DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-161192

SYSTEM DESIGN PACKAGE FOR A SOLAR HEATING AND COOLING SYSTEM INSTALLED AT AKRON, OHIO

Prepared from documents provided by

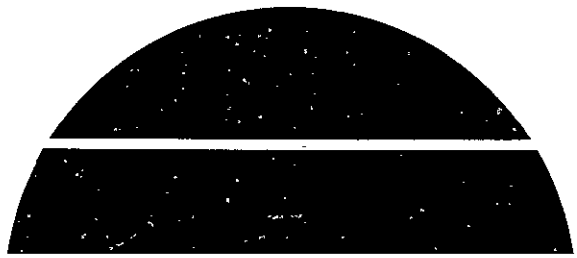
Solaron Corporation
4850 Olive Street
Commerce City, Colorado 80022

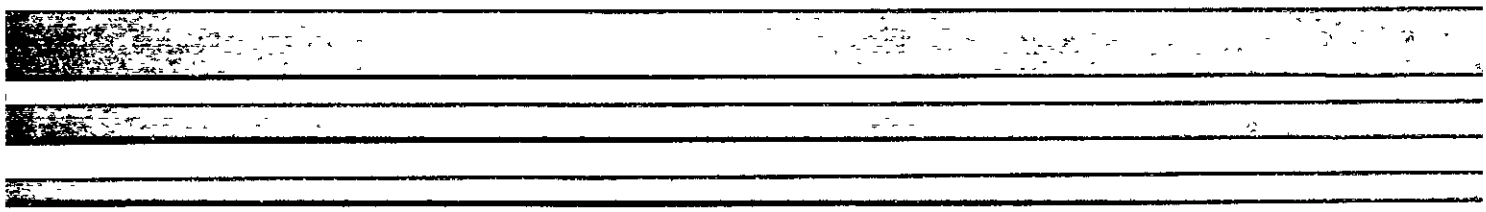
Under Contract NAS8-32249 with

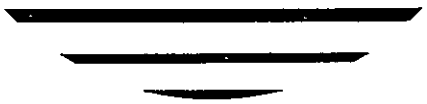
National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

April 1979

For the U. S. Department of Energy







U.S. Department of Energy

Solar Energy

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This work was done under the technical management of Mr. Ralph Cole, George C. Marshall Space Flight Center, Alabama.

16. ABSTRACT

This package contains information used to evaluate the design of Solaron's solar heating, cooling, and domestic hot water system. A conventional heat pump provides summer cooling and back-up heating (when solar energy is not available). Included in the package are such items as the design data brochure, system performance specification, system hazard analysis, spare parts list, and detailed design drawings.

A Solaron solar system is installed in a single-family dwelling at Akron, Ohio, and at Duffield, Virginia.

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TABLE OF CONTENTS

*Drawings appear in the same order as listed on drawing list.

DESIGN DATA BROCHURE

AKRON SOLAR HEATING/HEAT PUMP OFF-PEAK STORAGE SYSTEM

Akron, Ohio

Background

In 1976, Solaron Corporation was awarded a contract by NASA to develop and install two prototype solar heating and cooling systems, toinclude the heating potable domestic hot water. Through a team effort, including work by Solaron Corporation, and Carrier Corporation, possible configurations were evaluated. The final design was completed after careful analysis of computer simulations and efficiency studies.

The System

The system in the Akron Metropolitan Housing Authority home combines a Solaron solar heating system with a conventional Carrier heat pump. The Solaron system will provide space heating and domestic hot water heating while the Carrier heat pump will provide back-up heating (when solar energy is not available) and summer cooling. The unique attribute of the system is that the conventional Carrier Heat Pump will also use off-peak electricity for heating and cooling storage.

During off-peak hours, the heat pump will store heated water (in the winter) or store chilled water (in the summer). Then, while peak rates are in effect, the heat pump system will use the stored energy to either heat or cool the residence.

The use of this system will offer the homeowner many advantages. The Solaron solar system will substanially decrease the need for daytime heating and water heating. In fact, during the Spring and Fall, when outdoor temperatures are mild, the Solaron system will store a significant amount of heat for use at night, greatly decreasing conventinal energy needs.

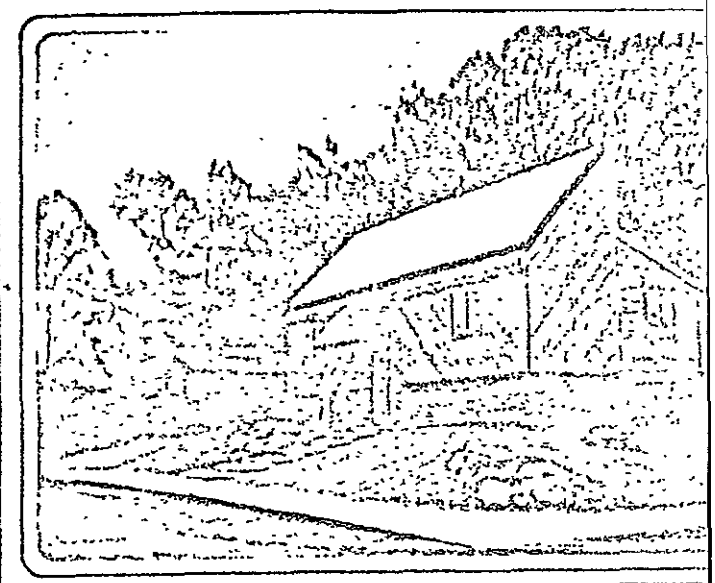
Because utilities that use peak rates encourage the use of off-peak electricity by lowering the rates in off-peak hours, the off-peak storage in the Akron home offers the homeowner substantial savings. The homeowner is, essentially, saving money by paying lower utility rates for energy stored during off-peak hours which will actually be used during peak hours.

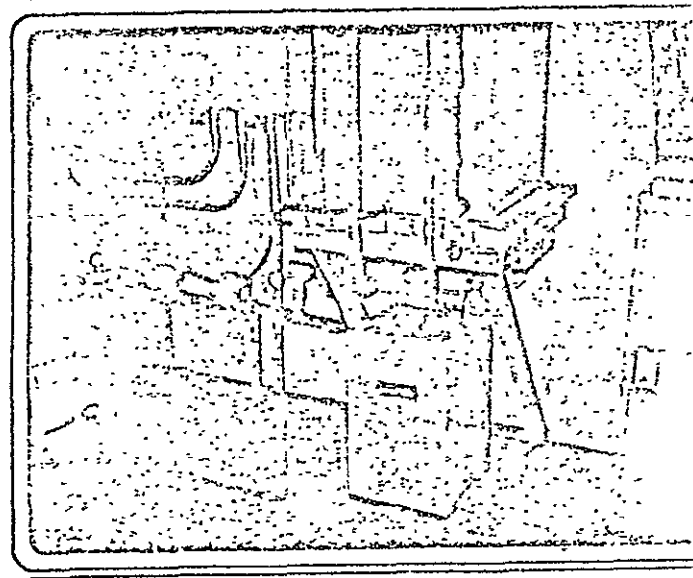
The advantages extend far beyond homeowner savings. If hundreds of thousands of these systems were installed in a region, the effect would be to greatly decrease the peak use of electricity. By reducing the peaks and filling in the "valleys", electrical use would tend to level off during a 24 hour period. By leveling off electrical use, the power producing facilities would operate at a more efficient level. Finally, the reduction in peak loads would decrease the need to build big new power plants to cover peak periods. The end result would be to slow the increase in electrical power costs to the consumer.

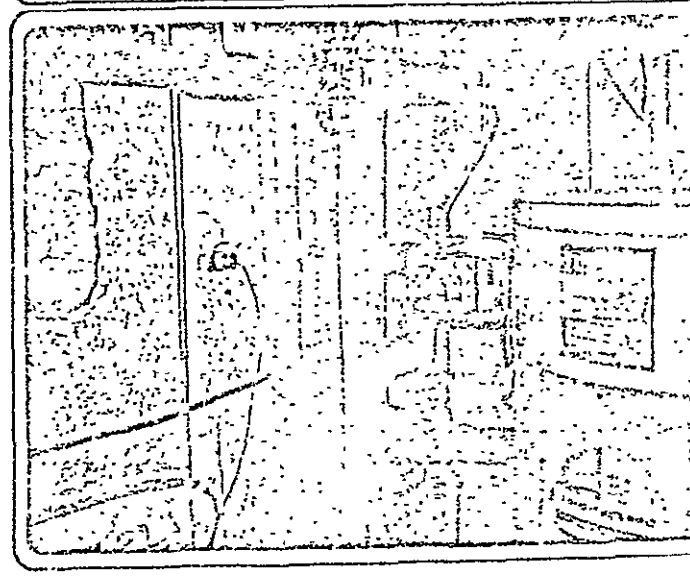
Modes of Operation

As shown on the reverse side of this brochure, the Solaron/Carrier System has a number of distinct modes of operation.

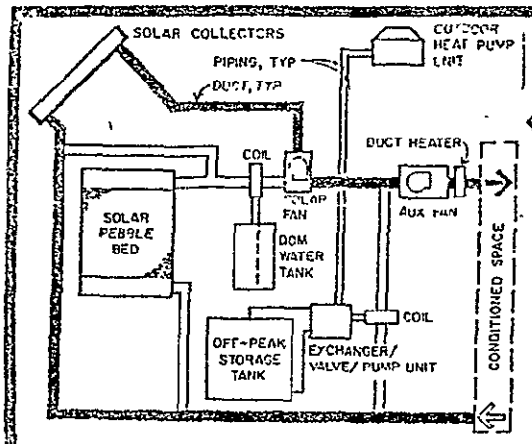
A. Solar heating direct from collector.
B. Storing solar heat and heating hot water.
C. Heating from solar storage.
D. Heating from solar storage and off-peak heat storage.
E. Heating conventionally by heat pump.
F. Off-peak heat storage.
G. Heating from off-peak storage.
H. Solar hot water heating (summer).
I. Solar hot water heating (summer) and conventional heat pump cooling.
J. Off-peak cooling storage.
K. Solar hot water heating (summer) and cooling from off-peak storage.
L. Cooling from off-peak storage.
M. Conventional heat pump cooling.



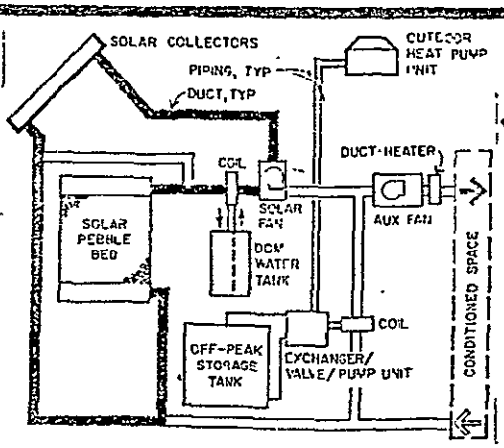




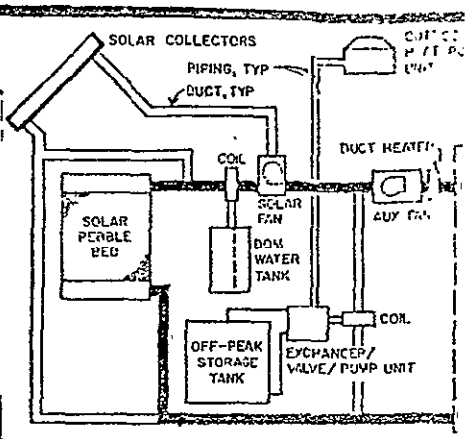
SYSTEM MODES OF OPERATION



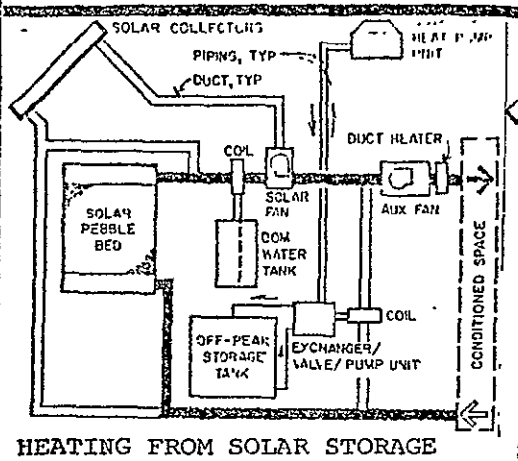
SOLAR HEATING FROM COLLECTORS



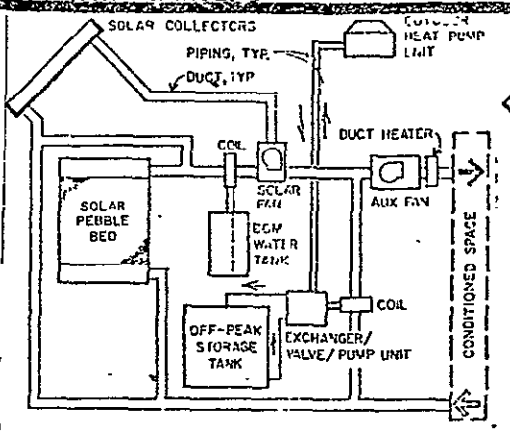
STORING SOLAR HEAT AND HOT WATER HEATING



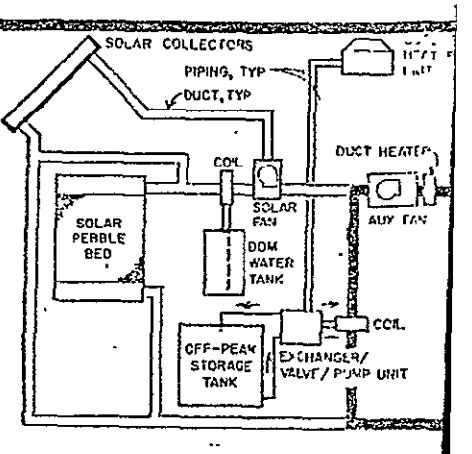
HEATING FROM SOLAR STORAGE



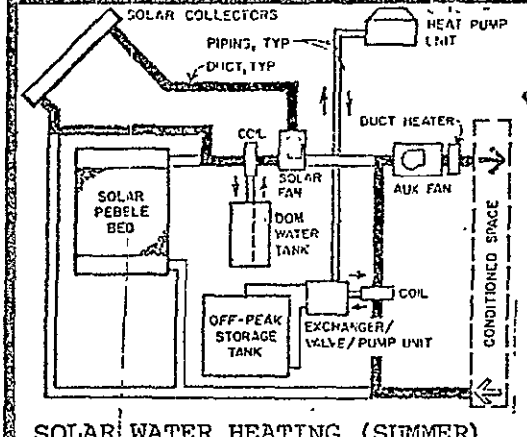
HEATING FROM SOLAR STORAGE AND OFF-PEAK STORAGE OF HEAT



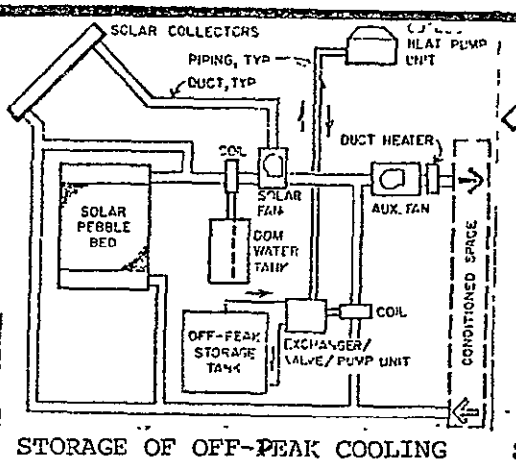
STORAGE OF OFF-PEAK HEAT



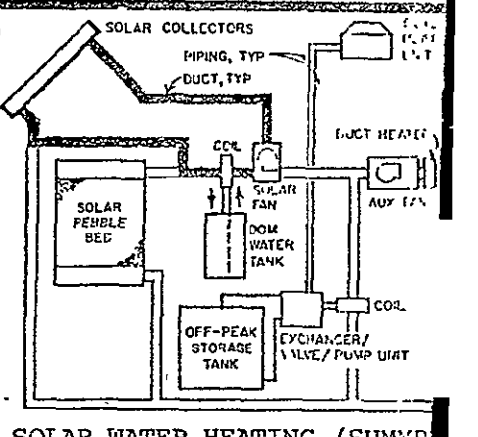
HEATING FROM OFF-PEAK STORA



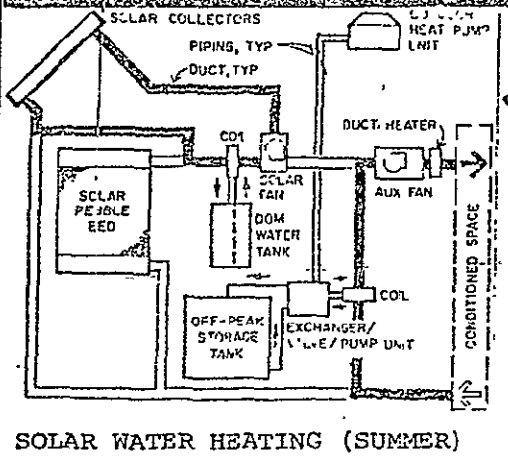
SOLAR WATER HEATING (SUMMER) & COOLING FROM HEAT PUMP



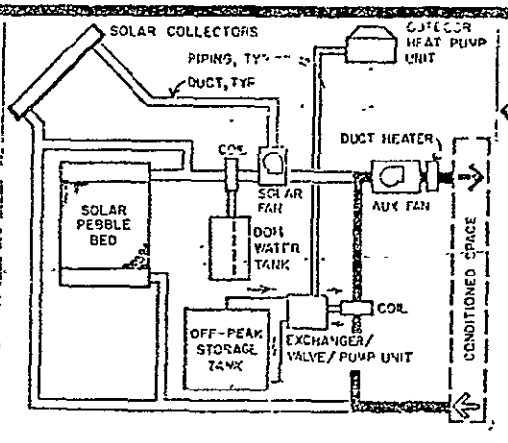
STORAGE OF OFF-PEAK COOLING



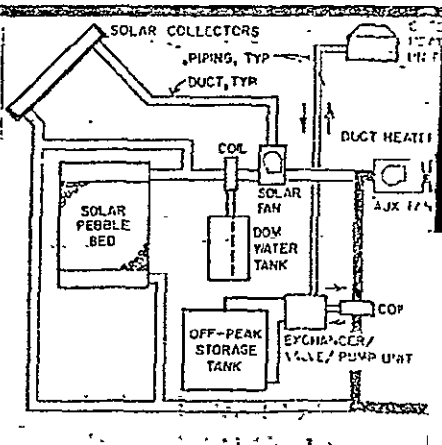
SOLAR WATER HEATING (SUMMD



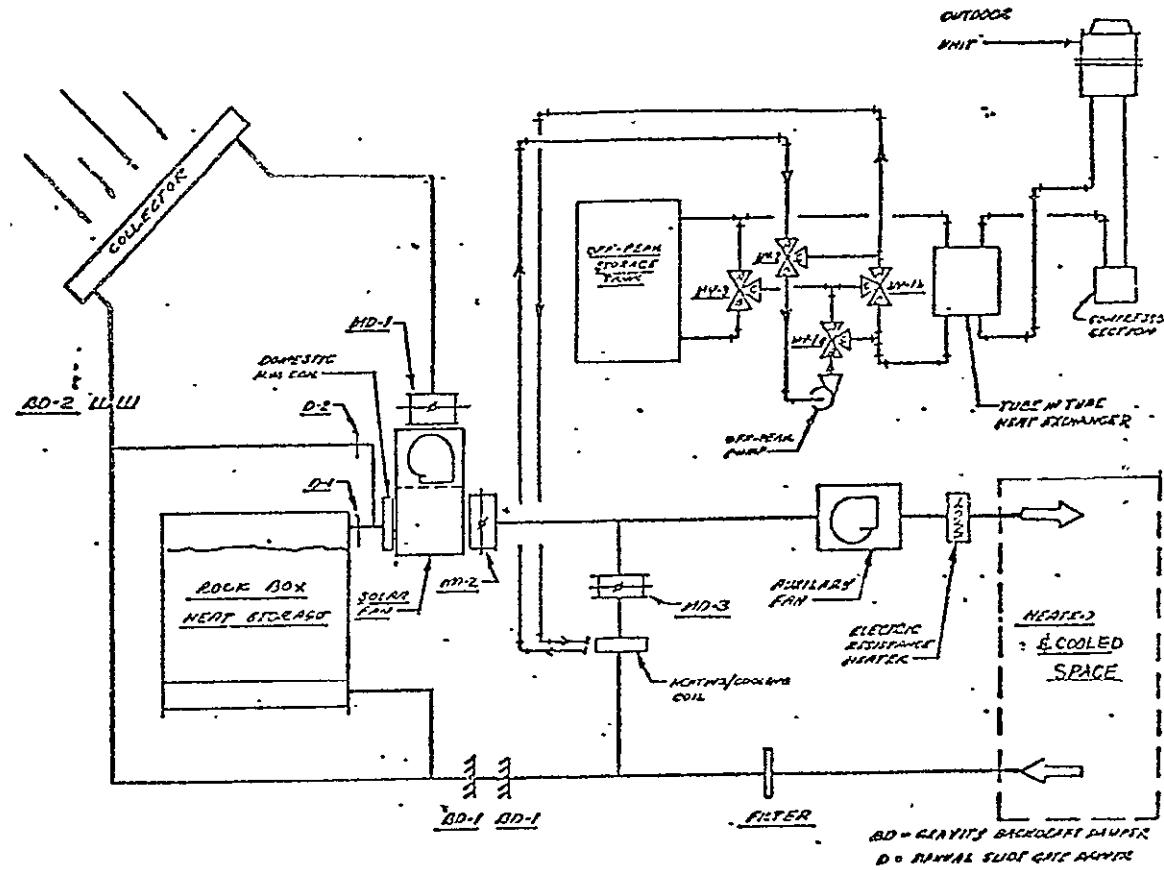
SOLAR WATER HEATING (SUMMER) & COOLING FROM OFF-PEAK STG.



COOLING FROM OFF-PEAK STORAGE



CONVENTIONAL HEAT PUMP HEATING



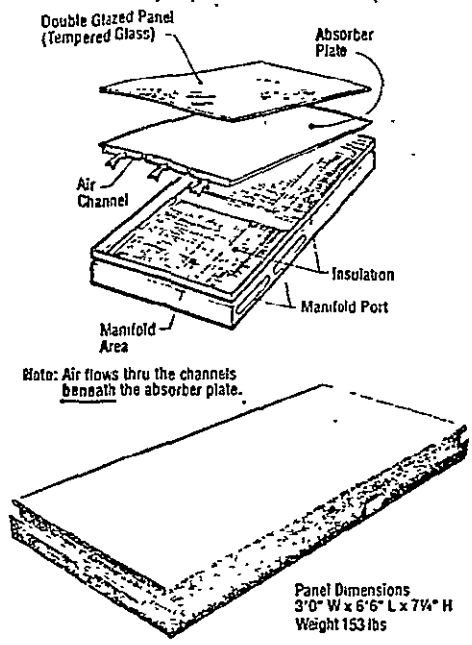
O = OPEN
C = CLOSED
D = MANUALLY OPERATED DAMPER

BD = GRAVITY BACKDRAFT DAMPER
MD = MOTORIZED DAMPER
MV = MOTORIZED VALVE

SEQUENCE OF OPERATIONS

MODE			MV-1	MD-2	MD-3	BD-1	BD-2	D-1	D-2	MV-12 A	MV-12 B	MV-12 C	MV-16 A	MV-16 B	MV-16 C	MV-2 A	MV-2 B	MV-2 C	MV-3 A	MV-3 B	MV-3 C	PUMPS		FANS		CONTROL VALVE MV-5	FANS
																						24V	120V	208-240	277	MV-5	C-2	FANS
	FIRST STAGE HEAT'G	HEATING FROM COLLECTOR	O	O	C	O	O	O	C	*	*	*	*	*	*	*	*	*	*	*	*	OFF	*	ON	ON	OFF	—	OFF
		HEATING FROM STORAGE	C	O	C	O	C	O	C	*	*	*	*	*	*	*	*	*	*	*	*	OFF	*	OFF	ON	OFF	—	OFF
	STORING HEAT		O	C	O	C	O	O.	C	*	*	*	*	*	*	*	*	*	*	*	*	OFF	*	ON	OFF	OFF	—	OFF
	STORING HEAT & DOMESTIC H/W HTG.		O	C	O	C	O	O	C	*	*	*	*	*	*	*	*	*	*	*	*	ON	*	ON	OFF	OFF	—	OFF
WATER HEATING	ON-PEAK	FROM STORAGE (STORAGE HOT)	*	C	O	C	*	*	*	O	O	C	C	O	C	O	O	C	C	O	O	*	ON	*	ON	OFF	—	OFF
		CONVENTIONALLY (STORAGE COLD)	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	O	C	O	*	ON	*	ON	ON	—	OFF
		ELECTRIC RESISTANCE (AUX. ENERGY)	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	O	C	O	*	ON/OFF	*	ON	ON/OFF	—	ON
	OFF-PEAK	CONVENTIONALLY	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	O	C	O	*	ON	*	ON	ON	—	OFF
		ELECTRIC RESISTANCE (AUX. ENERGY)	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	O	C	O	*	ON/OFF	*	ON	ON/OFF	—	ON
	MODE	STORE HEAT	*	*	*	*	*	*	*	C	O	O	O	C	O	C	O	O	C	O	O	*	ON	*	*	ON	—	OFF
WATER COOLING	ON-PEAK	FROM STORAGE	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	C	O	O	*	ON	*	OFF	—	ON	OFF
		CONVENTIONALLY	*	C	O	C	*	*	*	O	O	C	O	O	C	O	O	C	O	C	O	*	ON	*	ON	—	ON	OFF
	OFF-PEAK	CONVENTIONALLY	*	C	O	C	*	*	*	O	O	C	O	O	C	O	O	C	O	C	O	*	ON	*	ON	—	ON	OFF
	MODE	STORE COOL	*	*	*	*	*	*	*	O	O	C	O	O	C	C	O	O	C	O	O	*	ON	*	*	—	ON	OFF
CONTINUOUS AIR CLG. FAN MODE			*	C	O	C	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	ON	*	ON	*	*	OFF
SUPPLEMENTAL HEATING			O	C	O	C	O	C	O	*	*	*	*	*	*	*	*	*	*	*	*	ON	*	ON	*	—	*	OFF
DEAD STATE			C	O	O	C	C	*	*	C	O	O	O	C	O	O	O	C	O	C	O	OFF	OFF	OFF	OFF	OFF	OFF	OFF

* - OPERATION OF DEVICE IS INDEPENDANT OF MODE. IN OTHER WORDS, THE PARTICULAR DEVICE COULD BE ON OR OFF OR OPEN OR CLOSED WHEN IT IS DENOTED BY THE ASTERISK.



SOLARON COLLECTOR PANEL DETAILS (patents applied for)

The Solaron solar collector is an advanced type of an air heating, flat plate collector. Our exclusive internal manifolding allows the Solaron collector to be completely modular. Factory preassembled collector panels are plugged into each other with a minimum of installation time. Air inlets and outlets are field cut into each collector array as required. The Solaron solar collector is designed for installation on any structurally sound surface, such as a roof, wall or specially made supports.

The Solaron solar collector has the following general construction characteristics:

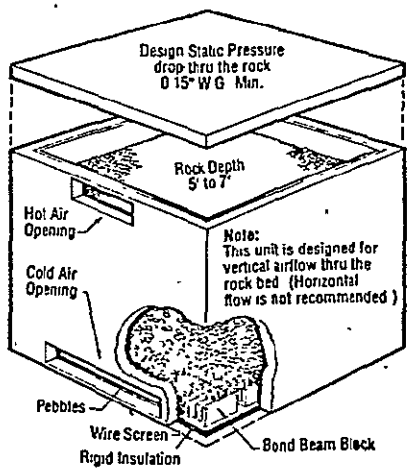
Absorber: 28 gauge steel with porcelain enamel coating.

Glazing: Two ⅛" sealed special low iron tempered glass panels with a long life EPDM perimeter gasket. Glass plate can be easily removed for service or replacement.

Pan: 20 gauge steel, fully insulated with 3¾" fiberglass batt. Painted external surfaces.

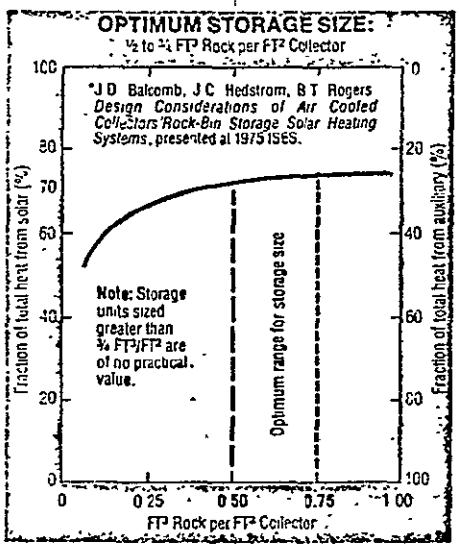
Connection Ports: Unique flange configuration permits tight air seal automatically as modules are installed.

Cap Strip: Painted steel designed to provide weather seal between panels.

