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SYSTEM DESIGN PACKAGE FOR SIMS PROTOTYPE SYSTEM 4, SOLAR HEATING AND DOMESTIC HOT WATER

Prepared from documents furnished by

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16. ABSTRACT

This report is a collation of documents and drawings that describe a prototype solar heating and hot water system using air type solar energy collection techniques. The system consists of a modular designed pre-packaged solar unit containing solar collectors, a rock storage container, blowers, dampers, ducting, air-to-water heat exchanger, DHW preheat tank, piping and system controls. The system was designed to be installed adjacent to a small single family dwelling. The description, performance specification, subsystem drawings, verification plan/procedure, and hazard analysis of the system are packaged for evaluation of the system with information sufficient to assemble a similar system.

The prepackage solar unit has been installed at the Mississippi Power and Light Company, Training Facilities, Clinton, Mississippi.

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1.0 INTRODUCTION

A solar domestic hot water and space heating system using air type solar energy collection techniques is presented for a specific design. The system consists of a modular designed prepackaged solar unit containing solar collectors, a rock storage container, blowers, dampers, ducting, air-to-water heat exchanger, DHW preheat tank, piping and system controls. The system was designed to be installed adjacent to a small single family dwelling. The prepackaged unit is documented for 135, 203 or 271 square foot collector arrays utilizing a particular commercially available solar collector with appropriate storage capacity. This document describes design, performance and hardware specifications in sufficient detail to (1) fabricate a prepackaged unit, (2) to allow architectural engineers and contractor to procure, install the site oriented hardware and finally (3) to permit a contractor to operate and maintain the system.

2.0 SYSTEM DESCRIPTION

SIMS Prototype System 4 is an air-operated solar space and domestic hot-water heating system. Eleven functional components, as described below are, configured in the system as illustrated in Figure 2.0-1.

Functional Components

(1) Solaron Corporation Series 2001 flat plate air-type solar collectors

(2) Pre-fabricated modular pebble bed, thermal storage unit

(3) One Grainger Inc. Model 7C812 air blower

(4) One Grainger Inc. Model 2C986 air blower with 5K900 motor

(5) Two Ruskin Model CD454PW/MP1161 control dampers

(6) Two American Warming Model SHB-D-1217 back-draft dampers with cohrelastic blades

(7) Two American Warming Model DAA-P-8150 balancing dampers

(8) Jackson Manufacturing Model UCO 5225 hot water tank for system preheat tank

(9) Halstead Mitchell Model SW2-18-18-8 air-to-liquid heat exchanger

(10) The conventional hot water heater

(11) The auxiliary heat source

(12) Control components (described in later section)

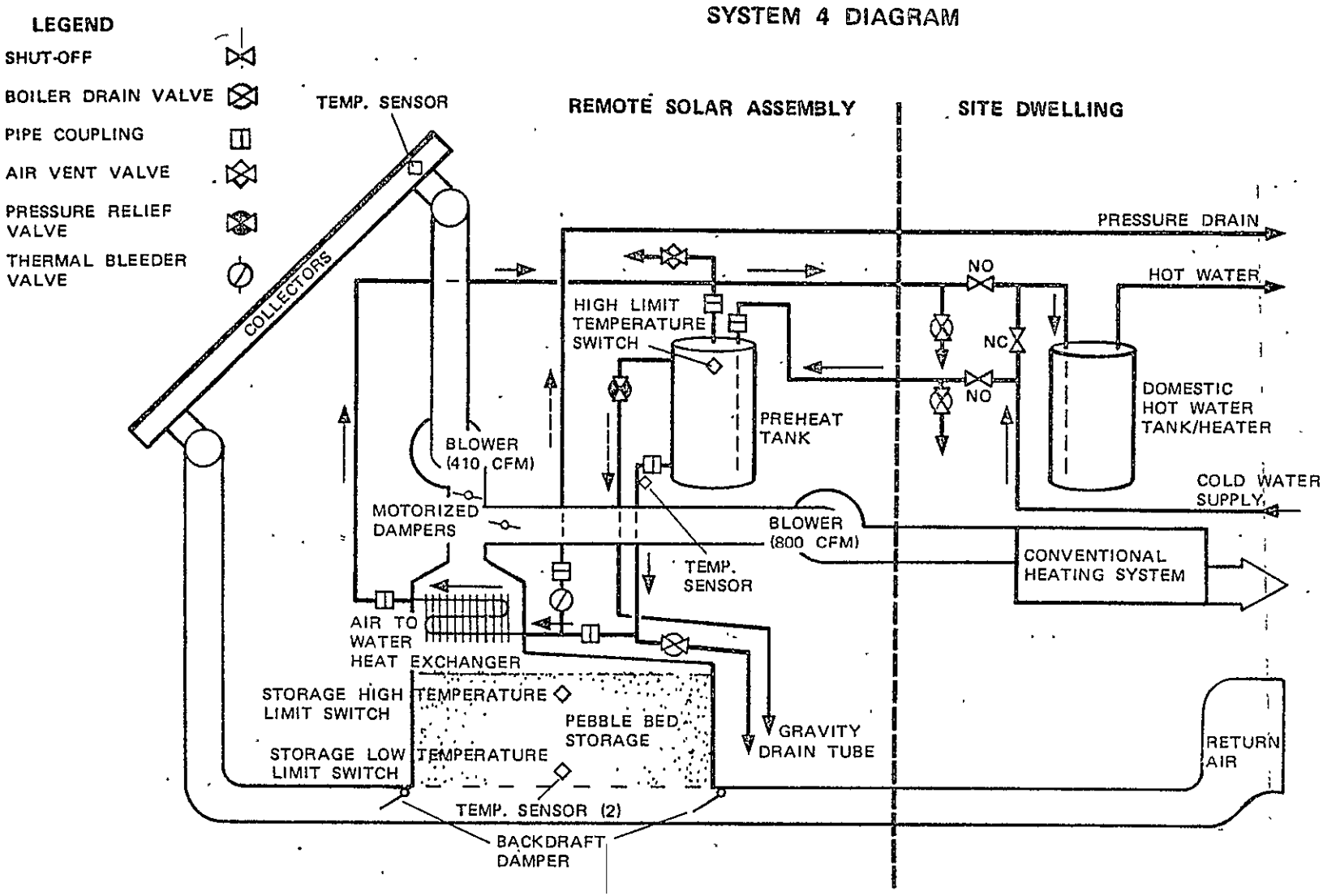


Figure 2.0-1, System 4 Schematic Diagram

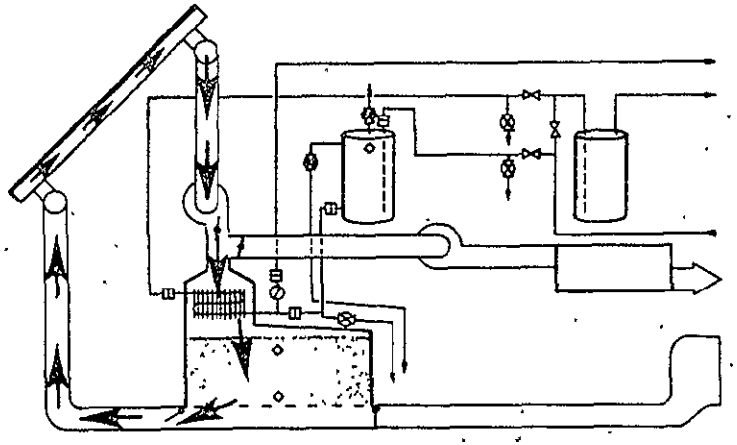
As illustrated in Figure 2.0-2, the system has three modes of operation to maintain three different air circulation loops: (1) Collector to Storage, (2) Collector to Load and (3) Storage to Load. Air flow is controlled by two blowers and two control dampers as indicated in Table 2.0-1. Solar energy is collected in modes (1) and (2). Space heating is accomplished in Modes (2) and (3).

Water is circulated in the domestic hot water preheat loop between the air-to-water heat exchanger and the preheat tank by syphon action. Domestic hot water heating is primarily accomplished in mode 1 when air temperatures to the heat exchanger are hottest; however, when air temperatures to the heat exchanger are higher than preheat tank water temperatures, water heating can also be accomplished in modes 2 and 3.

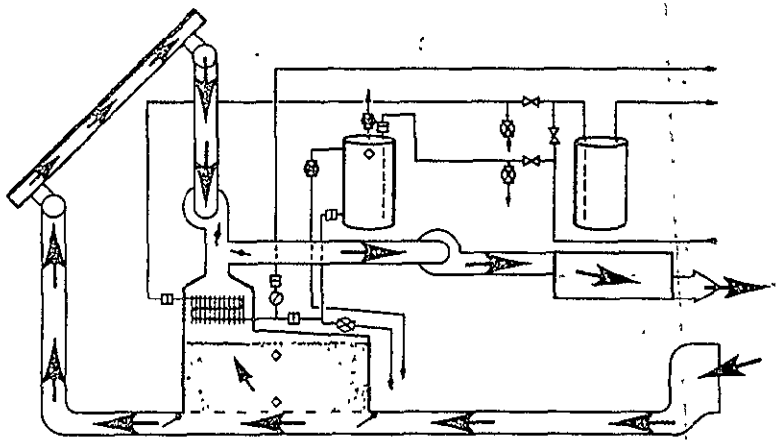
Two non-solar components (10), a conventional domestic hot water tank, and (11), an auxiliary heat source, operate in conjunction with the solar hardware to augment system heating requirements. These components are site dependent and existing items at the site. Their location in the overall system is illustrated in Figure 2.0-1. The two non-solar components (10), a domestic hot water tank, and (11), an auxiliary heating unit, are contained within the site dwelling and are connected to the Remote Solar Assembly by insulated piping and ducting.

All of the solar components (1) through (9) are assembled together in a modularized structure, to form a stand alone Remote Modular Assembly. This prepackaged unit is documented for 135, 203 and 271 net square foot collector array sizes utilizing the Solaron Corporation Series 2001 collector. Appropriately sized modular thermal storage units are included in the designs for each of the three collector array sizes. Larger Remote Modular Assemblies could be assembled using the same modular hardware, but with appropriate blower and duct changes.

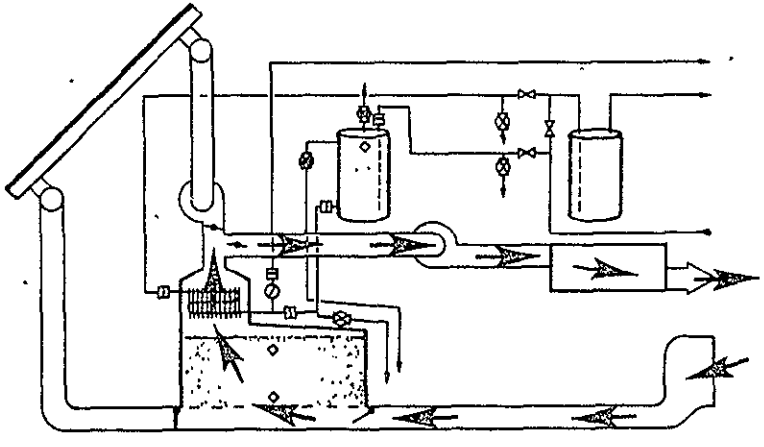
System control consists of simple on-off temperature sensitive components. These components and electrical circuits are described in the Control Subsystem, Section 2.5.



MODE 1 Collector to Storage



MODE 2 Collector to Load



MODE 3 Storage to Load

Figure 2.0-2, System 4 Modes of Operation

Mode	Collector Loop Control Damper	Collector Loop Blower	Load Loop Control Damper	Load Loop Blower
Mode 1 Collector to Storage	Open	On	Closed	Off
Mode 2 Collector to Load	Open	On	Open	On
Mode 3 Storage to Load	Closed	Off	Open	On

Air Flow Control Matrix

The system can be functionally divided into Collector, Energy Storage, Energy Transport, Domestic Hot Water, Controls and Auxiliary Energy Subsystems. Each of these subsystems is described in the following sections.

2.1 COLLECTOR SUBSYSTEM

System 4 collector subsystem consists of either 8, 12 or 16 Solaron Corporation, Series 2001, air heated collectors with appropriate mounting and flashing hardware. The basic collector is a 3 ft. wide by 6.5 ft long by 7 1/4 inches thick rectangular parallelopiped shaped unit with a 24-gage steel enclosure. The back surface insulation of the collector is 1 inch thick, 2 pounds per cubic foot fiber glass batt. The absorber is 24-gage steel with a PPG "Duracron 600" surface finish. The absorptivity and emmissivity of the absorber is 0.94 and 0.82 respectively. The weight of each collector is 153 pounds. The collector is double glazed with 1/8" thick low iron tempered safety glass (Fourco) having a total transmittance of 0.77. The Series 2001 collectors can be ganged 2-high for serial air flow. Many additional collectors can be ganged together by paralleling the 2-high collectors to form 2 by X collector array. System 4 Design Description Drawing, 7934983, shows series-parallel air flow paths for 2x2, 2x4 and 2x8 collector arrays. Air manifolding between collectors is maintained within the collectors.

The Solaron series 2001 collector efficiency is described by Figure 2.1-1. The collector parameters used in plotting this curve are defined as follows:

η	=	Collector efficiency
T_{in}	=	Collector inlet air temperature in ^{o}F
T_{amb}	=	Ambient outside air temperature in ^{o}F
τ	=	Effective combined transmittance of both glazings at normal incidence
α	=	Absorber solar absorptance
F'	=	Collector efficiency factor
F_R	=	Collector heat removal factor
U_L	=	Collector heat loss factor
W_C	=	Air flow rate test condition
I	=	Solar insolation in Btu/Hr Ft^2
$(\tau\alpha)_n$	=	Effective transmittance - solar absorptance product at normal incidence

2.2 STORAGE SUBSYSTEM

System 4 storage subsystem consists of a bed of pebbles contained in a rectangular shaped thermally insulated enclosure. The enclosure fabricated for the System 4 demonstration is 117.5" long by 70" wide by 52 3/4" high and contains approximately 5 1/2 tons of washed rounded stones 3/4" to 1 1/2" diameter.

The storage subsystem is designed and documented per 7934940 drawing for 75, 112.5 and 150 cubic feet capacities as required for 8, 12 and 16 collector array sized systems respectively. These storage capacities result in a thermal storage capacity of approximately 10 Btu/^{o}F per square foot of collector.

Air is circulated from top to bottom through the pebbles when operating in the collector to storage mode of operation. Air flow is reversed and passes up through the pebbles when operating in either the storage to load or collector to load modes of operation. In the latter mode, only a portion of the total air passes up through storage (about 1/2 of the total load).

The pebble bed enclosure is constructed by assembling side panels, end panels and top cover panels within the Remote Solar Assembly. The floor in the structure forms the base of the storage enclosure. Pebbles are supported 12 inches above the floor of the enclosure by a welded steel grating assembly. The space between the grating and the floor forms a lower plenum. The space between the top cover and the surface of the pebbles forms an upper plenum. The enclosure has three openings. One opening, 18" x 18" is located in the top center cover and provides passage to the upper plenum. The other two openings, 6" x 48" are located one each near the base of the ends of the enclosure and provide passage to the lower plenum.

Basic building - block panels have been designed to fabricate each of the three capacities described above. Larger storage capacities can be obtained in 37.5 cubic feet increments by assembling the necessary combinations of the existing design building - block panels. Panels required for a 8, 12 and 16 collector systems are defined in Table 2.2-1.

Table 2.2-1 Rock Bed Storage Enclosure Hardware

System Description	Panel Usage	Panel Part No.	Panel Size	Qty.	Openings
8 Collector Assy					
7934940-1	Side	7934936	48"x36"x4 3/4"	4	None
7934940-1	Top	7934978	70"x40 3/4"x4 3/4"	1	18"x18"
7934940-1	Top	7934937	70"x40 3/4"x3/4"	1	None
7934940-1	End	7934938	70"x48"4 3/4"	2	6"x46"
12 Collector Assy					
7934940-2	Side	7934936	48"x36"x4 3/4"	6	None
7934940-2	Top-End	7934937	70"x40 3/4"x4 3/4"	2	None
7934940-2	Top-Center	7934939	70"x36"x4 3/4"	1	18x18
7934940-2	End Panel	7934938	70"x48"x4 3/4"	2	6"x46"
16 Collector Assy					
7934940-3	Side	7934936	48"x36"x4 3/4"	8	None
7934940-3	Top-Inner	7934939	70x36"x4 3/4"	1	18"x18"
7934940-3	Top-Inner	7934977	70"x36"x4 3/4"	1	None
7934940-3	Top-Outer	7934937	70x36"x4 3/4"	2	None
7934940-3	End	7934938	70"x48"x4 3/4"	2	6"x46"

The insulated panels are a sandwich type construction consisting of 4.25 thick isocyanurate foam, Upjohn CPR 9545, with .060 "thick polyester-glass face sheets bonded with epoxy adhesive, Dexter Corp. EA934. Polyester-glass channel, 4 3/4" x 1 5/8" x 3/16" is bonded to all edges of the sandwich panels including openings to protect the foam. Isocyanurate foam sheets are laid on the floor of storage to insulate the base.

The grating which supports the pebbles is a welded assembly that is sized consistent with the storage panel modular concept. One grating assembly is required for each 37.5 cubic feet of storage. The assembly consists of a rectangular sheet of steel grating to which four legs are welded. The grating has 3/16" x 3/4" bearing bars 1 3/16" on centers with 1/4" square cross bars 4" on centers. The legs are 2" x 2" x 3/16" steel structural angle. A 1/2" x 1/2" mesh steel wire cloth with .040" diameter galvanized wire is laid above the grating to prevent small pebbles from falling through the grating.

A piece of perforated sheet metal is placed on the top surface of the pebble bed and centered under the top center air opening. The purpose of the sheet is to deflect the air to eliminate channeling of air through the center of the pebble bed.

2.3 ENERGY TRANSPORT SUBSYSTEM

The energy transport subsystem is a two-blower system with control dampers, balancing dampers, back draft dampers and interconnecting duct work. This subsystem consists of the following hardware:

Item	Description	Qty.
Collector Loop Blower Assembly	Grainger 7C812	1
Load Loop Blower Assembly	Grainger 2C986 blower with 5K900 motor	1
Control Dampers	Ruskin CD454PB/WMP 1161	2
Balancing Dampers	American Warming DAA-P-8150	2
Back Draft Dampers	American Warming SHB-D-1217	2
Collector Loop Duct	12" Round 26 gage galv.	AR
Load Loop Duct	14" Square 26 gage galv.	AR

Air flow is adjusted in either the collector loop or load loop by varying the pulley diameters of the motor shaft pulley. The blowers are belt driven, "A" width, with motors mounted to the blower housing on a swivel base to facilitate belt tension adjustment. The motors are 115 VAC, sleeve bearing, automatic-reset-thermally protected motors. The motor for the collector loop is a 1/2 horse power, 1725 rpm, split-phase motor. The motor for the load loop is a 3/4 horse power, 3450 rpm, capacitor start motor.

The collector loop blower has a 4.35" pitch diameter pulley on the blower shaft and a 1.9" to 2.9" pitch diameter variable pitch pulley on the motor shaft. No adjustment in pulley diameter is considered necessary after the initial setting. The load loop blower has a 6.85" pitch diameter pulley on the blower shaft and a 2.8" to 3.8" pitch diameter variable pitch pulley on the motor shaft. Pulley diameter adjustment will most likely be required when the system is installed in the field so as to obtain the desired air flow. Motor current should be monitored while adjusting pulley diameters to verify that the motor rating is not exceeded.

The collectors are manifolded together in two eight (8) collector series - parallel arrays as shown in System 4 Design Description Drawing 7934983. Air is ducted to each array in two parallel loops in a "Y" configuration. Balancing dampers are installed in series with the collector arrays in each parallel loop so that the flow through the two loops can be equalized.

The purpose of the back-draft dampers is to eliminate the possibility of reverse air flow in the collector loop and load loop ducts. The dampers are the fabric vane type and are 14"x14"x1 1/2". The vane material is #1010 cohrlastic. Dampers are installed in the 14x14" ducts at outlet from storage in the collector loop and at the inlet to storage in the load loop.

Two 115 VAC motorized control dampers are utilized in the system to provide on-off air flow control in the collector and load loops. The dampers are metallic parallel blade construction. A linkage between a crank on the drive motor shaft and a crank on the damper blades provides the necessary force to open the damper blades. A helical tension spring attached to the crank of the drive motor applies the force necessary to close the damper when the drive motor is de-energized.

The collector loop ducting is mainly 12" diameter round 26 gage galvanized steel. The load loop ducting is 14" square, 26 gage galvanized steel. Irregular shaped transistion ducts are utilized at inlet and outlet to items such as storage unit, blowers and air to water heat exchanger. These transistion pieces are fabricated of 26 gage galvanized steel sheet stock.

All ducting and items in the duct such as the air to water heat exchanger and blowers are covered with 3 inches of Upjohn Inc., uthane 190, urethane foam to provide insulation with a R value of 20 or better. The insulation was bonded to the surface to be insulated with vapor barrier contact adhesive, Midwest Chemical Co. Bon-grip 169-24. The outside surface of the insulation is painted with polyvinyl chloride mastic weather barrier, WC-1 E2, which is manufactured by the Vimasco Corp., Netro, West Virginia. The paint forms a tough water proof surface over the otherwise delicate urethane insulation surface.

2.4 DOMESTIC HOT WATER SUBSYSTEM

Figure 2.4-1 is a schematic diagram of the domestic hot water system. Hot water is provided in the solar system by means of (1) an air-to-water heat exchanger in the air duct at the top of storage and (2) a 52-gallon water storage tank to preheat the water supplied to the conventional building hot water heater. Water circulates from the heat exchanger to the preheat tank by thermosyphon action whenever water in the heat exchanger is heated above the water temperature in the preheat tank. The conventional domestic hot water heater draws its supply from the preheat tank and auxiliary energy is used only if the temperature of preheat tank is below the water heater set point. Cold supply water is drawn into the base of the preheat tank when domestic hot water is used. Cold water at the base of the preheat tank is drawn to the heat exchanger while hot water in the heat exchanger rises to the top of the preheat tank through 1" diameter soft copper tubing to maintain the thermosyphon flow.

A thermal bleeder valve is installed at a low point in the thermosyphon line close to the heat exchanger to provide positive protection against freeze-ups. The valve senses the surrounding water temperature in the water line near the heat exchanger and begins to open at temperature below $40^{o}F$ and is full open at $34^{o}F$. When water is bled from the system, it will be replaced by warmer city water to maintain the water temperature in the heat exchanger above freezing temperatures. Water drawn by the thermal bleeder valve may raise or lower the temperature of water in other parts of the domestic hot water system to temperatures equal to the supply water temperature which serves to protect other parts of the system from freezing.

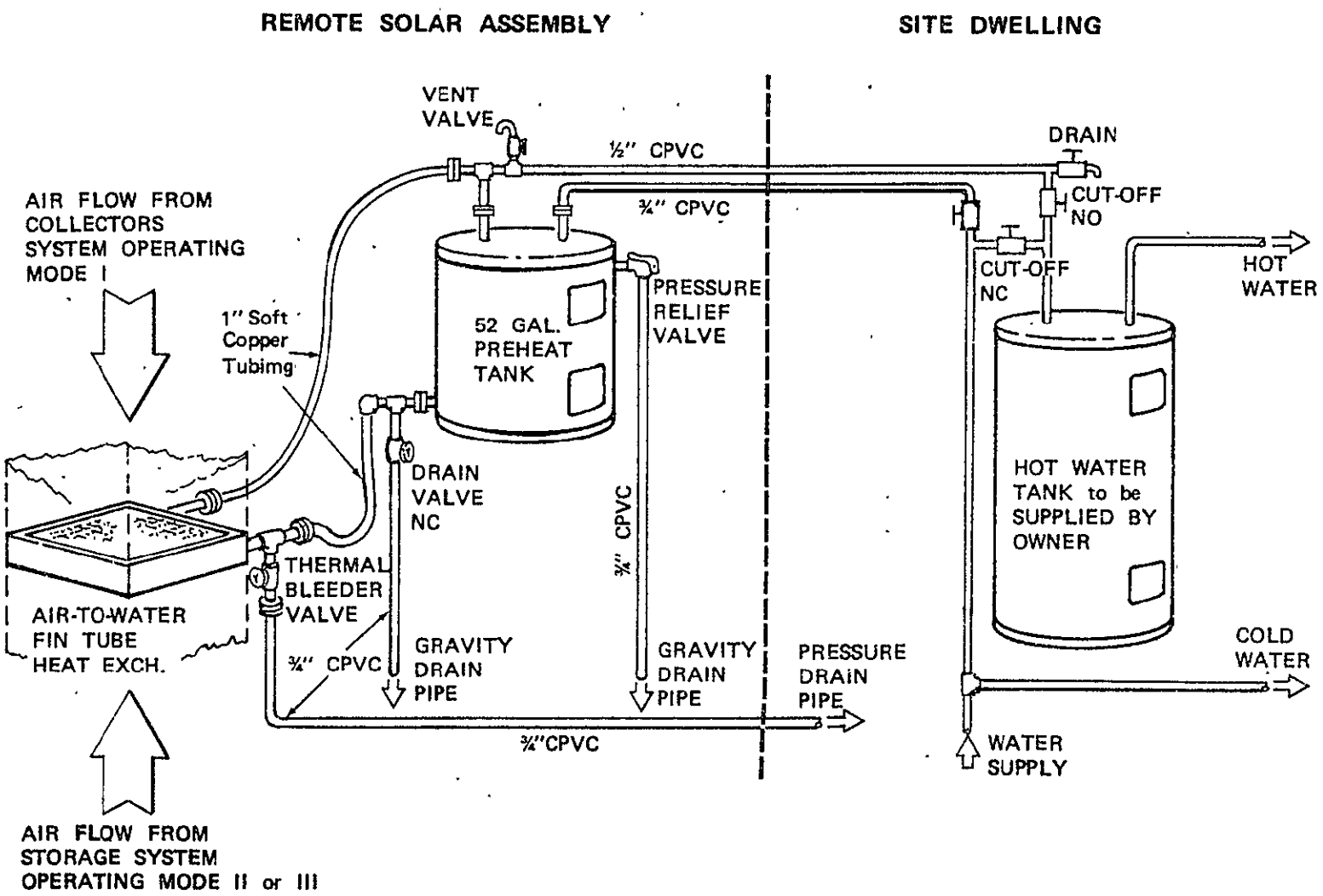


Figure 2.4-1, Hot Water Subsystem Diagram

The main components of the domestic hot water system for System 4 are:

Item	Description	Qty.
Heat Exchanger	Halstead Mitchell, SW2-18-18-8	1
Preheat Tank	W. L. Jackson, UC05225	1
Thermal Bleeder Valve	McMaster Carr, 4858 N 16	1
DHW Heater	30 gal 4.5 KW DHW Heaters *	2

* Any DHW heater available at the site is compatible with system.

2.5 CONTROL SUBSYSTEM

The control subsystem provides the means to control the collector loop blower, the load loop blower and the auxiliary heating unit. The control subsystem consists of the following component hardware:

Table 2.5-1

Item	Description	Function
ΔT Controller No. 1	Solar Control Corp. Mod. 77-171*	Closes with a ΔT > 40°F Opens with a ΔT < 40°F
ΔT Controller No. 2	Solar Control Corp. Mod. 77-171*	Closes with a ΔT > 25°F Opens with a ΔT < 25°F
Storage Temp High Limit Switch	ASCO Mod 10A/QF11A4	Opens at 200°F on temp. ris Closes at 190°F on temp. fa
Storage Temp Low Limit Switch	ASCO Mod 10A/QF11A4	Opens at 95°F on temp rise, Closes at 90°F on temp. ris
Preheat Tank High Limit Switch	Grainger 2E051	Adjusted to open at 150°F on temp. rise
Blower Relays (2)	Honeywell R8225D 1003	Coil operates on 24 VAC and switch power to the blowers
Site Dwelling Thermostat (2 Stage)	Honeywell T42H	Contacts close in sequence with temp. rise
Summer Mode Switch	Standard wall switch (SPST)	Manually operated
Transformer (2)		Converts 120 VAC to 24 VAC
Pressure Relief Valve	Watts Mod 10x6	Valve opens at 185°F on ris
Thermal Bleeder Valve	McMaster Carr Mod 4858N16	Valve starts to open at 38° and is full open at 34°F

The control components are arranged in two basic circuits as shown in Figure 2.5-1. One circuit controls the collector loop blower so that solar energy can be collected when available and/or transferred from pebble bed storage to water storage on demand. The other circuit controls the load loop blower so the heat can be delivered to the site dwelling when heat is required.

* Note: The controller is modified to eliminate the freeze and boil protection features and to energize the control relay with a ΔT > 40°F and de-energize the control relay with a ΔT < 25°F.

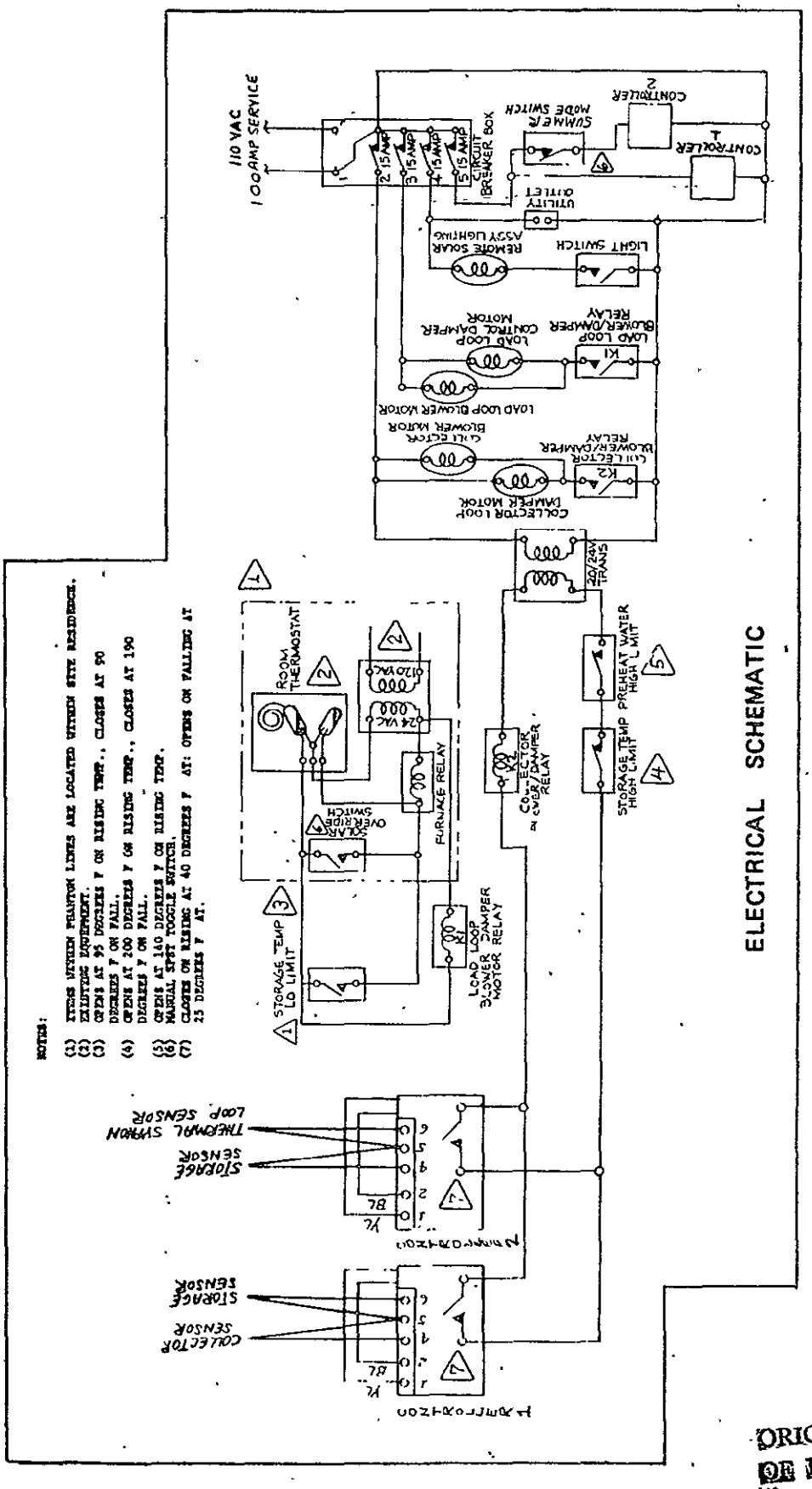


Figure 2.5-1

2.5.1 Collector Loop Blower Control

Collecting Energy

Solar energy is collected when heat is available in the solar collectors by running the collector loop blower. Energy can be collected in modes 1 and 2 with control component states as shown in Table 2.5-1. A ΔT Controller, Controller No. 1, senses the temperature difference between the outlet of collector and bottom of storage. A control relay within the controller is energized when the temperature difference is $40^{o}F$ or larger. This closes the relay contacts which completes the collector blower circuit and energizes the collector blower relay. The circuit is deenergized and the blower motor power cut-off when any of the following events occur:

(1) The temperature difference between outlet of collector and bottom of storage is less than $25^{o}F$.

(2) The Storage Temperature High Limit Switch contact opens when the bottom of storage is $200^{o}F$ or higher.

(3) The Preheat Tank High Limit Switch contact opens because the DHW preheat tank is $140^{o}F$ or higher.

Transferring Energy

Energy is transferred from rock bed storage to the domestic hot water preheat tank when an excess of solar energy is available. This is accomplished by running the collector blower. Since hot air from storages passes through the collectors on its way to the air-to-water heat exchanger, energy will be lost through the collectors. This mode of operation is therefore not permitted in the Spring, Fall and Winter seasons.

Energy can be transferred from storage to the preheat tank in mode 1 when solar energy is not available at the collector by running the collector blower with control components states as shown in line 2 of Table 2.5-1.

In the summer mode, a ΔT Controller, Controller No. 2, senses the temperature difference between the bottom of pebble storage and bottom of the preheat tank. The control relay within the controller is energized and deenergized to control the collector blower in the same manner Controller No. 1 does. Since the control relay in both Controller No. 1 and Controller No. 2 are in parallel in the blower control circuit, either controller can activate the collector blower; however the control relay in both controllers must be open to deenergize the collector blower.

2.5.2 Summer Mode Switch

The summer mode switch controls power to Controller No. 2. When switched to the summer mode position, Controller No. 2 is capable of controlling the collector blower motor. When switched to the alternate position, Controller No. 2 is disabled.

2.5.3 Load Loop Blower Control

Heat is delivered to the site dwelling whenever the load loop blower is running provided heat is either being collected or is available in storage. Heat is delivered exclusively from storage when the first stage contact of the site thermostat closes and the Storage Temperature Low Limit Control contact is open (top of rock storage is above 90°F). When the second stage sites dwelling thermostat contact closes or the Storage Temperature Low Limit Control contact closes (top of rock storage is above 95°F) and the first stage contact is closed, auxiliary heat will be supplied in addition to any solar heat available from storage.

2.5.4 Boil Protection

A pressure relief valve is used as a safety device to limit the pressure and temperature of the water in the preheat tank. This valve will open permitting water to drain from the preheat tank if the water temperature exceeds 185°F.

2.5,5 Freeze Protection

A freeze protection valve is used to protect the DHW heat exchanger from freezing if the Remote Solar Assembly is inactive in freezing weather for an extended period as if a prolonged power failure is encountered. The valve is thermally operated and will begin to open at 40°F and be fully open at 34°F. Water will flow through the valve to a drain when the valve opens. Make-up water from the water supply system will supply the heat necessary to prevent freeze-up.

2.6 AUXILIARY ENERGY SUBSYSTEM

Since the solar system is not sized to provide 100% of the space heat required, an auxiliary source of heat is required. The auxiliary heat device is sized to carry the site dwelling load independent of the solar capability.

System 4 design incorporates auxiliary heat in series with solar storage as shown in Figure 2.0-1. Auxiliary heat in this configuration could be electric strip heat, gas or oil fired furnace. The load loop blower should be capable of moving air through the auxiliary device; however, if the pressure drop is excessive, another blower in series may be required. The operating temperature of this second blower motor in the load loop should be compatible with the solar heated air that it will operate in if it is duct mounted.

If System 4 were used with a heat pump, or if the heating ducts are also to be used for air conditioning, the heat pump or air conditioner would have to be added in parallel with the solar heating system as shown in Figure 2.6-1. The auxiliary heat in the parallel configuration would operate from the site dwelling thermostat second stage contacts.

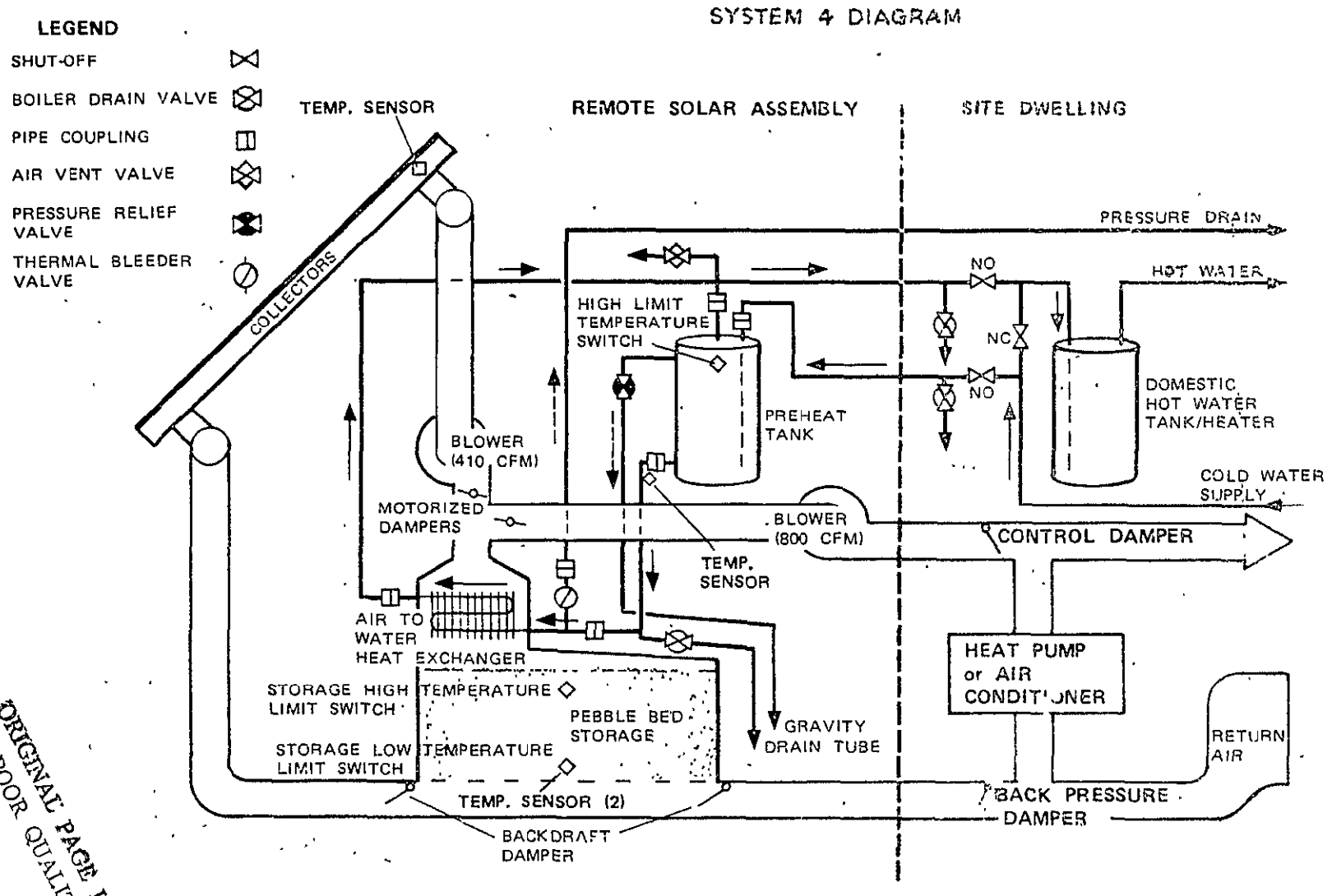
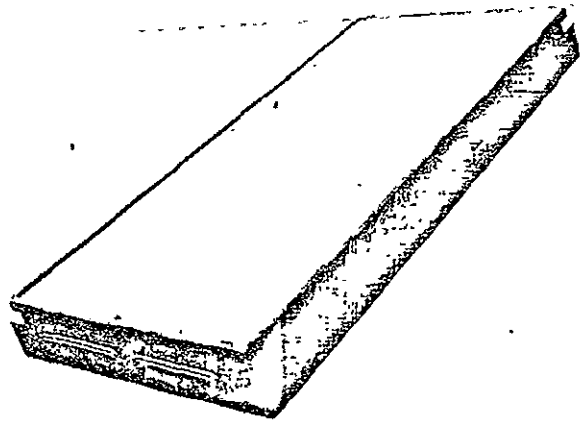


Figure 2.6-1, System 4 with Auxiliary Heat and Air Conditioning in Parallel

APPENDIX

Major Component Vendor Data

SOLARON COLLECTOR PANEL DETAILS



COLLECTOR PANEL

FIGURE 2 COLLECTOR

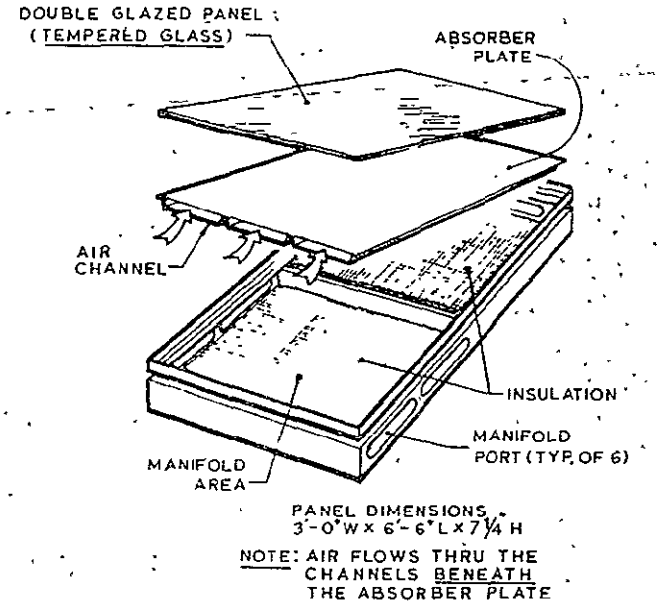


FIGURE 3 COLLECTOR MANIFOLD

C. Components (Fig. 2, 3 & 4)

1. Solar Collector (PATENTS APPLIED FOR)

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

The Solaron solar collector has the following general construction characteristics:

Absorber: 28 gauge steel with porcelain enamel coating.

