DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150611

SUBSYSTEM DESIGN PACKAGE FOR SOLAR II COLLECTOR

Prepared by

Life Sciences Engineering
Route 1, Box 746
Morrison, Colorado 80465

Under Contract NAS8-32231 with

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

For the U. S. Department of Energy

(NASA-CR-150611) SUBSYSTEM DESIGN PACKAGE FOR SOLAR II COLLECTOR Contractor Report, May 1977 - Dec. 1977 (Life Sciences Engineering) 38 p HC A03/MF A01 CSCL 10A

N78-21602

Unclas
G3/44 14123

U.S. Department of Energy

Solar Energy

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
DOE/NASA CR-150611		

4. TITLE AND SUBTITLE	5. REPORT DATE
Subsystem Design Package for Solar II Collector	January 1978
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT #
9. PERFORMING ORGANIZATION NAME AND ADDRESS Life Sciences Engineering Route 1, Box 746 Morrison, Colorado 80465	10. WORK UNIT NO. 11. CONTRACT OR GRANT NO. NAS8-32261
12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546	13. TYPE OF REPORT & PERIOD COVERED Contractor Report May 77 - December 77
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

This work was done under the technical management of Mr. John M. Caudle, George C. Marshall Space Flight Center, Alabama.

16. ABSTRACT

This report contains the necessary information to evaluate the design of the Solar II Air Flat Plate Collector, Model SC4X8. The document consists of the Design Data Brochure, Subsystem Performance Specification, and Detailed Design Drawings. The collector was developed by Life Sciences under NASA/MSFC Contract NAS8-32261, and under the direction of the National Aeronautics and Space Administration.

17. KEY WORDS	18. DISTRIBUTION STATEMENT Unclassified-Unlimited William A. Brooksbank, Jr. WILLIAM A. BROOKSBANK, JR. Manager, Solar Heating and Cooling Project Ofc

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	79	NTIS

MSFC - Form 3292 (May 1969)

TABLE OF CONTENTS

SOLAR II

LIFE SCIENCES ENGINEERING

RT 1, BOX 746
MORRISON, COLORADO 80465

DESIGN BROCHURE

Description

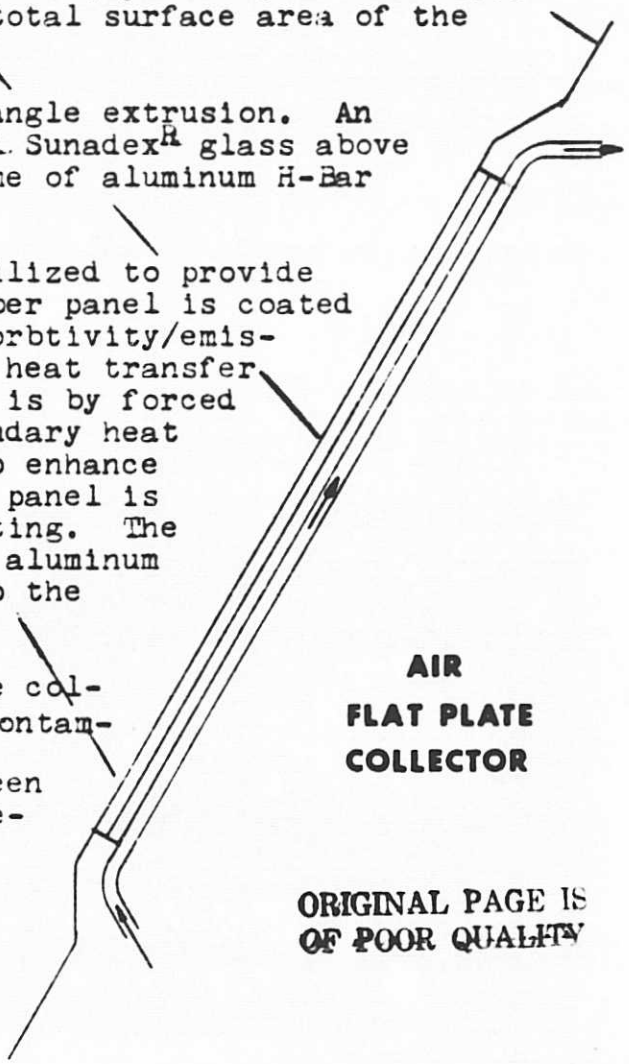
The Solar II, Model SC4X8 Collector was developed under the direction of the National Aeronautics and Space Administration, (NASA), under Contract No. NAS8-32261. This contract was part of the nation wide Solar Energy Research and Development Program for technical information to be placed in the public domain.

Solar II is an Air Flat Plate Collector, 4'x8'x2½" weighing 130 pounds and having an effective solar collection area (aperture) of over 29.5 square feet, which represents 94% of the total surface area of the collector.

The lower frame is made of 1/8" aluminum angle extrusion. An inner aluminum frame supports the tempered Sunadex® glass above the absorber panel. A separate outer frame of aluminum H-Bar holds the outer glazing of 4 mil Tedlar®.

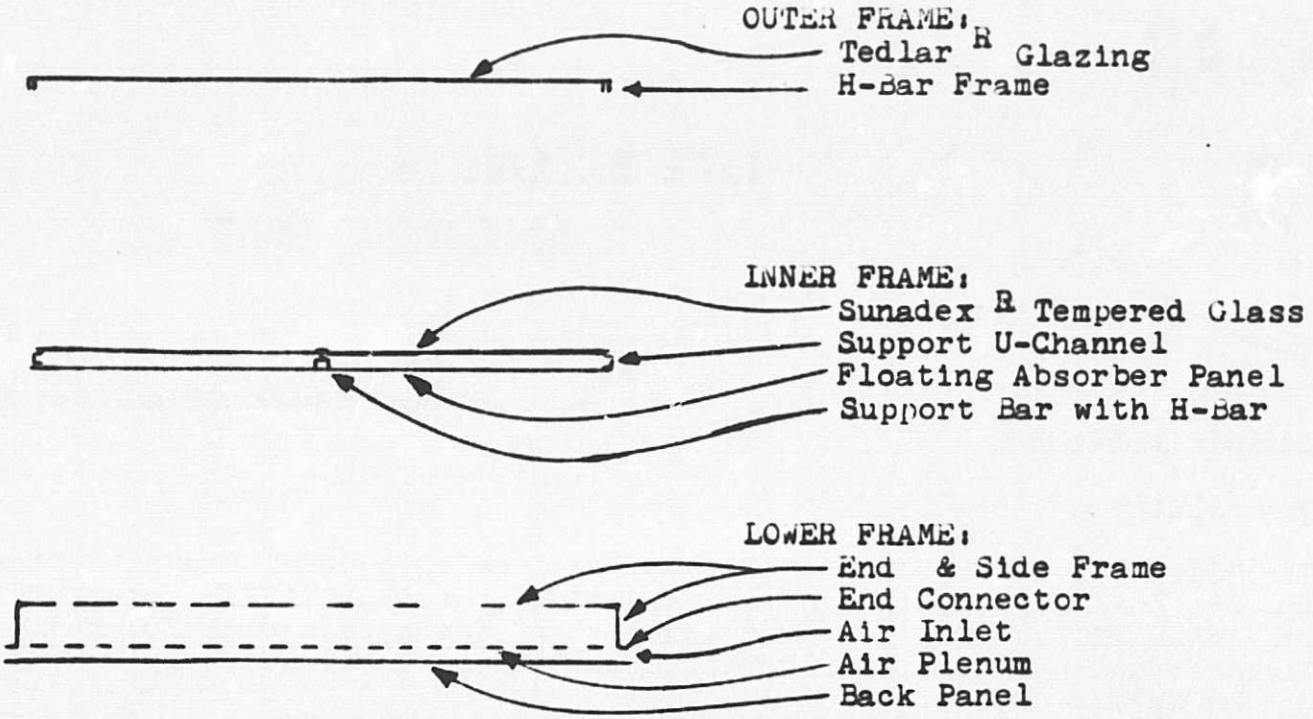
A "floating" absorber panel concept is utilized to provide for expansion and contraction. The absorber panel is coated with 3M Black Velvet® paint having an absorbtivity/emissivity of .98/.90. The primary method of heat transfer from the absorber panel to the air stream is by forced air convection in the air plenum. A secondary heat transfer method is by radiant heating. To enhance radiant heating, the back of the absorber panel is painted with a high temperature black coating. The back side of the air plenum is a finished aluminum panel that radiates thermal energy back to the absorber panel through the air stream.

Insulation is placed on the outside of the collector to minimize heat losses and avoid contamination of glazings by outgassing of the insulation. Insulation is installed between the back of the collector and the roof, between collectors and around the perimeter of the collector subsystem.



AIR FLAT PLATE COLLECTOR

(303) 697-8624
697-8250



SIMPLIFIED BREAKDOWN OF SOLAR II COMPONENTS

Accessories

Collector Interconnector - SC4X8CIC, connects 2 collectors in series. Order with collectors as the collector End Connector is special.

Dessicant Unit - SC4X8 DU, recommended for humid climates. Dessicant units must be installed in the factory.

Plastic U-Channel - SC4X8PUC - encloses the side edges of the collectors in parallel, protects the insulation from water and prevents excessive heat losses.

Typical Installation Arrangements

Solar II Collectors are installed on a south facing roof within ± 20° of due south. The south facing roof should be free from plumbing penetrations and chimney shadowing, etc.

The Solar II Collectors were designed for roof pitch angles from 45° to 70° for optimum winter performance. A rule of thumb for collector pitch angles, is the local latitude plus 15°. Collector sizing depends on local economics (fuel costs, ect.), climate and house heat loads. Sizing usually runs between 1/3 and 1/2 the house square footage.

Life Sciences Engineering currently provides the Solar II Collector Subsystem. Arrangements must be made for interfacing with the existing heating system in older homes, or in the case of homes under design, the backup heating system. This includes separate blower and

and ducting. A storage subsystem of 1½" river bed rock or concrete block, protected by insulation is standard for current solar heating systems. The control subsystem must interface with the existing heating control subsystem. It must also control the dampers to direct 140°F heat to the house while higher heat must be directed to the storage subsystem.

Primarily the Solar II Collectors were designed for parallel operation as they are eight feet long. For large roofs, the collectors may be installed in series or series-parallel. The air flow through two series connected collectors will require faster blower operation to keep the outlet temperatures into the house at 140°F (or lower). Standard flow rates for the parallel connected collectors is recommended at 120 CFM, which has been found to increase the temperature of the inlet air by 50°F with clear skies, (120CFM per collector).

Unit Dimensions and Mounting Instructions

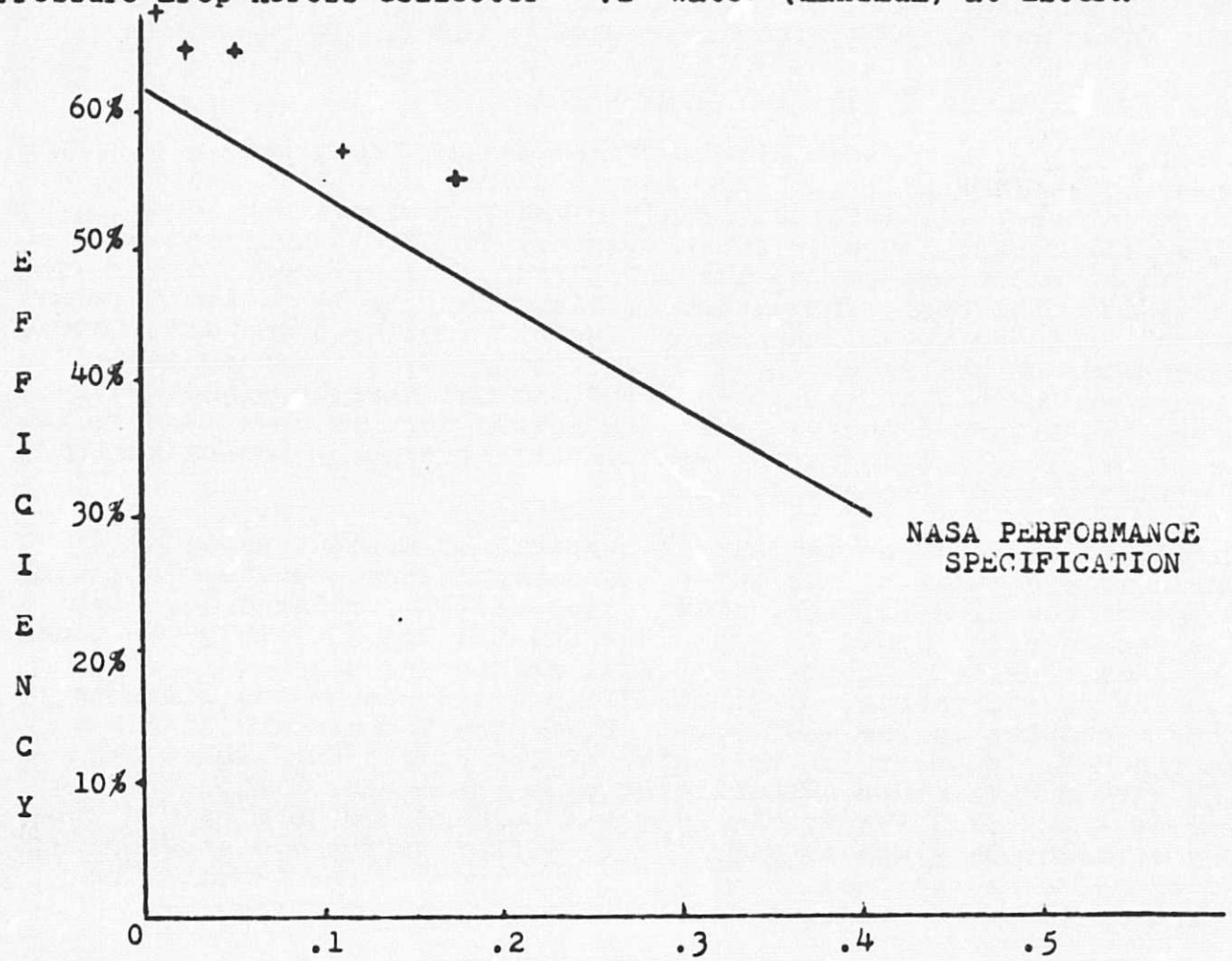
The Solar II Collectors are 4'x8'x2½" and may be installed in parallel, series, or series-parallel. The Installation, Operation and Maintenance Manual provides detailed drawings and procedures for installation of the collectors. Briefly rough openings of 3"x45" are required for connecting collectors to the ducting/plenum. After support 2x4's are installed on the roof, insulation (minimum R-9) is installed between the 2x4's and the rough openings. Install ducting connectors to the End Sections on the ground level. A lifting device is recommended to transfer the collectors to the roof and set them in place. Collectors are attached to the roof with screws through mounting brackets. Provision is made in the mounting bracket holes for expansion and contraction of the collectors.

