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DOE/NASA CONTRACTOR
REPORT

DOE/NASA CR-161513

**SOLAR HEATING AND DOMESTIC HOT WATER SYSTEM INSTALLED AT
KANSAS CITY FIRE STATION, KANSAS CITY, MISSOURI - Final Report**

Prepared from documents furnished by

City of Kansas City, Missouri
City Hall, 414 East 12th Street
Kansas City, Missouri 64152

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For the U. S. Department of Energy



(NASA-CR-161513) SOLAR HEATING AND DOMESTIC HOT WATER SYSTEM INSTALLED AT KANSAS CITY, FIRE STATIONS, KANSAS CITY, MISSOURI Final Report (City of Kansas City, Mo.) 170 p
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U.S. Department of Energy



Solar Energy

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I. INTRODUCTION

Fire Station 24 is a 3 bay fire station located in the central portion of Kansas City, Missouri; however, the original design for this project was for a different site and for a 2 bay station. For this semi-rural site the City retained Midgley Shaughnessy Fickel and Scott Architects to provide architectural services.

Towards the end of completing the contract documents for this station, the Gas Company notified the City that it would cost them approximately \$35,000 to have a gas line installed to service the site. The City began looking at alternate energy sources and through the initiation and encouragement of Cleve Humbert, Assistant City Architect in charge of Maintenance, solar energy became a viable option to be investigated.

The most important criteria that the architects looked for in a solar system was simplicity and reliability. It was determined that an air system met the requirement better than a liquid system and that the Solaron Corporations experience and quality product gave them an edge over other companies. In November of 1975 a response was submitted to PON 1 requesting funding for a solar heating system. In April of 1976 the City was notified the proposal was one of 34 proposals selected. Preliminary design was started in October 1976 and construction documents completed in March 1977. In June 1977 City requested approval from DOE to relocate the fire station to 22nd and Hardesty. The revised drawings were completed and released for bids in September 1977. In December the City awarded a contract for construction and construction started in February 1978. The building was occupied by the City in April of 1979.

II. SUMMARY OF PROJECT INFORMATION

A. General Information

Owner: City of Kansas City, Missouri

Contractor: D.F. Cahill Construction Co.
4721 Denver Avenue
Kansas City, Missouri 64130

Operational Date: August, 1979

Building:

Type: Fire Station

Area: 8,800 sq. ft.

Location: 22nd & Hardesty, Kansas City, Missouri

B. Meteorological Data

Latitude: 29° N

<u>Climate Data:</u>	Winter	Summer
Avg. temp. (°F)	41.0	71.7
Avg. insolation (ly/d)	298	545
Degree days (heating):	4711	

C. Solar Energy System

Application: Heating, 47%; hot water, 75%

Collector:

Type: Air cooled, flat plate

Area: 2808 sq. ft.

Manufacturer: Solaron Corporation
Denver, Colorado 80222

Storage:

Type: 1/2-inch diameter rock

Capacity: 1,428 cu. ft.

Auxilliary/Back-up System:

Heat pumps and resistance heating (operations area)

Resistance heaters (apparatus bay)

Electric heater (water)

III. DESCRIPTION OF THE SOLAR HEATED FIRE STATION

The fire station consists of two basic areas. The operations area (which is also air conditioned) occupied by the firemen, and the apparatus bay occupied by the fire equipment. The operations area contains 2,800 sq. feet and the apparatus bay 6,000 sq. feet. A winter design temperature of 50⁰ was established for the apparatus bay and 70⁰ for the operations.

The solar energy system is based on a prototype model which has been in continuous successful operation since 1957. There are three arrays of collectors, two mounted on the roof and one large array attached to the building. There are a total of 144 factory assembled modules 36 in. by 78 in. Each module has double tempered glass covers and a sheet absorber, with an air duct below the permanent black absorber surface.

The solar collectors were designed as an integral part of the apparatus bay. East and west screen walls were used to eliminate the awkward profile created by the three rows of roof mounted collectors. The fire station architect has been awarded a certificate of design excellence by the Midwest Concrete Industry Association for his conceptual development.

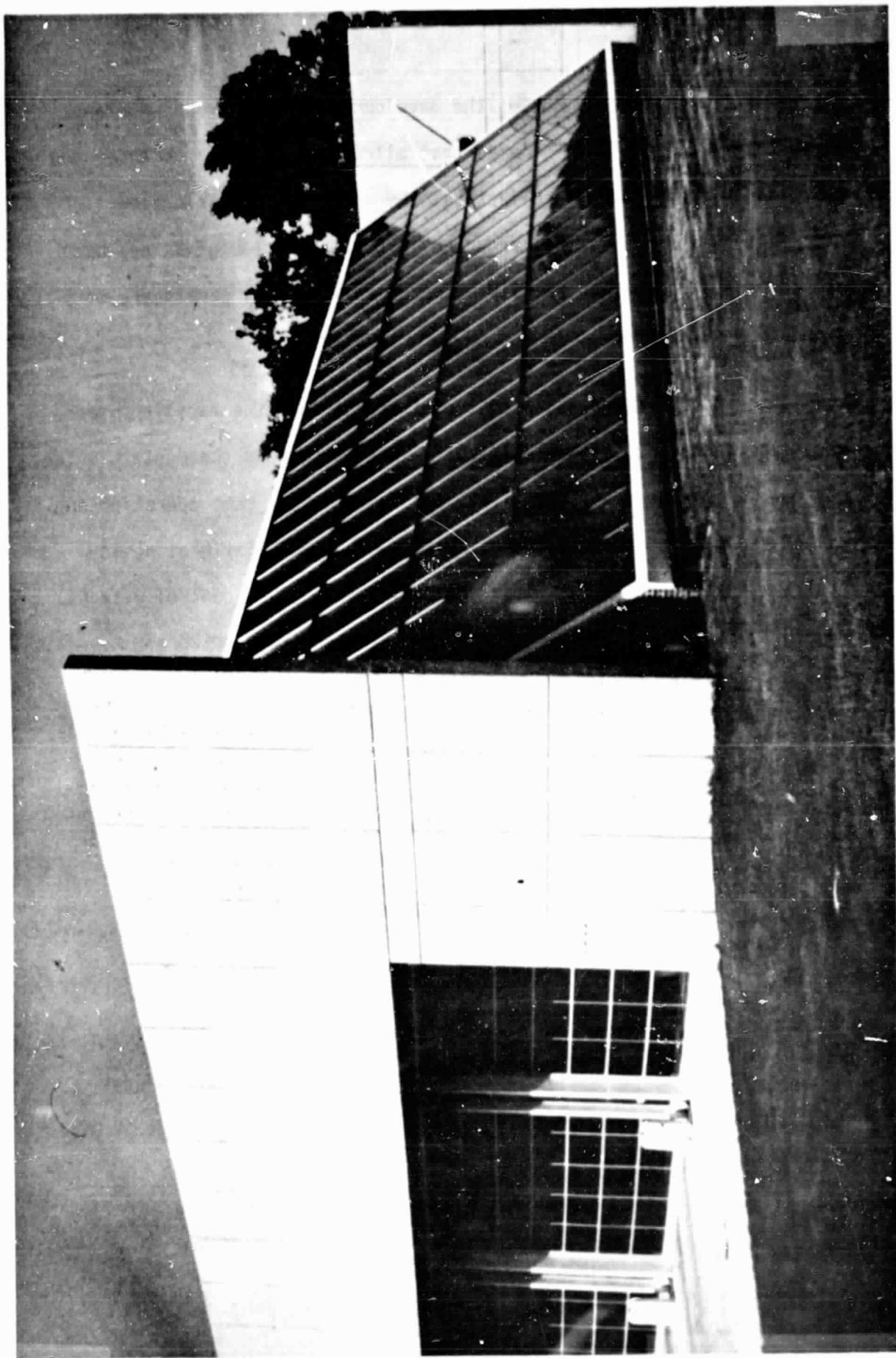
The extent of collector shading caused by the screen walls was measured at Kansas State University with equipment capable of providing sunpath and solar angle information relative to radiant energy and shading calculations. From these measurements, it was established that throughout the entire heating season between the hours of 10:00 a.m. and 3:00 p.m., the maximum shading was 1.5 per cent and between the hours of 9:00 a.m. and 4:00 p.m., the maximum shading was 7.6 per cent.