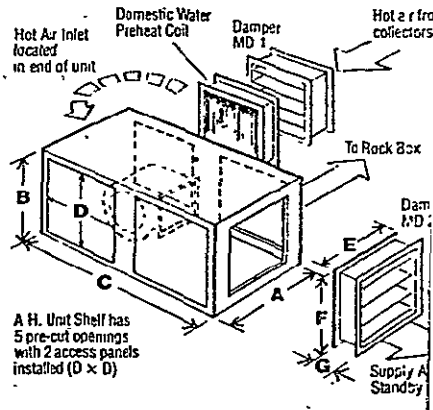


PEBBLE-BED HEAT STORAGE UNIT

The use of pebbles in the heat storage unit is particularly effective with an air circulating solar heating system. The pebble bed maintains a steep temperature stratification (i.e. hot on top and cold on the bottom). This allows air to be provided at the highest available temperature to the heated space from the top of the pebble bed. It also allows air to return from the bottom of the bed to the collector at essentially room temperature. This ensures maximum efficiency of solar heat collection and delivery.



The heat storage unit must be built and installed by the local contractor to Solaron standard drawings and specifications. Contact Solaron for a copy of these specs.



Model No	Air Handling Unit (in.) A	B	C	D	Dampers & Coil E	F	G	CFM Ra at 1.2" S
AU—0400	20	18	42	14	16	15	8	300 to 1
AU—0500	24	22	51	18	20	20	10	1200 to 2
Larger custom built air handlers are also available								

AIR HANDLING UNIT

Solaron provides a standard factory preassembled air handling unit, including a blow and motor driven dampers. A separate damper p is furnished for mounting in the duct system, (i.e backdraft dampers).

A typical installation for the air handling u near the auxiliary heater and heat storage, is sho in the General System Description (upper left). T air handler can be mounted either vertically or horizontally, and with proper orientation and clearance to receive all connecting ducts withou interference.

SOLARON AUTOMATIC CONTROL UNIT

The automatic temperature control unit included as part of the Solaron system. The controller handles all of the operational modes are shown in the schematics on page 2. The controller operates the solar side of the system ties into a 2-stage thermostat to provide solar a auxiliary heat to the space as required. The star controller can be modified (with Solaron hardw to combine with heat pumps or other types of auxiliary heating systems. Solaron can provide technical assistance to design special controlle large projects or special applications.

SOLARON®
SOLAR ENERGY SYSTEMS

The system installed at the Akron Metropolitan Housi Authority was designed by Solaron Corporation of Denver, Colorado under NASA Contract #NAS8-32249.

This work has been supported by the Solar Heating a Cooling Research and Development Branch, Office of Conservation and Solar Applications, U. S. Departme of Energy.

SOLARON CORPORATION, 720 South Colorado Blvd.
Denver, Colo. 80222

Specification No. SHC 3017
Page Date 11/20/78

APPENDIX A

SYSTEM IDENTIFICATION

This Appendix defines the performance and installation drawings for Solaron Heating, Cooling & Hot Water. System Model Number SHC 3017 Heat Pump.

SYSTEM PERFORMANCE SHEETS

Site -

The system shall be installed in a single family/dwelling in the city of Akron, county of Summit, state of Ohio.

Heating Capacity

The system will provide solar energy for 35 % of the average total heating load during the heating season based on an average total heating load of 7.067 BTU/Month and a peak heating load of 27,260 BTU/hr. /x 10^6* at a 64° ΔT

*9 month average

Cooling Capacity

The system will provide solar energy for 0 % of the average total cooling load during the cooling season, based on an average total cooling load of 3.6 / BTU/Month and a peak cooling load of 20,000 BTU/hr. / x 10^6*

*3 month average

Auxiliary Energy

The average rate of auxiliary energy used for heating shall be no greater than 4.12 x 10^6 BTU/Month of the total energy required for heating, including hot water. This shall be no greater than 44*% of the total energy required for heating. The average rate of auxiliary energy used for cooling during the cooling season shall be no greater than 1.8 x 10^6 BTU/Month. This shall be no greater than 50 ‡ % of the total energy required for cooling.

* 9 month average with C.O.P. = 1.5
‡ 3 month average with C.O.P. = 2.0

Specification No. SHC 3017
Page Date 11/20/78

Hot Water

80 gallons of potable (or useable) hot water shall be delivered at no less than 5 gal/min at temperatures no less than 140 °F. Recovery time shall be no greater than 2 hours. The average hot water heating load will be $\frac{1.83 \times}{10^6}$ BTU/Month of which 65 % is provided by auxiliary energy.

Operating Requirements

The maximum electrical energy required to drive the solar portion of the system at its rated capacity shall be no greater than 0.7 K.W. The maximum electrical energy required to drive the complete system shall be no greater than 1.2 K.W. The average yearly electrical energy required to drive the system shall be no greater than 4000 K.W.H. Water requirements for cooling condensers and/or air humidification shall be no greater than 0 gal/hr.

Physical Data - Table III

The following subsystems shall have:

	Design life no less than	Weight (filled) no greater than	Installation dimensions
Heating (Duct Heater)	10 years	100 lbs	2' x 2' x 2'
Cooling (H & C Coil)	10 years	200 lbs	3' x 2' x 1'
Auxiliary Energy (H.P. & Tank)	10 years	10000 lbs	outdoor 3' x 3' x 3' H.P. 4' x 2' x 2' storage 6' x 6' x 6'
Storage (Pebble Bed)	20 years	30000 lbs	8'x6.75'x7.5'
Potable Water (or useable)	5 years	1600 lbs	preheat 5.25'Hx2.2'D wtr.htr. 5'H x 2'D
Collector	20 years	9 lbs/ft^2	8"x14'x43'
Energy Transport	20 years	15 lbs/ft	N/A
Controls	10 years	50 lbs. each	N/A
(Other)			

The existing system consists of the following:

1. 546 sq. ft. (total area) of the Collector described in the proposal with an efficiency of 40% under the following conditions $T_{in} = 70^{o}F$, $H_t = 300$ BTU/HR./FT.^{2}, $T_a = 48^{o}F$.

2. 27000 pounds of rock storage in one box. The insulation is R-11 or equal.

3. A control system as for controlling heating, cooling, hot water and the off-peak system.

4. A transport system with 100 feet of 14" x 16" duct, covered with 1 inch of fiberglas insulation. The mass flow is 1000 SCFM.

5. The annual solar insolation at the Akron location that the existing system is 4.6×10^5 BTU's per sq. ft. (45^{o} Tilt).

In general, no parts of the delivered system pose any major hazards to personnel, other equipment or to the structure. Only minor hazards, common to all heating and ventilating equipment exist in the system and are outlined below.

I. Electrical

The Carrier heat pump, outdoor unit, the Solaron solar fan and room fan, the duct heater and the domestic water heater all operate at 230 volt, single phase. Since all these components have been installed in accordance with all local and national electrical codes their hazard to personnel and to the structure are minimal.

The off-peak pumps, the domestic water pump, and the control unit operate at 120 volts. These components have also been installed in accordance with all local and national electrical codes and therefore represent only a minimal hazard to personnel and to the structure.

II. Temperature

The stagnation temperature present in a no-flow condition in the solar collector is approximately 350^{o}F. This is the temperature reached at the absorber. The temperature on the exterior surfaces of the collector can reach 200^{o}F under these conditions. This temperature represents a minor hazard to personnel, and it is therefore recommended that if and when servicemen work on the array they use a pair of gloves.

III. Pressure

The domestic water subsystem works at mains water pressure. All piping is therefore designed to operate at this pressure and conforms to local and national plumbing codes, which minimizes the hazard to the structure and personnel.

IV. Flammability

There are no flammability hazards present in the system.

V. Toxicity

There are no toxic fluids used in the system.

SPECIAL INSTALLATION AND MAINTENANCE TOOLS

No special tools are required to install and service the entire solar heating, cooling and off-peak system. The only tools and test equipment required are those normally carried by an HVAC contractor/serviceman on his service vehicle. The required tools and test equipment are listed in the installation operation and maintenance manual.

SPARE PARTS LIST

All needed spares for the delivered system are "off-the-shelf" hardware and are available from Solaron, Carrier or one of their OEM suppliers. The recommended spare parts that are unique to the Solaron system (exact duplicates are not available elsewhere) are listed below:

(1) ΔT Board SHC130

Replaces differential thermostat in Solaron HC0116 control unit.

Recommended Qty.: 1
Lead Time: In stock in Denver
Price: $82.60

(2) T_{co} collector sensor SHC131

Sensor for above ΔT board; senses collector outlet temperature.

Recommended Qty.: 1
Leadtime: In stock in Denver
Price: $26.14

(3) BD damper DV0020

Backdraft damper used to prevent back flow on return air side of the system.

Recommended Qty.: 1
Leadtime: In stock in Denver
Price: $69.00

(4) Collector Glazing GL0034

Replaces double glazed unit used in series 2000 collectors.

Recommended Qty.: 1
Leadtime: In stock in Denver
Price: $104.50

ACCEPTANCE DATA PACKAGE

Drawings List for OTS-30

(Akron)

I. SOURCE CONTROL DRAWINGS

A. Solaron Collector and Hardware Details

B. Blank Drawing of Pebble Bed Heat Storage

C. AU0400 and AU0500 Air Handler (Solar and Room Fans)

D. Solaron Motorized Dampers MD-1, 2, 3

E. Wiring Diagram - Solaron HC0116 Heat Pump Control Unit

F. Wiring Diagram - Off Peak Controller

G. A. O. Smith PEC-52, PEC-80 Domestic Water Heater and Preheat Tank

H. Grundfos Stainless Steel Circulator Pump UM 25-18SU

I. Grundfos Variable Head Circulator Pump UP 26-64

J. Honeywell Modutrol Motors M845A, M845E (motors for valves MV1A, MV1B, MV2 and MV3)

K. Honeywell Valve Linkage Q618A (valve linkages for above valves)

L. Honeywell Three-Way Valve V5013A

M. Eaton Storage Tank

N. Carrier 38HQ Heat Pump and Outdoor Unit

O. Carrier Coaxial Heat Exchanger

P. Carrier Coaxial Heat Exchanger

Q. Modifications to 38HQ940 Outdoor Unit

II. DELIVERED SYSTEM DRAWINGS

A. Akron House Plans and Elevations D1000A

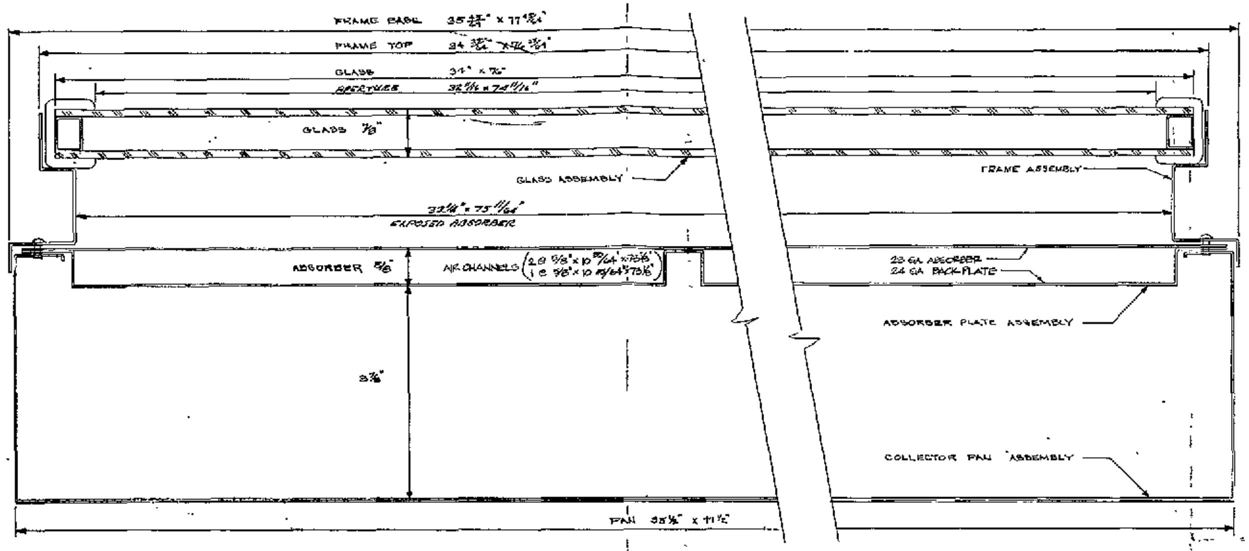
B. Akron House Mechanical Room D1001A

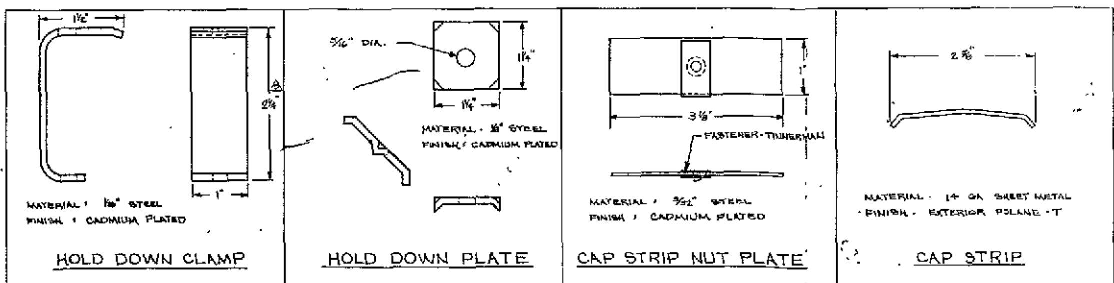
C. Akron House Heat Storage Unit D1002A

D. Akron House System Monitoring D1003

E. Akron House System Monitoring D1004

F. Akron House Wiring Diagram D1005





HOLD DOWN CLAMP

HOLD DOWN PLATE

CAP STRIP NUT PLATE

CAP STRIP

NO	DATE	REVISION
5	5/5/78	CLAMP 2¼" DIM WAS 2½"
4	[illegible]	[illegible]
3	9/2/77	COLLECTOR
2	8/2/77	NUT PLATE, COLLECTOR
1	4/5/76	CAP STRIP

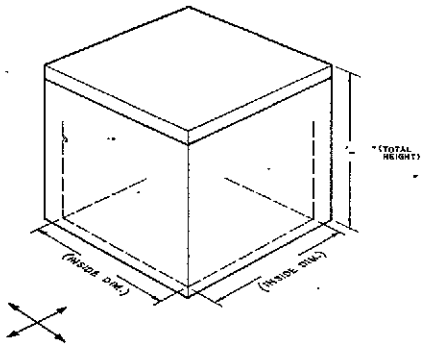
SOLAR ENERGY SYSTEMS
300 Galleria Tower
720 S. Colorado Blvd.
Denver Colorado

SOLARON COLLECTOR & HARDWARE DETAILS

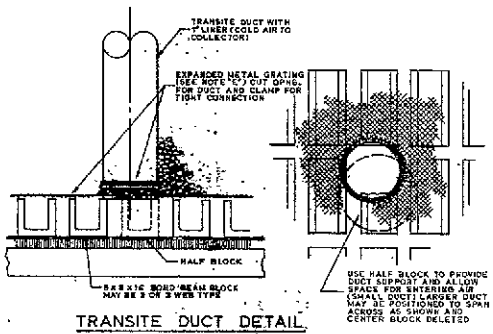
SOLARON

FOLDOUT FRAME 1

FOLDOUT FRAME 2

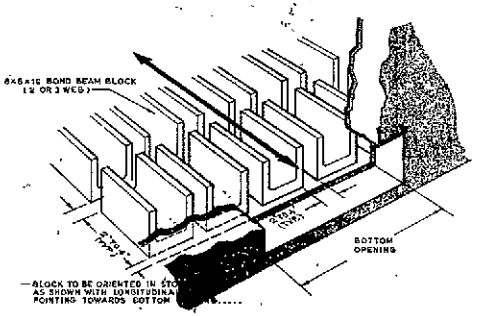


STORAGE BOX OPENINGS

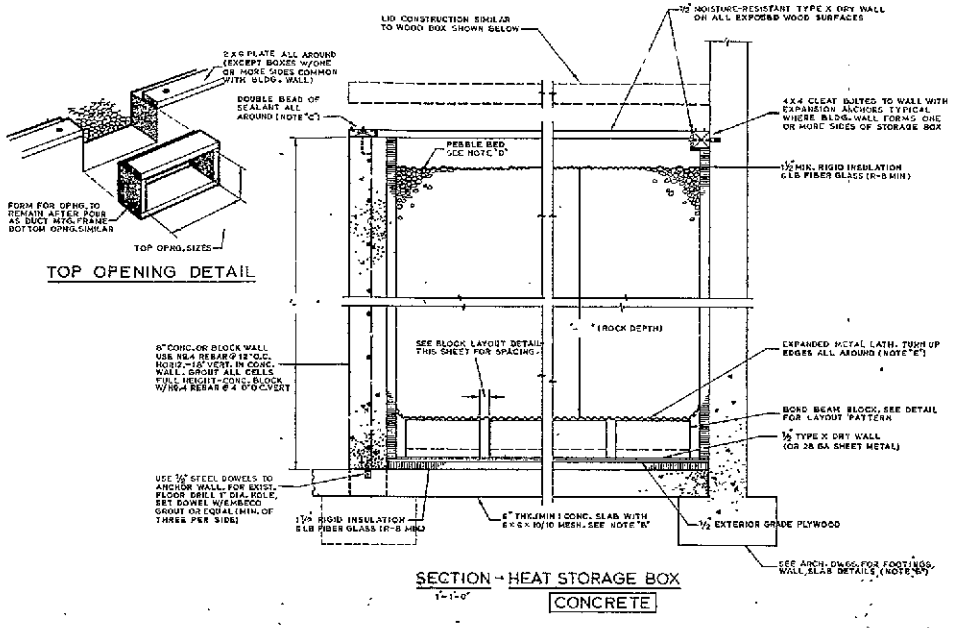


TRANSITE DUCT DETAIL

1"=1'-0"



BLOCK LAYOUT PATTERN

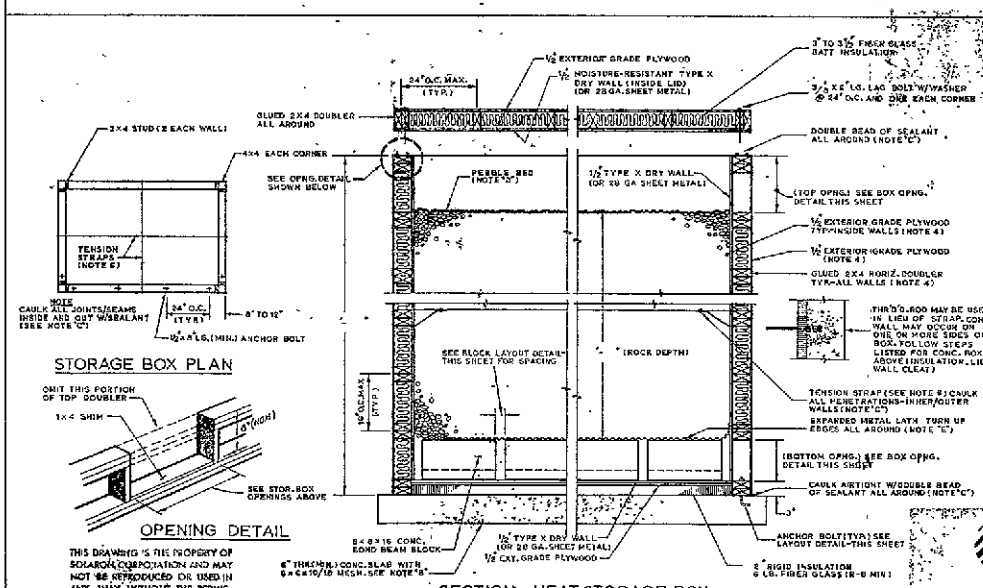


TOP OPENING DETAIL

SECTION – HEAT STORAGE BOX

1"=1'-0"

CONCRETE



STORAGE BOX PLAN

OPENING DETAIL

SECTION – HEAT STORAGE BOX

1"=1'-0"

WOOD

GENERAL NOTES

A. ANY SUBSTITUTION OF MATERIALS, CHANGES OF DIMENSIONS OR CHANGES IN LOCATION OF PEBBLE BIN AS SHOWN MUST BE APPROVED BY SOLARON CORPORATION IN WRITING PRIOR TO START OF CONSTRUCTION.

B. ALL FOOTING AND STRUCTURAL SUPPORTS ARE THE RESPONSIBILITY OF OWNER AND / OR ARCHITECT AND ARE TO BE SIZED ACCORDING TO SOIL REPORT INFORMATION. COORDINATE THIS DWG. WITH ARCHITECTURAL DWGS. FOR TYPE, SIZE AND LOCATION.

C. JOINTS, CRACKS, SEAMS AND PENETRATIONS INSIDE AND OUT IN WALLS, FLOOR AND LID OF BIN TO BE SEALED AIR-TIGHT WITH DOW CORNING #781 OR #732 SILICONE SEALANT CAULK OR APPROVED EQUAL.

D. THE ROCK SHALL BE ROUND WASHED RIVER ROCK NOT OVER 3IN FRACTURED. 80% OF THE ROCK SHALL BE THE SIZE SHOWN BELOW WITH A MINIMUM AMOUNT OF FINES (I.E. LESS THAN ¾" DIAMETER). THE ROCK SHALL BE CLEAN AND FREE OF DIRT.

E. METAL LATH: 3/8 OR DIAMOND MESH 3.4 LB/SQ. YD. (GALVANIZED) ADJOINING PIECES TO BE OVERLAPPED A MIN. OF 10".

F. TREATMENT FOR THE INSIDE SURFACES OF THE BOX SHALL BE SUITABLE FOR TEMPERATURES OF 170 DEGREES F. NO COMBUSTIBLE MATERIAL TO BE USED

G. LID TO BE CONSTRUCTED OF ¼" EXTERIOR GRADE PLYWOOD INSIDE & OUT 2 X 4's - 24" ON CENTERS, AND ½" MOISTURE-RESISTANT-TYPE "X" DRY WALL ON INSIDE SURFACE TOWARD PEBBLES.

CONCRETE CONSTRUCTION

1. WALL CONSTRUCTION TO BE 8" MINIMUM REINFORCED CONCRETE OR 8" MINIMUM CONCRETE BLOCK (SAND OR GRAVEL SUBSTITUTIONS OF OTHER MASONRY MATERIALS CAN BE MADE PROVIDING THEY ARE OF SIMILAR STRENGTH AND INSULATION VALUE)
2. INSULATE INTERIOR SURFACE WITH 1½" RIGID FIBERGLASS BOARD INSULATION (6 LB. DENSITY WITH R-8 MINIMUM). SECURE TO WALL.
3. FORM OUT FOR BOTTOM AND TOP OPENINGS AS REQUIRED FOR A GIVEN APPLICATION WITH 2 X DIMENSION LUMBER WHICH SHOULD BE LEFT INTACT WHEN FORMS ARE REMOVED TO PROVIDE MOUNTING FRAME FOR DUCTWORK.

WOOD CONSTRUCTION

4. WALL CONSTRUCTION TO BE DOUBLE 2 x 4's, GLUED AND NAILED RUNNING HORIZONTALLY 16" O.C. AND END NAILED TO VERTICAL 2x4's (NO TOE-NAILING). VERTICAL 2x4's TO BE GLUED AND NAILED TO 4x4 CORNERS. INLET AND OUTLET OPENING TO BE FRAMED WITH 2x4 BLOCKING, OUTSIDE SHEATHING TO BE INSTALLED AFTER WALL FRAMING IS SET, ANCHORED AND INSULATED AND TO CONSIST OF 1/2" EXTERIOR GRADE PLYWOOD GLUED AND NAILED TO ALL FRAME MEMBERS. INSIDE SHEATHING TO BE 1/2" EXTERIOR GRADE PLYWOOD OVERLAID WITH 1/2" TYPE X DRYWALL (ALL SEAMS TAPED AND FILLED). 28 GA. SHEETMETAL MAY BE SUBSTITUTED FOR THE DRYWALL.
5. INSULATE ALL VOIDS WITH 3" TO 3½" FIBERGLASS BATT INSULATING (R-11 MINIMUM).
6. A TENSION STRAP TO MINIMIZE THE BOWING OF THE CENTER OF WALLS CAN BE EITHER 3000 P.S.I. STEEL BANDING STRAP (3/4" WIDE) WITH DOUBLED WIRE ROPE CLIPS AND TURN BUCKLE, OR 1/2" DIAMETER ROD WITH WASHERS AND DOUBLE NUTS. PRE-TENSION STRAP, CABLE OR ROD UNTIL WALL CENTERS HAVE CONCAVED INWARD APPROXIMATELY 1/8" BEFORE APPLYING SEALANT TO JOINTS
7. SUBSTITUTION OF 2x6's FOR 2x4's IS SATISFACTORY IF INSULATION VALUE OF R-19 IS DESIRED OR IF ADDITIONAL STRENGTH IS REQUIRED FOR WALL SECTIONS.

_____ CUBIC FEET OF ROCK _____ IN. DIAMETER

_____ TONS @ 100 LBS./CUBIC FOOT

STORAGE UNITS THAT ARE LOCATED OUTSIDE OR IN AN UNHEATED AREA SHALL BE INSULATED TO A MINIMUM OF R-30

SOLARON SOLAR ENERGY SYSTEMS

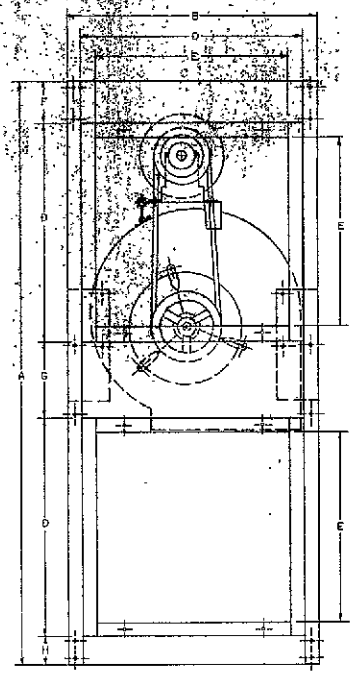
SOLARON CORPORATION
PHONE 303/758-0611

303 GALLERIA TOWER
720 S. COLORADO BLVD.
DENVER, COLORADO 80222

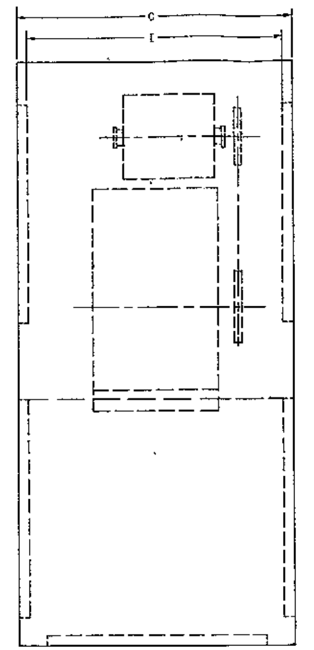
DES. _____ CHD. _____ APP. _____ DATE _____
SCALE _____ DWG. _____ SHEET _____ OF _____

FOLDOUT FRAME 1

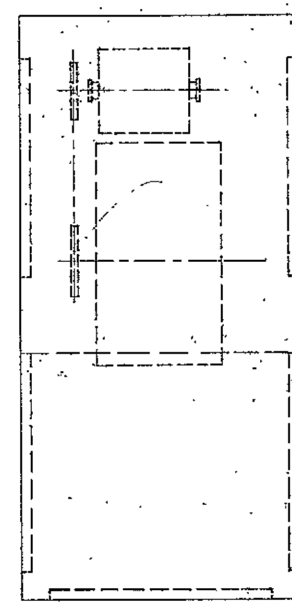
FOLDOUT FRAME 2



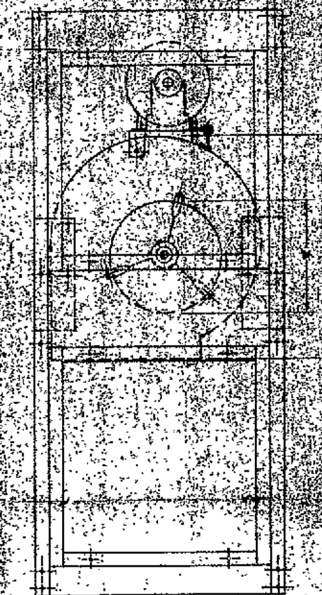
FRONT



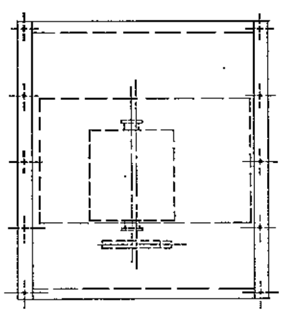
LEFT



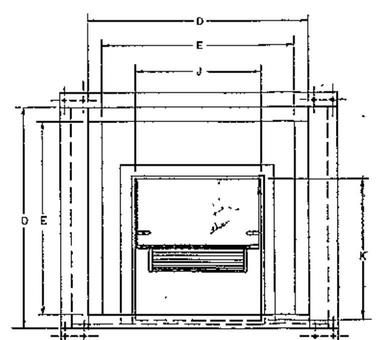
RIGHT



BACK



TOP



BOTTOM

		DESCRIPTION	AU-400	AU-500
CABINET	A	OVERALL HEIGHT	42"	51"
	B	OVERALL WIDTH	18"	24"
	C	OVERALL DEPTH	26"	32"
	D	PANEL OPENING	15-7/8"	19-3/4"
	E	INSIDE CLEAR SPACE BEHIND PANELS	13-7/8"	16-3/4"
	F	UPPER PANEL SPACER	2"	2-1/8"
	G	MIDDLE PANEL SPACER	5-1/8"	6-1/4"
	H	LOWER PANEL SPACER	2-1/8"	3-1/8"
	I	CLEAR SPACE BETWEEN PANELS	10-1/2"	22-1/2"
BLOWER	J	BLOWER OUTLET (HEIGHT)	9-3/8"	12"
	K	BLOWER OUTLET (WIDTH)	10-7/8"	15-5/8"
	L	BLOWER HEIGHT (OVERALL)	15-3/16"	16-3/4"
	M	BLOWER OPENING (INLET)	[illegible]	8-13/16"

UL DATA REQUIREMENTS

SOLARON AIR HANDLER UNIT

MATERIAL SPECIFICATIONS

OUTSIDE & INSIDE PANELS

1. Insulation

Vendor(s) [illegible]
U.L. Number(s) [illegible]
Description [illegible]

2. Adhesive

Vendor(s) [illegible]
U.L. Number(s) [illegible]
Description [illegible]

3. Screws

Vendor(s) [illegible]
U.L. Number(s) [illegible]
Description [illegible]

4. Cabinet

Painted No. 20 ga steel, top, bottom and sides. Sections screwed together with sheet metal screws.