Solar II Collectors can be shipped complete or without glass at a considerable savings to the owner. The recommended Sunadex® glass or equivalent low iron (approx. .01%) glass may be purchased locally. Since the tempered Sunadex® glass(46½"x47-5/16"x5/32") weigh 40 pounds each, local purchase of the glass will reduce shipping costs of the collector by two thirds. To install the glass attach the silicone rubber U-channel on one 46½" edge. Slide the U-channel with glass into the H-Bar support in the center of the collector. Lower the glass with suction cups. Check the space around the 3 sides of the glass is 5/32" from the frame. Apply a bead of Dow Corning 732 silicone between the glass and the frame. After curing add a second bead of 732 over the last ¼" of glass and over to the frame. The Tedlar® frame is reinstalled after the silicone has cured.

Standard roofing techniques for weather proofing, such as cant strips and aluminum flashing around the perimeter of the collector subsystem is recommended. Insulate around the collectors' perimeter with R values of 9 or better. Between the collectors, where the spacing is 3/4", an R value of 4 or better should be used. Foam insulation may be used around the perimeter. Urea formaldehyde insulation is recommended for this purpose. Special Noryl® plastic U-channel is recommended to protect the insulation between the collector sides from water leakage, and to minimize heat losses. The plastic U-channel fits into the adjacent H-Bar channels of 2 collectors. Caulking the interface between the plastic U-channel and the H-Bar finishes this weather proofing.

Physical Data

Dimensions - 4'x8'x2½"
Effective Collection Area (aperture) - 29.56 square feet
Collector Weight - 130 pounds
Absorber Panel - aluminum, floating from support bar
Absorber Coating - 3M Black Velvet®, absorbtivity/emissivity .98/.90
Inner Glazing - Sunadex® tempered glass, transmissivity .91+
Outer Glazing - 4 mil Tedlar®, transmissivity .91
Collector Frame - Aluminum Extrusion
Performance
70°F inlet temperature - 120°F outlet air to home or storage at 120CFM
140°F inlet air temperature - 176°F outlet air to <u>storage only</u> at 120CFM
Pressure Drop Across Collector - .1" water (maximum) at 120CFM



SOLAR II EFFICIENCY AS A FUNCTION OF OPERATING CONDITIONS

* Note: Operating Conditions = $\frac{\text{Inlet Temp. - Ambient Temp.}}{\text{Solar Insolation}}$

DESIGN FOR MAN

LIFE SCIENCES ENGINEERING

303 697-8250, 697-8624

SECTION B
PERFORMANCE SPECIFICATION
SPEC NO. SHC-3058
FINAL ISSUE

LIFE SCIENCES ENGINEERING

TABLE OF CONTENTS

SUBSYSTEM PERFORMANCE IDENTIFICATION

1. Introduction

This Performance Specification establishes the requirements for the design and performance of the Solar II Collector Subsystem for use in solar heating only of single family residences and mobile homes. It designates the Interim Performance Criteria applicable to this subsystem and defines the deviations. This appendix specifies the performance of the collector subsystem and the installation drawings.

2. Applicable Documentation

2.1 Government Documents

Interim Performance Criteria for Solar Heating and Combined Heating/Cooling Systems and Dwellings, Jan. 1, 1975. U. S. Department of Housing and Urban Development.

2.2 Contractor Documents

SHC-3070, Installation, Operation and Maintenance Manual, 9/15/77.

SHC-3094, Design Data Brochure, 9/10/77.

3. Application of Interim Performance Criteria by Type of Subsystem

The Interim Performance Criteria in Table I are applicable.

4. Deviations from Interim Performance Criteria

None

5. Government Furnished Property

None

6. Government Directed Requirements

Government directed requirements have been incorporated into this specification.

7. Subsystem Appendices

None

8. Warranty (Limited)

The Solar II Collector is warranted for 1 year from time of delivery. This warranty covers manufacturing craftsmanship and normal environment conditions. It does not cover installation mishandling

or willful damage. If the collector was purchased without glass from the factory, the local distributor/subcontractor shall warrant the glass for breakage and leakage for 1 year. In the event of a failure, a replacement component will be supplied for the failed component.

SPECIFICATION NO SHC-3058
REVISION P-2
DATE 12/20/77

TABLE I

RESIDENTIAL SUBSYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

SUBSYSTEM APPLICATION

A – APPLICABLE TO TYPE SYSTEMS INDICATED

NA – NOT APPLICABLE

TYPE SYSTEMS

H – HEATING

HC – HEATING AND COOLING

HW – HOT WATER

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS			RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS		
	H	HC	HW		H	HC	HW
1.1 H and HC Performance	NA	NA	NA	1.3.1 Collector Efficiency	A	A	A
1.1.1 Heating Design Temperatures	NA	NA	NA	1.4 Thermal Storage	NA	NA	NA
1.1.2 Cooling Design Temperatures	NA	NA	NA	1.4.1 Storage Capacity	NA	NA	NA
1.1.3 Relative Humidity and Water Vapor Pressure	NA	NA	NA	1.5 Habitability of Occupied Spaces	NA	N	NA
1.1.4 Solar Contribution	NA	NA	NA	1.5.1 Heat or Humidity Transfer Effects	NA	NA	NA
1.1.5 Operation Impairment	NA	NA	NA	1.6 Energy Transport Efficiency	NA	NA	NA
1.2 HW System/Subsystem Performance	NA	NA	NA	1.6.1 Thermal Losses and Electrical Power	NA	NA	NA
1.2.1 Water Design Temperature	NA	NA	NA	1.7 Control	NA	NA	NA
1.2.2 Storage Design Capacity	NA	NA	NA	1.7.1 Installation and Maintenance	NA	NA	NA
1.2.3 Solar Contribution	NA	NA	NA	1.7.2 Manual Adjustment	NA	NA	NA
1.2.4 Operational Impairment	NA	NA	NA	1.7.3 Inhabited Space Temperature	NA	NA	NA
1.3 Collector Performance	A	A	A	1.7.4 Hot Water Temperature	NA	NA	NA
				1.8 Auxiliary Energy	NA	NA	NA
				1.8.1 Design Loads	NA	NA	NA

TABLE I

RESIDENTIAL SUBSYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

SUBSYSTEM APPLICATION

A – APPLICABLE TO TYPE SYSTEMS INDICATED

NA – NOT APPLICABLE

TYPE SYSTEMS

H – HEATING

HC – HEATING AND COOLING

HW – HOT WATER

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS			RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS		
	H	HC	HW		H	HC	HW
2.1 System Design Conditions	A	A	A	2.3.1 Pressure Test: Nonpotable Fluids	NA	NA	NA
2.1.1 Equipment Capabilities	A	A	A	2.3.2 Pressure Test: Potable Water	NA	NA	NA
2.1.2 Noise or Erosion - Corrosion	A	A	A	2.3.3 Air Transport Systems	A	A	A
2.1.3 Operating Conditions	A	A	A	2.4 Collector Adjustment	NA	NA	NA
2.1.4 Fluid Flow in Collectors	A	A	A	2.4.1 Orientation and Tilt	NA	NA	NA
				2.4.2 Mutual Shadowing	A	A	A
2.1.5 Entrapped Air	NA	NA	NA	2.5 Subsystem Isolation	NA	NA	NA
2.1.6 Thermal Expansion of Fluids	NA	NA	NA	2.5.1 Shutdown in Multi-family Housing	NA	NA	NA
2.1.7 Pressure Drops	A	A	A				
2.1.8 Condensate Removal	NA	A	NA	2.6 Heat Transfer Fluid Quality	A	A	A
2.2 Mechanical Stresses	A	A	A	2.6.1 Liquid Quality	NA	NA	NA
				2.6.2 Air Quality	A	A	A
2.2.1 Vibration Stress Levels	A	A	A	2.6.3 Fluid Quality	NA	NA	NA
2.2.2 Vibration from Moving Parts	A	A	A	2.6.4 Freezing Protection	NA	NA	NA
				2.7 Piping Supports	NA	NA	NA
2.2.3 Water Hammer	NA	NA	NA	2.7.1 Applicable Plumbing Standards	NA	NA	NA
2.2.4 Vacuum Relief Protection	NA	NA	NA	2.8 Excessive Pressure and Temperature Protection	NA	NA	NA
2.2.5 Thermal Changes	A	A	A	2.8.1 Relief Valves and Vents	NA	NA	NA
2.2.6 Flexible Joints	NA	NA	NA				
2.3 Leakage Prevention	A	A	A	3.1 Structural Design Basis	A	A	A

SPECIFICATION NO SUC-2058
REVISION R-2
DATE 12/29/77

TABLE I

RESIDENTIAL SUBSYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

SUBSYSTEM APPLICATION

A – APPLICABLE TO TYPE SYSTEMS INDICATED

NA – NOT APPLICABLE

TYPE SYSTEMS

H – HEATING

HC – HEATING AND COOLING

HW – HOT WATER

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS			RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS		
	H	HC	HW		H	HC	HW
3.1.1 Applicable Standards	A	A	A	3.8.1 Foundation Settlement	NA	NA	NA
3.1.2 Service Loads	A	A	A	3.9 Ponding Condition	A	A	A
3.2 Failure Loads and Load Capacity	A	A	A	3.9.1 Design Provisions	A	A	A
3.2.1 Ultimate Load Combinations	NA	NA	NA	4.1 Plumbing and Electrical Installation	NA	NA	NA
3.2.2 Ice Loads	NA	NA	NA	4.1.1 Plumbing Codes	NA	NA	NA
3.2.3 Vehicular Loads	NA	NA	NA	4.1.2 Electrical Codes	NA	NA	NA
3.2.4 Load Capacity	NA	NA	NA	4.2 Fail-Safe Controls	NA	NA	NA
3.3 Damage Control	A	A	A	4.2.1 System Failure Prevention	NA	NA	NA
3.3.1 Resistance to Damage	NA	NA	NA	4.2.2 Automatic Pressure Relief Valves	NA	NA	NA
3.3.2 Glazing Design	A	A	A	4.3 Fire Safety	A	A	A
3.4 Cyclic Loads	NA	NA	NA	4.3.1 Applicable Fire Standards	A	A	A
3.4.1 Deflection Limitations	NA	NA	NA	4.3.2 Penetrations through Fire Rated Assemblies	NA	NA	NA
3.5 Cutting of Structural Elements	NA	NA	NA	4.4 Toxic	NA	NA	NA
3.5.1 Design Provisions	NA	NA	NA	4.4.1 Provisions of Catch Basins	NA	NA	NA
3.6 Creep and Residual Deflection	NA	NA	NA	4.4.2 Detection of Toxic and Flammable Fluids	NA	NA	NA
3.6.1 Deflection Limitations	NA	NA	NA	4.5 Safety	NA	NA	NA
3.7 Hail Resistance	A	A	A	4.5.1 Emergency Egress and Access	NA	NA	NA
3.7.1 Hail Size and Loading	A	A	A	4.5.2 Identification and Location of Controls	NA	NA	NA
3.8 Constraint Loads	NA	NA	NA				

SPECIFICATION NO. SSC-3058
REVISION A-2
DATE 12/20/77

TABLE I

RESIDENTIAL SUBSYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

SUBSYSTEM APPLICATION

A – APPLICABLE TO TYPE SYSTEMS INDICATED

NA – NOT APPLICABLE

TYPE SYSTEMS

H – HEATING

HC – HEATING AND COOLING

HW – HOT WATER

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS			RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS		
	H	HC	HW		H	HC	HW
4.6 Protection of Potable Water & Circulated Air	A	A	A	5.2.3 Thermal Cycling Stresses	A	A	A
4.6.1 Contamination by Materials	NA	NA	NA	5.2.4 Leakage	NA	NA	NA
4.6.2 Separation of Circulation Loops	NA	NA	NA	5.2.5 Deterioration of Gaskets and Sealants	A	A	A
4.6.3 Backflow Prevention	NA	NA	NA	5.2.6 Transmission Losses Due to Outgassing	A	A	A
4.6.4 Growth of Fungi	A	A	A	5.3 Chemical Compatibility of Components	A	A	A
4.7 Excessive Surface Temperatures	A	A	A	5.3.1 Materials/Transfer Fluid Compatibility	NA	NA	NA
4.7.1 Protection from Heated Components	A	A	A	5.3.2 Corrosion of Dissimilar Materials	A	A	A
5.1 Effects of External Environment	A	A	A	5.3.3 Corrosion by Leachable Substance	NA	NA	NA
5.1.1 Solar Degradation	A	A	A	5.3.4 Effects of Decomposition Products	A	A	A
5.1.2 Soil Corrosion	NA	NA	NA	5.4 Components Involving Moving Parts	NA	NA	NA
5.1.3 Airborne Pollutants	A	A	A	5.4.1 Wear and Fatigue	NA	NA	NA
5.1.4 Dirt Retention on Cover Plate Surface	A	A	A	6.1 Accessibility for Maintenance	A	A	A
5.1.5 Abrasive Wear	A	A	A	6.1.1 Access for System Maintenance	A	A	A
5.1.6 Fluttering by Wind	A	A	A	6.1.2 Access for System Monitoring	A	A	A
5.2 Temperature & Pressure Resistance	A	A	A	6.1.3 Draining and Filling of Liquids	NA	NA	NA
5.2.1 Thermal Degradation	A	A	A	6.1.4 Flushing of Liquids Subsystems	NA	NA	NA
5.2.2 Deterioration of Heat Transfer Fluids	NA	NA	NA				