The solar heating hardware installation was met with few difficulties. Adapting the collectors and related equipment to the building structure

was carefully engineered during the development of construction plans. Other than a few sealant failures that allowed storm water to enter the building through the roof collectors, the installation has proved satisfactory. Vandalism has occurred in that collector glass has been broken. Replacement was readily effected as the glass panels are of standard manufacture.

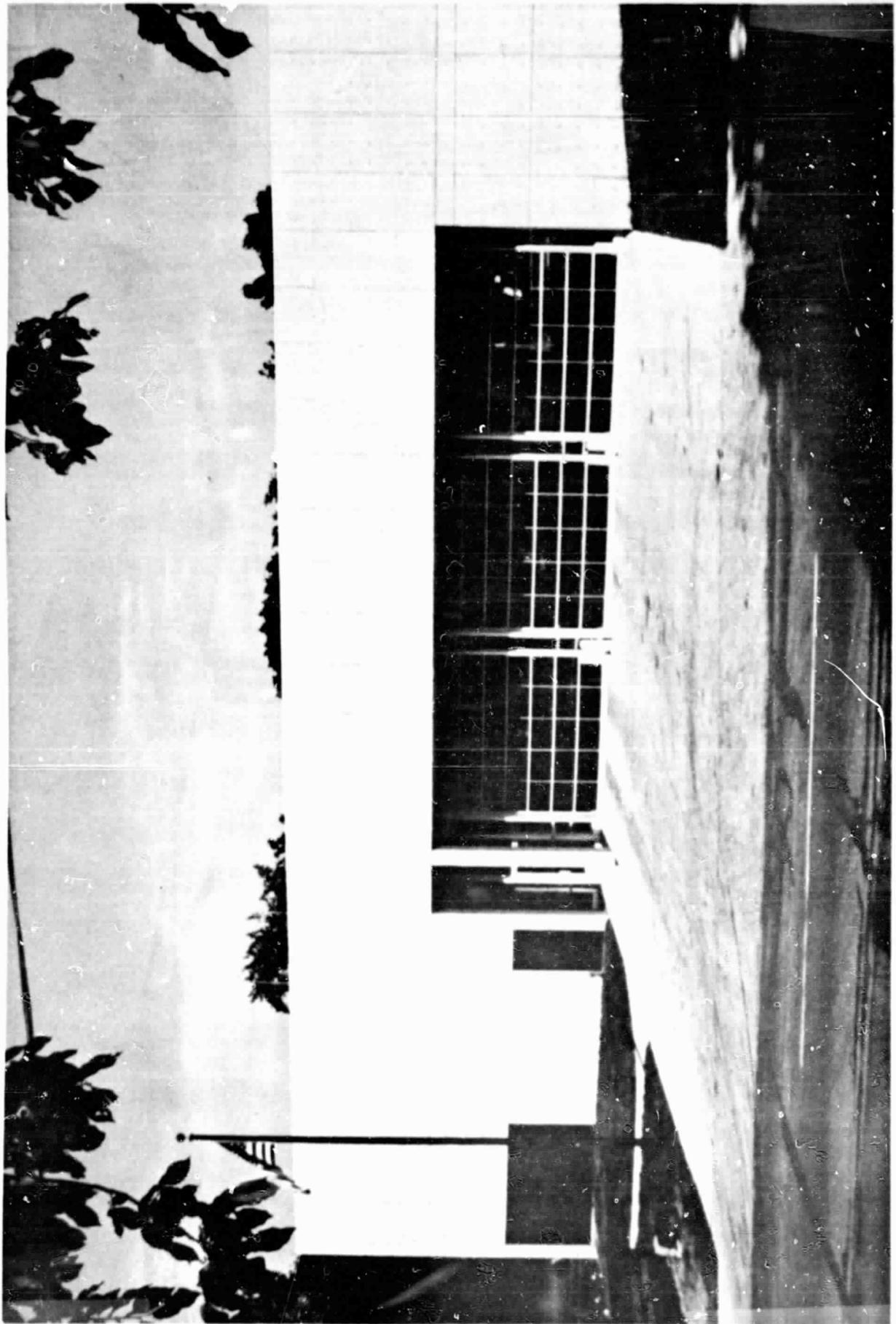
Due to the hybrid temperature control installation, the facility users have experienced occasional difficulty in setting room thermostats which control three sources of heat i.e., solar heat, heat pump operation and direct resistance electrical duct heaters. Future solar heating installations should provide for single unit temperature control without regard to setting of multiple thermostats in each room or zone.

Floor plans and building details can be found in Appendix A.