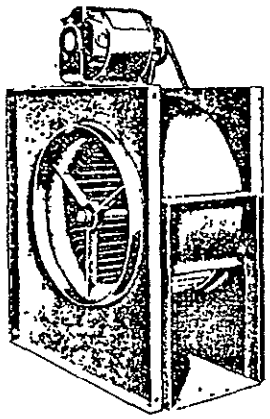
Glazing: Two 1/8" sealed special low iron tempered glass panels with a long life EPDM perimeter gasket. Glass plate can be easily removed for service or replacement.

Pan: 20 gauge steel, fully insulated with 3 3/4" fiberglass batt. Painted external surfaces.

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

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

SINGLE-INLET, 4-WAY DISCHARGE BLOWERS



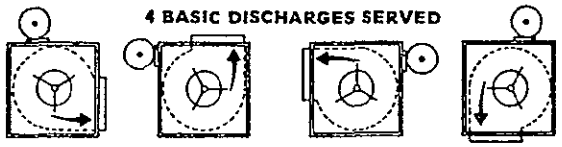
Adaptable to 4 Discharge Positions on the Job
9½ to 18⅛" Dia. Single-Width Wheels

Dayton

$50.72
No 2C986

Designed and built for general duct ventilation, exhausting, air conditioning, and industrial air-moving applications. Single-inlet type for quiet, efficient performance. Adaptable to any of 4 standard discharges on the job by merely re-locating adj. motor mount and motor on frame—see diagrams. Belt length remains same for each discharge position. Precision, balanced, single-width wheels on ball bearings. Heavy gauge, die-stamped steel housings. Gray finish. Resilient-mounted, automatic-reset thermally protected Dayton motor and drive packed separately when blower is ordered complete. Request Bulletin 706.

4 BASIC DISCHARGES SERVED



Wheel Dia.	Wheel Width	Shaft Dia.	Inlet Dia.	Outlet H	Outlet W	Overall Size H	Overall Size W	Overall Size D	BLOWER ONLY Less Motor & Drive Stock No.	Retail	Each	Shpg. Wt. Less Mtr. & Drive
9½"	4⅝"	¾"	10"	10¾"	6⅛"	16⅛"	10¾"	14⅞"	2C986	$84.70	$50.72	22
10⅞	6	¾	11	11¾	8¼	18	12⅛	16⅜	2C987	97.21	58.21	29
12⅝	6	¾	13¼	13¾	8¼	21⅛	12⅛	19¼	2C988	153.32	91.81	36
15"	6	1	15⅛	15⅞	8¼	25	12⅛	22⅛	2C989	155.84	145.81	47
18⅛	9	1	19⅛	18⅞	12¾	30	17⅞	26⅞	4C218	193.10	180.67	82

SINGLE-INLET BLOWERS WITH MOTOR & DRIVE

Wheel Dia.	CFM AIR DELIVERY AT RPM SHOWN Free Air	1/8" SP	1/4" SP	3/8" SP	1/2" SP	5/8" SP	Blower RPM	BLOWER WITH 1725 RPM MOTOR & DRIVE MOTOR DATA HP	Volts 60 Hz	Type	All With Automatic Thermal Protection Stock No.	Each
9½"	1090	940	810	695	590	450	926	1/4	115	Split	7C808	$80.43
	1210	1075	945	805	745	645	1030	1/3	115	Split	7C810	85.76
	1330	1205	1085	980	885	800	1100	1/2	115	Split	7C812	100.19
10⅞"	1360	1205	1030	840	600	—	705	1/4	115	Split	7C814	92.47
	1485	1360	1220	1065	885	625	765	1/3	115	Split	7C816	93.91
	1680	1575	1445	1310	1175	1010	850	1/2	115	Split	7C818	108.75
	1935	1850	1740	1610	1485	1350	1030	3/4	115/230	Cap.	7C820	121.14
12⅝"	1820	1610	1310	1030	645	—	580	1/3	115	Split	7C822	128.25
	2050	1885	1690	1390	1165	880	652	1/2	115	Split	7C824	142.01
	2345	2190	2020	1815	1505	1285	750	3/4	115/230	Cap.	7C826	153.33
	(f)	(f)	(f)	(f)	1820	1565	816	3/4	115/230	Cap.	7C828	151.52
15"	2100	1775	1450	1000	—	—	480	1/3	115	Split	7C830	183.84
	2400	2150	1860	1550	1070	—	500	1/2	115	Split	7C832	195.06
	2670	2580	2375	2100	1750	1360	605	3/4	115/230	Cap.	7C834	210.97
	3010	2830	2640	2430	2165	1830	652	1	115/230	Cap.	7C836	227.68
	3010	2830	2640	2430	2165	1830	652	1	230/460	3-Ph.	7C837(*)	219.47
18⅛"	4300	3980	3510	2980	2320	—	467	1	230/460	3-Ph.	7C337(*)	296.03
	4950	4570	4180	3750	3250	2660	525	1½	230/460	3-Ph.	7C338(*)	299.08
	5480	5190	4860	4490	4020	3480	583	2	230/460	3-Ph.	7C339(*)	306.37
	6120	5900	5630	5320	4940	4530	653	3	230/460	3-Ph.	7C340(*)	342.49

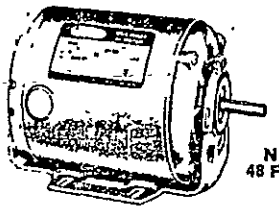
(*) 3-phase rigid mounted motors—Not thermally protected.
(f) **Motor Overloaded**—Not recommended for operation at this static pressure, with this HP.

Dayton Full-Fact Carton Label Makes Motor Stocking and Selection Easier

Over 975 Dayton motor types have Full-Fact carton labels. The helpful Dayton label illustrates and identifies specific motor, and lists all its important electrical and mechanical features clearly, for easy reference by dealer and user. Providing complete information on the label simplifies motor selection, helps assure customer satisfaction.

SEE WARRANTY INFORMATION ON PAGE BEFORE INDEX

FURNACE BLOWER and FAN-DUTY MOTORS

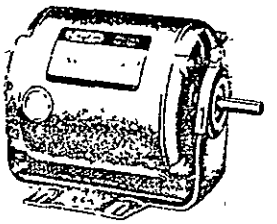


NEMA 48 FRAME

1/6 to 3/4 HP, 1725 or 1725/1140 RPM
Split Phase, Thermal Protection
40° & 50°C Rise, Continuous Duty
Low Noise, Reduced Starting Torque

$26.83
1/6 HP

Dayton



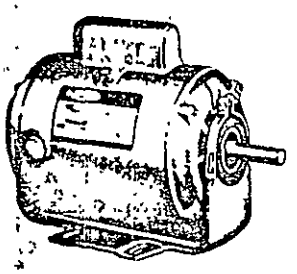
NEMA 56 FRAME

For furnace blowers, air coolers, belt-driven fans and similar applications that require reduced starting torque, low starting amps and low noise level. Split phase, 115, 208-230 & 115/230V, 60 Hz. Resilient mounted. Sleeve bearings. 40°C ambient, Class A insulation, continuous duty. Rotation easily reversed. Open, dripproof. Automatic reset thermal protection. Recognized by UL for construction under the Motor Component Recognition Program CSA approved Gray.

HP	RPM	Volts 60 Hz	NEMA Frame	Shaft Dia.	Shaft Long	Type Shaft	Full-Load Amps†	°C Rise	Service Factor	Stock No.	Retail	Each	Shpg. Wt.
1/6	1725	115	48	5/8"	1 1/2"	Flat	3.3	10	1.35	5K906	$40.98	$26.83	13
1/4	1725	115	48	5/8	1 1/2	Flat	5.3	50	1.0	5K908	42.39	27.76	13
	1725	115	48	5/8	1 1/2	Flat	4.4	40	1.35	5K907	44.13	28.90	15
	1725	115	48/56*	5/8*	1 1/2	Flat*	(3.4)	40	1.35	5K977*	44.13	28.90	16
	1725	115	56	5/8	1 7/8	Key	4.4	40	1.35	5K260	44.13	28.90	16
1/3	1725	115	48	5/8	1 1/2	Flat	6.3	50	1.0	5K909	46.49	30.44	14
	1725	115	48	5/8	1 1/2	Flat	5.8	40	1.35	5K682	51.22	33.54	17
	1725	208-230	48	5/8	1 1/2	Flat	2.8	40	1.0	6K717	54.37	35.60	17
	1725	115	48/56*	5/8*	1 1/2	Flat*	5.8	40	1.35	6K030*	51.22	33.54	17
	1725	115	56	5/8	1 7/8	Key	5.1	40	1.35	5K261	51.22	33.54	19
	1725/1140‡	115	56	5/8	1 7/8	Key	6.0	40	1.35	5K654	79.59	52.12	21
1/2	1725	115	48	5/8	1 1/2	Flat	7.0	40	1.25	5K910	71.71	46.96	19
	1725	115	48/56*	5/8*	1 1/2	Flat*	7.0	40	1.25	5K258*	71.71	46.96	18
	1725	115	56	5/8	1 7/8	Key	7.6	50	1.0	6K399	58.00	37.98	18
	1725	208-230	56	5/8	1 7/8	Key	3.9	40	1.25	6K729	74.86	49.02	21
	1725	115	56	5/8	1 7/8	Key	7.4	40	1.25	5K416	71.71	46.96	20
	1725/1140§	115	56	5/8	1 7/8	Key	9.2	50	1.0	5K620	79.59	52.12	23
	1725/1110§	115	56	5/8	1 7/8	Key	8.5	40	1.25	6K394	101.65	66.56	24
3/4	1725	115/230	56	5/8	1 15/16	Key	12.0	40	1.25	6K624	98.92	63.47	24

(*) Nos. 5K977, 5K258 and 6K030 have NEMA 48 frame body mounted on NEMA 56 frame cradle base and supplied with 5/8" split steel bushing. (†) At 1725 RPM. (‡) 1/6 HP at 1140 RPM. (§) 1/4 HP at 1110 RPM.

1/2 to 2 HP CAPACITOR-START BLOWER MOTORS

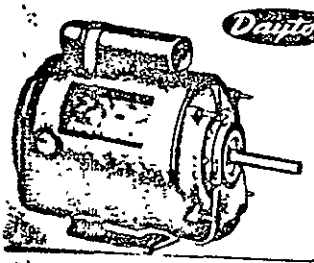


Dayton

$39.22
1/2 HP

For belt-driven furnace fans and blowers that require reduced starting torque, lower starting amps and noise level. Capacitor-start, induction-run type. 40°C ambient, 1.25 service factor, Class A insulation (40°C rise), continuous duty. Automatic reset thermal protection Open, dripproof. Sleeve bearings, except No. 6K805 has ball bearings. Resilient mount. NEMA 48 and 56 frames. Reversible rotation. Recognized by UL for construction under the Motor Component Recognition Program. CSA approved. Gray. Dayton brand.

HP	RPM	Volts 60 Hz	NEMA Frame (See p. 16)	Full-Load Amps @115V	Stock No.	Retail	Each	Shpg. Wt.
1/2	3450	115/208-230	48	8.6	6K804	$59.89	$39.22	16
3/4	3450	115/208-230	56	9.2	5K900	71.71	46.96	21
1	1725	115/208-230	56	12.8	6K157	122.93	80.50	30
1	3450	115/208-230	56	11.6	5K901	90.62	59.34	23
2	3450	115/208-230	56	20.4	6K805	145.78	95.46	37



Dayton

1/4 HP, 1 & 2-SPEED FAN DUTY

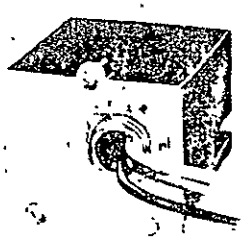
Permanent Split Capacitor Type, TENV, Air-Over

$38.72
1100 RPM

For direct driven exhaust and circulator fans 115V, 60 Hz. Resilient mounted. Sleeve bearings. 40°C ambient, 55°C rise, continuous duty. Totally enclosed. Automatic reset thermal protection CW rotation, easily reversed. NEMA 48 frame Overall length 10 3/16"; 7 7/16" less shaft. Recognized by UL for construction under the Motor Component Recognition Program. CSA approved. Gray.

HP	RPM	Full-Load Amps @1100 RPM	Stock No.	Retail	Each	Shpg. Wt.
1/4	1100	3.6	3M339	$58.39	$38.72	16
1/4	1100/2-Spd.	3.1	3M340	60.19	39.44	18

R8225A,B,C,D FAN RELAY



FOR CONTROL OF VOLTAGE AND CIRCUITS

Used in heating, cooling, or heating-cooling systems. Integral 1/2 inch conduit spud allows relay to be mounted on a standard junction box. Contacts: Silver cadmium oxide. Max. Operating Ambient: 115 F. Mounting Means: Threaded 1/2 inch NPT conduit spud. Dimensions (inches): 2-11/16 high, 2-1/2 wide, 3-7/16 deep. Listed by Underwriters Laboratories Inc.

RESISTIVE RATINGS: For N.O. contacts—16 amp at 120V, 8 amp at 240V; auxiliary contacts—3 amp at 120V, 2 amp at 240V ac.

TRADELINE MODELS:

Order Number	Contact Ratings (amperes)			
	120V ac		240V ac	
	N.O. (1 hp)	N.C. (3/4 hp)	N.O. (1 hp)	N.C. (3/4 hp)
R8225A1017[a]	16.0 FL 96.0 LR	13.8 FL 82.8 LR	8.0 FL 48.0 LR	6.9 FL 41.4 LR

Additional Models

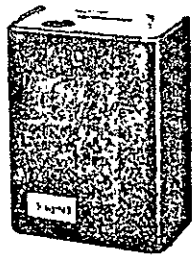
Order Number	Contact Ratings (amperes)			
	120V ac		240V ac	
	N.O. (3/4 hp)	N.C. (3/4 hp)	N.O. (1 hp)	N.C. (3/4 hp)
R8225A1041	13.8 FL 82.8 LR	13.8 FL 82.8 LR	8.0 FL 48.0 LR	6.9 FL 41.4 LR
R8225B1007	13.8 FL 82.8 LR	—	8.0 FL 48.0 LR	—
R8225C1005	13.8 FL 82.8 LR	13.8 FL 82.8 LR	8.0 FL 48.0 LR	6.9 FL 41.4 LR
R8225D1003 (main)	13.8 FL 82.8 LR	—	8.0 FL 48.0 LR	—
(aux.)	3.0 FL 18.0 LR	—	1.9 FL 11.4 LR	—

[a]134259 Flush Mounting Bracket included.

SWITCHING AND COIL RATINGS:

Models	Switching	Configuration and Color-coding	Operating Coil Pull-in		
			Inrush	Sealed	Voltage
R8225A	spdt	BLACK, RED, BROWN	11 VA maximum	6 VA maximum	18V maximum at 75 percent of rated voltage
R8225B	1 spst N.O.	BLACK, BLACK			
R8225C	1 spst N.O. 1 spst N.C.	BLACK, BLACK; RED, RED			
R8225D	dpst 1 main N.O. 1 aux. N.O.	LOAD CONTACTS: BLACK, BLACK; AUXILIARY CONTACTS: YELLOW, YELLOW			

R8146A ADD-ON HEATING RELAY

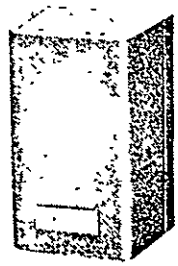


PROVIDES SWITCHING FOR A SELF-GENERATING (POWERPILE) HEATING SYSTEM WHEN COOLING IS ADDED TO EXISTING INSTALLATION.

Used with R856B, R8226, R8227, or R8239 Fan Centers and T87F Room Thermostat. R8146A isolates millivolt heating system power from 24 volt cooling system control circuit. Electrical Rating: Contacts—0.25 amp at 0.25 to 12V dc or 1.5 amp at 24V ac. Relay Coil—0.4 amp at 24V ac. Ambient Temp. Range: 0 to 100 F. Mounting Dimensions (inches): 5-1/4 high, 4-1/4 wide, 3 deep. Listed by Underwriters Laboratories Inc.

Order Number	Switching	Coil Voltage
R8146A1005	spst	24V ac

R8093A THERMAL TIME DELAY RELAY



PREVENTS SHORT INTERMITTENT COMPRESSOR OPERATION BY DELAYING START OF COMPRESSOR ON DEMAND FROM THERMOSTAT.

Prevents compressor damage as a result of rapid cycling. Prevents excessive inrush current on simultaneous start of 2 compressors. Switch Action: Spst normally open contacts. Contact Rating: 1.5 amp at 24V ac, 50/60 Hz. Heater Voltage: 24V ac; heater current 0.08 amp. Timing: Make—35 seconds (nominal); Break—35 seconds maximum (minimum on time is 3 seconds). Ambient Temperature: 40 to 140 F at 85 to 110 percent rated voltage. Unit will operate at 0 F at rated voltage. Quick-connect terminals. Case Dimensions (inches): 3-3/4 high, 2-5/16 wide, 2-1/8 deep.

Order Number	Case and Cover
R8093A1008	Yes
R8093A1024[a]	No

[a]Includes mounting bracket.

DATE SEPTEMBER 1, 1976

SUPERSEDES WS– 11

Halstead & Mitchell
A DIVISION OF HALSTEAD INDUSTRIES INC.

SEE PRICE LIST FSP–11 FOR DE, CW & LARGER SIZE COILS.

Hot Water and Standard Steam Coils

WITH PLATE FINNED SURFACE. 5/8" O.D. STAGGERED TUBE DESIGN

* 4 gpm ΔP_w = 2.4 ft
6 gpm ΔP_w = 4.2 ft

MOST COIL SIZES SHIPPED FROM STOCK

1 ROW COILS				2 ROW COILS			
	MBH @60° EAT 800 FPM				MBH @60° EAT 800 FPM		
COIL MODEL	200° - 180° Hot Water	5 PSI STEAM	LIST PRICE	COIL MODEL	200° - 180° Hot Water	5 PSI STEAM	LIST PRICE
SW1-6-12-8	13	15	131.00	SW2-6-12-8	20	26	166.00
SW1-6-15-8*	16	19	136.00	SW2-6-15-8*	26	33	170.00
SW1-6-18-8	18	23	138.00	SW2-6-18-8*	31	40	173.00
SW1-9-9-8*	14	17	136.00	SW2-9-9-8*	23	30	168.00
SW1-9-12-8	18	23	140.00	SW2-9-12-8	30	39	173.00
SW1-9-15-8*	23	28	145.00	SW2-9-15-8	38	49	180.00
SW1-9-18-8	28	34	150.00	SW2-9-18 8	46	60	186.00
SW1-12-12-8	25	30	150.00	SW2-12 12-8	41	53	186.00
SW1-12-15-8*	31	37	160.00	SW2 12-15-8	51	66	196.00
SW1-12-18-8	37	46	170.00	SW2-12-18-8	61	79	202.00
SW1-12-24-8	49	61	180.00	SW2-12-24-8	81	106	232.00
SW1-12-30-8	63	75	198.00	SW2-12-30-8	102	133	254.00
SW1-12-36-8*	75	90	220.00	SW2-12 36 8	122	158	281.00
SW1-15-18-8	46	57	180.00	SW2-15-18-8	76	99	215.00
SW1-15-24-8	61	76	195.00	SW2-15-24 8	102	132	251.00
SW1-15-30-8	78	94	225.00	SW2-15-30-8	126	164	292.00
SW1-15-36-8*	94	113	256.00	SW2-15-36-8	152	198	328.00
SW1-18-18-8*	56	68	200.00	SW2-18-18 8	92	119	235.00
SW1-18-24-8	75	90	232.00	SW2-18-24-8	122	158	297.00
SW1-18-30-8*	94	113	260.00	SW2-18-30-8	152	198	333.00
SW1-18-36-8	113	135	280.00	SW2-18-36-8	183	238	359.00
SW1-18-48-8*	150	180	328.00	SW2-18-48-8	244	316	420.00
SW1-21-30-8*	110	131	288.00	SW2-21-30-8	178	231	360.00
SW1-21-36-8*	131	158	314 00	SW2-21-36-8	213	277	402.00
SW1-21-48-8*	175	210	368.00	SW2-21-48-8	287	371	472.00
SW1-24-24-8	100	120	281.00	SW2-24-24-8	164	212	360.00
SW1-24-30-8*	125	150	319.00	SW2-24-30-8	205	265	409.00
SW1-24-36-8	150	180	345.00	SW2-24-36-8	244	316	442.00
SW1-24-48-8	200	240	398 00	SW2-24-48-8	325	421	510 00
SW1-27-54-8*	253	304	459.00	SW2-27-54-8	415	537	589.00
SW1-30-48-8*	250	300	470.00	SW2-30-48 8	410	530	602.00

NOTES:

1. All prices are subject to change without notice.
2. F.O.B.—Scottsboro, Alabama; Terms-Net 30
3. Prices include casing.
4. Aluminum fins and copper tubing are standard.
5. For copper fins, contact factory for quotation.
6. For red brass tubing, contact factory for quotation.
7. Cleanable tube water coils are available. Contact factory for quotation.

MODEL NUMBER EXPLANATION

Coil Type, Rows Deep, Fin Height, Fin Length, Fins Per Inch

Example

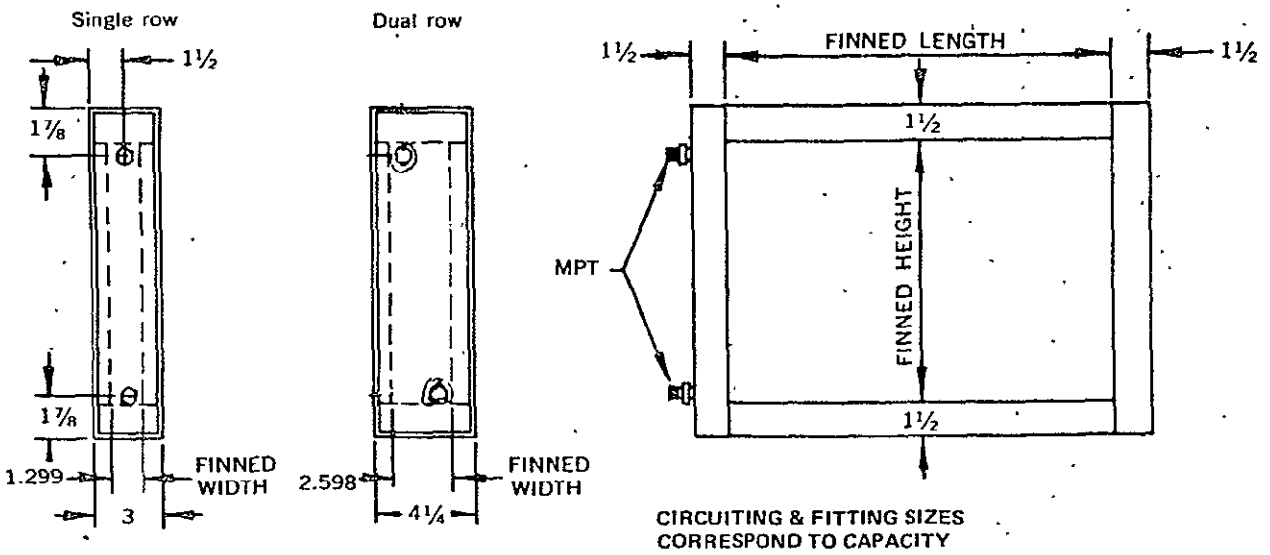
SW—1—6—18—8 Steam or Water, 1 Row Deep 6" Finned Height 18" Finned Length, 8 Fins Per Inch.

*NORMALLY NOT STOCK ITEM

SEE REVERSE SIDE FOR FURTHER DETAILS

3

DIMENSIONS



CIRCUITING & FITTING SIZES CORRESPOND TO CAPACITY

CAPACITY CORRECTION FACTORS

FACE VELOCITY		
FPM Face Vel.	Water Coil.	Steam Coil
400		
500	.83	.77
600	.87	.85
700	.94	.94
800	1.00	1.00
900	1.05	1.085
1000	1.09	1.125

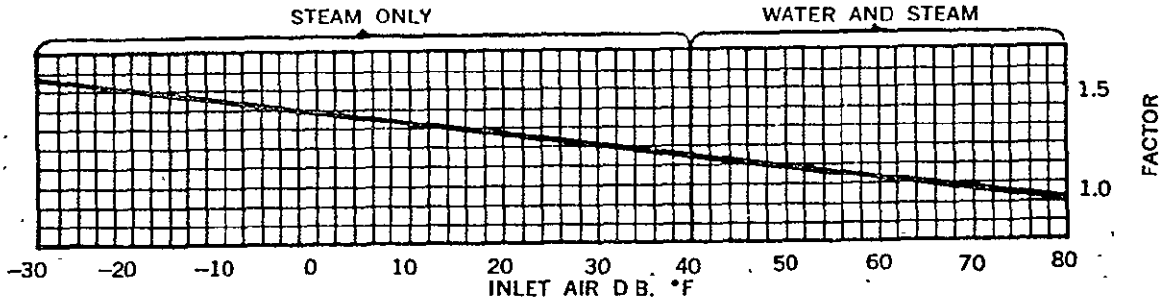
STEAM TEMP.	
PSI	Corr * Factor
2	.95
5	1.00
10	1.07
15	1.13
20	1.18
25	1.22

* @ 60° EAT

AVER. WATER TEMP.	
Degree	Corr. Factor
140	.63
150	.71
160	.79
170	.86
180	.93
190	1.00
200	1.07

FINS/INCH	
FPI	Corr. Factor
6	.85
8	1.00
10	1.13
12	1.22
14	1.31

Inlet Air Dry Bulb Temp.



AIR SIDE FRICTION LOSS

FACE VELOCITY FPM (STD. AIR)	PRESSURE DROP (Inches W.G.)	
	1 Row	2 Row
400	.04	.09
500	.07	.14
600	.09	.19
700	.12	.24
800	.15	.30
1000	.22	.45
1200	.30	.63
1400	.39	.80

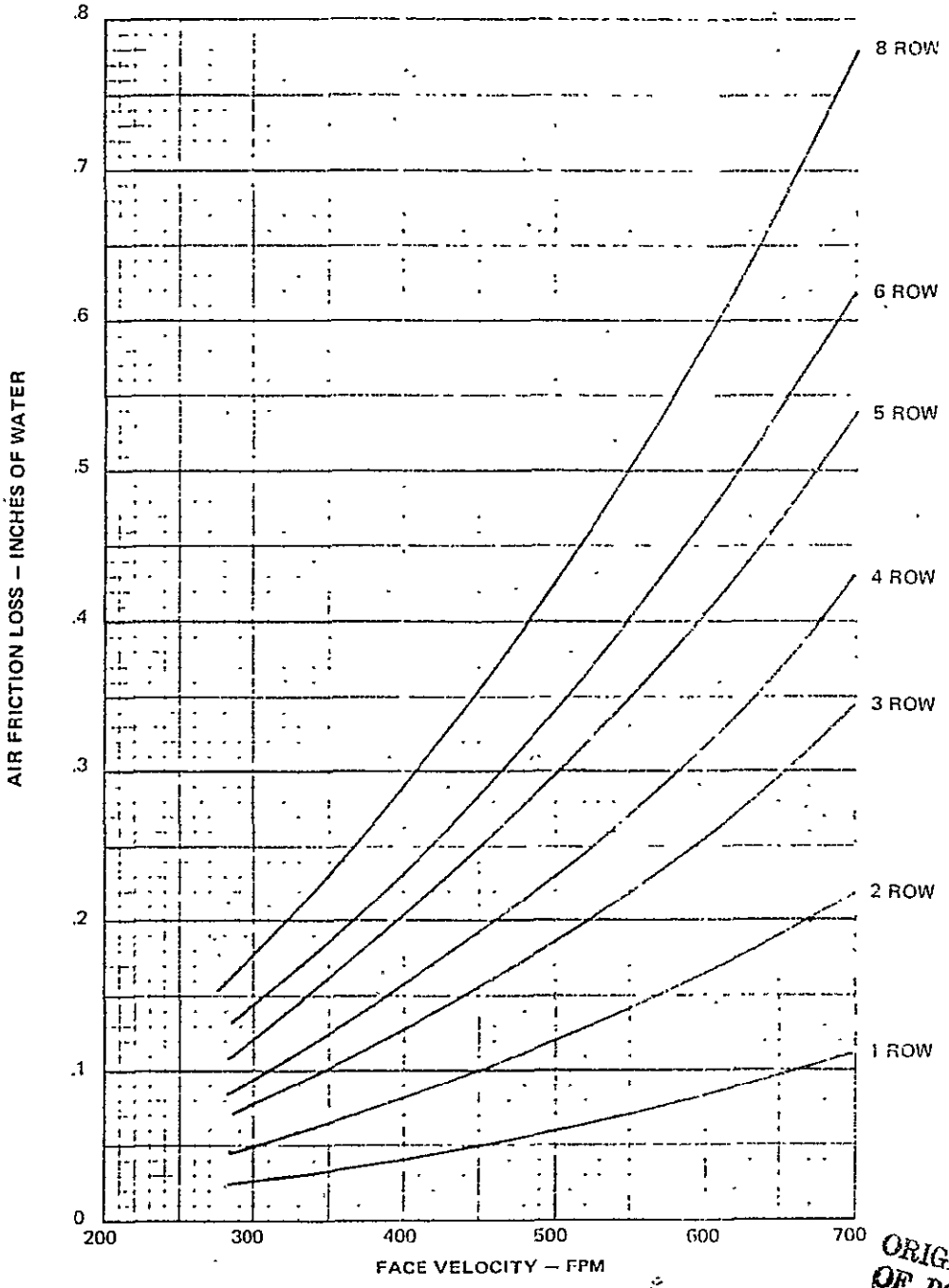
CORRECTION FACTORS AIR SIDE FRICTION LOSS

FINS/INCH	Corr. Factor
6	.84
8	1.00
10	1.16
12	1.33
14	1.52

5/8" O.D. COPPER TUBES
1 1/2 x 1.299 STAGGERED
CORRUGATED PLATE FIN

TYPE E6210
TYPE C6210

AIR FRICTION LOSS FOR DRY SURFACE



WETTED SURFACE CORRECTION FACTORS

Entering Dew Point Minus Refrig. or Water Temp	Factor
0	1.00
10	1.11
20	1.20
30	1.27
40	1.35

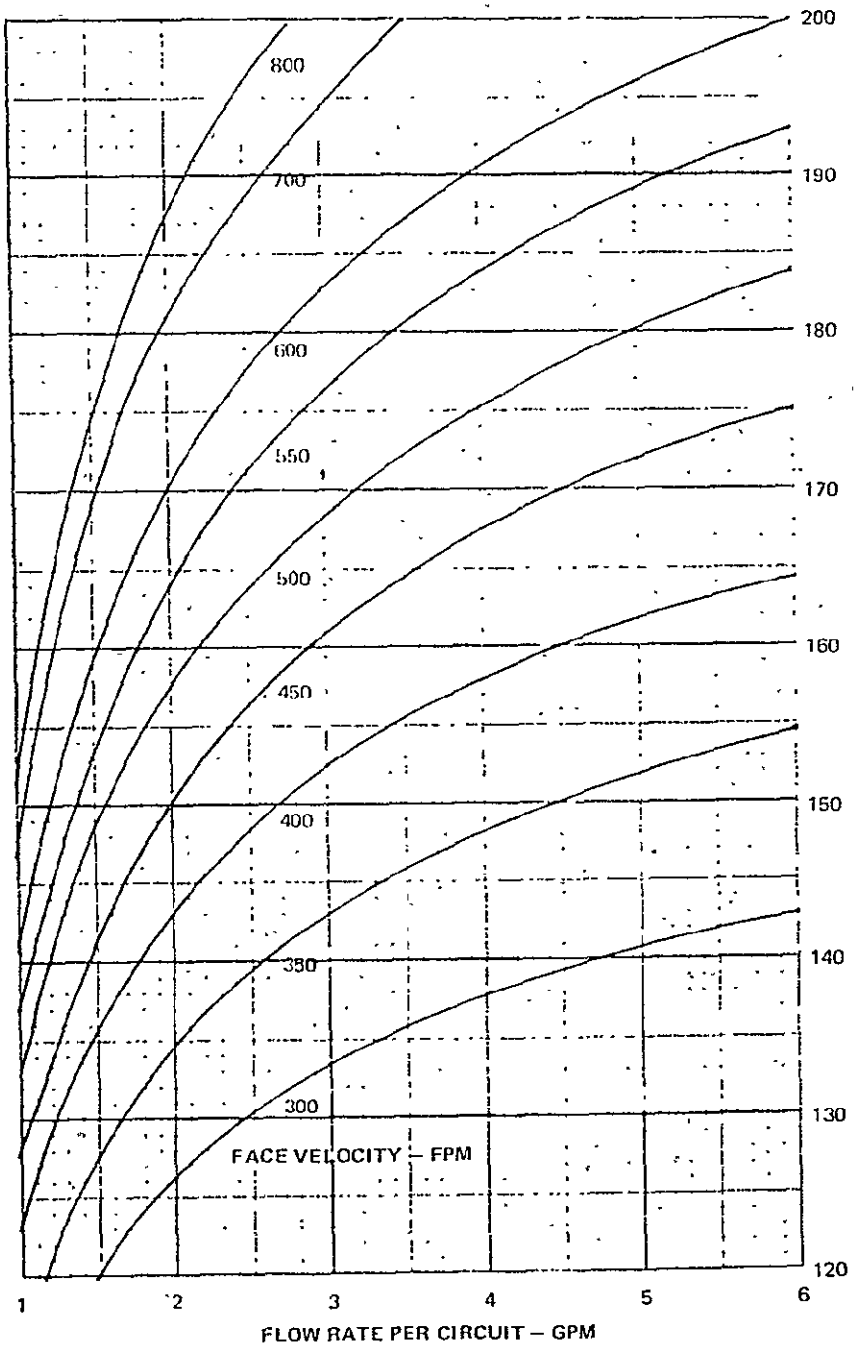
FINS PER INCH CORRECTION FACTORS

FPI	Factor
6	.84
8	1.00
10	1.16
12	1.33
14	1.51

Halstead & Mitchell
Ephrata, Pennsylvania • Wynne, Arkansas

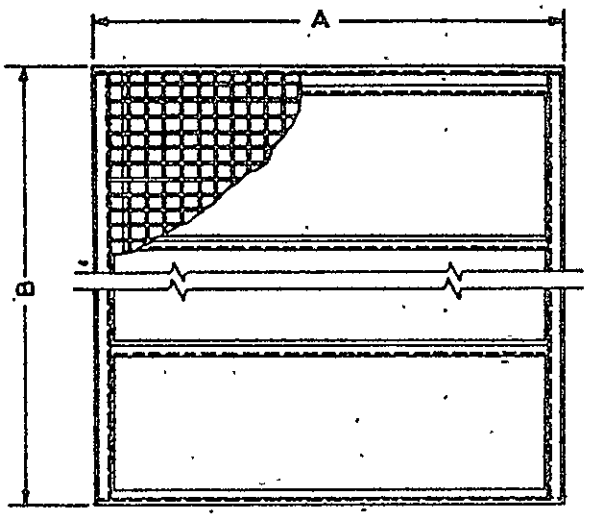
HEAT TRANSFER COEFFICIENTS

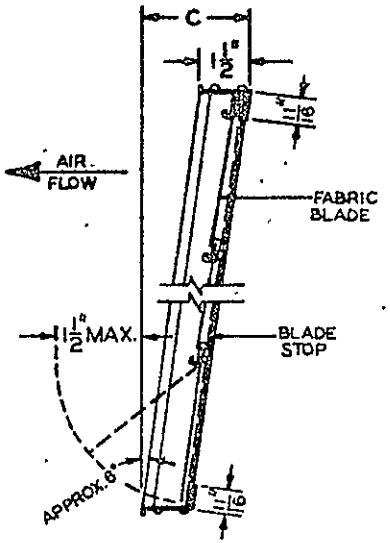
6210 SURFACE CHILLED WATER COILS
DRY SURFACE



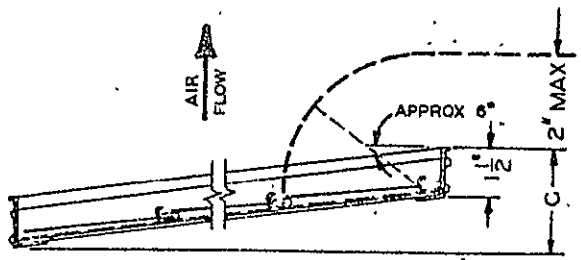
Halstead & Mitchell
Zelienople Pennsylvania • Wynne, Arkansas
Telephone 412 452-9400

Pages containing Ruskin Mfg. Co. 1976 copyright information have been deleted. For control damper, type CD454, information, contact Ruskin Mfg. Co., Grandview, Missouri 64030.





VERTICALLY MOUNTED



HORIZONTALLY MOUNTED

SPECIFICATIONS:-

THE FOLLOWING SPECIFICATIONS INDICATE NORMAL CONSTRUCTION OF THE FABRIC BLADE BACK PRESSURE DAMPERS.

FRAME- .050" EXTRUDED ALUMINUM, 6063-T5 ALLOY
BLADES- FOR DUCT VELOCITY THRU 900 F.P.M. A COATED FABRIC MATERIAL 4" WIDE WILL BE USED. WHERE VELOCITY IS UNDER 300 F.P.M. #1010 CORLASTIC IS RECOMMENDED, AVAILABLE AT EXTRA COST. ADVISE VELOCITY AND BLADE MATERIAL.
BLADE STOPS - COATED 1/2" .047 GALVANIZED STEEL SCREEN
FINISH - MILL
MAXIMUM 'C' DIMENSION - 0" TO 12" HIGH - 2-3/4"
13" TO 19" HIGH - 3-1/2"
25" TO 24" HIGH - 4"
BLADE ANGLE WILL BE CONSTANT, APPROXIMATELY 6 DEGREES, THEREFORE, DEPTH WILL VARY DEPENDING ON HEIGHT, BUT WILL NEVER EXCEED ABOVE 'C' DIMENSIONS.
MAXIMUM PANEL SIZE - 36" WIDE X 24" HIGH. WHEN LARGER UNIT IS REQUIRED DAMPER WILL BE FABRICATED IN MULTIPLE SECTIONS FOR FIELD ASSEMBLY.
MAXIMUM TEMPERATURE ALLOWANCE 250 DEGREES F. FOR SPECIAL HIGH TEMPERATURE APPLICATION, INFORMATION ON REQUEST.

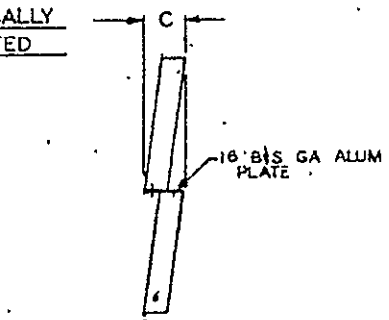
A&B ARE DUCT SIZES. BACK PRESSURE DAMPERS ARE FABRICATED 1/8" OVERSIZE.

UNITS ARE FABRICATED FOR EITHER HORIZONTAL OR VERTICAL MOUNTING, PLEASE SPECIFY.

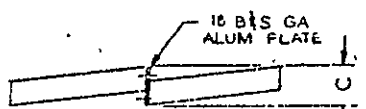
OTHER GAUGES AND MATERIAL FOR FRAME, BLADE STOP AND BLADES ARE AVAILABLE ON REQUEST.

FASTENERS, THEIR TYPE AND LOCATION AND METHOD OF FASTENING ARE SUBJECT TO OUR SELECTION TO MAINTAIN BEST CONSTRUCTION PRACTICES. SPECIFICATIONS ARE SUBJECT TO NORMAL TOLERANCES, DIMENSIONAL AND VISUAL.

DRAWINGS ARE SUBJECT TO CHANGE WITHOUT NOTICE.



