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DR. 738

SAN-1510-1

SOLAR HEATING SYSTEM FOR THE FIRST BAPTIST CHURCH,
1500 E. MELGAARD ROAD, ABERDEEN, S. DAK. 57401

Final Report

By
Harold E. Salem

April 16, 1979

Work Performed Under Contract No. EG-77-A-03-1510

MASTER

U.S. Department of Energy

Solar Energy

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Final Report on the

SOLAR HEATING SYSTEM

for the

FIRST BAPTIST CHURCH

1500 E. Melgaard Road

Aberdeen, S. Dak. 57401

AGREEMENT NUMBER

EG-77-C-03-1510

ACCOUNTING & APPROPRIATION DATA

EA-01-01

57-70-91 (37)

GOVERNMENT PROJECT MANAGER

KENN JEW
1333 BROADWAY
OAKLAND, CA 94612

PASTOR

HAROLD E. SALEM
1406 SQUIRE LANE
ABERDEEN, SO. DAK. 57401

DATE

APRIL 16, 1979

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MICHAUD, COOLEY, HALLBERG, ERICKSON & ASSOCIATES

CONSULTING ENGINEERS

310 PLYMOUTH BUILDING, MINNEAPOLIS, MINNESOTA 55402

September 25, 1978

Mr. Fen Salter
Lawrence Berkley Lab.
Berkley, CA 94720

RE: First Baptist Church Solar System
Aberdeen, South Dakota

Dear Fen:

The intent of the solar systems check-out was to determine whether the installed system meets the design requirements and if performance lies within acceptable limits.

Due to limited time and weather conditions, a complete systems check-out involving pressure drops, flow rates and temperatures for each mode of performance under actual climatic variations is impossible to accomplish.

The various modes of operation were simulated with temperatures and velocities being checked for each. The following is a summary of the results.

Aberdeen Baptist Church Solar Check-Out

Date: August 17, 1978

Attendance: Art McFadden City Air Conditioning
Joe Hallberg Michaud, Cooley, Hallberg, Erickson & Assoc.

Cloud Cover: Ranging from 30%-60% cloudiness

Outdoor Temp.: 85-90°

Solaron Air Handler: Designed for 2800 cfm at 2 hp.
measured at 2500 cfm at 5-5.5 amps (approx. 1 hp.)

Mr. Fen Salter
Page 2
September 25, 1978

Domestic Hot Water Pump: Design according to Solaron Guide.
Installed pump = 1/20 hp. Gpm range 0-23
with a corresponding head of 0-14 feet.
It is estimated that the installed pump
operates at 12 gpm with a 6 foot head.

Solar Radiation

August radiation on a tilted surface of 53°
For Rapid City, S.D. = 1,859 BTU/Sq.Ft./Day
or approximately 200 BTU/Hr/Sq.Ft. during midday,
or approximately 280,000 BTU/Hr. during midday.

Mr. Fen Salter
Page 3
September 25, 1978

Based upon the temperature measurements and flow rates the solar system proves to function properly for the given test period. We feel additional measurements should be taken during the heating season.

We further recommend that the contractor increase the fan motor speed in order that the system will deliver 2800 cfm. The result will increase the heat content of the air leaving the collectors, and reduce collector air temperature.

Cordially,

A handwritten signature in cursive script that reads "Joseph W. Hallberg".

Joseph W. Hallberg

JWH:dmh

CC: Dept. of Energy
Art McFadden
Floyd Bergquist

	COLLECTORS				DOM HT. WTR.				** WATER SIDE				STORAGE			
	t_i	t_o	D_t	MBTU/hr	t_{AL}	t_{AE}	$D_t A$	MBTU/hr	t_{WE}	t_{WL}	$D_t w$	MBTU/hr	t_{SE}	t_{SL}	$D_t s$	MBTU/hr
MODE 1 (Htg from coil)	78	116	38	102.6	103	116	13	35.1	*104	109	5	29.8	-	-	-	-
MODE 2 (Htg. Storage)	80	152	70	129.0	145	152	7	18.9	*115	130	15	-	145	82	63°	170.1
									Maximum storage capacity reached							
MODE 3 (Htg From Storage)	-	-	-	-	-	-	-	-	-	-	-	-	90	105	15°	40.5

* Assuming 12 gpm & 85% efficient heat exchanger.

** Temp measured at the surface of the pipes.

t_i - entering air temp. to collectors
 t_o - leaving air temp. to collectors
 t_{AL} - leaving air temp. from coil
 t_{AE} - entering air temp. from coil
 t_{WE} - water temp. entering coil
 t_{WL} - water temp. leaving coil
 t_{SE} - air temp entering storage
 t_{SL} - air temp. leaving storage
 D_t - Delta t or temp diff.

SOLAR COOPERATIVE
AGREEMENT NUMBER EG-77-A-03-1510
STATEMENT OF WORK

Operational and Maintenance Manuals

Operation and Maintenance Manuals will be prepared which are consistent with standard industry practice.

Draft versions of these Operation and Maintenance Manuals shall be prepared and submitted with the draft of the Technical Progress Report. Final Operation and Maintenance Manuals shall be provided with the Technical Progress Report.

Acceptance Test Plan (ATP)

The Participant shall develop an ATP which contains the procedure to be followed during acceptance test. A draft version of the plan shall be submitted for review at the Final Design Review.

The ATP is to verify: ..

1. That each item of solar connected equipment (i.e., collectors, storage tanks, controls fans, pumps, etc.) is operating, as designed, within the manufacturer's specified limits;
2. That the system is balanced to conform as closely as practical to the design performance specifications.

The ATP shall include items to be tested, test objectives, test requirements, and test methods.

Data collected to verify (1) and (2) above will be recorded along with the date, time and individual(s) performing test.

The Government furnished instrumentation system will be used to accomplish the acceptance tests.

III. REVIEWS

The Participant shall conduct the reviews described below at Aberdeen, South Dakota. These reviews are to define the specific solar system for installation, acceptance and operation.

CONTRACT PRICING PROPOSAL (RESEARCH AND DEVELOPMENT)				Office of Management and Budget Approval No. 29-RO184	
This form is for use when (a) submission of cost or pricing data (see FAR 1.4107-3) is required and (b) substitution for the Optional Form 32 is authorized by the contracting officer.				PAGE NO 1	NO. OF PAGES
NAME OF OFFEROR First Baptist Church		SUPPLIES AND/OR SERVICES TO BE FURNISHED Solar Energy System			
HOME OFFICE ADDRESS Aberdeen, South Dakota					
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED		TOTAL AMOUNT OF PROPOSAL \$		GOV'T SOLICITATION NO.	
DETAIL DESCRIPTION OF COST ELEMENTS					
1. DIRECT MATERIAL (Items on Exhibit A)			EST COST (\$)	TOTAL EST COST	REFER- ENCE
a. PURCHASED PARTS 2,938 + 34,190			37,128		A-1, A-2
b. SUBCONTRACTED ITEMS			11,600		A-2
c. OTHER — (1) RAW MATERIAL Shipping Costs 8.75 X 78			683		
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS (if other than cost)					
TOTAL DIRECT MATERIAL				49,411	
2. MATERIAL OVERHEAD* (Rate 10 % of 48,728 base)				4,873	
3. DIRECT LABOR (Specify)		ESTIMATED HOURS	RATE/HOUR	EST COST (\$)	
Mechanical & Electrical		649	14.00	9,086	A-2
General Construction				1,468	A-1
TOTAL DIRECT LABOR				10,554	
4. LABOR OVERHEAD (Specify Department or Cost Center)		O.H. RATE	BASE	EST COST (\$)	
		17%	10,554	1,794	
TOTAL LABOR OVERHEAD				1,794	
5. SPECIAL TESTING (including field work at Government installations)			EST COST (\$)		
TOTAL SPECIAL TESTING					
6. SPECIAL EQUIPMENT (If direct charge) (Items on Exhibit A)					
7. TRAVEL (If direct charge) (Items on attached Schedule)			EST COST (\$)		
a. TRANSPORTATION			66,632		
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL				66,632	
8. CONSULTANTS (Identify — purpose — rate)			EST COST (\$)		
Architectural & Engineering Fee 9%			5,997		
TOTAL CONSULTANTS				5,997	
9. OTHER DIRECT COSTS (Items on Exhibit A)					
TOTAL DIRECT COST AND OVERHEAD				72,629	
10. GENERAL AND ADMINISTRATIVE EXPENSE (Rate 7 % of cost element No. 10)				5,084	
12. ROYALTIES					
TOTAL ESTIMATED COST				77,713	
14. FEE OR PROFIT				NONE	
TOTAL ESTIMATED COST AND FEE OR PROFIT					

This proposal is submitted for use in connection with and in response to (Provide RFP No.)

