchanger Pump	Grundfos 10gpm	UPS 20-42

Table 8.4 Air-Handling Control Materials