MULLION FOR VERTICALLY MOUNTED UNITS



MULLION FOR HORIZONTALLY MOUNTED UNITS

NO. REQ'D	A	B	BLADE MAT'L	VELOCITY	NO PANELS	GA FRAME	TYPE MOUNTING

DATE_____
CUSTOMER_____
CUSTOMER ORDER NO_____
AGENTS ORDER NO_____
JOB_____

H	LOGO CHG	12-6-71	JH
G	REDRAWN, FRAME CHG'D	12 26-68	DVL
F	FRAME MATERIAL CHG'D	5-14-65	N.C.
E	REDRAWN, GEN. REV	1-5-65	GH
	REVISION	DATE	BY

american warming and ventilating inc
1017 SUMMIT ST TOLEDO OHIO

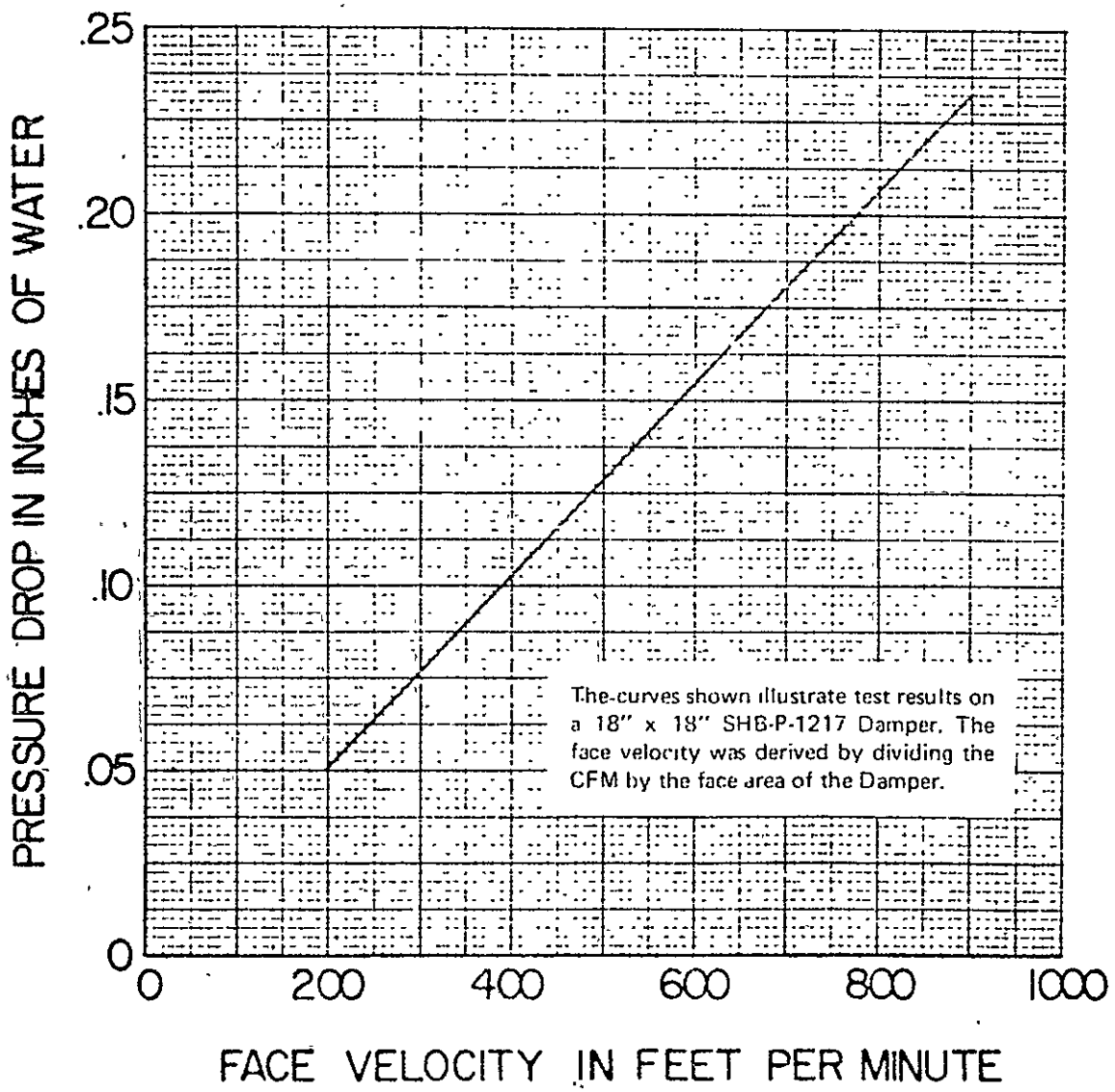
FABRIC BLADE BACK PRESSURE DAMPER
SHB-P-1217 21236-3

CKD BY		APPD BY	
DRN BY DVL	DWG NO SHB-D-1217		REV H
DATE 12-27-68			

CATALOG SECTION 2 DAMPERS - BACK PRESSURE

american warming
and ventilating inc

SERIES SHB-P-1217 DAMPER
FACE VELOCITY VS. STATIC PRESSURE



P.O. BOX 1717CS
1017 SUMMIT ST.
TOLEDO, OHIO 43603
(419) 243-7151

AMCA MEMBER

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VALVES

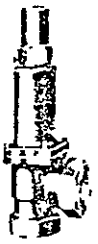
RELIEF

Thermal Bleeder Valves

Automatically drains water lines and water cooled equipment for positive protection against freeze-ups . . . eliminates freeze damage repairs, down-time, and wasted water. Opens only when danger of freezing is imminent and closes as soon as temperature rises to a safe level. Self-actuating and self-operating . . . does not depend on any power source. Maximum working pressure 100 PSI. Has ¾" IPS inlet and outlet. Constructed of heavy brass body, stainless steel spring, and Buna S poppet . . . will not rust or corrode. Sensor is sealed, never needs to be replaced under normal operating conditions . . . requires no service

Nos. 4858N12 & N14—is full open or closed for use where temp drops rapidly, N16—trickle starts at 38°F

No	Actuated By Temp	Full Open	Full Closed	NET EACH
4858N12	Ambient Air	34°F.	40°F.	$105.98
4858N14	Ambient Air	29°F.	35°F.	105.98
4858N16	Surround Water	34°F.	40°F	105.98



By-Pass Relief Valves

This valve has bronze body and stainless steel trim. It is popular for use with hydraulic pumping units, where a predetermined pump discharge pressure must be maintained on such equipment as a machine tool hydraulic mechanism, ram, press, lift, or any system requiring regulation of the pump discharge pressure. Suitable in systems where the valve must discharge into high or variable pressures in the bypass return lines. Suitable for water, other liquids and fuel oils of all types. Not recommended for steam. Maximum Temperature, 450°F.

No.	Size In	Spring Adjustment Range Lbs	NET EACH
4662K12	½	5-75	$36.68
4662K13	½	50-150	36 68
4662K14	½	100-300	36.68
4662K15	½	200-600	36 68
4662K16	¾	5-75	36.68
4662N17	¾	50-150	36 68
4662K18	¾	100-300	36 68
4662K19	¾	200-600	36.68
4662N21	1	5-75	76.37
4662N22	1	50-150	76.37
4662N23	1	100-300	76 37
4662K24	1	200-600	76 37
4662K25	1¼	5-75	76.37
4662N26	1¼	50-150	76 37
4662N27	1¼	100-300	76.37
4662N28	1¼	200-600	76.37

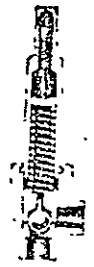
Pressure-Temperature Relief Valves

Construction features include: Brass on lower end of valve, bronze on upper part, stainless steel spring and all working parts brass

Combines the outstanding qualities of a pressure relief and a temperature relief valve into one unit. Valve reseats automatically

All connections ¾" female thread. Meets ASME requirements. Rated and certified by the National Board. Temperature relief capacities established by AGA at 205,000 BTU/hr. (steam). Thermostatic element starts to open at 200°F, opens fully at 210°F

No	9761N11	9761N12	9761N13	9761N14
Opening Pressure, PSI	75	100	125	150
Pressure Relief, BTU/Hr. Steam Disch ASME	1,229,000	1,576,000	1,924,000	2,271,000
NET EACH	$14.45	$14.45	$14.45	$14.45



Forged Steel Relief Valves

Standard construction provides for carbon steel springs for relieving pressure to 600 PSI at temperatures to 450°.

Valves are available for greater relieving pressure (to 900 PSI) and higher temperatures. Prices On Request

A maximum working pressure of 2000 PSI at 100°F or 700 PSI at 850°F is permissable. Meets ASME code for unfired pressure vessels.

Relieves pressure in pump lines, drums, heat exchangers, unfired pressure vessels handling water, steam, oil, or vapor. May be used to relieve into the atmosphere or into another part of the piping system. Forged steel body, stainless steel ball and seat. Angle pattern, screwed connections

No. 4709N

Size In	¼	⅜	½	¾	1
NET EACH	$57.00	$57.00	$78.63	$93.32	$112.71

NOTE: When ordering specify: Set Pressure, Service Temperature, Size and Number.

Guided Piston Relief Valves

ALUMINUM • BRASS • STAINLESS STEEL

These relief valves are available with Aluminum, Brass or Stainless Steel bodies. Spring and piston are all stainless steel

Furnished with a soft seat for gas and liquid service. Seat Material: 5-125 PSI Synthetic rubber, 125-3100 PSI Teflon. For Service from −65 to 225°F.

Also available with metal to metal seat, designed for general industrial liquid application such as oil and water and Silicone seat designed for fuel, chemical and other services . . Prices on request.

Furnished standard with female inlet and outlet. Male inlet and female outlet available . . . Prices on request.

Available with factory set pressure as indicated

Direct acting relief valve with excellent characteristics of quick, smooth unloading and accurate operation within the pressure range.

NOTE: When ordering specify No. 4706K, Size, Factory Pressure Setting, Type of Service and whether aluminum, brass or stainless steel is desired

No. 4706K

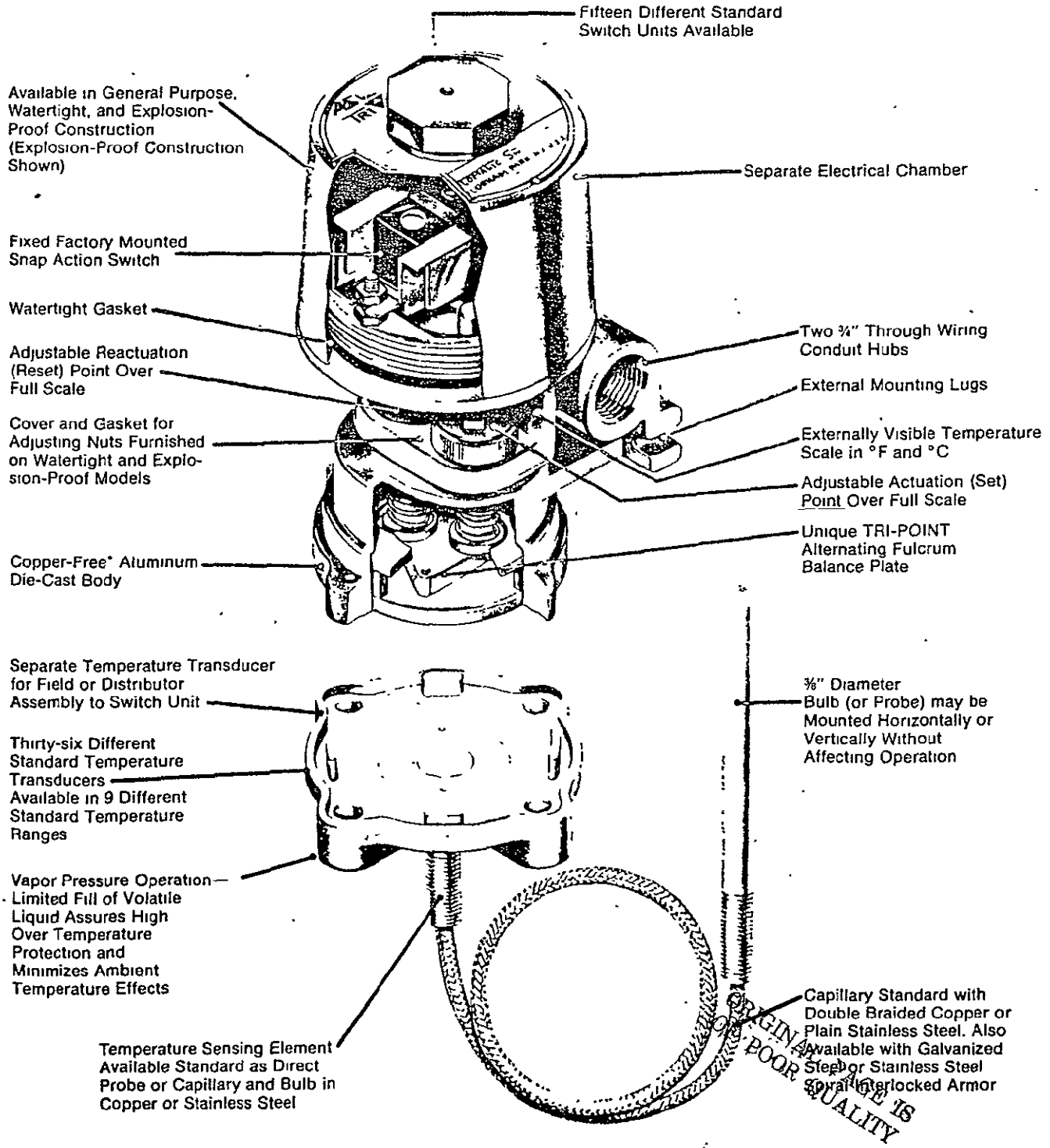
	NET EACH ¼" Size	⅜" Size	½" Size	¾" Size	Pressure Range Settings Available Range	Factory Set
Aluminum	$ 32.38	$ 33.17	$ 34.44	$ 38.63	5-15 PSI	10 PSI
Brass	32 38	33 17	34 44	38 63	10-50 PSI	35 PSI
Stainless Steel	91.44	93.02	94.21	109.25	40-125 PSI	90 PSI

	NET EACH ⅜" Size	¼" Size	¾" Size	½" Size	Pressure Range Settings Available Range	Factory Set
Aluminum	$ 32.38	$ 33.17	$ 34.44	$ 38.63	115-250 PSI	200 PSI
Brass	32.38	33 17	34 44	38.63	235-450 PSI	360 PSI
Stainless Steel	91.44	93.02	94.21	109.25	430-650 PSI	550 PSI
					630-850 PSI	750 PSI
					630-1020 PSI	850 PSI

	NET EACH ⅜" Size	¼" Size	¾" Size	½" Size	Pressure Range Settings Available Range	Factory Set
Aluminum	$ 42.28	$ 43.15	$ 44.78	$ 48.61	800-1500 PSI	1000 PSI
Brass	42 28	43 15	44 78	48.61	1400-2100 PSI	1750 PSI
Stainless Steel	104.50	106.08	107.27	122 71	1500-2750 PSI	2200 PSI
					2000-3100 PSI	2600 PSI

ASCO's TRI-POINT™ TEMPERATURE SWITCH

incorporates the features most wanted!



*0.6% copper content or less

ASCO TRI-POINT

SERIES: SA10 • SA11 • SA12

Temperature Switches

ADJUSTABLE DEADBAND TYPE
Independently Adjustable Set and Reset Points Over Entire Range

GENERAL DESCRIPTION: This series of ASCO TRI-POINT Temperature Switches is the adjustable deadband type. They consist of two separate sub units, a factory adjusted switch assembly unit and a temperature transducer unit. The temperature transducer utilizes a vapor fill to actuate the switch assembly unit in response to temperature changes. These temperature switches may be purchased as an assembled unit, or they may be purchased as two separate units for field assembly. *In all cases, when ordering, the third digit of the switch assembly unit must be identical to the third digit of the temperature transducer unit.*

Example: SA10A Assembled to QA10A1
Must Be Identical

OPERATION The temperature transducer uses the vapor pressure principle in which the vapor pressure of the liquid in the sensing bulb is related to the temperature being sensed. This pressure is converted into a force and transmitted to the balance plate. Two independently adjustable springs apply a counter force to the balance plate. Movement of the balance plate in two steps is transmitted to the snap action electrical switch by an operating rod. The actuation (set) point and the reactuation (reset) point are both independently adjustable over the full temperature range of the switch. The temperature difference between the set and reset points is the deadband and is adjustable from the minimum as listed below to the maximum of the full range.

OPTIONAL FEATURES: Several options are available; for details and availability, consult pages 9, 10 and 11.

ELECTRICAL INFORMATION: Consult page 9 for electrical ratings and schematics for standard and optional snap action switches.

SPECIFICATIONS

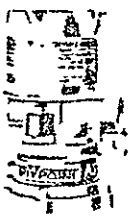
HOW TO SELECT AND ORDER

1. Determine the temperature range needed. Preferably the actuation point should be in the middle two thirds of the span. Check that the maximum temperature rating is sufficient.
2. Read across and select one switch assembly unit with the proper enclosure.
3. Continue across the same line and select one transducer according to the construction desired.
4. Field Assembly: Order the switch assembly unit and the transducer unit by their respective catalog numbers if you desire to field assemble the temperature switch. The third digit in each catalog number must be identical.
5. Factory Assembly: Add the two catalog numbers together separated by a slash ( ), if you desire a completely assembled temperature switch.

Example: For a temperature switch required to actuate at 50°F, select a 0-90°F switch. Such a temperature switch with a general purpose enclosure and copper capillary and bulb would be catalog number SA10A QD11A1.

SWITCH ASSEMBLY UNITS

(Two ¾" NPT Conduit Hubs Standard).



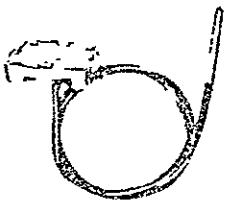
General Purpose Type

Explosion-Proof Type

TEMPERATURE TRANSDUCER UNITS

Direct Probe

Capillary and Bulb



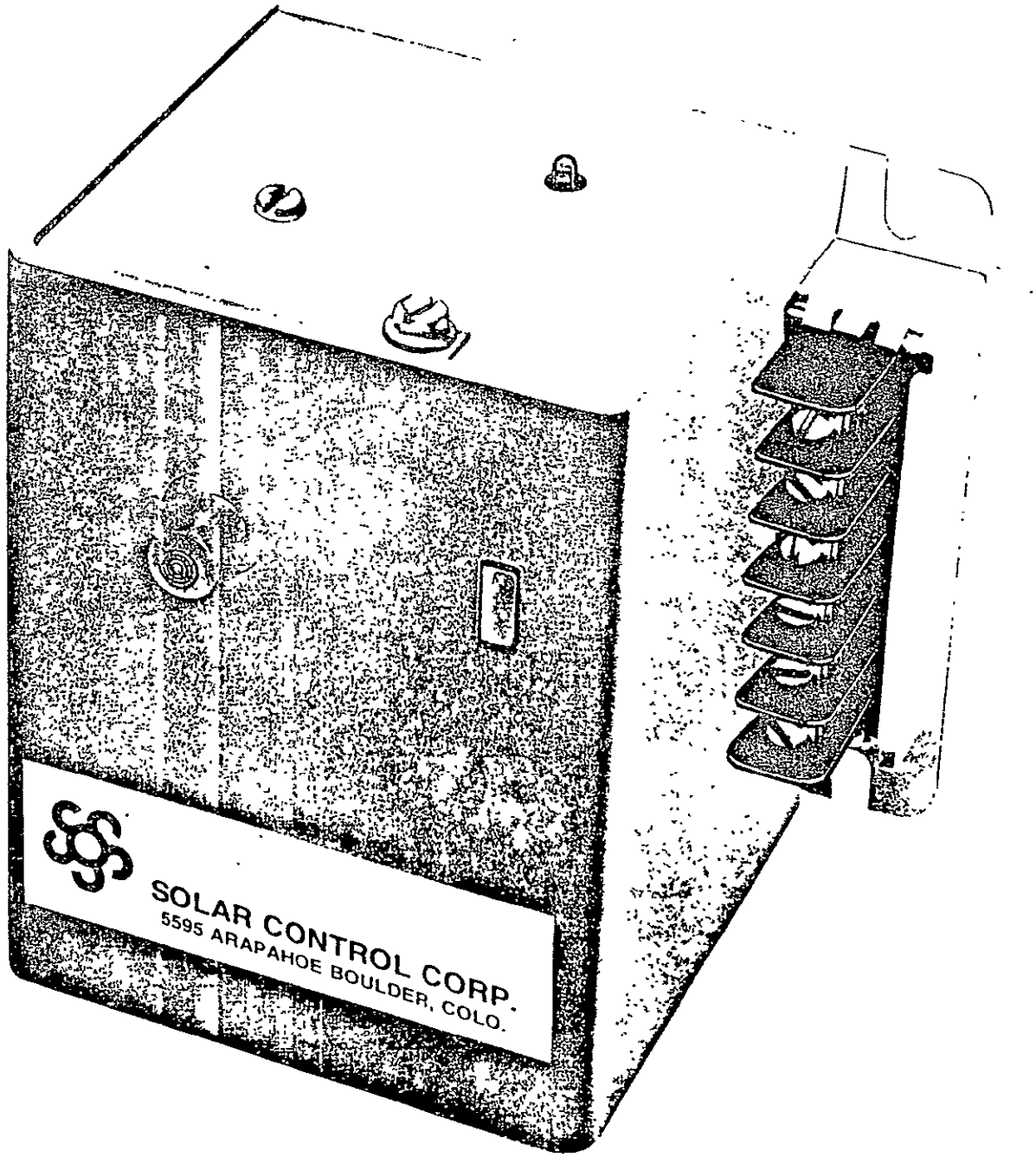
Armored Copper Capillary or Plain Stainless Steel Capillary

ADJUSTABLE OPERATING RANGE (in Degrees)		MAX. TEMP. (In Degrees)	DEADBAND AT MID RANGE* (In Degrees)	GENERAL PURPOSE ENCLOSURE	WATERTIGHT ENCLOSURE	EXPLOSION-PROOF ENCLOSURE	DIRECT PROBE		6' CAPILLARY AND BULB	
							COPPER	316 S.S.	COPPER (Armored Capillary)	316 S.S. (Plain Capillary)
				CATALOG NO.	CATALOG NO.	CATALOG NO.	CATALOG NO.	CATALOG NO.	CATALOG NO.	CATALOG NO.
°F	—60 - 20	200	6	SA10A	SA11A	SA12A	QA10A1	QA10A4	QA11A1	QA11A4
°C	—51 - —7	93	3.3							
°F	—30 - 60	250	6	SA10A	SA11A	SA12A	QB10A1	QB10A4	QB11A1	QB11A4
°C	—34 - 16	121	3.3							
°F	0 - 90	300	8	SA10A	SA11A	SA12A	QD10A1	QD10A4	QD11A1	QD11A4
°C	—18 - 32	149	4.4							
°F	50 - 160	350	7	SA10A	SA11A	SA12A	QF10A1	QF10A4	QF11A1	QF11A4
°C	10 - 71	177	3.8							
°F	100 - 220	450	8	SA10A	SA11A	SA12A	QJ10A1	QJ10A4	QJ11A1	QJ11A4
°C	38 - 104	232	4.4							
°F	160 - 260	500	9	SA10A	SA11A	SA12A	QL10A1	QL10A4	QL11A1	QL11A4
°C	71 - 127	260	5.0							
°F	225 - 340	600	12	SA10A	SA11A	SA12A	QN10A1	QN10A4	QN11A1	QN11A4
°C	107 - 171	316	6.7							
°F	300 - 450	700	12	SA10A	SA11A	SA12A	QT10A1	QT10A4	QT11A1	QT11A4
°C	149 - 232	371	6.7							
°F	350 - 510	800	18	SA10A	SA11A	SA12A	QU10A1	QU10A4	QU11A1	QU11A4
°C	177 - 266	427	10							

*At Extreme Ends of Range. Values May Vary up to 50% of Listed Deadband.

SOLAR CONTROL CORP.

SOLID STATE SOLAR HOT WATEF CONTROLLER

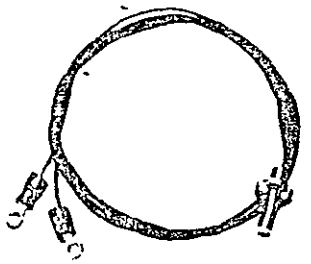


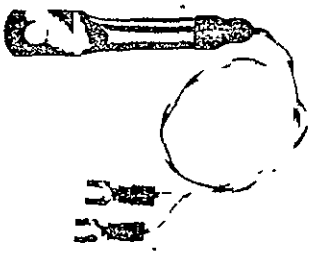
Model 77-171
Solid-State Solar Hot Water Controller

Description

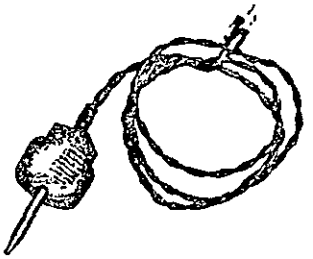
The model 77-171 is a solid-state differential thermostat capable of fully controlling a solar hot water heating system. The unit is designed for a lifetime of maintenance free service, and incorporates freeze and boil protect circuitry.

Air and Water Probes





Air probes are available for clamp or screw mounting.

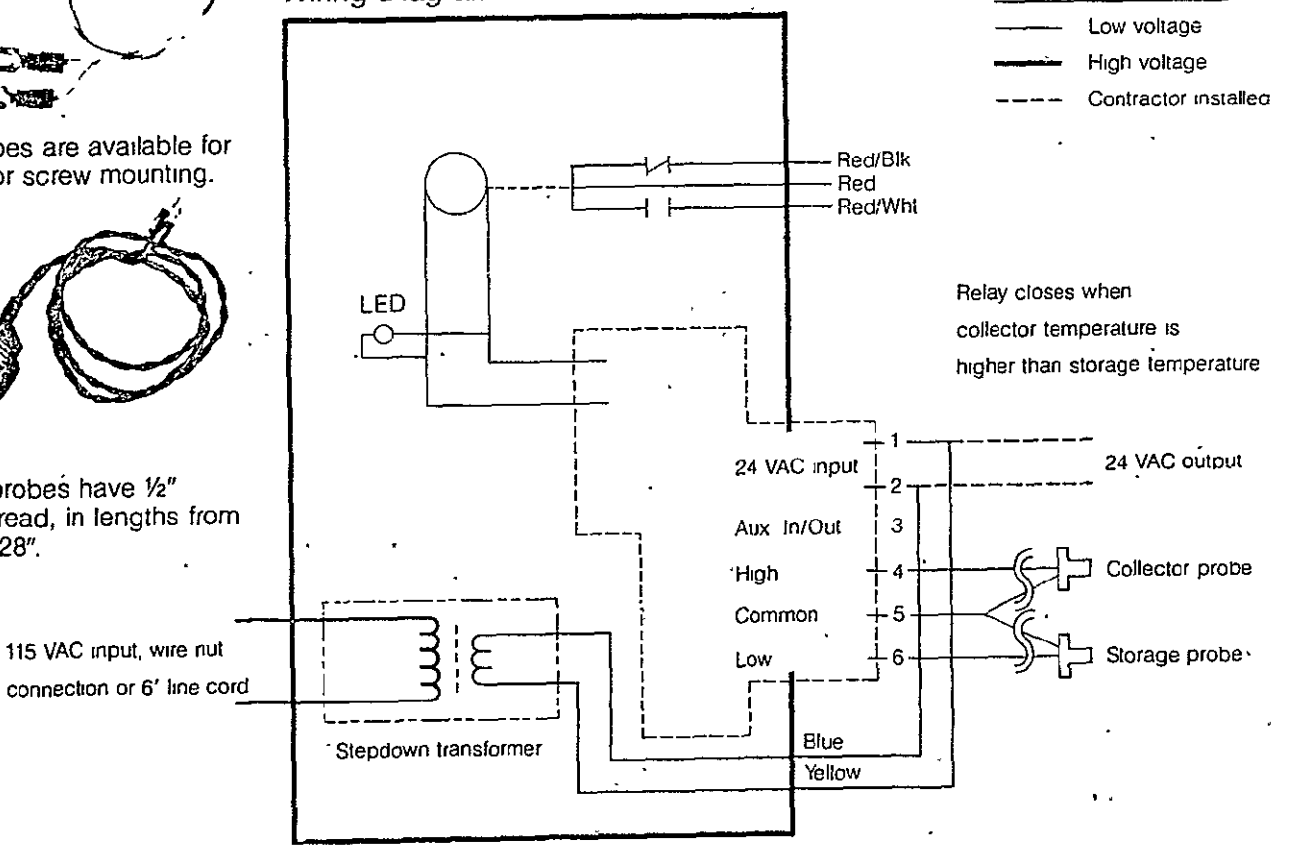


Water probes have ½" NPC thread, in lengths from 2¾" to 28".

Specifications

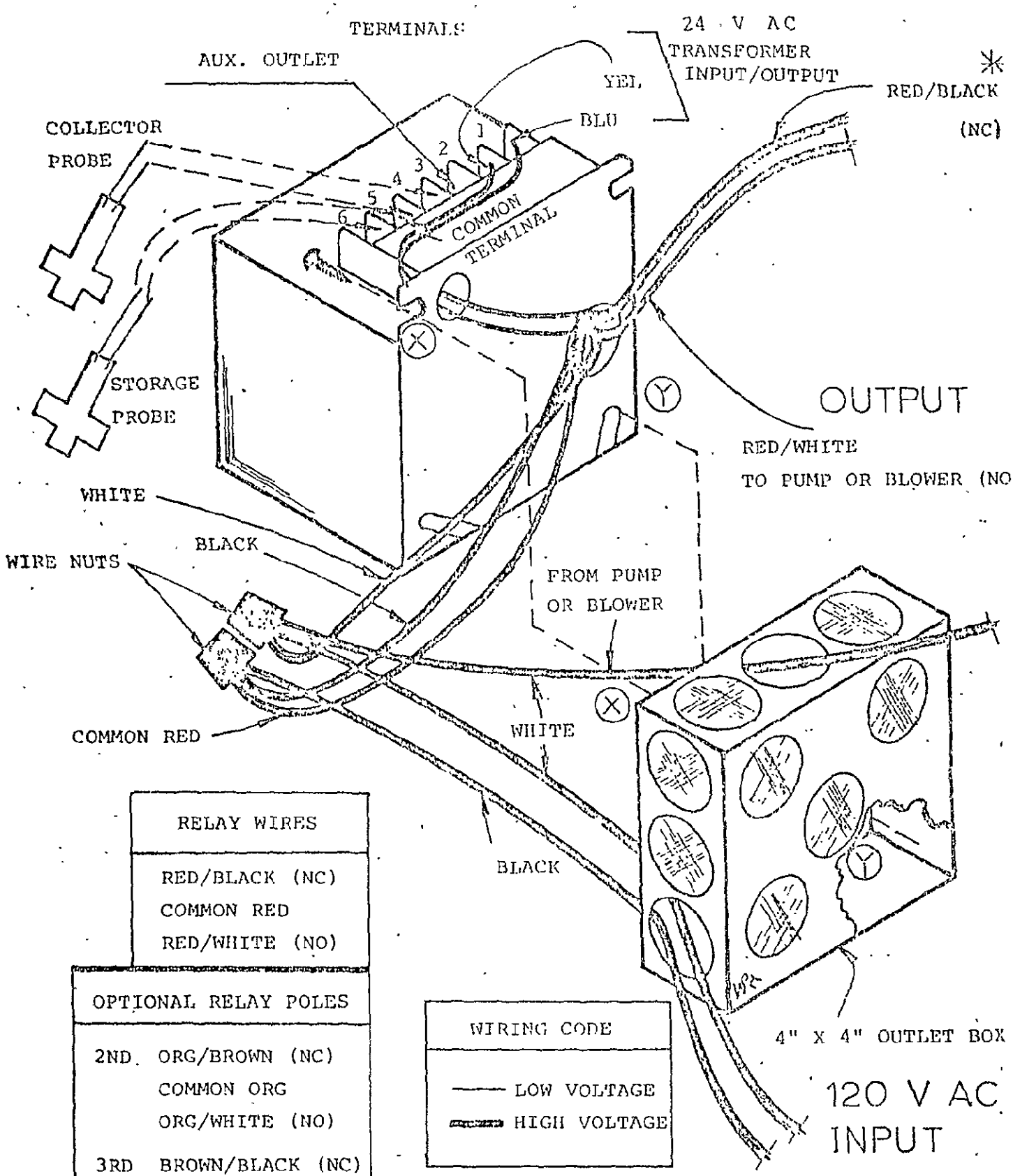
Input Voltage	Either 120 VAC ±10V or 24 VAC ±4V
Input Power	3 watts, no load.
Control Relay	SPDT, 10A. (resistive) at 28 VDC or 120 VAC Higher ratings available.
Output Voltage	Either 120 VAC or 24 VAC.
Sensors	Matched thermistors, (±1°C over range from 0°C to +100°C) in a metal housing, with high temperature teflon leads
Differential Turn-off Offset	Typically 4°F ±2° @100°F, (can be adjusted by a resistor change)
Differential Turn-on Offset	Typically 20°F ±2° @ 100°F, (can be adjusted by a resistor cha
Temperature Range	Controller chassis −40°F to 140°F Sensors. −40°F to +300°F
Tracking Accuracy	± 5°F over entire operating range
Isolation Protection	1500 V
Size	4" × 4" × 3½"
Weight	2 lbs
Mounting	Mounts on 4" × 4" "J" box

Wiring Diagram



SOLAR CONTROL CORP. 5595 Arapahoe Road, Boulder, Colorado 80302 303/449-9180

FIELD INSTALLATION DIAGRAM

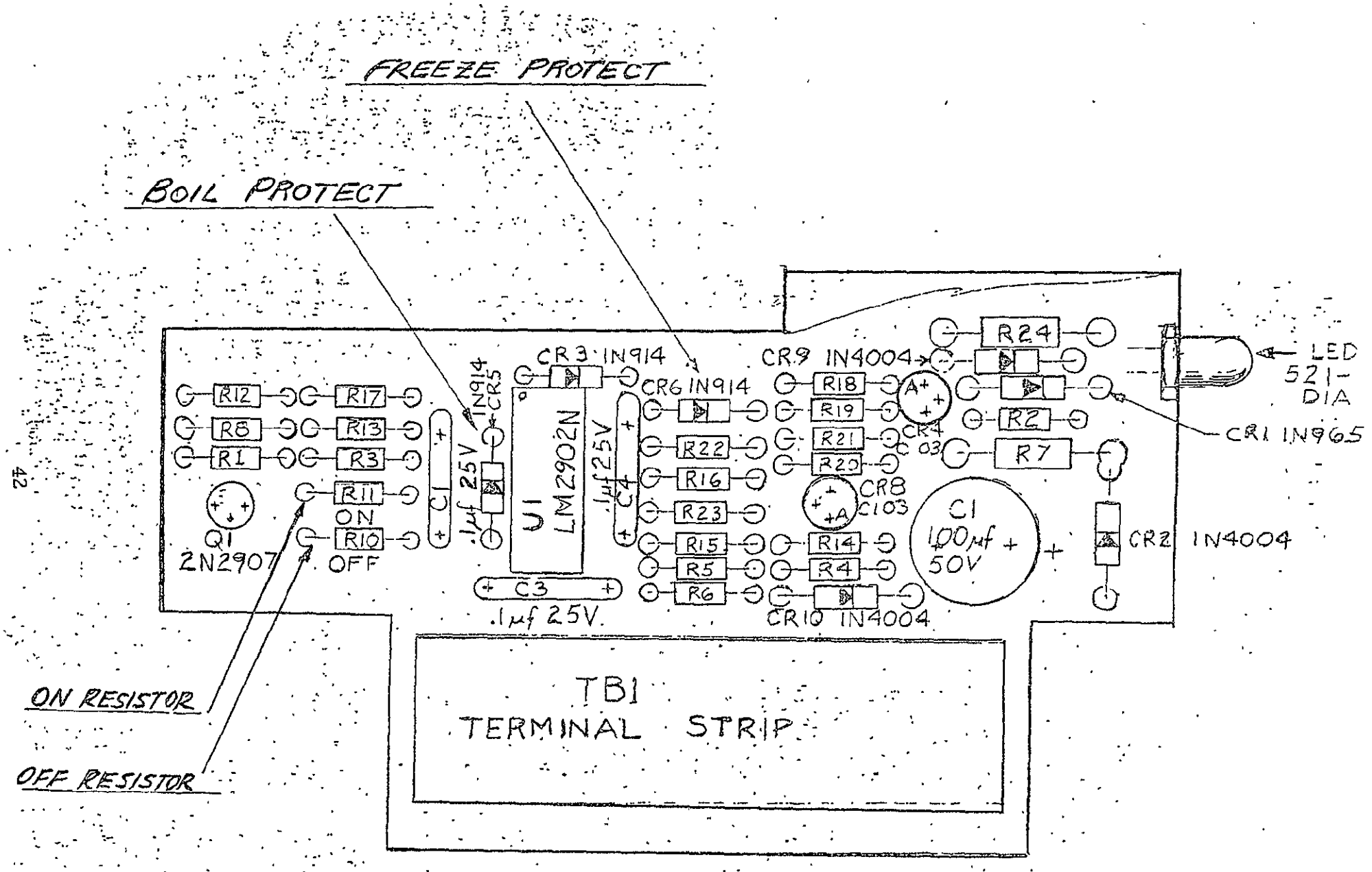


RELAY WIRES
RED/BLACK (NC)
COMMON RED
RED/WHITE (NO)

OPTIONAL RELAY POLES	
2ND.	ORG/BROWN (NC)
	COMMON ORG
	ORG/WHITE (NO)
3RD	BROWN/BLACK (NC)
	COMMON BROWN
	BROWN/WHITE (NO)

WIRING CODE
—— LOW VOLTAGE
═══ HIGH VOLTAGE

✳ CAP IF NOT USED.


FREEZE PROTECT
BOIL PROTECT
R12
R17
R8
R13
R1
R3
R11
ON
R10
OFF
Q1
2N2907
C1
.1µf 25V
IN914
CR5
CR3 IN914
U1
LM2902N
CR6 IN914
C4
.1µf 25V
C3
.1µf 25V.
CR9 IN4004
R18
R19
R21
R20
CR4
C103
CR8
C103
R22
R16
R23
R15
R5
R6
R14
R4
CR10 IN4004
C1
100µf +
50V
R24
R2
R7
CR2 IN4004
LED
521-
DIA
CR1 IN965
ON RESISTOR
OFF RESISTOR
TB1
TERMINAL STRIP

RESISTANCE TEMPERATURE TABLE
U.S. INDUSTRIAL SPEC. $R_{212F}/R_{32F} = 1.3911$
PLATINUM RESISTANCE THERMOMETER
100 OHMS AT 32°F.