TABLE I

SPECIFICATION NO. SHC-501
REVISION P-2
DATE 12/20/77

RESIDENTIAL SUBSYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

SUBSYSTEM APPLICATION

A – APPLICABLE TO TYPE SYSTEMS INDICATED

NA – NOT APPLICABLE

TYPE SYSTEMS

H – HEATING

HC – HEATING AND COOLING

HW – HOT WATER

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS			RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS		
	H	HC	HW		H	HC	HW
6.1.5 Filters	NA	NA	NA	7.2.2 Storage Area	NA	NA	NA
6.1.6 Potable Water Shutoff	NA	NA	NA	7.2.3 Utility Chases	NA	NA	NA
6.2 Installation, Operation and Maintenance Manual	A	A	A	7.3 Functioning of Dwelling Site	NA	NA	NA
6.2.1 Installation Instructions	A	A	A	7.3.1 Space Use	NA	NA	NA
6.2.2 Maintenance and Operation Instructions	A	A	A	7.3.2 Shading of Adjacent Structures	NA	NA	NA
6.2.3 Maintenance Plan	A	A	A	7.3.3 Impace of Environment	NA	NA	NA
6.2.4 Replacement Parts	A	A	A	7.3.4 View	NA	NA	NA
6.3 Repair and Service Personnel	A	A	A	8.1 Interference with Mechanical Operation	NA	NA	NA
6.3.1 Maintenance of H and HC Systems	A	A	A	8.1.1 Blockage of Solar Subsystem	NA	NA	NA
6.3.2 Maintenance of DHW System	A	A	A	8.1.2 Shading of Collector	NA	NA	NA
7.1 Design	NA	NA	NA	8.1.3 Sensor Location	NA	NA	NA
7.1.1 Dwelling Design	NA	NA	NA	8.2 Mechanical & Electrical Functioning of Dwelling and Site	NA	NA	NA
7.1.2 Mobile Home Design	NA	NA	NA	8.2.1 Exhaust and Venting	NA	NA	NA
7.1.3 Site Design	NA	NA	NA	8.2.2 Utilities	NA	NA	NA
7.1.4 Passive Use of Solar Energy	NA	NA	NA	8.3 Mechanical & Electrical Functioning of Connections	NA	NA	NA
7.2 Adequate Space	NA	NA	NA	8.3.1 Plumbing Connections	NA	NA	NA
7.2.1 Collector Area	NA	NA	NA				

TABLE I

RESIDENTIAL SUBSYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

SHEET 1 of 4

SUBSYSTEM APPLICATION

A – APPLICABLE TO TYPE SYSTEMS INDICATED

NA – NOT APPLICABLE

TYPE SYSTEMS

H – HEATING

HC – HEATING AND COOLING

HW – HOT WATER

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS			RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEMS		
	H	HC	HW		H	HC	HW
8.3.2 Electrical Connections	NA	NA	NA	11.2.2 Heat and Moisture	A	A	A
9.1 Structural Integrity	NA	NA	NA	11.2.3 Exterior Penetrations	NA	NA	NA
9.1.1 Movements in Adjacent Structures	NA	NA	NA	11.3 Durability and Reliability of Connections	NA	NA	NA
9.2 Structural Integrity of Dwelling	NA	NA	NA	11.3.1 Material Compatibility	NA	NA	NA
9.2.1 Loads	NA	NA	NA	12.1 Maintainability of H, HC, HW Systems	NA	NA	NA
9.2.2 Penetration of Structural Members	NA	NA	NA	12.1.1 Accessibility		A	NA
9.3 Structural Connections	NA	NA	NA	12.1.2 Misuse	NA	NA	NA
9.3.1 Structural Connections	NA	NA	NA	12.1.3 Permanent Maintainance Accessories	NA	NA	NA
9.3.2 Brittle Subsystem	NA	NA	NA	12.2 Maintainability of Dwelling and Site	NA	NA	NA
9.3.3 Strength and Stiffness	NA	NA	NA	12.2.1 Accessibility	NA	NA	NA
10.1 Safety of Dwelling and Site	NA	NA	NA	12.2.2 Ice Dams	NA	NA	NA
10.1.1 Fire	NA	NA	NA	12.3 Connections	NA	NA	NA
10.1.2 Accidents	NA	NA	NA	12.3.1 Accessibility	NA	NA	NA
11.1 Durability	NA	NA	NA	13.1 Visual Characteristics of Dwelling and Site	NA	NA	NA
11.1.1 Vegetation	NA	NA	NA	13.1.1 Dwelling	NA	NA	NA
11.2 Durability and Reliability of Dwelling and Site	NA	NA	NA	13.1.2 Neighborhood	NA	NA	NA
11.2.1 Chemical Corrosion	A	A	A				

Spec No. SHC-3058
Revision R-2
Date 7-22-77

A SUBSYSTEM IDENTIFICATION

This specification defines the performance and installation drawings for the Solar II Collector Subsystem, Life-Sciences Engineering Subsystem Model Numbers: SC4X10, SC4X8, and SC22X48.

A-1 SUBSYSTEM PERFORMANCE SHEETS (When installed in accordance with the Installation Manual.)

Total Heating Capacity

The total heating capacity for a 96 square feet collector in 3 panels of the collector subsystem shall be no less than 14400 BTU/Hr under the following conditions (a) Air entering at a temperature of 70° F dry bulb, 50% RH (b) Air exit temperature of 120° F dry bulb. (c) Flow rate 350 CFM when measured at in b. (d) Clear day conditions at sun position as of December 21 at solar noon.

Exposed heated panel (baseboard or ceiling) temperature shall not exceed 130° F.

Solar Collector

The Solar Collector will collect a minimum of 795 BTU/ft^2/day of energy at an outlet fluid temperature equal to or greater than 172° F into storage where 140° F air in-flow from storage to the collector for the following conditions:

Tilt Angle 60° Aximuth Angle 187½°

Ambient Temperature 40° F (outside)

Wind Velocity 440 Ft/Min

Date 12/21/75

Noon Solar Flux Normal to the Collector Surface 300 BTU/Hr/Ft^2

Longitude and Latitude 105W, 39.5°N.

A-2 INSTALLATION DRAWING SHEETS

Installation Drawings are supplied on the following pages.

$$\eta = \frac{MC_p (T_O - T_I)}{A_C I}$$

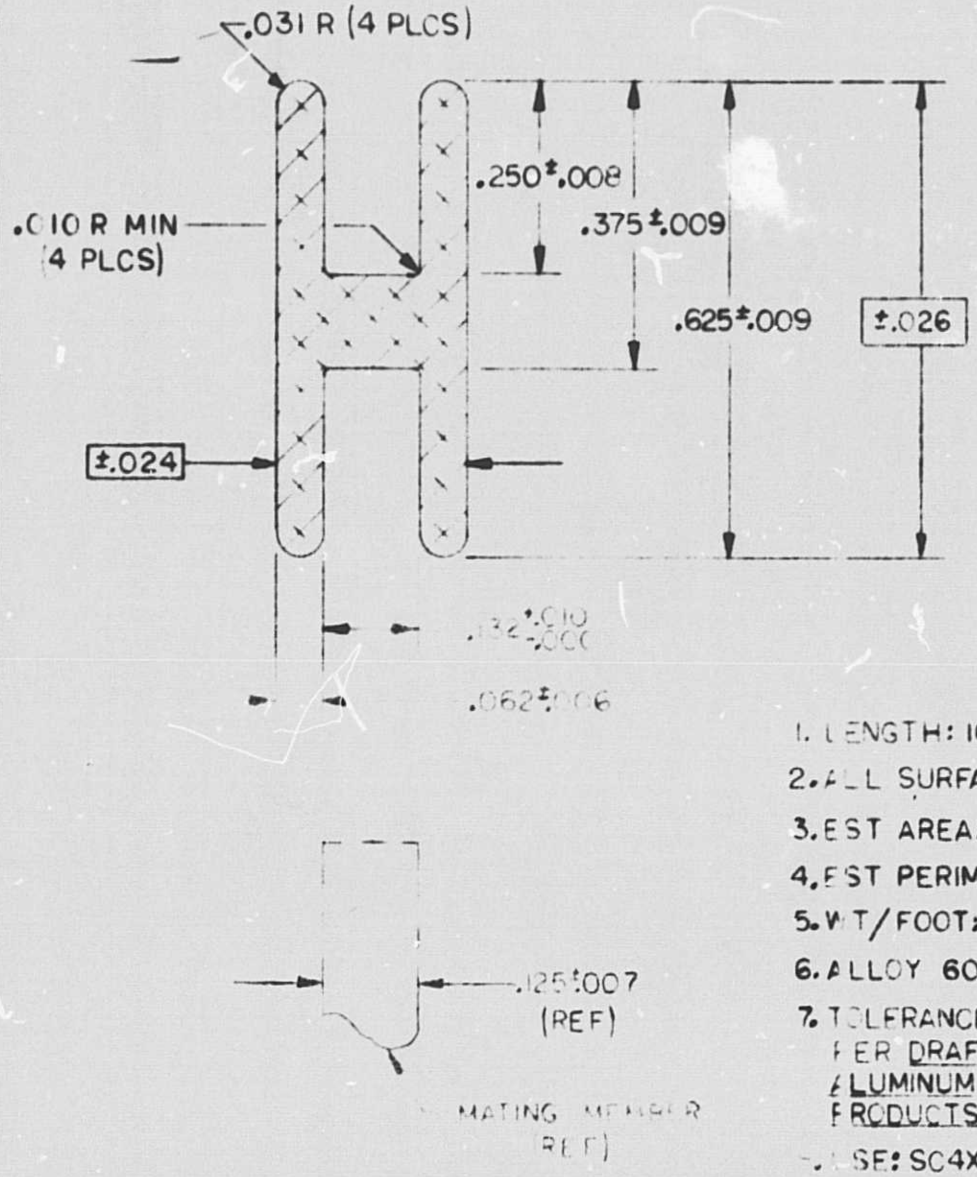
T_O - COLLECTOR TRANSPORT MEDIA OUTLET TMEPERATURE (^OF)
T_I - COLLECTOR TRANSPORT MEDIA INLET TEMPERATURE (^OF)
T_a - AMBIENT TEMPERATURE (^OF)
M - TRANSPORT MEDIA MASS FLOWRATE (LB/HR)
C_p - SPECIFIC HEAT OF TRANSPORT MEDIA (BTU/LB ^OF)
A_C - AREA OF COLLECTOR (FT^2)
I - TOTAL SOLAR INSOLATION IN THE COLLECTOR PLANE (BTU/HR – FT^2)
(DIRECT COMPONENT ONLY CONCENTRATORS)

FIGURE 1 EFFICIENCY AS A FUNCTION OF OPERATING CONDITIONS
PERFORMANCE MUST BE ABOVE LINE

SECTION C

DESIGN DRAWINGS

DESIGN DRAWING LIST

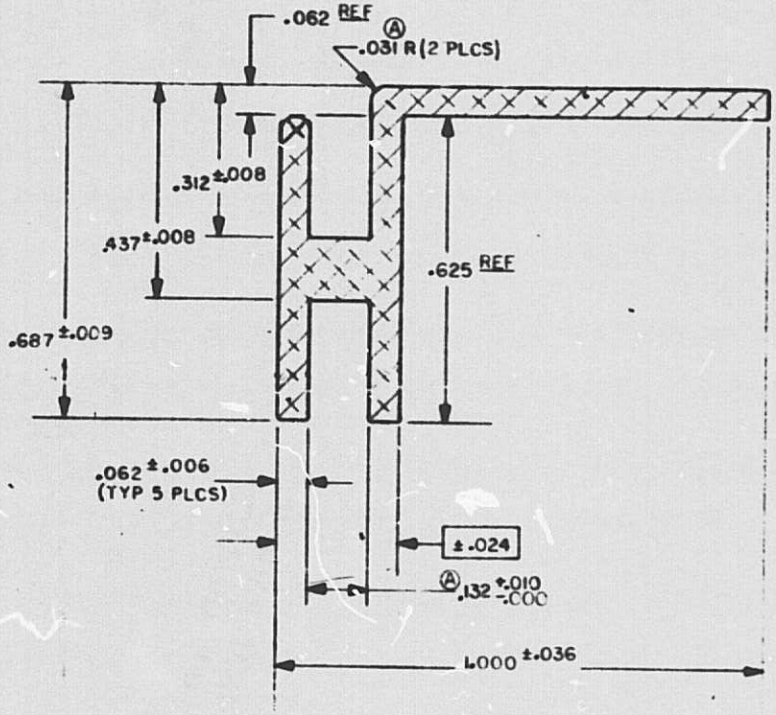


NOTES:

1. LENGTH: 16'-0" MINIMUM.
2. ALL SURFACES EXPOSED.
3. EST AREA: 0.071 SQ.IN.
4. EST PERIMETER: 2.417 IN.
5. WT/FOOT: 0.085 LB/FT.
6. ALLOY 6063-T5
7. TOLERANCES NOT CALLED OUT ARE PER DRAFTING STANDARDS FOR ALUMINUM EXTRUDED AND TUBULAR PRODUCTS 7th ED.
8. USE: SC4X8101

TITLE	EXTRUDED SHAPE TEDLAR RETAINER
PROJECT NAS 8-32261	
SCALE 4X	DRAWN CONDIT 20 JUN 77 CHECKED APPVD
MFGR NO	
SCIENCES ENGINEERING MORRISON, CO 80463	
SH 1 OF 1	DWG NO SC4X8502