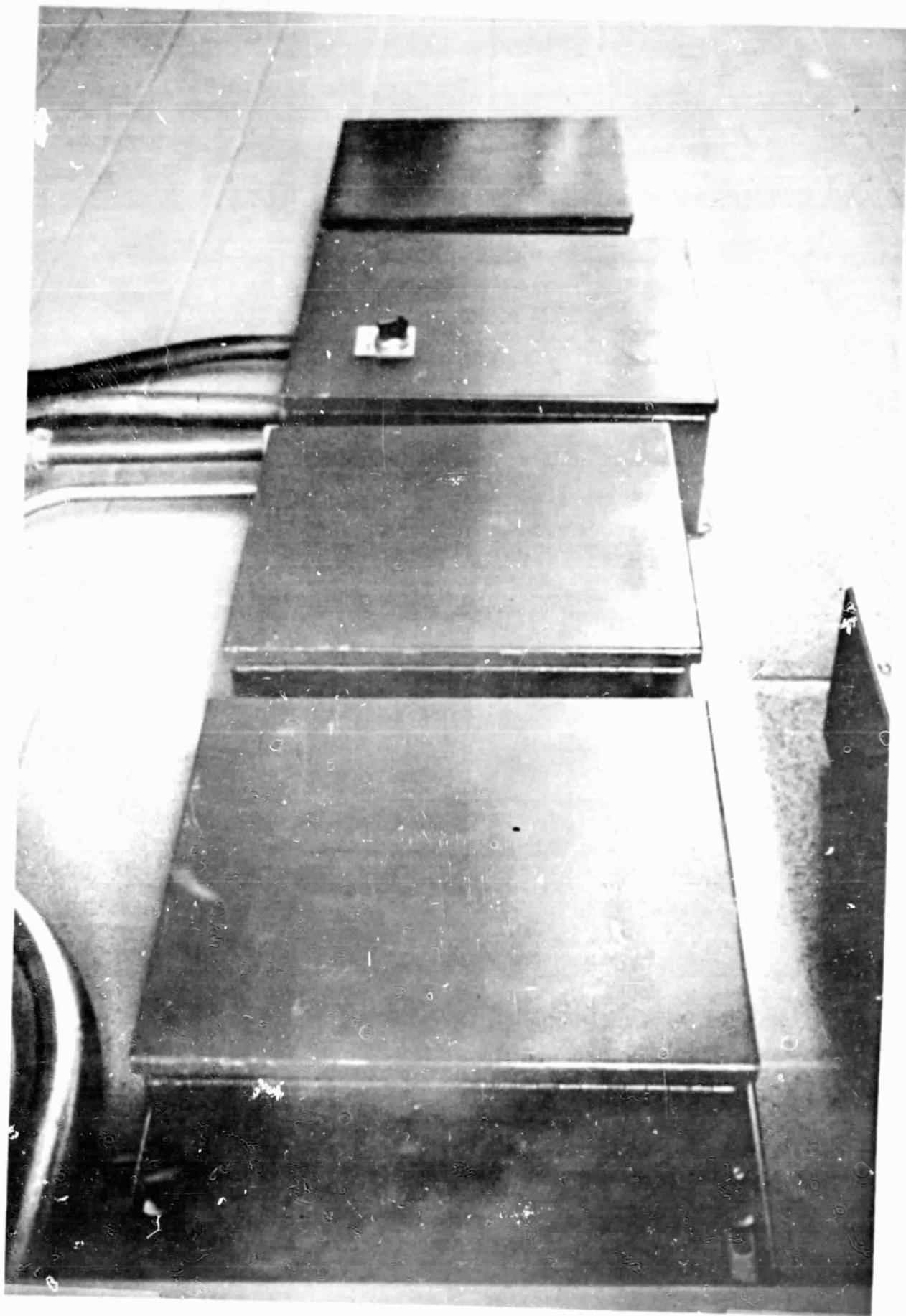


View of Solaron Collectors

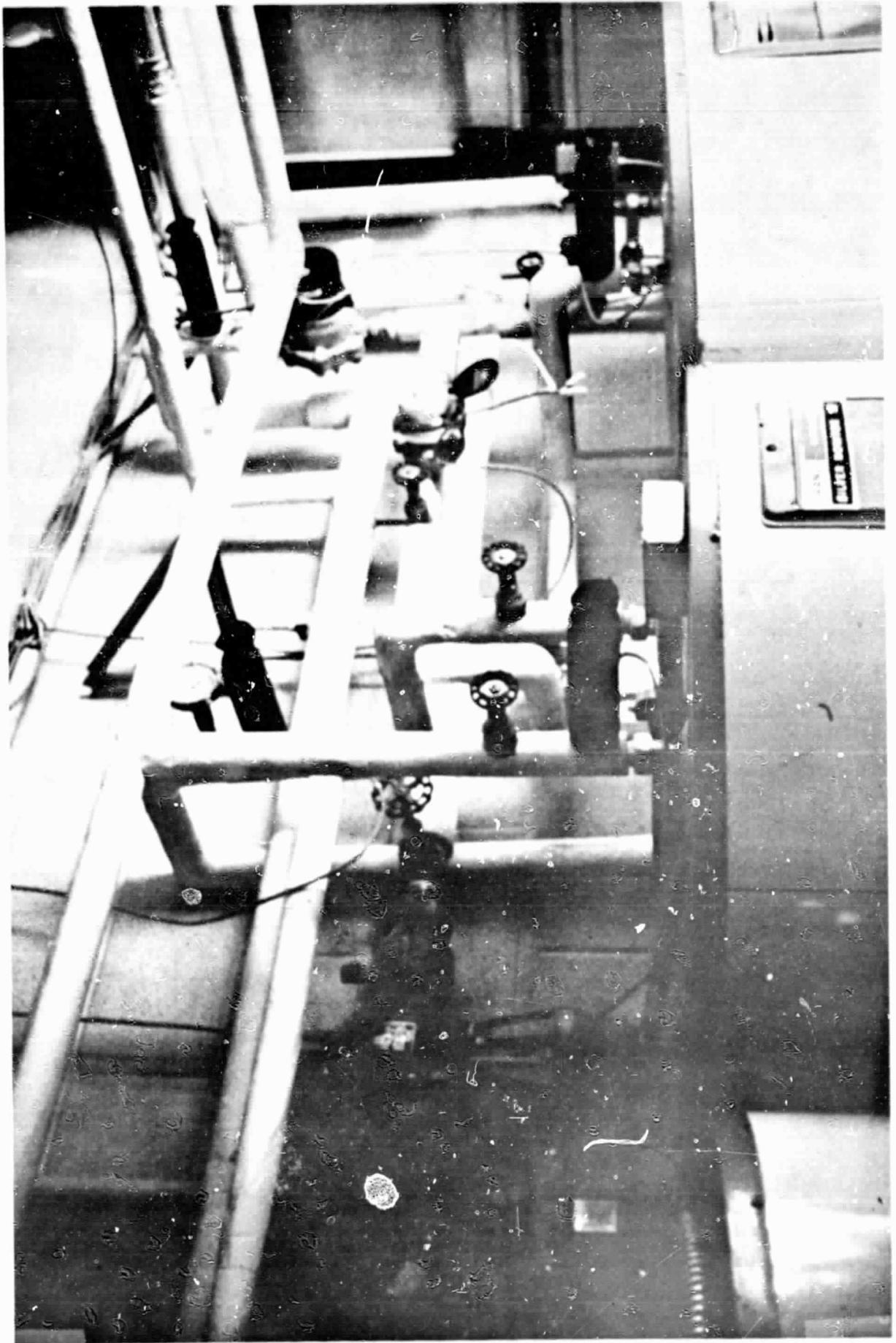
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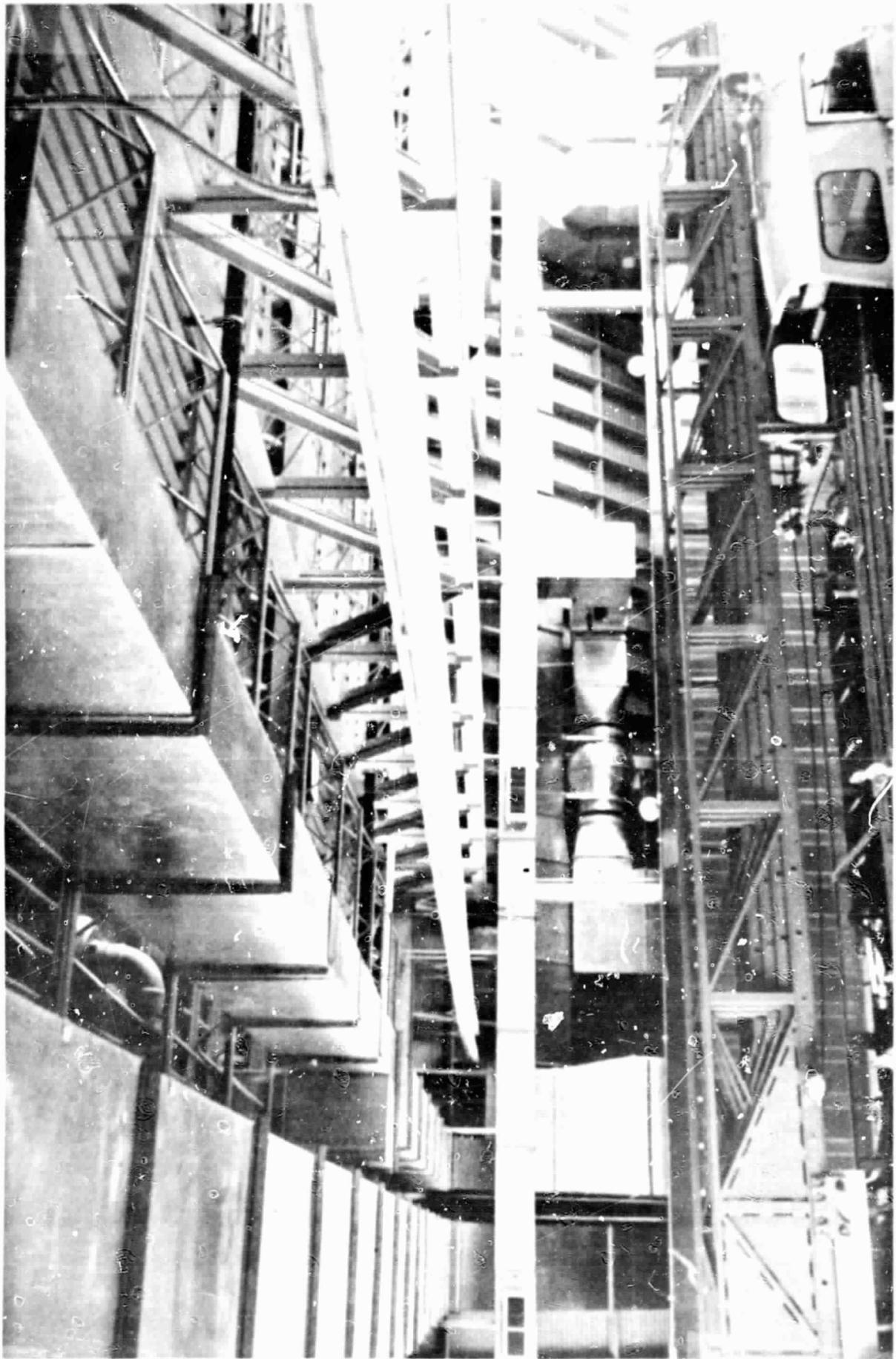
Front View Kansas City Fire Station #24