MINCO

TABLE 12-100

7300 Boone Ave. No., Minneapolis, Minnesota 55428 (USA) Telephone: (612) 786-3121

T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)
-328.0	17.26	-283.0	28.12	-238.0	38.79	-193.0	49.28
-327.0	17.50	-282.0	28.36	-237.0	39.02	-192.0	49.52
-326.0	17.75	-281.0	28.60	-236.0	39.26	-191.0	49.75
-325.0	17.99	-280.0	28.84	-235.0	39.49	-190.0	49.98
-324.0	18.23	-279.0	29.08	-234.0	39.73	-189.0	50.21
-323.0	18.48	-278.0	29.32	-233.0	39.96	-188.0	50.44
-322.0	18.72	-277.0	29.56	-232.0	40.20	-187.0	50.67
-321.0	18.96	-276.0	29.79	-231.0	40.43	-186.0	50.90
-320.0	19.21	-275.0	30.03	-230.0	40.67	-185.0	51.14
-319.0	19.45	-274.0	30.27	-229.0	40.90	-184.0	51.37
-318.0	19.69	-273.0	30.51	-228.0	41.13	-183.0	51.60
-317.0	19.94	-272.0	30.75	-227.0	41.37	-182.0	51.83
-316.0	20.18	-271.0	30.99	-226.0	41.60	-181.0	52.06
-315.0	20.42	-270.0	31.22	-225.0	41.84	-180.0	52.29
-314.0	20.66	-269.0	31.46	-224.0	42.07	-179.0	52.52
-313.0	20.91	-268.0	31.70	-223.0	42.30	-178.0	52.75
-312.0	21.15	-267.0	31.94	-222.0	42.54	-177.0	52.98
-311.0	21.39	-266.0	32.17	-221.0	42.77	-176.0	53.21
-310.0	21.63	-265.0	32.41	-220.0	43.01	-175.0	53.44
-309.0	21.87	-264.0	32.65	-219.0	43.24	-174.0	53.67
-308.0	22.11	-263.0	32.89	-218.0	43.47	-173.0	53.90
-307.0	22.36	-262.0	33.12	-217.0	43.71	-172.0	54.13
-306.0	22.60	-261.0	33.36	-216.0	43.94	-171.0	54.36
-305.0	22.84	-260.0	33.60	-215.0	44.17	-170.0	54.59
-304.0	23.08	-259.0	33.83	-214.0	44.41	-169.0	54.82
-303.0	23.32	-258.0	34.07	-213.0	44.64	-168.0	55.05
-302.0	23.56	-257.0	34.31	-212.0	44.87	-167.0	55.28
-301.0	23.80	-256.0	34.54	-211.0	45.10	-166.0	55.51
-300.0	24.04	-255.0	34.78	-210.0	45.34	-165.0	55.74
-299.0	24.29	-254.0	35.02	-209.0	45.57	-164.0	55.97
-298.0	24.53	-253.0	35.25	-208.0	45.80	-163.0	56.20
-297.0	24.77	-252.0	35.49	-207.0	46.04	-162.0	56.43
-296.0	25.01	-251.0	35.73	-206.0	46.27	-161.0	56.66
-295.0	25.25	-250.0	35.96	-205.0	46.50	-160.0	56.89
-294.0	25.49	-249.0	36.20	-204.0	46.73	-159.0	57.12
-293.0	25.73	-248.0	36.43	-203.0	46.97	-158.0	57.35
-292.0	25.97	-247.0	36.67	-202.0	47.20	-157.0	57.58
-291.0	26.21	-246.0	36.91	-201.0	47.43	-156.0	57.81
-290.0	26.45	-245.0	37.14	-200.0	47.66	-155.0	58.04
-289.0	26.69	-244.0	37.38	-199.0	47.89	-154.0	58.27
-288.0	26.93	-243.0	37.61	-198.0	48.13	-153.0	58.49
-287.0	27.17	-242.0	37.85	-197.0	48.36	-152.0	58.72
-286.0	27.41	-241.0	38.08	-196.0	48.59	-151.0	58.95
-285.0	27.65	-240.0	38.32	-195.0	48.82	-150.0	59.18
-284.0	27.88	-239.0	38.55	-194.0	49.05	-149.0	59.41

T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)
-148.0	59.64	-103.0	69.87	-58.0	81.00	-13.0	90.11
-147.0	59.87	-102.0	70.10	-57.0	80.22	-12.0	90.34
-146.0	60.10	-101.0	70.32	-56.0	80.45	-11.0	90.56
-145.0	60.32	-100.0	70.55	-55.0	80.67	-10.0	90.71
-144.0	60.55	-99.0	70.77	-54.0	80.90	-9.0	90.03
-143.0	60.78	-98.0	71.00	-53.0	81.12	-8.0	91.15
-142.0	61.01	-97.0	71.23	-52.0	81.34	-7.0	91.37
-141.0	61.24	-96.0	71.45	-51.0	81.57	-6.0	91.59
-140.0	61.47	-95.0	71.68	-50.0	81.77	-5.0	91.82
-139.0	61.69	-94.0	71.90	-49.0	82.01	-4.0	92.04
-138.0	61.92	-93.0	72.13	-48.0	82.24	-3.0	92.26
-137.0	62.15	-92.0	72.36	-47.0	82.46	-2.0	92.48
-136.0	62.38	-91.0	72.58	-46.0	82.69	-1.0	92.71
-135.0	62.61	-90.0	72.81	-45.0	82.91	0.0	92.93
-134.0	62.83	-89.0	73.03	-44.0	83.13	1.0	93.15
-133.0	63.06	-88.0	73.26	-43.0	83.36	2.0	93.37
-132.0	63.29	-87.0	73.48	-42.0	83.58	3.0	93.59
-131.0	63.52	-86.0	73.71	-41.0	83.80	4.0	93.81
-130.0	63.74	-85.0	73.93	-40.0	84.03	5.0	94.03
-129.0	63.97	-84.0	74.16	-39.0	84.25	6.0	94.25
-128.0	64.20	-83.0	74.38	-38.0	84.47	7.0	94.48
-127.0	64.43	-82.0	74.61	-37.0	84.70	8.0	94.70
-126.0	64.65	-81.0	74.83	-36.0	84.92	9.0	94.92
-125.0	64.88	-80.0	75.06	-35.0	85.14	10.0	95.14
-124.0	65.11	-79.0	75.28	-34.0	85.35	11.0	95.36
-123.0	65.34	-78.0	75.51	-33.0	85.57	12.0	95.58
-122.0	65.56	-77.0	75.73	-32.0	85.81	13.0	95.80
-121.0	65.79	-76.0	75.96	-31.0	86.03	14.0	96.02
-120.0	66.02	-75.0	76.18	-30.0	86.26	15.0	96.25
-119.0	66.25	-74.0	76.41	-29.0	86.48	16.0	96.47
-118.0	66.47	-73.0	76.63	-28.0	86.72	17.0	96.69
-117.0	66.70	-72.0	76.86	-27.0	86.92	18.0	96.91
-116.0	66.93	-71.0	77.03	-26.0	87.13	19.0	97.13
-115.0	67.15	-70.0	77.31	-25.0	87.37	20.0	97.35
-114.0	67.34	-69.0	77.53	-24.0	87.59	21.0	97.57
-113.0	67.61	-68.0	77.76	-23.0	87.82	22.0	97.79
-112.0	67.83	-67.0	77.98	-22.0	88.04	23.0	98.01
-111.0	68.06	-66.0	78.21	-21.0	88.26	24.0	98.23
-110.0	68.29	-65.0	78.43	-20.0	88.48	25.0	98.46
-109.0	68.51	-64.0	78.65	-19.0	88.71	26.0	98.68
-108.0	68.74	-63.0	78.88	-18.0	88.93	27.0	98.90
-107.0	68.97	-62.0	79.10	-17.0	89.15	28.0	99.12
-106.0	69.19	-61.0	79.33	-16.0	89.37	29.0	99.34
-105.0	69.42	-60.0	79.55	-15.0	89.60	30.0	99.56
-104.0	69.64	-59.0	79.78	-14.0	89.82	31.0	99.79

T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)
32.0	100.00	77.0	109.89	122.0	119.70	167.0	129.44
33.0	100.22	78.0	110.11	123.0	119.92	168.0	129.66
34.0	100.44	79.0	110.32	124.0	120.13	169.0	129.87
35.0	100.66	80.0	110.54	125.0	120.35	170.0	130.09
36.0	100.88	81.0	110.76	126.0	120.57	171.0	130.30
37.0	101.10	82.0	110.98	127.0	120.79	172.0	130.52
38.0	101.32	83.0	111.20	128.0	121.00	173.0	130.73
39.0	101.54	84.0	111.42	129.0	121.22	174.0	130.95
40.0	101.76	85.0	111.64	130.0	121.44	175.0	131.16
41.0	101.98	86.0	111.86	131.0	121.65	176.0	131.38
42.0	102.20	87.0	112.07	132.0	121.87	177.0	131.59
43.0	102.42	88.0	112.29	133.0	122.09	178.0	131.81
44.0	102.64	89.0	112.51	134.0	122.30	179.0	132.03
45.0	102.86	90.0	112.73	135.0	122.52	180.0	132.24
46.0	103.08	91.0	112.95	136.0	122.74	181.0	132.46
47.0	103.30	92.0	113.17	137.0	122.95	182.0	132.67
48.0	103.52	93.0	113.38	138.0	123.17	183.0	132.89
49.0	103.74	94.0	113.60	139.0	123.39	184.0	133.10
50.0	103.96	95.0	113.82	140.0	123.60	185.0	133.32
51.0	104.18	96.0	114.04	141.0	123.82	186.0	133.53
52.0	104.40	97.0	114.26	142.0	124.04	187.0	133.75
53.0	104.62	98.0	114.48	143.0	124.25	188.0	133.96
54.0	104.84	99.0	114.69	144.0	124.47	189.0	134.18
55.0	105.05	100.0	114.91	145.0	124.69	190.0	134.39
56.0	105.28	101.0	115.13	146.0	124.90	191.0	134.60
57.0	105.50	102.0	115.35	147.0	125.12	192.0	134.82
58.0	105.72	103.0	115.57	148.0	125.34	193.0	135.03
59.0	105.94	104.0	115.78	149.0	125.55	194.0	135.25
60.0	106.16	105.0	116.00	150.0	125.77	195.0	135.46
61.0	106.38	106.0	116.22	151.0	125.99	196.0	135.68
62.0	106.60	107.0	116.44	152.0	126.20	197.0	135.89
63.0	106.82	108.0	116.65	153.0	126.42	198.0	136.11
64.0	107.04	109.0	116.87	154.0	126.63	199.0	136.32
65.0	107.26	110.0	117.09	155.0	126.85	200.0	136.54
66.0	107.48	111.0	117.31	156.0	127.07	201.0	136.75
67.0	107.70	112.0	117.53	157.0	127.28	202.0	136.97
68.0	107.92	113.0	117.74	158.0	127.50	203.0	137.18
69.0	108.13	114.0	117.96	159.0	127.71	204.0	137.39
70.0	108.35	115.0	118.18	160.0	127.93	205.0	137.61
71.0	108.57	116.0	118.40	161.0	128.15	206.0	137.82
72.0	108.79	117.0	118.61	162.0	128.36	207.0	138.04
73.0	109.01	118.0	118.83	163.0	128.58	208.0	138.25
74.0	109.23	119.0	119.05	164.0	128.79	209.0	138.47
75.0	109.45	120.0	119.27	165.0	129.01	210.0	138.68
76.0	109.67	121.0	119.48	166.0	129.22	211.0	138.89

T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)	T(F)	R(OHMS)
212.0	139.11	257.0	148.[illegible]	302.0	158.22	347.0	167.67
213.0	139.32	258.0	148.[illegible]	303.0	158.43	348.0	167.88
214.0	139.54	259.0	149.[illegible]	304.0	158.64	349.0	168.09
215.0	139.75	260.0	149.[illegible]	305.0	158.85	350.0	168.30
216.0	139.96	261.0	149.[illegible]	306.0	159.06	351.0	168.51
217.0	140.18	262.0	150.[illegible]	307.0	159.28	352.0	168.72
218.0	140.39	263.0	150.[illegible]	308.0	159.49	353.0	168.93
219.0	140.60	264.0	150.[illegible]	309.0	159.70	354.0	169.13
220.0	140.82	265.0	150.[illegible]	310.0	159.91	355.0	169.34
221.0	141.03	266.0	151.61	311.0	160.12	356.0	169.55
222.0	141.25	267.0	151.82	312.0	160.33	357.0	169.76
223.0	141.46	268.0	152.04	313.0	160.54	358.0	169.97
224.0	141.67	269.0	152.25	314.0	160.75	359.0	170.18
225.0	141.89	270.0	152.46	315.0	160.96	360.0	170.39
226.0	142.10	271.0	152.67	316.0	161.17	361.0	170.59
227.0	142.31	272.0	152.88	317.0	161.38	362.0	170.80
228.0	142.53	273.0	153.09	318.0	161.59	363.0	171.01
229.0	142.74	274.0	153.31	319.0	161.80	364.0	171.22
230.0	142.95	275.0	153.52	320.0	162.01	365.0	171.43
231.0	143.17	276.0	153.73	321.0	162.22	366.0	171.64
232.0	143.38	277.0	153.94	322.0	162.43	367.0	171.85
233.0	143.59	278.0	154.15	323.0	162.64	368.0	172.05
234.0	143.81	279.0	154.37	324.0	162.85	369.0	172.26
235.0	144.02	280.0	154.58	325.0	163.06	370.0	172.47
236.0	144.23	281.0	154.79	326.0	163.27	371.0	172.68
237.0	144.45	282.0	155.00	327.0	163.48	372.0	172.89
238.0	144.66	283.0	155.21	328.0	163.69	373.0	173.10
239.0	144.87	284.0	155.42	329.0	163.90	374.0	173.30
240.0	145.09	285.0	155.63	330.0	164.11	375.0	173.51
241.0	145.30	286.0	155.85	331.0	164.32	376.0	173.72
242.0	145.51	287.0	156.06	332.0	164.53	377.0	173.93
243.0	145.72	288.0	156.27	333.0	164.74	378.0	174.14
244.0	145.94	289.0	156.48	334.0	164.95	379.0	174.34
245.0	146.15	290.0	156.69	335.0	165.16	380.0	174.55
246.0	146.36	291.0	156.90	336.0	165.37	381.0	174.76
247.0	146.58	292.0	157.11	337.0	165.58	382.0	174.97
248.0	146.79	293.0	157.32	338.0	165.79	383.0	175.18
249.0	147.00	294.0	157.53	339.0	166.00	384.0	175.38
250.0	147.21	295.0	157.75	340.0	166.21	385.0	175.59
251.0	147.43	296.0	157.96	341.0	166.41	386.0	175.80
252.0	147.64	297.0	158.17	342.0	166.62	387.0	176.01
253.0	147.85	298.0	158.38	343.0	166.83	388.0	176.21
254.0	148.06	299.0	158.59	344.0	167.04	389.0	176.42
255.0	148.28	300.0	158.80	345.0	167.25	390.0	176.63
256.0	148.49	301.0	159.01	346.0	167.46	391.0	176.84

PENN BASO

PENN CONTROLS
DIVISION OF JOHNSON SERVICE COMPANY

Y61, Y62, Y63
3741-C
3741-B

series Y61, Y62, Y63

BASO® TRANSFORMERS

For Use With PENN-BASO Gas Controls and Ignition Systems

APPLICATION

These transformers are designed to match the 25 volt power requirements of Penn-Baso gas controls and ignition systems.

Transformers for use with Penn motor actuators, Actrol™ staging and other low voltage control circuits are described in Bulletin 3742. Bulletin 3740 describes the Penn-Baso igniter transformers.

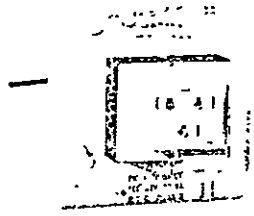


Fig 1 — Y61AA-2 plate mounted 20 VA transformer is illustrated above. Note the three secondary terminals

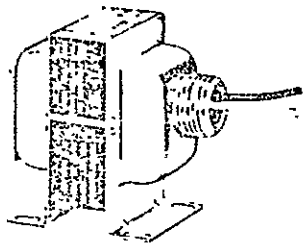


Fig. 2 — The foot mounted Y61AC-2 is illustrated. Note addition of the conduit hub

FEATURES

- — Transformers deliver 25 volts minimum at their VA. ratings at 100% power factor.
- — Choice of primary voltages to meet power requirements.
- — Plate, foot or conduit hub mounting models available.
- — Choice of terminal board or lead wire connections.
- — Two or three terminal secondary as selected.
- — Color coded lead wires for simplicity and standardization.

GENERAL DESCRIPTION

Baso transformers are high quality devices that provide rated secondary output under rated load.

Secondary voltage of 25 volts. Transformers may be used on 50 or 60 Hz. power supply.

Series Y61 and Y62 are NEC Class 2 energy limiting.

Series Y63 is NEC Class 2 internally fuse protected.

MISCELLANEOUS SPECIFICATIONS

Open Circuit Voltage (No Load): Y61, 27.5; Y62, 29.5; Y63, 27.5.

Finish: Cold drawn steel end bells, frame, feet and plate, zinc plated with dichromate dip.

Laminations: Soft Silicon iron with edges painted black.

Identification: Stamped on laminations, foot or hub mounted models. Stamped on plate of plate mounted models.

Minimum Ambient Temperature: —40° F (—40° C).

Packaging: Bulk pack supplied to OEM's. Individual reshippable package supplied at extra cost.

Series Number	Bulk Pack Qty.	Approx. Wt. Lbs. (kg)
Y61 Plate	36	60.5 (27.2)
Y61 Foot	45	54 (24.3)
Y62 Plate	36	76 (34.2)
Y62 Foot	30	49 (22)
Y63 Plate	12	30 (13.5)
Y63 Hub	32	66 (29.7)

PRODUCT NUMBER SELECTION CHART

Product Number	Primary		Secondary		Mounting	Dimensions (See Figure)
	Voltage	Electrical Connection	Voltage	Electrical Connection		
20 VA. CAPACITY TRANSFORMERS						
Y61AA-3	120	8" B & W Lead Wires	25	3 Terminals	4" x 4" Plate	3
Y61AB-3	120	8" B & W Lead Wires	25	2 Terminals	2" x 4" Plate	4
Y61AC-2	120	8" B & W Lead Wires	25	2 Terminals	Foot, ½"-14 NPS Male Hub	5
Y61AE-2	120	10" B & W Lead Wires	25	3 Terminals	Foot	6
Y61AF-2	120	8" B & W Lead Wires	25	2 Terminals	½"-14 NPS Male Hub	7
Y61BF-2	240	8" B & Y Lead Wires	25	2 Terminals	½"-14 NPS Male Hub	7

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DWG NO. 7933649

	REVISIONS				
CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVED
	66352 JT	-	RELEASE		

CONTR NO.	INTERNATIONAL BUSINESS MACHINES CORP. FEDERAL SYSTEMS DIVISION HUNTSVILLE, ALA. 35807	
PREPARATION DS. Sinton 6/5/78	TITLE SYSTEM PERFORMANCE SPECIFICATION FOR SIMS PROTOTYPE SYSTEM DESIGN NO. 4	
DSGN CHK		
DWG CHK		
DSGN APPROVAL JKracke 6-6-78	SIZE A / CODE IDENT NO. / DWG NO. 7933649	
	SCALE / WT	SHEET 1 of 20

TABLE OF CONTENTS

1.0 INTRODUCTION

This performance specification establishes the requirements for the design and performance of the solar heating and domestic hot water system utilizing air collectors and a forced air (central) heating auxiliary energy subsystem. It designates the Performance Criteria applicable to this type system and defines the deviations. The appendices specify the system performance for the defined site location and system size, the installation drawings, and the detailed configuration diagrams and drawings.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Specific document reference made in subsequent paragraphs shall be by basic title or reference number only.

2.1 Government Documents

Interim Performance Criteria for Solar Heating and Combined Heating/Cooling Systems and Dwellings, January 1, 1976, U. S. Department of Housing and Urban Development.

Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, April, 1976, NBSIR 76-1059, U. S. Department of Housing and Urban Development.

SIMS Contract Statement of Work, NAS8-32036, April 4, 1976 (with current modifications).

2.2 IBM Documents

The following documents are referenced for information only:

System Four Design Description Drawing, 7934983
Remote Solar Assembly Drawing, 7934940

3.0 APPLICATION OF INTERIM PERFORMANCE CRITERIA BY TYPE OF SYSTEM

The application of each paragraph of the Interim Performance Criteria (IPC) to this type of system is provided in Table I. Since this system provides solar heating and domestic hot water, system type "H" designates the IPC application to this system.

4.0 DEVIATION FROM INTERIM PERFORMANCE CRITERIA

The IPC deviations identified by subsystem evaluation are listed in the following paragraph.

4.1 Deviations to Residential IPC

The collector subsystem evaluation has identified several areas of non-conformance as tabulated below. No vendor analysis or test data was available to substantiate that these requirements can be met.

Paragraph	Description
3.3.1	Resistance to damage
5.1.1	Solar degradation
5.2.1	Thermal degradation

4.2 Deviations to Commercial IPC

Not applicable.

TABLE I

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 1 of 7

APPLICATION

A - APPLICABLE TO SYSTEMS INDICATED
I - APPLICABLE TO SYSTEM AND BUILDING
NA - NOT APPLICABLE

TYPE SYSTEMS

H - HEATING
HC - HEATING AND COOLING
HW - HOT WATER ONLY

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

TABLE I (CONTINUED)

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 2 of 7

APPLICATION

A - APPLICABLE TO SYSTEMS INDICATED
I - APPLICABLE TO SYSTEM AND BUILDING
NA - NOT APPLICABLE

TYPE SYSTEMS

H - HEATING
HC - HEATING AND COOLING
HW - HOT WATER ONLY

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

TABLE I (CONTINUED)

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 3 of 7

APPLICATION

A - APPLICABLE TO SYSTEMS INDICATED
I - APPLICABLE TO SYSTEM AND BUILDING
NA - NOT APPLICABLE

TYPE SYSTEMS

H - HEATING
HC - HEATING AND COOLING
HW - HOT WATER ONLY

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H	RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H
2.8 Excessive Pressure and Temperature Protection	A	3.5.1 Design Provisions	I
2.8.1 Relief Valves and Vents	A	3.6 Creep and Residual Deflection	I
3.1 Structural Design Basis	A	3.6.1 Deflection Limitations	I
3.1.1 Applicable Standards	A	3.7 Hail Resistance	A
3.1.2 Service Loads	A	3.7.1 Hail Size and Loading	A
3.2 Failure Loads and Load Capacity	A	3.8 Constraint Loads	A
3.2.1 Ultimate Load Combinations	A	3.8.1 Foundation Settlement	A
3.2.2 Ice Loads	A	3.8.2 Constrain Loads	A
3.2.3 Vehicular Loads	I	3.9 Ponding Condition	A
3.2.4 Load Capacity	A	3.9.1 Design Provisions	A
3.3 Damage Control	A	4.1 Plumbing and Electrical Installation	A
3.3.1 Resistance to Damage	A	4.1.1 Plumbing Codes	A
3.3.2 Glazing Design	A	4.1.2 Electrical Codes	A
3.4 Cyclic Loads	A	4.2 Fail-Safe Controls	A
3.4.1 Deflection Limitations	A	4.2.1 System Failure Prevention	A
3.5 Cutting of Structural Elements	I	4.2.2 Automatic Pressure Relief Valves	A

TABLE I (CONTINUED)

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 4 of 7

APPLICATION

A - APPLICABLE TO SYSTEMS INDICATED
I - APPLICABLE TO SYSTEM AND BUILDING
NA - NOT APPLICABLE

TYPE SYSTEMS

H - HEATING
HC - HEATING AND COOLING
HW - HOT WATER ONLY

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H	RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H
4.3 Fire Safety	A	4.7 Excessive Surface Temperatures	A
4.3.1 Applicable Fire Standards	A	4.7.1 Protection from Heated Components	A
4.3.2 Penetrations through Fire Rated Assemblies	I	5.1 Effects of External Environment	A
4.4 Toxic	A	5.1.1 Solar Degradation	A
4.4.1 Provisions of Catch Basins	A	5.1.2 Soil Corrosion	A
4.4.2 Detection of Toxic and Flammable Fluids	A	5.1.3 Airborne Pollutants	A
4.5 Safety	I	5.1.4 Dirt Retention on Cover Plate Surface	A
4.5.1 Emergency Egress and Access	I	5.1.5 Abrasive Wear	A
4.5.2 Identification and Location of Controls	A	5.1.6 Fluttering by Wind	A
4.6 Protection and Potable Water and Circulated Air	A	5.2 Temperature and Pressure Resistance	A
4.6.1 Contamination by Materials	A	5.2.1 Thermal Degradation	A
4.6.2 Separation of Circulation Loops	A	5.2.2 Deterioration of Heat Transfer Fluids	A
4.6.3 Backflow Prevention	A	5.2.3 Thermal Cycling Stresses	A
4.6.4 Growth of Fungi	A	5.2.4 Leakage	A
		5.2.5 Deterioration of Gaskets and Sealants	A

TABLE I (CONTINUED)

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 5 of 7

APPLICATION

A - APPLICABLE TO SYSTEMS INDICATED
I - APPLICABLE TO SYSTEM AND BUILDING
NA - NOT APPLICABLE

TYPE SYSTEMS

H - HEATING
HC - HEATING AND COOLING
HW - HOT WATER ONLY

RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H	RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H
5.2.6 Transmission Losses Due to Outgassing	A	6.1.5 Filters	A
5.3 Chemical and Compatibility of Components	A	6.1.6 Potable Water Shutoff	A
5.3.1 Materials/Transfer Fluid Compatibility	A	6.2 Installation, Operation and Maintenance Manual	A
5.3.2 Corrosion of Dissimilar Materials	A	6.2.1 Installation Instructions	A
5.3.3 Corrosion by Leachable Substnace	A	6.2.2 Maintenance and Operation Instructions	A
5.3.4 Effects of Decomposition Products	A	6.2.3 Maintenance Plan	A
5.4 Components Involving Moving Parts	A	6.2.4 Replacement Parts	A
5.4.1 Wear and Fatigue	A	6.3 Repair and Service Personnel	A
6.1 Accessibility for Maintenance	A	6.3.1 Maintenance of H and HC Systems	A
6.1.1 Access for System Maintenance	A	6.3.2 Maintenance of DHW System	A
6.1.2 Access for System Monitoring	A	7.1 Design	I
6.1.3 Draining and Filling of Liquids	A	7.1.1 Dwelling Design	I
6.1.4 Flushing of Liquids Subsystems	A	7.1.2 Mobile Home Design	I
		7.1.3 Site Design	I
		7.1.4 Passive Use of Solar Energy	I

TABLE I (CONTINUED)

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 6 of 7

APPLICATION

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TYPE SYSTEMS

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RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H	RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H
7.2 Adequate Space	I	8.3 Mechanical and Electrical Functioning of Connections	I
7.2.1 Collector Area	I		
7.2.2 Storage Area	I	8.3.1 Plumbing Connections	I
7.2.3 Utility Chases	I		
7.3 Functioning of Dwelling Site	I	8.3.2 Electrical Connections	I
7.3.1 Space Use	I	9.1 Structures Integrity	I
7.3.2 Shading of Adjacent Structures	I	9.1.1 Movement in Adjacent Structures	I
7.3.3 Impact on Environment	I	9.2 Structural Integrity of Dwelling	I
7.3.4 View	I		
8.1 Interference with Mechanical Operation	I	9.2.1 Loads	I
		9.2.2 Penetration of Structural Members	I
8.1.1 Blockage of Solar Subsystem	I		
		9.3 Structural Connections	I
8.1.2 Shading of Collector	I		
8.1.3 Sensor Location	I	9.3.1 Structural Connections	I
8.2 Mechanical and Electrical Functioning of Dwelling Site	I	9.3.2 Brittle Subsystem	I
8.2.1 Exhaust and Venting	I	9.3.3 Strength and Stiffness	I
8.2.2 Utilities	I	10.1 Safety of Dwelling and Site	I

TABLE I (CONTINUED)

RESIDENTIAL SYSTEMS, INTERIM PERFORMANCE CRITERIA SUMMARY

Sheet 7 of 7

APPLICATION

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RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H	RESIDENTIAL INTERIM PERFORMANCE CRITERIA PARAGRAPH	TYPE SYSTEM H
10.1.1 Fire	I	12.2.1 Accessibility	I
10.1.2 Accidents	I	12.2.2 Ice Dams	I
11.1 Durability	I	12.3 Connections	I
11.1.1 Vegetation	I	12.3.1 Accessibility	I
11.2 Durability and Reliability of Dwelling and Site	I	13.1 Visual Characteristics of Dwelling and Site	I
11.2.1 Chemical Corrosion	A	13.1.1 Dwelling	I
11.2.2 Heat and Moisture	I	13.1.2 Neighborhood	I
11.2.3 Exterior Penetrations	I		
11.3 Durability and Reliability of Connections	A		
11.3.1 Material Compatibility	A		
12.1 Maintainability of H, HC, HW Systems	I		
12.1.1 Accessibility	I		
12.1.2 Misuse	I		
12.1.3 Permanent Maintenance Accessories	I		
12.2 Maintainability of Dwelling and Site	I		

5.0 GOVERNMENT FURNISHED PROPERTY

The following items shall be provided by the government:

(1) Collector subsystem: SOLARON 2001 Air Collectors and Installation Hardware

(2) Control subsystem: Solar Control Corp., Model 77-171, Controllers

6.0 GOVERNMENT DIRECTED REQUIREMENTS

The following requirements are specified in NAS8-32036 and by verbal direction from the contract officer:

(a) IBM shall deliver one system for the following application:

- o Single Family Residence
- o Solar Space Heating and Domestic Hot Water
- o Direct Air System (Air Collector)
- o Forced Air (Central) Heating Auxiliary

(b) All hardware and subsystems, except collectors and controllers, shall be purchased by IBM to good commercial practices as off-the-shelf hardware.

(c) The solar hardware, including collector subsystem, storage subsystem, air transport system, DHW preheat tank, and control subsystem shall be assembled together to form a complete stand-alone remote solar assembly.

(d) The remote solar assembly shall be a modular design such that collector and pebble bed size can be varied.

(e) The system including the remote solar assembly shall be sized and fabricated for a small single family dwelling in the Jackson, Mississippi area such that a solar capability of approximately 50% can be achieved for the combined heating and hot water load.

7.0 GEOGRAPHICAL AREA

This heating and hot water system is designed for a single family residence located in the United States. Areas of application include all regions of the U. S. except the extreme north, and regions with low heating degree days, such as Southern California and Florida. The Remote Solar Assembly, 7934940-2, that will be delivered is intended for the Jackson, Mississippi area. The Remote Solar Assemblies 7934940-1 and 7934940-2 are documented and permit a modular size variation for solar heating capability. These three assemblies contain 135, 203 and 271 square feet of collector area. Although a larger size is not documented, 339 and 407 square feet collector sizes could be obtained by selecting additional structure and storage modules without changing duct or blower sizes.

Appendix A1
Performance Specification for Clinton, Mississippi

A1-0 SYSTEM IDENTIFICATION

This appendix defines the system performance prediction for SIMS Prototype Heating and Hot Water System, Model Number 4, as installed at the designated site in Clinton, Mississippi. The design daily average horizontal insolation (typical winter mean) is 1140 BTU/ft^2 and the typical annual heating degree day (^{0}F winter mean) is 2300. The system solar hardware configuration for this site is defined by assembly drawing 7934940-2. Two hot water tanks each with a 30 gallon volume and each containing 4.5 kilowatt heater elements will be contained in the hot water system. Auxiliary space heat will be provided by a 15 kilowatt duct heater.

A1-1 SYSTEM PERFORMANCE SHEETS

Space Heating Capacity

The system will provide solar energy for 35 percent of the total space heating load during the heating season based on an average annual heating load of 30.69 MM BTU and a peak space heating load of 30,600 BTU/Hr.

Cooling Capacity

The system will provide solar energy for N/A percent of the average total cooling during the cooling season, based on an average total cooling load of N/A BTU/month and a peak cooling load of N/A BTU/Hr.

Auxiliary Energy

The average annual rate of auxiliary energy supplied to the heating and hot water load shall be no greater than 30.89 MM BTU. This shall be no greater than 51.8 percent of the total energy required for heating and hot water. The average rate of auxiliary energy used for cooling during the cooling season shall be no greater than N/A BTU/Month. This shall be no greater than N/A percent of the total energy required for cooling.

Hot Water

One hundred gallons of potable (or usable) hot water shall be delivered at no less than 1.7 gal/min at temperature no less than 140°F. Recovery time shall be no greater than 1.5 hours. The average hot water heating load will be 2.41 MM BTU/Month of which 37 percent is provided by auxiliary energy.

Operating Requirements

The maximum electrical energy required to drive the solar portion of the system at its rated capacity shall be no greater than 0.6 K.W. The maximum electrical energy required to drive the complete system shall be no greater than 25.5 K.W. The average yearly electrical energy required to drive the system shall be no greater than 10,720 K.W.H. Water requirements for cooling condensers and/or air humidification shall be no greater than N/A gal/hr.

A1-2 Physical Data

The following subsystems shall have:

	Design life no less than	Weight (filled) no greater than	Installation dimensions
Heating	20 years	N/A lbs	N/A
Cooling	N/A years	N/A lbs	N/A
Auxiliary Energy	20 years	75 lbs	Note 1
Storage	20 years	11,000 lbs	Note 2
Potable Water	10 years	1600 lbs	Note 1 & 2
Collector	20 years	2000 lbs	Note 2
Energy Transport	20 years	900 lbs	Note 1 & 2
Controls	20 years	40 lbs	Note 1 & 2

Note 1: See Installation Drawings

Note 2: See Remote Solar Assembly Drawing 7934940

System Documentation

System 4 design is documented in the following documents:

Title	Reference No.
Design Description Drawing	7934983
Remote Solar Assembly Drawing	7934940
Design Data Brochure	DOE/NASA CR-150759

REVISIONS					
CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVED

DWG NO.

Date: 13 May 1977

CDRL Item Numbers - 2a
- 13

Revised: 22 February 1978

Revised: 8 July 1978

CONTR NO. NAS8-32036	INTERNATIONAL BUSINESS MACHINES CORP. FEDERAL SYSTEMS DIVISION HUNTSVILLE, ALA. 35807	
PREPARATION J. G. Daniel 5/19/77	TITLE	Verification Plan/Procedure for Prototype Solar Energy Heating and Hot Water System Model No. 4
DSGN CHK		
DWG CHK		
DSGN APPROVAL 5-19-77	SIZE A / CODE IDENT NO. / DWG NO. 7933648	
	SCALE / WT	SHEET 1 of 25

7933648

1. PURPOSE

1.1 The purpose of this document is to present the plan/procedure for verifying the requirements of Performance Specification for prototype solar energy heating and hot water system model No. 4.

2. SCOPE

2.1 This document describes the plan/procedure for performing prototype systems verification and includes development, qualification, and acceptance verification. Requirements for analysis verification and/or test verification are included in this plan/procedure.

3. APPLICABLE DOCUMENTS

3.1 The following documents form a part of this plan to the extent specified herein:

- Interim Performance Criteria for Solar Heating and Combined Heating/ Cooling Systems and Dwellings, HUD - January 1, 1975
- Performance Specification for Prototype Heating and Hot Water System Model No. 4.
- System 4 Design Description Drawing

4. VERIFICATION APPROACH

4.1 Prototype system verification to the requirements of the system performance specification and interim performance criteria will be accomplished in three verification categories - development, qualification, and acceptance. The verification methods utilized for system verification will be similarity, analysis, inspection, demonstration and test as required.

Prototype system verification will commence with a detailed analysis of all system hardware, components, and subsystems and progress through system evaluation and testing. Figure I of this plan depicts a summary flow for system verification.

A detailed system test procedure for performing the test requirments of this document will be prepared. This procedure will describe the methods and procedures for conducting prototype system test on the MSFC system test breadboard facility.

Following completion of verification program, final system verification documentation will be prepared and submitted to MSFC. This will contain all information pertinent to system verification.

5. DEVELOPMENT VERIFICATION REQUIREMENTS

5.1 Hardware/Component/Subsystem Verification - All hardware, components and subsystems that comprise the prototype system shall be verified to be in accordance with the requirements of the prototype system performance specification and the interim performance criteria. Verification of hardware, components, and subsystems will be accomplished by engineering analysis, similarity, inspection, demonstration and/or testing methods.

Subsystem test evaluation will be conducted on the system collectors. All other prototype system subsystems, hardware and components will be verified individually by analysis and/or during prototype system verification.

5.2 System Development Verification - Development verification will be conducted on prototype system M/N 4 to ensure that system will perform to the requirements of the system performance specification and interim performance criteria. Development verification will consist of the following:

- Analysis of hardware, component, and subsystem evaluation data for compliance to system performance specification and interim performance criteria requirements.
- Analysis of system design for compliance to system performance specification and interim performance criteria requirements.

- System testing on MSFC System Test Breadboard Facility. Tests to be conducted are as follows:

  - System operational functional test

  - System capacity for control, energy collection, storage, and distribution to load at outside ambient weather conditions and with simulated load conditions.

5.2.1 System Operational Functional Test - System operational functional testing shall be performed on prototype system M/N4 to verify proper operation of the system.

5.2.1.1 System Checkout and Adjustment: Prior to beginning verification testing, the system shall be checked out to insure that wiring is assembled correctly and controls will work as required per System 4 Design Description Drawing 7934983.

Blower speed and balancing damper adjustments shall be made to obtain air flow in accordance with System 4 Design Description Drawing, 7934983.

Limit switches operating ranges and dead band shall be adjusted in accordance with System 4 Design Description Drawing, 7934983.

5.2.1.2 Collector Loop Control Evaluation - The performance of the collector loop controls shall be evaluated during available solar radiation periods.

Collector Loop Blower On-Off Control - The performance of the collector thermoswitch shall be evaluated by continuously monitoring (1) collector absorber temperature near the switch and (2) air outlet temperature from collector in which the switch is located. A plot of absorber and air temperature versus time shall be generated to evaluate control at start-up and shut-down. The thermoswitch opening and closing event times shall also be marked on these plots.

Storage Temperature High Limit Control - The temperature of storage at the location of the Storage Temperature High Limit Switch (bottom of storage) shall be monitored to establish a reference. The temperature at which the collector loop blower is interrupted and then initiated by the Storage Temperature High Limit Switch shall be measured and recorded.

Preheat Tank High Limit Switch - The temperature of water in the top of the preheat tank shall be monitored to establish a reference. The temperature at which the collector blower operation is terminated and then initiated by the Preheat Tank High Limit Switch shall be measured and recorded.

5.2.1.3 Load Loop Control Evaluation - The performance of the load loop control shall be evaluated during available solar radiation periods. The demand for heat shall be introduced by applying 24 VAC to the Load Loop Blower Relay coil and Storage Temperature to Limit Switch in series.

Storage Temperature Lo Limit Control - The temperature of storage at the location of the Storage Temperature Lo Limit Switch (top of storage) shall be monitored to establish a reference. The temperature at which the first stage Room Thermostat Control would be interrupted and then initiated by the Storage Temperature to Limit Switch shall be measured and recorded.

Freeze Protection Bleeder Valve - Water at 34°F from the thermal simulator shall be introduced into the thermosyphon loop at the tee at the outlet of the preheat tank. The temperature measurement normally, at this point, shall be temporarily removed so that the cold water can be introduced into the line. Water shall be caused to drain at 2 gpm through the heat exchanger by drawing water from the line that goes to the domestic hot water tank. As the water temperature begins to drop in the heat exchanger, the flow rate from the bleed line (pressure drain) and water pressure in the water system shall be measured and recorded. A plot of flow rate in gpm versus temperature of the heat exchanger shall be generated. An alternate approach to this test is to perform a component test. The heat exchanger and thermal bleeder valve shall be set up on a bench and insulated in a similar manner to a System 4 installation.

5.2.2 System Operational Functional Test Procedure - Test procedures for conducting system operational function tests will be prepared. These procedures will describe the detailed test methods, instrumentation and all other procedural information pertinent to system operational functional testing.

5.2.3 System Verification Tests - System performance shall be evaluated during available solar radiation periods. Domestic water supply to preheat tank shall be at normal tap water supply temperatures; however, the temperature of water from beginning to end of draw shall be as uniform as possible. Temperature, flow and insolation measurements shall be made at 2-minute intervals throughout the tests. Test measurements shall be as described in Appendix B.

5.2.3.1 Domestic Hot Water Heating - The performance of the domestic hot water heating system shall be evaluated during good solar insolation days. The thermal loads shall consist of draining hot water and replacing with tap water as follows:

Load A - 52 gallons just prior to collector blower turn on.
Load B - 12 gallons at 10 AM, 12 Noon, 2 PM and 3 PM.
Load C - 10 gallons at 10 AM, 10 gallons at 12 Noon,
20 gallons at 2 PM and 20 gallons at 3:30 PM.

The above loads shall be run starting early in a solar day with collector turn-on with a depleted rock storage, i.e., storage pumped down to a uniform 70°F temperatures throughout the rock bin. The loads shall also be run starting with rock storage saturated, i.e., bottom of storage at 95°F. The high limit switch shall be jumpered to maintain collector blower operation in the saturated condition.

5.2.3.2 System Loads - Heat shall be collected during good solar days. Heating load shall be applied by controlling the air temperature of the air input to the return air duct of the Remote Solar Assembly and dumping hot air from storage and air from the collector depending on the mode of operation. Temperature, flow and insolation measurements shall be made at 2-minute intervals throughout the solar days. Loads shall be applied to the system as follows:

5.2.3.2.1 No Load Storage - The rock bin shall be depleted of heat by drawing air through the bin at 70°F from a load simulator until stabilized. The test shall then be started at the beginning of a good solar day with collector turn-on. Heat shall be collected without load except losses, until the rock bin is saturated, i.e., bottom of storage is at 95°F.

5.2.3.2.2 Storage Pump-Down - The rock bin shall be saturated by supplying heat until storage is saturated. The test shall then begin by circulating 70°F air from the load simulator to the cold air return ducts of the Remote Solar Assembly and dumping heat from the hot air supply ducts of the Remote Solar Assemlby until storage is stabilized at 70°F.

5.2.3.2.3 Modulated Load - The rock bin shall be depleted of heat by drawing air through the bin at 70°F from a load simulator until stabilized. The test shall then be started at the beginning of a good solar day with collector turn-on. Simultaneously, the load loop blower shall be turned on at 30-minute intervals and allowed to run for 20 minutes, i.e., on for 20 minutes, off for 10 minutes. Air shall be supplied to the cold air return duct of the Remote Simulator Assembly at 70°F from the load simulator and hot air shall be dumped out the hot air supply duct of the Remote Solar Simulator.

5.2.3.3 Data Requirements

Domestic Hot Water Heating Tests - The following measurements shall be recorded at the most frequent time interval capability of the test facility for subsequent review and processing.

Preheat tank - water inlet and outlet temperature (°F)
Heat exchanger - water inlet and outlet temperature (°F)
Heat exchanger - air upstream and downstream temperatures (°F)
Heat exchanger - air flow (SCFM)

This data shall be processed and integrated to obtain the heat stored in the preheat tank and the heat lost with the drained water, i.e., $\int m C_p \Delta T dt$ Btu/day (or test run duration).

Other measurements defined in Appendix B for the preheat tank/thermosyphon loop shall be recorded at start of test runs, before and after water loading (water draws), at start of test runs and prior to completion of test runs to provide information on preheat tank stratification, limit switch performance and quantity of heat removal from preheat tank. Thermal/elevation plots shall be prepared showing the temperature vs. elevation location in the thermosyphon loop (including preheat tank).

Incident Radiation - The pyronometer, total radiation measurement, in the tilt plane of the collectors shall be recorded at the most frequent time interval capability of the test facility for subsequent review and processing. This data shall be integrated to obtain the available average daily insolation. i.e., $\int I\, dt$ Btu/day (or test run duration).

System Loads - The following measurements shall be recorded at the most frequent time interval capability of the test facility for subsequent review and processing.

Rock bed storage - air inlet and outlet temperatures (^{o}F)

Rock bed storage - air flow to storage (collector loop flow minus load loop flow) (SCFM)

Collector - air inlet and outlet temperatures (^{o}F)

Collector - air flow in collector loop (SCFM)

Load - air to load and from load temperatures (^{o}F)

Load - air flow to load (SCFM)

This data shall be processed and integrated to determine the heat obtained from the collectors heat stored in the rock bed and heat delivered to load, i.e., $\int \dot{m}\, C_p\, \Delta T\, dt$ Btu/day (or test run duration).

Other measurements defined in Appendix B for the collector, rock bed storage and load loop supply shall be recorded at start of test runs, hourly throughout test runs and at completion of test runs to provide information on collector absorber surface, blower control and limit switch operation. Temperature/distance plots shall be prepared showing the temperature vs. distance relationship in the rock storage bed.

Blower power and air pressure measurements shall be made and recorded after the system specified flow rates are established.

5.3 System Development Verification Test Procedures - Test procedures for conducting prototype system verification testing will be prepared. These procedures will describe the hardware configuration for testing, detailed test methods and procedures, sketches of test setup, test time, limits, data and report requirements, and all other procedural information pertinent to test evaluation program.

5.4 System Design Changes During Development Verification - Any design changes occurring during development verification will be verified by engineering analysis or test evaluation. Ample data will be provided for each design change to verify that the resultant change meets performance criteria requirements and that the resultant change has no adverse effects on the total system performance.

5.5 Development Verification Data - Test data accumulated during the early stages of development testing will be thoroughly evaluated and assessments will be performed on necessary system design changes. This will assure early design maturity of prototype system M/N 4.

5.6 Development Verification Extent/Level - Development verification program will be conducted to the extent necessary to verify that the final prototype system design meets or exceeds the requirements of the system performance specification and the interim performance criteria or that any requirement which has not been met has been properly dispositioned and MSFC approved by a deviation approval request. Any such deviation from the specified requirements will be documented in the final verification documentation and will become a part of the prototype system performance specification.

5.7 Additional Development Testing - Additional testing and evaluations other than those specified herein may be accomplished. Additional testing and evaluations will be coordinated with MSFC SIMS contracting officer or his designated representative. Additional testing and evaluation will be properly controlled, documented and reported.