REV	DESCR		
A	REVISED: NOTES 8 & 10, DWG NO./DIM. (ALLOY: WAS -T42, USE: WAS TBD, DWG NO: WAS SC4X8500-29-3-1, .137: WAS .125±.012, -.031R. WAS .062R)	CONDIT 24 JUN 77	



NOTES:

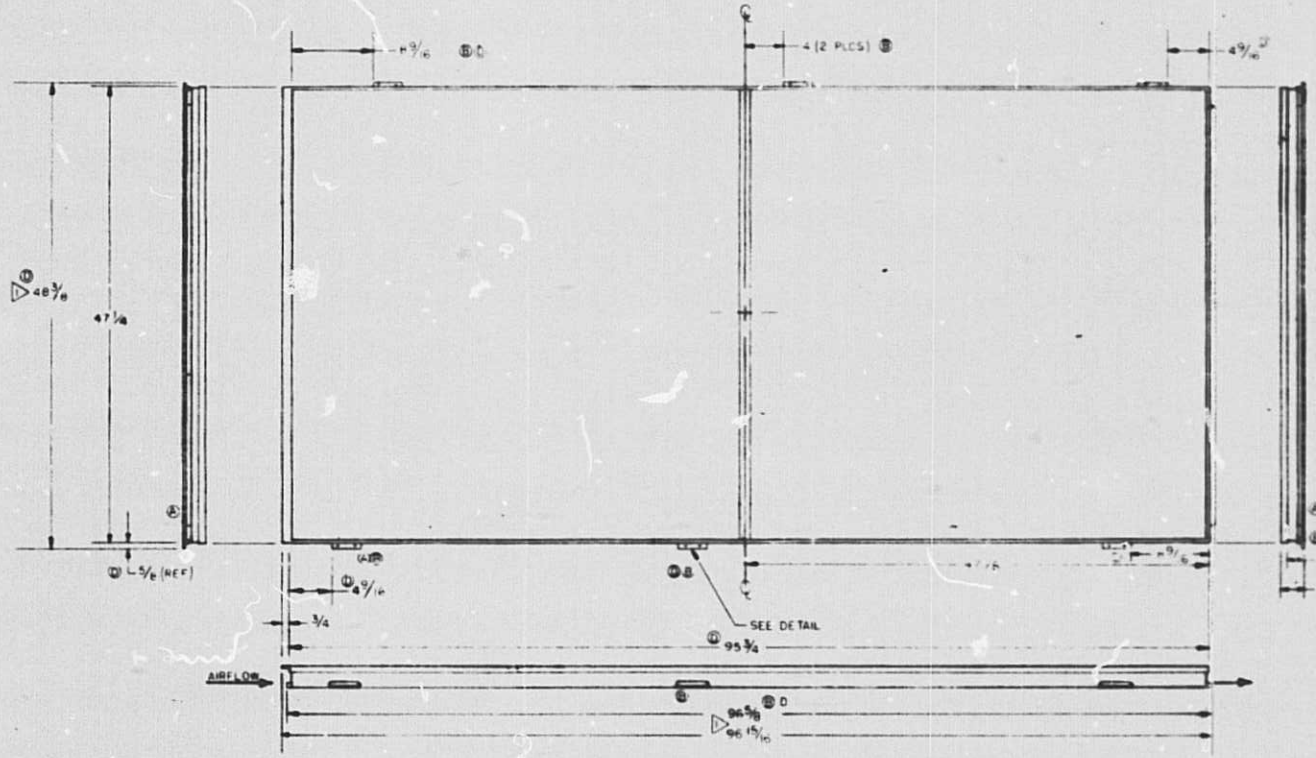
1. LENGTH: 16'-0" MINIMUM.
2. ANGLES: 90±2°.
3. BREAK SHARP EDGES .010R, EXCEPT AS SHOWN.
4. ALL SURFACES EXPOSED.
5. EST AREA: 0.142 SQ. IN.
6. EST PERIMETER: 4.357 IN.
7. WEIGHT/FOOT: 0.170 LB/FT.
8. Ⓐ ALLOY: 6063-T5
9. TOLERANCES NOT CALLED OUT ARE PER DRAFTING STANDARDS FOR ALUMINUM EXTRUDED AND TUBULAR PRODUCTS, 7TH ED.
10. Ⓐ USE: SC4X8101

EXTRUDED SHAPE
CLASS I SEMIHOLLOW

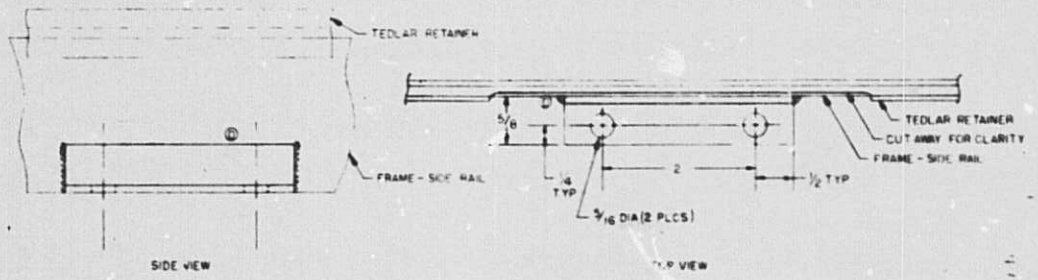
SCALE: 4X	APPROVAL:	SHT 1/1	DRAWN: G. CONDIT
DATE: 28 APRIL 77			CHECKED:

LIFE SCIENCES ENGINEERING | Ⓐ SC4X8500

REV	DESCR	BY	APPD
A	ADDED MTG BRKTS, BACKSTRAPS, SC4XR106, & SC4XB105. REVISED SUPPORT BAR.	CONDIT 30MAY77	
B	REVISED MTG BRKTS & ADDED DETAIL. REVISED SUPPORT BAR.	CONDIT 7JUN77	
C	REVISED NO. OF BASELINE SPEC & ADDED DIM TO MTG BRKT.	CONDIT 30JUL77	
D	REVISED MTG. BRKT. WELDS & LOCATIONS; REVISED AIR INLET/OUTLET; ADDED OVERALL DIMENSION & [illegible] NOTE.	CONDIT 15SEP77	

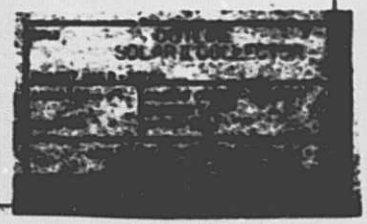


▷ NOTE: ENVELOPE DIMENSIONS ARE 47 1/8 × 95 5/8 × 2 3/8. FLANGED DIMENSIONS INCLUDE MOUNTING BRACKETS, BUILT-IN DUCT ADAPTERS, & FLANGE.

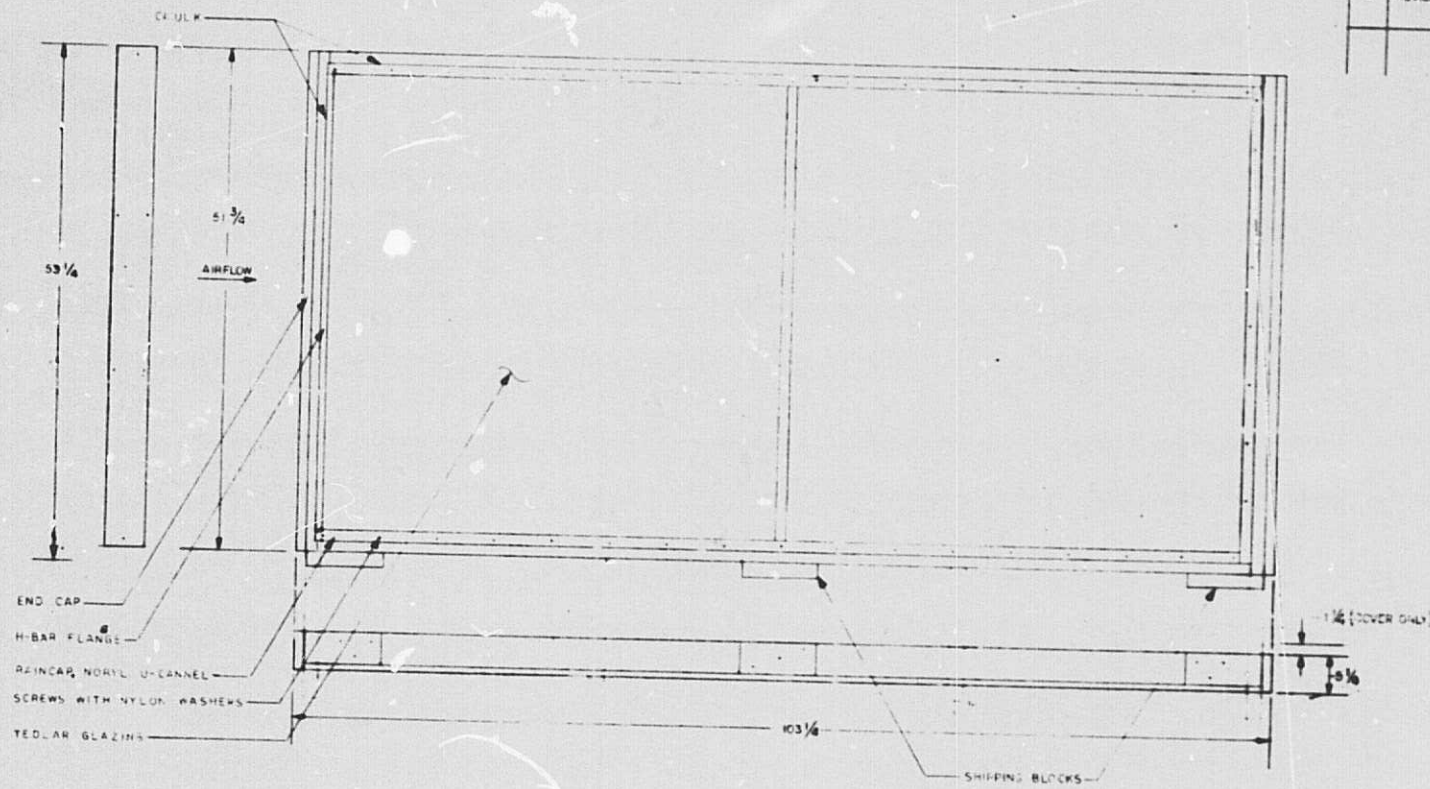


DETAIL
TYPICAL
MOUNTING BRACKET

DET	QTY	NOMEN	P/N
		INSTALLATION & OPERATION MANUAL	SMC - 3170
		INSTALLATION DRAWING	SC4XB104
		SPEC - CLEANING, TREATING, AND PAINTING OF MATERIALS	SC4XB105
		SPEC - BASELINE CONFIGURATION	SC4XB200-4
	1	SOLAR COLLECTOR ASSY	SC4XB101-9

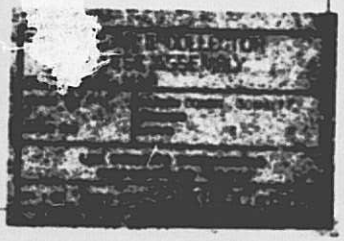


REV	DESCR	BY	APPD
4	REVISED REDRAWN	CONDIT 10SEP77	CJW RJ

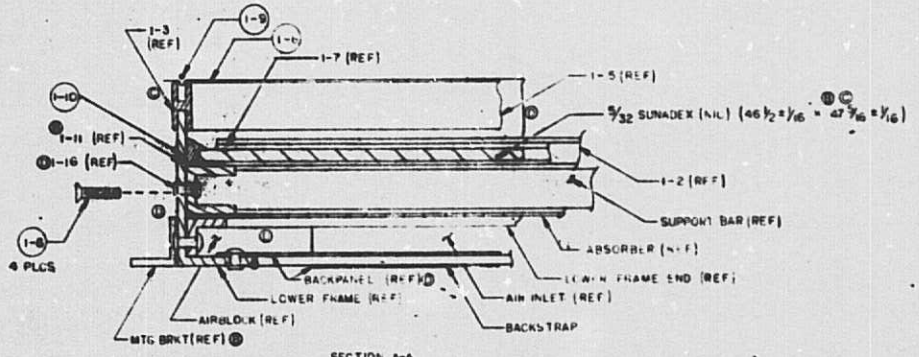


-19

NOTE:COVER NOT SHOWN.