ERDA PON DSE-76-2 Document Control #5016

and reflects our best estimates as of this date, in accordance with the Instructions to Offerors and the conditions which follow.

TITLE NAME AND TITLE Harold E. Salem, Pastor	SIGNATURE
NAME OF FIRM First Baptist Church, Aberdeen, South Dakota	DATE OF SUBMISSION

EXHIBIT A--SUPPORTING SCHEDULE (Specify. If more space is needed, use reverse)

COST ITEM	ITEM DESCRIPTION (See footnote 5)	EST COST (\$)
Labor	GENERAL CONSTRUCTION FOR SOLAR SYSTEM - Exhibit A-1	Material
	Storage Bed	
100	Excavation - 10 yds.	
48	Footing - 30 ft.	153
170	Conc. Block Wall - 5 ft. x 30 ft. = 150 sq. ft.	201
44	Insulation - 150 + 80 = 230 sq. ft.	65
	Transite Header - 15 ft.	150
200	Rock Fill - 800 cu. ft.	480
380	Wood Framing Support - 1,521 sq. ft.	1,141
456	Edge Trim & Flashing & Caulking - 152 ft.	608
1398		2,798
70	General Conditions @ 5%	140
1498 - TOTAL LABOR		TOTAL MATERIAL - 2,938
		GRAND TOTAL 4,406

I. HAS ANY EXECUTIVE AGENCY OF THE UNITED STATES GOVERNMENT PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER GOVERNMENT PRIME CONTRACT OR SUBCONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO (If yes, identify below)

NAME AND ADDRESS OF REVIEWING OFFICE AND INDIVIDUAL TELEPHONE NUMBER/EXTENSION

II. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS PROPOSED CONTRACT?

☐ YES ☒ NO (If yes, identify on reverse or separate page)

III. DO YOU REQUIRE GOVERNMENT CONTRACT IDENTIFICATION TO PERFORM THIS PROPOSED CONTRACT?

☒ YES ☐ NO (If yes, identify) ☐ ADVANCE PAYMENTS ☒ PROGRESS PAYMENTS OR ☐ GUARANTEED LOANS

IV. DO YOU NOW HOLD ANY CONTRACT (Or do you have any independently financed (R&D) projects) FOR THE SAME OR SIMILAR WORK CALLED FOR BY THIS PROPOSED CONTRACT?

☐ YES ☒ NO (If yes, identify)

V. DOES THIS COST SUMMARY CONFORM WITH THE COST PRINCIPLES SET FORTH IN AGENCY REGULATIONS?

☒ YES ☐ NO (If no, explain on reverse or separate page)

See Reverse for Instructions and Endnotes

OPTIONAL FORM NO. 310-71

This proposal is submitted for use in connection with and in response to (Drawn RFP, etc.)

and reflects our best estimates as of this date, in accordance with the Instructions to Offerors and the Footnotes which follow.

TYPED NAME AND TITLE

SIGNATURE

ABERDEEN CHURCH.

NAME OF FIRM

MECH & ELEC COSTS EXHIBIT A-2

DATE OF SUBMISSION

HRS.

EXHIBIT A-SUPPORTING SCHEDULE (Specify. If more space is needed, use reverse)

COST EL NO.	ITEM DESCRIPTION (See footnote 5)	EST COST (\$)
325	SOLAR AIR COLLECTORS 1560 SQ. FT. @ 78¢/sq. ft. + HARDWARE	26,910.00
40	SUPPLY AIR UNIT 3000 CFM	1700.
18	WINTER STORAGE TANK 300 GAL.	1700.00
5	HOT WATER COIL 6"	450
6	CIRCULATING PUMP 30 gpm	500
15	FRESH AIR LOUVER 6"	100
15	EXH. LOUVER 6"	100
4	2 - 18X18" FILTERS W/FRAMES	20
8	2 - 18X18" STORAGE COILS	70
125	18X18" DUCT 200' W/INSUL. 8.9¢/ft. 6.33 x 1.13	1900
14	8" MAN. DAMPERS 25	40
20	2" PIPE & FITTINGS 100' x 1.91	190
20	18" x 18" MOTOR DAMPS (10)	230
30	FLASHING -	200
4	VALVES.	180
649	914.5¢/sq. ft. = 9086	34,190
		9086
	TEMP CONTROL -	2450.00
	ELECTRICAL	350.00
	TEST & BAL 40 @ 20.00	800.00
	MONITORING 12 @ 250.00	3000.00
	COST OF ADAPTING to PRESENT	5000
	STRUCTURE	11,600.00

I. HAS ANY EXECUTIVE AGENCY OF THE UNITED STATES GOVERNMENT PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER GOVERNMENT PRIME CONTRACT OR SUBCONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☐ NO (If yes, identify below.)

NAME AND ADDRESS OF REVIEWING OFFICE AND INDIVIDUAL

TELEPHONE NUMBER/EXTENSION

* 35.18/4

II. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS PROPOSED CONTRACT?

☐ YES ☐ NO (If yes, identify on reverse or separate page)

III. DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT?

☐ YES ☐ NO (If yes, identify.): ☐ ADVANCE PAYMENTS ☐ PROGRESS PAYMENTS OR ☐ GUARANTEED LOANS

IV. DO YOU NOW HOLD ANY CONTRACT (Or, do you have any independently financed (IRGD) projects) FOR THE SAME OR SIMILAR WORK CALLED FOR BY THIS PROPOSED CONTRACT?

☐ YES ☐ NO (If yes, identify.):

V. DOES THIS COST SUMMARY CONFORM WITH THE COST PRINCIPLES SET FORTH IN AGENCY REGULATIONS?

☐ YES ☐ NO (If no, explain on reverse or separate page)

See Reverse for Instructions and Footnotes

OPTIONAL FORM 60 (10-71)

PROJECT INFORMATION SUMMARY DATA SHEET 2

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5016

A BUILDING SUMMARY

1. OWNER NAME AND ADDRESS First Baptist Church, Aberdeen, South Dakota
2. BUILDING FLOOR AREA, SQ. FT. N/A
3. SOLAR CONDITIONED AREA, SQ. FT. N/A
4. TOTAL ENERGY REQUIREMENTS ANTICIPATED BTU/YR Cooling: N/A
Space Heating: N/A
Hot Water: N/A
5. SOLAR ENERGY UTILIZATION
 - (a) N/A % SPACE HEATING
 - (b) N/A % COOLING
 - (c) N/A % HOT WATER
6. BACK-UP ENERGY SYSTEM (TYPE) N/A
7. OTHER (SPECIFY) N/A

B FUNDING SUMMARY

1. LAND COST, \$ N/A X
2. TOTAL BUILDING COST, INCLUDING SOLAR SYSTEM \$ 561,713
3. ERDA COST SHARE \$ 69,942 (.90 %)
4. TOTAL BUILDING COST WITH CONVENTIONAL ENERGY SYSTEM, \$ 484,000
5. SOLAR SYSTEM COST DIFFERENTIAL, \$ (ITEM 2 — ITEM 4) 77,713
6. TOTAL, INSTALLED SOLAR ENERGY SYSTEM COST, \$ 66,632
7. TOTAL, SOLAR SYSTEM COST EFFECTIVENESS, \$ / BTU/YR .000451
8. PAYBACK, SOLAR ENERGY SYSTEM COST,
based on annual 15% fuel cost escalation YR 19

N/A: NOT APPLICABLE AT THIS TIME:

PROJECT INFORMATION SUMMARY DATA SHEET 3

C SOLAR ENERGY SYSTEM

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5016

• SOLAR COLLECTOR

1. TYPE _____ N/A _____
2. MFR: (S) _____ N/A _____
3. UNIT COST, \$/SQ. FT. 15.38 _____
4. TOTAL COST, \$ 23,400.00 _____
5. SHIPPING/DELIVERY COST, \$ 683.00 _____
6. DELIVERED COST, \$ (C4 + C5) 24,083.00 _____
7. STRUCTURAL, INSTALLATION, MATERIAL COSTS, \$ 5,346 _____
8. INSTALLATION LABOR COST, \$ 5,427 _____
9. OTHER (SPECIFY) \$ 3,798 _____
10. TOTAL, INSTALLED SOLAR COLLECTOR COST, \$(C6 + C7 + C8 + C9) 38,654 _____