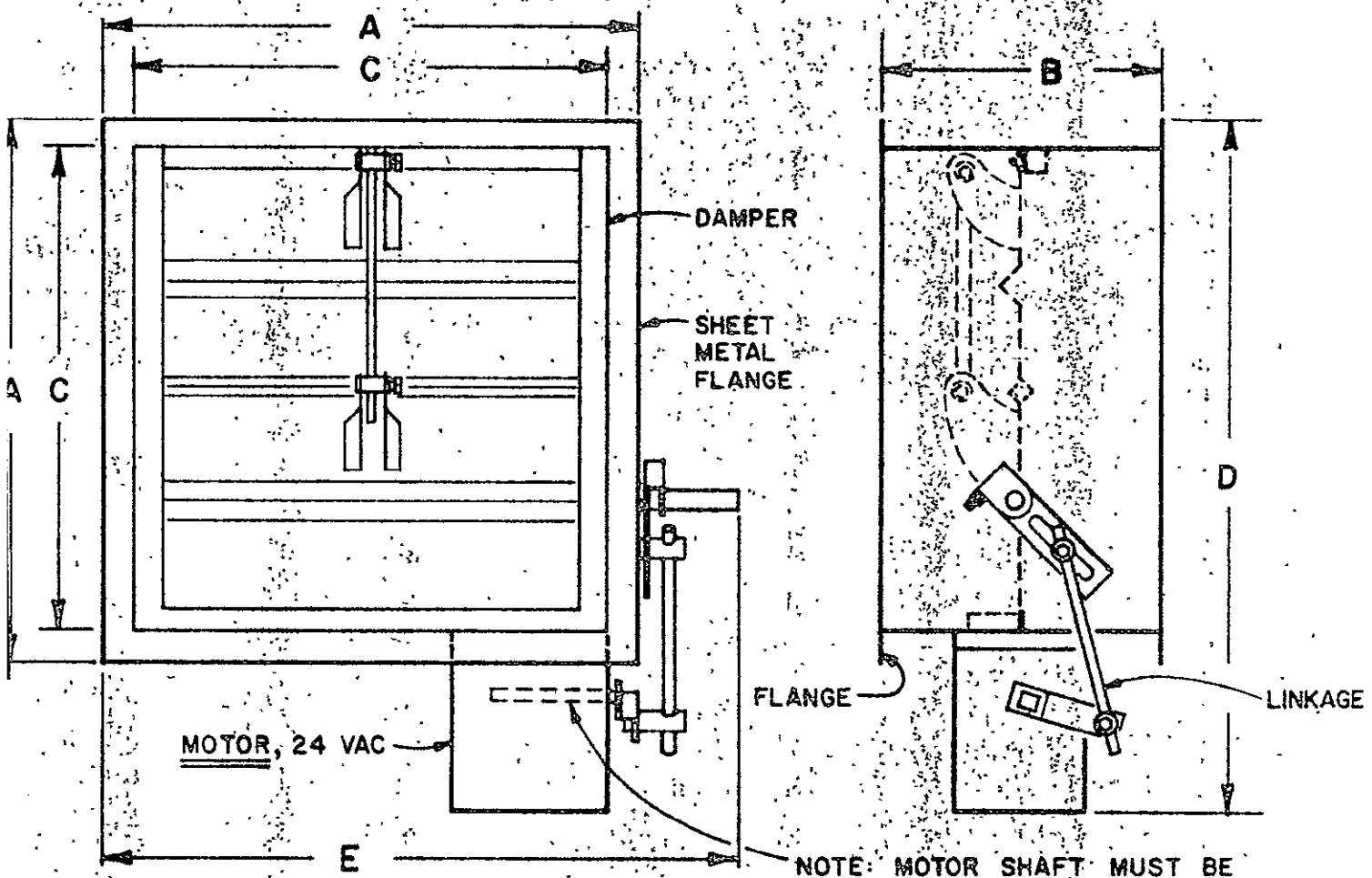
SOLARON SOLAR ENERGY SYSTEMS

SOLARON CORPORATION
PHONE: 303/759-0101
300 GALLERIA TOWER
720 S. COLORADO BLVD.
DENVER, COLORADO 80222

SCALE 1/4" = 1"

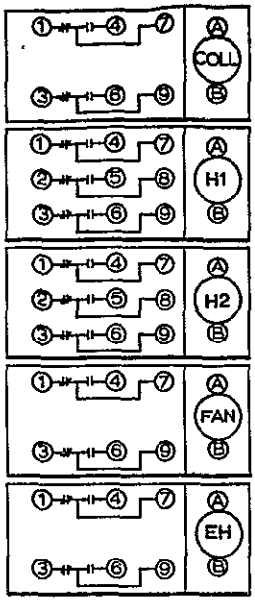
16

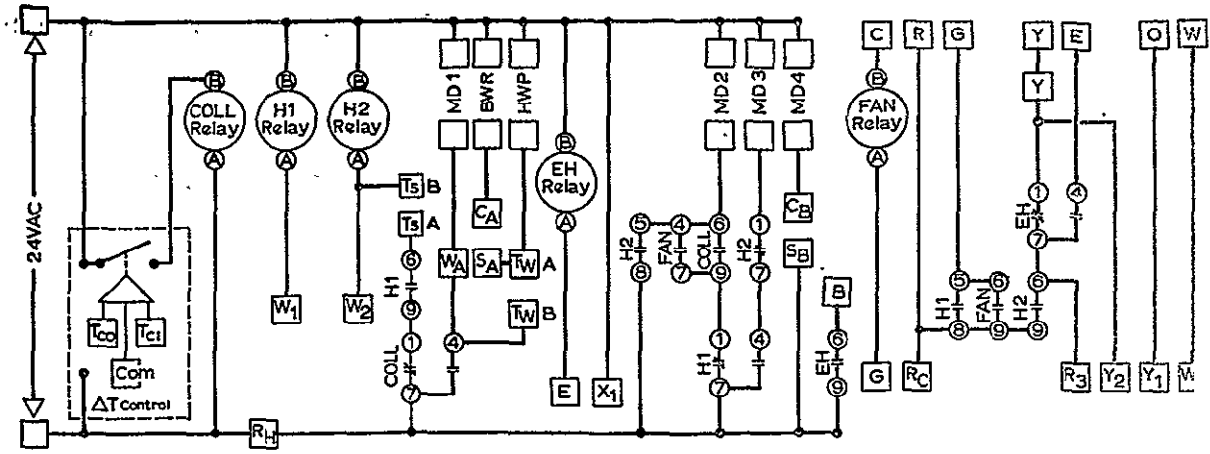
SOLARON MOTORIZED DAMPERS - MD-1, 2, 3



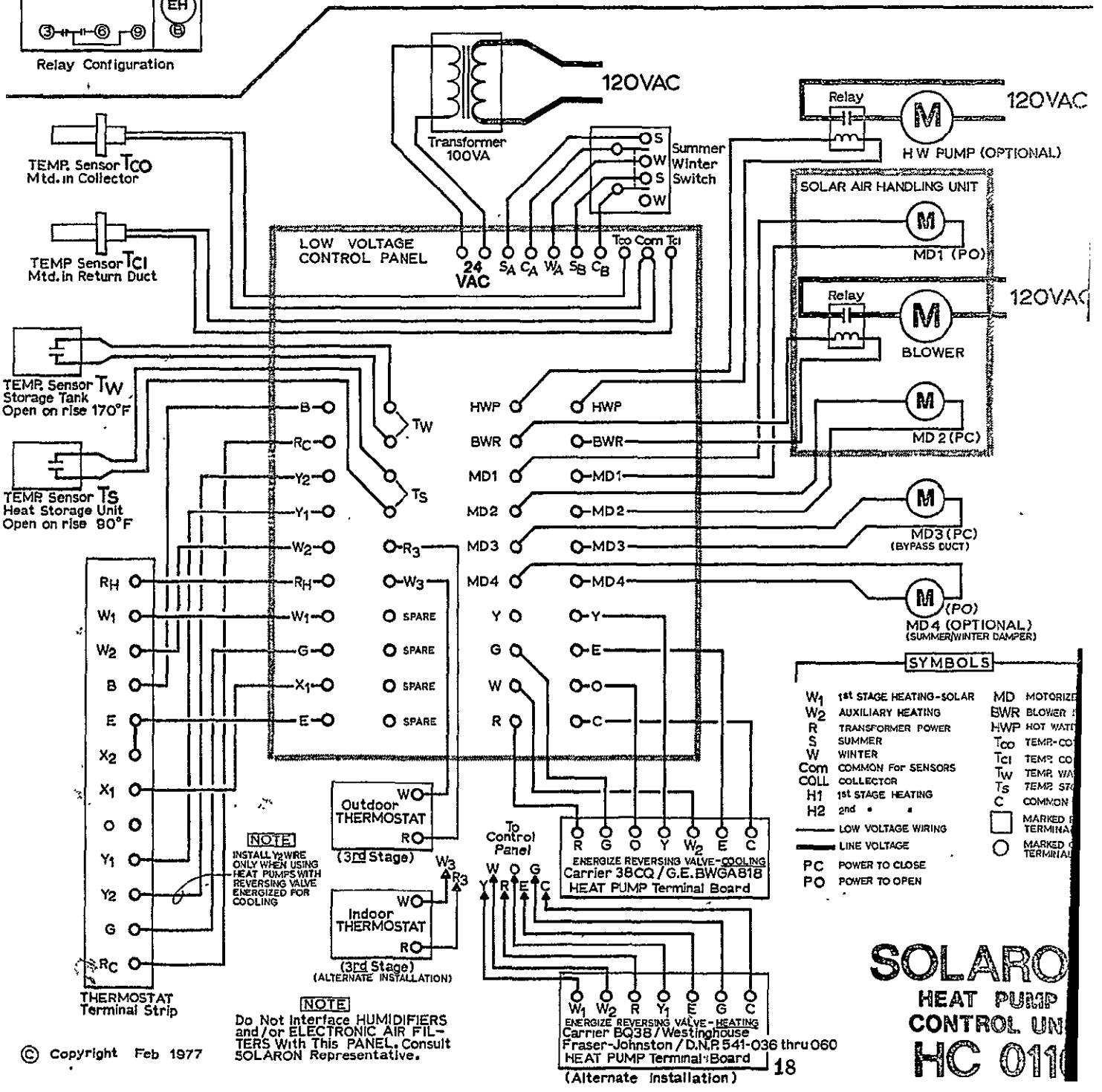
	A	B	C	D	E
AU-0400	16"	8"	14"	20"	19"
AU-0500	20"	10"	18"	23"	23"

DAMPER POSITIONS IN THEIR UNPOWERED CONDITION		
MD-1	NORMALLY CLOSED	POWERED TO OPEN
MD-2	NORMALLY OPEN	POWERED TO CLOSE
MD-3	NORMALLY OPEN	POWERED TO CLOSE





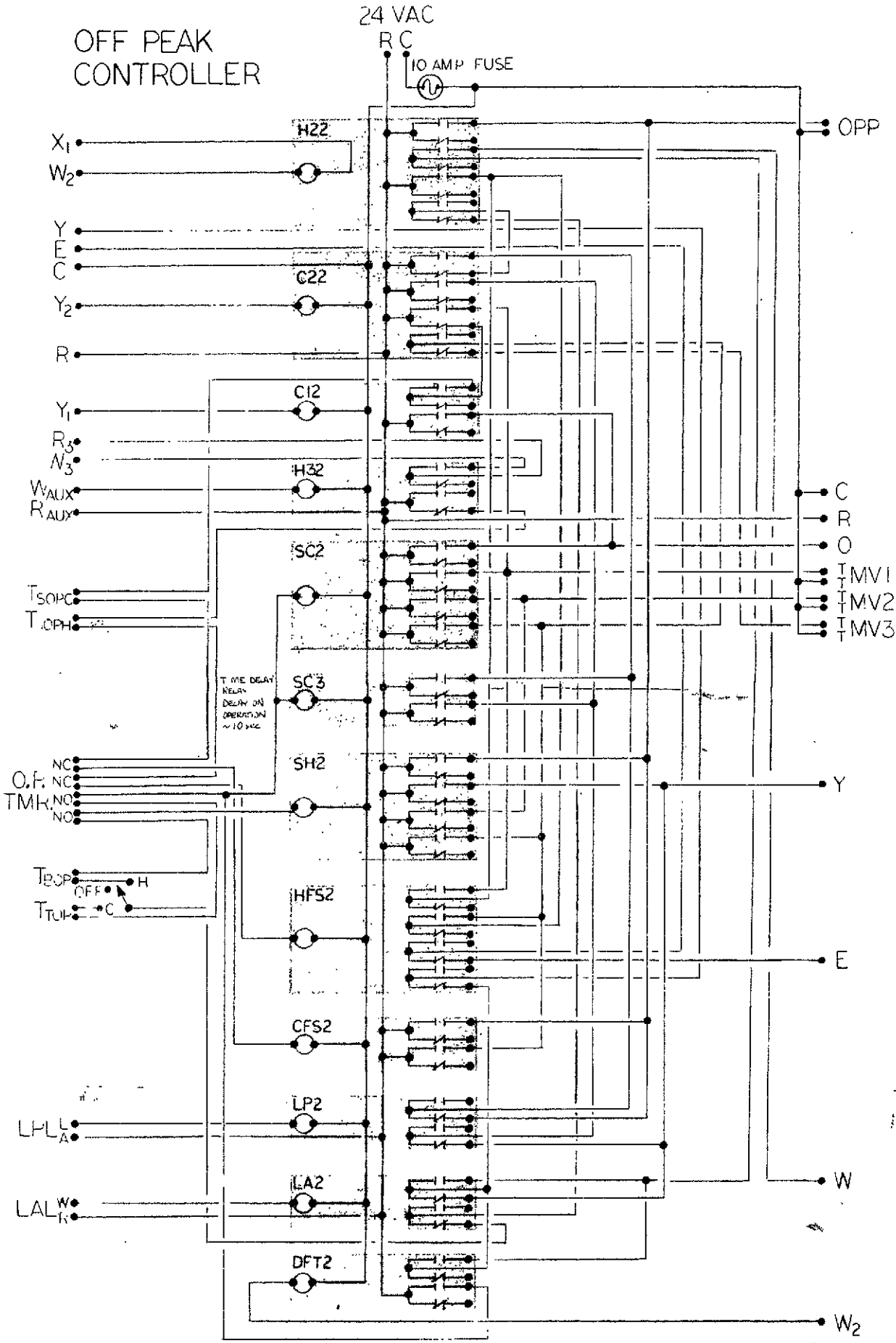
CONTROL PANEL SCHEMATIC

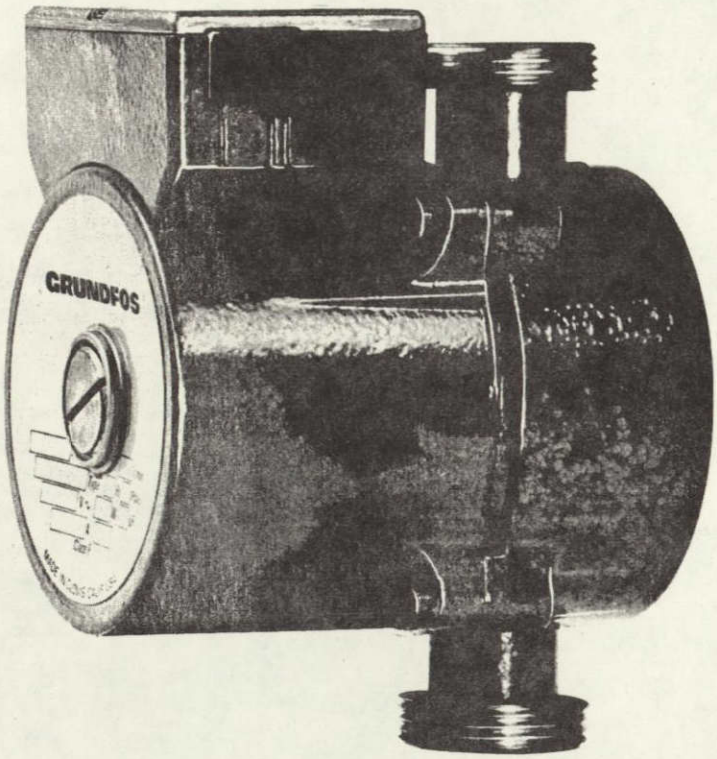


NOTE
INSTALL Y2 WIRE ONLY WHEN USING HEAT PUMPS WITH REVERSING VALVE ENERGIZED FOR COOLING

NOTE
Do Not Interface HUMIDIFIERS and/or ELECTRONIC AIR FILTERS With This PANEL. Consult SOLARON Representative.

SOLARO
HEAT PUMP
CONTROL UN
HC 011


OFF PEAK
CONTROLLER
24 VAC
R C
10 AMP FUSE
FOLDOUT FRAME 1
FOLDOUT FRAME 2
H22
C22
C12
H32
SC2
SC3
SH2
HFS2
CFS2
LP2
LA2
DFT2
X1
W2
Y
E
C
Y2
R
Y1
R3
W3
WAUX
RAUX
TSOPC
TOPH
NC
O.P. NC
TMR. NO
NO
TSOP
TTUH
OFF
H
C
LPL
LAL
OPP
C
R
O
TMV1
TMV2
TMV3
Y
E
W
W2
TIME DELAY RELAY DELAY ON OPERATION ~10 sec
SOLARON
SOLAR ENERGY SYSTEMS
Profit from the sun



INFORMATION: Stainless steel circulator pump — UM 25-18 SU

The UM 25-18 SU is a revolutionary circulator pump. The water passing through the pump touches nothing but high-quality fabricated stainless steel. The volute section, for example, is constructed of type 316 stainless.

CONSTRUCTION

The UM 25-18 SU is a water lubricated pump. However, in order to protect the rotor and bearings from damaging impurities which may be present in the circulating water, they are separated from the stator and the pump chamber by a liquid filled rotor can. The motor shaft extends out from the rotor can, into the pump chamber through the aluminum oxide bearing, which also functions as a seal. During initial operation, the pump is automatically self-vented; however, due to the isostatic principle, there is no further recirculation of water into the closed rotor can.

The pump's "diamond-hard" aluminum oxide bearing construction, combined with the high starting torque of the motor, ensures re-start after shutdown.

MATERIALS

Stainless Steel: ..... Pump chamber, rotor can, shaft, rotor cladding, bearing plate, impeller, thrust bearing cover.

Aluminum oxide: ..... Top bearing, shaft ends, bottom bearing.

Carbon / aluminum oxide: ..... Thrust bearing.

Aluminum: ..... Motor housing, pump housing cover.

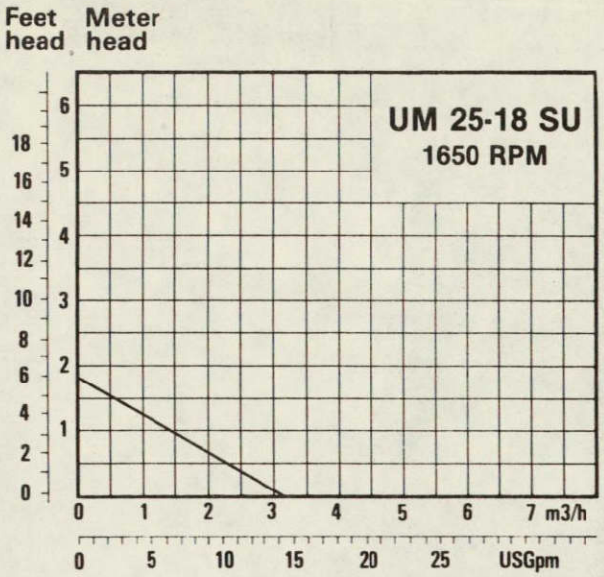
Ethylene / propylene rubber: ..... O-rings, gasket.

Silicon rubber: ..... Winding Protection.

APPLICATIONS

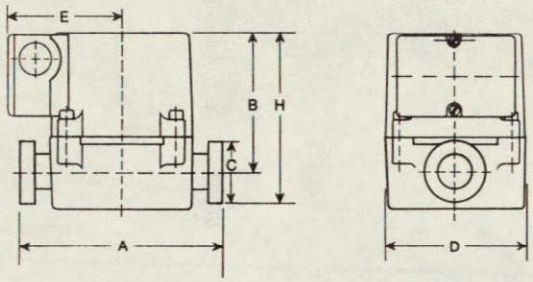
The UM 25-18 SU is particularly suited for open and potable systems. The stainless steel construction protects the pump from the corrosion that has plagued cast-iron and bronze-lined pumps in these types of applications. The pump is intended for circulation and booster applications in domestic water and solar systems.

PERFORMANCE CURVE UM 25-18 SU



The UM 25-18 SU is operated by an energy conserving 1/35th HP (0.66 amp) motor which has built-in overload protection. However, because of advanced engineering design, the pump produces up to 6 feet of head or a flow of up to 14 GPM. The pump's small size and high efficiency make it suitable for many varied applications and greatly reduces installation problems. The UM 25-18 SU is (UL) listed.

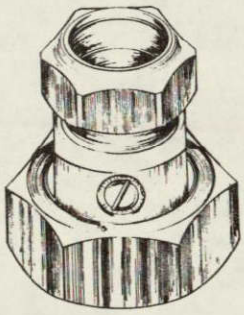
DIMENSIONS UM 25-18 SU



Type	A mm inches	B mm inches	C mm inches	D mm inches	E mm inches	H mm inches	Packing 1 x w x h mm/"	Ship.vol. m^3 Cbft.	Weight Kg Lbs.
UP 25-18 SU	152.4 6"	95.25 3¾	38.1 1½"	106 4⅛"	82 3¼	127 5"	200 x 180 x 160 7⅞ x 7 x 6¼	0.005 ⅕	3 6½

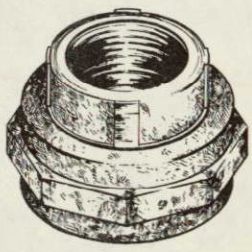
COMPRESSION ISOLATION VALVES

GRUNDFOS recommends the use of isolation valves with circulation pumps in all systems.



THREADED HALF-UNIONS

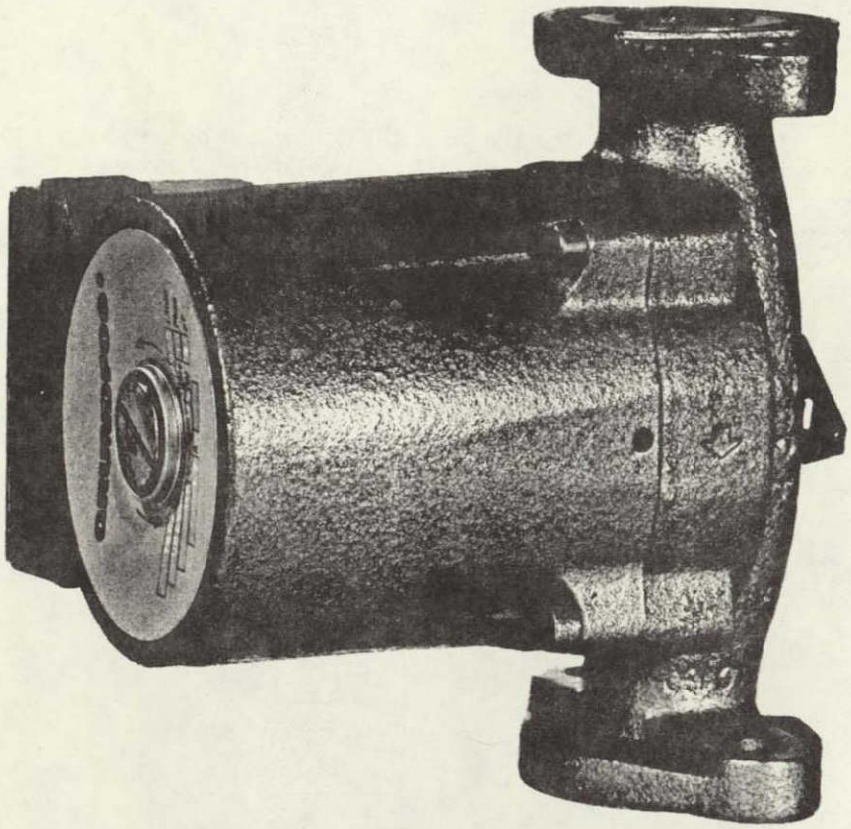
If Isolation Valves are not used, ¾" iron-pipe half-unions are available.



ORDER NUMBERS

		Bronze Valves		Bronze Half-Unions	
Type	Order No.	Dim.	Order No.	Dim.	Order No.
UM 25-18 SU	51.07 43 33	¾"	51.98 43	¾"	52.99 82

GRUNDFOS	VARIABLE HEAD CIRCULATOR PUMP	UP 26-64



INFORMATION Variable Head Circulator Pump – UP 26-64

The UP 26-64 is fitted with variable-head-control. This innovative mechanism, which controls both the head and the flow produced by the pump, allows the installer, by a simple hand adjustment, to precisely match the UP 26-64 to the demands of many varying systems.

CONSTRUCTION

The UP 26-64 is a water lubricated pump. However, in order to protect the rotor and bearings from damaging impurities which may be present in the circulating water, they are separated from the stator and the pump chamber by a liquid filled rotor can. The motor shaft extends out from the rotor can, into the pump chamber through the aluminum oxide bearing, which also functions as a seal. During initial operation, the pump is automatically self-vented; however, due to the isostatic principle, there is no further recirculation of water into the closed rotor can.

The pump's "diamond-hard" aluminum oxide bearing construction, combined with the high starting torque of the motor, ensures re-start after shutdown.

MATERIALS

Stainless steel: ..... Rotor can, shaft, rotor cladding, bearing plate, impeller, variable flow adjustment plate, thrust bearing cover.

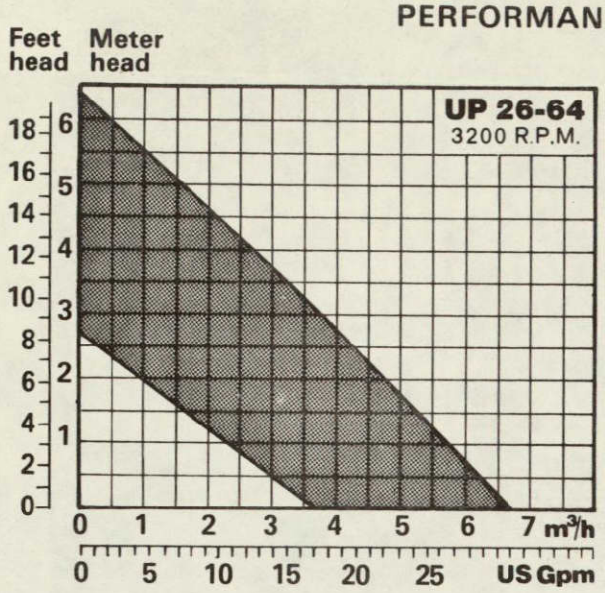
Aluminum oxide: ..... Top bearing, shaft ends, bottom bearing.

Carbon/aluminum oxide: ..... Thrust bearing.
Cast iron ..... Pump housing.
Ethylene/propylene rubber: ..... O-rings, gasket.
Silicone rubber: ..... Winding Protection.

APPLICATIONS

The UP 26-64 should only be used in closed systems (i.e. solar, hydronic). The pump is intended only for the circulation of water. However, solutions such as ethylene glycol can be used without hindering pump performance. For open system applications ask for Grundfos' stainless steel volute circulator pumps.

PERFORMANCE CURVES UP 26-64



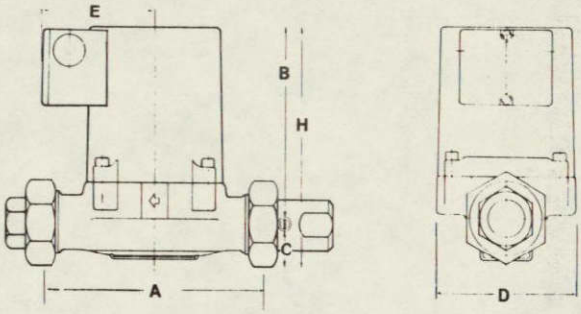
ELECTRICAL AND PERFORMANCE DATA

The UP 26-64 is operated by an energy-conserving 1/12th HP (1.65 amp) motor, which has built-in overload protection. However, because of its advanced design, the pump produces heads from 8 to 20 feet or flows from 16 to 30 GPM. The pump's small size and high efficiency make it suitable for many varied applications and greatly reduces installation problems. The UP 26-64 is (UL) listed.