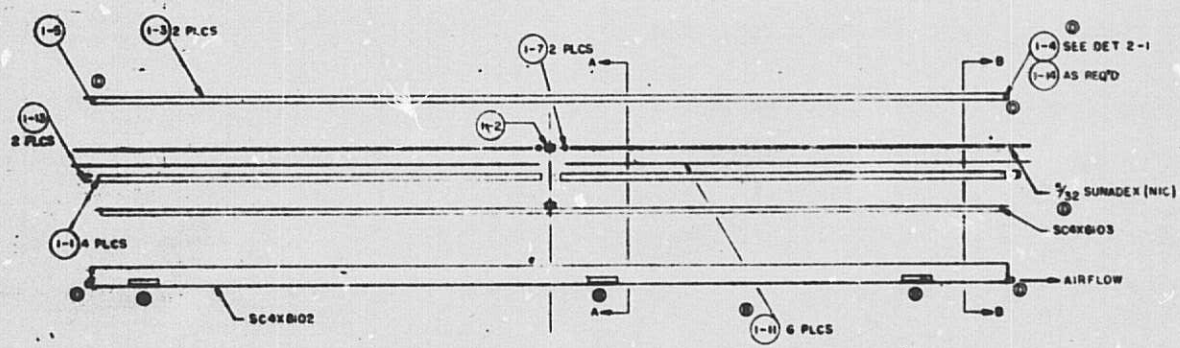
REV	DESCR	BY	
A	REVISED EXPLODED VIEW. REDREW SECTION A-A. REVISED B/M. ADDED: SHT 2, BACKSTRAP, SECTION B-B, MTG BRKT, NOTES, 1-8 → 1-11, & DETAILS.	DRC 27MAY77	
B	REVISED: MTG BRKTS, B/M FOR 1-2, 1-7, 1-11 & 1-13. ADDED: SUNADEX DIMS, 1-11 ⓓ. REVISED B/M FOR 1-1 (LENGTH) ADDED NOTE 2.	CONDIT 8JUN77	
C	REVISED: B/M FOR 1-3, 1-4, 1-5, 1-11 & SECTION A-A; ADDED 1-14 & 1-15; REVISED DIMS FOR SUNADEX.	CONDIT 24JUN77	
D	DELETED: DIM ON -9 ASSY (SUNADEX), NOTE 1, & ITEM 1-15; ADDED 1-16; REVISED: DIMS OF 1-11, 12, 13, B/M OF 1-16, AIR INLET/OUTLET & SECT A-A.	CONDIT 10 SEP77	



SECTION A-A
SCALE: FULL

NOTES:

1. DELETED. SEE ASSEMBLY PROCESS PLAN.



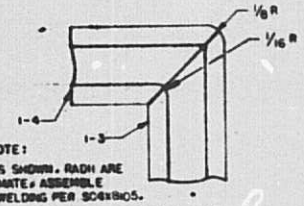
-9 ASS'Y

2. TOLERANCES: ± 1/32 UNLESS NOTED.

DET	QTY	NOMEN
1-16	40	RIVET, AD4448S, OR EQUIV
1-15		DELETED
1-14	A/R	ADHESIVE, HYSOL EA934
1-13	2	U-CHAN, 5/8 × 5/8 × 1/8 × 45-3/8, AL ALL 6063-T6
1-12	3	SHEET, 1 × 1 × .062, AL ALL 5005-H34
1-11	12FT	TAPE, 5/8 × 1/16, SILICONE OR EQUIV
1-10	A/R	ADHESIVE, DOW-CORNING RTV732 OR EQUIV
1-9	25FT	SPLINE, PLASTIC, 0.145 ANSON OR EQUIV
1-8	1	FILM, TEDLAR, 4 MIL × 50 × 100
1-7	2	U-CHAN, 9/32 × 5/16 × 1/16, 48-3/8, AL ALL 6063-T6
1-6	4	SCREW, 10-32 × 1/2 FH, AL ALL 2024-T6
1-5	1	EXTRUSION, SC4X8500 × 47-1/8
1-4	1	EXTRUSION SC4X8502 × 47-1/8
1-3	2	EXTRUSION, SC4X6502 × 88-3/4
1-2	1	H-BAR, 1 × 7/16 × 48-1/8, AL ALL 6063-T6
1-1	4	U-CHAN, 5/8 × 5/8 × 1/8 × 48-1/8, AL ALL 6063-T6

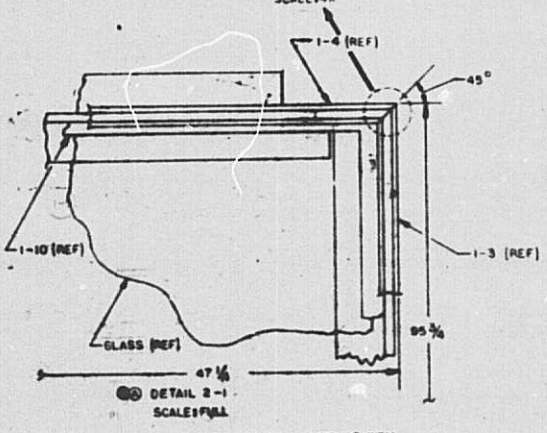
REV	DESCR	BY	APPRD
A	REVISED SECTION B-B, CORNER DETAIL, & DETAIL 2-1; ADDED 1-14, 1-15, & DETAIL 2-3.	CONDIT 24JUN77	
B	REVISED: SECT B-B, DET 2-1, 2-2, & CORNER DETAIL. DELETED DET 2-3.	CONDIT 10SEP77	

B SECTION B-B
SCALE: FULL



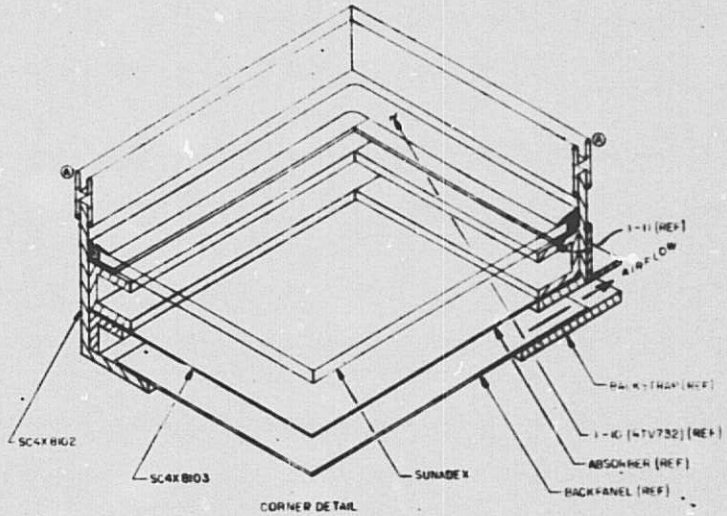
NOTE:
ROUND AS SHOWN. RADII ARE APPROXIMATE. ASSEMBLE BY GTA WELDING PER SC4X8105.

2A TYPICAL CORNER (H-BAR)
SCALE: 4X

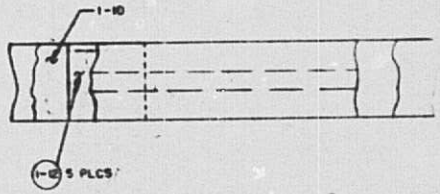


2A DETAIL 2-1
SCALE: FULL

A NOTE: USE 1-15 ON MATING SURFACES OF H-BARS, AS WELL AS UNDERSIDE OF 1-18 STIFFNER.



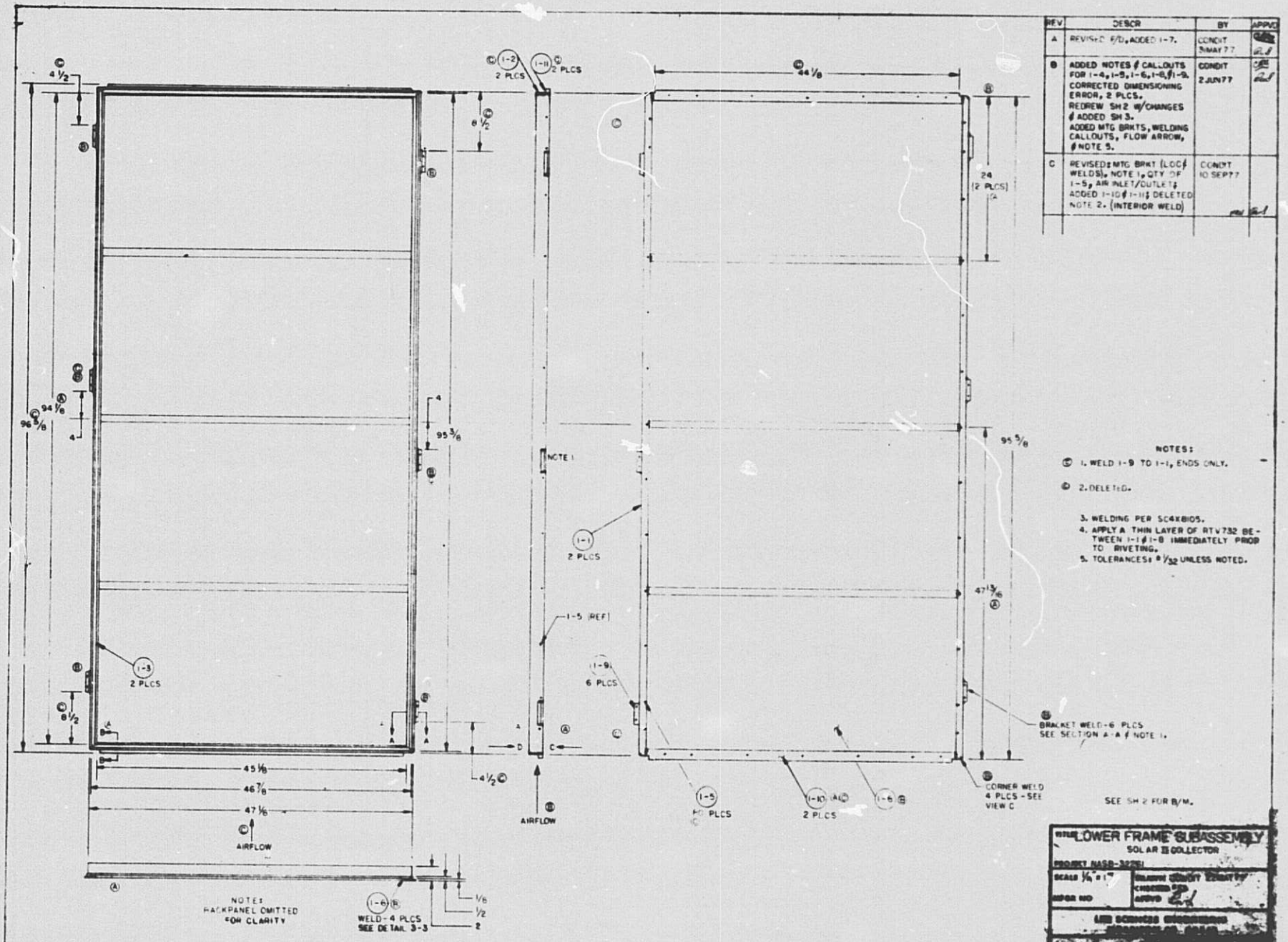
CORNER DETAIL
SCALE: FULL



2 DETAIL 2-2
SCALE: FULL

DELETED

2A DETAIL 2-3

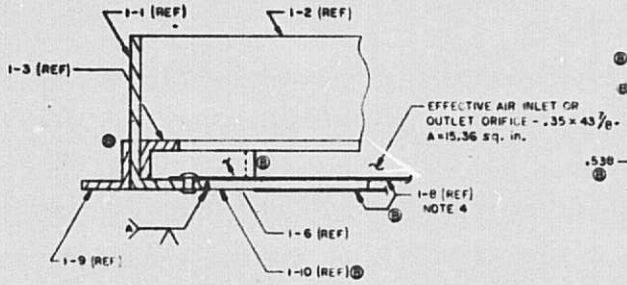


REV	DESCR	BY	APPVD
A	REVISED P/D, ADDED 1-7.	CONDIT 3MAY77	
B	ADDED NOTES & CALLOUTS FOR 1-4, 1-5, 1-6, & 1-9. CORRECTED DIMENSIONING ERROR, 2 PLCS. REDREW SH 2 W/CHANGES & ADDED SH 3. ADDED MTG BRKTS, WELDING CALLOUTS, FLOW ARROW, & NOTE 5.	CONDIT 2 JUN 77	
C	REVISED MTG BRKT (LOC & WELDS), NOTE 1, QTY OF 1-5, AIR INLET/OUTLET; ADDED 1-10 & 1-11; DELETED NOTE 2. (INTERIOR WELD)	CONDIT 10 SEP 77	

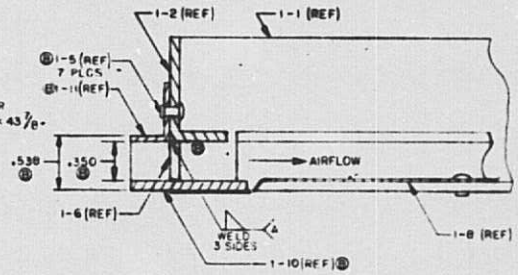
NOTES:
1. WELD 1-9 TO 1-1, ENDS ONLY.
2. DELETED.
3. WELDING PER SC4X8105.
4. APPLY A THIN LAYER OF RTV 732 BETWEEN 1-1 & 1-8 IMMEDIATELY PRIOR TO RIVETING.
5. TOLERANCES: ± 1/32 UNLESS NOTED.