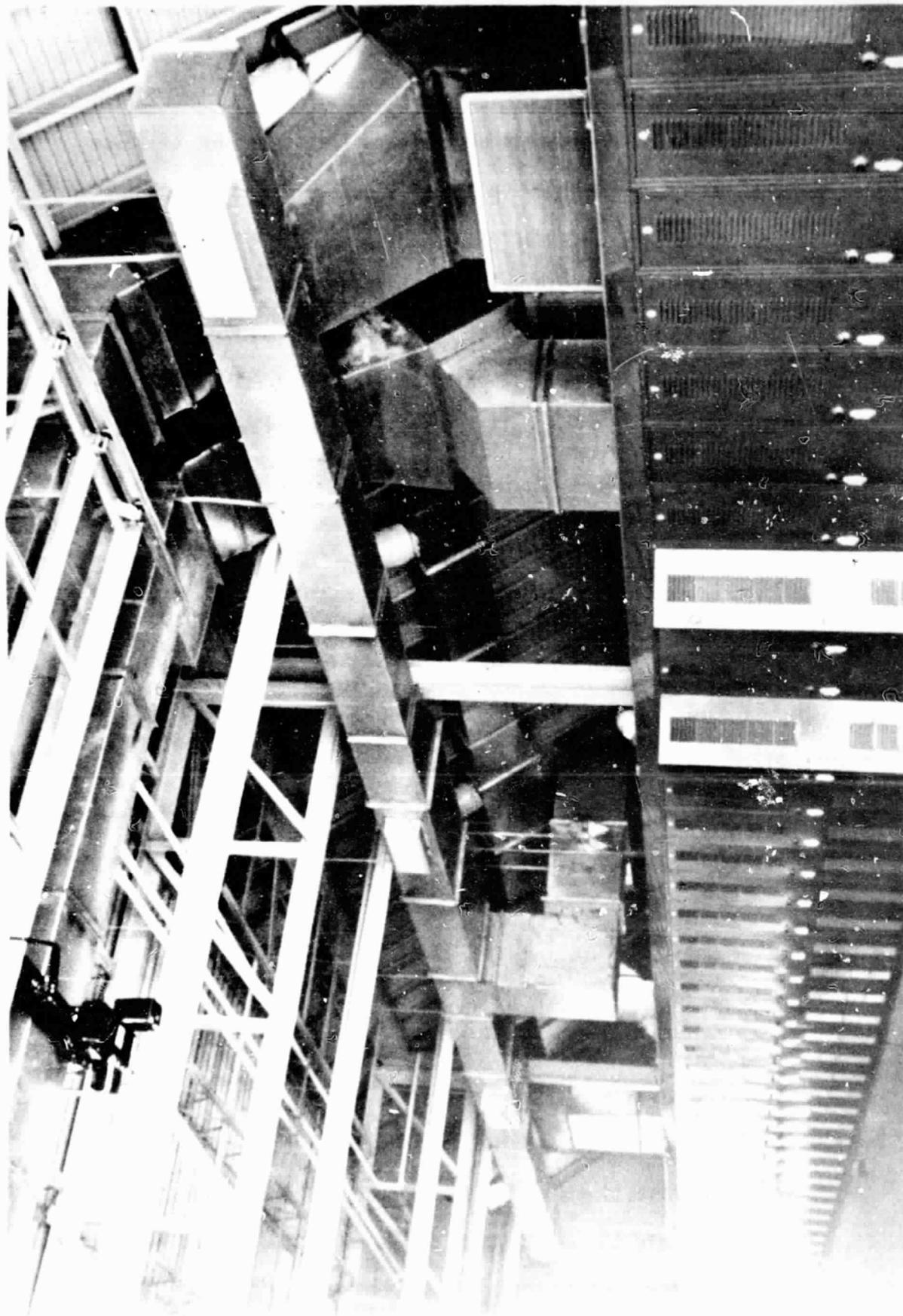
Solaron Control Boxes



Hot Water Heater Storage Tank Area



Solar System Ducting/Air Handler #3



Apparatus Room Heat Distribution Ductwork

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IV. DESCRIPTION OF THE SOLAR HEATING SYSTEM

A. Solar Collector

1. There are 3 separate arrays of collectors. Two of these arrays are mounted on the roof and consist of 24 collectors each. One large array extends from the roof to the ground forming the south wall of the apparatus bay. This array consists of 96 collectors.
2. Total No. of Collectors: 144
Total Sq. Ft. of Collectors: 2,808 sq. ft.

B. Storage System

1. Space Heating Storage consists of an insulated reinforced concrete box 35'-4" long x 8'-7" wide x 8'-3-1/2" high containing 71.5 tons of 1/2" diameter crushed limestone.
2. Hot water storage consists of 1 - 120 gallon glass lined steel tank.

C. Air Handling Systems

1. A.H.U. #1 (5600 CFM): moves air through collectors and storage.
2. A.H.U. #2 (4200 CFM): moves air AHU #1 to operations area.
3. A.H.U. #3 moves air from AHU #1 to the apparatus bay.

D. Solar Hot Water Heating

1. An air-water heat exchanger built into the ductwork preheats water for two 120 gallon electric water heaters. Water is stored in one 120 gallon tank.

E. Automatic Control System

1. Thermostats and other temperature sensing devices automatically regulate the water pump, air handling units, and the motorized dampers used to operate the system.

F. Auxiliary Heating Systems

1. The operations area has three split system heat pumps with auxiliary electric resistance heaters.
2. The apparatus bay has four 30 KW electric unit heaters.

G. Data Acquisition System

Fifty-Five sensors located throughout the installation provide data on parameters such as air flow, air temperature, water temperature and sunlight striking the collector. These data are automatically stored on tape and sent daily to a data processing center for reduction, evaluation, printing and distribution. This monitoring subsystem will provide answers to such key questions as system efficiency and reliability, operating costs and approximate fuel savings.

H. Modes of Operation

The system has six modes of operation.

1. Heating the building with hot air from the collector.
2. Storing heat by drawing heat from the collector through the rock box.
3. Heating the building with heat stored in the rock box.
4. Heating water by drawing air from the collector past heat exchange coils and back to the collector. In this mode the building and the rock box are bypassed. Water heating also occurs during modes (1),(2) and (3).
5. Heating with the heat pumps. When the heating requirements of the building are more than can be supplied by the solar heating system, the auxiliary heat pumps automatically come on and provide the needed heat.

6. Heating with electric resistance. When the heat pumps can no longer provide the heating required, the auxiliary resistance heaters come on.

A schematic of the heating system and the six (6) modes of operation are shown in figures 1 - 6. Dashed lines indicate air flow.

Further details of the solar heating system, including as-built drawing and diagrams, a description of hardware, a detailed sequence of operations, and maintenance instructions are found in Appendixes B - E.