6. QUALIFICATION VERIFICATION REQUIREMENTS/PROCEDURE

6.1 Qualification Verification Requirements - Requirements for qualification verification are as follows:

Verification that the prototype system meets or exceeds the requirements of system performance specification. These requirements are:

Interim Performance Criteria Requirements
Government Directed Requirements
System Identification Requirement
Site Identification Requirement
System Heating Capacity Requirement
Auxiliary Energy Requirement
Hot Water Requirement
Operating Requirements
System Physical Requirements (Design Life, Weight, Dimensions)

6.2 Qualification Verification Procedures - Procedures for verification of each qualification verification requirement are contained in the following subparagraphs.

6.2.1 Interim Performance Criteria Requirement - An analysis will be conducted on prototype system M/N 4 to satisfy this requirement. Each interim performance criteria requirement will be analyzed individually and recorded on an interim performance criteria certification form. This form will indicate compliance or noncompliance to the requirement and will identify the evaluation method utilized to satisfy the requirement. A sample copy of the interim performance criteria certification form is contained in Appendix I of this document. The certification form when completed will become a part of the final verification report.

6.2.2 Government Directed Requirements - This requirement will be satisfied by an analysis of the directed requirement, prototype system and the system performance specification to verify that the directed requirements have been satisfied.

6.2.3 System Identification Requirement - This requirement will be satisfied by review of performance specification and the prototype system to verify that the system is properly identified (type, contractor name, system model no.).

6.2.4 Site Identification Requirement - This requirement will be satisfied by review of performance specification to verify that the site for the prototype system is properly identified and described.

6.2.5 System Heating Capacity Requirement - This requirement will be satisfied by an analysis of the prototype system design and the climate conditions anticipated for the selected site at which the prototype system will be located. Test data obtained during system development testing will be utilized to verify the design models for the prototype system.

6.2.6 Auxiliary Energy Requirement - This requirement will be satisfied by an analysis of the prototype system load requirements and the prototype system auxiliary energy subsystem design.

6.2.7 Hot Water Requirement - This requirement will be satisfied by an analysis of the prototype system design and the hot water load requirements specified for the prototype system. Test data obtained during system development testing will be utilized to verify the design models for the hot water subsystem.

6.2.8 Operating Requirements - This requirement will be satisfied by an analysis of the prototype system design and the system operating requirements (maximum power to drive system, average yearly electrical power, water requirements). Test data obtained during system development testing will be utilized to verify the design models for the prototype system.

6.2.9 System Physical Requirements - This requirement will be satisfied by an analysis of the prototype system design and the system physical requirements (design life, weight, dimensions).

6.3 Prototype System Qualification

6.3.1 Qualification verification will consist of an analysis of all changes implemented during development verification. All test, analysis, and evaluation data originating during development verification will be evaluated to the requirements of the prototype system performance specification and interim performance criteria.

6.3.2 The prototype system will be considered qualification verified when it is determined that the final system design and hardware has met or exceeded the requirements of the system performance specification and the interim performance criteria or that any requirement which has not been met has been properly dispositioned and MSFC approved by a deviation approval request.

6.3.3 The results of qualification verification will be documented and submitted to MSFC.

7. ACCEPTANCE VERIFICATION REQUIREMENTS/PROCEDURE

7.1 Acceptance verification will be conducted on prototype system M/N 4 to verify that the system meets all specified requirements. Acceptance verification will consist of the following.

- Inspection of system to verify performance specification and workmanship standards
- Inspection of operational test data and evaluations to verify system performance
- Inspection of acceptance data package
- Inspection of shipping list versus hardware to be delivered
- Inspection of shipping instructions and precautions
- Inspection of documentation required for system (installation, operation, maintenance requirements, system drawings and specifications, etc., in accordance with prototype system performance specification and data package requirements).

7.2 The results of acceptance verification will be documented and submitted to MSFC.

8. PROTOTYPE SYSTEM VERIFICATION HARDWARE DISPOSITION

Following the completion of prototype system development, qualification and acceptance verification program, the system hardware shall be removed from the MSFC breadboard facility. The assembled system, including all contained subsystems shall be available for shipment to a designated demonstration site.

Miscellaneous hardware used during system test will be retained at the MSFC breadboard facility for possible future utilization.

9. PROTOTYPE SYSTEM VERIFICATION DOCUMENTATION

9.1 Prototype System Test Procedure - Prototype system test procedure for prototype system M/N 4 will be generated utilizing the requirements of this document, prototype system performance specification, and drawings. Test procedure will be prepared prior to the start of system verification testing. Test procedure shall contain at a minimum the following information.

(a) Identification of hardware/system to be verified (model number, serial number, manufacturer, size, description, etc.)

(b) Test requirements

(c) Development verification test methods/procedures

(d) Instrumentation and data requirements

(e) Location of tests to be conducted

(f) Test limits and tolerances

(g) Test equipment to be utilized

(h) Detailed test setup and system configuration sketches

(i) Test reporting procedures

7933648

9.2 Verification Documentation - Final prototype system verification documentation will be generated following completion of system verification and submitted to MSFC. The verification documentation shall consist of the following:

(a) Performance Test Report

(b) Verification Status Summary

(c) Design Data Brochure

9.2.1 Performance Test Report - Performance Test Report shall contain the following as a minimum:

(a) System identification and description

(b) Test objectives

(c) Test description and procedure

(d) Subsystem test results

(e) System test results

(f) Analysis of test data

(g) System performance

(h) Discussion of special tests

(i) Significant observations and conclusions

9.2.2 Verification Status Summary - Verification Status Summary shall contain the following as a minimum:

(a) Verification requirements

(b) Results of system interim performance criteria analysis and certification

(c) Performance specification verification analysis

(d) Acceptance verification analysis

(e) Performance analysis summary

9.2.3 Design Data Brochure - Design Data Brochure shall contain the following verification documentation as a minimum:

(a) System configuration description

(b) System functional description

(c) Identification of system components

(d) Operating instructions

(e) Maintenance requirements

(f) Installation requirements

10. VERIFICATION MATRIX

Cross reference matrix for prototype system M/N 4 verification is contained in page no. 78 of this document. This matrix is applicable to system selected for physical testing.

PROTOTYPE SYSTEM MODEL 4 VERIFICATION
APPROACH/FLOW

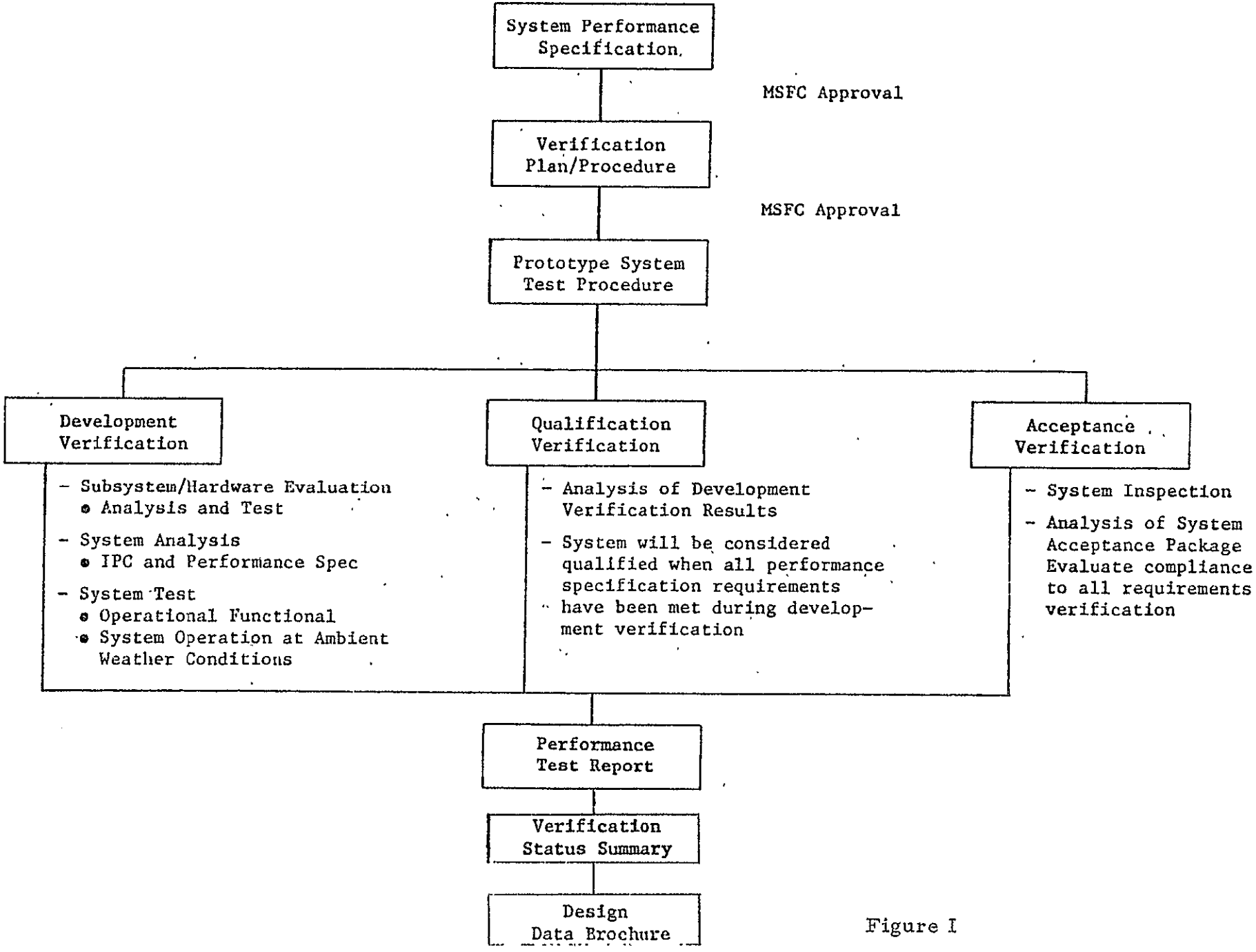


Figure I

VERIFICATION CROSS REFERENCE MATRIX

ENGINEERING SPECIFICATION

CODE 20234

ITEM (Name & Part No.)	VERIFICATION CROSS REFERENCE MATRIX
Prototype System M/N 4	

VERIFICATION METHOD: 1. Similarity 2. Analysis 3. Inspection 4. Test N/N Not Applicable

PERFORMANCE SPECIFICATION REQUIREMENT	VERIFICATION PHASE			REMARKS
	Development	Qualification	Acceptance	
Interim Performance Criteria	2	2		
Government Directed Requirements	2, 3	2, 3	3	
System Identification Requirements	2, 3	2, 3	3	
Site Identification Requirement			3	
System Heating Requirement	2, 4	2		
Auxiliary Energy Requirement	2, 4	2		
Hot Water Requirement	2, 4	2		
Operating Requirements	2, 4	2		
System Physical Requirements	2	2	3	

APPENDIX B

SYSTEM 4 VERIFICATION TEST MEASUREMENTS

System 4 Verification Test Measurements

Temperature and flow measurements shall be made as follows:

Preheat Subsystem

Measurements shall be made in the preheat subsystem as follows:

(1) Five preheat tank surface temperature measurements shall be made along a longitudinal line where accessibility can be gained. One of these five measurements shall be as high on the tank as possible (top). One measurement shall be as low on the tank as possible (bottom). One measurement shall be at the center of the tank. One measurement shall be on the tank midway between the top and center measurements. One measurement shall be on the tank midway between the bottom and center measurements.

(2) One inlet and one outlet preheat tank water temperature shall be installed in the thermosyphon loop through one leg of a tee in the water lines. Sensors shall not protrude into the thermosyphon loop water flow path so as to restrict the flow. The tee shall be 3/4 inch female national pipe thread.

(3) One inlet and one outlet heat exchanger water temperature measurements shall be installed through one leg of a tee in the water lines. Sensors shall not protrude into the thermosyphon loop water flow path so as to restrict the flow. The tee shall be 3/4 inch female national pipe thread.

(4) A water temperature probe shall be installed into each of the two heating element probe openings on the preheat tank. The heating elements shall be permanently removed and replaced by adapters to facilitate mounting the temperature sensors. The temperatures probes shall sense the temperature near the center of the tank.

(5) One inlet and one outlet preheat tank water temperature measurement shall be installed in the water supply loop through one leg of a tee in the water lines. The tee shall be 3/4 inch female national pipe thread.

(6) One water supply flow measurements shall be installed in the preheat water supply line. Measurement shall be installed close to the supply line entrance to the Remote Solar Assembly wall.

Collectors

Inlet and outlet temperature measurements shall be installed in the ducts. One sensor shall be in each of the two manifold ducts that enter and leave the collectors. One collector has five temperature sensors on its absorber. These measurements shall be monitored. The measurements are platinum resistance temperature sensors and they are located as follows:

(1) No. 1 at geometric center.
(2) No. 2 and 3 along longitudinal axis 2/3 the way out from the geometric center toward the edge of the collector.
(3) No. 4 and 5 along the transverse axis 2/3 the way out from the geometric center toward the edge of the collector.

A flow measurement shall be located in each of the two ducts that lead to the inlets to the collectors. One flow measurement shall be located in the duct that leads to collector between the tee in the duct and the blower.

Rock Storage

The rock storage bin shall be evaluated for channeling by measuring the temperatures at 8 points in each of three parallel planes as shown in Figure 1. The planes shall be established 4 inches down from the top rock surface, at center and 4 inches up from the bottom rock surface. Air inlet and outlet temperature measurements shall also be installed. One temperature measurement shall be at the inlet and one measurement shall be at each of the two outlets. A flow measurement shall be installed in each of the two outlet ducts leaving storage.

Other Measurements

Ambient air temperature measurement shall be made to monitor the ambient air environment around the Remote Solar Assembly.

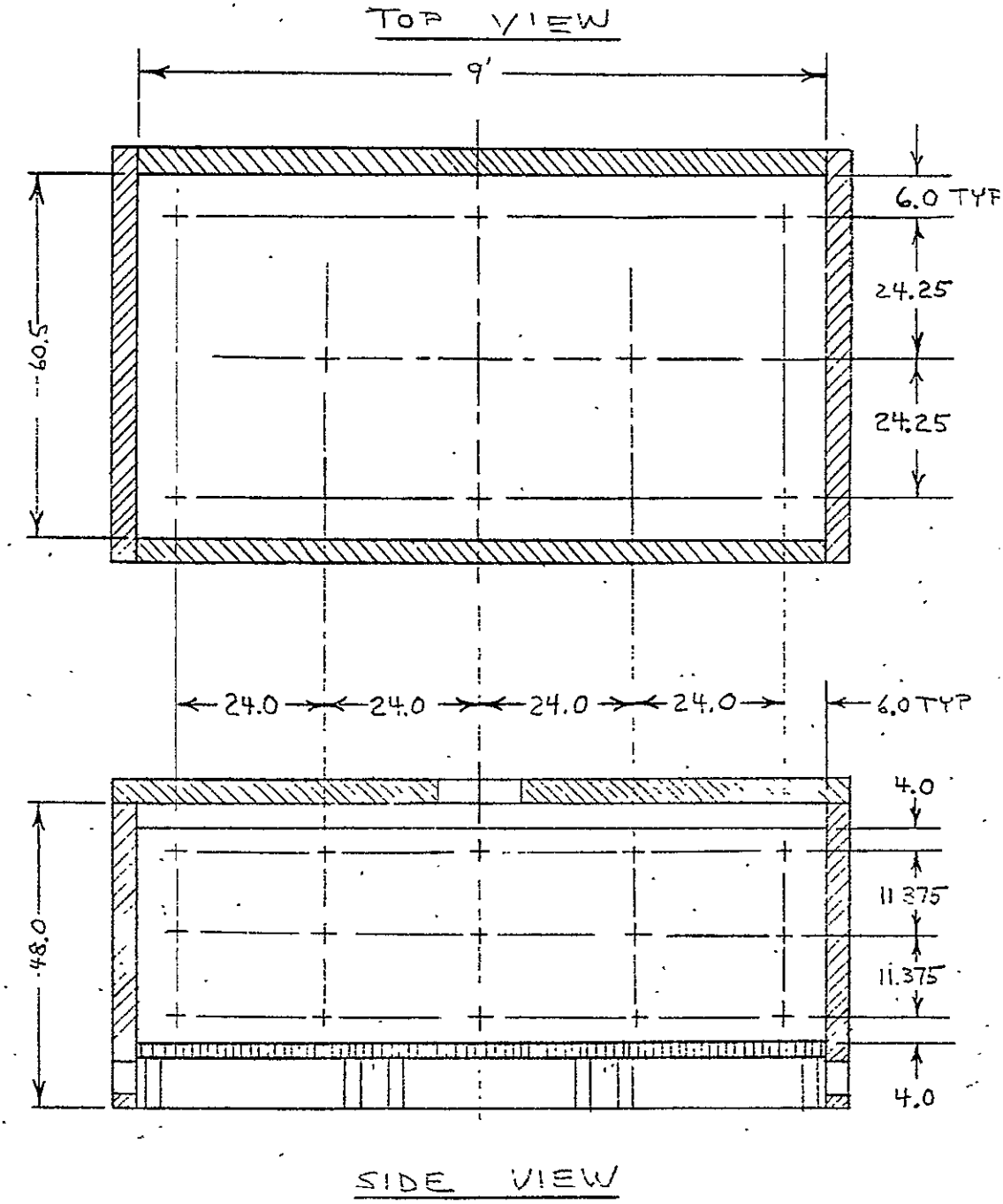
Total incident radiant energy shall be measured in the tilt plane of the collectors. Blower and control damper motor power shall be measured.

Pressure measurements shall be made around the collector and load air flow loops to determine the pressure differential delivered by the blowers and the pressure drops developed along duct runs and acorss dampers and storage.

System 4 Verification Test Measurements Summary

	Temperature	Flow	Insolation	Pressure	Drop
Collector					
Air inlet	2	2	-	1	-
Air outlet	2	1	-	1	-
Absorber Surface	5	-	-	-	-
Insolation	-	-	1	-	-
At Collector Thermoswitch	1	-	-	-	-
Storage					
Air inlet	1	-	-	-	-
Air outlet	2	2	-	-	-
Rock Bed	24	-	-	2	-
At Storage High Limit Switch	1	-	-	-	-
At Storage Low Limit Switch	1	-	-	-	-
Preheat Tank					
Thermosyphon Loop					
Preheat Tank Surface	5	-	-	-	-
Water inlet	1	-	-	-	-
Water outlet	1	-	-	-	-
Submerged in Tank (water)	2	-	-	-	-
At Preheat Tank Limit Switch	1	-	-	-	-
Heat exchanger	1	1	-	-	-
Water inlet	1	1	-	-	-
Water outlet	1	-	-	-	-
Air inlet	1	-	-	-	-
Air outlet	1	-	-	-	-
Load Supply Loop					
Inlet	1	1	-	-	-
Outlet	1	-	-	-	-
Ambient Temperature	1	-	-	-	-
Blowers @ rated flow (Δ_p)	-	-	-	2	2
Control Damper motors	-	-	-	-	2
	55	7	1	6	4

ROCK STORAGE BIN



KEY:

+ LOCATION OF PRT

FIGURE 1

CONTRACT NO. NAS8-32036

VERIFICATION STATUS SUMMARY

FOR

SYSTEM NO. 4

PROTOTYPE SOLAR HEATING AND HOT WATER SYSTEM

FIRST ARTICLE REVIEW DATA PACKAGE
REQUIREMENT PARAGRAPH 4.3.3(a)
APPENDIX B

JUNE 9, 1978

PREPARED BY [signature]

APPROVED BY [signature]

1.0 PURPOSE

1.1 The purpose of this document is to present a summary of the verification status for Prototype Solar System No. 4.

2.0 SCOPE

2.1 This document provides a summary of Prototype System No. 4 verification which includes verification of performance specification requirements and acceptance verification requirements. Requirements of the performance specification will be satisfied by analysis and test.

3.0 VERIFICATION REQUIREMENTS

3.1 Performance Specification Requirements

Prototype System No. 4 shall be in accordance with the requirements of Performance Specification (IBM Document No. 7933649). All requirements will be verified by test or analysis. Requirements are as follows:

- Interim Performance Criteria Requirements.
- Government Directed Requirements
- System Identification Requirement
- System Performance Requirement
- System Installation Description Requirement

3.2 Acceptance Verification Requirements

Prototype System No. 4 shall be in accordance with the acceptance verification requirements IBM Document No. 7933648. Requirements are as follows:

- Inspection of system to verify performance specification and workmanship standards.

- Inspection of acceptance data package

  - Shipping and handling instructions
  - Warranty and Test Agency Certification
  - "Final Acceptance" and Shipping Form (DD250) including forms for all ship-separate items

4.0 VERIFICATION SUMMARY

4.1 Narrative Abstract - Prototype System No. 4 was subjected to test and analysis verification to verify the requirements of performance specification No. IBM 7933649. Verification was conducted in accordance with the requirements of IBM Document No. 7933648 (Verification Plan/Procedure for Prototype Solar Energy Hot Water System Model No. 4). Acceptance verification will be conducted during final acceptance of Prototype System Model No. 4.

Prototype System No. 4 meets all requirements of Performance Specification No. 7933649 with the exception of interim performance criteria deviations on the system collectors. Deviations are identified in Appendix I of this document.

Verification of Prototype System No. 4 will be considered completed with MSFC approval of deviation approval request for system collectors and with the successful completion of acceptance verification to be conducted during final system acceptance.

4.2 Verification Results

4.2.1 Performance Specification Verification

4.2.1.1 Interim Performance Criteria - Prototype System No. 4 meets all interim performance criteria requirements with the exception of collectors. Deviations were required for the collectors. A deviation from these requirements is requested by IBM since the subject collectors are Government furnished to IBM. Detailed interim performance criteria evaluation is contained in Appendix I of this document.

4.2.1.2 Government Directed Requirements - These requirements have been satisfied by review of performance specification requirments and system design drawing. System 4 meets requirements.

4.2.1.3 System Identification Requirement - Requirement has been satisfied by identification of system in the performance specification (system type and system model number). System 4 meets requirements.

4.2.1.4 Site Identification Requirement - Requirement has been satisfied by identification of the geographical areas which the design accommodates as listed in the performance specification. System 4 meets requirements.

4.2.1.5 Hot Water Requirement - Requirement has been satisfied by test and analysis of system design. System 4 meets requirements.

4.2.1.6 Operating Requirements - Requirement has been satisfied by test and analysis of system design. System 4 meets requirements.

4.2.1.7 System Physical Requirements - Requirement has been satisfied by analysis of system design. System 4 meets requirements.

4.3 Acceptance Verification Requirements

4.3.1 Inspection of System - This requirement will be satisfied during final acceptance of System 4.

4.3.2 Inspection of Acceptance Data Package - This requirement will be satisfied during final acceptance of System 4.

APPENDIX I

PROTOTYPE SYSTEM NO. 4

INTERIM PERFORMANCE CRITERIA EVALUATION

INTERIM PERFORMANCE CRITERIA
CERTIFICATION

System Type Heating and Hot Water

System Model No. Prototype System 4

System Mfg. IBM

Analysis Conducted by Vivian S. Sinclair

Date June 9, 1978

INTERIM PERFORMANCE CRITERIA EVALUATION INSTRUCTIONS

I. Evaluate system for each IPC requirement listed on IPC Certification Sheets. All requirements are to be in accordance with HUD Interim Performance Criteria for Solar Heating and Combined Heating/Cooling Systems and Dwellings.

II. Check each requirement status

Yes - Meets IPC requirement

No - Does not meet IPC requirement

N/A - Requirement not applicable

III. List IPC requirement evaluation method utilized

Analysis

Test

Inspection

Demonstration

Other

IV. All requirements which are not met shall be defined and recorded on IPC Deviation Report Form attached.

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
Heating and Heating and Cooling System Performance	1.1	X			Analysis	Requires verification for specific site. Cooling portion N/A.
Hot Water System Subsystem Performance	1.2	X			Test & Analysis	
Collector Performance	1.3	X			Test & Analysis	
Thermal Storage	1.4	X			Test & Analysis	
Habitability of Occupied Space	1.5	X			Design Review	
Energy Transport Efficiency	1.6	X			Test & Analysis	
Control	1.7	X			Test & Analysis	
Auxiliary Energy	1.8	X			Analysis	

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
System Design Conditions	2.1	X			Test and Analysis	Condensate removal N/A
Mechanical Stresses	2.2	X			Test and Analysis	
Leakage Prevention	2.3	X			Test	Applicable portions of system will be pressure tested during system installation or during system performance test.
Collector Adjustment	2.4	X			Analysis	Fixed by assembly design.
Subsystem Isolation	2.5			X		Single family dwelling
Heat Transfer Fluid Quality	2.6	X			Design Review	
Piping Supports	2.7	X			Design Review	
Excessive Pressure and Temperature Protection	2.8	X			Design Review	Pressure relief valve installed in DHW preheat tank and in DHW tanks.

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
Structural Design Basis	3.1	X			Design Analysis	
Service Loads	3.1.2	X			Test and Analysis	Collector tested
Failure Loads and Load Capacity	3.2	X			Analysis	
Ultimate Load Combination	3.2.1 3.2.4	X X			Test and Analysis	Collector tested
Damage Control	3.3				Analysis	
Resistance to Damage	3.3.1	X			Test and Analysis	Collector tested
Glazing Design	3.3.2 3.4	X			Design Review	
Cyclic Loads	3.4	X			Design Review	
Cutting of Structural Elements	3.5	X			Design Review	
Creep and Residual Deflection	3.6	X			Design Review	
Hail Resistance	3.7	X			Design Review	
Constraint Loads	3.8	X			Design Review	
Ponding Conditions	3.9	X			Design Review	

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
Plumbing and Electrical Installation	4.1	X			Design Review	
Fail Safe Controls	4.2	X			Design Review	
Fire Safety	4.3	X			Design Review	
Toxic and Flammable Fluids	4.4	X			Design Review	No toxic of flammable fluids used
Safety	4.5	X			Design Review	
Protection of Potable Water and Circulated Air	4.6	X			Design Review	No toxic fluid used
Excessive Surface Temperatures	4.7	X			Design Review	All heated surfaces insulated. No excessive temperatures possible.
Effects of External Environment	5.1		X		Test and Design Analysis	Long term affects on collector not yet available

C-2

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
Temperature and Pressure Resistance	5.2	X	X		Test & Analysis	Long term affects not yet available
Transmission losses due to outgassing	5.2.6	X				Collector subjected to long term stall condition testing
Chemical Compatibility of Components	5.3	X			Design Analysis	
Components Involving Moving Parts	5.4	X			Test & Design Review	
Accessibility for Maintenance	6.1	X			Design Review	
Installation, Operation and Maintenance Manual	6.2	X			Design Data Brochure Review	
Repair and Service Personnel	6.3	X			Design Review	

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
Design	7.1			X		
Adequate Space	7.2	X			Design Review	Prepackaged solar system designed for adequate space for all solar components
Functioning of Dwelling/FAcility Site	7.3	X			Design Review	Site dwelling is compatible with prepackaged solar system installation.
Interference with Mechanical Operation	8.1	X			Design Review	Prepackaged solar system is compatible with site auxiliary heating and DHW systems
Mechanical and Electrical Functioning of Dwelling and Site	8.2	X			Design Review	Prepackaged solar system is compatible with site and will be installed in accordance with local codes.
Mechanical and Electrical Functioning of Connections	8.3	X			Design Review	Interconnections between site and prepackaged solar system meet requirements
Structural Integrity	9.1	X			Analysis and Design Review	
Structural Integrity of Dwelling	9.2	X			Design Review	

IPC REQUIREMENT	IPC NO.	MEETS IPC		N/A	EVALUATION METHOD	COMMENTS
		YES	NO			
Structural Connections	9.3	X			Analysis	
Safety of Dwellings and Site	10.1	X			Design Review	
Durability	11.1	X			Design Review	
Durability and Reliability of Dwelling and Site	11.2	X			Design Review	
Durability and Reliability of Connections	11.3	X			Design Review	
Maintainability of H, HC, HW Systems	12.1	X			Design Review	Cooling N/A
Maintainability of Dwelling and Site	12.2	X			Design Review	
Connections	12.3	X			Design Review	
Visual Characteristics	13.1	X			Design Review	

INTERIM PERFORMANCE CRITERIA DEVIATION REPORT

1. Report Number	2. Date	3. Prepared By	4. Organization	5. Item Name
	6/9/78	D. L. Linton		Flat Plate Collector

6. Item Part Number	7. Item S/N	8. Item Mfg. By	9. IPC Deviation
		Solaron	

10. IPC Number	11. IPC Paragraph	12. Approved By (IBM)	13. Approved By (MSFC)	14. Date Approved (MSFC)
	5.1.1 5.2.1			

15. Description of Deviation

No data was supplied by vendor to show the effects of prolonged exposure to sunlight and elevated no flow temperatures.

16. Probable Cause

17. Remarks

18. Deviation Disposition

PROTOTYPE SYSTEM 4

HAZARDS ANALYSIS

May 1977

Revised January 23, 1978

PROTOTYPE SYSTEM NO. 4
HAZARDS ANALYSIS

A hazards analysis was performed to define potential hazards or undesired events relative to the System No. 4 design, to identify the safety requirement, to eliminate the hazard, and to indicate the means of compliance with each safety requirement. A summary of the hazards analysis results are given in Table 1.

All potential hazards identified are minor level hazards and no major hazard levels have been found. No residual hazards have been identified, and no failure modes have been identified which would contribute to the occurrence of a hazard. As shown in Table 1, the use of standard off-the-shelf hardware minimizes potential hazards.

HAZARD DATA SUMMARY

TABLE 1

Areas of Consideration	Safety Requirement	Hazard/Undesired Event	Means of Compliance
Mechanical Protection	• Mechanical Hazards not significantly greater than conventional residence.	• Injury due to pinch or sharp edges.	• All operator and service area edges rounded.
		• Short circuits due to wire abrasion.	• Design does not present unusual or unique mechanical hazards.
		• Mechanical damage due to faulty installation.	• Approved tie down, strain relief and feed through hardware and installation.
		• Mechanical damage due to migration of components during operation	• Drawings provided with sufficient design detail and notes to highlight proper installation.
		• Rotating Equipment	• Belt guard on blower belts
			• Heat exchanger to preheat tank is thermosyphon loop
		• Humidity and Fungus	• All equipment mounted within the residence or weather proof enclosure.

HAZARD DATA SUMMARY
TABLE 1 Cont'd

Areas of Consideration	Safety Requirement	Hazard/Undesired Event	Means of Compliance
Primary Voltages	• Section 516 and 616 MPS (4900.1 and 4910.1). • Part E of ANSI A119.1 • Hazard exposure not significantly greater than conventional residence.	• Personnel Shock • Equipment damage due to short circuit or overload.	• Use conventional equipment and installation. • All external metal parts, surfaces and shields to be at electrical ground. • UL approved 60A main circuit breaker • UL approved 15A individual circuit breakers • 115V wiring run in conduct • All wire UL approved
		• Stored Energy	• Primary voltage in service areas are protected by shields or shrink sleeve insulation.
Secondary Voltages		• Short between primary and secondary circuits	• Stored energy minimal • Low voltage control circuit
Electromagnetic Interference	• Maintain circuit separation	• Interference between power, data and control functions	• Transformer isolation and physical separation between primary and secondary circuits. • Sensor and control wires separated. Sensor inputs are protected by ground wires for each channel.

HAZARD DATA SUMMARY

TABLE 1 Cont'd

Areas of Consideration	Safety Requirement	Hazard/Undesired Event	Means of Compliance
Fire Safety	• Use materials which do not present a fire hazard significantly greater than conventional systems	• Flammability of materials	• Used conventional components of proven safety
		• Air flow loss due to fan failure or blockage	• UL recognized components • Duct and pipe insulation good to 250°F
	• Proper clearance and venting of elevated temperature surface		• Storage and collector insulation good to 300°F. Classification UL 723
	• Emergency egress and access not be less than conventional system	• Occupant entrapment	• Over temperature protect to cut out furnace.
	• Identified and accessible main shut-off valves and switches	• Difficulty in terminating system operation or isolating failure	• Conventional design criteria met for egress and access. Convenient and accessible equipment room • Main shutoff valves and switches are clearly labeled and easily accessible within equipment room

HAZARD DATA SUMMARY
TABLE 1 Cont'd

Areas of Consideration	Safety Requirement	Hazard/Undesired Event	Means of Compliance
Domestic Hot Water	• Where applicable Section 515 and 615 MPS (4900.1 and 4910.1)	• Personnel exposure to high temperatures	• Used commercially available DHW tanks, pumps and heat exchanger of proven design
	• Part C ANSI A119.1	• Personnel exposure to high pressures	• Automatic 210°F temperature and 150 PSI pressure relief valve
	• Hazards not significantly greater than conventional residential installation	• Equipment damage	• Fail Safe DHW temperature control
			• Insulated heat exchanger and connecting pipes
			• Non-potable fluid not used
			• Safety shield used over primary terminal and shrink sleeving used on 115V wire terminals within service areas
		• Contamination of potable water	
Control		• Primary 115 Volt Shock	• Primary and control voltages transformer isolated with wiring physically separated
		• Shorts from primary 115V to 24V control circuits	• Autonomous temperature limits and interlocks within control circuits
		• Control failures	
	• Fail Safe control		

HAZARD DATA SUMMARY
TABLE 1 Cont'd

Areas of Consideration	Safety Requirement	Hazard/Undesired Event	Means of Compliance
Air Handler Fans	• Section 516 and 616 MPS (4900.1 and 4910.1)	• Primary 115 Volt Shock	• Primary 115 Volt circuit terminations enclosed
	• Part C ANSI-A119.1		• Over temperature protected motor
	• UL acceptance	• Toxic or Flammable materials	• UL approved components
			• Use commercial components of proven design
			• Independent review of material hazards
			• Fan totally enclosed
			• Use conventional equipment of proven design and installation
		• Rotating Equipment entanglement	
Auxiliary Heat			• Primary power terminations enclosed
		• Electrical Shock	• Over temperature protected heat strips
		• Fire hazard if air flow interrupted	• Heater installed in insulated duct
		• Excessive surface temperatures	

Item c. (Acceptance Data Package)

Warranty & Test Agency Certification

Limited warranties as received from suppliers.

Blowers	1 year
Control Dampers	1 year
Preheat tank	5 years
Roof ventilator	1 year

Underwriters Laboratories (UL) is reviewing the system and will submit a final report. All components and materials were selected to use only those items with UL approval when possible. UL listing or approval of this system is therefore expected without difficulty.

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO
7934940	2	ELEC				—	6-5-78	66352 JT
		METAL						
		PLASTIC						

7945130

DEVELOPMENT NO	Q/M

NOTES:

1. MAKE FROM:
   SOLAR CONTROL CORP.
   CONTROLLER MODEL NO. 77-171

2. SEE MODEL NO. 77-171 SCHEMATIC:
   A. REMOVE CR5 AND CR6
   B. REMOVE R10, REPLACE WITH CB-123-5
   C. REMOVE R11, REPLACE WITH CB-103-5

[redacted]

IBM MATERIAL	NO
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE	
TREATMENT	

7945130 A

SCALE 0 1 / 0 25.4

THIRD ANGLE PROJECTION

INCH ↔ mm

MUST CONFORM TO ENG SPEC: 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm
LINEAR ±			
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	CONTROLLER ALTERED	
DESIGNER	RPC	6-5-78
DETAILER	RDC	6-5-78
DWG CHK	D. Sutton	6-5-78
DSGN APPRO	J Kraske	6-5-78
CLASSIFICATION		

20-7787-4 MRO# 780520797 MECHANICAL FORMAT ASTROCLOTH N030T 9-279

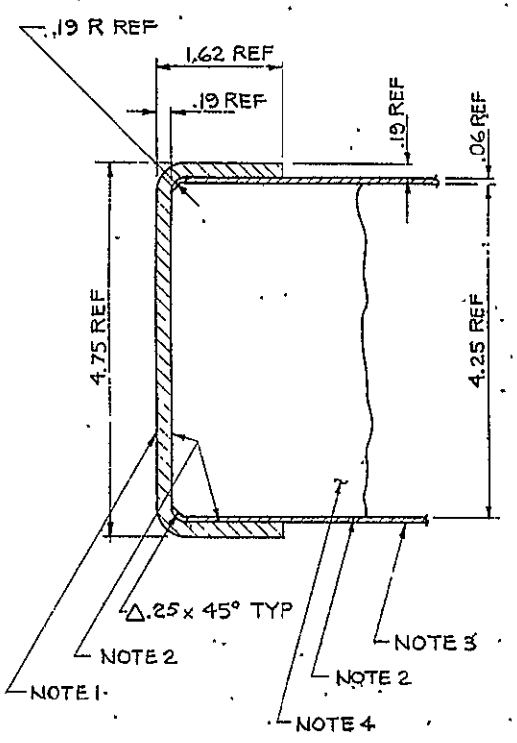
DRAFTING MEDIA GRAPHIC CONTROLS CORPORATION Buffalo, New York Printed in U.S.A.

[redacted]

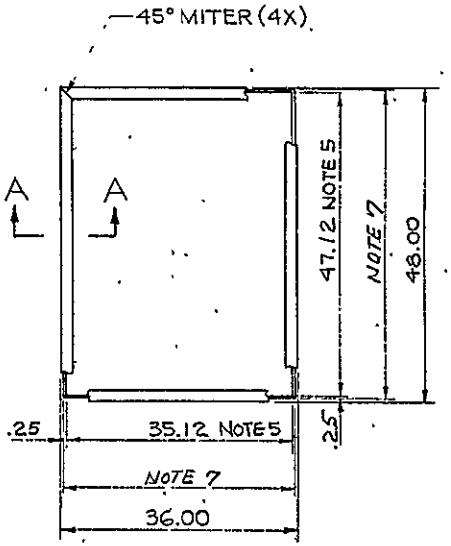
RELEASED FOR ASM	QTY
7934940	6

TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
ELEC			R	–	6-5-78	663527T				
METAL										
PLASTIC										

7934936	
DEVELOPMENT NO	Q/M



SECTION A-A
SCALE: FULL



NOTES:

1. MATERIAL: CHANNEL, FIBERGLASS REINFORCED POLYESTER, GLASTIC 1788-IC OR EQUIV. NEMA GPO-2
2. MATERIAL: ADHESIVE, HYSOL 934 OR EQUIV. APPLY UNIFORM LAYER .01-.06 THICK
3. MATERIAL: FIBERGLASS REINFORCED POLYESTER LAMINATE, .060 THICK, NEMA GPO-2; GLASTIC OR EQUIV.
4. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT^3 DENSITY UPJOHN-TRYMER CPR 9545 OR EQUIV.
5. FACE SHEET DIMENSIONS FOR CHANNEL RADII CLEARANCE
6. SAND LIGHTLY ALL SURFACES OF POLYESTER GLASS SHEET AND CHANNEL TO BE BONDED
7. CUT FOAM TO FIT CHANNELS WITH .06 CLEARANCE FOR BOND.

IBM MATERIAL	NO
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

7934936 C

SCALE 1/12

THIRD ANGLE PROJECTION

INCH
m m

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

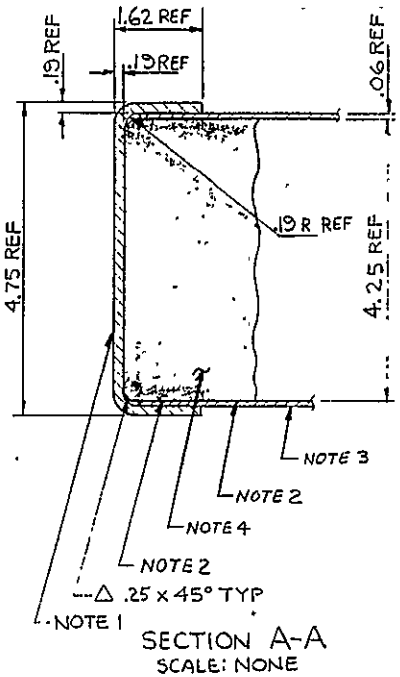
TOLERANCES UNLESS OTHERWISE NOTED		INCH	m m
LINEAR ±		.XX=.12	
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	PANEL, SIDE	
DESIGNER	RDC	11-21-77
DETAILER	RLS	11-22-77
DWG CHK	[signature]	1-13-78
DSGN APPRO	[signature]	1-16-78
CLASSIFICATION		

[redacted]

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO	7934937
7934940	2	ELEC				—	6-5-78	66352JT					DEVELOPMENT NO / Q/M
		METAL											
		PLASTIC											



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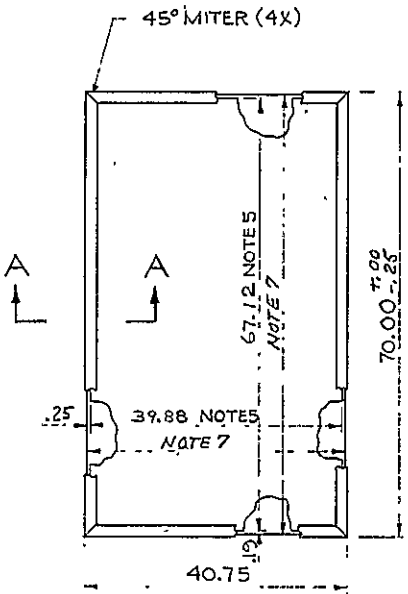
SCALE: NONE



NOTES:

1. MATERIAL: CHANNEL, FIBERGLASS REINFORCED POLYESTER, NEMA GPO-2. GLASTIC 1788-IC OR EQUIV.
2. MATERIAL: ADHESIVE, HYSOL EA934 OR EQUIV. APPLY UNIFORM LAYER .01-.06 THICK
3. MATERIAL: FIBERGLASS REINFORCED POLYESTER LAMINATE, .060 THICK, NEMA GPO-2, GLASTIC OR EQUIV.
4. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT³ DENSITY, UPJOHN-TRYMER CPR 9545 OR EQUIV.
5. FACE SHEET DIMENSIONS FOR CHANNEL RADII CLEARANCE
6. SAND LIGHTLY ALL SURFACES OF POLYESTER GLASS SHEET AND CHANNEL TO BE BONDED
7. CUT FOAM TO FIT CHANNELS WITH .06 CLEARANCE FOR BOND.