• AREA	_____ N/A _____
	LIQUID AIR
• OPERATING FLOW	_____ N/A _____
• BURST PRESSURE	_____ N/A _____
• ABSORBER DESCRIPTION	_____ N/A _____
• ABSORBER COATING	_____ N/A _____
• OTHER COMMENTS	_____ N/A _____
• TRANSFER FLUID	_____ N/A _____
• GLAZING	_____ N/A _____

ENERGY TRANSPORT AND STORAGE

11. PIPING, VALVES, PUMPS, \$ 8,338 _____
12. CONTROLS, \$ 7,260 _____
13. STORAGE TANKS, \$ HW 1,870 _____
Rock 1,137 _____
14. NUMBER OF TANKS _____ N/A _____
15. TOTAL TANK CAPACITY, CU.FT. _____ N/A _____
16. INSTALLATION LABOR COST, \$ 9,243 _____
17. COOLING UNIT COST, \$ _____ N/A _____
18. COOLING UNIT CAPACITY, TONS _____ N/A _____
19. COOLING CONTROLS, DISTRIBUTION SYSTEM, \$ _____ N/A _____
20. COOLING SYSTEM INSTALLATION LABOR, \$ _____ N/A _____
21. INSULATION COSTS \$ Storage Bed Only 130 _____
22. OTHER COSTS (SPECIFY) \$ _____
23. TOTAL, ENERGY TRANSFER CONTROL, \$(C11, 12, 13, 16, 17, 19, 20, 21, 22) _____ 27,978
24. TOTAL, INSTALLED SOLAR ENERGY SYSTEM COST, \$ (C10 + C23) _____ 66,632

• TYPE:	_____ N/A _____
• CAPACITY: (GAL.)	_____ N/A _____
• HEAT EXCHANGER TYPE	_____ N/A _____
• BURST PRESSURE	_____ N/A _____
• HEAT TRANSFER COEFFICIENT (HEAT EXCHANGER)	_____ N/A _____

N/A: NOT APPLICABLE AT THIS TIME

PROJECT INFORMATION SUMMARY DATA SHEET 4

D ENERGY UTILIZATION

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5016

• SOLAR ENERGY COLLECTION

1. AVERAGE ANNUAL INSOLATION, UPON COLLECTOR SURFACE BTU/SQ. FT./YR.
Maximum possible when 100% sunny days (745,849)
Most probable because of cloud cover (478,751)
2. UNIT ENERGY COLLECTED, BTU/SQ. FT./YR. 113,248
3. TOTAL ENERGY COLLECTION, BTU/YR. 172,250,000
4. SOLAR SPACE HEATING USAGE, BTU/YR. 156,660,000
5. SOLAR HOT WATER USAGE, BTU/YR. 15,590,000
6. SOLAR COOLING USAGE, BTU/YR. N/A
7. TOTAL SOLAR ENERGY USAGE, BTU/YR. 172,250,000
8. INSTALLED SOLAR COLLECTOR EFFECTIVENESS \$/BTU/YR. .000224
9. INSTALLED SOLAR ENERGY SYSTEM, \$/BTU/YR. .000387

• BUILDING ENERGY LOAD

10. SPACE HEATING, BTU/YR. N/A
11. HOT WATER, BTU/YR. N/A
12. COOLING, BTU/YR. N/A
13. TOTAL ENERGY LOAD, BTU/YR. N/A
14. TOTAL, BACK-UP ENERGY USAGE, BTU/YR. N/A

• SOLAR SYSTEM OPERATIONS

15. SOLAR SYSTEM OPERATING COST, \$/YR. 50.00
16. SOLAR SYSTEM MAINTENANCE COST, \$/YR. 50.00
17. TOTAL SOLAR SYSTEM OPERATIONAL COST \$/YR. 100.00

• CLIMATIC DATA

LATITUDE N/A DEG.

DEGREE DAYS: HEATING N/A COOLING N/A

PROJECT INFORMATION SUMMARY DATA SHEET 5

ERDA USE ONLY

SEASON		WINTER		SUMMER	
AVE. TEMP.	N/A	° F	N/A	° F	N/A
AVE. INSOLATION	N/A	LY	N/A	LY	N/A

• COST DATA

18. BACK-UP ENERGY UNIT COST, \$/BTU .0000040

19. TOTAL, BACK-UP ENERGY COST, \$/YR. \$ 1,526

20. EQUIV. BACK-UP ENERGY COST W/O SOLAR OPERATION, \$/YR 2,215

21. ENERGY COST SAVING, \$/YR. 689

22. PAYBACK, SOLAR ENERGY SYSTEM COST, YRS. 19 years
 based on annual 15% fuel cost escalation

N/A: NOT APPLICABLE AT THIS TIME

E COST SHARING

1. APPLICANT, \$(%)	<u>\$ 7,771</u>	<u>10%</u>
2. CONTRACTOR(S), \$(%)		
3. CONSULTANT(S), \$(%)		
4. OTHER(S), \$(%)		
5. ERDA, \$(%)	<u>\$ 69,942</u>	<u>90%</u>
6. TOTAL \$	<u>\$ 77,713</u>	<u>100%</u>

CITY AIR CONDITIONING

501 RR AVENUE EAST • P.O. BOX 617
ABERDEEN, SOUTH DAKOTA 57401

FIRST BAPTIST CHURCH SOLAR PROJECT

DESCRIPTION OF SYSTEM

The collectors are flat plate type - air is used for heat transfer. The storage unit is rock - located under the building. The system also has a domestic water preheater.

PROBLEMS IN BUILDING SYSTEM

1. Not adequate room for ductwork.
2. Not adequate room in equipment room.
3. Interfacing of electric and pneumatic control systems.
4. Collector array is 30° - should have been 53° to prevent excess amounts of snow and ice build up. To compound this problem there is a lower roof at bottom of collectors
5. System should have one additional blower to operate in the heat from storage cycle.

MAJOR MAINTENANCE PROBLEMS

1. Excess complexity of control system.
2. Cannot keep collector array water tight, with ice sliding down face of panels.
3. No way to monitor system on sight.

RECOMMENDATIONS

I would recommend a control service contract with Johnson Controls to maintain control system.

Submitted by

Arthur J. McFadden

ADJUST LOCATION
OF DUCT
AS NEEDED

ROUTE VENT TO
AVOID NEW DUCT
ABOVE

NEW ROLL BOX

FOUNDATION PLAN - MECHANICAL
REVISED
1/10 = 1'-0"
Δ DENOTES RELOCATION

1ST BAPTIST CHURCH
ABERDEEN S.D. - SOLAR -
UNDERGROUND REVISIONS

DATE 8-2-77
DRAWN DB
COMM 7737

SHEET NO
SC2
REVISED

1ST BAPTIST CHURCH
ABERDEEN S.D. - SOLAR -
JOIST SPACING REVISIONS

DATE 8-2-77
DRAWN OB
COMM 7127

SHEET NO

SC4

1ST BAPTIST CHURCH
ABERDEEN S.D. - SOLAR
FLASHING

DATE 9-12-77
DRAWN DB
COMM 7727

SHEET NO
SC5

①
SC6

U-BLOCK LAYOUT

1ST BAPTIST CHURCH
ABERDEEN S.D. — SOLAR
U-BLOCK LAYOUT

DATE 9-12-77
DRAWN OB
COMM 7727

SHEET NO
SC6

INSTALLA

S.O.L.A.R. 700.00.100 Revision 1

3-77

Series 2000 COLLECTOR PANELS

Collectors must be
stored in dry area

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SOLARON TM
SOLAR ENERGY SYSTEMS
720 S COLORADO BLVD
DENVER COLORADO 80222

ION MANUAL

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DWG. 1 STARTING PANELS SUPPORT STRIP

STEP #1

The builder and/or framer must install the roofing felt and the 1-1/2" x 1-1/2" starter strip at the bottom edge of the collector array as shown above, BEFORE any collector panel installation is started. This strip serves as support for bottom row of collectors until hold downs are installed and also is used to ensure proper alignment of the entire collector array. The collector array must be laid out so that it will fit on the roof with 6" clear on all sides for cap strip support and perimeter insulation. (see Drawing #2). Do not install 1-1/2" x 7-1/8" perimeter frame prior to collector mounting.

RECOMMENDED TOOL LIST

1/4" or 3/8" reversible, variable speed electric drill, sabre saw, reciprocating saw or skill saw, medium slot-type screw driver, 50 ft. or longer tape measure, 10 ft. to 16 ft. tape, chalk line, square (18"x24"), 2-7/16" hex sockets for 1/4" driver, two 1/4" X 6" extensions (to be mounted in drill chuck), utility knife, pliers (standard), Solaron pull-up tool (limited application), come-along with 30' min. cable length, sunglasses (polarizing), work gloves, safety helmets, safety ropes & accessories (if needed), ladders (appropriate for height of array being worked on), roof jacks (if required), machine for lifting collector onto roof (crane, front loader, etc.), matches or cigarette lighter, caulk gun, left & right snips, scratch awl, 5/16" dia. drill bit 10" long, Scribe.