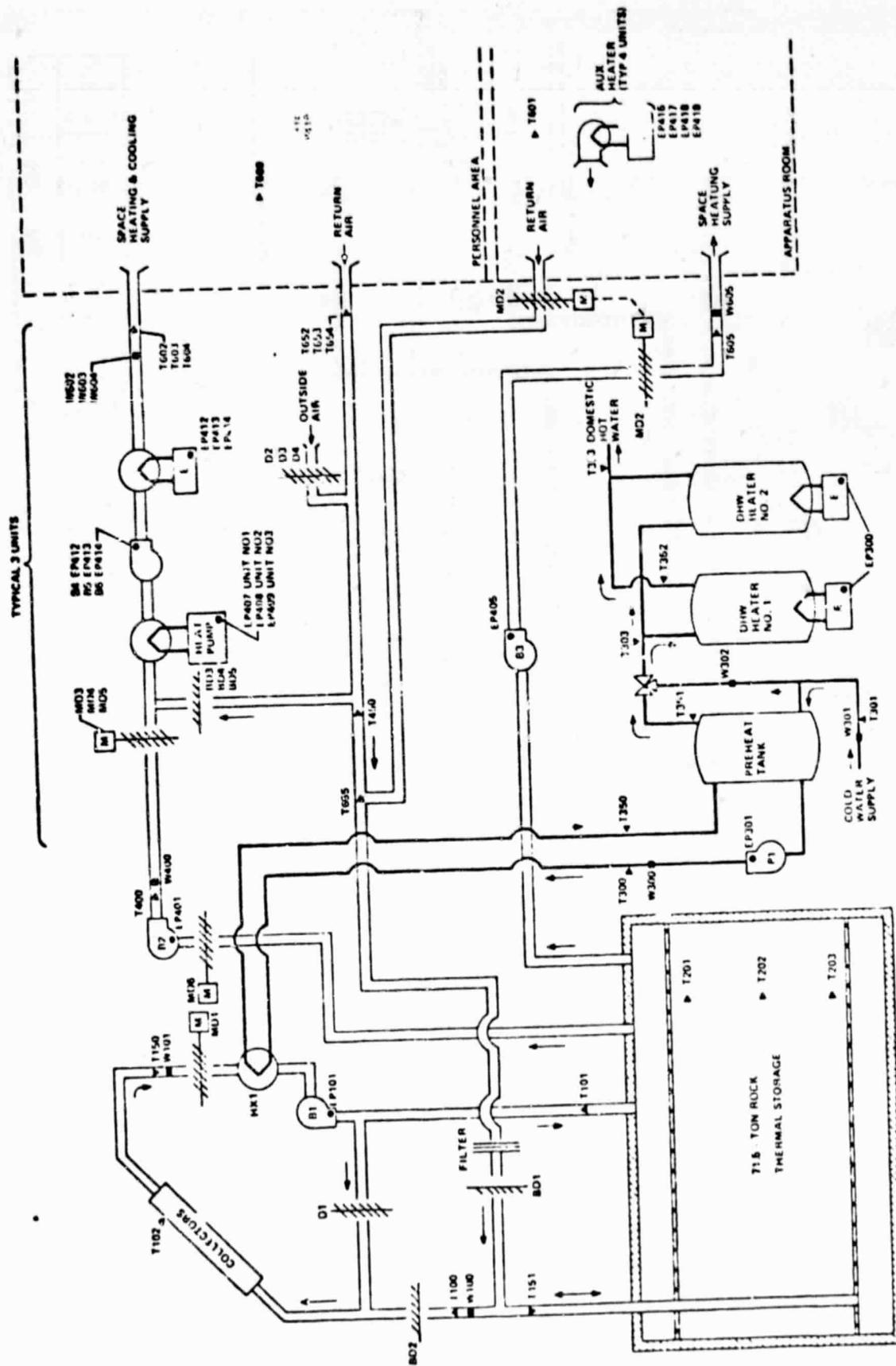
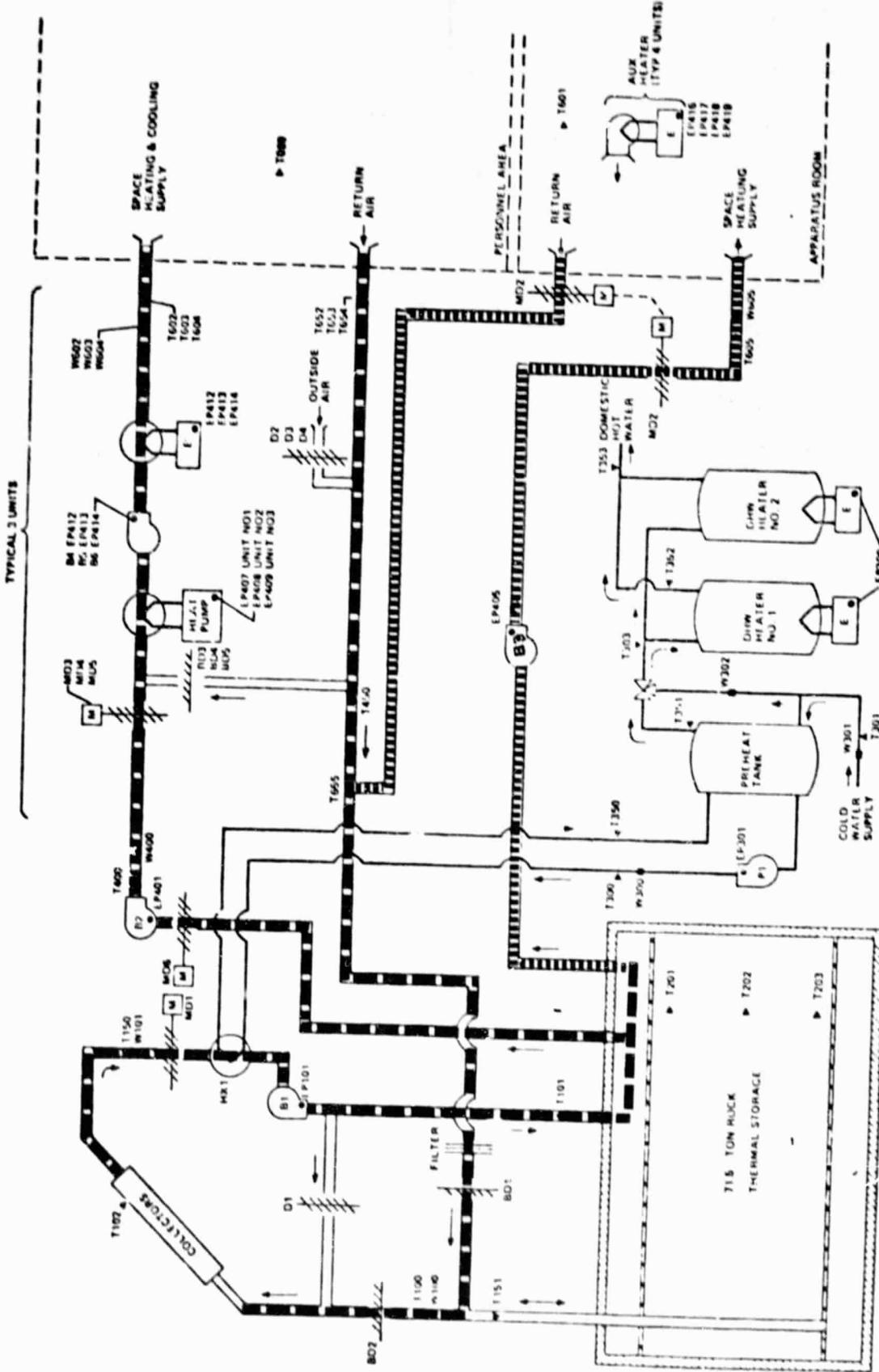