IBM MATERIAL: NO	0 1 2 / 0 25.4 50.8	MUST CONFORM TO ENG SPEC 890350			IBM	
		CODE IDENT 20234			NAME	PANEL, TOP
IBM MATL ALTERNATE: NO	SCALE 1/12	TOLERANCES UNLESS OTHERWISE NOTED	INCH	mm		
		LINEAR ±	.XX=.12		DESIGNER	[illegible]
CASE DEPTH		ANGLES ±			DETAILER	[illegible]
HARDNESS	THIRD ANGLE PROJECTION	RADII UNLESS OTHERWISE NOTED			DWG CHK	[illegible]
7934937 C	SURFACE TREATMENT	INCH / mm	EDGE/CORNER BREAKS	OUTSIDE MAX		DSGN APPRO
				INSIDE MAX		CLASSIFICAT

620 3769 6 MROB 760830817 MECHANICAL FORMAT [illegible]

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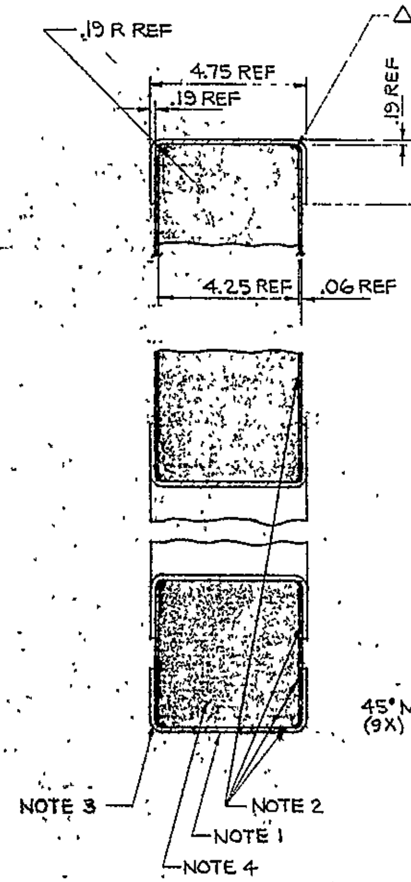
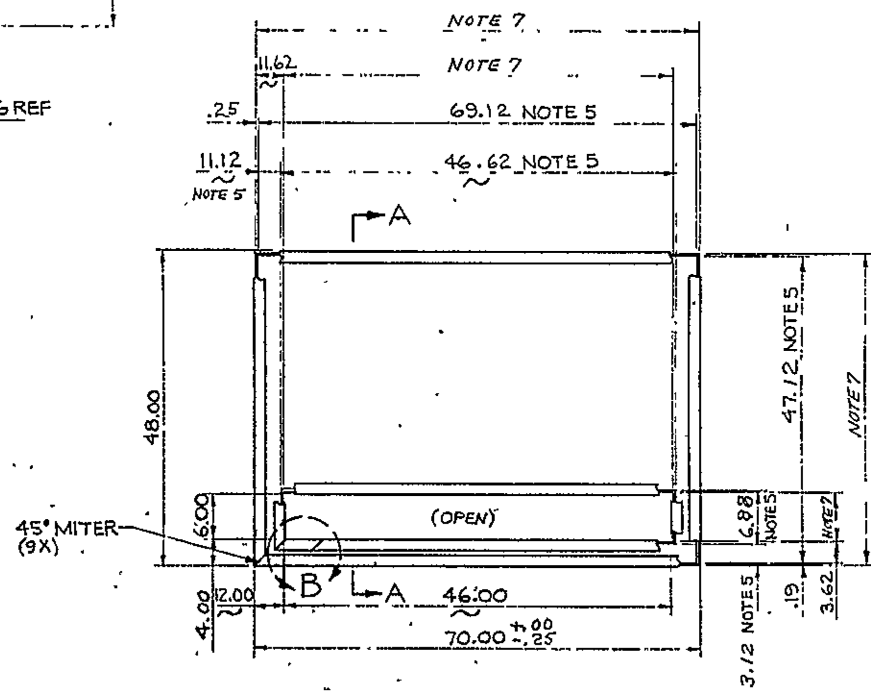
OF POOR QUALITY

[redacted]

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL			R	SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO	7934938
7934940		ELEC				≃	6-5-78	66352JT					DEVELOPMENT NO / Q/M
		METAL											
		PLASTIC											

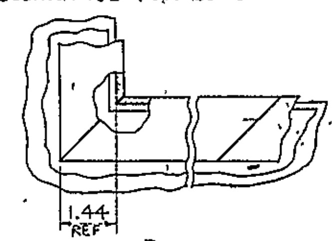


SECTION A-A
SCALE: 1/2



NOTES:

1. MATERIAL: CHANNEL, FIBERGLASS REINFORCED POLYESTER, GLASTIC 1788-1C OR EQUIV. NEMA GPO-2
2. MATERIAL: ADHESIVE, HYSOL EA934 OR EQUIV. APPLY UNIFORM LAYER .01 TO .06 THICK
3. MATERIAL: FIBERGLASS REINFORCED POLYESTER LAMINATE, .060 THICK NEMA GPO-2. GLASTIC OR EQUIV.
4. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT^3 DENSITY UPJOHN-TRYMER CPR 9545 OR EQUIV.
5. FACE SHEET DIMENSIONS FOR CHANNEL RADII CLEARANCE
6. SAND LIGHTLY ALL SURFACES OF POLYESTER GLASS SHEET AND CHANNEL TO BE BONDED
7. CUT FOAM TO FIT CHANNELS WITH .06 CLEARANCE FOR BOND



VIEW B
SCALE: 1/2

IBM MATERIAL	NO	SCALE 1/12	MUST CONFORM TO ENG SPEC 890350	IBM
IBM MATL ALTERNATE	NO		CODE IDENT 20234	NAME PANEL, END
CASE DEPTH			TOLERANCES UNLESS OTHERWISE NOTED — INCH / mm	DESIGNER RDC 11-13-77
HARDNESS		THIRD ANGLE PROJECTION	LINEAR ± .XX = .12	DETAILER RLS 11-14-77
SURFACE TREATMENT		INCH / mm	ANGLES ±	DWG CHK D.S.Sutton 1-13-78
			RADII UNLESS OTHERWISE NOTED	DSGN APPRO [signature] 1-16-78
			EDGE/CORNER BREAKS — OUTSIDE MAX / INSIDE MAX	CLASSIFICATION

7934938 C

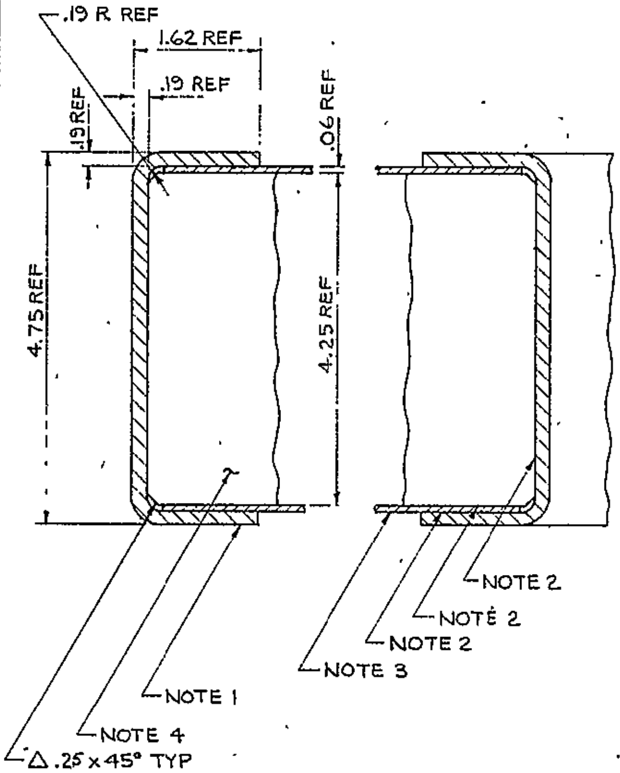
MECHANICAL FORMAT

[redacted]

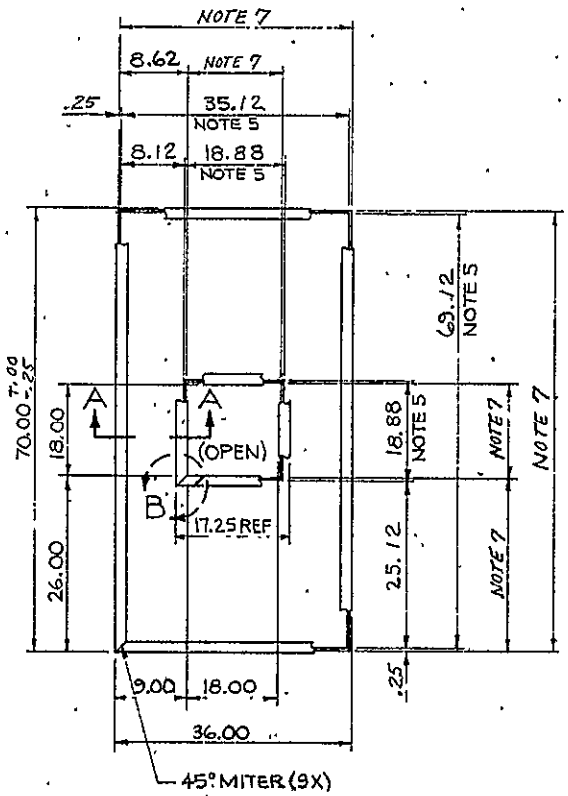
RELEASED FOR ASM	QTY	TECHNICAL APPROVAL			SYM	DATE	CHANGE NO	SYM	DATE	CHANGE NO
7934940		ELEC		R	–	6-5-78	66352JT			
		METAL								
		PLASTIC								

7934939

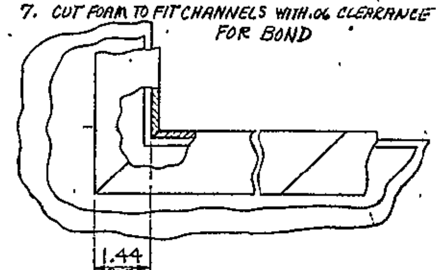
DEVELOPMENT NO | Q/M



SECTION A-A
SCALE: FULL



NOTES:
1. MATERIAL: CHANNEL, FIBERGLASS REINFORCED POLYESTER, NEMA GPO-2. GLASTIC 1788-1C OR EQUIV
2. MATERIAL: ADHESIVE, HYSOL EA934, OR EQUIV. APPLY UNIFORM LAYER .01-.06 THICK.
3. MATERIAL. FIBERGLASS REINFORCED POLYESTER LAMINATE, .060 THICK, NEMA GPO-2. GLASTIC OR EQUIV.
4. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT^3 DENSITY. UPJOHN-TRYMER CPR 9545 OR EQUIV.
5. FACE SHEET DIMENSIONS FOR CHANNEL RADII CLEARANCE
6. SAND LIGHTLY ALL SURFACES OF POLYESTER GLASS SHEET AND CHANNEL TO BE BONDED
7. *CUT FOAM TO FIT CHANNELS WITH .06 CLEARANCE FOR BOND*



VIEW B
SCALE: 1/2

IBM MATERIAL	NO	MUST CONFORM TO ENG SPEC 890350	IBM
		CODE IDENT 20234	NAME: PANEL, TOP
IBM MATL ALTERNATE	NO	TOLERANCES UNLESS OTHERWISE NOTED — INCH / mm	
		LINEAR ± .XX=.12	DESIGNER: RDC 11-22-77
CASE DEPTH		ANGLES ±	DETAILER: RLS 11-23-77
HARDNESS		RADII UNLESS OTHERWISE NOTED	DWG CHK: D.E. Sutton 1-13-78
SURFACE TREATMENT		EDGE/CORNER BREAKS — OUTSIDE MAX / INSIDE MAX	DSGN APPRO: [signature] 1-16-78
			CLASSIFICATION

0 2
0 25.4 50.8
SCALE 1/12
THIRD ANGLE PROJECTION
INCH / mm

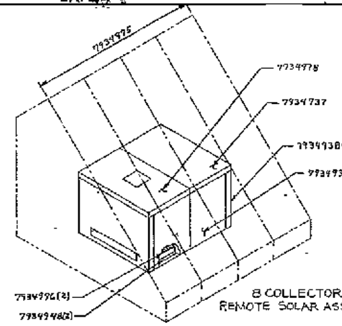
7934939 C

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
CEI	1	ELEC			N	–	6-5-78	66352JT				
		METAL										
		PLASTIC										

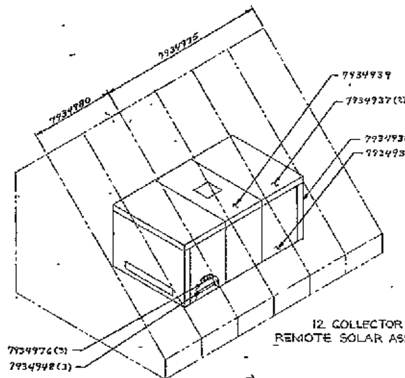
7934940

DEVELOPMENT NO | Q/M

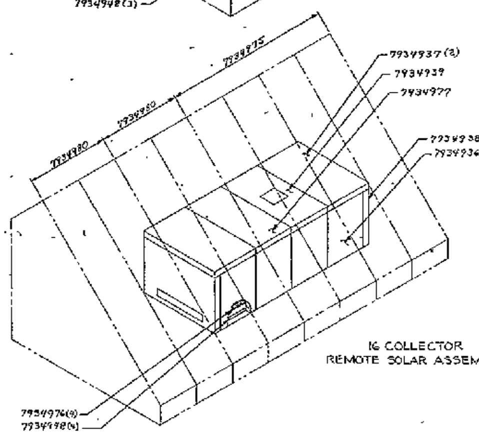
SHT 1 OF 5



8 COLLECTOR
REMOTE SOLAR ASSEMBLY



12 COLLECTOR
REMOTE SOLAR ASSEMBLY



16 COLLECTOR
REMOTE SOLAR ASSEMBLY

NOTES-

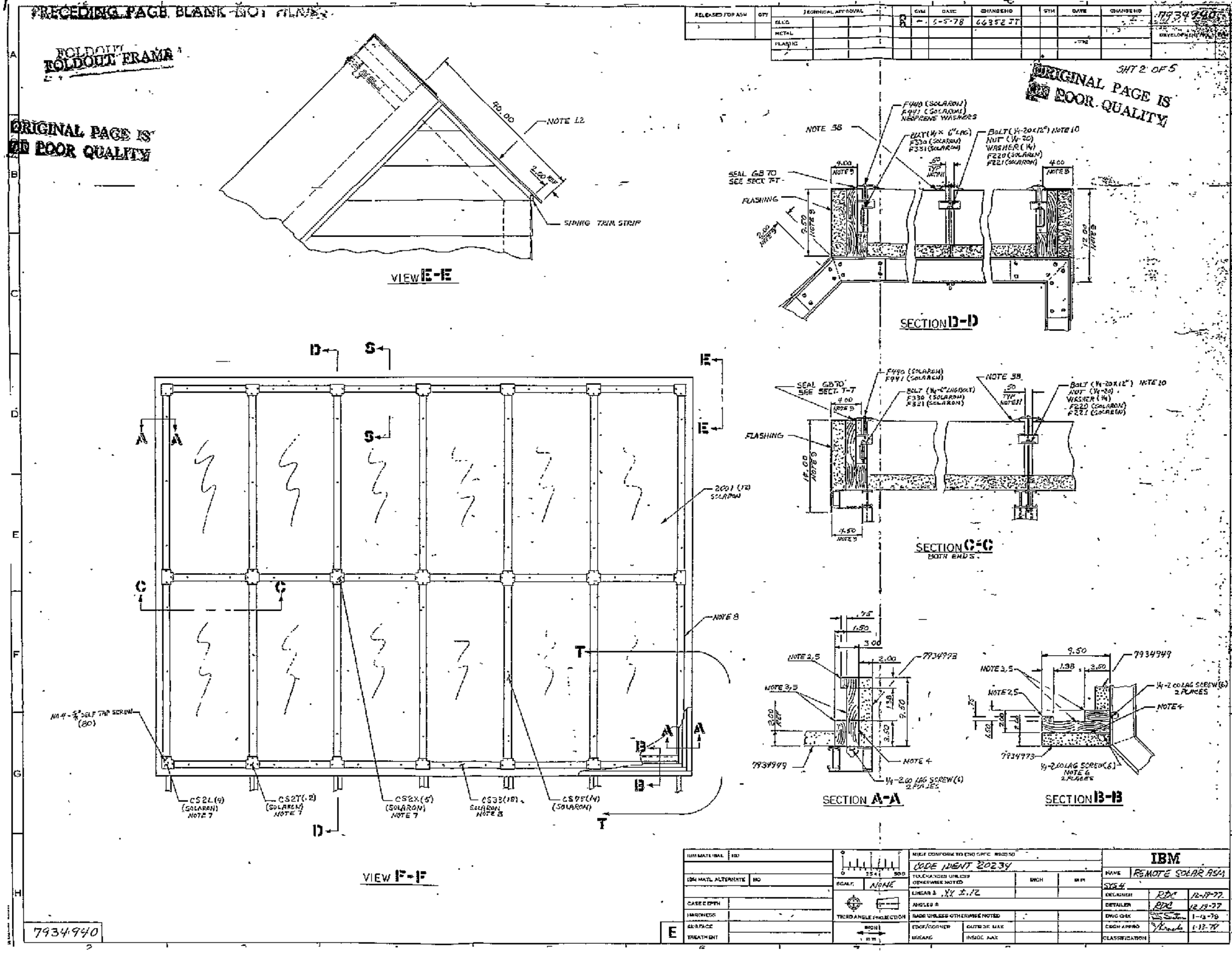
1. THIS DRAWING DEPICTS A 12 COLLECTOR REMOTE SOLAR ASSEMBLY. SEE BILL OF MATERIAL FOR THE APPROPRIATE HARDWARE REQUIREMENTS FOR 8 COLLECTOR AND 16 COLLECTOR DESIGNS. SEE TAB
2. MATERIAL 3/4 IN EXTERIOR GRADE PLYWOOD
3. MATERIAL. 2x4, 2x10 GRADE #2 (TERMITE) TREATED YELLOW PINE
4. BOND INSULATION TO 2x10, USING WATERPROOF GLUE, AFTER ASSEMBLY OF WOOD TO STRUCTURE.
5. BOND USING WATERPROOF GLUE, NAIL IN PLACE AT BONDING USING 6d GAL. NAILS. IF PIECING OF WOOD IS NECESSARY, PIECE TOGETHER USING LAP JOINT, GLUE & SCREW JOINT.
6. RELIEVE INSULATION TO CLEAR LAG SCREW HEAD & ALUM. ANGLE. EQUAL SPACED LAG SCREWS
7. USE DOUBLE BEAD OF SEALANT (DOW CORNING NO. 732-CL-11 OR EQUIV) TO FORM WEATHERPROOF SEAL, AT JOINTS
8. SEAL PERIMETER TO FLASHING USING G570 OR EQUIV
9. ALUM. FLASHING TO BE ATTACHED WITH SELF TAPPING SCREWS. FLASHING MAY HAVE SEAMS BUT MUST BE WEATHERPROOF. COLOR WHITE. APPLY RTV 732-CL-11 UNDER SCREW HEADS.
10. IF THE 1/4-20 x 12" BOLT IS NOT AVAILABLE, 1/4-20 THREADED ROD MAY BE USED
11. USE 1/2" SPACER FOR PROPER ALIGNMENT OF COLLECTORS (3" x 3" x 1/2" PLYWOOD BLOCK)
12. SHED ROOF TO BE CONSTRUCTED OF FIBER GLASS REINFORCED TRANSLUCENT, GRANITIZED FINISH SHEETS, COLOR WHITE. ROOF MAY HAVE SEAMS, BUT MUST BE OF WATERPROOF CONSTRUCTION
13. SUPPORT DUCT USING STEEL ANGLE WITH ANCHOR PLATE. SCREW ANGLE TO DUCT AND FLOOR FOR SUPPORT.
14. SHEET METAL ADAPTER (26 GA) 6.0 x 18.0 TO 14.5 x 14.5
15. SHEET METAL ADAPTER (26GA) 6.5 x 11.25 TO 14.0 x 14.0
16. INSULATION: COVER FLAT DUCT WORK WITH URETHANE FOAM (3" THICK "UPJOHN" UTHANE-190) BOND IN PLACE WITH "PAN GRIP 149-24" (MIDWEST CHEM CO). ROUND DUCT WORK COVER WITH 3" THICK ROUND FOAM ("UPJOHN" UTHANE-190). COAT ALL DUCT INSULATION WITH "VIMASCO WC-1-E2" OR EQUIV.
17. SECURE PRE-HEAT TANK TO MTG PLATE USING (4) 1/4-20 x 1.4 BOLTS
18. SHEET METAL ADAPTER 14.0 x 14.0–18.0 WITH ADAPTER FOR 12.0 ROUND PIPE, MOUNT CD464 PB (CONTROL DAMPER) INSIDE. ATTACH ADAPTER TO BLOWER HOUSING WITH SELF TAPPING SCREWS
19. SUSPENDED DUCT AND PIPE TO BE SECURED IN PLACE USING PIPE STRAP.
20. BLOWER SUPPORT 2.0 x 2.0 - .12 ALUM ANGLE WITH A 20.0 x 24.0 - .25 ALUM. PLATE WITH MTG. HOLES AND EXHAUST AREA FOR BLOWER.
21. TANK SUPPORT 31.0 x 36.0 - .25 ALUM. PLATE WITH (2) I BEAMS ON 18.0 CENTERS, SELF TAP SCREW IN PLACE.
22. FOR ELECTRICAL SCHEMATIC SEE DWG. 7934979, 7934983
23. SHEET METAL ADAPTER 18.0 x 18.0 x 15.0 (26GA) USE SELF TAPPING SCREWS TO INSTALL
24. SOFT COPPER RUNS SHALL BE FORMED TO MAKE PIPE RUNS AS SHORT AS POSSIBLE.
25. ALUM. PERFORATED SHEET 24.0 x 24.0, .03-.06 THICK, (.25-.38 DIA HOLES, 20-30% OPEN) PLACE IN ROCK STORAGE DIRECTLY UNDER HEAT EXCHANGER
26. DRILL AND MOUNT BRACKETS USING #8 SELF TAPPING SCREWS
27. INSERT COPPER TUBES DURING FILLING OF ROCK STORAGE (DEEP LEVEL). INSERT 36.0 OF SENSOR TUBING INTO COPPER TUBE, REMAINDER OF SENSOR TUBE TO BE COILED NEAR SENSOR. PLUG OPENING WHERE SENSOR TUBE COMES OUT OF DETAIL 'P' WITH RTV 3110. ALLEVIATE WHERE SENSOR TUBE COMES THRU ROCK STORAGE.
28. DRILL .19 DIA HOLE IN COLLECTOR DUCT. INSTALL SENSOR AS SHOWN USING #4 SELF TAPPING SCREW. SENSOR IS SHIPPED WITH CONTROLLER (7945130)
29. MATERIAL: 3/4 IN EXTERIOR GRADE PLYWOOD (24.0 x 36.0) LOCATED NEAR REAR DOOR, MOUNT BREAKER BOX, RECEPTACLE AND LIGHT SWITCH.
30. WASHED PEBBLES 3/4 IN TO 1 1/2 IN DIA. FILL BIN TO WITHIN 6.0 IN OF TOP INSIDE SURFACE.
31. ALL ELECTRICAL HARDWARE AND ITS INSTALLATION SHALL MEET UNIFORM BUILDING CODES AND BE 'UL' APPROVED.
32. APPLY STEEL BAND IN LOCATION AS SHOWN WITH APPROX 600 LB TENSION AT EACH BAND.
33. APPLY RTV 3110 TO ALL MATING SURFACES OF STORAGE BIN PANELS, TO FORM AN AIR TIGHT STORAGE BIN.
34. THIS COLLECTOR SHALL BE THE SPECIAL SOLARON SERIES 2001 COLLECTOR. IT WILL HAVE 5 THERMAL SENSORS MOUNTED TO THE ABSORBER SURFACE.
35. SEAL INSIDE, ROCK STORAGE PANELS TO BASE USING RTV-3110
36. SOLDER USING 50/50 SOLDER.
37. FOUR (4) INCH DIA INSPECTION PORT, COVER HOLE WITH LEXAN (.12 THICK, CLR) AND SHEET-METAL SCREW IN PLACE, SEAL LEXAN TO DUCT WITH RTV-731
38. RUBBER SEAL SUPPLIED WITH SOLARON COLLECTOR.
39. INSTALL 3/4 INCH DIA x 4 INCH PIPE NIPPLE WITH CPVC UNIONS IN 3/4 INCH CPVC LINE.
40. INSTALL 3.12 x 1.38-.08 ALUM CHANNEL (6063-T6) NEAR & FAR SIDE AS SHOWN IN VIEW W-W. RIVET CHANNELS TO I BEAM AS SHOWN.
41. COVER WALK AREA WITH 3/4 INCH EXTERIOR PLYWOOD, PAINT LIGHT GRAY
42. BREAK ALL CORNERS AND SHARP EDGES.
43. COVER OPENINGS IN BASE OF STRUCTURE WITH .04 THICK STEEL, SHEET METAL SCREW IN PLACE, SEAL WITH DUCT MASTIC.
44. INSULATE PREHEAT TANK WITH 3 1/2" (R11) FIBERGLASS BLANKET INSULATION.
45. INSULATE WATER PIPES WITH URETHANE FOAM (3" THICK "UPJOHN" UTHANE-190). COAT INSULATION WITH "VIMASCO" WC-1-E2.
46. SEAL ALL DUCT JOINTS USING RTV-190.
47. VENTILATOR TUBE LOCATED IN SECOND BAY FROM LEFT SIDE OF STRUCTURE (IN TRANSLUCENT ROOF). MOUNT PLYWOOD TO STRUCTURE (INSIDE) USING 2x2-.12 ALUM. ANGLES. SECURE BASE TO PLYWOOD WITH WOOD SCREWS. BASE (12.0 ROUND) TO EXTEND THRU ROOF, SEAL BASE TO ROOF USING RTV-731.
48. SHIM BETWEEN PLATE 7934981 AND TOP COVERS AS REQUIRED USING ALUM SHEET STOCK.
49. DRILL .19 DIA HOLE IN TOP OF TUBE. INSTALL SENSOR AS SHOWN USING STANDARD .19 ID "O" RING. CLAMP SENSOR WITH STANDARD RADIATOR HOSE CLAMP, DRILL .19 DIA HOLE IN CLAMP. SENSOR IS SHIPPED WITH CONTROLLER (7945130).

TAB DRAWING	
7934940-1	8 COLLECTORS
7934940-2	12 COLLECTORS
7934940-3	16 COLLECTORS

IBM MATERIAL	NO	MUST CONFORM TO ENG SPEC 690050	IBM
IBM MATL. ALTERNATE	NO	CODE IDENT 20234	NAME: REMOTE SOLAR ASSEMBLY, SYSTEM 4
CASE DEPTH		SCALE 1/12	DESIGNER: RDC 1-5-78
HARDNESS		TOLERANCES UNLESS OTHERWISE NOTED — INCH / MM	DETAILER: RLS 12-12-77
SURFACE TREATMENT		LINEAR ± / ANGLES ±	DWG CHK: 1-13-78
		THIRD ANGLE PROJECTION; RADII UNLESS OTHERWISE NOTED; EDGE/CORNER OUTSIDE MAX; BREAKS INSIDE MAX	DSGN APPRO: 1-13-78
			CLASSIFICATION

E

7934940



IBM MATERIAL	NO	MUST CONFORM TO ENG SPEC 850050	IBM
IBM MATL ALTERNATE	NO	CODE IDENT 20234	NAME: REMOTE SOLAR ASM
SCALE	NONE	TOLERANCES UNLESS OTHERWISE NOTED	SYS 4
CASE DEPTH		LINEAR ± .XX ±.12	DESIGNER: RDC 12-19-77
HARDNESS		ANGLES ±	DETAILER: RDC 12-19-77
SURFACE TREATMENT		EDGE/CORNER BREAKS: OUTSIDE MAX / INSIDE MAX	DWG CHK: 1-13-78
	THIRD ANGLE PROJECTION		DSGN APPRO: 1-13-78
			CLASSIFICATION

E

7934940

1 FOLDOUT FRAME

2 FOLDOUT FRAME

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OF POOR QUALITY

RELEASED FOR ASM	MFG	TECHNICAL APPROVAL			BY	DATE	CHANGE NO	BY	DATE	DRAWING NO	
		ELEC			R	6-5-78	663823T				DEVELOPMENT NO / S/A
		METAL									7934940 A
		PLASTIC									

SHT 3 OF 5

NOTE 50

PARTIAL VIEW W-W

⅛ FLAT HD BLIND RIVET, ALUM ALLOY
6 REQ'D., 6 PLACES. LOCATE
FROM 7934981 NOTE 1

CLEARANCE HOLE FOR ⅛ RIVET,
6 REQ'D, 6 PLACES, LOCATE
FROM 7934981. NOTE 1

7934981(a) PLATE

47.00 REF

.44

SECTION H-H
SCALE: 1/4

10-24 x ½ LG ROUND HD SELF-TAPPING
SCREW, 3 REQ'D., 3 PLACES.
LOCATE FROM 7934981. NOTE 1

NOTE 48

10-24 x ½ LG ROUND HD SELF-TAPPING
SCREW, 3 REQ'D, 6 PLACES. NOTE 1

6.06 TYP

2 EQUAL SPACES @ 12.00 = 24.00 TYP

38

SECTION J-J
SCALE: 1/4

℄ STORAGE UNIT

7934937(2) PANEL, TOP, NOTE 1

7934939 PANEL, TOP

47.00 TYP

34.98 REF

10-24 x ½ LG ROUND HD SELF-TAPPING SCREW,
3 REQ'D, 2 PLACES. LOCATE FROM 7934982

RIGHT HAND FRONT CORNER OF STRUCTURE

7934938 (2) PANEL, END

.98 X .020 STEEL BAND 3 REQ'D.
NOTE 32

G

NOTE 40

W

47.00

7934982 (2) ANGLE

TOP OF SHEET STEEL 7934941 REF

7934986 (6) PANEL, SIDE NOTE 1

7934975 STRUCTURE, TYPE 5

7934980 STRUCTURE, TYPE 4

H

J

℄ STORAGE UNIT

10-24 x ½ LG ROUND HD SELF-TAPPING
SCREW, 6 REQ'D, 2 PLACES. LOCATE
FROM 7934982

NOTE 30

NOTE 35

7934976(3) GRATING NOTE 1

7934948(3) INSULATION, BASE. NOTE 1

SECTION G-G

IBM MATERIAL	NO			MUST CONFORM TO IDNG SPEC. 660830		IBM	
IBM MATL ALTERNATE	NO			CODE IDENT. 20234		NAME	REMOTE SOLAR
			SCALE 1/12	TOLERANCES UNLESS OTHERWISE NOTED	INCH / MM	ASSEMBLY	
GRAIN DEPTH				LINEAR ± .XX = ± 12		DESIGNER	R.D.C. 1-5-78
HARDNESS				ANGLES ±		DETAILER	R.L.S. 12-15-77
SURFACE TREATMENT			THIRD ANGLE PROJECTION	BURR LIMITS EXCEPT AS NOTED		DWG CHK	[illegible] 1-13-78
			INCH MM	EDGE/CORNER BREAKS /	OUTSIDE MAX. / INSIDE MAX.	DSGN APPRO	[illegible] 1-13-78
						CLASSIFICATION	

7934940

E

FOLDOUT FRAME 1

FOLDOUT FRAME 2

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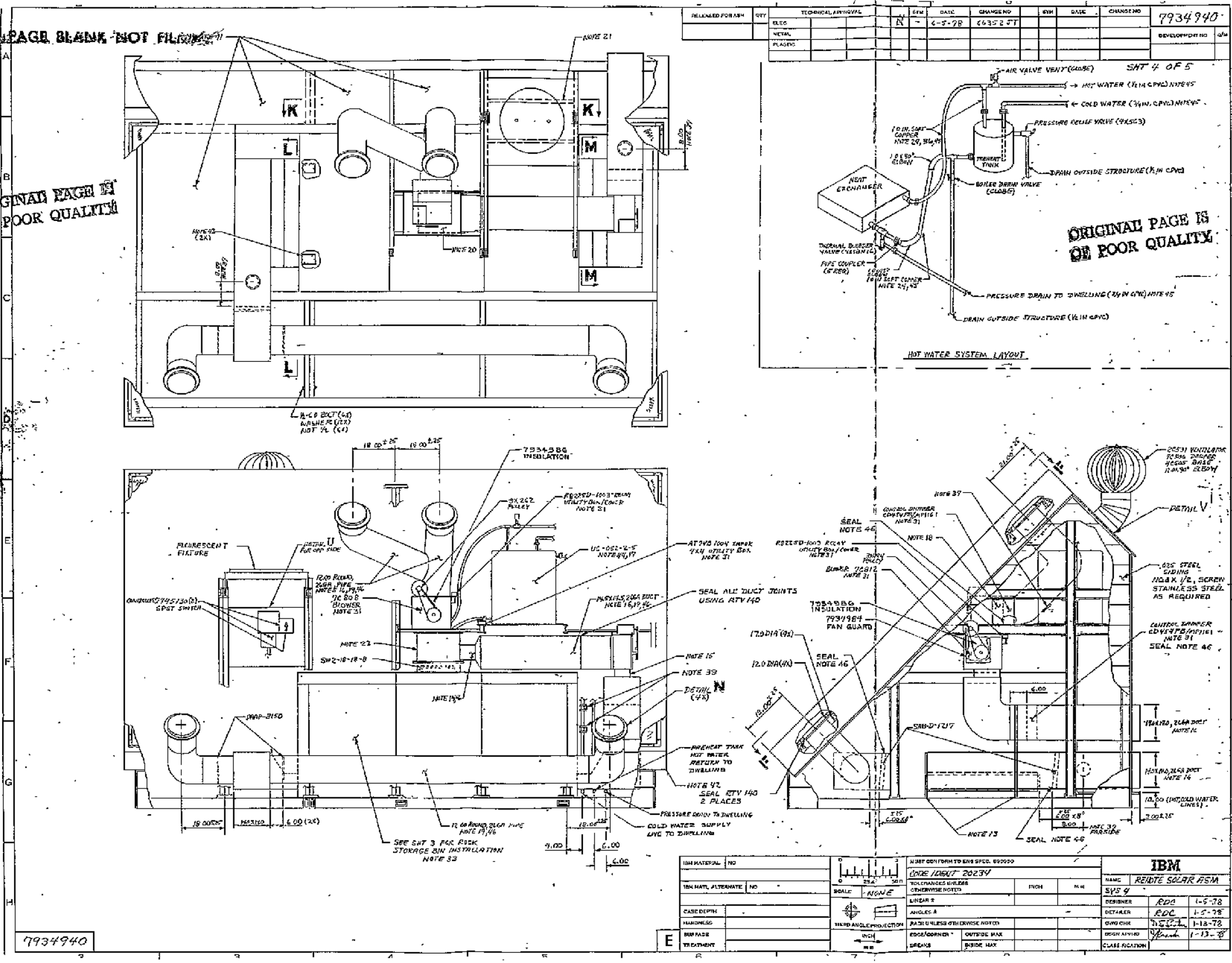

7934940
SHT 4 OF 5
AIR VALVE VENT (GLOBE)
HOT WATER (1/2 IN CPVC) NOTE 45
COLD WATER (3/4 IN. CPVC) NOTE 45
PRESSURE RELIEF VALVE (9X563)
PREHEAT TANK
HEAT EXCHANGER
BOILER DRAIN VALVE (GLOBE)
DRAIN OUTSIDE STRUCTURE (1/2 IN CPVC)
PRESSURE DRAIN TO DWELLING (3/4 IN CPVC) NOTE 45
DRAIN OUTSIDE STRUCTURE (1/2 IN CPVC)
HOT WATER SYSTEM LAYOUT
NOTE 21
NOTE 20
NOTE 42 (2X)
793486 INSULATION
FLUORESCENT FIXTURE
DETAIL U
SEAL AIR DUCT JOINTS USING RTV 140
NOTE 15
NOTE 39
DETAIL N (4X)
NOTE 42
SEAL RTV 140 2 PLACES
PRESSURE DRAIN TO DWELLING
COLD WATER SUPPLY LINE TO DWELLING
PREHEAT TANK HOT WATER RETURN TO DWELLING
SEE SHT 3 FOR ROCK STORAGE BIN INSTALLATION NOTE 33
NOTE 22
NOTE 37
NOTE 18
DETAIL V
.025 STEEL SIDING
NO.8 X 1/2, SCREW STAINLESS STEEL AS REQUIRED
CONTROL DAMPER
SEAL NOTE 46
SEAL NOTE 46
SEAL NOTE 46
NOTE 13
SEAL NOTE 46
793484 FAN GUARD
12.0 DIA (4X)
17.0 DIA (4X)
IBM
NAME REMOTE SOLAR ASM
SYS 4
DESIGNER RDC 1-5-78
DETAILER RDC 1-5-78
CODE IDENT 20234
SCALE NONE
THIRD ANGLE PROJECTION
7934940

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FOLDOUT FRAME 2

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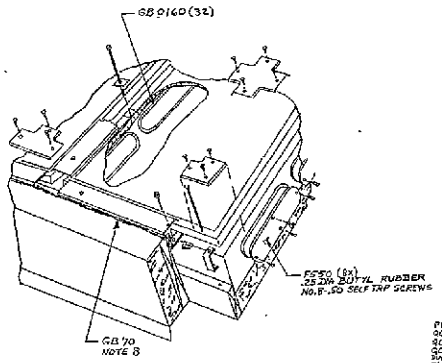
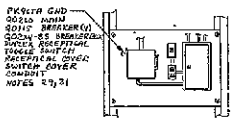
ORIGINAL PAGE IS OF POOR QUALITY

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL		ITEM	DATE	CHANGE NO	ITEM	DATE	CHANGE NO	7934740
		ELEC		R	6-5-78	662527				DEVELOPMENTNO
		METAL								
		PLATING								

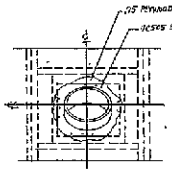
SHT 6 OF 5



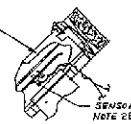
VIEW T-T



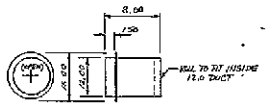
DETAIL U



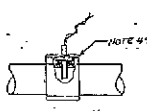
DETAIL V



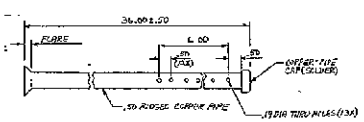
SECTION S-S



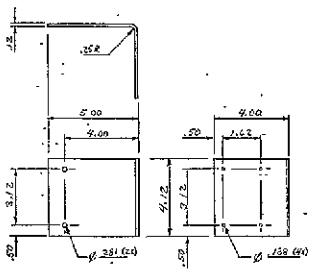
DETAIL N
.040 SHEET METAL
(QTY 2)



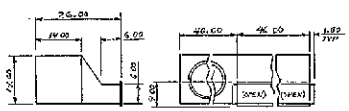
DETAIL X



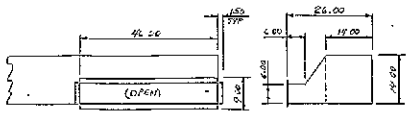
DETAIL P
(QTY 2)



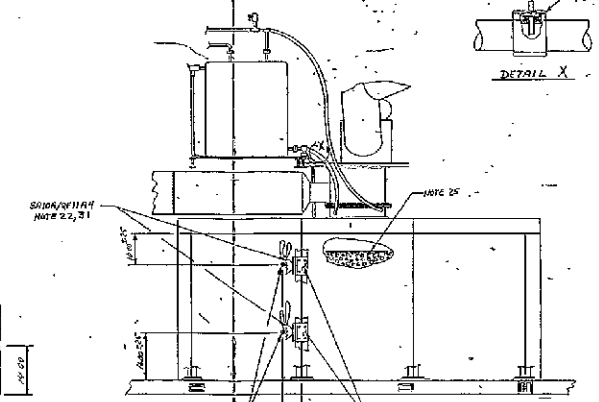
DETAIL R
QTY 2
MATL: ALUM 6061



SECTION L-L
.040 SHEET METAL



SECTION M-M
.04 GA SHEET METAL



VIEW K-K

ITEM MATERIAL	NO
IBM MATL ALTERNATE	NO
CAD/CDP/DP	
HARDNESS	
SURFACE TREATMENT	

MUST CONFORM TO ENG SPEC, 8R0330

CODE IDENT 80234

TOLERANCES UNLESS OTHERWISE NOTED: INCH | MM

LINEAR ± .XX ± .12

ANGLE ±

FAIR UNLESS OTHERWISE NOTED

EDGE/CORNER | OUTSIDE MAX | INSIDE MAX

BREAKS

SCALE NONE

THIRD ANGLE PROJECTION

IBM

NAME REMOTE SOLAR ASM

SYS 4

DESIGNER	RDC	1-5-78
DETAILED	RDC	1-5-78
ENG CHK	DSC	1-13-78
ENGR APPR		1 13 78
CLASSIFICATION		

7934740

E

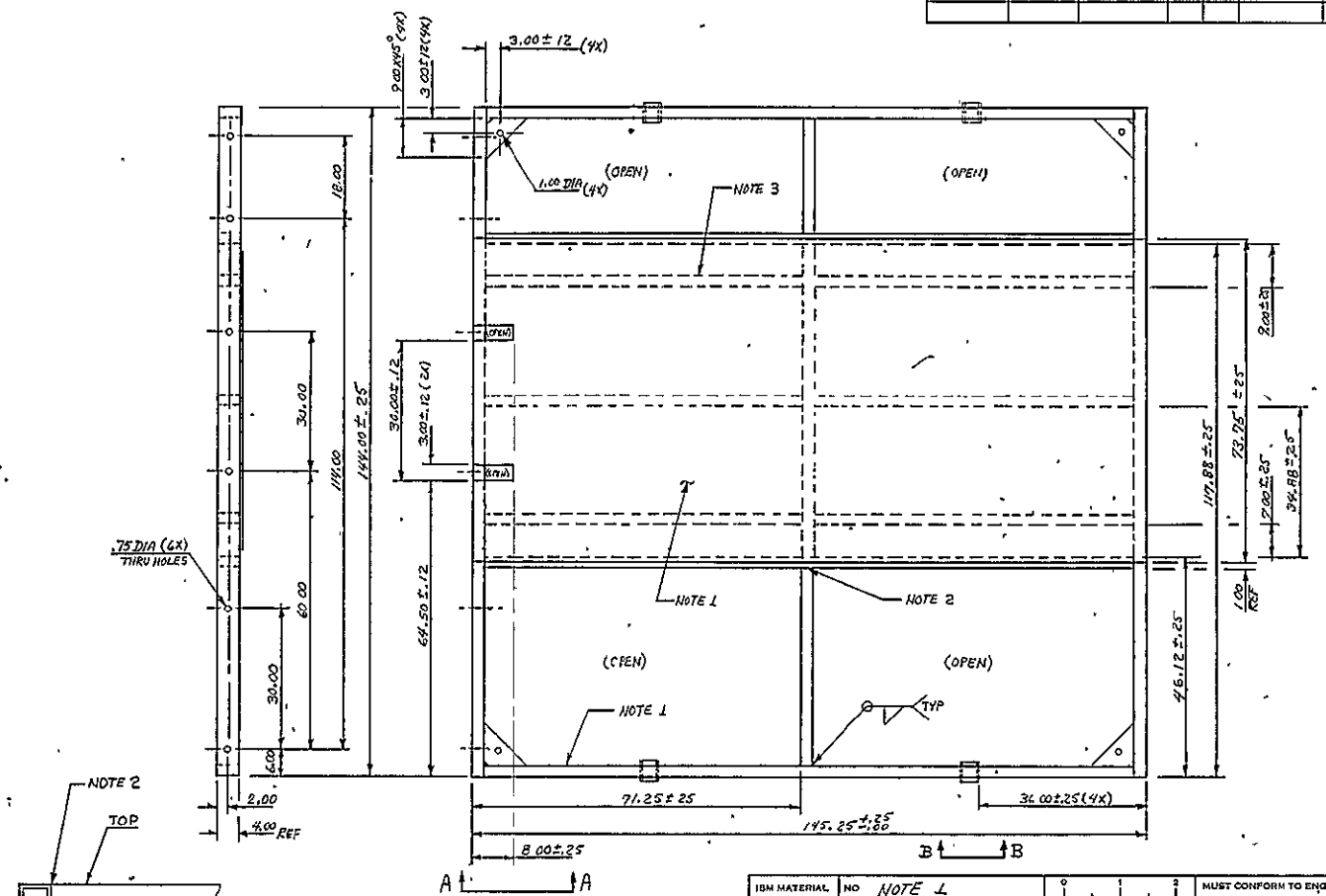
RELEASED FOR ASM	QTY
7934975	1

TECHNICAL APPROVAL			SYM	DATE	CHANGE NO
ELEC			—	6-5-78	66352 JT
METAL					
PLASTIC					

SYM	DATE	CHANGE NO

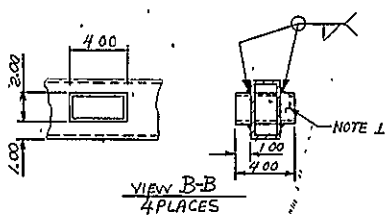
7934941

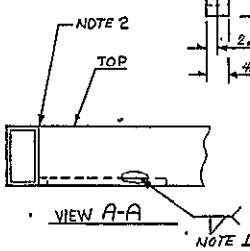
DEVELOPMENT NO | Q/M



NOTES:

1. MATERIAL:
   2.0 X 4.0 - .12 STEEL TUBING (C1025, C1010)
   16 GA (.06) STEEL SHEET (C1010)
   .25 THICK GUSSET PLATE (C1010)
2. WELDS ON TOP OF FRAME TO BE GROUND FLUSH.
3. TACK WELD FROM BOTTOM SIDE. SHEET STEEL MAY BE PIECED AT CROSS MEMBERS.
4. PRIME AND PAINT, COLOR BLACK (RUST INHIBITIVE PAINT).