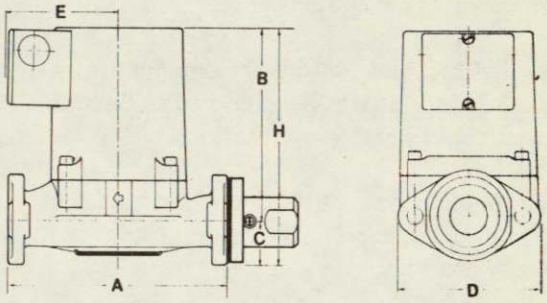
Contact Grundfos for information regarding the complete line of circulator pumps and twin pumps.

DIMENSIONS

UP 26-64 U



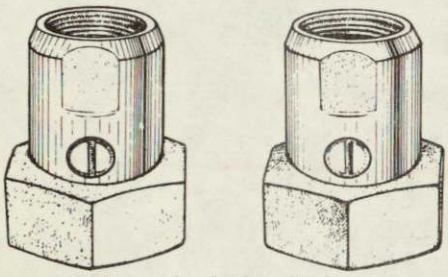
UP 26-64 F



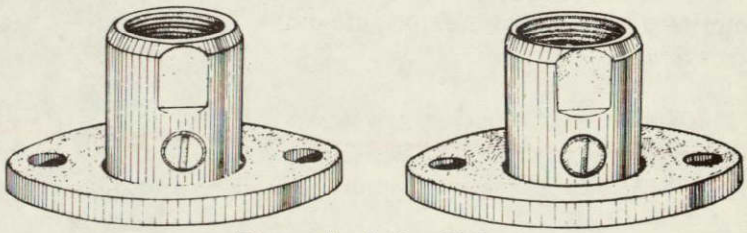
Type	A mm inches	B mm inches	C mm inches	D mm inches	E mm inches	H mm inches	Shipping Carton 1xwxh mm/"	Pack Vol m^3 cb. ft.	Weight kg Lbs.
UP 26-64U with unions	180 7 1/16	129 5 1/16	32 1 1/4	103 4 1/16	81 3 3/16	161 6 5/16	195 x 200 x 200 7 11/16 x 7 7/8 x 7 7/8	0.008 1/4	5.5 12 1/8
UP 26-64F with flanges	165 6 1/2	129 5 1/16	33.5 1 5/16	106 4 3/16	81 3 3/16	162 6 3/8	195 x 200 x 200 7 11/16 x 7 7/8 x 7 7/8	0.008 1/4	5.5 12 1/8

ISOLATION VALVES

GRUNDFOS recommends the use of isolation valves with circulation pumps in all systems.



Union Isolation Valve



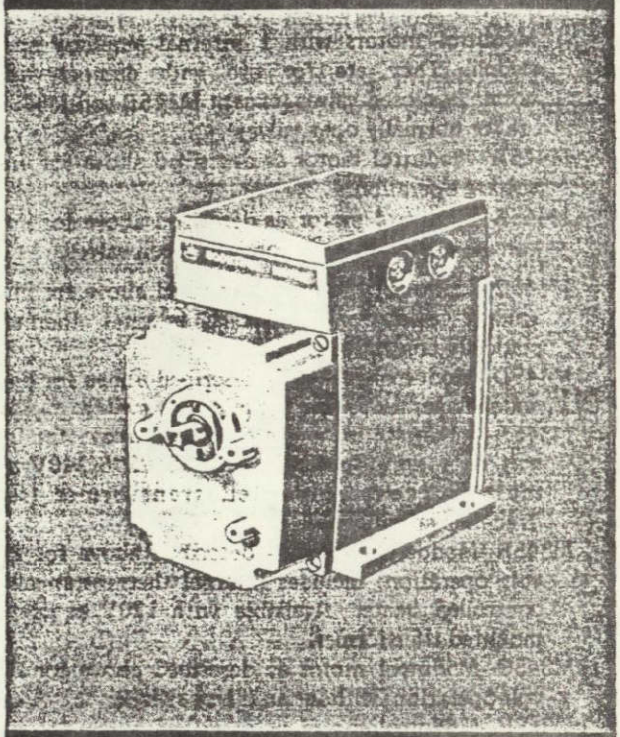
Flange Isolation Valve

ORDER NUMBERS

		Unions		Flanges		Flange Valves Union Valves	
Type	Order No.	Dim.	Order No.	Dim.	Order No.	Dim.	Order No.
UP 26-64F with flanges	52.22 30 13	3/4" 1"	51.95 21 51.95 22	3/4" 1"	51.96 01 51.96 02	1"	51.97 72
UP 26-64U with unions	52.25 20 13			1 1/4" 1 1/2"	51.96 03 51.96 04	1"	51.98 72

Honeywell

MODUTROL MOTORS



M445 A,B,C,D
M845 A,B,C,E

THE M445 AND M845 ARE 2 POSITION, SPRING RETURN MODUTROL MOTORS. THEY ARE USED TO OPERATE DAMPERS OR VALVES IN APPLICATIONS WHERE IT IS NECESSARY OR DESIRABLE TO HAVE THE CONTROLLED ELEMENT RETURN TO THE STARTING POSITION IN THE EVENT OF POWER FAILURE OR INTERRUPTION.

- ☐ The M445 operates on line voltage; the M845 operates on 24V ac.
- ☐ The M445C and M845B are equipped with internal, thermostatically controlled heaters for use in cold weather applications.
- ☐ The M445B and M845E are designed for normally open valves; all other motors are normally closed.
- ☐ All models have a one minute, 160 degree stroke.
- ☐ Sturdy, lightweight, die-cast aluminum case.
- ☐ Integral spring returns motor to normal position when power fails or is interrupted.
- ☐ Built-in spdt adjustable switch is available on some models for the control of auxiliary equipment.
- ☐ Oil immersed gear train assures long life and quiet operation.
- ☐ Full line of accessories includes weatherproofing kit and explosion-proof housing as well as auxiliary switches and a number of linkages.
- ☐ Tradeline M845A includes multitap transformer for 120/208/240V ac control circuits.

S.K.
REV. 7-75 (.025)

Residential Div. Form Number 60-2037–2

SPECIFICATIONS

TRADELINE MODELS

Tradeline models of this device are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Tradeline model specifications are the same as those of standard models except as noted below:

TRADELINE MODELS AVAILABLE: M845A Modutrol Motor–2 position, spring return motor for use with dampers and normally closed valves. An internal spdt switch is provided for actuating auxiliary equipment. Motor operates from 24V ac and includes a cover mounted transformer for 120/208/240V ac control circuits.

ELECTRICAL RATINGS: Voltage and frequency–motor requires 24V ac, 60 Hz. Cover mounted transformer has 120/208/240V ac multitap primary and 24V ac secondary.

ADDITIONAL FEATURES:

- –Multitap transformer for 120/208/240V ac control circuits.
- –Tradeline pack with cross reference label and special instruction sheet.

STANDARD MODELS

MODELS:

The M445 and M845 are 2 position, spring return Modutrol motors with 1 internal auxiliary spdt switch. They are for use with dampers and normally closed valves (except M445B and M845E are for normally open valves).

M445A–Modutrol motor as described above for line voltage operation.

M445B–Modutrol motor as described above for line voltage operation with normally open valves.

M445C–Modutrol motor as described above for line voltage operation. Includes internal thermostatically controlled heater.

M445D–Modutrol motor as described above for line voltage operation; without auxiliary switch.

M845A–Modutrol motor as described above for 24 volt operation. Available with 120/208/240V ac multitap cover mounted transformer (see Tradeline specifications).

M845B–Modutrol motor as described above for 24 volt operation. Includes internal thermostatically controlled heater. Available with 120V ac cover mounted transformer.

M845C–Modutrol motor as described above for 24 volt operation; without auxiliary switch.

M845E–Modutrol motor as described above for 24 volt operation with normally open valves. With 120V ac cover mounted transformer.

ELECTRICAL RATINGS:

MODEL	WATTS	VA	VOLTAGE, AC 50/60 HZ
M445A	17	21	120,208,220[a], 240
M445B	17	21	120
M445C	47[b]	53	120
M445D	17	21	120
M845A[c]	18	21	24
M845B[c]	49[b]	51	
M845C	18	21	
M845E[d]	18	21	

[a]50 Hz only.

[b]Including 30 watts for internal heater.

[c]Available with cover mounted transformer.

[d]Includes cover mounted transformer.

AUXILIARY SWITCH RATING[a] (in amperes):

	120V AC	240V AC
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

[a]Switch rating is for one contact only; if both are used, second contact is rated 40 VA.

(continued on page 3)

ORDERING INFORMATION

WHEN ORDERING REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING SPECIFICATION NUMBER, OR . . .

SPECIFY–

1. MODEL NUMBER, SPECIFY TRADELINE IF DESIRED.
2. VOLTAGE AND FREQUENCY, ON MODELS WITH COVER MOUNTED TRANSFORMER AVAILABLE, SPECIFY WHEN ORDERING.
3. ACCESSORIES, IF REQUIRED.

ORDER FROM–

1. YOUR USUAL SOURCE, OR
2. HONEYWELL
   1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422
   (IN CANADA–HONEYWELL CONTROLS LIMITED
   740 ELLESMERE ROAD
   SCARBOROUGH, ONTARIO)

INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

INTERNAL HEATER THERMOSTAT (M445C, M845B ONLY): Automatically makes at 20 F on temperature fall, breaks at 50 F on temperature rise.

CRANK SHAFT: Double ended shaft, 3/8 inch square.

STROKE: 160 degrees.

DUTY CYCLE: Unlimited.

MAXIMUM OPERATING TORQUE: 50 pound-inches (may be divided between the 2 ends of motor if no more than 25 pound-inches is applied to auxiliary end).

DEAD WEIGHT LOAD ON SHAFT:
Power end–200 pounds.
Auxiliary end–10 pounds.

AMBIENT TEMPERATURE RATING:
Maximum–125 F.
Minimum–15 F (minus 40 F with internal heater).

UNDERWRITERS' LABORATORIES, INC. LISTED: M445A,B,D and M845A,B,E–File No. E4436, Guide No. XAPX. (NOTE: Only motors with line voltage or auxiliary switches require listing.) require listing.)

DIMENSIONS: See Fig. 1.

ACCESSORIES:

Q607 Auxiliary Switch–controls auxiliary equipment as a function of motor position.

Q605 Damper Linkage–connects motor to damper. INCLUDES MOTOR CRANK ARM.

Cover-transformer–die-cast aluminum cover with built-in transformer. Part No. 130810A has 120V ac primary and 24V ac secondary; Part No. 130810B has multitap primary for 120/208/240V ac and 24V ac secondary.

Q601 Linkage–connects Modutrol motor to water or steam valve.

Q100 Linkage–connects Modutrol motor to butterfly valve.

Q618 Linkage–connects Modutrol motor to water or steam valve.

7640JT Weatherproofing Kits–weatherproofs the M445 and M845 Modutrol Motors.

7616BR Motor Crank Arm–included with Q605 but not with motor.

DHE 94 Explosion-proof Housing–encloses Modutrol motor for use in explosive atmospheres. Not for use with Q601 and Q445 Linkages. Order from Crouse Hinds Co. Requires Honeywell 7617DM Coupling.

W859A,B Economizer Controls–provide changeover, mixed air, and minimum position controls. Mounts on top of motor.

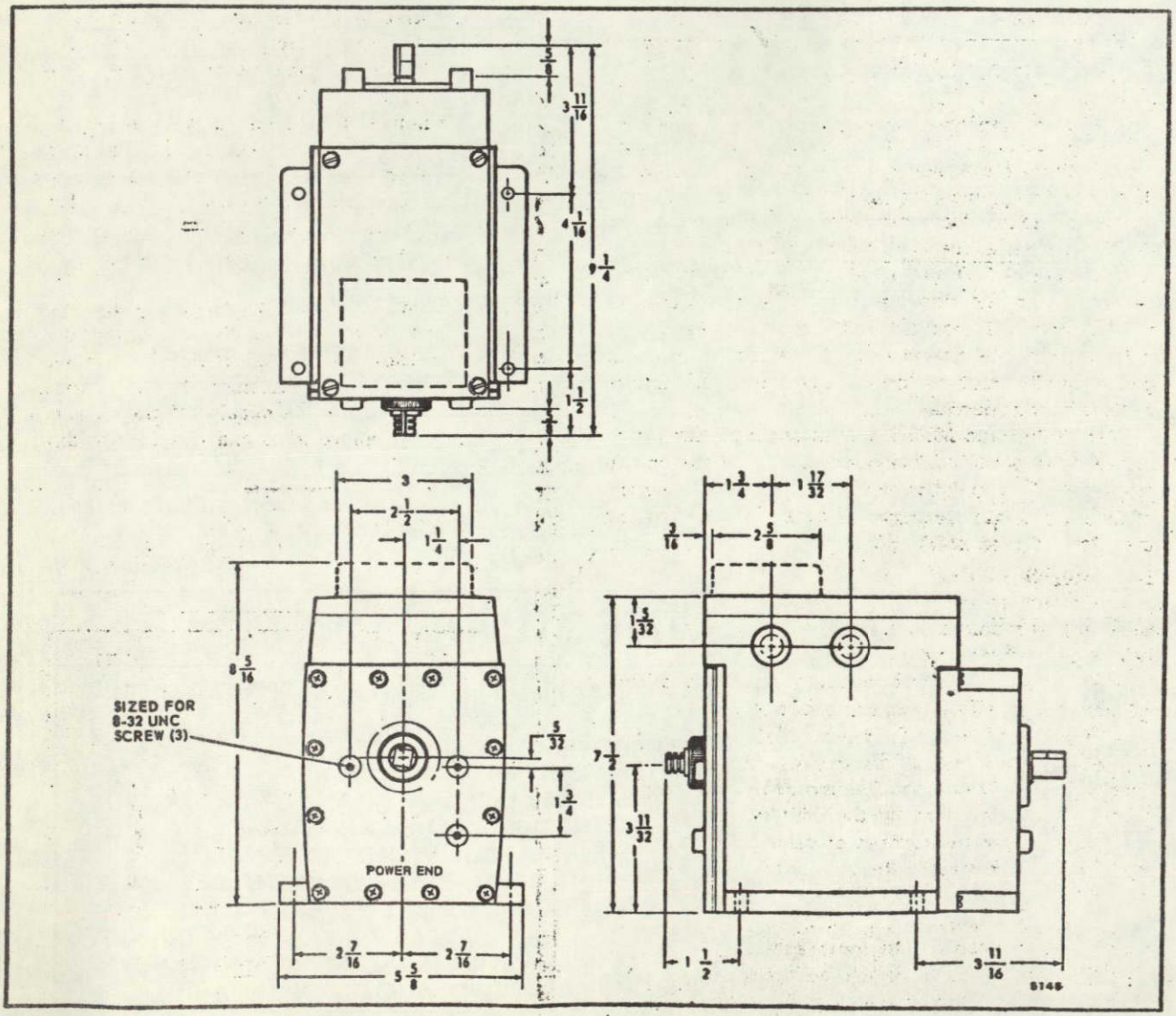


FIG. 1–DIMENSIONS OF M445 AND M845 MOTORS (IN INCHES). BROKEN LINES SHOW ADDITION OF COVER MOUNTED TRANSFORMER.

INSTALLATION

CAUTION

1. Installer must be a trained, experienced serviceman.
2. Disconnect power supply before installation to prevent electrical shock and equipment damage.
3. All wiring must comply with applicable codes and ordinances.
4. Do not exceed the ratings given in the SPECIFICATIONS section.
5. Always conduct a thorough checkout when installation is complete.

LOCATION

Install the Modutrol motor in any location except where acid fumes or other deteriorating vapors might attack the exposed metal parts of the motor or in atmospheres of escaping gases or other explosive mixtures. When choosing a location, allow enough clearance for mounting auxiliary equipment and servicing the motor.

MOUNTING

CAUTION

Do not turn the motor shaft manually or with a wrench as damage to the gear train will result.

The motor has a flange on the bottom for mounting. The mounting holes are sized for 1/4 inch machine screws or bolts. The motor may be mounted in any position as long as the shaft is horizontal.

The M445A,C,D and M845A,B,C are shipped from the factory in the closed position. The closed position is the limit of counterclockwise ↶ rotation, as viewed from the power end of the motor, with the groove in the shaft on top and the flat of the shaft 10 degrees from horizontal.

The M445B and M845E are shipped from the factory in the open position. The open position is the limit of clockwise ↷ rotation as viewed from the power end of the motor, with the groove in bottom of the shaft and the flat of the shaft 10 degrees from horizontal.

LINKAGES

The motor comes without a crank arm. The motor crank arm is included in the Q605 Damper Linkage or may be ordered separately (Part No. 7616BR).

When planning for and installing a motor and linkage, check for the following points of operation.

1. When energized, the motor shaft must be free to travel to the end of its stroke while opening or closing a valve or damper. The motor must be stopped at the end of its stroke by the limit switch and must not be stalled by the damper or valve. This holds true even if the full energized stroke is not required to drive the valve or damper through its required stroke.

2. When de-energized, the spring returns the motor to its starting position. In some applications, it may be desirable to use a shortened stroke to provide additional force with the motor in the de-energized position, as, for example, when holding a damper closed.

In these cases, the linkage may be adjusted so that the damper closes before the motor reaches its internal mechanical limit in the de-energized mode. (Note that this applies to the de-energized mode only; the motor must always be free to travel to end of its stroke when energized.

CAUTION

When shortening the motor stroke in the de-energized position as described above, use extreme care in adjusting the linkage as damage to the linkage or damper may result.

3. Do not exceed load or torque ratings in any application.

WIRING

CAUTION

Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.

All wiring must comply with applicable codes and ordinances. Make sure that the voltage and frequency stamped on the motor correspond to the characteristics of the power supply. Do not exceed switch ratings when wiring auxiliary switches.

Wiring terminals and conduit knockouts are provided for wiring the motor. When wiring, remove top cover by removing 4 screws, replace when wiring is complete. Models with cover mounted transformer have a bracket to support the cover on motor when wiring. Multitap transformers have color-coded leads for wiring the power supply; refer to Fig. 15.

Internal schematics and typical wiring hookups are shown in Figs. 2 to 14. Note that these diagrams for M845 motors show an external transformer. On motors with a cover mounted transformer, the secondary leads are wired to the motor terminals. (If the transformer is not required, remove leads and wire 24V ac directly to the motor.)

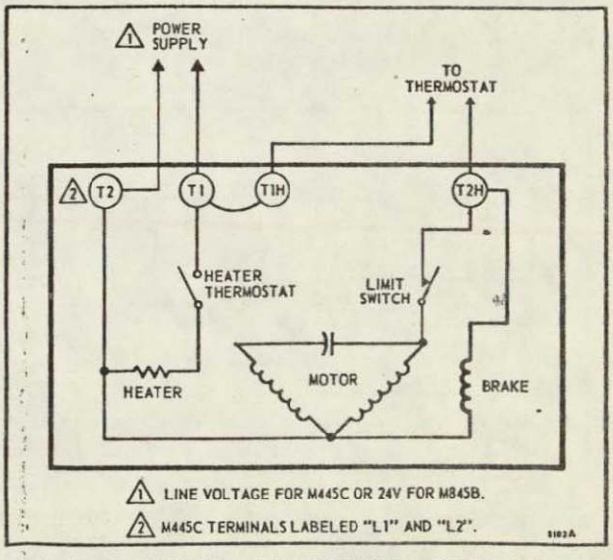


FIG. 2–INTERNAL SCHEMATIC DIAGRAM FOR THE M445C AND M845B WITH INTERNAL HEATER.

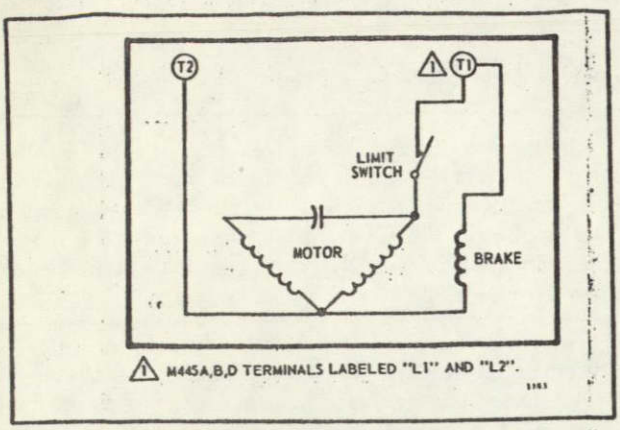


FIG. 3–INTERNAL SCHEMATIC DIAGRAM FOR M445A,B,D AND M845A,C,E.

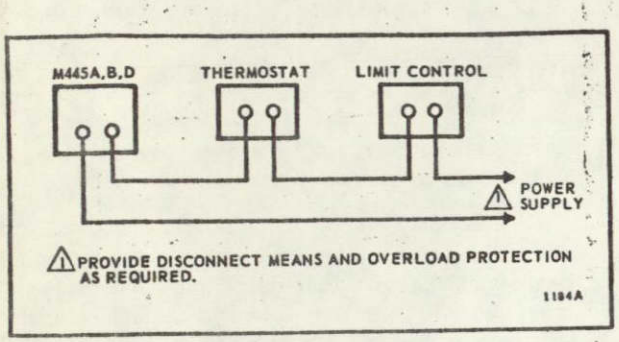


FIG. 4–CONNECTION DIAGRAM FOR M445A,B,D MODUTROL MOTORS.

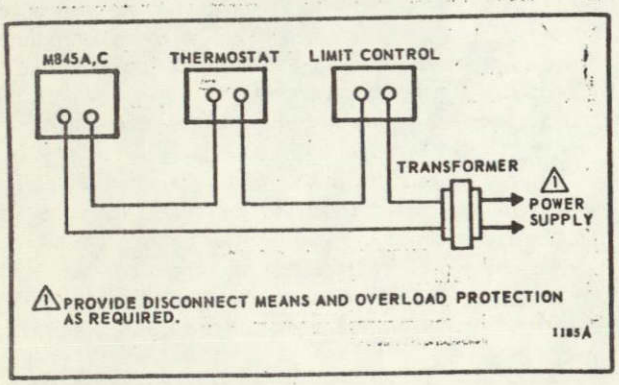


FIG. 5–CONNECTION DIAGRAM FOR M845A,C,E MODUTROL MOTORS.

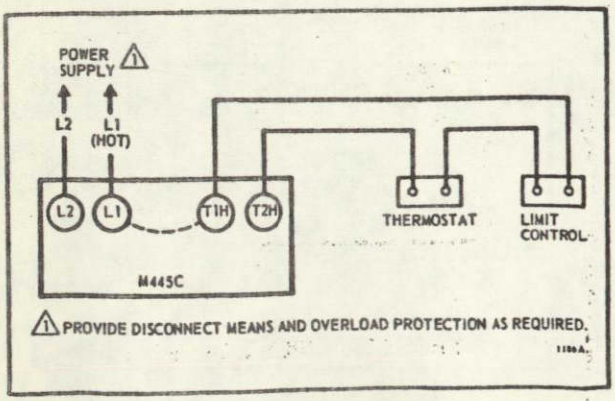


FIG. 6–EXTERNAL CIRCUIT CONNECTIONS FOR THE M445C (WITH INTERNAL HEATER).

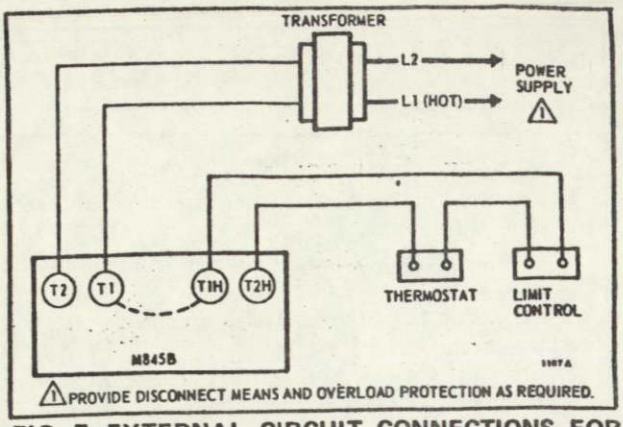


FIG. 7–EXTERNAL CIRCUIT CONNECTIONS FOR THE M845B (WITH INTERNAL HEATER).

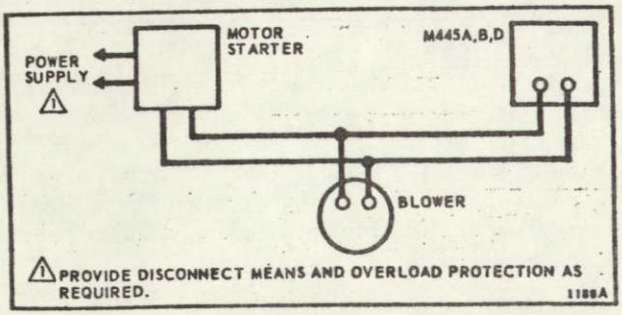


FIG. 8–POWER CONNECTION FOR M445A,B,D MODUTROL MOTORS USED TO CONTROL AIR DAMPERS.

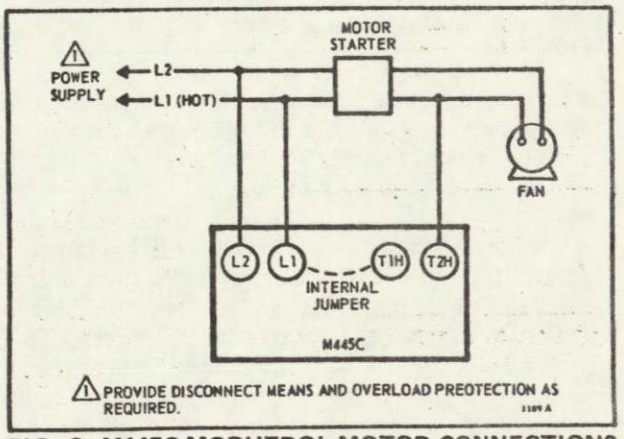


FIG. 9–M445C MODUTROL MOTOR CONNECTIONS WHEN USED TO OPEN A DAMPER ON FAN START. DAMPER CLOSES WHEN FAN STOPS.

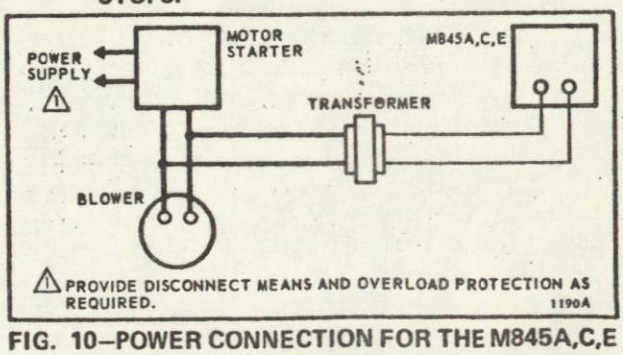


FIG. 10–POWER CONNECTION FOR THE M845A,C,E MODUTROL MOTORS USED TO CONTROL AIR DAMPERS. DAMPERS CLOSE WHEN FAN STOPS.

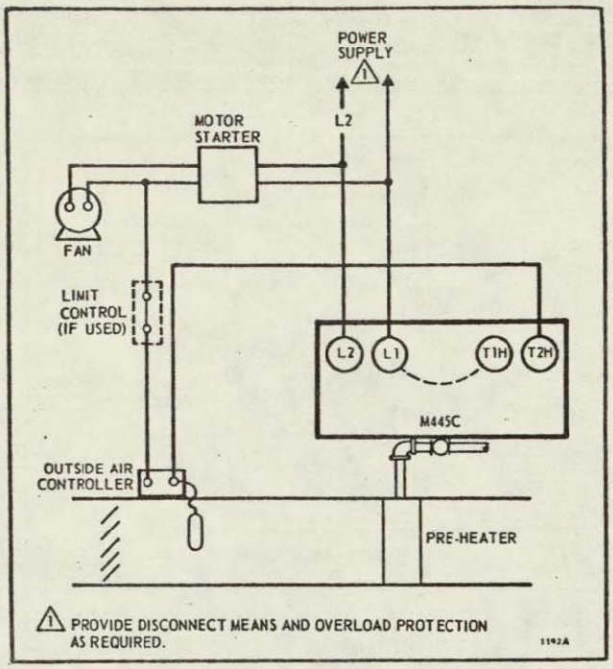


FIG. 11–WIRING DIAGRAM FOR AN M445C MODUTROL MOTOR USED TO CONTROL A PRE-HEATER COIL VALVE.

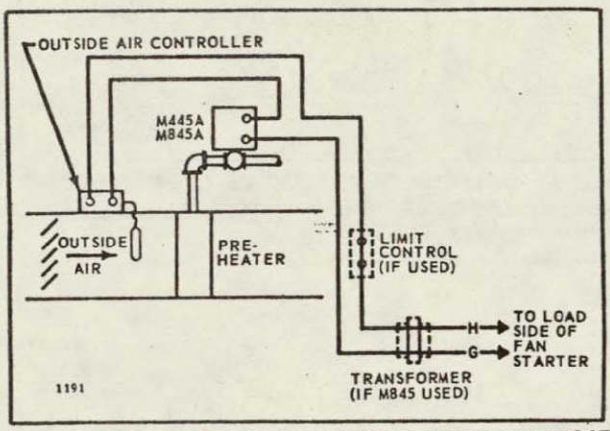


FIG. 12–WIRING DIAGRAM FOR M445 OR M845 WITHOUT INTERNAL HEATER CONTROLLING A PRE-HEATER COIL VALVE.