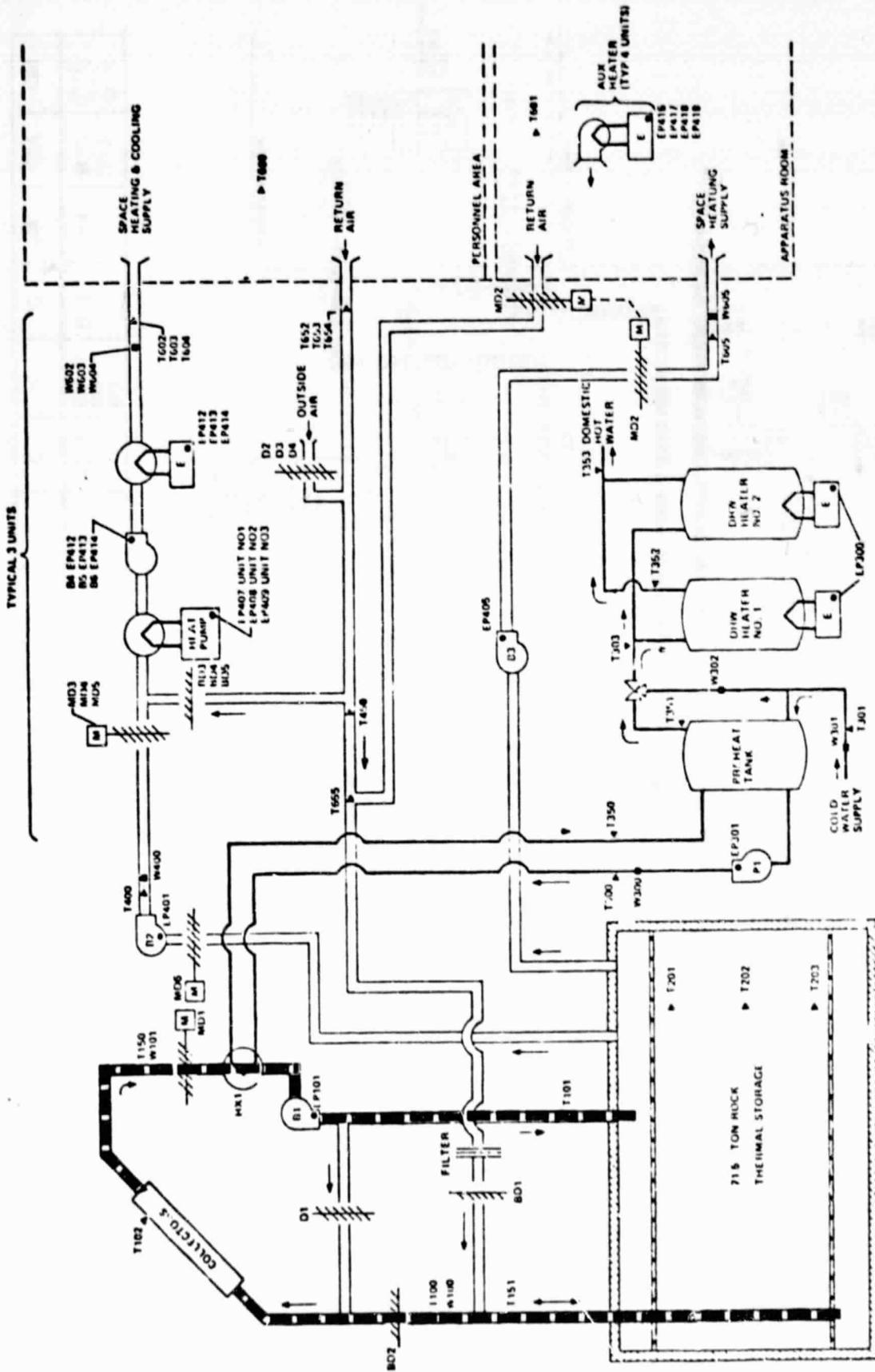