IBM MATERIAL NO	NOTE 1
IBM MATL ALTERNATE NO	
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	NOTE 4

SCALE: NONE

THIRD ANGLE PROJECTION

INCH / mm

MUST CONFORM TO ENG SPEC: 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm
LINEAR ±	.XX ± .12		
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	BASE, NO.8	
SYSTEM 4		
DESIGNER	RDC	12-2-77
DETAILER	RDC	12-2-77
DWG CHK	SSJ	1-13-78
DSGN APPRO		1-16-78
CLASSIFICATION		

7934941

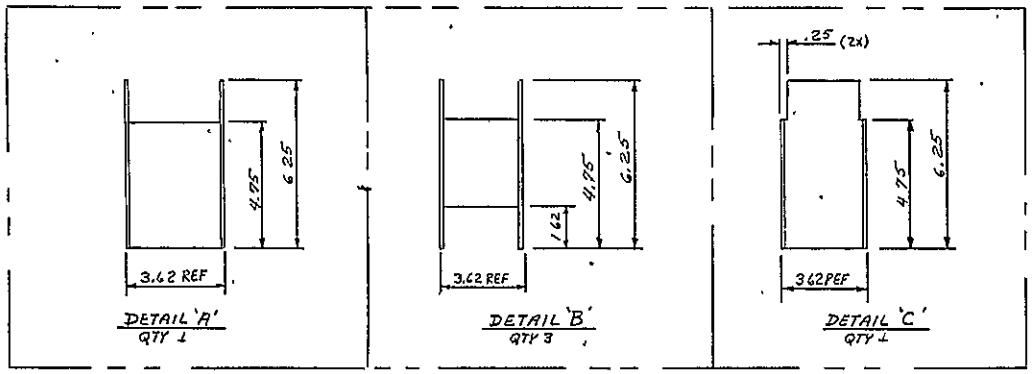
[redacted]

RELEASED FOR ASM	QTY
7934975	2

TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
ELEC			R	—	6-5-78	663525T				
METAL										
PLASTIC										

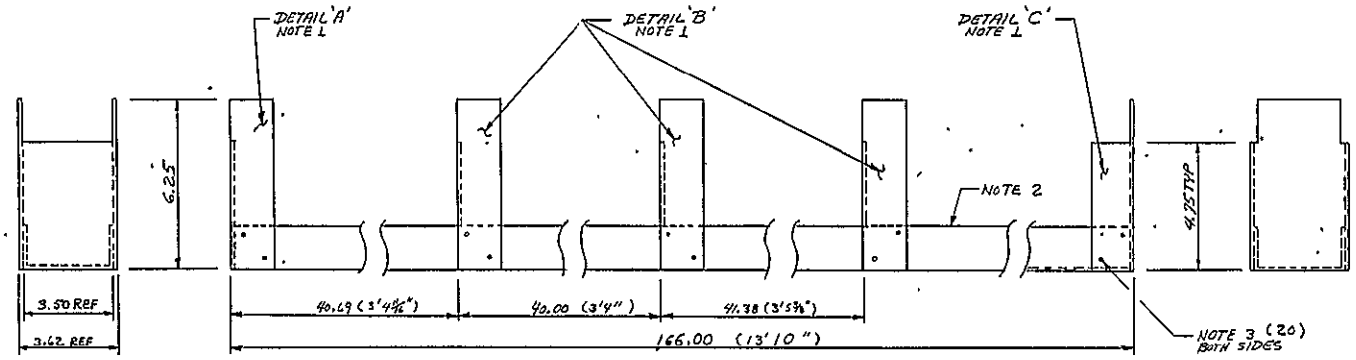
7934942

DEVELOPMENT NO	O/M



NOTES.

1. MATERIAL: 3.62 X 1.38 CHANNEL (ALUM 'TRACK')
2. MATERIAL: 3.50 X 1.62 CHANNEL (ALUM 'CORNER')
3. POP RIVET IN PLACE, OR EQUIV. HOLDING MATERIAL.



IBM MATERIAL	NO NOTE 1, 2
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

D

0 1 2
0 25.4 50.8
SCALE NONE
THIRD ANGLE PROJECTION
INCH
mm

MUST CONFORM TO ENG SPEC 890350			
CODE IDENT 20234			
TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm
LINEAR ±	.XX ±.25		
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	OVERHANG ASM	
DESIGNER	RDC	11-21-77
DETAILER	RDC	11-21-77
DWG CHK	DJ Sutton	1-13-78
DSGN APPRO	J Krook	1-16-78
CLASSIFICATION		

7934942

[redacted]

RELEASED FOR ASM	QTY
7934975	16
7934980	8

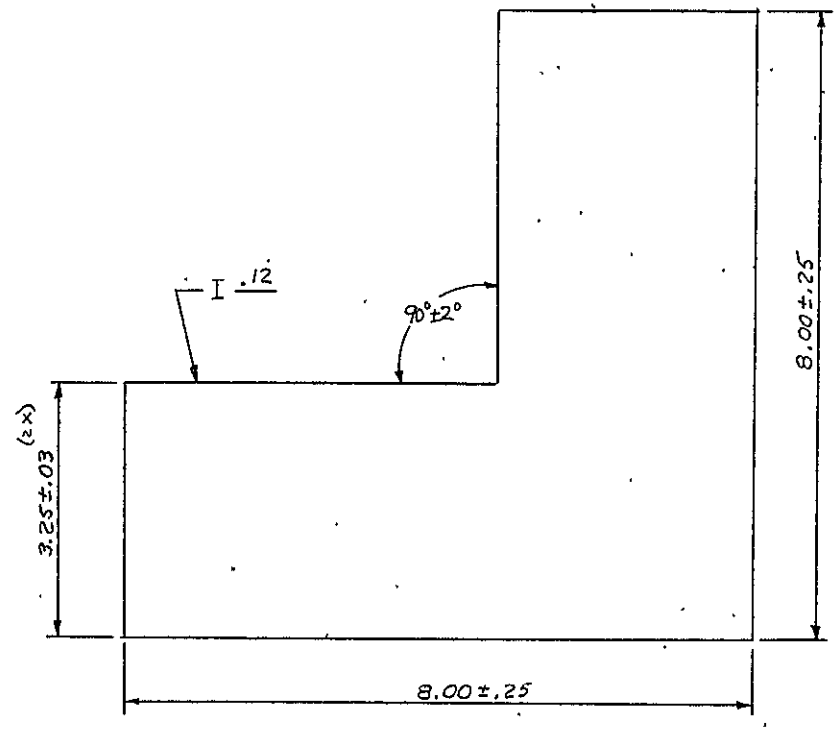
TECHNICAL APPROVAL		
ELEC		
METAL		
PLASTIC		

SYM	DATE	CHANGE NO
—	6-5-78	66352JT

SYM	DATE	CHANGE NO

7934943

DEVELOPMENT NO | Q/M



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IBM MATERIAL NO	6061-T6 (ALUM ALY)
IBM MATL ALTERNATE NO	
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

SCALE 1/1

THIRD ANGLE PROJECTION

INCH
m m

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	m m
LINEAR ±			
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX	.02	
	INSIDE MAX		

IBM

NAME BRACE-TOP

DESIGNER	RDC	11-9-77
DETAILER	RDC	11-9-77
DWG CHK	DS Sutton	1-13-78
DSGN APPRO	[illegible]	1-16-78
CLASSIFICATION		

7934943 C

[redacted]

RELEASED FOR ASM	QTY
7934975	32
7934980	16

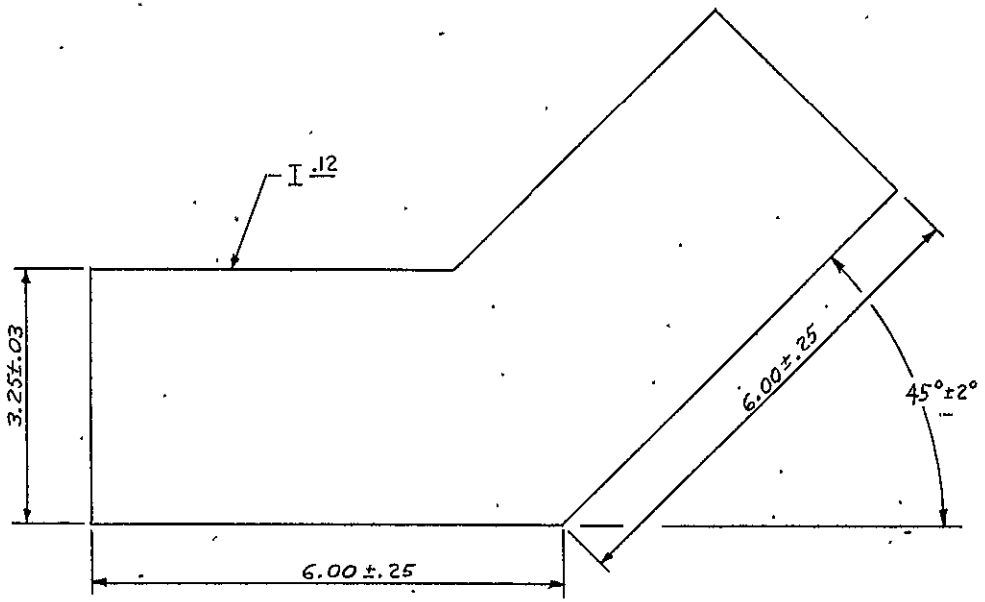
TECHNICAL APPROVAL		
ELEC		
METAL		
PLASTIC		

	SYM	DATE	CHANGE NO
	—	6-5-78	GG 352 JT

	SYM	DATE	CHANGE NO

7934944

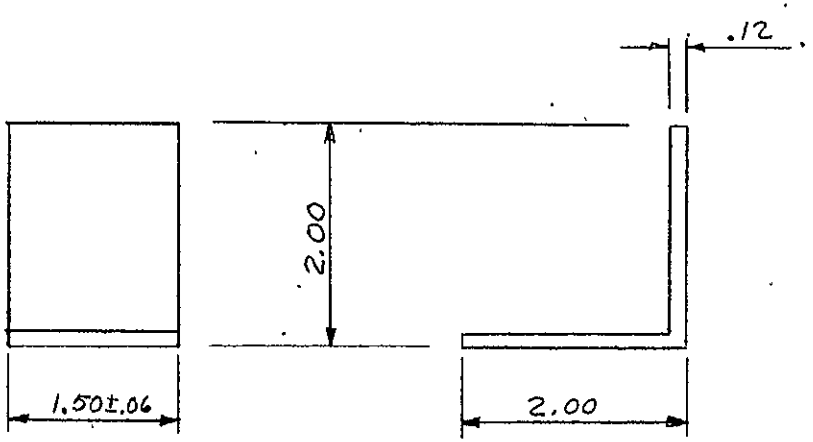
DEVELOPMENT NO | Q/M



IBM MATERIAL	NO 6061 T6 (ALUM ALY)	MUST CONFORM TO ENG SPEC 890350			IBM
		CODE IDENT 20234			NAME KNEE-PLATE
IBM MATL ALTERNATE	NO	SCALE 1/1	TOLERANCES UNLESS OTHERWISE NOTED	INCH / mm	
			LINEAR ±		DESIGNER RDC 11-9-77
CASE DEPTH		THIRD ANGLE PROJECTION	ANGLES ±		DETAILER RDC 11-9-77
HARDNESS			RADII UNLESS OTHERWISE NOTED		DWG CHK DSSutton 1-13-78
7934944 C	SURFACE TREATMENT	INCH / mm	EDGE/CORNER BREAKS OUTSIDE MAX .02		DSGN APPRO JKrucke 1-16-78
			INSIDE MAX		CLASSIFICATION

122

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL			R	SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO	7934945
7934975	56	ELEC			R	–	6-5-78	66352 JT					DEVELOPMENT NO. Q/M
7934980	24	METAL											
		PLASTIC											

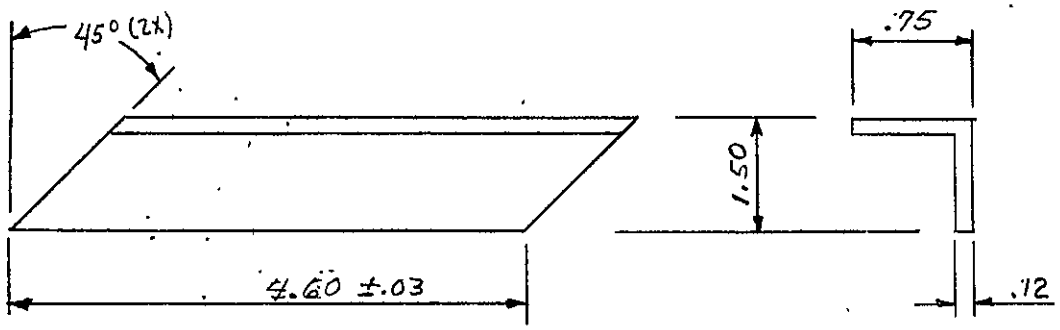


123

[redacted]

IBM MATERIAL NO 6061-T6 (ALUM ANGLE)		0 1 / 0 25.4	MUST CONFORM TO ENG SPEC 890350			IBM	
			CODE IDENT 20234				
IBM MATL ALTERNATE NO 6063-T5 (ALUM ANGLE)		SCALE 1/1	TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm	NAME SUPPORT ANGLE
CASE DEPTH			LINEAR ±				
HARDNESS			ANGLES ±				DESIGNER RDC 11-9-77
SURFACE TREATMENT		THIRD ANGLE PROJECTION	RADII UNLESS OTHERWISE NOTED				DETAILER RDC 11-9-77
7934945	B	INCH / mm	EDGE/CORNER BREAKS	OUTSIDE MAX	.02		DWG CHK. D Linton 1-13-78
				INSIDE MAX			DSGN APPRO J Kracke 1-16-78
							CLASSIFICATION

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO.		SYM	DATE	CHANGE NO	7934946	
7934975	16	ELEC				-	6-5-78	66352JT					DEVELOPMENT NO	Q/M
7934980	8	METAL												
		PLASTIC												



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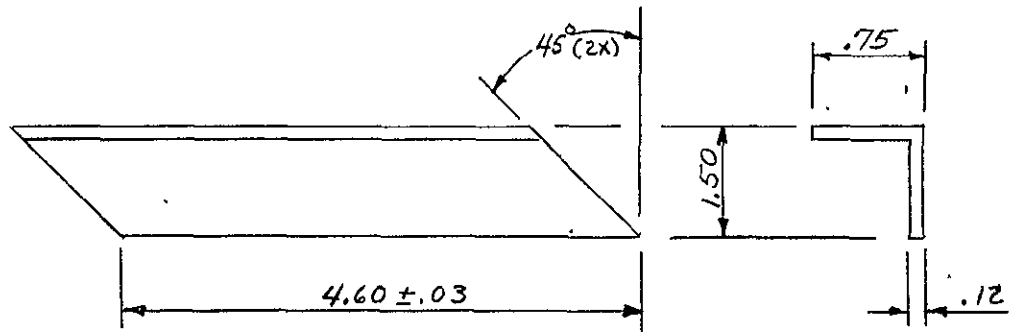
[redacted]

IBM MATERIAL NO 6061-T6 (ALUM ANGLE)		0 1 0 25.4	MUST CONFORM TO ENG SPEC 890350			IBM
IBM MATL ALTERNATE NO 6063-T5 (ALUM ANGLE)		SCALE 1/1	CODE IDENT 20234			NAME SUPPORT ANGLE
CASE DEPTH			TOLERANCES UNLESS OTHERWISE NOTED	INCH	m m	
HARDNESS		THIRD ANGLE PROJECTION	LINEAR ±			DESIGNER RDC 11-9-77
SURFACE TREATMENT			ANGLES ±			DETAILER RDC 11-9-77
7934946	B	INCH m m	RADII UNLESS OTHERWISE NOTED			DWG CHK DSS 1-13-78
			EDGE/CORNER BREAKS OUTSIDE MAX	.02		DSGN APPRO JKrach 1-16-78
			EDGE/CORNER BREAKS INSIDE MAX			CLASSIFICATION

820 7768 5 MRO# 780520807 MECHANICAL FORMAT ASTROCLOTH N600 OGILVIE PRESS

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO	7934947	
7934975	32	ELEC				—	6-5-78	66352 JT					DEVELOPMENT NO	Q/M
7934980	16	METAL												
		PLASTIC												



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[redacted]

IBM MATERIAL NO 6061-T6 (ALUM ANGLE)		0 1	MUST CONFORM TO ENG SPEC 890350			IBM	
IBM MATL ALTERNATE NO 6063-T6 (ALUM ANGLE)		0 25.4	CODE IDENT 20234			NAME	SUPPORT ANGLE
CASE DEPTH		SCALE 1/1	TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm	DESIGNER RDC 11-9-77
HARDNESS			LINEAR ±				DETAILER RDC 11-9-77
SURFACE TREATMENT		THIRD ANGLE PROJECTION	ANGLES ±				DWG CHK DSSutton 1-13-78
7934947	B	INCH mm	RADII UNLESS OTHERWISE NOTED				DSGN APPRO JKracke 1-16-78
			EDGE/CORNER BREAKS	OUTSIDE MAX	.02		CLASSIFICATION
				INSIDE MAX			

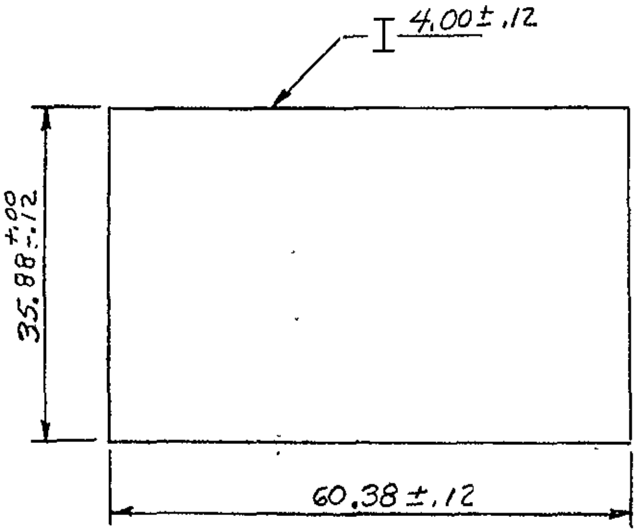
620 7768 B MRO# 780520807 MECHANICAL FORMAT ASTROCLOTH MADE OGILVIE PRESS

RELEASED FOR ASM	QTY
7934940	3

TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
ELEC				–	6-5-78	66352 JT				
METAL										
PLASTIC										

7934948

DEVELOPMENT NO	Q/M



NOTES:

1. MATERIAL: FOAM PLASTIC ISOCYANURATE, 2LBS/FT^3 DENSITY. (TRYMER CPR 9545, UPJOHN CORP OR EQUIV.)

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[redacted]

IBM MATERIAL	NO NOTE 1
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

SCALE 1/12 — THIRD ANGLE PROJECTION — INCH / mm

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED	INCH	mm
LINEAR ±		
ANGLES ±		
RADII UNLESS OTHERWISE NOTED		
EDGE/CORNER BREAKS — OUTSIDE MAX		
EDGE/CORNER BREAKS — INSIDE MAX		

IBM

NAME	INSULATION, BASE	
DESIGNER	RDC	11-15-77
DETAILER	RDC	11-16-77
DWG CHK	DS Sinton	1-16-78
DSGN APPRO	J Kracke	6-5-78
CLASSIFICATION		

7934948 B

620 7768 8 MRO# 780520807 MECHANICAL FORMAT ASTROCLOTH

RELEASED FOR ASM	QTY
7934940	12

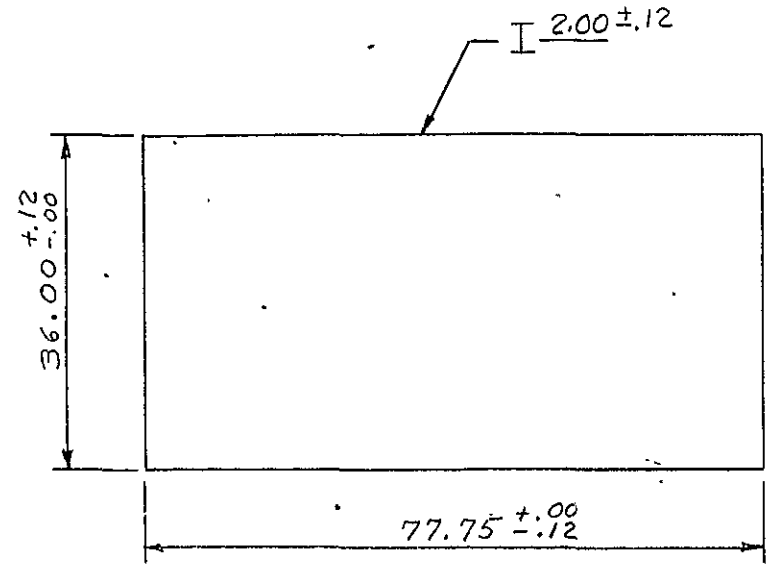
TECHNICAL APPROVAL		
ELEC		
METAL		
PLASTIC		

	SYM	DATE	CHANGE NO
	—	6-5-78	66352 JT

	SYM	DATE	CHANGE NO

7934947

DEVELOPMENT NO	Q/M



NOTES:

1. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT³ DENSITY. (TRYMER CPR9545, UPJOHN CORP OR EQUIV.)

[redacted]

IBM MATERIAL NO	NOTE 1		
IBM MATL ALTERNATE	NO		
CASE DEPTH			
HARDNESS			
SURFACE TREATMENT			
7934949	B		

0 1 0 25.4
SCALE 1/12
THIRD ANGLE PROJECTION
INCH mm

		INCH	mm
MUST CONFORM TO ENG SPEC 890350			
CODE IDENT 20234			
TOLERANCES UNLESS OTHERWISE NOTED			
LINEAR ±			
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	INSULATION, BLOCK	
DESIGNER	RDC	11-15-77
DETAILER	RDC	11-16-77
DWG CHK	DS Sutton	1-13-78
DSGN APPRO	JKrucke	1-16-78
CLASSIFICATION		

620 7768 5 MRO# 780520807 MECHANICAL FORMAT

OGILVIE PRESS

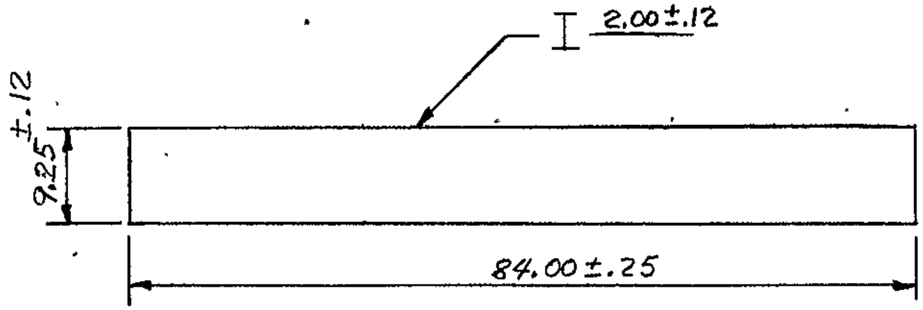
RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
7934940	10	ELEC			R	–	6-5-78	66352 JF				
		METAL										
		PLASTIC										

7934973

DEVELOPMENT NO | Q/M

NOTES:

1. MATERIAL: FOAM PLASTIC ISOCYANURATE, 2LBS/FT^3 DENSITY. (TRYMER CPR9545, UPJOHN CORP OR EQUIV.)



.128

[redacted]

IBM MATERIAL NO	NOTE 1
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

SCALE 1/12

THIRD ANGLE PROJECTION

INCH / mm

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED	INCH	mm
LINEAR ±		
ANGLES ±		
RADII UNLESS OTHERWISE NOTED		
EDGE/CORNER BREAKS — OUTSIDE MAX		
EDGE/CORNER BREAKS — INSIDE MAX		

IBM

NAME INSULATION, TRIM

DESIGNER	RDC	11-15-77
DETAILER	RDC	11-16-77
DWG CHK	[signature]	1-13-78
DSGN APPRO	[signature]	1-16-78
CLASSIFICATION		

7934973 B

620 7768 5 MRO# 780320807 MECHANICAL FORMAT ASTROCLOTH NSSCT

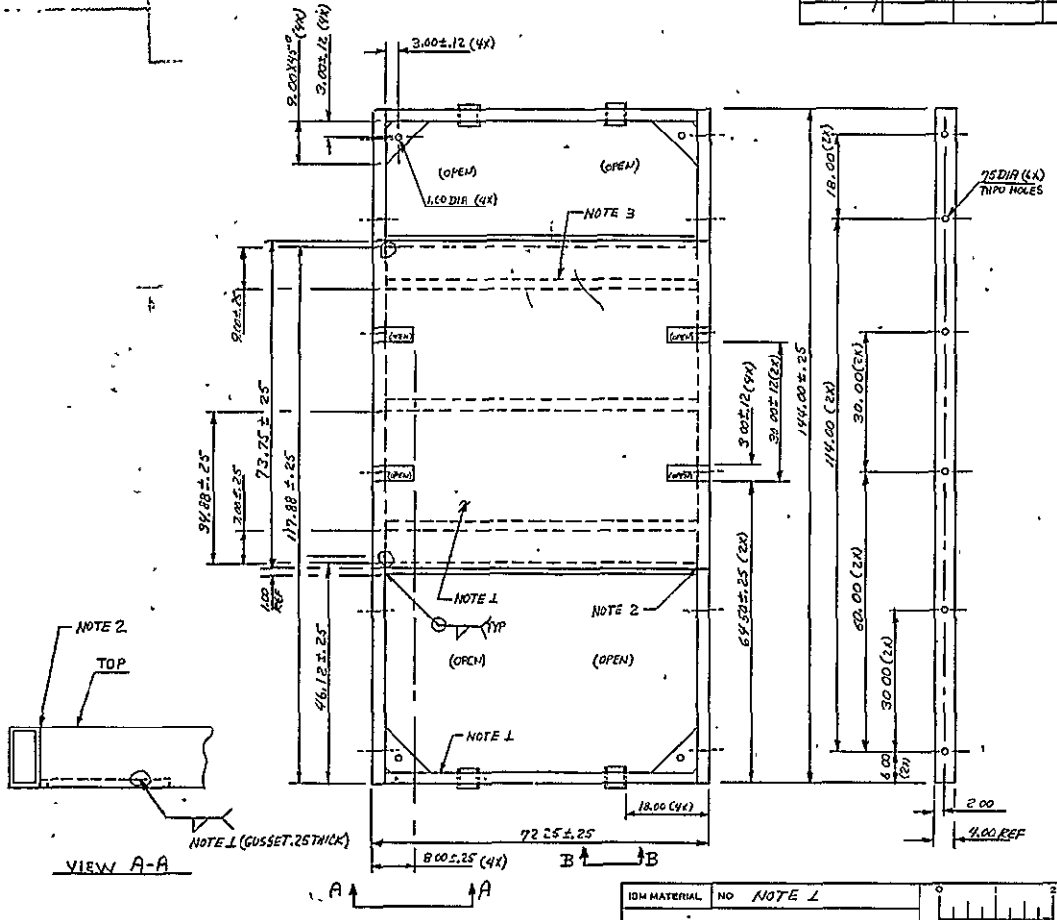
RELEASED FOR ASM	QTY
7934980	L

TECHNICAL APPROVAL			SYM	DATE	CHANGE NO
ELEC			.0	6-5-78	663523JT
METAL					
PLASTIC					

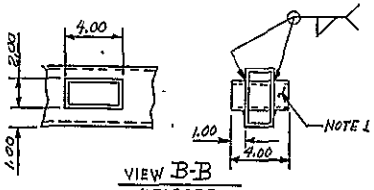
SYM	DATE	CHANGE NO

7934974

DEVELOPMENT NO | O/M



VIEW A-A



VIEW B-B
4 PLACES

NOTES:

1. MATERIAL:
   2.0 X 4.0 - .12 STEEL TUBING (C1025, C1010)
   .14 GA (.04) STEEL SHEET (C1010)
   .25 THICK GUSSET PLATE (C1010)
2. WELDS ON TOP OF FRAME TO BE GROUND FLUSH.
3. TACK WELD FROM BOTTOM SIDE. SHEET STEEL MAY BE PIECED AT CROSS MEMBERS
4. PRIME AND PAINT, COLOR BLACK (RUST INHIBITNE PAINT)

IDM MATERIAL	NO NOTE 1		
IDM MATL ALTERNATE	NO		
CASE DEPTH			
HARDNESS			
SURFACE TREATMENT	NOTE 4		

SCALE NONE

THIRD ANGLE PROJECTION

INCH / mm

MUST CONFORM TO ENG SPEC: 690350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED	INCH	mm
LINEAR ±	.XX ±.12	
ANGLES ±		
RADII UNLESS OTHERWISE NOTED		
EDGE/CORNER BREAKS	OUTSIDE MAX	
	INSIDE MAX	

IBM

NAME	BASE NO. 4	
SYSTEM 4		
DESIGNER	RDC	12-2-77
DETAILER	RDC	12-2-77
DWG CHK	DSSutton	1-13-78
DSGN APPRO	[illegible]	1-14-78
CLASSIFICATION		

7934974

[redacted]

FOLDOUT FRAME

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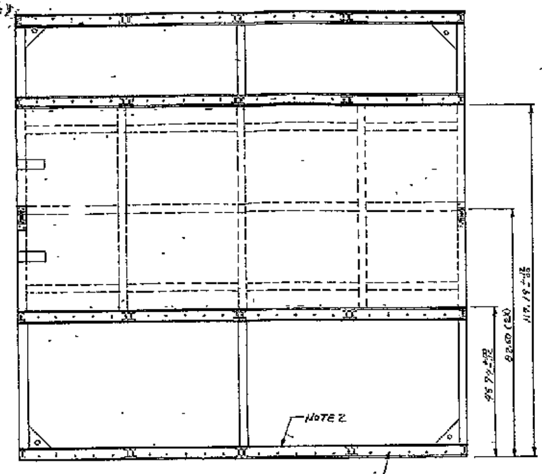
RELEASED FOR ASM	QTY	TECHNICAL APPROVAL			LTR	DATE	CHANGE NO
7934940		ELEC			M	6-5-78	66352 JT
		METAL					
		PLASTIC					

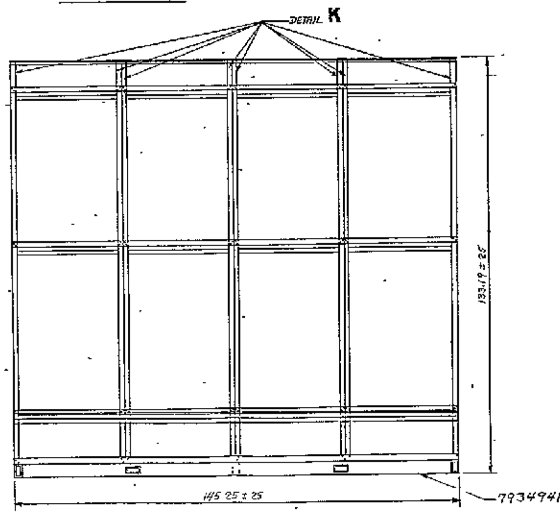
FOLDOUT FRAME

7934975

SHT 1 OF 3

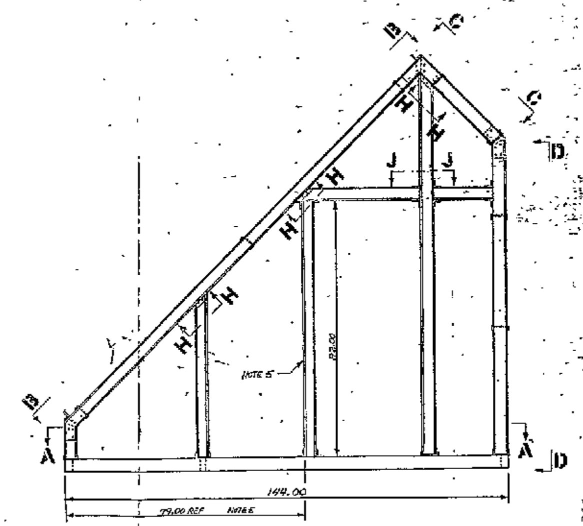


SECTION A-A



NOTES:

1. MATERIAL: 3.60X1.62-.08 ALUM CHANNEL (6063T6)
2. MATERIAL: 3.42X1.38-.08 ALUM CHANNEL (6063-T6)
3. MATERIAL: 3.60X1.62-.08 ALUM I BEAM (6063-T6)
4. MATERIAL: 2.00X2.00-.12 ALUM ANGLE (6063-T6)
5. INSTALL THIS BEAM AT BOTH ENDS OF STRUCTURE USING #8-3/4 SELF-TAPPING SCREWS.
6. SECURE STRUCTURE TO BASE USING POP-RIVETS (OR EQUIV) FIVE (5) EQUALLY SPACED RIVITS BETWEEN VERTICAL I BEAMS.
7. THIS DETAIL IS NOT SHOWN IN OTHER SECTIONS FOR CLARITY. REMOVE AND REINSTALL ON LEFT SIDE OF STRUCTURE WHEN MULTIPLE UNITS ARE ADDED.
8. POP-RIVIT (OR EQUIV) ALUM MATING PARTS IN PLACE AT ASSEMBLY.
9. INSTALL STORM DOOR USING #8-3/4 SELF TAPPING SCREWS.
10. INSTALL .005 THICK POLY ETHYLENE SHEET BETWEEN STEEL BASE AND ALUM BASE CHANNELS BEFORE RIVETING.
11. INSTALL RIVETS WET, USING ZINC CHROMATE RUST INHIBITER.