TITLE: LOWER FRAME SUBASSEMBLY
SOLAR IS COLLECTOR
PROJECT NASA-32151
SCALE 1/8" = 1"
DRAWN
CHECKED
APPVD
DWG NO
LMSC SCIENCES ORGANIZATION

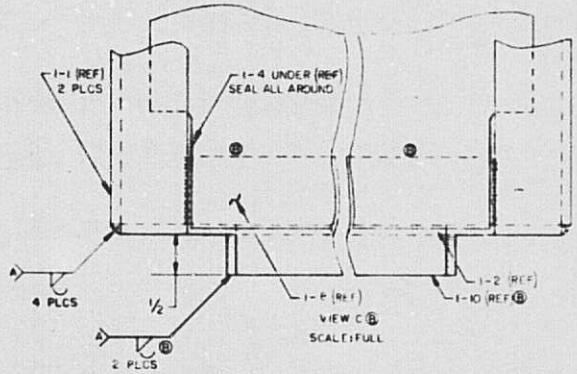
A	REDRAWN WITH CHANGES	CONDIT 2 JUN 77	
B	DELETED: WELD ON 1-1 & 1-2 (SECT B-B), WELD ON 1-7 & 1-8 (VIEW C) REVISED: QTY OF 1-5 & 1-7, NOMEN OF 1-6, ALL DETAILS ON THIS SHEET, ADDED: 1-10 & 1-11, REVISED DIM ON 1-3	CONDIT 10 SEP 77	

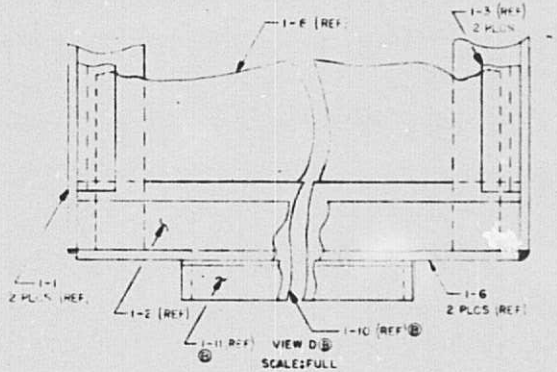


B SECTION A-A
SCALE: NONE



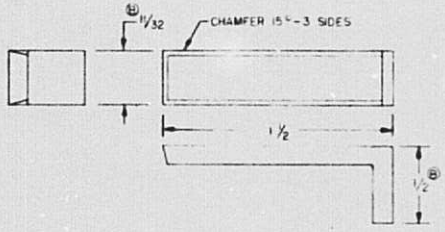
B SECTION B-B
SCALE: NONE



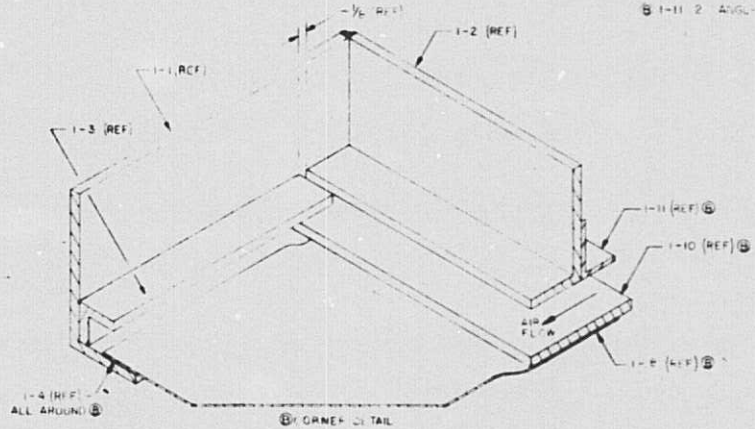


A INDICATES WELD PER SC4X805.

DET	QTY	NOMEN
1-1	2	ANGLE, 1 x 2 x 1/8, AL ALL 6063-T4
1-2	2	ANGLE, 3/4 x 1-1/2 x 1/8 x 46-7/8, AL ALL 6063-T4
B 1-3	2	ANGLE, 1/2 x 1/2 x 1/8 x 93-7/8, AL ALL 6063-T4
1-4	A/R	ADHESIVE, DOW-CORNING RTV 732 OR EQUIV.
B 1-5	80	RIVET, POP, DAYTON 5X520 OR EQUIV.
B 1-6	4	ANGLE, 1-1/2 x 5/8 x 1/8, AL ALL 6063-T4.
B 1-7	3	BAR, 1 x 1/8 x 45-1/8, AL ALL 6063-T4
1-8	1	SHEET, .025 THK, AL ALL 5005-H34
1-9	6	ANGLE, 5/8 x 5/8 x 3/32 x 3, AL ALL 6063-T4
B 1-10	2	BAR, 1/2 x 1/8 x 45-1/8, AL ALL 6063-T4
B 1-11	2	ANGLE, 3/4 x 1/2 x 1/8 x 44-1/8, AL ALL 6063-T4



B DETAIL 2-1
1-6 AIRBLOCK
SCALE: 2:1

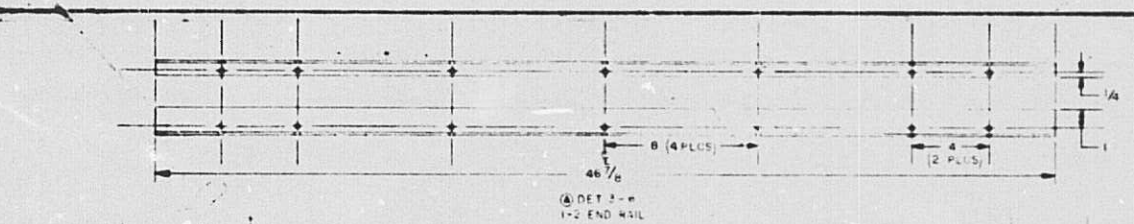


B CORNER DETAIL
SCALE: FULL

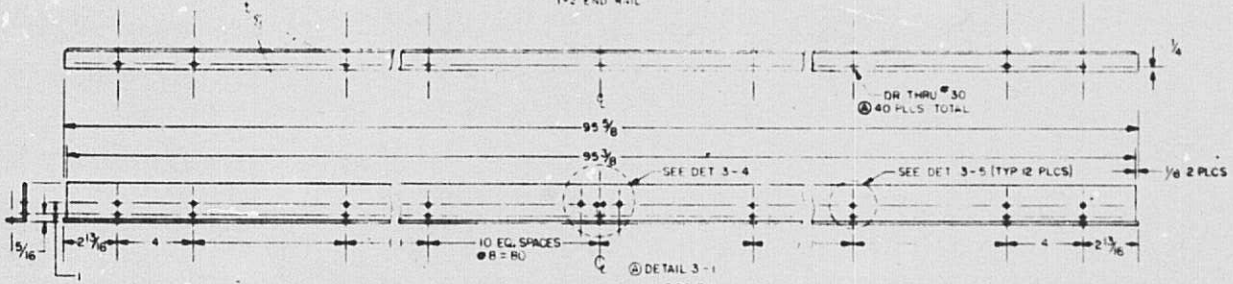
LIFE SCIENCES INCORPORATED
MORRISON, CO 80465

SH 2 OF 3 SC4X8102

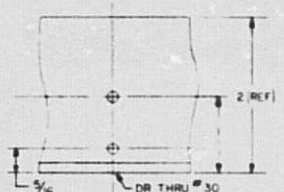
REV	DESCR	BY	APP
A	REVISED NO OF HOLES IN DET 3-1, CUTOUT IN DET 3-2, 1-6 & 1-10 IN DET 3-3; ADDED DETS 3-6 3-7.	CONDIT 10SEP77	



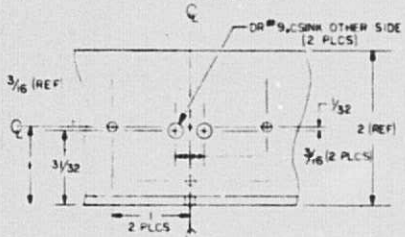
Ⓐ DET 3-6
1-2 END RAIL



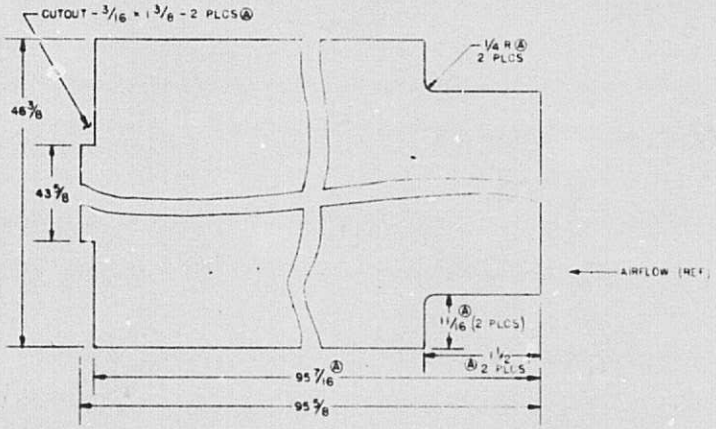
Ⓐ DETAIL 3-1
1-1 SIDE RAIL
SCALE: 1/4



DETAIL 3-5
SCALE: FULL

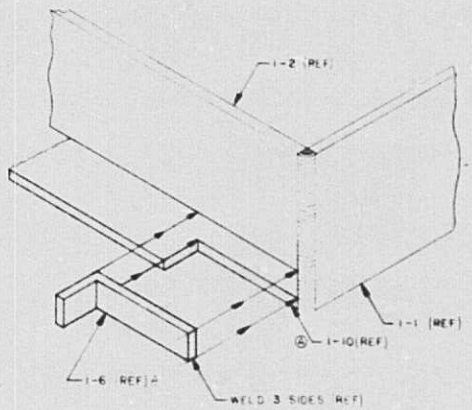


DETAIL 3-4
SCALE: FULL

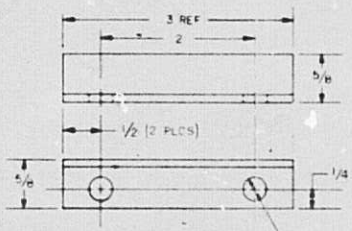


Ⓐ DETAIL 3-2
1-8 BACKPANEL
SCALE: FULL

NOTE:
BACKPANEL TO BE MATCH-DRILLED TO SIDE RAILS DURING ASSEMBLY.

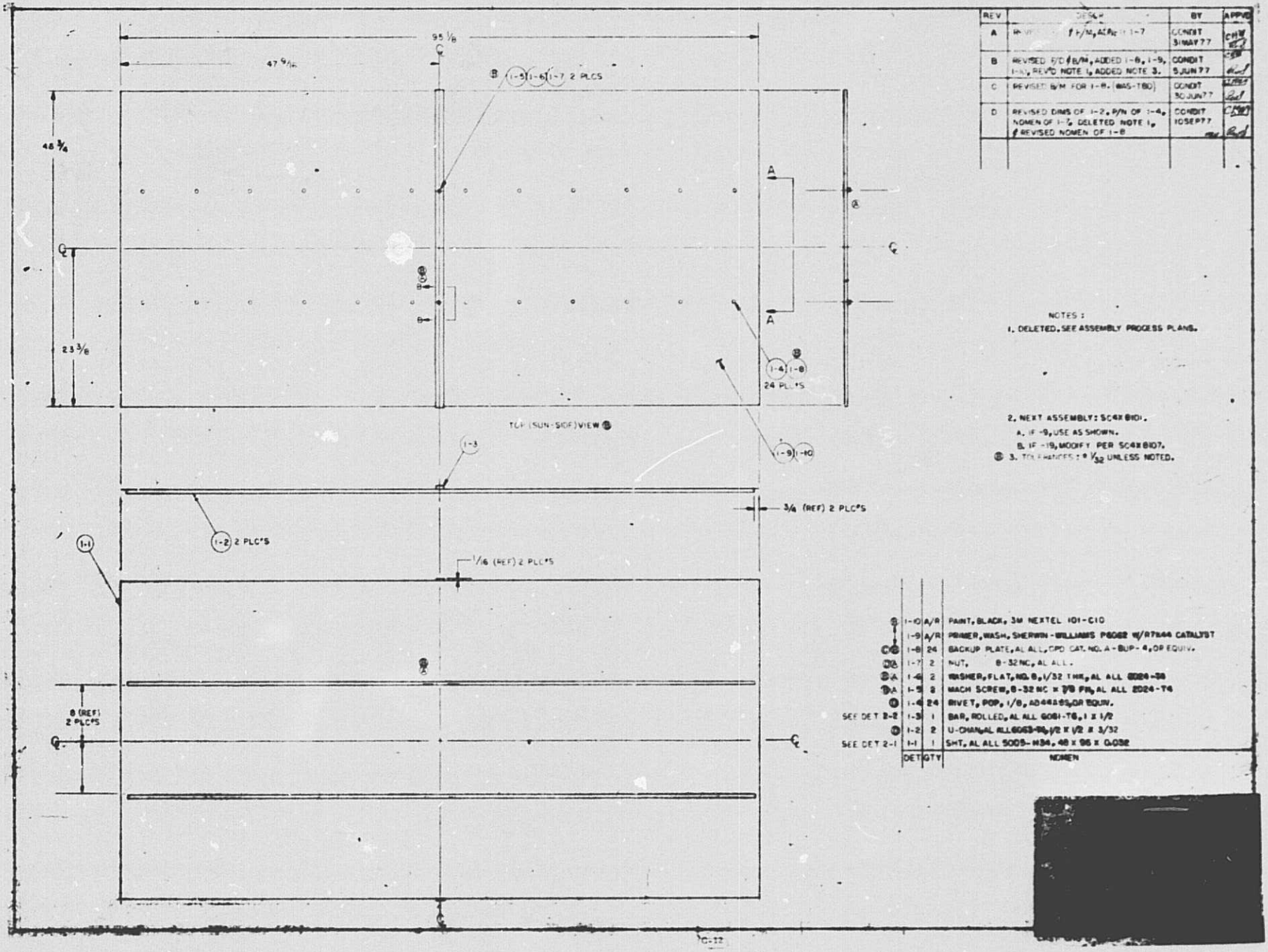


Ⓐ DETAIL 3-3
INSTALLATION OF
1-6 AIRBLOCK.
SCALE: FULL



Ⓐ DET 3-7
1-9 MOUNTING BRACKET
SCALE: FULL

REV	DESCRIPTION	BY	APPVD
A	REVISED F/D [illegible], ADDED 1-7	CONDIT 31MAY77	CHW
B	REVISED F/D [illegible], ADDED 1-8, 1-9, 1-10, REVD NOTE 1, ADDED NOTE 3.	CONDIT 5JUN77	CHW
C	REVISED B/M FOR 1-8. (WAS-TBD)	CONDIT 30JUN77	CHW
D	REVISED DIMS OF 1-2, P/N OF 1-4, NOMEN OF 1-7, DELETED NOTE 1, & REVISED NOMEN OF 1-8	CONDIT 10SEP77	CHW



NOTES :