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DWG. 2 ARRAY LAYOUT ON ROOF

STEP #2

Chalk outline of actual perimeter of the collector array onto the roofing felt, as shown above, making certain that your lines are square and plumb.

STEP #3

From plan of collector array (mech. drawing) determine location of holes to be cut in sheathing. These holes permit access for starting collar connection between panel and duct work (see drawing #3 & #5). The holes in the collector panels can only be cut in the manifold section as shown in drawings 3 and 5. This must be coordinated with roof sheathing holes. Cut roof sheathing holes 2" in diameter larger than collar (i.e. plans show an 8" collar, cut a 10" hole. Hole may be either round or square.

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NOTE

TILT PANEL TO ALLOW ACCESS FOR CUTTING HOLE IN BOTTOM (DUCT CONNECTION). DO NOT INVERT PANEL. GLASS IS NOT CLAMPED IN PLACE AND COULD DROP FROM FRAME WITH IMPROPER HANDLING

LAY BEAD OF DOW-CORNING CAULKING NO. 732-CL-11 UNDER COLLAR FLANGE FOR AIRTIGHT SEAL

SEE COLLECTOR ARRAY PLAN (MECH. PLAN) FOR HOLE SIZE

STARTING COLLAR (W FLANGE) FOR FLEX. DUCT CONN. MUST BE INSULATION GUARD TYPE (COLLAR EXTENDS 1" INTO PANEL)

DWG. 3 CUTTING OF COLLAR HOLE (method 4 a)

STEP #4

Collar holes to be cut in the collector panels by one of two methods as follows:

- (a) Should the location of the mounted panel prevent easy access for hole cutting use method shown above for cutting hole before the collector panel is mounted to the roof sheathing. Make sure the hole you cut in the bottom of the panel and through insulation lines up with hole already cut in the roof sheathing.
- (b) After collectors are installed securely on the roof (as per Step #5) cut the required holes in the bottom of each predetermined collector panel (confirm the size & location of each hole with the mechanical plans).

Any method of collar mounting requires caulking with Dow-Corning #732-CL-11 to form air-tight joint between collar flange and the collector.

DWG. 4 HOLD-DOWN HARDWARE INSTALLATION

STEP #5

Referring to drawings 4 and 5, drill 5/16" holes in roof sheathing for collector hold downs in designated places, as shown in drawing 5. Secure exterior hold downs after collector is in place. When two panels are mated, drill 5/16" holes for the interior hold downs after the adjoining collector is pulled tightly against the port gasket. The gasket must be kept clean and applied to a clean surface.

5

DIMENSIONS TYPICAL
FOR ALL MANIFOLDS

HOLE TO BE CUT IN BOTTOM
OF PANEL FOR DUCT CONN-
ECTION (PAGE 3) MUST BE
LOCATED IN MANIFOLD SPACE.
HOLE NOT ALWAYS CENTERED
DUE TO RAFTERS. (TYPICAL-
ALL COLLECTORS)

HOLD-DOWN POINT (TYP.-
10 PLACES) USE THIS
PATTERN-ALL PANELS
SEE PAGE 4 FOR HOLD-
DOWN HARDWARE.

DWG. 5 HOLD-DOWN HARDWARE ATTACHMENT POINTS

STEP #5 (Cont.)

Place each bolt with clamp into its proper hole (external hardware around the perimeter and internal hardware between collector panels - see drawing 4). One person must put a washer and a lock nut onto the same bolt from the attic side of the roof and tighten. A 7/16" socket & 7/16" open end wrench or adjustable wrench is recommended for tightening hold down bolts. Internal hold down should "dimple" collector metal. Exterior hold down should catch rivet. Should the location of the collector place the hold down bolt directly over a structural member you have two methods of mounting. 1) Discard the 6" x 1/4" bolt and use a 6" x 1/4" lag bolt. Tighten directly into the structural member. 2) Discard the 6" x 1/4" bolt and drill a 5/16" hole all of the way through the structural member. Use 1/4" all-thread to the required length and mount as described above. CAUTION - be sure the structural integrity of a member is not affected by this method of mounting BEFORE you start drilling.

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Lag Hold-Downs

Place the hold down hardware (i.e. 6" X 1/4" lag bolt with the appropriate interior or exterior clamp) at the attachment points shown in drawing 5. Screw the lag bolt into the roof sheathing by using a 7/16" hex socket (on a 1/4" extension) and a 1/4" or 3/8" electric drill. Interior hold down clamps must dimple the collector metal to hold properly. Exterior clamps should catch one of the rivet heads on the collector. After lags have been drilled into place, a washer and tinnerman must be placed on the tip of lag from the underside of the roof.

Screw Hold-Downs

After placing collector in position, secure in place using 4 lag bolts or bolts. Using bugle-head drywall screws (2 3/8" #S12 or 6-20 X 1 5/16" flooring screws) drill into the backside of the collector and roof sheathing from the attic area. Eight (8) screws are required; four on each side near the edge of the collector. This procedure is recommended for very steep roof angles. DO NOT use sheetmetal screws for this application. Eight washers are also required and should be placed on the screw before drilling.

DWG. 6 PORT CONNECTIONS

STEP #6

Install the silicone gasket and attach end cap with screws to the collector panel, as shown above, making sure you obtain an airtight seal. As each panel is positioned in its location be sure that the gasket has been properly mounted around each port that will be immediately mated to an adjacent collector panel port. The gasket must seat evenly around the port to insure an airtight seal.

STEP #7

Lay a bead of Dow-Corning #732-CL-11 caulking compound around the opening in the bottom of the collector panel as shown in Drawing 3. This is to insure an airtight seal between the collector and the starting collar flange. Mount the starting collar in such a manner that will make a solid, airtight connection.

STEP #8 Relief Tube -

When collector is in place and secured, but before cap strip is installed, check red nylon pressure relief tube to make sure it is open so that pressure between panes of glass has had time to equalize to local atmospheric pressure. Next, seal tube by tying knot in tube and permanently sealing end by melting and squeezing the open end closed. Now place closed tube under neoprene gasket along the edge of the glass (see detail on dwg 6) & return gasket to normal position.

DWG. 7 CAP STRIP ASSEMBLY

STEP #9

After all the collectors are in place and secured, coordinate with builder to install 1-1/2" x 7-1/8" frame assembly around perimeter of array as per drawings 8 and 9 (mounting cap strip and flashing). Flashing must be installed before perimeter sealant and perimeter cap strip can be installed.

CAP STRIP/COVER PLATE INSTALLATION

STEP #10

Referring to Drawings 7 & 8 start installation of cap strip. Cap strip is mounted with 2-1/2" screws and metal backed neoprene washer. Place screw with washer through pre-drilled holes in cap strip. See Drawing 7. Turn the screw into the tinnerman clip approximately 3 turns. Place cap strip so that each edge is lined up on collector glass gasket evenly with nut plates under glass enclosure lip. By pressing on the screw while turning to secure nut plate, you will keep nut plate straight so that it will secure itself under adjacent glass enclosure shelves. Cap strips between collectors should be mounted during collector installation to hold glass in place.

NOTE: Wood Frame Ass'y. ($1\frac{1}{2} \times 7\frac{1}{8}$ " plus Plywd. Strip) To Be Installed After Collector Panels Are In Place

COLLECTOR FLASHING/SENSOR PLACEMENT

STEP #11

When you install the perimeter cap strip, the same procedure is followed, except that you will be placing one edge of cap strip on glass gasket and the other edge into the perimeter flashing sealant (See drawing 9). Flashing sealant is placed on flashing prior to cap strip mounting.

STEP #12

When installing the "Cross, El or Tee" cover plates, run a double bead of Dow-Corning 732-CL-11 silicone caulk on the cap strip as shown in Drawing 8. Install $\frac{5}{8}$ " Tec self-drilling screws in pre-drilled holes and tap into cap strip. A third hole must be drilled into the 90 degree L in accordance with the wood backing to obtain a tight seal in the corners (see Drawing 8).

NOTE: $2\frac{1}{2}$ " screws, metal backed neoprene washers, nut-plate and tinnermans & $\frac{5}{8}$ " self-tapping screws furnished by Solaron.