IBM MATERIAL	NO NOTES 1,2,3,4	SCALE	NONE	MUST CONFORM TO ENG SPEC. 890050		IBM	
IBM MATL ALTERNATE	NO	THIRD ANGLE PROJECTION		CODE IDENT 20239		NAME	STRUCTURE, TYPE B
CASE DEPTH				TOLERANCES UNLESS OTHERWISE NOTED	INCH / MM	SYSTEM 4	
HARDNESS				LINEAR ± .XX ± .12		DESIGNER	RDC 12-6-77
SURFACE TREATMENT				ANGLES ±		DETAILER	RDC 12-6-77
				RADII UNLESS OTHERWISE NOTED		DWG CHK	[illegible] 1-13-78
				EDGE/CORNER BREAKS	OUTSIDE MAX / INSIDE MAX	DSGN APPRD	[illegible] 1-11-78
						CLASSIFICATION	

7934975

[redacted]

E

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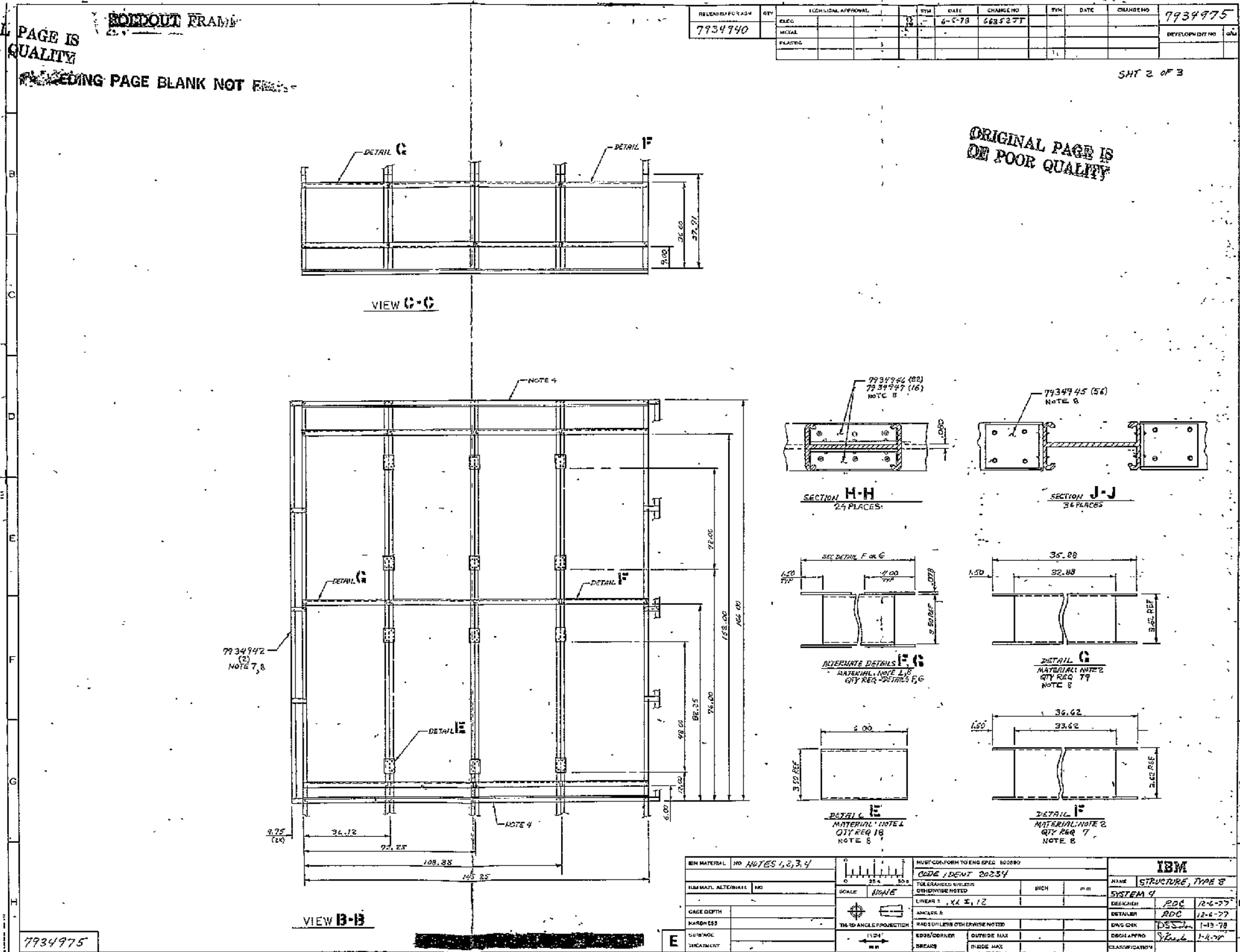

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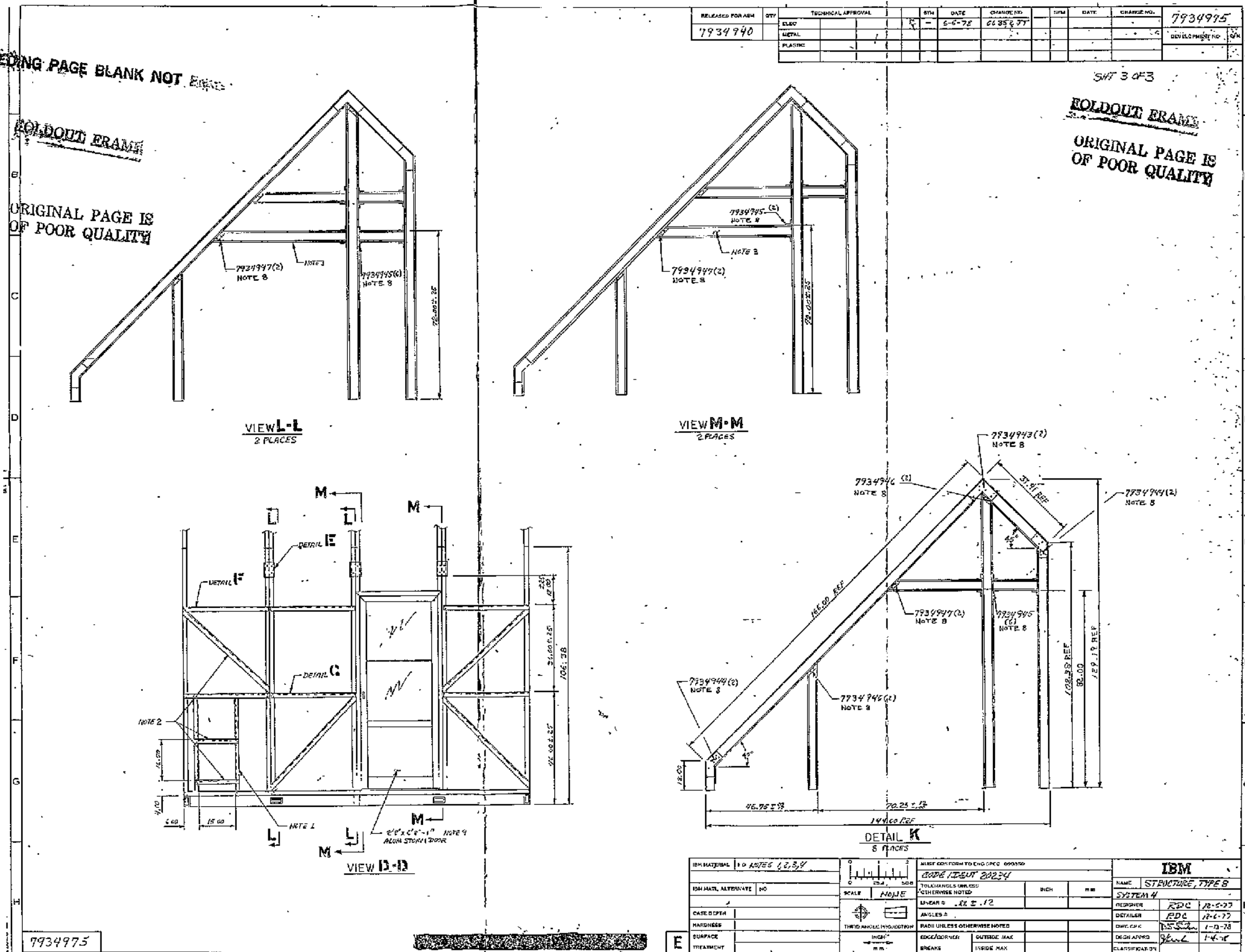

RELEASED FOR ASM
7934940
TECHNICAL APPROVAL
ELEC
METAL
PLASTIC
DATE
CHANGE NO.
6-5-78
7934975
DEVELOPMENT NO.
SHT 3 OF 3
7934947(2)
NOTE 8
NOTE 3
7934945(6)
NOTE 8
VIEW L-L
2 PLACES
7934945(2)
NOTE 8
NOTE 3
7934947(2)
NOTE 8
VIEW M-M
2 PLACES
DETAIL E
DETAIL F
DETAIL G
NOTE 2
NOTE 1
NOTE 4
ALUM STORM DOOR
106.38
VIEW D-D
7934943(2)
NOTE 8
7934946(2)
NOTE 8
7934944(2)
NOTE 8
146.00 REF
7934947(2)
NOTE 8
7934945(6)
NOTE 8
7934944(2)
NOTE 8
7934946(2)
NOTE 8
108.38 REF
98.00
129.19 REF
12.00
46.75
70.25
144.00 REF
DETAIL K
8 PLACES
IBM MATERIAL
SEE NOTES 1,2,3,4
IBM MATL ALTERNATE
NO
CASE DEPTH
HARDNESS
SURFACE TREATMENT
SCALE
NONE
THIRD ANGLE PROJECTION
MUST CONFORM TO ENG SPEC
CODE IDENT 20234
TOLERANCES UNLESS OTHERWISE NOTED
LINEAR
ANGLES
RADII UNLESS OTHERWISE NOTED
EDGE/CORNER
BREAKS
OUTSIDE MAX
INSIDE MAX
IBM
NAME
STRUCTURE, TYPE B
SYSTEM 4
DESIGNER
RDC
DETAILER
RDC
DWG CHK
DSGN APPRD
CLASSIFICATION
7934975
E

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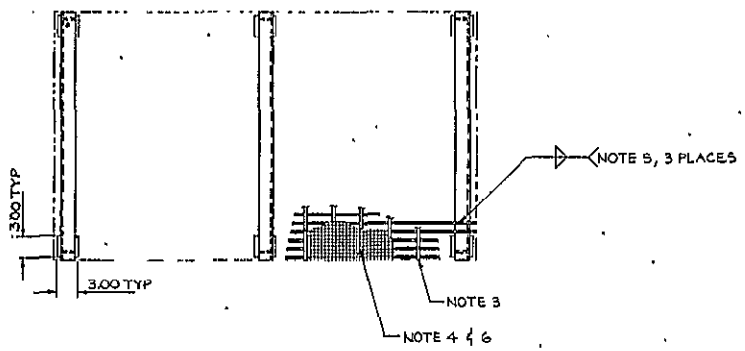
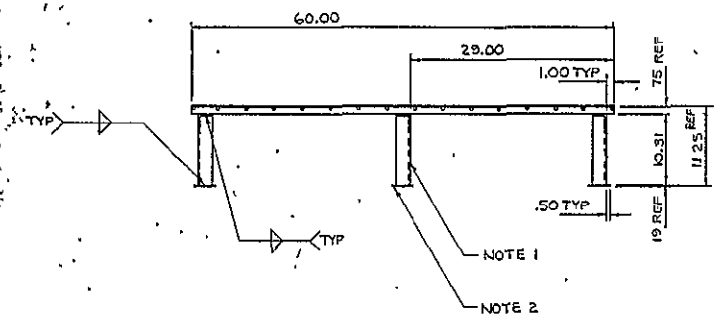
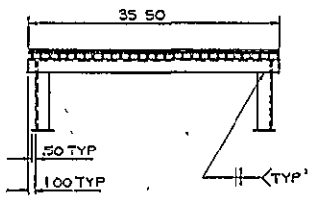
RELEASED FOR ASM	QTY
7934940	3

TECHNICAL APPROVAL			SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
ELEC									
METAL				6-5-78	66352 JT				
PLASTIC									

DEVELOPMENT NO	Q/M
7934976	







NOTES:
1. MATERIAL - STEEL ANGLE, 2x2x3/16 (C1010)
2. MATERIAL STEEL SHEET, 10 THICK (C1010)
3. MATERIAL STEEL GRATING, WELDED BEARING BARS 5/16 X 3/4, 1 3/16" ON CENTERS. CROSS BARS 4" ON CENTERS
4. MATERIAL WOVEN STEEL WIRE CLOTH, GALVANIZED, 1/2" ON CENTERS, BOTH DIRECTIONS. 040 APPROX WIRE DIA.
5. WELD APPROX EVERY 4TH BEARING BAR TO ANGLE
6. SECURE WOVEN STEEL WIRE CLOTH TO GRATING WITH BAILING WIRE
7. CLEAN, PRIME AND PAINT UNPAINTED SURFACES WITH RUST INHIBITIVE BLACK PAINT

IBM MATERIAL	NO
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

SCALE 1/8

THIRD ANGLE PROJECTION

INCH / mm

MUST CONFORM TO ENG SPEC: 690350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED	INCH	mm
LINEAR ±	XX = ± .25	
ANGLES ±		
RADII UNLESS OTHERWISE NOTED		
EDGE/CORNER BREAKS — OUTSIDE MAX		
EDGE/CORNER BREAKS — INSIDE MAX		

IBM

NAME	GRATING, ROCK SUPPORT	
DESIGNER		
DETAILER	RLS	12-7-77
DWG CHK	DS Sutton	1-13-78
DSGN APPRO	[illegible]	1-16-78
CLASSIFICATION		

7934976

[redacted]

[redacted]

RELEASED FOR ASM	QTY
7934940	1

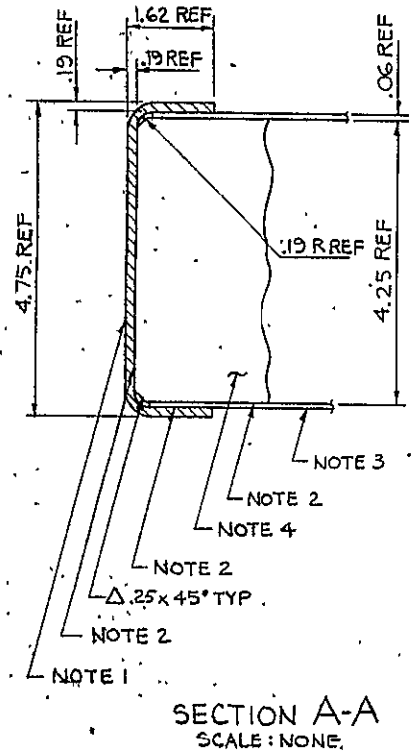
TECHNICAL APPROVAL		
ELEC		
METAL		
PLASTIC		

	SYM	DATE	CHANGE NO
R	—	6-5-78	663522

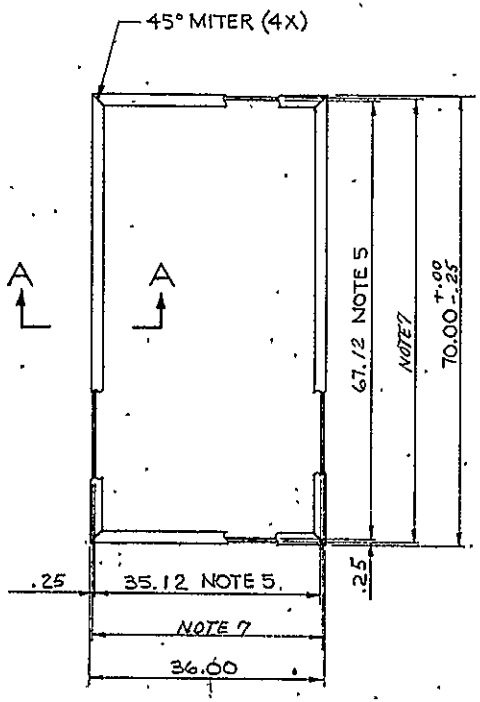
	SYM	DATE	CHANGE NO

7934977

DEVELOPMENT NO | Q/M



SECTION A-A
SCALE: NONE.



NOTES:

1. MATERIAL: CHANNEL, FIBERGLASS REINFORCED POLYESTER, NEMA GPO-2. GLASTIC 1788-IC OR EQUIV.
2. MATERIAL: ADHESIVE, HYSOL EA934 OR EQUIV. APPLY UNIFORM LAYER .01-.06 THICK
3. MATERIAL: FIBERGLASS REINFORCED POLYESTER LAMINATE, .060 THICK, NEMA GPO-2. GLASTIC OR EQUIV.
4. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT³ DENSITY. UPJOHN TRYMER CPR9545 OR EQUIV.
5. FACE SHEET DIMENSIONS FOR CHANNEL RADII CLEARANCE
6. SAND LIGHTLY ALL SURFACES OF POLYESTER GLASS SHEET AND CHANNEL TO BE BONDED
7. CUT FORM TO FIT CHANNELS WITH .06 CLEARANCE FOR BOND

IBM MATERIAL	NO
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

7934977 | C

SCALE 1/12

THIRD ANGLE PROJECTION

INCH / m m

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	m m
LINEAR ±		.XX=.12	
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	PANEL, TOP	
DESIGNER	RDC	12-1-77
DETAILER	RLS	12-2-77
DWG CHK	D.S. Sinton	1-13-78
DSGN APPRO	[illegible]	1-16-78
CLASSIFICATION		

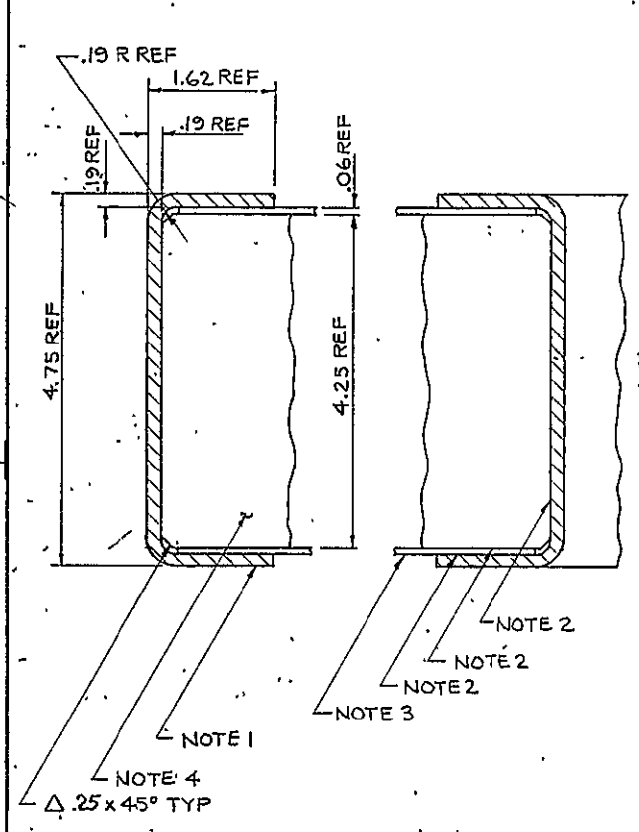
[redacted]

RELEASED FOR ASM	QTY
7934940	

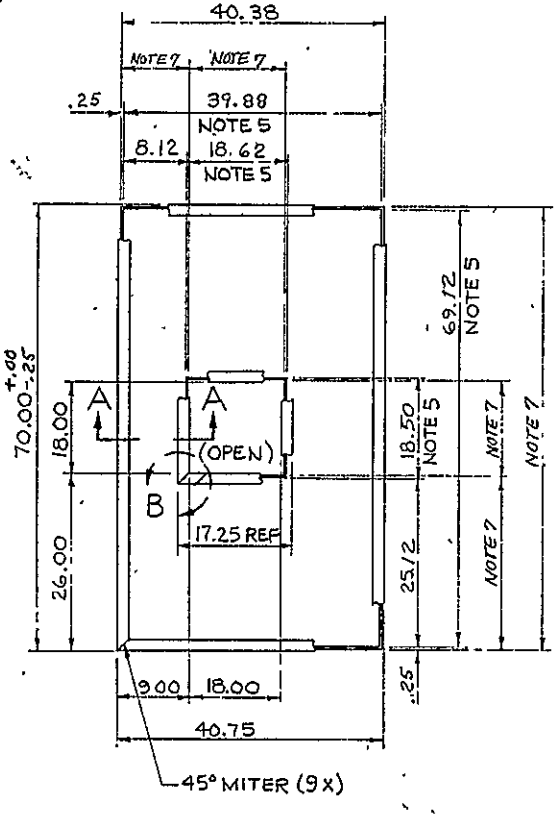
TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
ELEC				-	6-5-78	663525T				
METAL										
PLASTIC										

7934978

DEVELOPMENT NO	Q/M

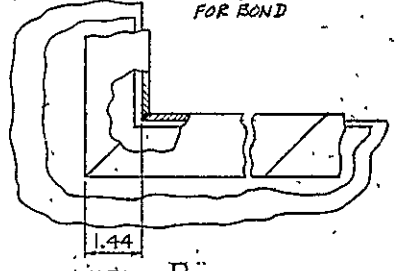


SECTION A-A
SCALE: FULL



NOTES:

1. MATERIAL: CHANNEL, FIBERGLASS REINFORCED POLYESTER, NEMA GPO-2. GLASTIC 1788-IC OR EQUIV.
2. MATERIAL: ADHESIVE, HYSOL EA934, OR EQUIV. APPLY UNIFORM LAYER .01-.06 THICK
3. MATERIAL: FIBERGLASS REINFORCED POLYESTER LAMINATE, .060 THICK, NEMA GPO-2. GLASTIC OR EQUIV.
4. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT³ DENSITY, UPJOHN TRYMER CPR 9545 OR EQUIV.
5. FACE SHEET DIMENSIONS FOR CHANNEL RADII CLEARANCE
6. SAND LIGHTLY ALL SURFACES OF POLYESTER GLASS SHEET AND CHANNEL TO BE BONDED
7. CUT FOAM TO FIT CHANNELS WITH .06 CLEARANCE FOR BOND



VIEW B

IBM MATERIAL	NO
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	

7934978 C

0 1 2
0 25.4 50.8
SCALE 1/12

THIRD ANGLE PROJECTION

INCH
m m

MUST CONFORM TO ENG SPEC B90350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	m m
LINEAR ±		.XX = .12	
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	PANEL, TOP	
DESIGNER	RDC	12-1-77
DETAILER	RLS	12-2-77
DWG CHK	DSS	1-13-77
DSGN APPRO	[illegible]	1-16-78
CLASSIFICATION		

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RELEASED FOR ASM	QTY	TECHNICAL APPROVAL	SYM	DATE	CHANGE NO
7934940		ELEC	D	6-5-78	668527T
		METAL			
		PLASTIC			

7934980

SHT 1 OF 2

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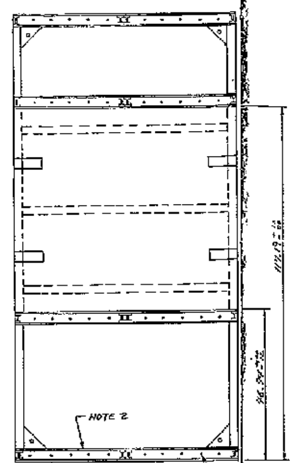
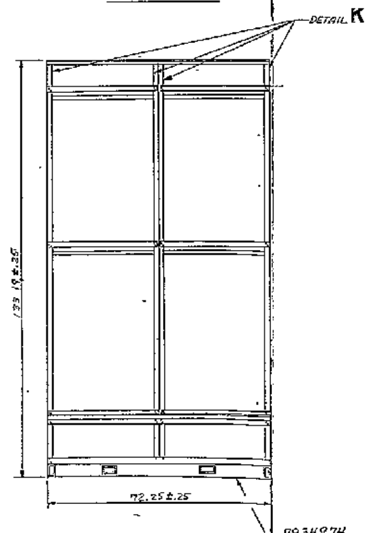
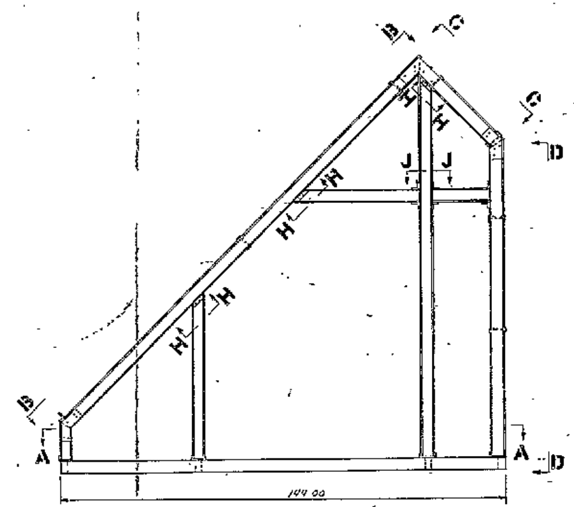
NOTES

1. MATERIAL: 3.50X1.62-.08 ALUM CHANNEL (6063-T6)
2. MATERIAL: 3.62X1.38-.08 ALUM CHANNEL (6063-T6)
3. MATERIAL: 3.50X1.62-.08 ALUM I BEAM (6063-T6)
4. MATERIAL: 2.00X2.00-.12 ALUM ANGLE (6063-T5)
5. POP RIVET (OR EQUIV) ALUM. MATING PARTS IN PLACE AT ASSEMBLY.
6. SECURE STRUCTURE TO BASE USING POP-RIVETS (OR EQUIV) FIVE (5) EQUALLY SPACED RIVETS BETWEEN VERTICAL I BEAMS.
7. INSTALL .005 THICK POLY ETYLENE SHEET BETWEEN STEEL BASE AND ALUM BASE CHANNELS BEFORE RIVETING
8. INSTALL RIVETS WET, USING ZINC CHROMATE RUST INHIBITOR.



SECTION A-A

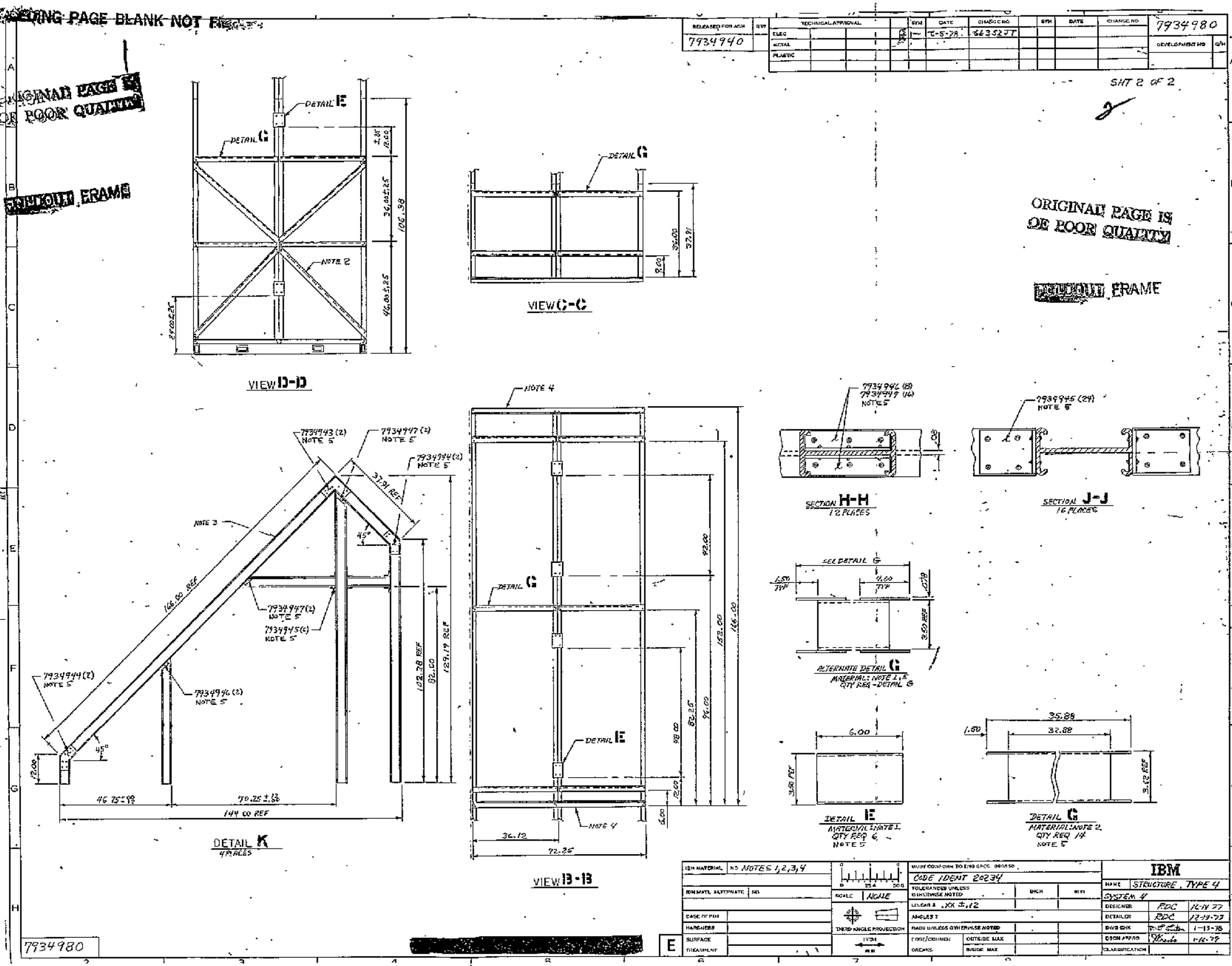




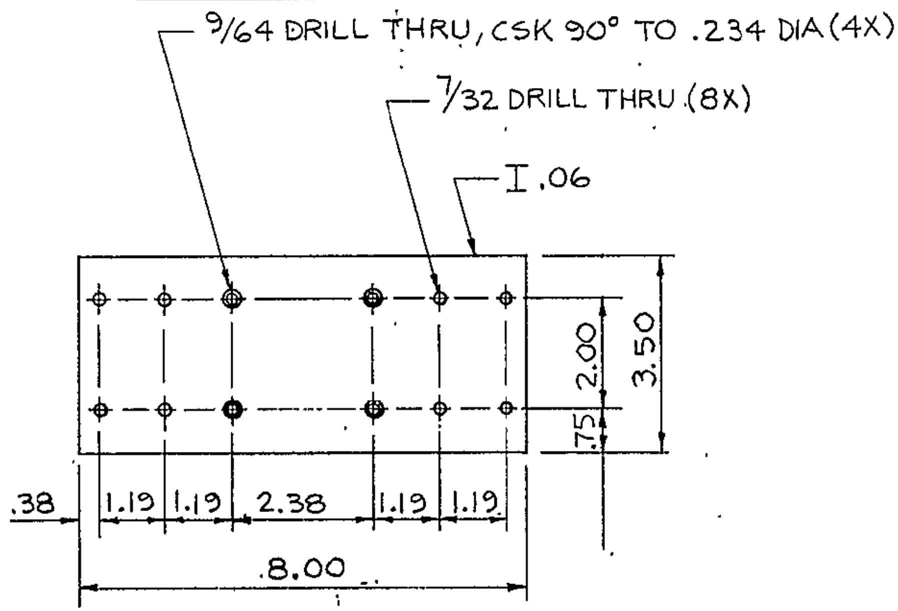
IBM MATERIAL	NO NOTES 1,2,3,4	SCALE NONE	MUST CONFORM TO ENG SPEC.	IBM
IBM NATL ALTERNATE	NO	THIRD ANGLE PROJECTION	CODE IDENT 20234	NAME STRUCTURE, TYPE 4
CASE DEPTH			TOLERANCES UNLESS OTHERWISE NOTED: INCH / mm	SYSTEM 4.
HARDNESS			LINEAR ± .XX ±.12	DESIGNER RDC 12-14-77
SURFACE			ANGLES ±	DETAILER RDC 12-14-77
TREATMENT			RADII UNLESS OTHERWISE NOTED	DWG CHK 1-15-78
			EDGE/CORNER BREAKS: OUTSIDE MAX / INSIDE MAX	DSGN APPRO 1-16-78
				CLASSIFICATION

E

7934980



RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO	7934981
7934940		ELEC				–	6-5-78	66352 JT					DEVELOPMENT NO / Q/M
		METAL											
		PLASTIC											



NOTES:
1. MATERIAL: ALUMINUM ALLOY SHEET STOCK

1.38

[redacted]

IBM MATERIAL NO	NOTE 1
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	
7934981	B

SCALE 1/2 — 0 1 / 0 25.4

THIRD ANGLE PROJECTION

INCH / mm

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED	INCH	mm
LINEAR ±	.XX= ±.03	.XXX= ±.010
ANGLES ±		
RADII UNLESS OTHERWISE NOTED		
EDGE/CORNER BREAKS — OUTSIDE MAX		
EDGE/CORNER BREAKS — INSIDE MAX		

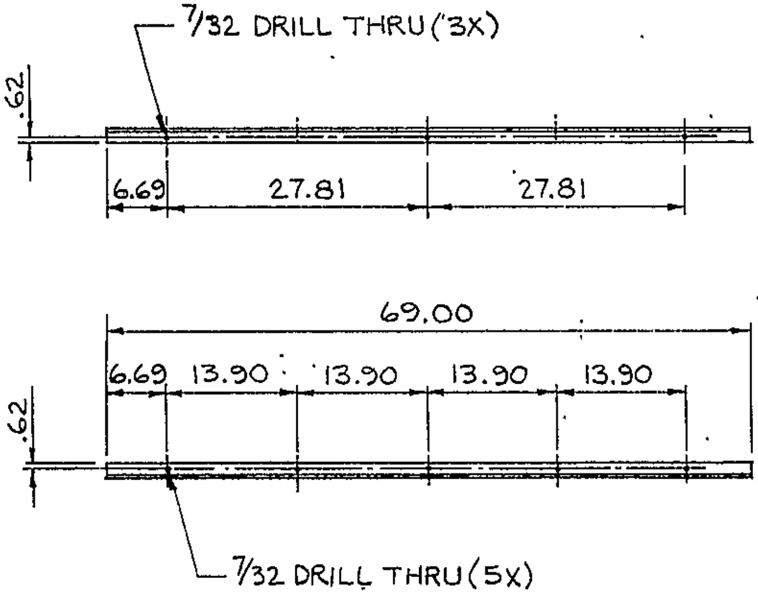
IBM

NAME	PLATE, FASTENER	
DESIGNER	RLS	12-16-77
DETAILER	RLS	12-16-77
DWG CHK	D S Sinton	1-13-78
DSGN APPRO	J Kraile	1-16-78
CLASSIFICATION		

520 7766 5 NRO# 780520807 MECHANICAL FORMAT ASTROCLOTH N4807 OGILVIE PRESS

RELEASED FOR ASM	QTY	TECHNICAL APPROVAL				SYM	DATE	CHANGE NO		SYM	DATE	CHANGE NO
7934940		ELEC				~	6-5-78	66352 JT				
		METAL										
		PLASTIC										

7934982	
DEVELOPMENT NO	Q/M



NOTES:
1. MATERIAL: 1 1/2 x 1 1/2 x 1/8 STEEL ANGLE
2. SURF. TREAT: PRIME AND PAINT, COLOR BLACK (RUST INHIBITIVE PAINT)

139

[redacted]

IBM MATERIAL NO	NOTE 1
IBM MATL ALTERNATE NO	
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	NOTE 2
7934982	B

SCALE 1/12

THIRD ANGLE PROJECTION

INCH / mm

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm
LINEAR ±		.XX = ±.03	
ANGLES ±			
RADII UNLESS OTHERWISE NOTED			
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	ANGLE, END PANEL	
DESIGNER	RLS	12-16-77
DETAILER	RLS	12-16-77
DWG CHK	DS Sinton	1-13-78
DSGN APPRO	J Kruche	1-16-78
CLASSIFICATION		

620 7768 B MRO# 780320807 MECHANICAL FORMAT ASTROCLOTH

RSA SIZE	L	W	H
8 COLLECTOR	12'-11"	12'-6"	11'-8"
12 COLLECTOR	18'-11"	12'-8"	11'-8"
16 COLLECTOR	24'-11"	12'-8"	11'-8"

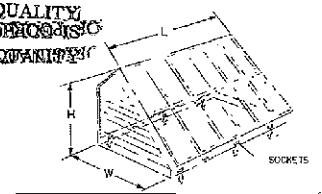
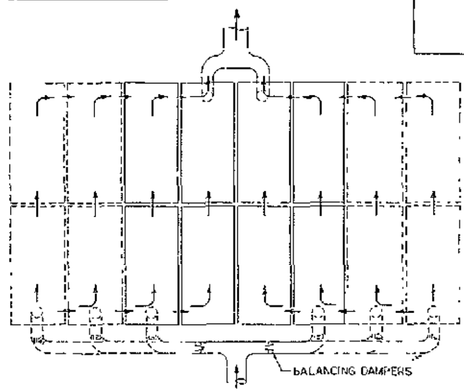
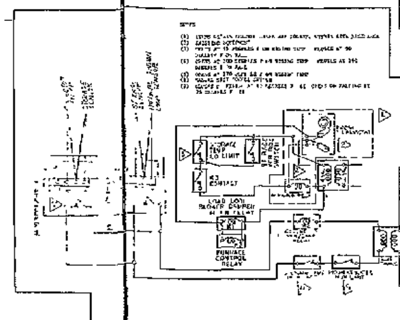


FIGURE 3

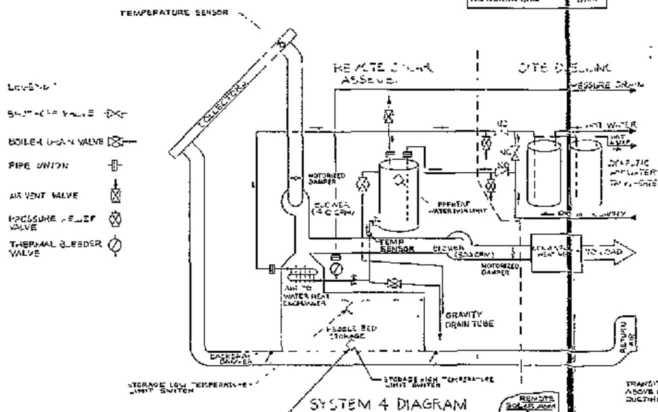


COLLECTOR ARRAY

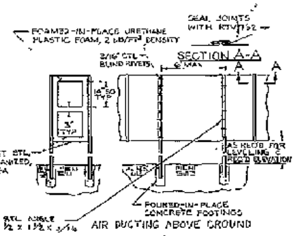


ELECTRICAL SCHEMATIC

WIRE TABLE

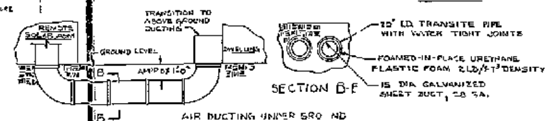


SYSTEM 4 DIAGRAM



AIR DUCTING ABOVE GROUND

FIGURE 1



SECTION B-B

AIR DUCTING UNDER GROUND

FIGURE 2

SYM	DATE	CHANGE
–	2-15-78	G63484
A	3-1-78	G63484E
B	6-6-78	G63523T
C	7-31-78	G63527A

7934983

IBM

SYSTEM 4

ASM, DESIGN DESCRIPTION

DETAILER RLS 12-21-77

CODE IDENT 20234

7934983

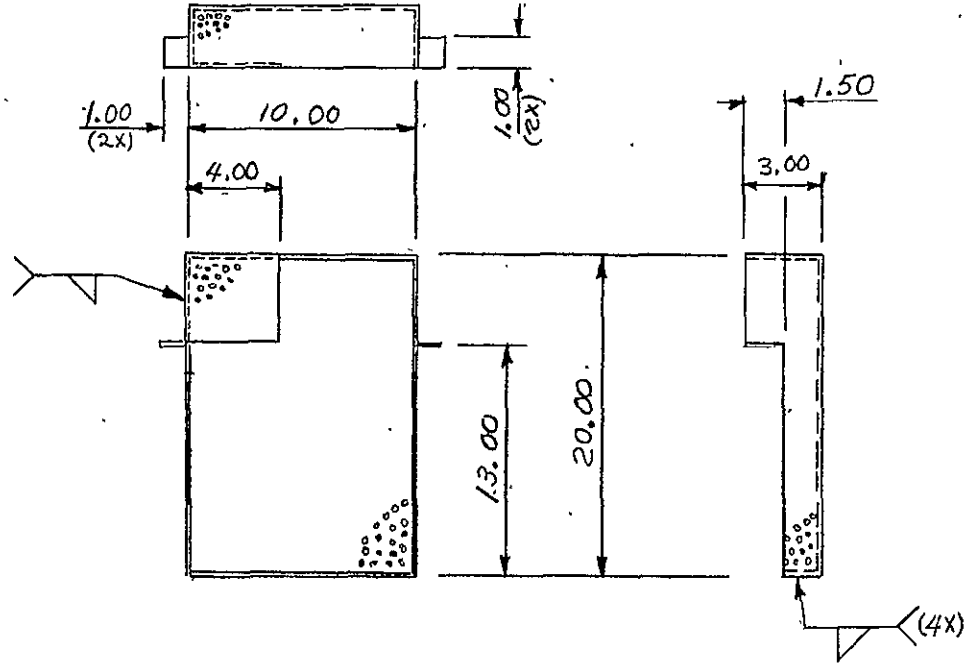
RELEASED FOR ASM	QTY
7934940	2

TECHNICAL APPROVAL		
ELEC		
METAL		
PLASTIC		

	SYM	DATE	CHANGE NO
R.	—	6-5-78	66352 JT

	SYM	DATE	CHANGE NO

7934984	
DEVELOPMENT NO	Q/M



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[redacted]

IBM MATERIAL	NO PERFORATED STEEL .25 DIA HOLES 30/50% OPEN		
IBM MATL ALTERNATE	NO		
CASE DEPTH			
HARDNESS			
SURFACE TREATMENT	PAINT BLACK		
7934984	B		

0 1 0 25.4

SCALE NONE

THIRD ANGLE PROJECTION

INCH mm

MUST CONFORM TO ENG SPEC 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED		INCH	mm
LINEAR ±	.XX ± .12		
ANGLES ±			
RADII UNLESS OTHERWISE NOTED		.12	
EDGE/CORNER BREAKS	OUTSIDE MAX		
	INSIDE MAX		

IBM

NAME	FAN GUARD	
SYS 4		
DESIGNER	RDC	1-9-78
DETAILER	RDC	1-9-78
DWG CHK	D Sinton	1-13-78
DSGN APPRO	J Krodo	1-16-78
CLASSIFICATION		

RELEASED FOR ASM	QTY
7934940	2

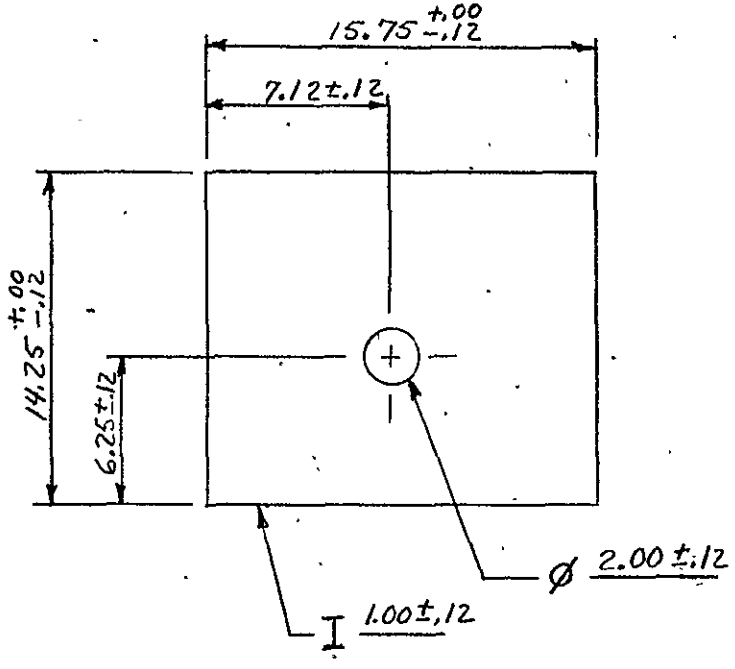
TECHNICAL APPROVAL		
ELEC		
METAL		
PLASTIC		

	SYM	DATE	CHANGE NO
	—	6-5-78	66352 JT

	SYM	DATE	CHANGE NO

7934986

DEVELOPMENT NO	Q/M



NOTES:

1. MATERIAL: FOAM PLASTIC, ISOCYANURATE, 2 LBS/FT³ DENSITY. (TRYMER CPR9545, UPJOHN CORP OR EQUIV)

[redacted]

IBM MATERIAL NO	NOTE 1
IBM MATL ALTERNATE	NO
CASE DEPTH	
HARDNESS	
SURFACE TREATMENT	
7934986	B

0 1 0 25.4 SCALE NONE

THIRD ANGLE PROJECTION

INCH / m m

MUST CONFORM TO ENG SPEC: 890350

CODE IDENT 20234

TOLERANCES UNLESS OTHERWISE NOTED	INCH	m m
LINEAR ±		
ANGLES ±		
RADII UNLESS OTHERWISE NOTED		
EDGE/CORNER BREAKS — OUTSIDE MAX		
EDGE/CORNER BREAKS — INSIDE MAX		

IBM

NAME	INSULATION, FAN	
DESIGNER	RDC	1-30-78
DETAILER	RDC	1-30-78
DWG CHK	D Sinton	6-5-78
DSGN APPRO	Krucko	6-5-78
CLASSIFICATION		

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