1. DELETED. SEE ASSEMBLY PROCESS PLANS.

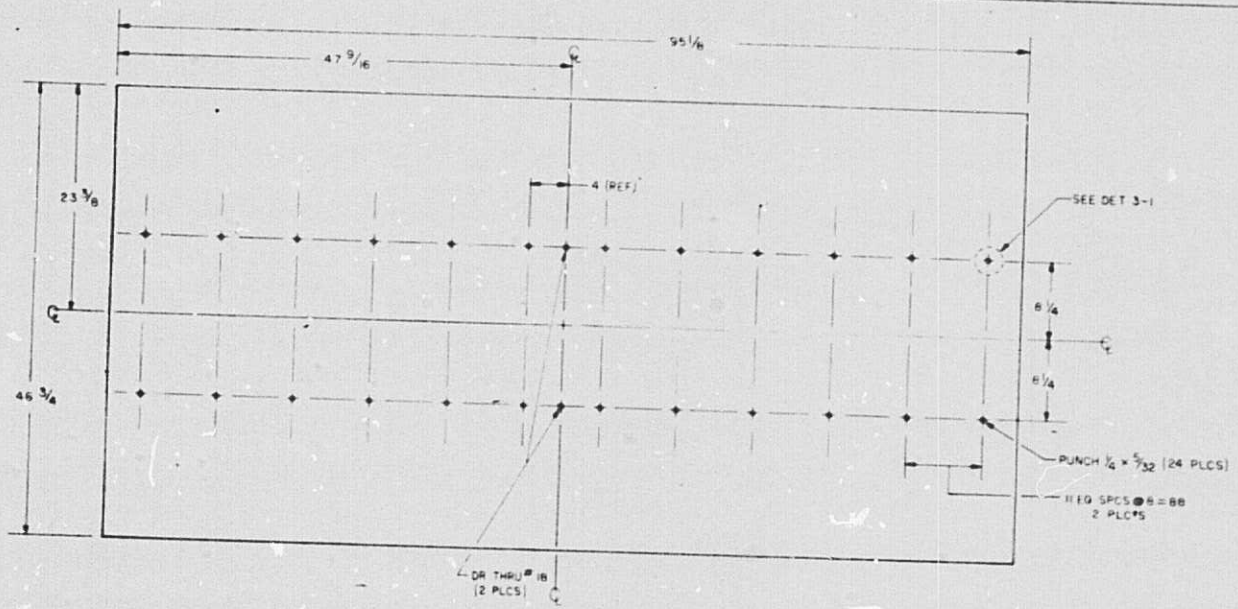
2. NEXT ASSEMBLY: SC4X810.
   A. IF -9, USE AS SHOWN.
   B. IF -9, MODIFY PER SC4X807.

3. TOLERANCES : ± 1/32 UNLESS NOTED.

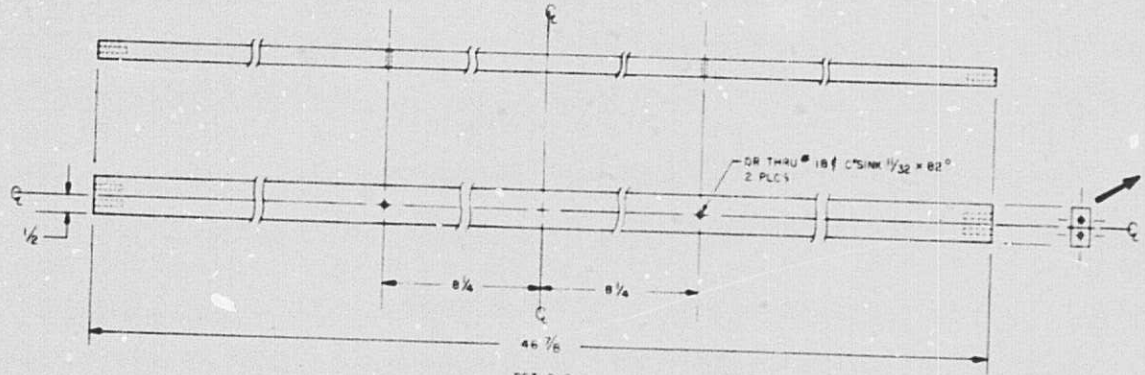
	DET	QTY	NOMEN
	1-10	A/R	PAINT, BLACK, 3M NEXTEL 101-C10
	1-9	A/R	PRIMER, WASH, SHERWIN-WILLIAMS P60G2 W/R7K44 CATALYST
C/B	1-8	24	BACKUP PLATE, AL ALL, CPD CAT. NO. A-BUP-4, OR EQUIV.
D/A	1-7	2	NUT, 8-32 NC, AL ALL.
D/A	1-6	2	WASHER, FLAT, NO. 8, 1/32 THK, AL ALL 2024-T3
D/A	1-5	2	MACH SCREW, 8-32 NC x 3/8 FH, AL ALL 2024-T4
B	1-4	24	RIVET, POP, 1/8, AD4425, OR EQUIV.
SEE DET 2-2	1-3	1	BAR, ROLLED, AL ALL 6061-T6, 1 x 1/2
D	1-2	2	U-CHAN, AL ALL 6063-T6, 1/2 x 1/2 x 3/32
SEE DET 2-1	1-1	1	SHT, AL ALL 5005-H34, 48 x 96 x 0.032

[redacted]

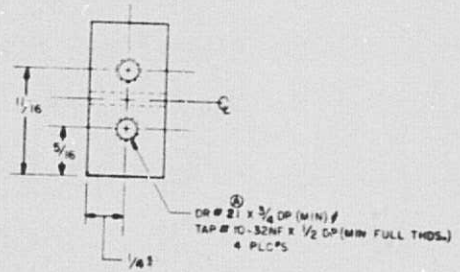
REV	DESCR	BY	APPVD
A	REVISED FOR EXPANSION & CONTRACTION OF ASSY.	CONDIT 5 JUN 77	
B	CORRECTED ERRORS IN DET 2-2.	CONDIT 30 JUN 77	



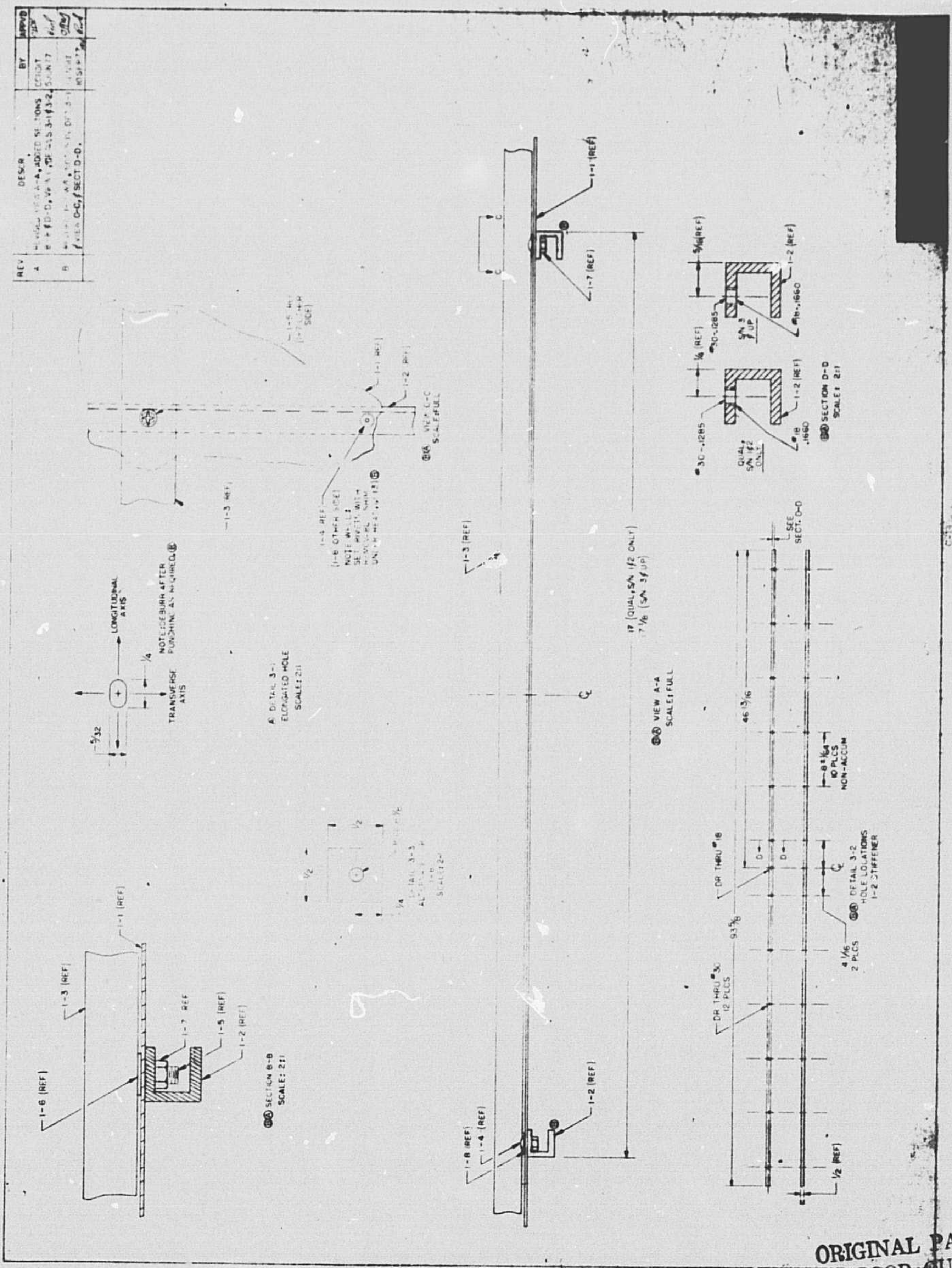
Ⓐ DET 2-1
HOLE LOCATIONS SCALE: 1/8



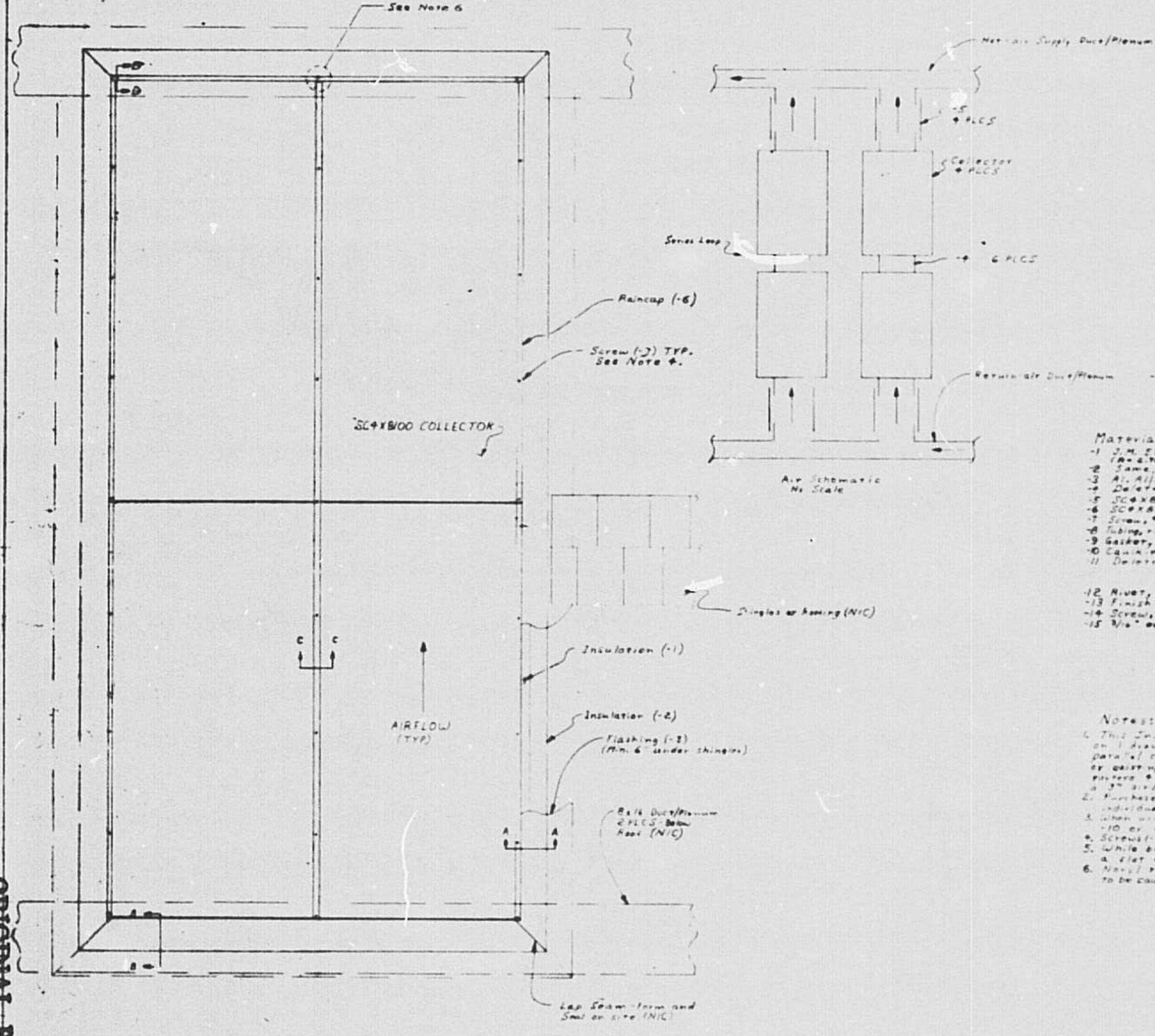
ⒷⒶ DET 2-2
SUPPORT BAR
SCALE: 1/2



DET 2-3
Ⓐ END DETAIL
SUPPORT BAR
SCALE: 2 TO 1



REV	DESCR	BY	APPVD
B	Revised & Redrawn - Deleted Sht. 1/3, and -4	Condit 29JUN77	CHW