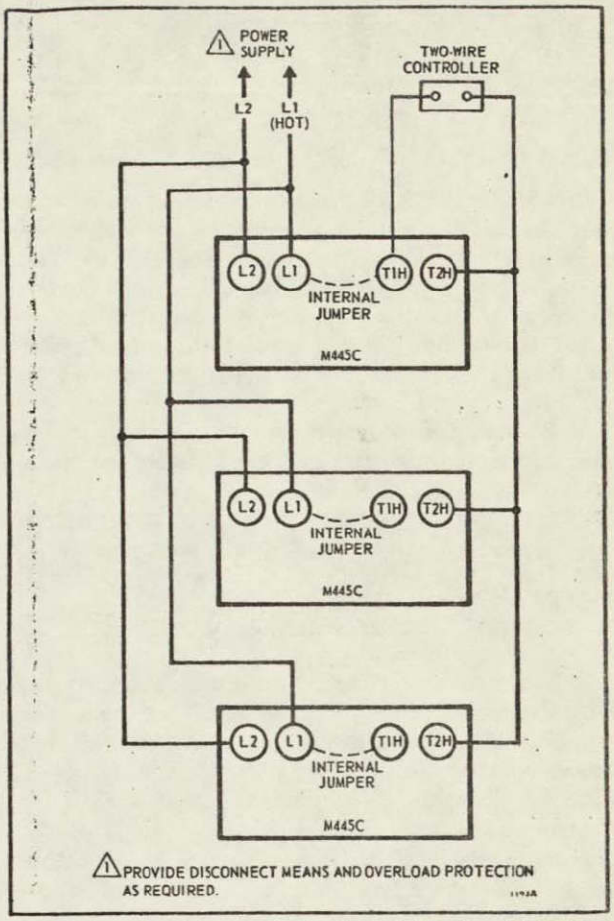


FIG. 13–THREE M445C MODUTROL MOTORS UNDER THE COMMAND OF ONE CONTROLLER.

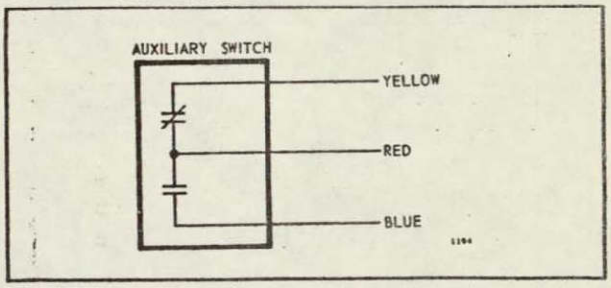


FIG. 14–AUXILIARY SWITCHES USED IN THE M445 AND M845 HAVE COLOR-CODED LEADWIRES.

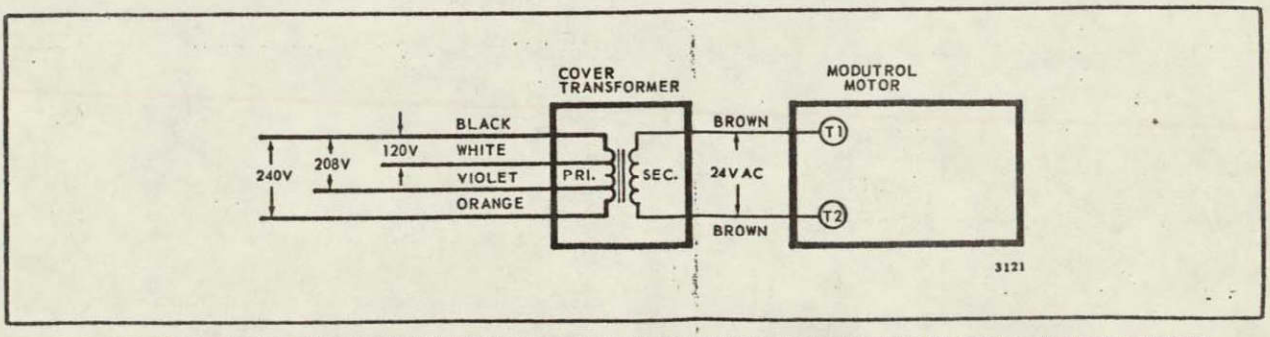


FIG. 15–WIRING DIAGRAM SHOWING COLOR-CODED LEADS FOR POWER SUPPLY CONNECTIONS.

ADJUSTMENTS

AUXILIARY SWITCHES

The M445 and M845 Modutrol Motors have an auxiliary switch that can be adjusted to operate at any point in the stroke of the motor. See Fig. 16. This switch may be adjusted approximately without running the motor by using the following procedure:

1. Remove the "C" clip holding the drive bracket against the spring hub. Take off the drive bracket. Refer to Fig. 18.

2. Remove the 4 screws from the corners of the return spring housing and pull the housing and spring straight out.

CAUTION

Do not attempt to adjust or loosen the locking screw on the differential cam.

3. With the motor in the normal position, loosen the adjustment screw for the operational cam. See Fig. 17. Using the 10-degree marks on the cam and a fixed point such as the cam roller for a guide, rotate the cams clockwise (counterclockwise for normally open motors) through an arc equal to the number of degrees the motor should travel before switch operates. Tighten the operational cam adjustment screw.

4. Replace the spring and return spring housing using the 4 screws removed earlier.

5. Replace the drive bracket and "C" clip.

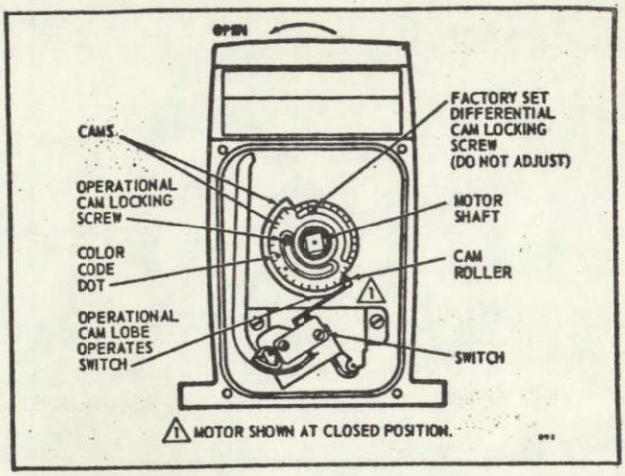


FIG. 16–LOCATION OF AUXILIARY SWITCH IN THE M445 OR M845 MODUTROL MOTOR.

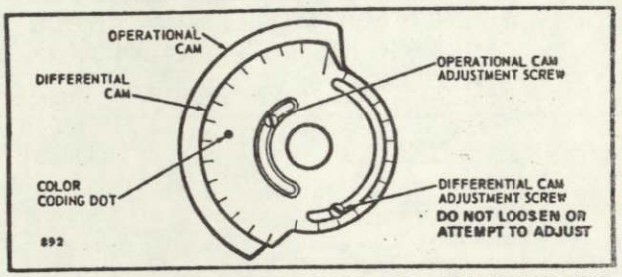


FIG. 17–SWITCH CAM MAY BE ADJUSTED TO OPERATE THE SWITCH DURING ANY PART OF THE STROKE.

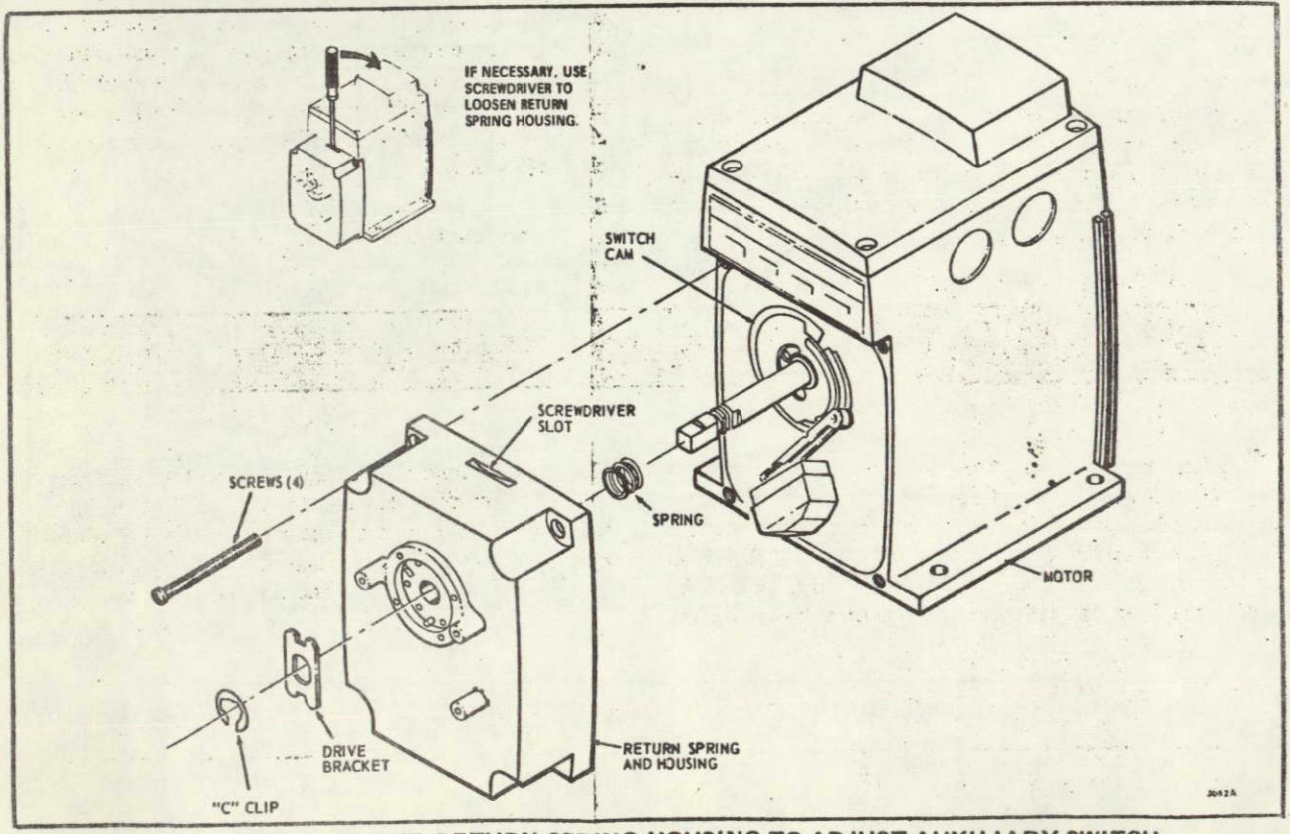


FIG. 18–REMOVING THE RETURN SPRING HOUSING TO ADJUST AUXILIARY SWITCH.

CHECKOUT

After the installation is complete, check the entire system for the following points of operation:

1. Motor operates the load properly.
2. Motor responds properly to the controller.
3. Motor returns to the starting position when power is interrupted.

DAMPER OPERATION

STEP 1

Check the entire motor-damper linkage to see that the mechanical connections are secure and properly made. Make sure the ball joint on the damper crank arm is properly placed to give the required amount of travel.

STEP 2

Energize the motor and run it to the full open position. Check the damper linkage while the motor is running to see that there are no loose or binding connections.

If the motor does not begin to run, check the control circuit for an "open" or "short," the presence of power, and the amount of power available at the motor. (The voltage at the motor must be at least 85 percent of the rated voltage on the nameplate.) Make sure that the maximum net load of the motor is not exceeded.

STEP 3

Interrupt the power to de-energize the motor and allow the spring to return the motor to the starting position. If the motor does not return, check to see that power is actually interrupted and that the return load is not exceeding the rated motor load.

VALVE OPERATION

STEP 1

Check the entire motorized valve assembly to see that the mechanical connections between the motor, linkage, and valve are proper and secure. Make sure that the linkage is adjusted according to the linkage instructions. Leave the cover off the linkage until the checkout is completed.

STEP 2

Make sure that the load does not exceed the motor rating. When using a Q601 Linkage with the motor, lubricate the bearing surfaces to prevent excessive loading. The valve packing must not be too tight. The motor actuating arm must be installed against the shoulder of the motor shaft to prevent binding at the connecting linkage bearings.

STEP 3

Energize the motor by setting the controller so that its contacts close. The motor should start and run smoothly, and the valve stem should move to the opposite end of its stroke. If this is not the case, make sure that there is power to the motor. If there is no power, check the controller circuit for open or short circuits. If the trouble still cannot be found, measure the voltage at the source supply. Line voltage must be at least 85 percent of the rated voltage stamped on the nameplate of the motor.

STEP 4

De-energize the motor by resetting the controller so its contacts open, or remove one of the wires from a controller terminal. Spring power should return the valve to its normal position. If this does not happen, check the linkage for binding or in the case of normally closed valves, check for fluid pressure in excess of the close-off rating.

STEP 5

Replace the linkage cover.

OPERATION

In an operational circuit, a single-pole, single-throw controller (line voltage for M445 or low voltage for M845) is wired in series with the motor circuit. When the controller switch closes, the motor is energized and runs to the end of its stroke. At this point, the limit switch is opened and the motor is de-energized. The brake solenoid is energized, however, and remains so as long as the controller is closed. The brake holds the motor in the open position until the controller opens. At this point the brake is released and the spring on the motor returns it to the starting position.

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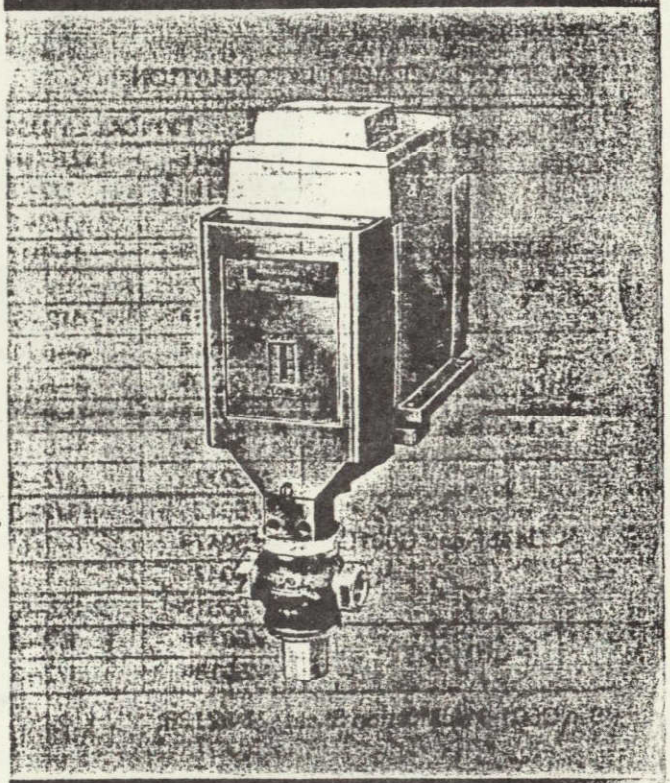
Honeywell

VALVE LINKAGE



Q618A

THE Q618 VALVE LINKAGE CONNECTS A MODUTROL MOTOR TO A 2- OR 3-WAY VALVE. IT IS USED ON HONEYWELL STEAM AND WATER VALVES HAVING A 3/4 INCH [19 MM] STROKE AND A 1-3/8 INCH [35 MM] BONNET, SUCH AS THE V5011 OR V5013.

- Linkage requires no adjustment for use on either 2- or 3-way valves.
- Linkage mounts easily on Modutrol motors and valves.
- Requires no adjustment, either at installation or later.
- Small, lightweight unit requires little space on the installation.
- Available with either 80 or 160 pound seal-off force.

S.K.
REV. 8-75 (.012)

Residential Div. Form Number 60-2039-2

SPECIFICATIONS

TRADELINE MODELS

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

TRADELINE MODELS:
Q618A Valve Linkage with 80 or 160 lb. seal-off force on valve stem.

ADDITIONAL FEATURES: Tradeline pack with cross reference label and special instruction sheet.

STANDARD MODELS

MODEL: Q618A Valve Linkage.
STROKE: 3/4 inch [19 mm], fixed.
SEAL-OFF FORCE ON VALVE STEM: 80 or 160 pounds.
VALVE BONNET SIZE: 1-3/8 inches [35 mm].
TEMPERATURE RATINGS: Limited only by temperature rating of valve and motor.

WEIGHT: 3-1/2 pounds.
MOTOR REQUIRED:
160 pound–M944, M644, M941.
80 pound–M945, M445, M845, M934, M634.
MOTOR STROKE: 160 degrees–normally open or normally closed.
DIMENSIONS: See Fig. 1.

LINKAGE REPLACEMENT INFORMATION:

OLD LINKAGES	TYPICALLY USED ON–		REPLACEMENT LINKAGES	
	VALVE	SIZE IN INCHES [MM]	STANDARD	TRADELINE
Q455C and Q601D	V5011	1/2–3 [12.5–76]	Q618A1008	Q618A1024
	V5013	1/2–3 [12.5–76]	Q618A1008	Q618A1024
	V5047[a]	1–1-1/2 [25.5–38]	Q601K1003	–
	V5047	2 [51]	Q618A1008	Q618A1024
	V5051[a]	2-1/2–6 [63.5–152.5]	Q601K1003	–
Q455D	V5011[a]	4–6 [101.5–152.5]	Q601E1000	–
	V5013[a]	4–6 [101.5–152.5]	Q601E1000	–
Q455E and Q601H	V5011[a]	4–6 [101.5–152.5]	Q601F1009	–
	V5013[a]	4–6 [101.5–152.5]	Q601F1009	–
Q445F and Q601G	V5011	1/2–3 [12.5–76]	Q618A1016	Q618A1032
	V5013	1/2–3 [12.5–76]	Q618A1016	Q618A1032
	V5047[a]	1–1-1/2 [25.5–38]	Q601L1002	–
	V5047	2 [51]	Q618A1016	Q618A1032
	V5051[a]	2-1/2–6 [63.5–152.5]	Q601L1002	–
Q455G	V5011[a]	1/2–3 [12.5–76]	Q601M1001	Q601M1019
	V5013[a]	1/2–3 [12.5–76]	Q601M1001	Q601M1019

[a]See Q601 Specification Sheet, 71-92136.

(continued on page 3)

ORDERING INFORMATION

WHEN ORDERING REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING SPECIFICATION NUMBER, OR

SPECIFY—
1. MODEL NUMBER, SPECIFY TRADELINE IF DESIRED.
2. SEAL-OFF FORCE.

ORDER FROM—
1. YOUR USUAL SOURCE, OR
2. HONEYWELL
1885 DOUGLAS DRIVE NORTH
MINNEAPOLIS, MINNESOTA 55422
IN CANADA–HONEYWELL CONTROLS LIMITED
740 ELLESMERE ROAD
SCARBOROUGH, ONTARIO
INTERNATIONAL SALES AND SERVICE OFFICES
IN ALL PRINCIPAL CITIES OF THE WORLD.

INSTALLATION

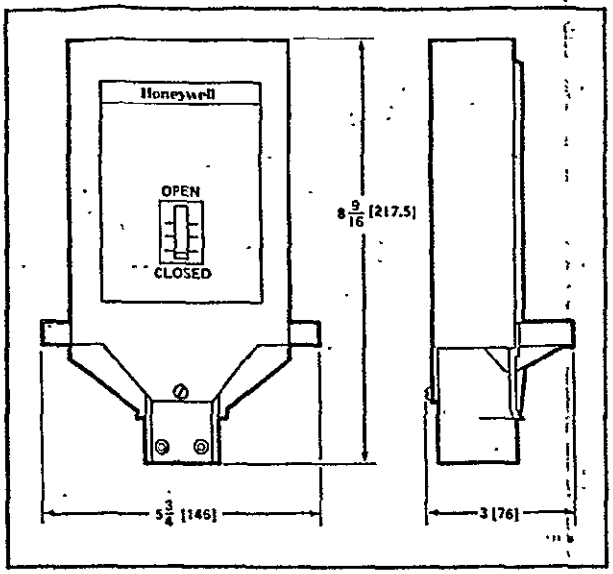


FIG. 1–Q618 INSTALLATION DIMENSIONS, IN INCHES [MILLIMETERS SHOWN IN BRACKETS].

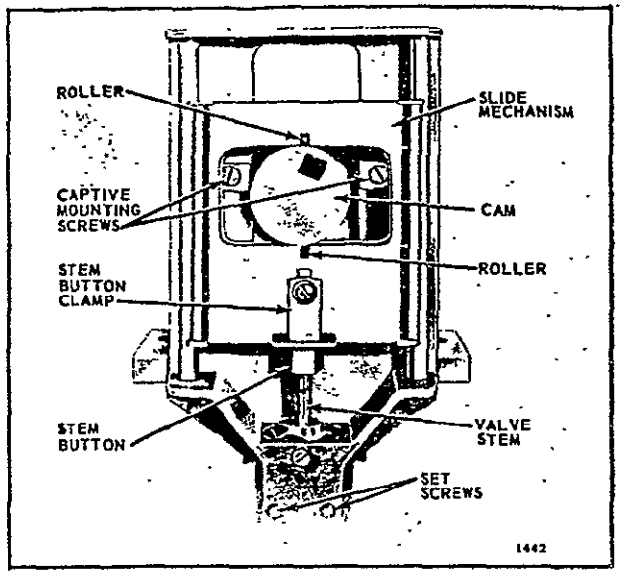


FIG. 2–INTERNAL PARTS OF THE Q618 VALVE LINKAGE.

CAUTION

1. Installer must be a trained, experienced serviceman.
2. Disconnect power supply before beginning installation.
3. Always conduct a thorough checkout when installation is complete.

The Q618A mounts on the power end of a Modutrol motor. The linkage and motor can be rotated 360 degrees around the valve stem. The motor, however, must be installed with the shaft in a horizontal position.

Refer to the instructions packed with the valve for information on valve installation.

Wiring diagrams and other motor installation information are found in the appropriate motor instruction sheet.

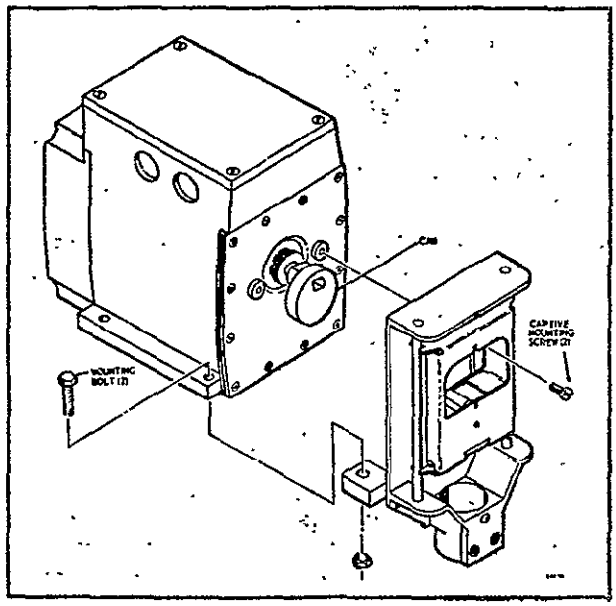


FIG. 3–ASSEMBLY OF THE Q618 VALVE LINKAGE TO A MODUTROL MOTOR.

MOUNT LINKAGE ON MOTOR

1. Remove the cover from the linkage.
2. Mount the cam on the shaft at the power end of the motor. Note that the key on the cam must fit into the keyway on the motor shaft.
3. Use the 2 bolts provided to fasten the linkage to the base of the motor. Note that the slide mechanism will have to be compressed slightly to fit over the cam. Put the nuts on these bolts, but leave them slightly loose (Figs. 2 and 3).
4. Fasten the linkage to the motor with the 2 captive self-tapping screws in the linkage.
5. Tighten the 2 machine bolts (step 3 above).

MOUNT LINKAGE AND MOTOR ON VALVE

CAUTION

Make sure nut on valve stem is tight.

1. Remove the stem button clamp.
2. Loosen, if necessary, the 2 setscrews and slide the linkage over the valve bonnet (Fig. 4).
3. Tighten the 2 setscrews to secure the linkage and motor to the valve.

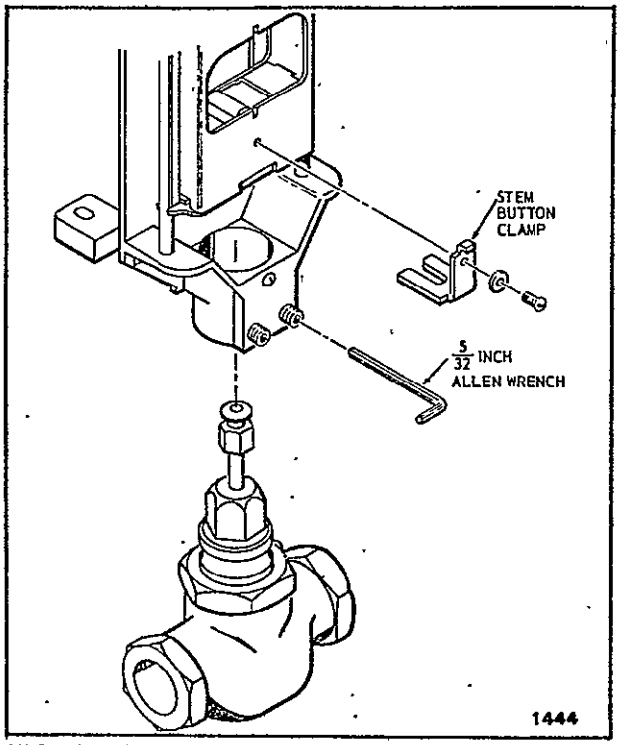


FIG. 4—ASSEMBLY OF THE LINKAGE TO THE VALVE.

CONNECT VALVE STEM TO LINKAGE

NORMALLY CLOSED MOTORS

1. Place a heavy duty screwdriver under the linkage slide and into the slot in the back of the linkage (Fig. 5).
2. Use the screwdriver as a lever to force the slide mechanism up (compressing the tension relief spring) until the stem button clamp can be fully inserted into its slot.
3. Replace and tighten the stem button clamp screw.
4. Replace the cover on the valve linkage.

NORMALLY OPEN MOTORS

1. Place a heavy duty screwdriver between the slide mechanism and the top of the linkage frame.
2. Use the screwdriver as a lever to force the slide mechanism down until the stem button clamp can be fully inserted into its slot.
3. Replace and tighten the stem button clamp screw.
4. Replace the cover on the valve linkage.

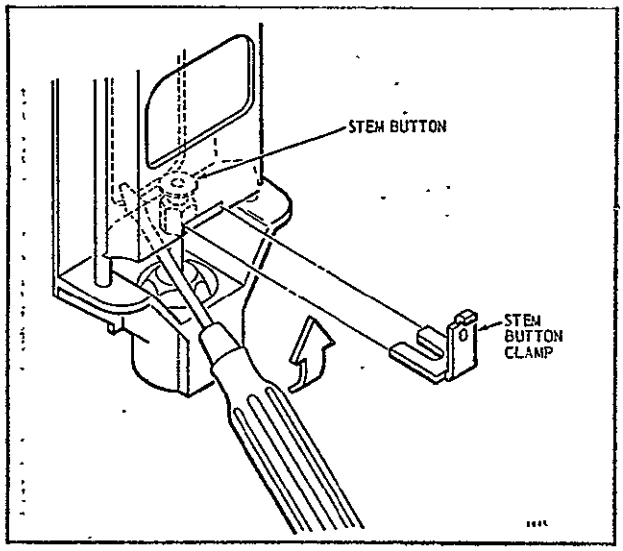


FIG. 5—THE STEM BUTTON CLAMP FASTENS THE VALVE STEM TO THE LINKAGE SLIDE MECHANISM.

CHECKOUT

After installation has been completed, the motor linkage, and valve should be checked for the following points of operation.

1. Motor should be free to run through its complete stroke.
2. The linkage should work freely without binding.
3. The valve must close off tightly at the bottom of its stroke (both ends of stroke for 3-way valve). Check for at least 1/32 [.8 mm] deflection of the roller bracket in closed position (Fig. 6).

Refer to the motor instructions for motor checkout procedure.

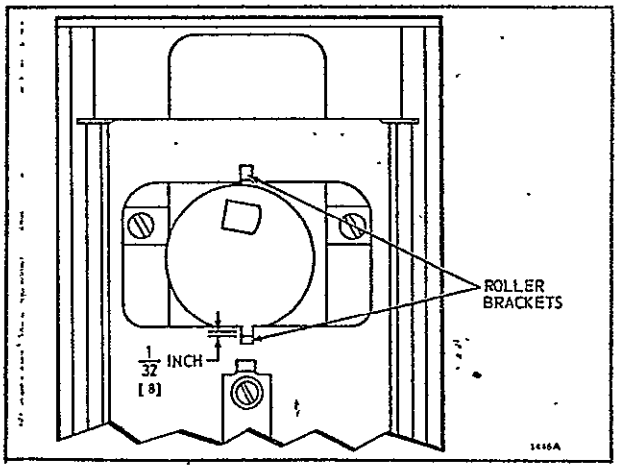


FIG. 6—FOR TIGHT CLOSE-OFF, THE ROLLER BRACKET ON THE LINKAGE MUST BE DEPRESSED AT LEAST 1/32 INCH [.8 MM] AT THE END OF THE MOTOR'S STROKE.

LUBRICATION

The Q618 Valve Linkage was lubricated at the factory and should require no additional lubrication at the time of installation. For optimum performance, the slide mechanism rollers may be lubricated yearly with a good grade of cup grease.

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HONEYWELL **TRADELINE** CONTROLS

V5013A
THREE-WAY MIXING VALVE

APPLICATION

The V5013A Three-Way Mixing valve is used to control hot and cold water.

The V5013A requires either a Q601 or Q618 Linkage and a Modutrol Motor to form a motorized valve assembly.

The Tradeline valve will replace existing V5013A Valves with the same flow coefficient, Cv.