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DWG. 10 ASSEMBLY DETAILS

1 HIGH VERTICAL ARRAY

(2003 "X" and "Y" PANELS)

SEE INSTALLATION MANUAL
FOR ADDITIONAL INSTRUCTIONS

3 HIGH

VERTICAL ARRAY

12

END CAP PAIR-TYPICAL
TO CLOSE OFF OUTSIDE
PORTS-PERIMETER OF
COLLECTOR ARRAY. SEE
PAGES 6,10, INSTALL-
ATION MANUAL

PORT GASKETS
BETWEEN ALL
INTERIOR PORT
CONNECTIONS. SEE
PAGES 6,10, INSTALL-
ATION MANUAL

HOLE CUT IN PANEL AND
SHEATHING FOR COLLAR
(PAGE 3, INSTALL. MANUAL)

HOT AIR FROM
COLLECTOR

COLD AIR TO
COLLECTOR

1 1/2 x 1 1/2 SUPPORT STRIP
(SEE PAGE 1, INSTALL. MANUAL)

SEE INSTALLATION MANUAL
FOR ADDITIONAL INSTRUCTIONS

1 HIGH

HORIZONTAL ARRAY

13

(2001 PANEL)

SEE INSTALLATION MANUAL
FOR ADDITIONAL INSTRUCTIONS

(2001 PANEL)

SEE INSTALLATION MANUAL
FOR ADDITIONAL INSTRUCTIONS

INSTALLATION

S.O.L.A.R. 1500.00.100

6-1977

SOLARONTM
Controller
HC0115

FOR USE WITH AU0400 &
AU0500 AIR HANDLER

CONTAINS OPERATION &
MAINTENANCE DETAILS

Applications:

1. Heating Only
2. " " w/Fan Circ.
3. Heating and Cooling
(NON HEAT PUMP)

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300 GALLERIA TOWER
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ION MANUAL

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LOCATING THE SOLARON CONTROL PANEL AND TRANSFORMER

Mount the control panel in a convenient location that allows easy access for electrical wiring and "summer/winter" switch operation. Generally the mechanical room is the best location. Electrical service consisting of one 115 VAC circuit is ample to power the 100 VA, 120 VAC/24VAC transformer accompanying the control panel. Separate power circuits may be needed for the AU0400 or AU0500 unit and the auxiliary heating unit (refer to local and national building codes).

Low voltage wiring is needed to connect the Soloron space thermostat to the Soloron control panel as well as between the auxiliary heating unit, damper motors and the control panel. Damper motors are low voltage.

The thermostat MUST be wired through the Soloron control panel, it CANNOT be wired direct to the auxiliary heating unit and/or Soloron air handling unit.

SOLAR SYSTEMS SENSORS

Sensors must be properly placed in the following locations before system start-up can be accomplished:

1. Tco - Sensor must be in absorber plate air channel (not in duct connection or manifold plenum).
2. Tci - Locate at junction of house return air duct and duct connecting to bottom of heat storage (for systems with by-pass of heat storage for summer water pre-heating, locate in duct to collector where "by-pass" tees in).
3. Ts - Top of rock in heat bin.
4. Tw - Locate in bottom of water storage tank (not the auxiliary water heater) near inlet of heat exchanger coil. (If using an unwired electric water heater for a storage tank, the thermostat in the tank can be used as Tw. Disconnect power leads from thermostat and power element and wire through terminals that open on temperature rise - set @ 140°F). Tw is field furnished (Honeywell L6006A1145 @ 140°F and differential set @ 10°F).

HUMIDIFIERS

Horizontally mounted type humidifiers are recommended. Locating the humidifier in a horizontal supply duct coming off of the auxiliary heating unit is ideal. Utilizing a sail-switch activated duct humidistat (similar to a Honeywell H49B) will simplify the wiring requirements of most installations.

DO NOT wire low voltage humidifiers or air cleaner relays in series with the thermostat wires (W₁ & W₂) as this can damage the Soloron controller. Sail or air pressure switches are recommended.

LOCATING THE THERMOSTAT

The Solaron multi-element thermostat should be located on an interior wall free from cold and warm drafts. Be sure adequate room air movement is present so the thermostat will provide a comfortable building temperature.

Do not locate the thermostat near lamps, heat outlets, stoves, refrigerators, television sets, etc. The heat given off by these appliances will not allow the thermostat to properly control the building temperature.

The thermostat heat anticipators should be set as follows: W_1 @ .10 amp, W_2 @ .10 amp. Cooling anticipators are non-adjustable.

SOLARON CONTROLLER AND THERMOSTAT LIST

The AU0400 and AU0500 air handlers can be used in various applications.

Application	Solaron Controller Controller	Thermostat & Sub-base	Additional Relays Needed
Heating Only	HC0115	HC0020 HC0040	(3)#SR0225 Relays 1-AU0400 Blower 1-Dom. Water Pump 1-Aux. Blower
Heating Only continuous fan option	HC0115	HC0020 HC0041	(3)#SR0225 Relays Same as Above *(1)Relay - Solaron
Heating/cooling continuous fan option	HC0115	HC0022 HC0041	(3)#SR0225 Relays Same as Above *(1)Relay - Solaron

*Insert optional Solaron relay into fourth base of HC0115 (Solaron relay part # is SR0157)

THERMISTOR TEMPERATURE/OHM RESISTANCE CHART

TEMP.		RESISTANCE OHMS	TEMP.		RESISTANCE OHMS
C°	F°		C°	F°	
0	32	105,310	90	194	2,312
5	41	80,725	95	203	1,962
10	50	62,354	100	212	1,671
15	59	48,519	105	221	1,428
20	68	38,022	110	230	1,225
25	77	30,000	115	239	1,054
30	86	23,827	120	248	910.0
35	95	19,044	125	257	787.9
40	104	15,314	130	266	684.3
45	113	12,388	135	275	595.9
50	122	10,077	140	284	520.3
55	131	8,242	145	293	455.4
60	140	6,777	150	302	399.6
65	149	5,600			
70	158	4,651			
75	167	3,880			
80	176	3,251			
85	185	2,736			

The above chart can be used by the Solaron service technician to determine temperatures at Tco and Tci sensor locations.

To measure the resistance of a thermistor sensor disconnect both of its wires from the control panel (Tco & Com. or Tci & Com.). Measure the resistance using a good, accurate OHM meter. Once the resistance has been read it can easily be located on the above chart as well as the corresponding temperature to the left of the resistance.

The temperature difference between Tci and Tco must be 40°F (+7°F) or greater to energize the "collector" relay. Should Tci & Tco leads be "crossed" the system will not operate under sunny conditions. Reversing the Tci & Tco leads will correct the problem. System will cease to collect solar energy when the differential drops to 25°F (+5°F) or less.

SOLARON CONTROL PANEL HC0115
WITH #HC0020 THERMOSTAT AND HC0040 SUB-BASE
- SEQUENCE OF OPERATION -

- I. SOLAR ENERGY AVAILABLE: When 40°F ($\pm 7^{\circ}\text{F}$) differential is achieved between sensors Tco (in collector) and Tci (in return air duct - see specific plans), the following events take place:
- A. Storing Heat - Room thermostat not calling for heat.
 - 1. Differential thermostat in Solaron controller will activate "COLL" (collector) relay.
 - a. MD1 (motorized damper) - will be energized and powered open to allow air to flow to the inlet of the solar air handler blower (BWR) which is energized at the same time.
 - b. HWP (hot water pump) is also energized at this time if the Tw sensor (aquastat on water storage tank) is not satisfied (i.e. sensor is less than 140°F).
 - c. MD2 (motorized damper) - will be energized and powered closed to prevent air from flowing to the auxiliary unit.
 - B. First Stage Heating is called for by room thermostat - W_1 & R_H .
 - 1. "H1" (first stage - solar heating) relay is energized.
 - a. "G" and "R" (fan-aux. furnace) are energized, bringing on the auxiliary blower.
 - b. MD2 opens as power through N.C. contacts in relay "HI" are interrupted.
 - c. Relay contacts close circuit to Ts sensor which is still an open circuit via the "COLL" relay contacts position.
 - C. Second Stage Heating is called for by room T-stat. First stage is still "made".
 - 1. "H2" (second stage - auxiliary heat) relay is energized completing circuit from "R" to "W" of auxiliary unit, bringing on back-up heat (gas, electricity, etc.)
- II. SOLAR ENERGY NOT AVAILABLE. When differential between Tco and Tci drops to 25°F ($\pm 5^{\circ}\text{F}$) or less, the following takes place:
- A. "COLL" Relay - de-energized
 - 1. HWP de-energized-pump off.
 - 2. BWR de-energized-solar blower off.
 - 3. MD1 de-energized & closed.
 - 4. MD2 de-energized & open.
 - B. Circuit completed to Ts sensor through "H1" relay contacts (when "H1" relay is energized).