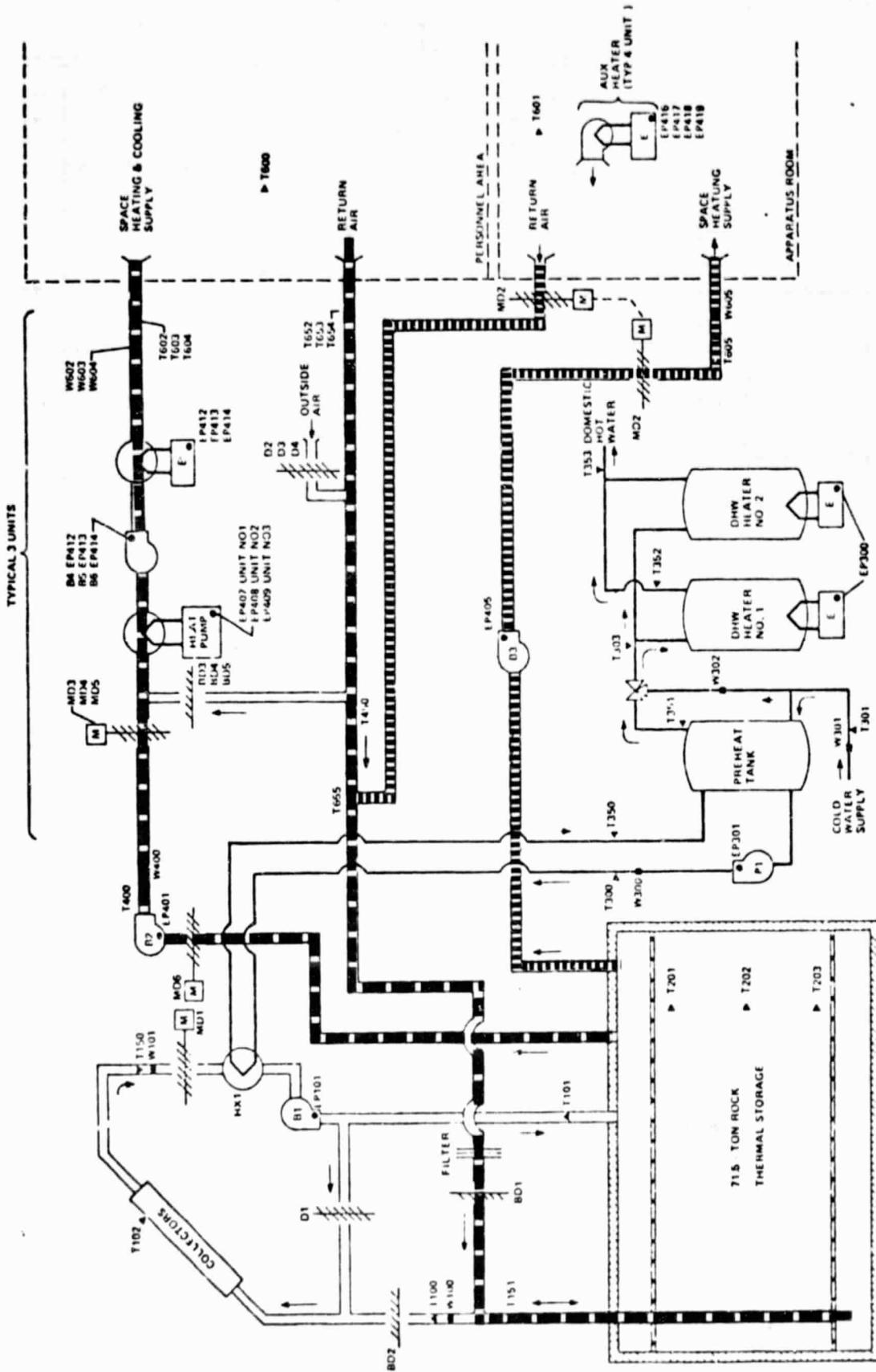
FIGURE 1 SCHEMATIC DRAWING OF SOLAR HEATING SYSTEM