GENERAL SPECIFICATION THREE-WAY MIXING VALVE BODY[a]

VALVE SIZE (INCHES)	CAPACITY INDEX (C_v)	MAXIMUM PRESSURE DIFFERENTIAL FOR NORMAL LIFE OF DISC AND SEAT	PACKING LIMITATIONS		MAX. TEMP. DIFFERENTIAL IN ALTERNATE HOT-COLD USE
			TEMP. LIMITS OF CONTROLLED LIQUID	PRESS. LIMITS OF CONTROLLED LIQUID (GAUGE)	
1/2	2.5 or 4.0	20 psi	Max. 240 F Min. 40 F	150 psi	140 F
3/4	6.3				
1	10.0				
1-1/4	16.0				
1-1/2	25.0				
2	40.0				

[a]Mixing valves are designed for mixing applications, and are not suitable for diverting applications.

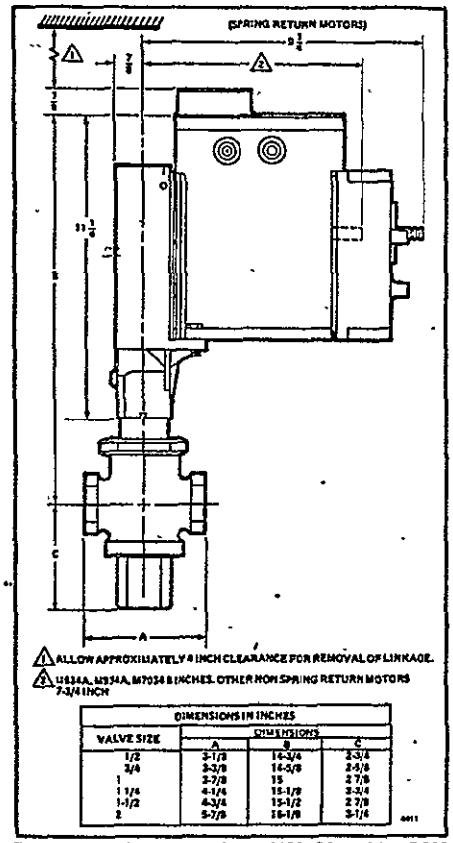

Fig. 1—Mounting dimensions V5013A with Q618 Linkage.

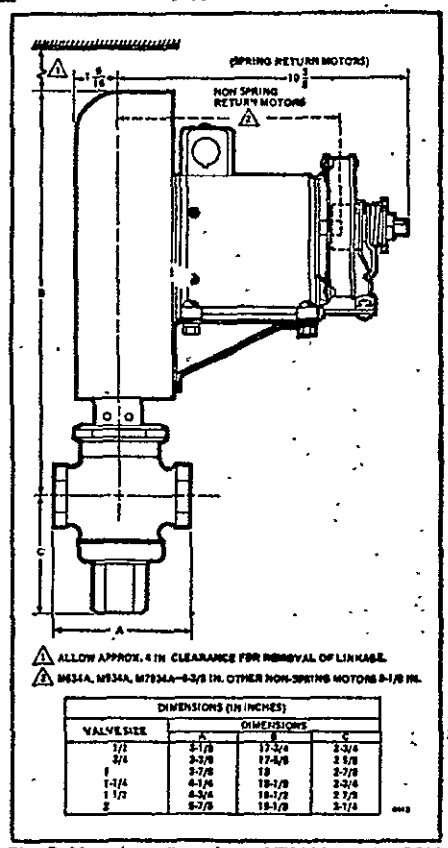

Fig. 2—Mounting dimensions V5013A with Q601 Linkage.

Rev. 9-72
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Form Number
95-6280-2
Residential Div.

REPLACEMENT PARTS

1. Teflon cone packing V5013A screw body; order 3 packings, Part No. 310623 for 1/2, 3/4, 1, or 1-1/4 inch valves; order 4 packings, Part No. 311432 for 1-1/2 or 2 inch valves.

2. For V5013A replacement parts list, see Honeywell publication 77-5613.

INSTALLATION

CAUTION

1. Installer must be a trained, experienced serviceman.
2. Before wiring the actuator motor, disconnect power supply to prevent electrical shock and equipment damage.
3. Mixing valves are not suitable for diverting applications.
4. Always conduct a thorough checkout when installation is complete.

LOCATION

In selecting a location, the following must be considered:

1. Make sure sufficient space has been provided for the complete valve assembly. The valve linkage and motor fit over the valve stem and require about 4 inches clearance for installation and service of motor and linkage. For installation dimensions, see Fig. 1 and 2.
2. The Modutrol motor must be mounted with the shaft horizontal.
3. The linkage should not be mounted below the valve where moisture or dirt may accumulate.
4. The ambient temperature must not exceed the maximum limits for the valve or motor. Controlled liquid pressure must not exceed the maximum pressure limits of the valve. The maximum pressure is 150 psig.

PIPING HOOKUPS

All piping must comply with local codes and ordinances. Refer to Figs. 3-5 for typical piping hookups.

CAUTION

Mixing valves are designed for mixing applications and are not suitable for diverting applications. When mixing valves are piped for diverting applications, the inlet pressure can slam the disc against the seat as it nears closing. This may cause loss of control, vibration, noise, and excessive wear.

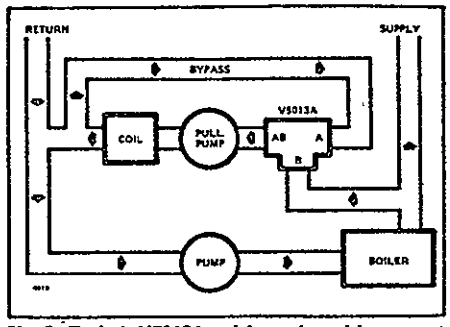

Fig. 3—Typical V5013A mixing valve with constant volume through coil. For typical motor-controller wiring see Fig. 7.

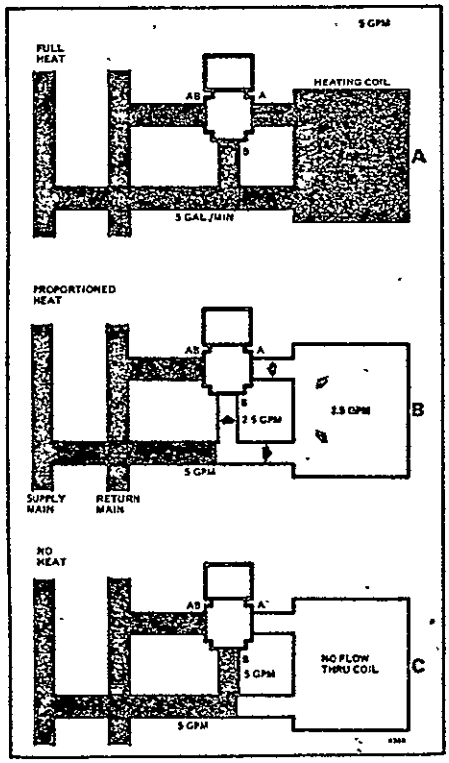

Fig 4—Three-way valve operation—coil bypass. Three-way valves maintain constant flow in piping. As the temperature requirements change, the volume of the fluid in the coil varies. For typical motor-controller wiring hookup see Fig. 9.

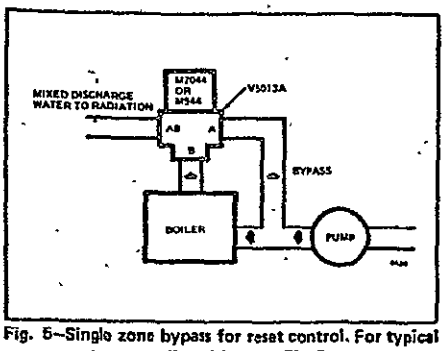

Fig. 5—Single zone bypass for reset control. For typical motor controller wiring, see Fig. 7.

VALVE INSTALLATION

Line up the pipes squarely with the valve at each end. If the pipes are forced into the valve, the body may become twisted and improper seating will result. Prevent pipe chips, scale, and dirt from entering the piping since they may lodge in the seat and prevent proper closing. Apply a vise or wrench to the valve only as shown in the following figure.

The bolts should be 1/8 inch smaller than the diameter of the bolt hole to allow clearance for installing. To prevent leakage, use a gasket material recommended for the medium to be handled.

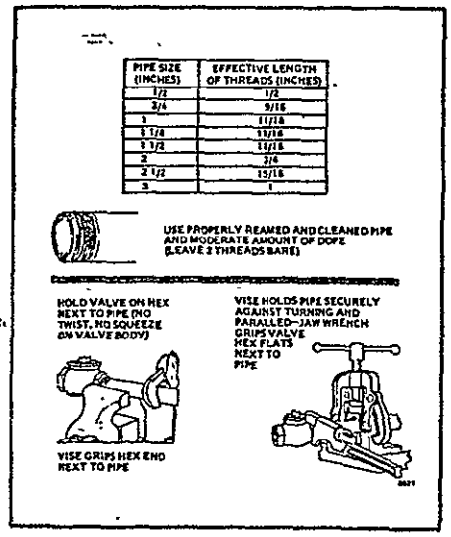

Fig. 6—Mounting of screwed valve bodies.

MOTOR-CONTROLLER WIRING

CAUTION
Disconnect power supply to prevent electrical shock and equipment damage.

All wiring must comply with local codes and ordinances.

When wiring the modulating motor to the controller, refer to the instructions packed with the motor and heating and/or cooling equipment. If instructions are not available, refer to the following section.

TYPICAL WIRING HOOKUPS

When a V5013A is piped with Port A connected to the bypass and Port B connected in the supply line from the boiler or chiller, as in Fig. 3 or 5 make series 90 motor and controller wiring connections as shown in Fig. 7 for heating applications or Fig. 8 for cooling applications.

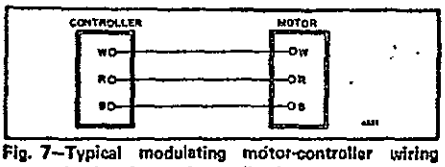

Fig. 7—Typical modulating motor-controller wiring hookup for heating application.

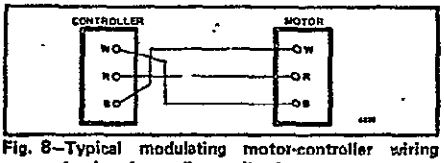

Fig. 8—Typical modulating motor-controller wiring hookup for cooling application.

REVERSE PORT HOOKUP WIRING

IF THE VALVE IS INSTALLED WITH PORTS A AND B REVERSED, THE SERIES 90 MOTOR AND CONTROLLER WIRING MUST BE REVERSED.

MIXING VALVE APPLICATIONS

If a V5013A Mixing Valve is installed with Ports A and B reversed (see Fig 4) (i.e., the hot water enters Port A rather than Port B, and the coil bypass is connected to Port B rather than Port A), series 90 motor controller wiring connections MUST be reversed.

On a call for heat in a V5013A operation, the stem travels upward opening Port B, the supply line from the boiler. When Port A rather than port B is connected in the supply line from the boiler, the motor-controller wiring must be reversed so that on a call for heat Port A opens and Port B closes.

When Ports A and B are reversed, make series 90 motor and controller wiring as shown in Fig. 9 for heating applications or as shown in Fig. 10 for cooling applications.

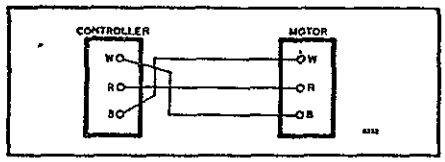

Fig. 9—Typical modulating motor-controller wiring hookup for heating application with valve Ports A and B reversed.

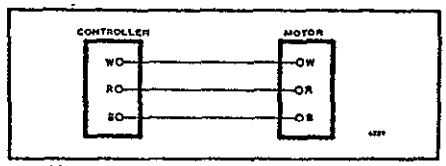

Fig. 10—Typical modulating motor-controller wiring hookup for cooling application with valve Ports A and B reversed.

OPERATION

V5013A HEATING APPLICATION, MIXING SERVICE

When the V5013A is used in a heating application for mixing service, Port B is connected in the supply line from the hot water boiler, Port A is connected to the bypass, and Port AB is connected to the load. A fall in temperature at the controller will partially open Port B and close Port A to increase the temperature of the water to the load. A rise in temperature at the controller will partially close Port B and open Port A to decrease the temperature of the water to the coil. See Figs. 3, 5, and 11.

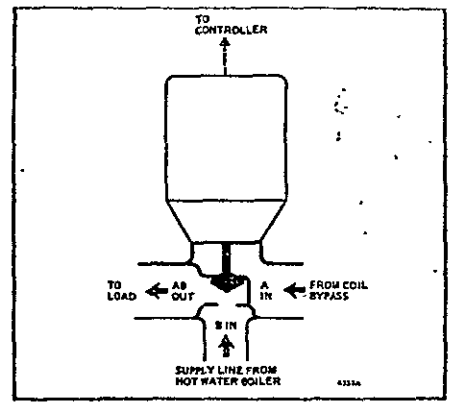

Fig. 11—V5013A or B used in heating application, mixing service.

CHECKOUT

It is important to check the valve stem to see that it operates freely. Impaired valve stem operation may indicate that the body was twisted by faulty piping or the stem was bent by rough handling. Either of these conditions may warrant replacement of the valve body or other components.

The valve should be checked at regular intervals for leakage around the packing. The packing is spring loaded and should seldom require attention. If leakage is discovered and inspection shows that the packing gland is screwed down tightly, the valve must be repacked.

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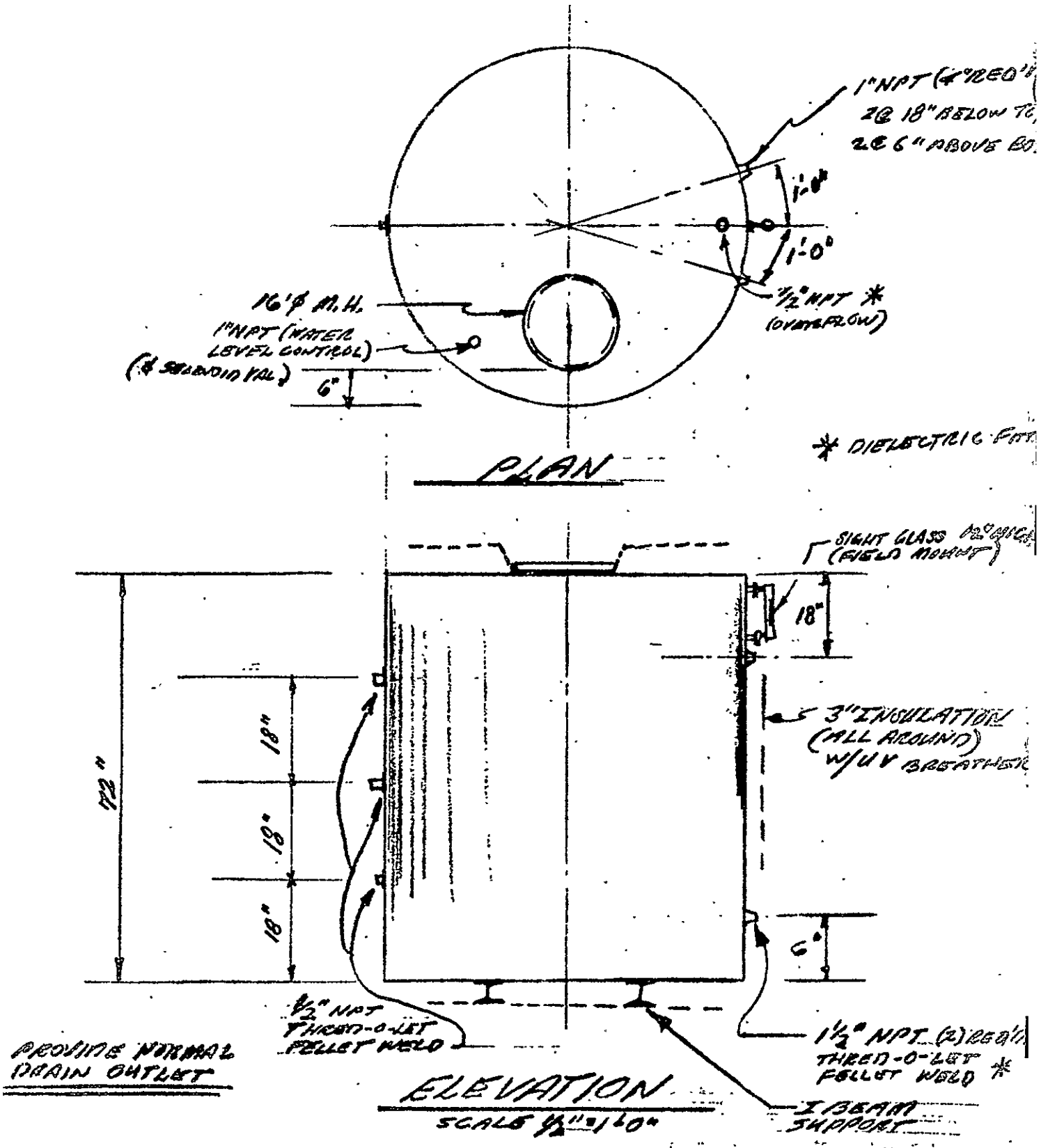

SOLARON®
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Weathermaster III
Heat Pump System

38HQ

Heating 31,000 to 51,000 Btuh
Cooling 27,500 to 46,000 Btuh

Carrier Heat Pumps 1932-

The Complete Heat Pump

Efficient Energy Usage

All Electric Comfort

Carrier®

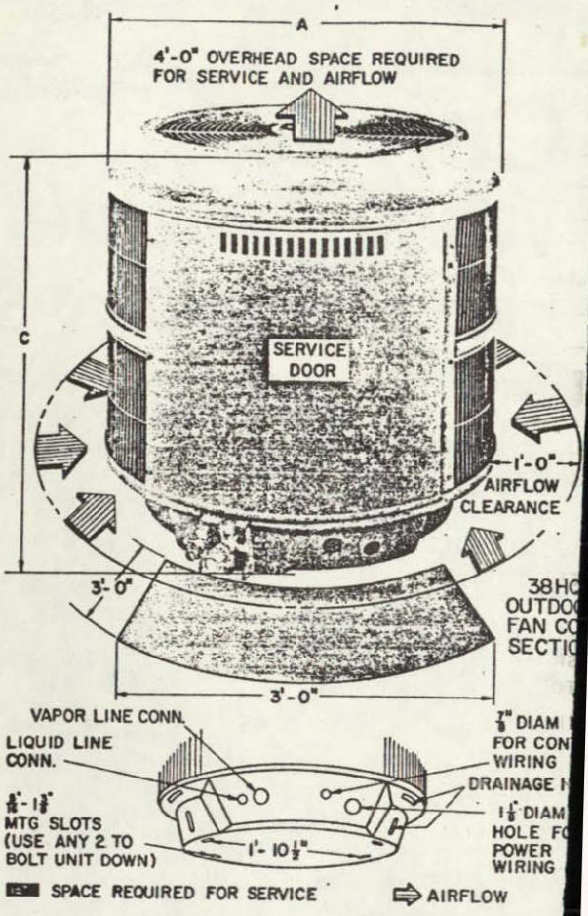
Physical data and dimensions

OUTDOOR FAN-COIL SECTION

UNIT	38HQ940	38HQ960
OPERATING WT (lb)	107	125
REFRIGERANT*	22	
Refrig Control	AccuRater™	
FAN	Propeller-Type, Direct Drive	
Air Discharge	Vertical	
Air Quantity (cfm)	3100	3600
Motor Rpm (60-Hz)	1015	1080
Motor Hp	1/3	1/4
COIL (Type)	Plate Fin	
Fins/in.	19	17
Face Area (sq ft)	10.5	15.3
Rows	2	2
DIMENSIONS (ft-in.)		
Diameter A	2-5¼	2-5¼
Height C	2-8	3-8
Mtg Slots	1-10½	
CONNECTIONS (in.)	Compatible Fitting (Vapor) and Flare (Liquid)	
Vapor Line†	¾	
Liquid Line†	⅜	

*The 38HQ outdoor fan coils contain correct operating charge for complete system (except 38HQ940/38HQ134 combination) when connected to 40FS/28MQ or 40AQ indoor units with 25 ft or less of tubing of recommended diameter. Charge adjustment may be required on other systems. The 38HQ940/38HQ134 combination requires an additional 14 oz of R-22.

†See recommended refrigerant line sizes under Indoor Compressor Section Physical Data table.



Certified dimension drawings available on request.

INDOOR COMPRESSOR SECTION

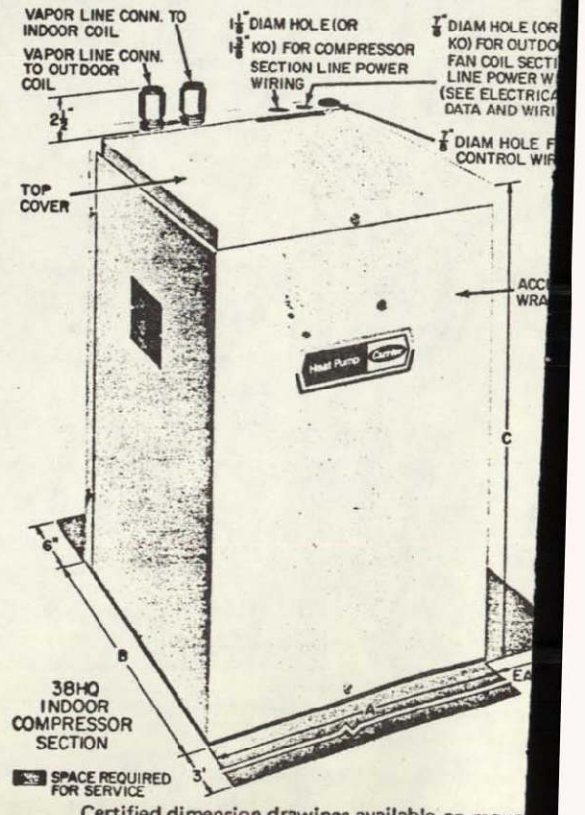
UNIT	38HQ127	38HQ134	38HQ140	38HQ146
OPERATING WT (lb)	111	117	141	142
REFRIGERANT	22			
COMPRESSOR	Hermetic			
Cylinders	2			
Rpm (60-Hz)	3500			
DIMENSIONS (ft-in.)				
Length A	1-2$^{3}/_{32}$			
Width B	1-4$^{3}/_{16}$			
Height C	1-11⅛ (Add 2½ in. for Refrigerant Fittings)			
CONNECTIONS (in. ODF)	Compatible Fittings			
Vapor Lines (2)*	¾			

*RECOMMENDED REFRIGERANT LINE SIZES

INDOOR COMPR SECTION	38HQ127	38HQ134	38HQ140	38HQ146
OUTDOOR FAN-COIL SECTION	38HQ940	38HQ940	38HQ960	38HQ960
VAPOR (in. OD)	¾	¾	⅞	1⅛†
LIQUID (in. OD)	⅜			

†The 38HQ146/38HQ960 system requires 1-1/8 in. vapor line for optimum performance. When using 7/8-in. vapor line, deduct 1-1/2% of rated capacity for every 25 ft of run. The 38HQ146 is factory supplied with four 3/4 x 1-1/8 in. connection adapters (field installed) for field-supplied 1-1/8 in. system vapor line.

NOTES:
1. Maximum allowable liquid line length is 100 feet. Maximum vapor line length from compression unit to indoor coil is 50 feet. Maximum vapor line length from compression unit to outdoor fan coil is 50 feet.
2. Maximum allowable vertical separation of indoor unit above or below outdoor unit is 50 feet.



Certified dimension drawings available on reque

Performance data

COMBINATION RATING INDEX

INDOOR COMPR SECTION	OUTDOOR FAN-COIL SECTION	INDOOR UNIT		ARI STANDARD RATINGS						
				Cfm	Cooling		Hi-Temp Heat		Low-Temp Heat		SRN
38HQ		Fan	Coil		TC	EER	TC	C.O.P.	TC	C.O.P.	
127	940	40AQ030*		1031	27,500	7.9	31,000	2.8	17,000	1.9	17
134	940	40AQ036		1256	33,500	7.8	37,500	2.8	21,000	2.1	17
		40FS160	28MQ036								
140	960	40FS160	28MQ042	1500	40,000	7.8	45,000	2.9	24,000	2.1	18
146	960	40FS200	28MQ048*	1725	46,000	7.9	51,000	2.9	28,000	2.1	18

Cooling Combination Rating tables. Integrated Heating Capacities table, page 8.

C.O.P. — Coefficient of Performance = $\frac{\text{Btuh output}}{\text{Btuh input}}$ or

$\frac{\text{Btuh output}}{\text{Unit wattage} \times 3.413}$. Based on ARI conditions.

EER — Energy Efficiency Ratio = $\frac{\text{Btuh}}{\text{Unit wattage}}$

Based on ARI conditions.

SRN — Sound Rating Number

TC — Total Capacity (1000 Btuh)

*Indoor units that require replacement of AccuRater refrigerant control piston when used with specified 38HQ units. Replacement piston is factory supplied.

Rated in accordance with ARI Standards 240-76 and 270-75.

Ratings are net values, reflecting the effects of circulating fan heat. Supplementary electric heat is not included. Ratings are based on:

Cooling Standard: 80 F db, 67 F wb indoor entering air temperature and 95 F db air entering outdoor unit.

Hi-Temp Heating Standard: 70 F db indoor entering air temperature and 47 F db, 43 F wb air entering outdoor unit.

Lo-Temp Heating Standard: 70 F db indoor entering air temperature and 17 F db, 15 F wb air entering outdoor unit.

COMBINATION RATING NOTES

1. Direct interpolation is permissible. Do not extrapolate.
2. SHC is based on 80 F db temperature of air entering indoor unit. Below 80 F db, subtract (corr factor x cfm) from SHC.

Above 80 F db, add (corr factor x cfm) to SHC.