If Ts sensor is above 90°F set point, system will heat space from heat storage unit. If Ts sensor is below 90°F set point, the circuit will be completed to "H2" relay and bring on the auxiliary heating unit without the need for the second stage of the thermostat to make.

SOLARON CONTROL PANEL HC0115
WITH #HC0020 THERMOSTAT AND HC0041 SUB-BASE

HEATING AND STORAGE SEQUENCE
SAME AS "HEATING ONLY" CONTROL

FAN OPERATION

Solaron Relay #SR0157 must be installed in HC0115 Control Panel (#4 "FAN" relay socket) for this application.

I. Sub-base switch modes.

A. Fan - "on & auto"

1. "Auto" position will permit auxiliary heating unit blower to operate only when heating is required.
2. "On" position will allow the auxiliary heating unit blower to run constantly and the MD3 (by-pass) damper to open full. The solar heat may be stored in this manner while the auxiliary system fan circulates air when the "FAN" relay in the controller is activated.

The following circuits are completed.

- a. MD2 is powered closed to allow solar heat to be collected in the heat storage bin or by-passed directly to the inlet of the collectors when heating water during "summer" operation.
 - b. The auxiliary fan is turned on since "R" circuit is completed to the "G" terminal of the auxiliary unit, energizing the auxiliary fan relay mounted in that unit.
 - c. MD3 (by-pass damper) is still in an "open" position since it is not powered at this time.
3. When the space heating thermostat calls for heat and the sub-base is set in "Fan-on" position, the following will occur:
 - a. MD3 will be powered closed (closing by-pass to force air through solar loop).
 - b. MD2 will be allowed to open.
 - c. Fan in auxiliary furnace will continue to operate.

HEATING AND COOLING (NOT HEAT PUMP)
--

SOLARON CONTROL PANEL HC0115 WITH HC0022 THERMOSTAT AND HC0041 SUB-BASE
--

Additional Solaron relay #SR0157 is required in HC0115 control panel (#4 "FAN" relay socket).

Heating and Storing modes same as with "Heating Only" control.

I. COOLING MODE

Thermostat calling for cooling - sub-base system switch is on "auto" or "cool" and set point of T-stat is below space temperature.

- A. 24 volt power is supplied to the thermostat and sub-base from the HC0115 controller.
 1. "R" (sub-base) has power - when thermostat contacts are "made" current flows to "Y" and "G" terminals of the sub-base.
 2. Current flows to the "compressor relay" mounted in the condensing unit and starts the cooling cycle.
 3. Current will also flow to the auxiliary unit "fan relay" via the "FAN" relay in the HC0115 controller.
 4. Power to MD2 closes damper. MD3 remains unpowered (full open).

DOMESTIC WATER HEATING

Switch "Winter" Position

Domestic water will be preheated anytime the system is storing heat or heating from collector.

Switch "Summer" Position

Domestic water will be preheated whenever enough solar energy is available to activate the system. When the stored water temperature reaches the set point of Tw sensor (about 140°F) the system will shut-down until the stored water temperature drops about 10°F.

GENERAL OPERATING PROCEDURE
FOR THE SYSTEM OWNER

SOLARON AU0400 AND AU0500 AIR HANDLERS

By simply adjusting the wall mounted thermostat you will be able to maintain a comfortably living or working environment.

By setting the switches located directly under the thermostat, and the sliding levers on top, you can select the type of operation you desire.

For winter heating set the top lever at the desired temperature that you wish to maintain. The thermostat will automatically operate the solar portion of your heating system as well as the auxiliary heating unit if conditions warrant its operation. Please do not "jiggle" the levers.

Should your space conditioning system feature cooling as well as heating, you merely move the switch underneath the thermostat to any desired position ("System Switch - Off - Heat - Auto - Cool). Locating the switch in the "Auto" position will permit the thermostat to automatically place the system in a heating or cooling mode of operation without further adjustment.

Space conditioning systems incorporating a heat pump heating and cooling auxiliary unit will have a thermostat switch position marked "Emerg. Heat". The only function of this switch is to provide emergency electric heat should the heat pump malfunction during a period of time when a serviceman is not readily available.

Nominal maintenance is required with this system. Please refer to "Maintenance Instructions" provided in the Installation Manual.

Please call your qualified Solaron serviceman should problems develop.

Installing Solaron Solar System Contractor

Name: _____

Address: _____

Phone: _____

The Solaron controller requires that its "Summer-Winter" switch be placed in the appropriate season position. When switching seasons it may be necessary to move some system dampers. Please have your installing contractor indicate these dampers to you.

Maintenance Instruction

The AU0400 and AU0500 require minimal upkeep for economical and long lasting operation.

Blower Type 1 - Permanently sealed bearings - no oil required.

Motor Type 2 - Blower Motor - Oil twice a year (#20 S.A.E. non-detergent oil).

Blower bearings - Permanently sealed - no oiling required.

V-Belt - Check wear and tension, replace if necessary.

Damper Motors - Oil with #10 S.A.E. non-detergent oil (similar to #465 Anderol or Goodlight #10 oil.) Twice a year.

Water Pump - The Grundfos circulator pump requires no oiling as it is water lubricated during normal operation.

DO NOT RUN PUMP DRY

INSTALLA

S.O.L.A.R. 900.40.050

6-1977

INLET

SERIES
AU0400
&
AU0500
AIR
HANDLER

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ION MANUAL

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SOLARON AU0400 AIR HANDLING UNIT

Solaron's model AU0400 series air handler units are shipped less motor and internal wiring to facilitate installation in a wide variety of applications. All AU0400 series units are manufactured with highly reliable belt drive type blowers. Motors are to be field installed to match each installations air delivery requirements. Compatible motors are 1/3, 1/2 & 3/4 H.P. of 115 or 230 volt power input. Class "B" insulation types of motors are required for use in the AU0400 units due to the higher operating temperatures typical of an air-type solar heating system. All units have a factory mounted "J" box for convenient line voltage field wiring.

WARNING: Do not install the AU0400 unit in a corrosive, explosive or contaminated atmosphere for any reason. Installation of this unit is subject to all applicable local and national building codes and ordinances.

The Solaron AU0400 may be mounted in several positions. Any mounting position must result in the blower shaft being in a horizontal position (i.e. parallel to the floor). DO NOT MOUNT in a position that places the blower shaft in a vertical orientation.

The AU0400 may be suspended from ceiling joists, wall-mounted or floor mounted. Provide adequate vibrations isolators to insure quiet operation.

NOTE: The AU0400 contains no electric heating coils or gas-fired exchangers that produce inherently high temperatures.

REQUIRED DAMPER MOUNTING

Mounting the Solaron dampers on the inlet and outlet of the AU0400 air handler is easily accomplished if the steps listed below are followed:

1. If the system incorporates the optional domestic water preheating, mount the water coil assembly to the inlet of the AU0400 unit using sheet metal screws. (If the inlet is to be on the end of the AHU, an opening must be field cut). Next, mount damper MD1 onto the mounting flange of the water coil assembly.
2. Position and mount with sheetmetal screws damper MD1 (inlet from collector "normally closed") over the opening on the inlet of the air handler, or water coil if used. Dampers are labeled to indicate direction of air flow and must be installed accordingly.
3. Position and mount with sheetmetal screws damper MD2 (outlet to auxiliary heating unit "normally open") over one of the openings on the outlet of the air handler. Field cutting may be required.
4. Position and mount the field supplied duct over one of the other openings on the outlet of the air handler going to the top of the heat storage bin.

NOTE: The damper motor must be mounted in a position that results in the output shaft of the damper motor being in a horizontal position (i.e., damper blades must be parallel to the floor). All joints must be sealed air-tight with silicone caulking.

2

Model No.	DAMPERS DOM. WATER COIL			
	A	B	C	D
AU-0400	16"	16"	8"	6"
AU-0500	20"	20"	10"	6"

TWO COVER PANELS ARE WITH UNIT. ADDITIONAL PANELS MUST BE FIELD FABRICATED.

Domestic hot water coil should be located on the outlet of the air from (rock box) as shown on the front cover

AU-0400 AND AU-0500 AIR HANDLING UNITS

DIMENSIONAL INFORMATION

The above drawing will furnish orientation information as well as essential dimensional data.