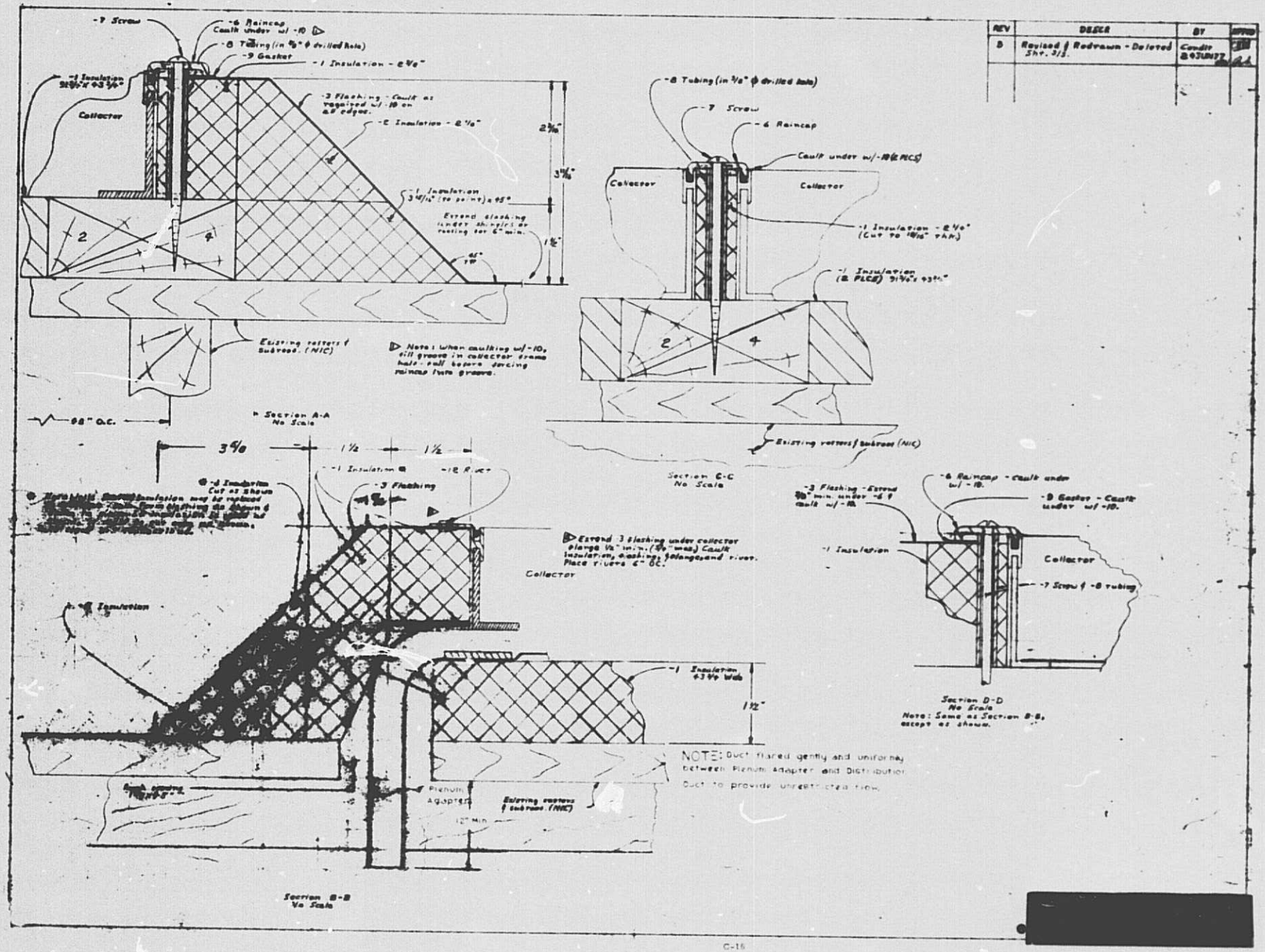
Plan View - SC4XB Quad
Surface Mount
Scale: 3/4" = 1'-0"

Materials (All NIC)

- -1 J.M. Exterior roof insulation (Fesco) or equivalent, 1½" thick. (minimum thickness, minimum)
- -2 Same, 4" Face Cant
- -3 Al. All. flashing, .019 × 15 wide, as req'd.
- -4 Deleted
- -5 SC4XBESC-5 Plenum Adapter
- -6 SC4XBSO1 Raincap
- -7 Screw, #12 × 4" RHWS
- -8 Tubing, rigid acrylic plastic, ⅝" OD, ½" ID × 2½" lg.
- -9 Gasket, ½", Conn. Hard Rubber R10470
- -10 Caulking compound, non-hardening, rubber base.
- -11 Deleted
- -12 Rivet, pop, ⅛" dia. × ⅛" grip.
- -13 Finish Lmbr, 2×4 - 8, Construction Grade.
- -14 Screw, #10 × 1½" RHWS
- -15 3/16" oversize washer.

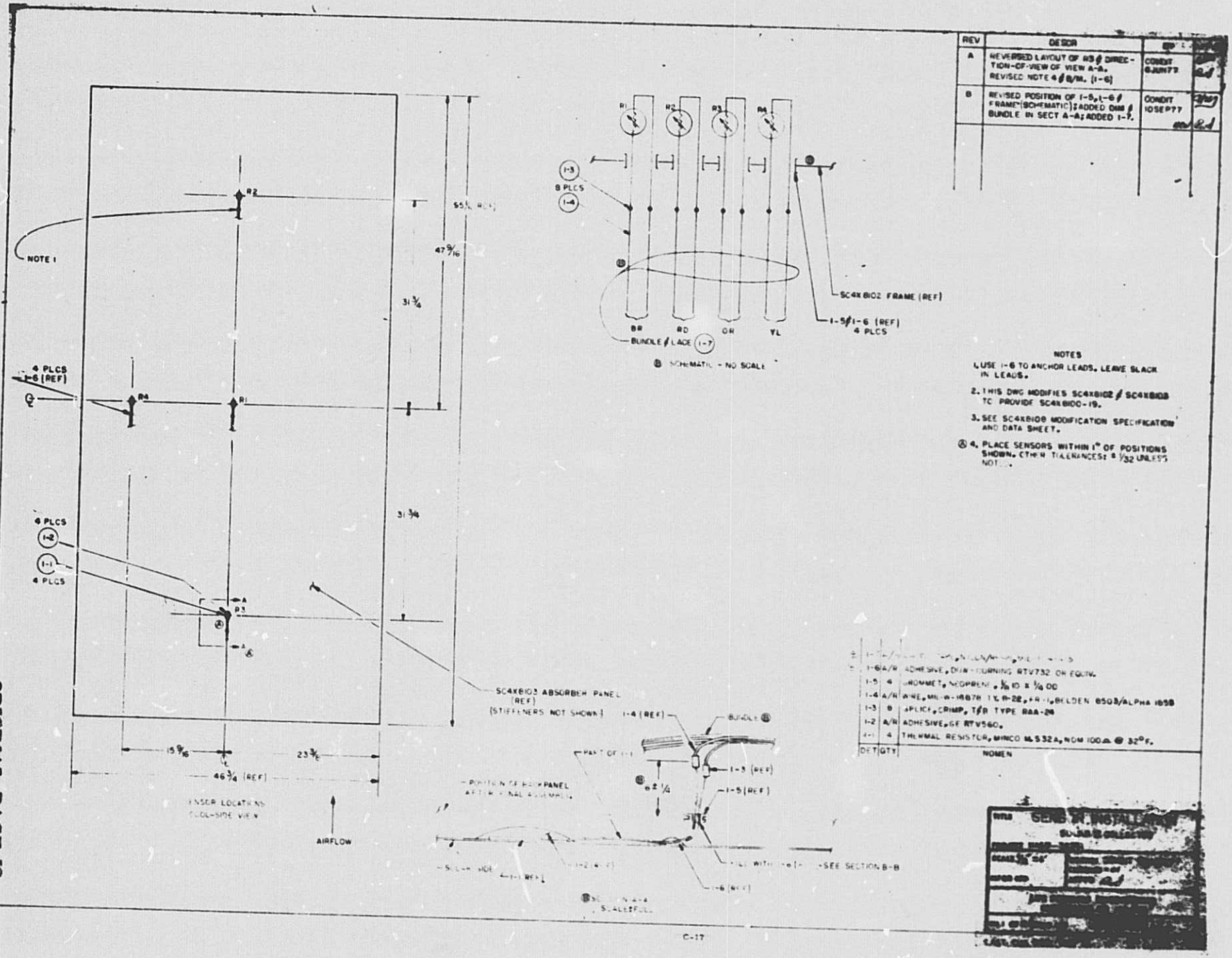
Notes:

1. This Installation Concepts Plan View shows 3 installation concepts on 1 drawing. Collectors may be installed in parallel, series, or series-parallel configurations. The Solar II collectors may be installed in new or existing roofs, or in stand-alone units. The collectors are shown on rafters 4'-0" O.C. They may be installed on rafters set 8'-0" O.C. if a 3" airblock is used at the inlet & outlet openings of the collector.
2. Purchase -1 in 4'×8' sheets & cut on site. Dimensions given may vary for individual installations.
3. When using random lengths as -1, -2, or -13, butt ends & seal with -10 or equivalent.
4. Screws (-7) shall be approx. 1'-0" apart.
5. While building frame (-13), shim as necessary to obtain a flat mounting surface.
6. Nail raincap (-6) joints to be mitred & caulked at corners. Butt joints to be caulked. Use -10. (above)



REV	DESCR	BY	APPRD
B	Revised & Redrawn - Deleted Sht. 3/3.	Condir 8 JUN 77	

[redacted]



REV	DESCR	BY
A	REVERSED LAYOUT OF R3 & DIRECTION-OF-VIEW OF VIEW A-A. REVISED NOTE 4 & B/M. (1-6)	CONDIT 6JUN77
B	REVISED POSITION OF I-5, I-6 & FRAME (SCHEMATIC); ADDED DIM & BUNDLE IN SECT A-A; ADDED I-7.	CONDIT 10SEP77

NOTES

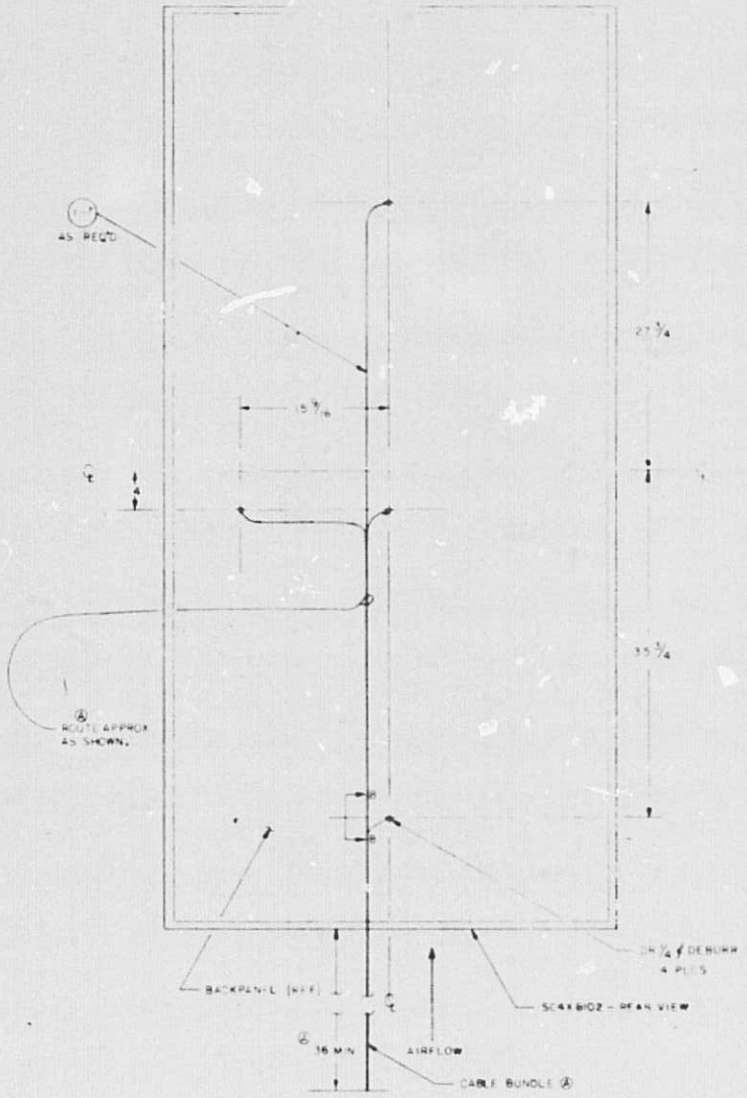
1. USE I-6 TO ANCHOR LEADS. LEAVE SLACK IN LEADS.
2. THIS DWG MODIFIES SC4XBIO2 & SC4XBIO3 TO PROVIDE SC4XBIO0-19.
3. SEE SC4XBIO8 MODIFICATION SPECIFICATION AND DATA SHEET.
4. PLACE SENSORS WITHIN 1" OF POSITIONS SHOWN. OTHER TOLERANCES ± 1/32 UNLESS NOTED.

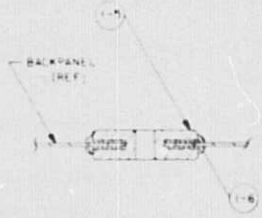
DET	QTY	NOMEN
I-6	A/R	ADHESIVE, DOW-CORNING RTV732 OR EQUIV.
I-5	4	GROMMET, NEOPRENE, 3/16 ID x 1/4 OD
I-4	A/R	WIRE, MIL-W-16878 TYPE B-28, #28, BELDEN 8503/ALPHA 1858
I-3	8	SPLICE, CRIMP, T&B TYPE 54A-28
I-2	A/R	ADHESIVE, GE RTV560.
I-1	4	THERMAL RESISTOR, MINCO MLS32A, NOM 100Ω @ 32°F.

SENSOR INSTALLATION

C-17

REV	DESCR	BY	APPD
A	ADDED CABLE BUNDLE Ⓐ IN REAR VIEW (SHT 2).	CONAT (DEPT)	





SECTION B-B
SCALE: 2/1

[redacted]

LAST CHG A 10 SEP 77