BYPASS FACTOR	ENTERING AIR DRY-BULB TEMP (F)					
	79	78	77	76	75	under 75
	81	82	83	84	85	over 85
	Correction Factor					
.10	.98	1.96	2.94	3.92	4.91	Use formula shown below.
.20	.87	1.74	2.62	3.49	4.36	
.30	.76	1.53	2.29	3.05	3.82	

Interpolation is permissible. Corr Fac = 1.09 x (1 — BF) x (db — 80)

3. Net capacities based on 25 actual ft of interconnecting piping and include a deduction for fan motor heat

LEGEND

BF — Bypass Factor
Ewb — Entering Wet-Bulb
KW — Unit Total Power Input
SHC — Sensible Heat Capacity (1000 Btuh)
TC — Total Cap (1000 Btuh)

COOLING COMBINATION RATINGS

1 — 38HQ127 — 38HQ940/40AQ030

Temp (F) Air Ent Outdoor Unit		Air Ent Indoor Unit — Cfm/BF								
		917/.12			1031/.13			1145/.14		
		Indoor Unit Ent Air Temp — Ewb (F)								
		72	67	62	72	67	62	72	67	62
85	TC	29.2	28.0	26.0	29.4	27.9	26.5	29.4	27.9	26.8
	SHC	14.9	20.1	24.4	15.4	20.7	25.5	15.6	21.4	26.2
	KW	3.29	3.22	3.10	3.35	3.27	3.18	3.40	3.32	3.26
95	TC	28.7	27.2	25.0	29.0	27.5	25.6	29.0	27.6	26.1
	SHC	15.0	20.0	23.9	15.4	21.0	25.0	15.8	21.9	25.7
	KW	3.48	3.39	3.26	3.55	3.50	3.35	3.60	3.52	3.43
100	TC	28.2	26.4	24.3	28.5	26.7	24.9	28.5	26.9	25.4
	SHC	14.8	19.8	23.4	15.3	20.8	24.4	15.7	21.7	25.1
	KW	3.57	3.46	3.33	3.64	3.53	3.42	3.70	3.60	3.51
105	TC	27.6	25.7	23.6	27.9	26.0	24.2	28.0	26.2	24.7
	SHC	14.7	19.5	22.9	15.2	20.6	23.8	15.7	21.6	24.5
	KW	3.67	3.54	3.40	3.74	3.61	3.49	3.80	3.68	3.59
115	TC	26.5	24.2	22.1	26.7	24.6	22.7	27.0	24.8	23.3
	SHC	14.4	19.1	21.9	15.1	20.3	22.7	15.6	21.2	23.2
	KW	3.86	3.69	3.54	3.92	3.77	3.64	4.00	3.84	3.74

2 — 38HQ134 — 38HQ940/40AQ036 or 40FS160 with 28MQ036

Temp (F) Air Ent Outdoor Unit		Air Ent Indoor Unit — Cfm/BF								
		1115/.11			1275/.13			1400/.14		
		Indoor Unit Ent Air Temp — Ewb (F)								
		72	67	62	72	67	62	72	67	62
85	TC	37.4	34.7	31.4	37.8	35.2	32.2	37.8	35.4	32.7
	SHC	19.1	24.8	29.9	19.8	26.4	31.1	20.2	27.3	32.2
	KW	4.18	4.05	3.89	4.27	4.15	4.00	4.33	4.21	4.06
95	TC	35.6	33.0	30.0	35.7	33.5	30.8	35.6	33.5	31.4
	SHC	18.4	24.1	28.8	19.0	25.5	30.1	19.3	26.2	31.1
	KW	4.40	4.23	4.11	4.48	4.30	4.23	4.53	4.43	4.31
100	TC	34.7	32.1	29.2	34.9	32.5	30.0	34.9	32.6	30.6
	SHC	18.1	23.8	28.0	18.7	25.1	29.5	19.1	26.0	30.4
	KW	4.52	4.38	4.23	4.61	4.48	4.34	4.66	4.54	4.43
105	TC	33.8	31.1	28.5	34.2	31.5	29.1	34.1	31.6	29.7
	SHC	17.8	23.4	27.3	18.5	24.8	28.9	18.9	25.8	29.7
	KW	4.64	4.49	4.33	4.74	4.59	4.45	4.79	4.85	4.54
115	TC	32.0	29.2	26.6	32.6	29.6	27.5	32.6	29.8	28.4
	SHC	17.3	22.6	26.4	18.1	24.1	27.3	18.6	25.3	28.2
	KW	4.88	4.71	4.54	4.99	4.81	4.67	5.05	4.88	4.77

3 — 38HQ140 — 38HQ960/40FS160 with 28MQ042

Temp (F) Air Ent Outdoor Unit		Air Ent Indoor Unit — Cfm/BF								
		1333/.11			1500/.12			1667/.13		
		Indoor Unit Ent Air Temp — Ewb (F)								
		72	67	62	72	67	62	72	67	62
85	TC	44.6	41.5	38.1	44.8	42.0	38.9	44.7	42.3	39.7
	SHC	22.7	29.1	35.1	23.1	30.4	36.9	23.4	31.5	38.4
	KW	4.86	4.73	4.57	4.93	4.82	4.68	5.00	4.90	4.79
95	TC	42.6	39.6	35.8	42.8	40.0	36.7	42.7	40.4	37.5
	SHC	22.0	28.6	34.0	22.5	29.9	35.7	22.9	31.3	37.0
	KW	5.16	5.01	4.81	5.24	5.10	4.94	5.30	5.20	5.05
100	TC	41.5	38.3	34.7	41.7	38.7	35.2	41.5	39.1	36.4
	SHC	21.6	28.1	33.3	22.2	29.4	34.9	22.5	30.8	36.1
	KW	5.30	5.13	4.94	5.38	5.24	5.06	5.44	5.33	5.18
105	TC	40.3	37.0	33.6	40.5	37.4	34.4	40.3	37.8	35.3
	SHC	21.1	27.5	32.5	21.8	28.9	34.0	22.1	30.3	35.1
	KW	5.44	5.25	5.06	5.52	5.35	5.18	5.58	5.45	5.31
115	TC	38.0	34.5	31.4	38.1	34.9	32.2	37.8	35.2	33.0
	SHC	20.3	26.5	31.1	21.0	28.0	32.0	21.2	29.4	32.9
	KW	5.72	5.49	5.30	5.80	5.59	5.43	5.86	5.70	5.56

4 — 38HQ146 — 38HQ960/40FS200 with 28MQ048

Temp (F) Air Ent Outdoor Unit		Air Ent Indoor Unit — Cfm/BF								
		1533/.13			1725/.14			1917/.15		
		Indoor Unit Ent Air Temp — Ewb (F)								
		72	67	62	72	67	62	72	67	62
85	TC	50.6	47.8	44.9	51.4	48.4	45.6	51.1	48.3	46.2
	SHC	25.1	32.6	40.2	25.9	33.6	41.5	26.2	34.2	42.5
	KW	5.50	5.38	5.24	5.62	5.48	5.35	5.68	5.56	5.43
95	TC	48.3	45.6	42.7	49.1	46.0	43.5	48.7	46.4	44.1
	SHC	24.4	31.8	39.4	24.5	32.9	40.1	25.6	33.9	41.1
	KW	5.81	5.68	5.53	5.95	5.80	5.64	6.01	5.89	5.71
100	TC	47.1	44.5	41.6	48.0	44.9	42.4	47.5	45.3	43.1
	SHC	23.7	31.5	38.5	24.3	32.6	39.5	24.8	33.7	40.1
	KW	5.96	5.83	5.67	6.12	5.94	5.79	6.18	6.04	5.8
105	TC	45.9	43.3	40.4	46.8	43.8	41.2	46.2	44.2	42.1
	SHC	23.0	31.1	37.6	24.0	32.3	38.8	24.1	33.4	39.1
	KW	6.11	5.97	5.81	6.28	6.08	5.93	6.34	6.19	6.0
115	TC	43.5	40.9	38.2	44.4	41.5	39.0	43.7	42.0	39.1
	SHC	22.5	30.4	36.6	23.3	31.7	36.8	23.4	33.0	37.1
	KW	6.40	6.25	6.09	6.58	6.38	6.21	6.65	6.50	6.3

HEATING CAPACITY CORRECTION FACTORS

CFM/TON* ENT INDOOR COIL	CORRECTION FACTORS		TEMP AIR ENT INDOOR COIL (F)	CORRECTION FACTORS	
	Cap.	Power		Cap.	Power
400	.98	.99	65	1.02	.99
450	1.0	1.0	70	1.0	1.0
500	1.02	1.01	75	.98	1.01

*Determine cfm/ton from Combination Rating tables.

Performance data (cont)

INTEGRATED HEATING CAPACITIES*

INDOOR COMPR SECTION	OUTDOOR FAN-COIL SECTION	INDOOR UNIT		TEMPERATURE OF AIR ENTERING OUTDOOR UNIT (Edb F)											
				-10		0		10		17		20		30	
38HQ		Fan	Coil	Cap.	Kw	Cap.	Kw	Cap.	Kw	Cap.	Kw	Cap.	Kw	Cap.	Kw
127	940	40AQ030		7.5	2.0	11.0	2.3	14.5	2.5	17.0	2.6	18.0	2.6	22.0	2.8
134	940	40AQ036		10.0	2.3	14.0	2.6	18.0	2.9	21.0	3.0	22.0	3.0	26.5	3.2
		40FS160	28MQ036												
140	960	40FS160	28MQ042	10.5	2.8	15.0	3.0	20.0	3.2	24.0	3.4	25.5	3.5	31.0	3.7
146	960	40FS200	28MQ048	13.0	3.2	18.5	3.5	24.0	3.8	28.0	4.0	29.5	4.1	35.5	4.2

INDOOR COMPR SECTION	OUTDOOR FAN-COIL SECTION	INDOOR UNIT		TEMPERATURE OF AIR ENTERING OUTDOOR UNIT (Edb F)							
				40		47		50		60		70	
38HQ		Fan	Coil	Cap.	Kw	Cap.	Kw	Cap.	Kw	Cap.	Kw	Cap.	Kw
127	940	40AQ030		27.5	3.1	31.0	3.3	33.0	3.3	39.0	3.5	46.0	3.8
134	940	40AQ036		34.0	3.8	37.5	3.9	39.5	4.1	45.0	4.4	52.0	4.7
		40FS160	28MQ036										
140	960	40FS160	28MQ042	40.0	4.3	45.0	4.6	48.0	4.8	57.0	5.3	67.0	6.0
146	960	40FS200	28MQ048	45.0	4.8	51.0	5.2	53.3	5.4	63.0	5.9	70.4	6.3

Cap. — Capacity (1000 Btuh), includes fan motor heat and deduction for thermal line losses of 15 ft of piping exposed to outdoor conditions.

Kw — Power input includes compressor motor power input, indoor and outdoor fan motor input.

*Integrated Heating Capacities — Values shown reflect a capacity reduction at those outdoor air temperatures at which frost forms on outdoor coil.

NOTE:
Heating ratings shown in table are without accessory electric heater and are based on 70 F db air entering indoor coil, 85% rh air entering outdoor coil, and ARI-rated cfm. See Heating Capacity Correction Factors table to calculate heating capacity and power input at other cfm's and indoor coil entering air temperature.

ARI STANDARD RATINGS FOR OPTIMIZER SYSTEMS
(ARI Category with Non-Specified Indoor Air Moving Unit)

INDOOR COMPR SECTION	OUTDOOR FAN-COIL SECTION	INDOOR COIL	ARI STANDARD RATINGS						
			Cfm	Cooling		Hi-Temp Heat		Lo-Temp Heat		SRN
38HQ-				TC	EER	TC	C.O.P.	TC	C.O.P.	
127	940	28MQ030*	1031	28,000	8.5	30,500	2.9	16,500	2.0	17
134	940	28MQ036	1256	33,500	7.9	37,500	2.8	21,000	2.1	17
140	960	28MQ042	1500	40,000	8.0	45,000	2.9	23,500	2.1	18
146	960	28MQ048*	1725	46,000	8.2	51,000	2.9	27,500	2.1	18

C.O.P. — Coefficient of performance = $\frac{\text{Btuh output}}{\text{Btuh input}}$ or

$\frac{\text{Btuh output}}{\text{Unit wattage} \times 3.413}$. Based on ARI conditions.

EER — Energy Efficiency Ratio = $\frac{\text{Btuh}}{\text{Unit wattage}}$

Based on ARI conditions.

SRN — Sound Rating Number

TC — Total Capacity (1000 Btuh)

*Indoor coils that require replacement of AccuRater refrigerant control piston when used with specified 38HQ units. Replacement piston is factory supplied.

Rated in accordance with ARI Standards 240-76 and 270-75.

Electrical data (60-Hz)

INDOOR COMPR SECTION	OUTDOOR FAN-COIL SECTION	V/PH	OPER VOLT*		COMPR		OFM	MWA
38HQ-			Max	Min	LRA	RLA	FLA	
127	940	230/1	254	207	72	17	1.5	24.3
134	940				88	20	1.5	28.0
140	960				94	24	2.2	33.0
146	960				106	27	2.2	36.8

FLA — Full Load Amps
LRA — Locked Rotor Amps
RLA — Rated Load Amps
MWA — Minimum Wire Amps

*Permissible limits of the voltage range at which the units will operate satisfactorily.

NOTES:

1. All units have 24-v control circuit which requires external power source.
2. Use copper or copper-clad aluminum wire only for compressor section; copper wire only for outdoor fan coil. See Installation, Start-Up and Service booklet.
3. Units require field-supplied grounding wire. See Installation, Start-Up and Service Instructions for wire sizes.

Application data

INSULATION TO VAPOR LINE EXPOSED TO OUTDOOR CONDITIONS

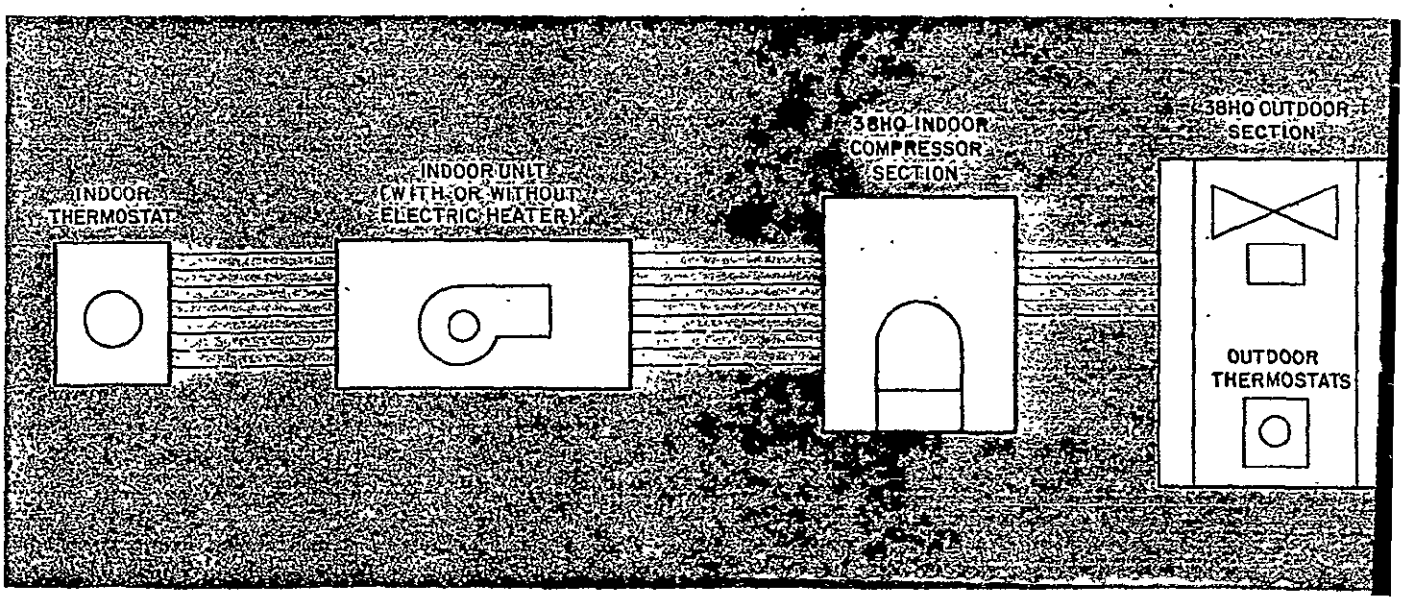
LENGTH OF EXPOSED VAPOR LINE* (ft)	INSULATION THICKNESS† (in.)
10	⅜
25	½
35	¾
50	¾

*Recommended vapor line insulation for piping exposed to outdoor conditions to prevent loss of heating during heating cycle. When vapor line goes thru interior spaces, insulation should be selected to prevent condensation on cooling cycle. Heating capacity should be reduced 1000 Btuh if over 35 ft of vapor line with 3/4-in. insulation is exposed to outdoor conditions.

†Closed cell foam plastic insulation with a thermal conductivity of .28 Btuh/sq ft/F/inch.

NOTE: Vapor lines of accessory precharged tubing packages (available for use with 38HQ units) are insulated with closed cell foam plastic insulation with a thermal conductivity of .28 Btuh/sq ft/F/inch.

Typical system control wiring requirement



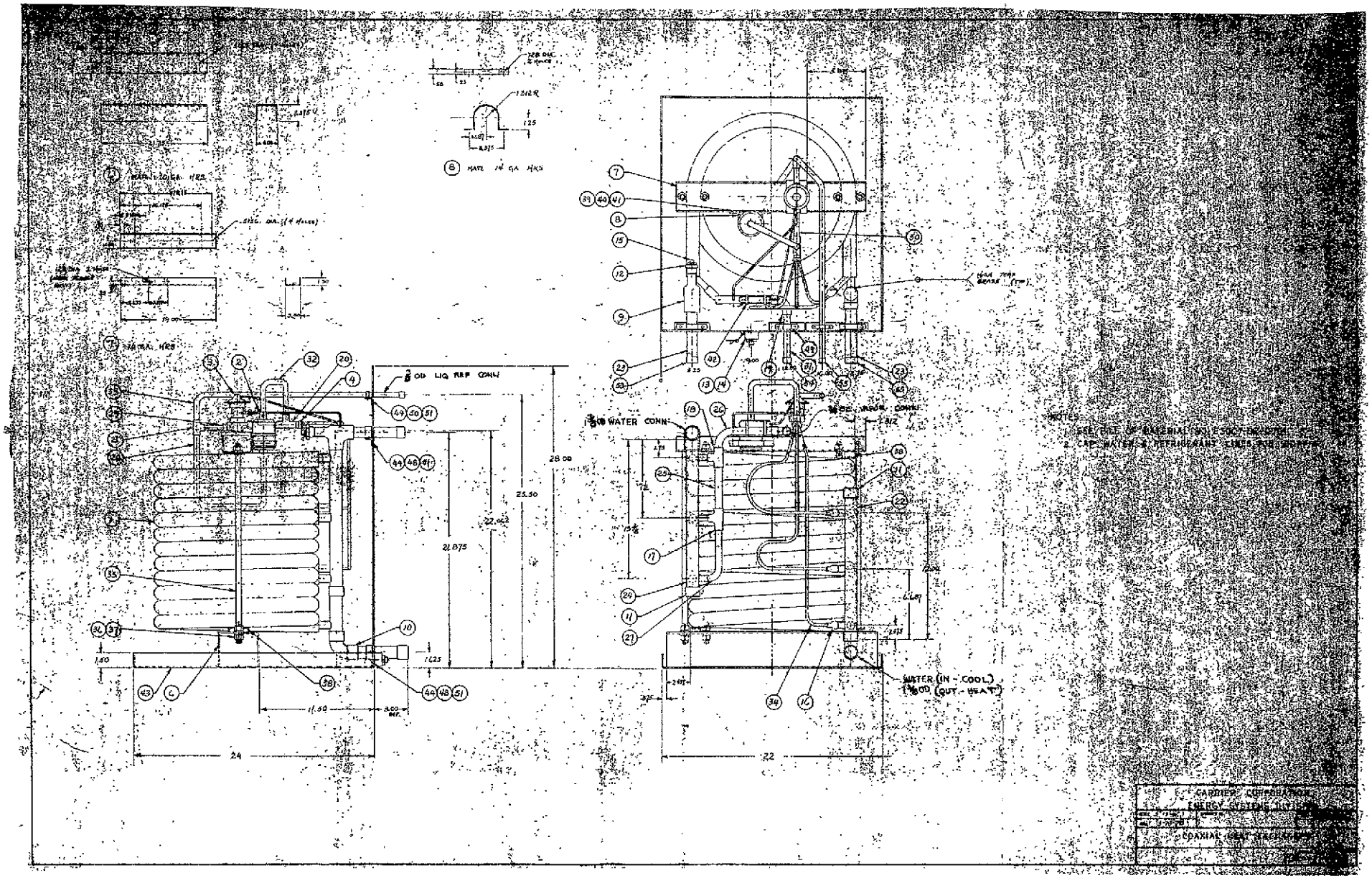
——— Wiring necessary for cooling and one-stage heating. Indoor fan-coil unit not equipped with electric heater.

— — — Add to cooling with one-stage heating wiring for cooling with 2-stage heating. Indoor fan coil equipped with electric heater.

——— Add to cooling with 2-stage heating wiring when 2 outdoor thermostats are used. (Accessory emergency heat relay required when 2 outdoor thermostats are used.)

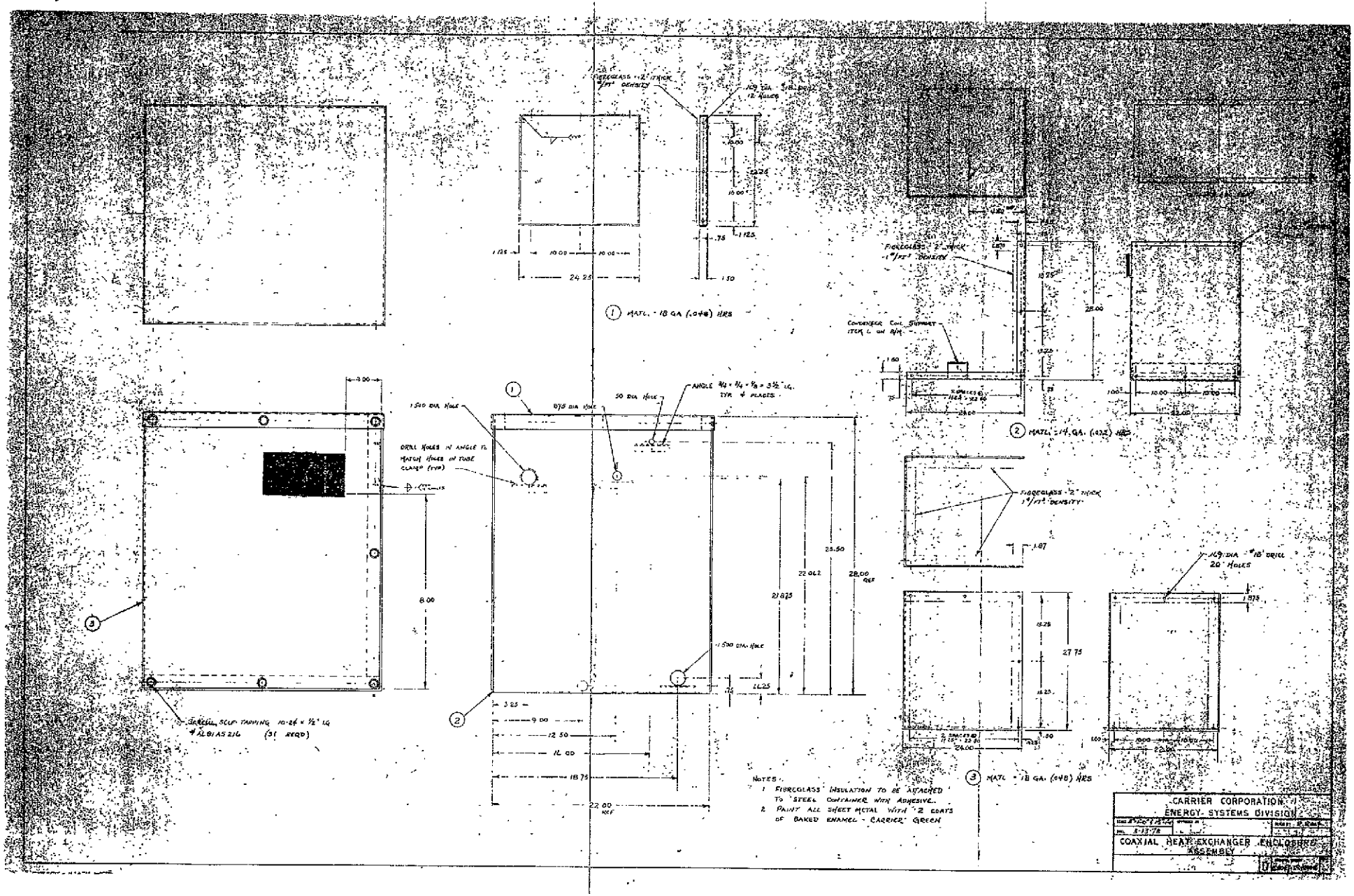
FOLDOUT FRAME 1

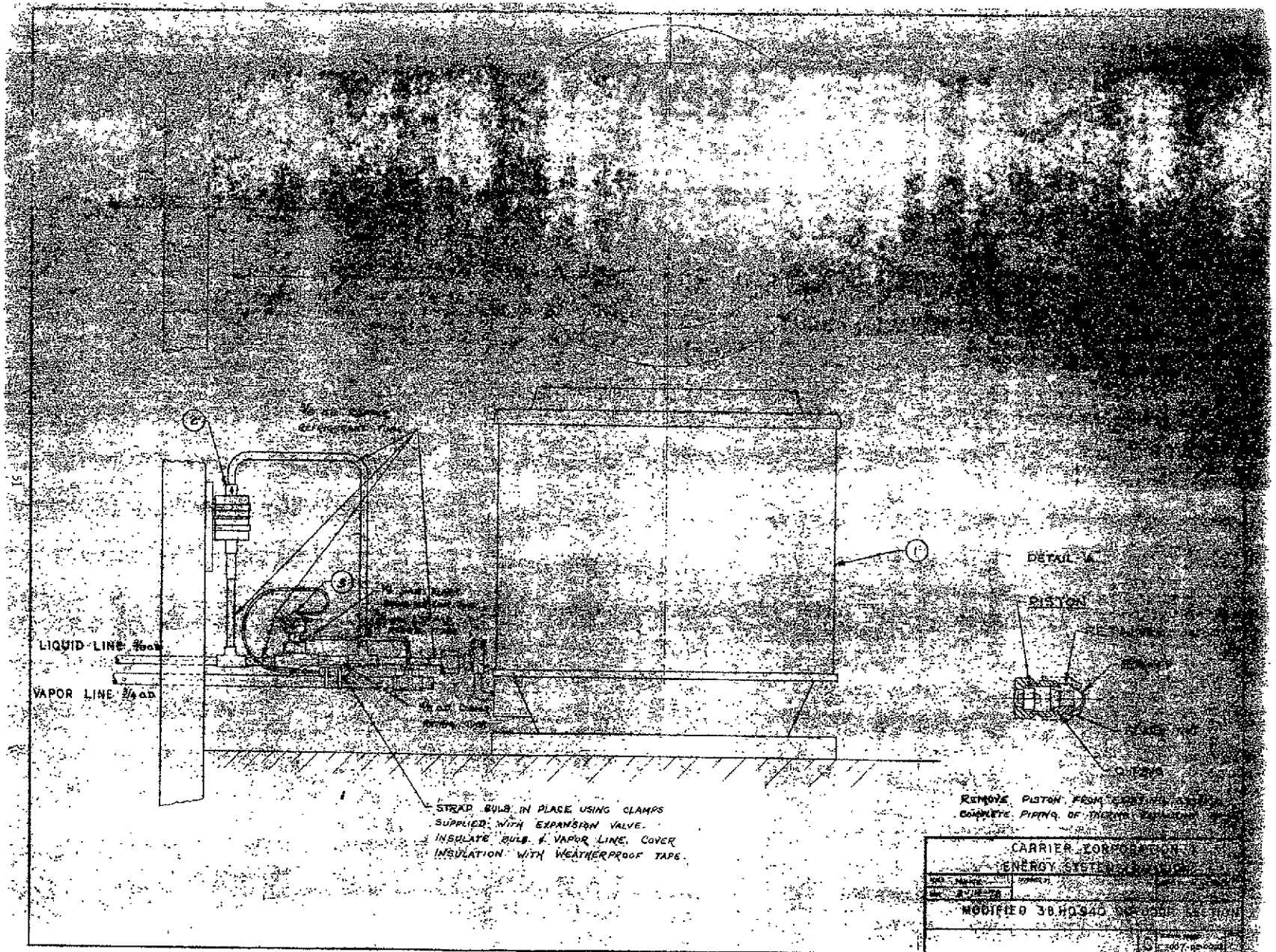
FOLDOUT FRAME 2



FOLDOUT FRAME 1

FOLDOUT FRAME 2



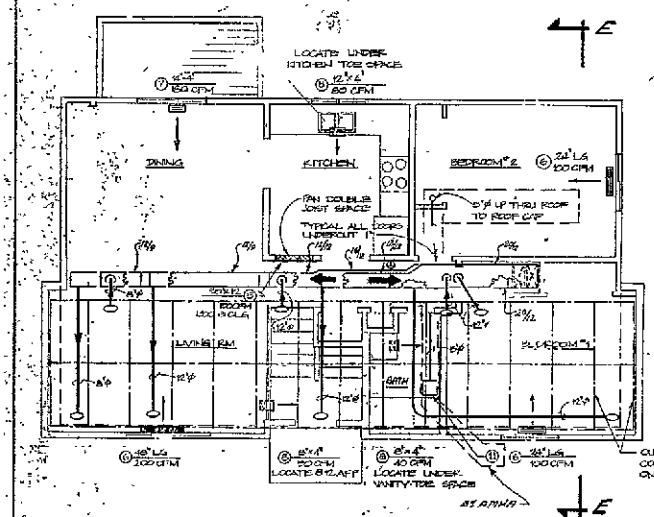


FOLDOUT FRAME 1

FOLDOUT FRAME 2

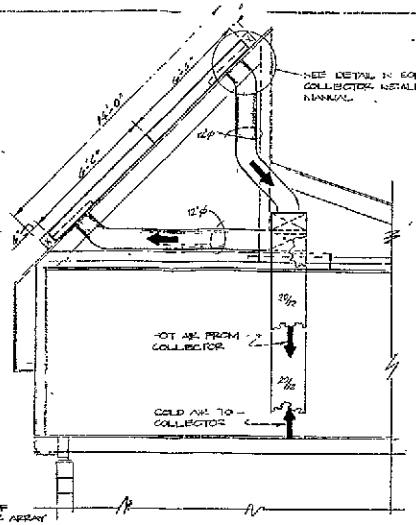
FOLDOUT FRAME 1

FOLDOUT FRAME 2



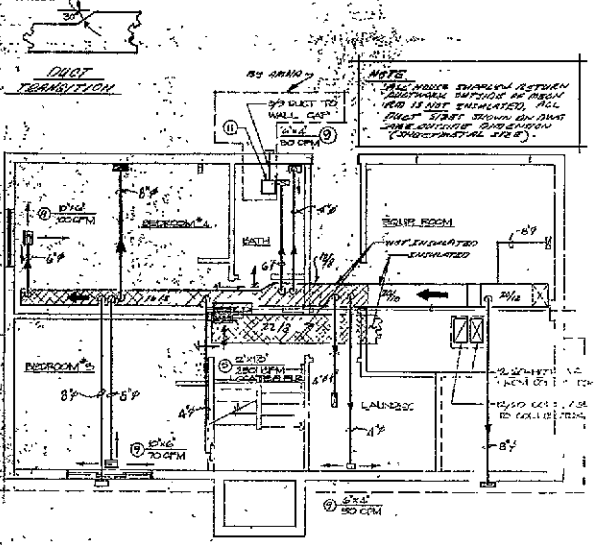
UPPER LEVEL PLAN

SCALE 1/4"=1'-0"



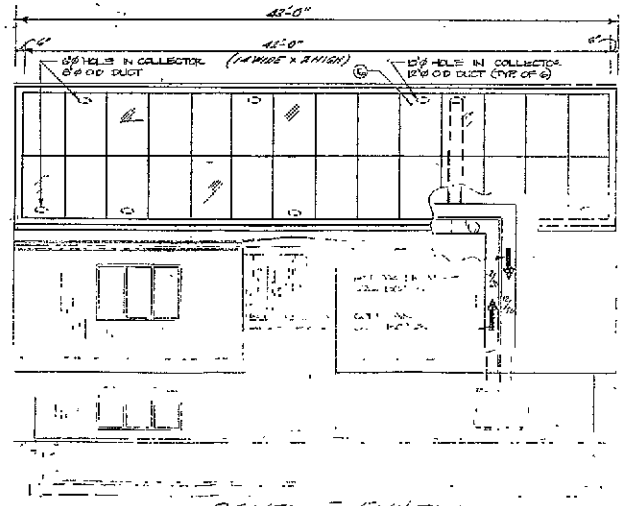
SECTION E-E

SCALE 3/8"=1'-0"



LOWER LEVEL PLAN

SCALE 1/4"=1'-0"



SOUTH ELEVATION

SCALE 1/8" = 1'-0"