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3

DIMENSIONS

UNIT	A	B	C	D	E	F
AU-0400	42	20	18	14	7	10
AU-0500	51	24	22	18	8	11

NOTES

INLETS

OUTLETS

- A₁** FACTORY CUT (DO NOT USE)
- A₂** FIELD CUT (RECOMMENDED)
- A₃** FIELD CUT (8% FAN CAPACITY REDUCTION)
- B₁** FACTORY CUT (STANDARD)
- B₂** FIELD CUT (OPTION)
- C** SERVICE ACCESS
FOR MOTOR AND DRIVE REMOVAL

AUO400 & AUO500 AIR HANDLING UNIT

4

Locate the filter "upstream" of backdraft damper BD-1 (and "by-pass" duct when used).

FILTERS

The Solaron air system requires a filter in the return air duct supplying air to the inlet side of the collector and the heat storage bin. A filter is not needed in the AU0400/AU0500 unit.

Should an electronic air cleaner be desired, install it in the return air duct mentioned above. DO NOT install on the inlet of the auxiliary furnace as the air temperatures at this location may exceed the electronic air cleaner's maximum operating temperature (usually 125°F).

HUMIDIFIERS

Horizontally mounted type humidifiers are recommended. Locating the humidifier in a horizontal supply duct coming off of the auxiliary heating unit is ideal. Utilizing a sail-switch activated duct humidistat (similar to a Honeywell H49B) will simplify the wiring requirements of most installations.

DO NOT wire low voltage humidifiers or air cleaner relays in series with the thermostat wires (W₁ or W₂) as this can damage the Solaron controller. Sail or air pressure switches are recommended.

LOCATING THE THERMOSTAT

The Solaron multi-element thermostat should be located on an interior wall free from cold and warm drafts. Be sure adequate room air movement is present so the thermostat will provide a comfortable building temperature.

Do not locate the thermostat near lamps, heat outlets, stoves, refrigerators, television sets, etc. The heat given off by these appliances will not allow the thermostat to properly control the building temperature.

The thermostat heat anticipators should be set as follows: W₁ @ .10 amp, W₂ @ .10 amp.

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SOLARON CONTROLLER & THERMOSTAT LIST

AU0400 and AU0500 air handler can be used in various applications.

Application	Solaron Controller	Thermostat & Sub-base	Additional Relays Needed
Heating Only	HC0115	HC0020 HC0040	(3)#SR0225 Relays 1-AU0400 Blower 1-Dom. Water Pump 1-Aux. Blower
Heating Only with continuous fan option	HC0115	HC0020 HC0041	(3)#SR0225 Relays Same as Above *(1)#SR0157 Relay
Heating/cooling with continuous fan option	HC0115	HC0022 HC0041	(3)#SR0225 Relays Same as Above *(1)#SR0157 Relay
Heat pump-reversing valve energized for heating	HC0116	HC0022 HC0042	(2)#SR0225 Relays 1-AU0400 Blower 1-Dom Water Pump
Heat Pump-reversing valve energized for cooling	HC0116	HC0023 HC0042	(2)#SR0225 Relays Same as Above

*Insert SR0157 relay into fourth base of HC0115

LOCATING THE SOLARON CONTROL PANEL

Mount the control panel in a convenient location that allows easy access for electrical wiring and "summer/winter" switch operation. Generally the mechanical room is the best location. Electrical service consisting of one 115 vac circuit is ample to power the 100 VA, 120 VAC/24 VAC transformer accompanying the control panel. Separate power circuits may be needed for the AU0400/AU0500 unit and the auxiliary heating unit (refer to local and national building codes).

Low voltage wiring is needed to connect the Solaron space thermostat to the Solaron control panel as well as between the auxiliary heating unit, damper motors and the control panel. Damper motors are low voltage.

The thermostat MUST be wired through the Solaron control panel, it CANNOT be wired direct to the auxiliary heating unit and Solaron air handling unit.

See instructions with each controller for specific directions and information on wiring schematics.

SOLAR SYSTEMS SENSORS

Sensors must be properly placed in the following locations before system start-up can be accomplished:

1. Tco - Sensor must be in absorber plate air channel (not in duct connection or manifold plenum).
2. Tci - Locate at junction of house return air duct and duct connecting to bottom of heat storage (for systems with by-pass of heat storage for summer water pre-heating, locate in duct to collector where by-pass tees in).
3. Ts - Top of rock in heat bin.
4. Tw - Locate in bottom of water storage tank (not the auxiliary water heater) near inlet of heat exchanger coil. (If using an unwired electric water heater for a storage tank, the thermostat in the tank can be used as Tw. Disconnect power leads from thermostat and power element and wire through terminals that "open" on temperature rise).

SYSTEM START-UP

Please review all steps before proceeding with the system start up of the Solaron Air Handler AU0400/AU0500.

1. Check for proper mounting of belt-drive motor (field installed).
2. Check belt tension.
3. Check pulleys for tightness on shafts.
4. Remove all tools, materials, etc. from inside unit.
5. Check auxiliary heating unit as per manufacturers recommendations.
6. Turn on power to solar air handling unit and controller.
7. Check rotation of solar air handler blower.
8. Turn on power to auxiliary heating unit.
9. Secure all access doors.
10. Check operation of all components and systems as per Solaron control instructions.
11. Give the system owner instructions on how to operate their new Solaron solar system.

BLOWER MOTOR AND DRIVE ASSEMBLY SELECTION PROCEDURE

1. Refer to building plans for air flow and static pressure requirements. Include pressure drop of all dampers and coils in system. (See Selection Example this Manual Pg. 10.)
2. Refer to the Air Delivery Table for each respective air handler:
 - a. select the row which indicates that static pressure required, and
 - b. select the column which shows the CFM required.The point where the row and column intersect will indicate what blower RPM and H.P. motor are needed to deliver the required air flow.

AU0400 AIR DELIVERY TABLE

"W.C." Ext. Static Pressure	CFM												RPM
	1/4 H.P.					1/3 H.P.				1/2 H.P.		3/4 HP	
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	
.6	-	-	-	-	-	-	-	-	-	1055	1120	1150	RPM
.8	1038	1041	1045	1045	1048	1058	1060	1092	1120	1156	1187	1235	
1.0	1185	1190	1157	1158	1158	1159	1160	1190	1220	1245	1280	1310	
1.2	1300	1300	1295	1279	1265	1260	1270	1290	1310	1335	1360	1389	
1.4	-	1422	1405	1385	1375	1370	1370	1375	1400	1420	1455	-	

AU0500 AIR DELIVERY TABLE

"W.C" Ext. Static Pressure	CFM															RPM
	3/4 H.P.							1 H.P.				1-1/2 H.P.				
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	
.8	-	-	-	-	-	-	1000	1021	1040	1064	1088	1116	1143	1171	1200	
1.0	1028	1032	1041	1043	1053	1064	1078	1093	1111	1132	1155	1181	1205	1234	1266	
1.2	1121	1122	1124	1127	1135	1143	1154	1167	1182	1200	1223	1248	1274	1307		
1.4	1213	1212	1211	1213	1213	1220	1229	1240	1256	1273	1295	1318	1343			
1.6	1301	1295	1290	1280	1288	1292	1304	1313	1329	1345	1366	1388				
1.8	1383	1376	1367	1363	1363	1365	1376	1387	1400	1417						

DRIVE ASSEMBLY SELECTION

Since the RPM is now known, merely refer to the Drive Assembly Table. Select the RPM needed in the left-hand column. To the right of the RPM column are other columns indicating the number of turns open a specific driver pulley must be in order to deliver that particular RPM. Select whichever column gives the RPM desired. The driven pulley, or fixed blower pulley, is selected from the extreme right hand column. V-belts are noted under each "Driver" column. To determine bore sizes of driver pulleys refer to the Blower Motor Chart for shaft dimensions. Bore size for all fixed pulleys is 3/4" for the AU0400 and 1" for the AU0500.

AU0400 DRIVE ASSEMBLY TABLE

RPM	Browning VL-44 Driver 1/2" or 5/8" Bore	Browning VM50-Driver 1/2" or 5/8" Bore	Fixed Blower Pulley-Driven (Browning AK56) 3/4" Bore
1025	3 1/2 Turns Open	- Turns Open	All RPM Ranges
1058	3 "	- "	
1092	2 1/2 "	- "	
1125	2 "	5 "	
1157	1 1/2 "	4 1/2 "	
1190	1 "	4 "	
1224	1/2 "	3 1/2 "	
1257	0 "	3 "	
1290	- "	2 1/2 "	
1323	- "	2 "	
1356	- "	1 1/2 "	
1389	- "	1 "	
1422	- "	1/2 "	
1455	- "	0 "	
V-Belt	4L350	4L360	

RECOMMENDED SELECTION
AREA IS NOT SHADED

AU0500 DRIVE ASSEMBLY TABLE

FAN RPM	Driver - Motor Sheave Browning VP50 (or VM50) X 5/8" (use w/3/4 or 1 H.P. motors)	Belt	Driver - Motor Sheave Browning VP56 X 5/8" (use w/1 or 1 1/2 H.P. motors)	Belt	Driven - Fan Sheave Browning BK70
994	6 Turns Open	A	- Turns Open		All RPM Ranges
1021	5 1/2 "	A	- "		
1048	5 "	B	- "		
1075	4 1/2 "	B	- "		
1102	4 "	B	- "		
1129	3 1/2 "	B	- "		
1155	3 "	B	6 "	B	
1182	2 1/2 "	B	5 1/2 "	B	
1209	2 "	B	5 "	C	
1236	1 1/2 "	C	4 1/2 "	C	
1262	1 "	C	4 "	C	
1288	- "		3 1/2 "	C	
1315	- "		3 "	C	
1341	- "		2 1/2 "	C	
1368	- "		2 "	C	
1395	- "		1 1/2 "	D	
1421	- "		1 "	D	

V-BELTS FOR AU0500			
V-Belts	A	5L420	Type V-Belts
	B	5L430	Type V-Belts
	C	5L440	Type V-Belts
	D	5L450	Type V-Belts

AU0400 AND AU0500 BLOWER MOTORS

H.P.	Serv. Factor*	NEMA Frame	Shaft Dia. & Len.	F.L.A. 115V	G.E. Model	Shpg. Wt.
Split Phase Motors - 1725 RPM 115/230V - 60 HZ - 1Ø (Class A)						
1/4	1.35	48Z	½" X 2¼"	5.2	5KH33FN15T**	15 lbs.
1/3	1.35	56Z	½" X 2¼"	6.0	5KH35JN30T**	18 lbs.
1/2	1.25	56Z	½" X 2¼"	9.0	5KH36MN22T**	23 lbs.
Capacitor -Start Motors - 1725 RPM 115/230 - 60 HZ - 1Ø (Class B)						
3/4	1.25	56Z	5/8" X 2¼"	11.6	5KC39UN7T**	30 lbs.
1	1.25	56Z	5/8" X 2¼"	14.6	5KC48TG726T**	35 lbs.
1-1/2	1.15	56	5/8" X 1-7/16"	21.0	6K324	39 lbs.

The above General Electric "Serv-S-Line" or Dayton motors are 1725 RPM, 115/230 Volt, 60 HZ, 1 phase, automatic reset, thermally protected types recognized by UL under the Motor Component Recognition Program. These motors are open, drip-proof type motors with Class "A" or "B" insulation, ball bearings, resilient base. The motor rotation can be reversed by reconnecting various electrical leads within the motor.

* Motors operated on 200 volts, 60 HZ will have a 1.0 service factor.

** Manufacturers producing motors of equal specification may be used.
CLASS B MOTORS ARE RECOMMENDED FOR REPLACEMENT.

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Selection Example:

Given: 312 ft² solar collector area (i.e. 2 high, 8 wide, vertical)

Solution: Air handler flow rate (2 CFM/ft²)(312 = 624 CFM, round up to 625 CFM)

The air handler motor and drive assembly must be selected to handle the external static pressure on the Solaron air handler. This selection should be based on the mode which has the highest static pressure drop. The possible modes are:

The highest pressure drop for this example is #1, heating from collectors. The external static pressure drop for this is:

Return grille (see mfg. data)	0.05" w.g.
Return air filter (sized @ 300 to 350 FPM) (see mfg. data)	0.25
Backdraft dampers (2 each) (see A&E Manual pg. 89)	0.20
Collectors (2 panels in series, 2 CFM/ft ²) (see A&E Manual, pg. 80)	0.23
Domestic water coil (see this Manual, pg. 11)	0.08
*Ductwork (see below)	0.19
External Static Pressure	<u>1.00" w.g.</u>

Motor: 625 CFM and 1.0" external static pressure
RPM would be 1158 (see AU0400 Air Delivery Table)
This falls in the region for the 1/2 H.P. motor.

Drive Assembly: 1158 RPM is required at the 700 CFM point. Select 1157 RPM for the 625 CFM requirement. This RPM would be obtained with the driver: Browning VL-44 set at 1-1/2 turns open.

Blower Pulley: Would be Browning AK-56.

Summary: 625 CFM at 1.0" external static pressure
1/2 H.P. motor Solaron #MT0050
Driver VL-44 Solaron #DR0120)
Pulley AK-56 Solaron #DR0120) Package
V-Belt 4 L 350 Solaron #UK0120)

*Ductwork: Static pressure drop through the ductwork is determined by the length and number of fittings. Solaron recommends that ductwork be sized at 0.08" w.g. pressure drop per 100 ft of duct. Fittings and elbows can be estimated by using 15 ft equivalent length of duct for each elbow with turning vanes.

The example above was based on:

(10 elbows)(15' elbow)	=	150'
Length of ductwork	=	90'
Total equivalent length	=	240'

$(240 \text{ ft}) \left(\frac{0.08''}{100 \text{ ft}} \right) = 0.192 \text{ w.g. pressure drop in ductwork}$

DOMESTIC WATER COIL CAPACITIES

The Solaron domestic water coil is a 1-row copper tube coil.

Calculated coil capacities for size and CFM as listed: 1/2" tube, 10 FPI, one 1/2" inlet and one 1/2" outlet, aluminum fin stock .0055, copper tube .017", capacities based on 3 GPM, ENT. water 50°, E.A.T. 180° F.

AIR HANDLER	SIZE	CFM	FACE VELOCITY	WATER P.D. FT. @ 3 GPM	LV.W.	LV.A	BTU/HR.
AU0400	13 3/4 X 14	600	447	8.20	64.7	146.3	22,050
		800	597	8.20	67.0	150.7	25,500
		1000	746	8.20	69.1	153.7	28,650
AU0500	17 1/2 X 18	1400	642	13.40	80.7	151.7	46,050
		1700	780	13.40	83.9	152.6	50,700

NOTE: MINIMUM WATER FLOW IS 1.5 GPM

The Solaron domestic water heating option is designed to be used with pump #WP3060 (115/60/-Ø ---- .85 amp).

AU0400 - OPTIONAL DOMESTIC WATER HEATING COIL - PRESSURE DROP												
CFM	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
Pres. Drop	.02	.03	.04	.05	.06	.08	.09	.11	.14	.17	.21	.25

Au0500 -											
CFM	1200	1500	1700	1900	2100	2300	2500				
Pres. Drop	.08	.09	.11	.14	.17	.25	.33				

GENERAL OPERATING PROCEDURE
FOR THE SYSTEM OWNER

SOLARON AU0400 AND AU0500 AIR HANDLERS

By simply adjusting the wall mounted thermostat you will be able to maintain a comfortably living or working environment.

By setting the switches located directly under the thermostat, and the sliding levers on top, you can select the type of operation you desire.

For winter heating set the top lever at the desired temperature that you wish to maintain. The thermostat will automatically operate the solar portion of your heating system as well as the auxiliary heating unit if conditions warrant its operation. Please do not "jiggle" the levers.

Should your space conditioning system feature cooling as well as heating, you merely move the switch underneath the thermostat to any desired position ("System Switch - Off - Heat - Auto - Cool). Locating the switch in the "Auto" position will permit the thermostat to automatically place the system in a heating or cooling mode of operation without further adjustment.

Space conditioning systems incorporating a heat pump heating and cooling auxiliary unit will have a thermostat switch position marked "Emerg. Heat". The only function of this switch is to provide emergency electric heat should the heat pump malfunction during a period of time when a serviceman is not readily available.

Nominal maintenance is required with this system. Please refer to "Maintenance Instructions" provided in the Installation Manual.

Please call your qualified Soloron serviceman should problems develop.

Installing Soloron Solar System Contractor

Name: _____

Address: _____

Phone: _____

The Soloron controller requires that its "Summer-Winter" switch be placed in the appropriate season position. When switching seasons it may be necessary to move some system dampers. Please have your installing contractor indicate these dampers to you.

Maintenance Instruction

The AU0400 and AU0500 require minimal upkeep for economical and long lasting operation.

Blower Type 1 - Permanently sealed bearings - no oil required.

Motor Type 2 - Blower Motor - Oil twice a year (#20 S.A.E. non-detergent oil).

Blower bearings - Permanently sealed - no oiling required.

V-Belt - Check wear and tension, replace if necessary.

Damper Motors - Oil with #10 S.A.E. non-detergent oil (similar to #465 Anderol or Goodlight #10 oil.) Twice a year.

Water Pump - The Grundfos circulator pump requires no oiling as it is water lubricated during normal operation.

DO NOT RUN PUMP DRY