VOID

ATTACHMENT 1

NO.	DESCRIPTION	DATE
1		
2		
3		
4		

SOLARON

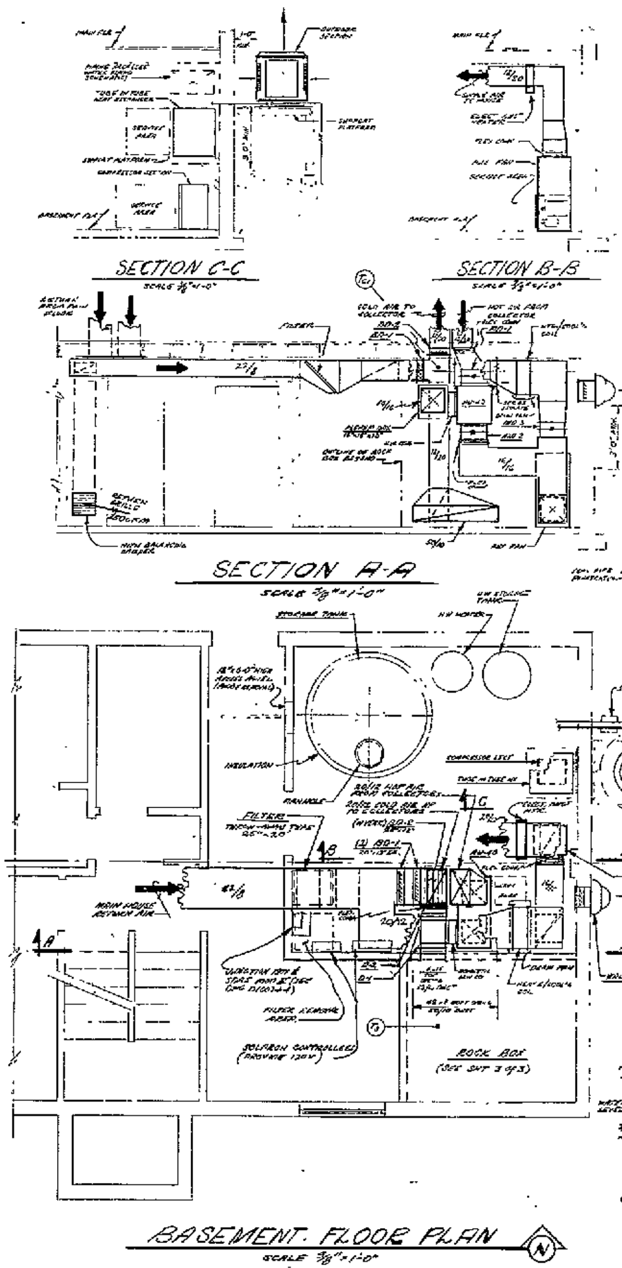
PARK HOME
PLANS & ELEVATIONS

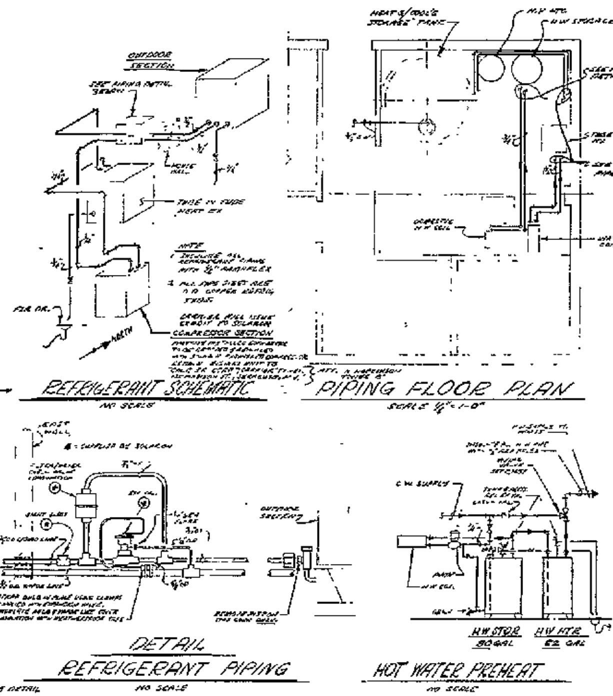
AS SHOWN

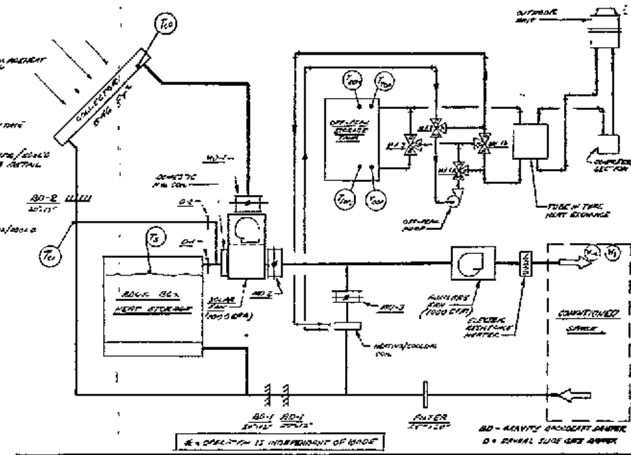
52

FOLDOUT FRAME 1

FOLDOUT FRAME 2







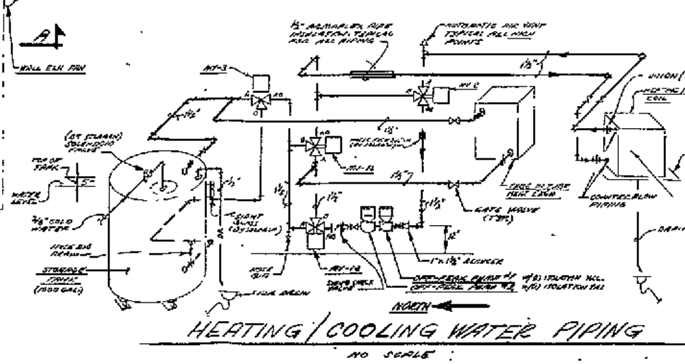
SEQUENCE OF OPERATIONS

O = OPEN
C = CLOSED

MODE		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	PUMPS		FANS		[illegible]		[illegible]
FIRST STAGE HEATING	HEATING FROM COLLECTOR	O	O	C	O	O	O	C	*	*	*	*	*	*	*	*	*	*	*	*	OFF	*	ON	ON	OFF	—	OFF
	HEATING FROM STORAGE	C	O	C	C	C	O	C	*	*	*	*	*	*	*	*	*	*	*	*	OFF	*	OFF	ON	OFF	—	OFF
STORING HEAT		O	C	O	C	C	O	C	*	*	*	*	*	*	*	*	*	*	*	*	OFF	*	ON	OFF	OFF	—	OFF
STORING HEAT & DOMESTIC H.W. HTG.		O	C	O	C	O	O	C	*	*	*	*	*	*	*	*	*	*	*	*	ON	*	ON	OFF	OFF	—	OFF
PEAK HEATING – ON-PEAK MODE	2nd – FROM STORAGE	*	C	C	C	*	*	*	O	O	C	C	O	C	O	O	C	C	O	O	*	ON	*	ON	OFF	—	OFF
	3rd – CONVENTIONAL	*	C	O	C	*	*	*	C	C	O	O	C	O	O	O	C	O	C	O	*	ON	*	ON	ON	—	OFF
	2nd/3rd – ELECTRIC RESISTANCE	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	O	C	O	*	[illegible]	*	ON	[illegible]	—	ON
PEAK HEATING – OFF-PEAK MODE	1st STG – CONVENTIONAL	*	C	O	C	*	*	*	C	O	C	C	C	C	O	O	C	O	C	O	*	ON	*	ON	ON	—	OFF
	2nd STG – ELECTRIC RESISTANCE	*	C	O	C	*	*	*	C	O	O	O	C	O	O	O	C	O	C	O	*	[illegible]	*	ON	[illegible]	—	OFF
	STORE HEAT	*	*	*	*	*	*	*	C	O	O	O	C	O	C	O	O	C	O	O	*	ON	*	*	ON	—	OFF
PEAK COOLING – ON-PEAK MODE	1st STG – FROM STORAGE	*	C	C	C	*	*	*	C	O	O	O	C	O	O	O	C	C	O	O	*	ON	*	ON	—	OFF	OFF
	2nd STG – CONVENTIONALLY	*	C	C	C	*	*	*	O	O	O	O	O	C	O	O	C	O	C	O	*	ON	*	ON	—	ON	OFF
PEAK COOLING – OFF-PEAK MODE	1st STG – CONVENTIONALLY	*	C	O	C	*	*	*	O	O	C	O	O	C	O	O	C	O	C	O	*	ON	*	ON	—	ON	OFF
	STORE COOL	*	*	*	*	*	*	*	O	O	C	C	O	C	C	O	O	C	O	O	*	ON	*	*	—	ON	OFF
CONTINUOUS AIR CIRC. (FAN ONLY)		*	C	O	C	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	ON	*	*	OFF
SUMMER WATER HEATING		O	C	O	C	O	C	O	*	*	*	*	*	*	*	*	*	*	*	*	ON	*	ON	*	—	*	OFF
DEAD STATE		C	O	O	O	C	*	*	C	C	O	O	C	O	O	O	C	O	C	O	OFF	OFF	OFF	OFF	ON	OFF	OFF

CHARGING PROCEDURE

1. After pulling 3 vacuums to 500 microns, charge heat pump system with 6 lbs. of R22 refrigerant
2. Allow system to run in heating mode and stabilize pressures before adding or removing refrigerant for optimum performance. Note exact amounts of refrigerant used and/or removed
3. Repeat pressure readings for cooling mode. System charge will have to be balanced for optimum operation in both modes.
4. Record exact final charges of refrigerant on rating plate of "Carrier" compressor box for future reference
5. All charging procedures to follow standard refrigeration practices as well as "Carrier" recommendations



NO	DATE	DESCRIPTION
3	3-14-78	[illegible]
2	5-11-78	[illegible]
1	5-26-78	[illegible]

REVISIONS

ATTACHMENT 1B

SOLARON CORPORATION
PHONE 303/759-0101
300 GALLERIA TOWER
720 S. COLORADO BLVD.
DENVER COLORADO

AKRON HOUSE
MECHANICAL ROOM

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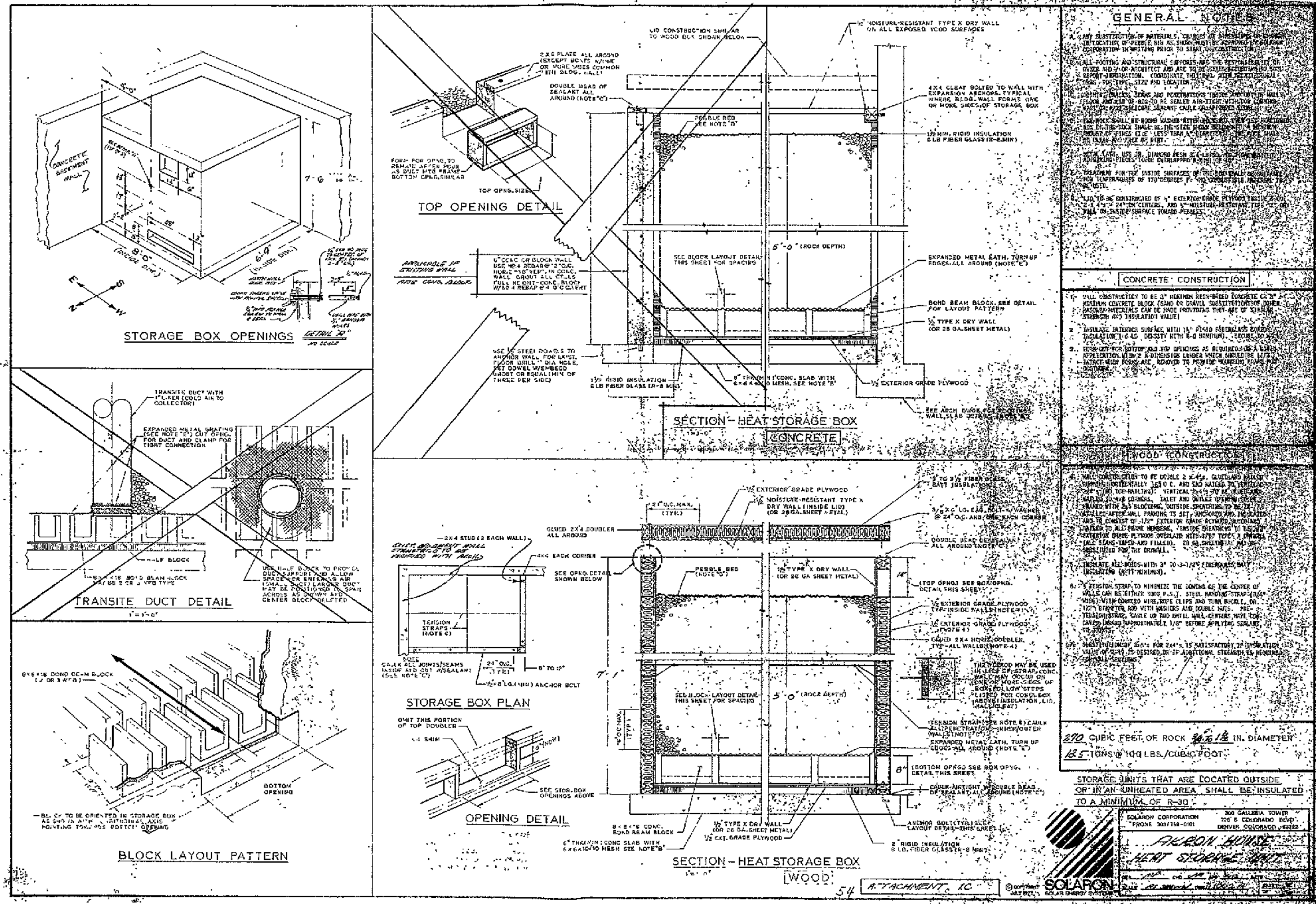

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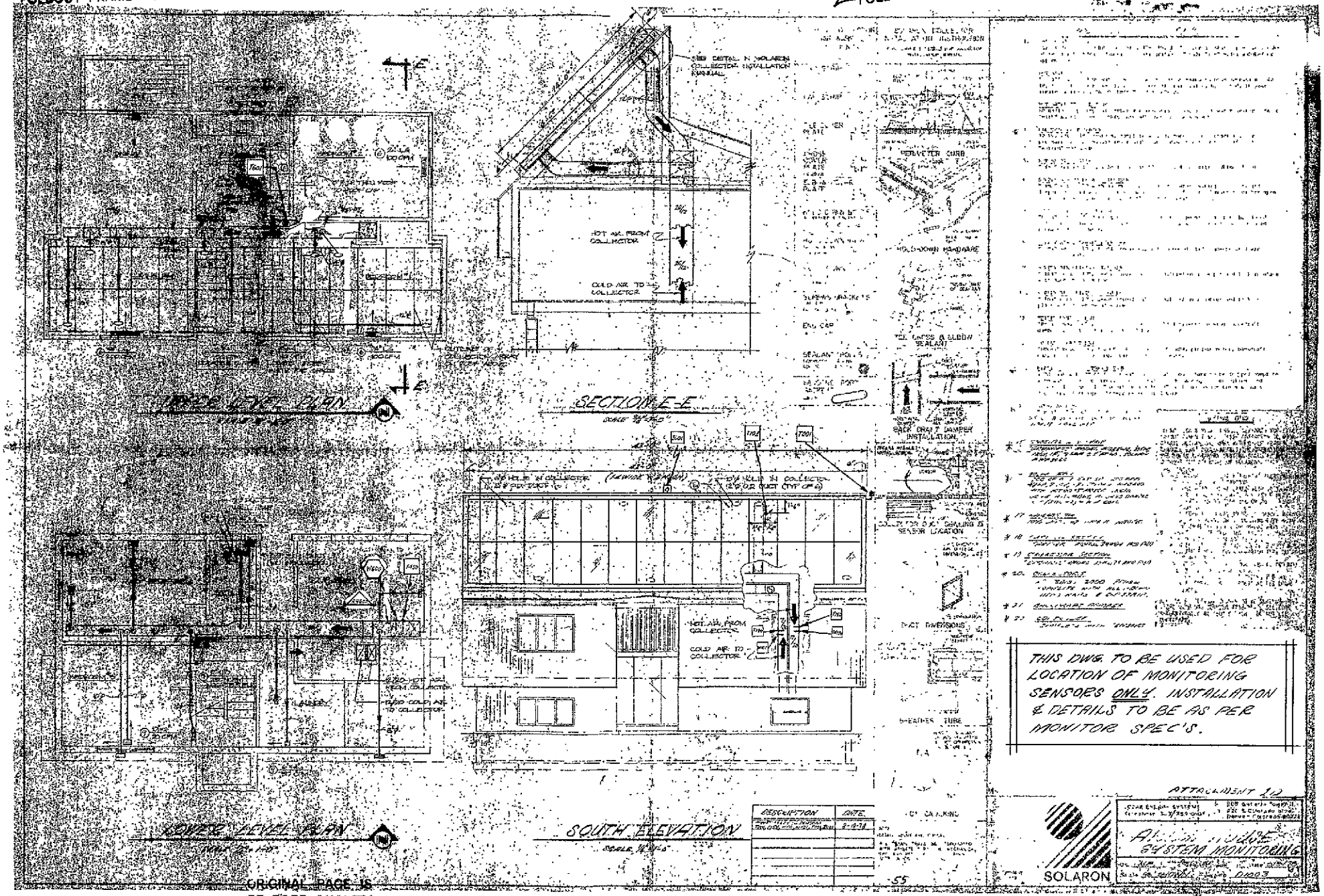

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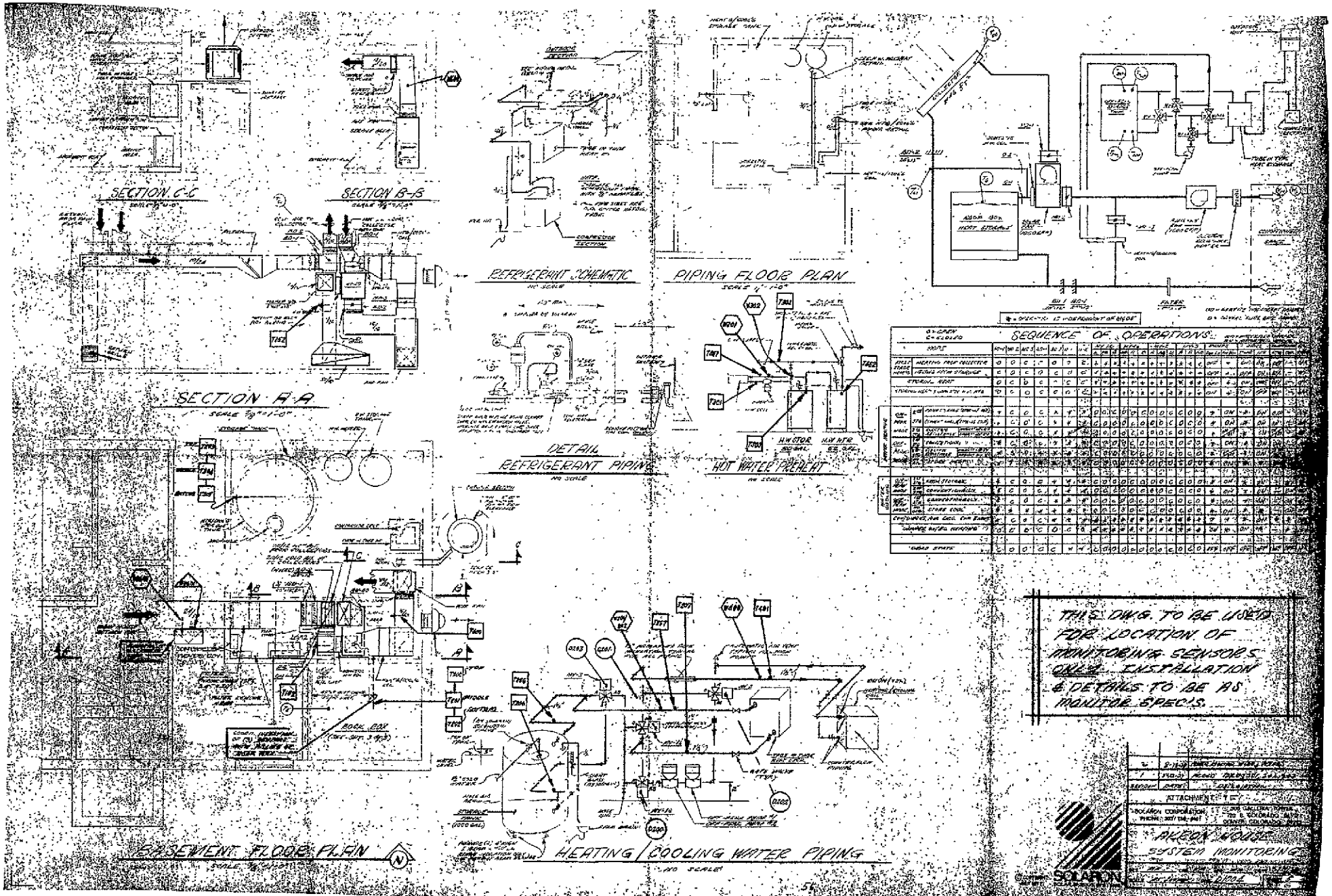

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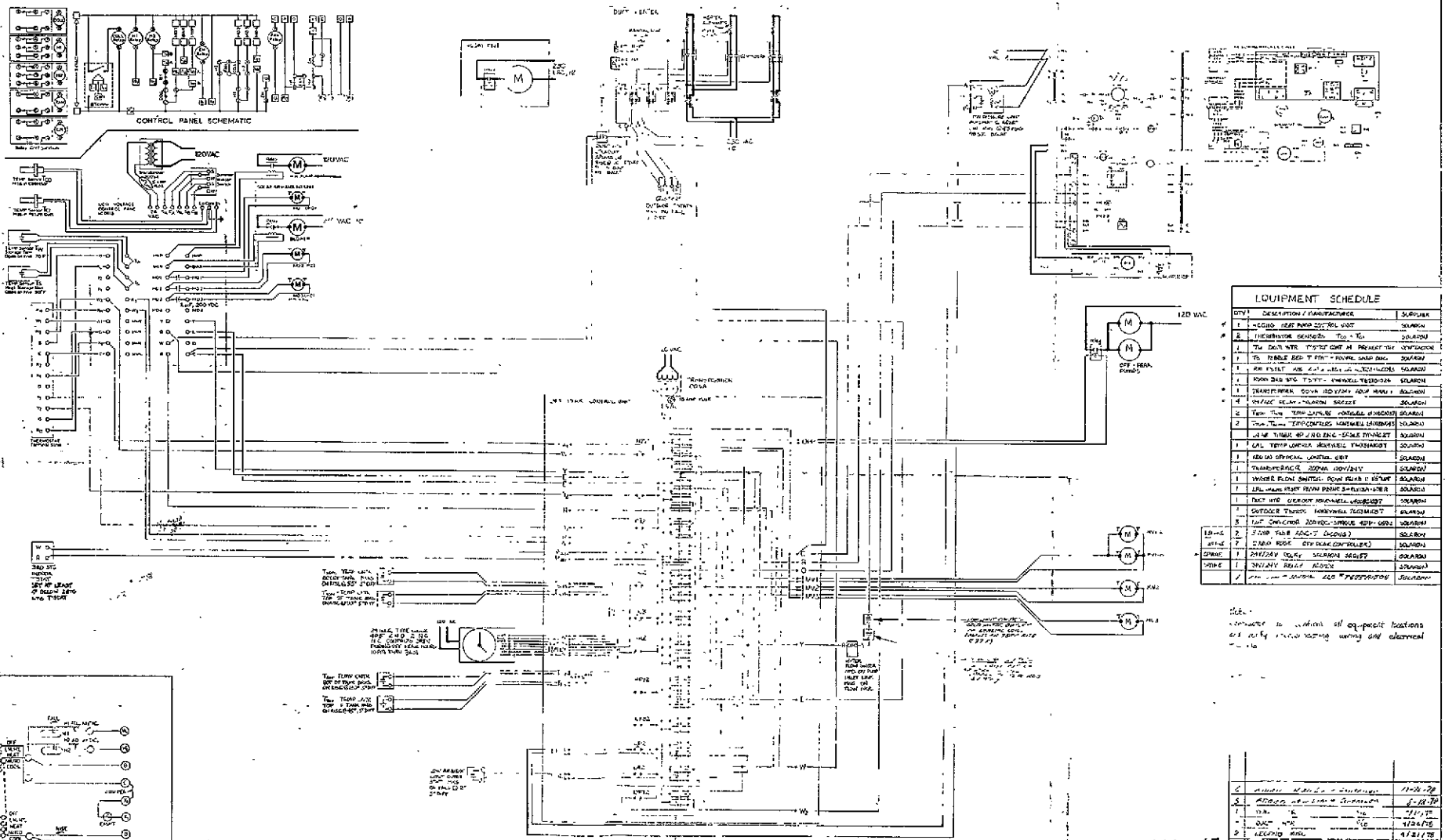

EQUIPMENT SCHEDULE

QTY	DESCRIPTION / MANUFACTURER	SUPPLIER
1	SOLAR HEAT PUMP CONTROL UNIT	SOLARON
4	THERMISTOR SENSORS Tcp, Tb, To	SOLARON
1	TH DUAL SETP THSTAT CONT H PRIORITY THERMOSTAT
1	TS THREE SPD T STAT - HONEYWELL T8130-024	SOLARON
1	AIR OUTLET SEN 4x14 SEN-AOS	SOLARON
1	ROOM SEN SPD THSTT - HONEYWELL T8130-024	SOLARON
1	TRANSFORMER, 50VA 120 VOLT PRIM SEC	SOLARON
4	INTAKE SCAT - SOLARON SCP222	SOLARON
6	TEMP TWO TEMP CONTROL HONEYWELL T4064A1012	SOLARON
2	TEMP TWO TEMP CONTROLLER HONEYWELL T4064A1012	SOLARON
	TIME TIMER, 30 2 NO 2 NC - SPACE TYPE T8222T	SOLARON
1	DIFF TEMP CONTROL HONEYWELL T4064A1012	SOLARON
1	HEATING OPERATING CONTROL L8148	SOLARON
1	TRANSFORMER, 100VA 240V/24V	SOLARON
1	WATER FLOW SWITCH - PADDLE FLOW 1 GPM	SOLARON
1	DIFF PRESS SWITCH PRESSURE SWITCH	SOLARON
1	FAST MTR GEAR MOTOR HONEYWELL M644C1002	SOLARON
1	OUTDOOR THERM HONEYWELL T6031A1027	SOLARON
3	TIME SWITCH 20 AMPS - SPACE TYPE T8222T	SOLARON
2	3 AMP TIME RELAY (DPDT)	SOLARON
2	2 AMP RELAY (DPDT RELAY CONTROLLER)	SOLARON
1	240 VAC RELAY SOLARON SR2E7	SOLARON
1	240 VAC RELAY SOLARON	SOLARON
1	[illegible] SOLARON "PRESSURATOR"	SOLARON

Note: Contractor to confirm all equipment locations are in by [illegible] wiring and electrical [illegible]

LEGEND

BWR	Boiler Pump	M1	1st Stage Heat Relay	A	24V Transformer Hot	W_{2nd}	2nd Stage Heat	DFTR	Defrost Thermistor Relay
C	24V Transformer Common	M2	2nd Stage Heat Relay	SOL	Stora. Cooled Water Valve	DT	Defrost Timer
COLL	Collector Relay	M2C	2nd Stage Heat Relay	SOLS	Stora. Chilled Water Valve	PC	Pilot Capacitor
LTD2	Load Room Thstt Relay	LH2	2nd Stage Heat Relay	SWH	Stora. Heat Relay	LRS	Low Pressure Switch
C1S	1st Stage Cooling Relay	LC2	Low Ambient Relay	Tcp	Temp. Bottom of Tank	OFM	Outdoor Fan Motor
C2S	2nd Stage Cooling Relay	LP2	Low Pressure Relay	T_b	Temp Top of Bed	CT	Quad Terminal
DHT2	Defrost Relay	M	Motor	Tbm	Temp Bottom of Tank	RC	Run Capacitor
E	Emergency Heat	MD	Motorized Damper	Ttank	Temp Top of Tank	RVS	Reversing Valve
Em	Emergency Heat Relay	MV	Motorized Valve	Ttop	Temp Top of Tank	ST	Suction Thermistor
TAH	Tank Heat	O	Reversing Valve	T_d	Temp Dwn Mtr Protect Tstat	TB	Terminal Block
G	Room Rly	OPP	Off Peak Pump	W	Strg Heat	TB2	Terminal Board
HWP	Dom Water Pump	P3	Power to Open	W_1	1st Stage Heat		Low Voltage Wiring
HTSS	Heat Tran Tank Pump	PC	Power to Close	W_2	2nd Stage Heat		Line Voltage Wiring

NO	REVISION	DATE
6	[illegible]	11-26-79
5	ADDED NEW LINE + SCHEMATIC	6-18-79
4	[illegible]	4/24/79
3	ADDED NEW	4/24/79
2	LEGEND ADDL	4/23/79
1	OFF PEAK CONTROL	4/20/79

ATTACHMENT 1F

SOLARON SOLAR ENERGY SYSTEMS

300 Galleria Tower 720 S. Colorado Blvd.
DENVER COLORADO 80222 (303) 759-0101

AARON HOUSE
WIRING DIAGRAM

drawn NLC chkd LC date 4/19/79
scale NONE drawing no. D1005 6/6

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