MODE #1 HEATING FROM COLLECTOR	MD-1	MD-2	MD-3	MD-4	MD-5	MD-6	BD-1	BD-2	BD-3	BD-4	BD-5	D-1	B-1	B-2	B-3	B-4	B-5	B-6	ON
	0	0	0	0	0	0	0	0	0	C	C	C	ON	ON	ON	ON	ON	ON	ON

FIGURE 2

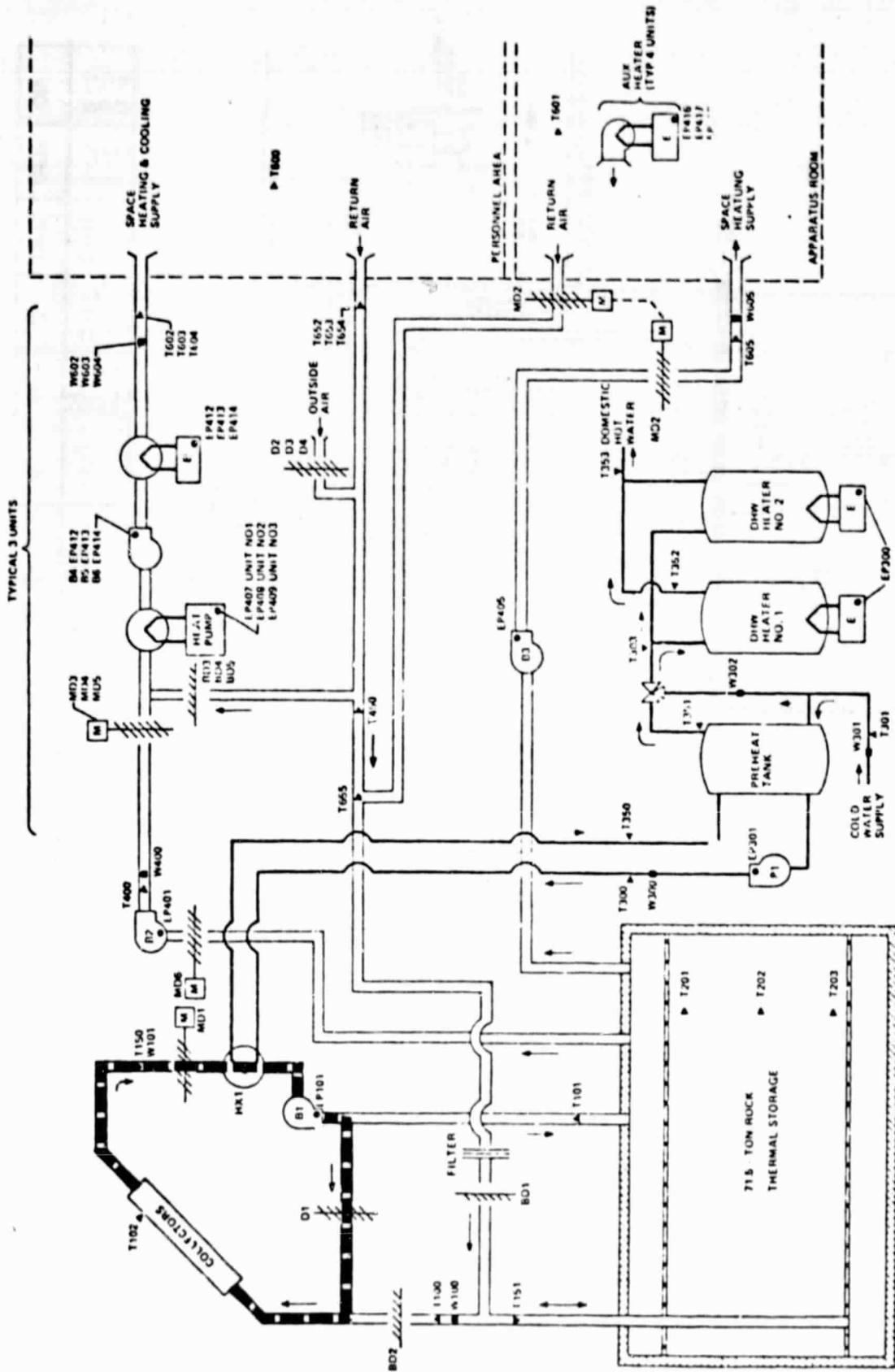




MODE #3	MD-1	MD-2	MD-3	MD-4	MD-5	MD-6	BD-1	BD-2	BD-3	BD-4	BD-5	B-1	B-2	B-3	B-4	B-5	B-6
	C	O	O	O	O	O	O	C	C	C	C	ON	ON	ON	ON	ON	ON
HEATING FROM STORAGE																	

FIGURE 4

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MODE #4	MD-1	MD-2	MD-3	MD-4	MD-5	MD-6	BD-1	BD-2	BD-3	BD-4	BD-5	D-1	B-1	B-2	B-3	B-4	B-5	B-6
SUMMER HOT WATER HEATING	C	C	C	C	C	C	C	C	O	O	O	O	ON	OFF	OFF	OFF	OFF	OFF

FIGURE 6

V. HISTORICAL NARRATIVE OF THE PROJECT

In June of 1976 a contract was awarded to the City by ERDA. The following is a summary of the sequence of events:

A. Design

1. Preliminary Design of the fire station and solar system started in September and was finished in October.
2. Preliminary Design Review was held on October 20, 1976. As a result of the preliminary design review the City decided to investigate adding the capability of providing domestic hot water heating utilizing the solar system.
- e. Construction documents were started in September 1976 and completed in March 1977.
4. Final Design Review was held on March 8, 1977.
5. The City did not release the drawings for bidding due to a re-evaluation of their priorities within the Fire Department.
6. In June 1977 the City asked ERDA for permission to relocate the fire station to another site with the stipulation that the solar system would remain basically unchanged. ERDA granted this request and new construction drawings were started.
7. The revised construction documents were completed and released for bidding the 1st of September.
8. The City awarded a contract for construction in January 1978/
9. Construction was delayed two months due to weather conditions. By the 1st week in May the footings and foundation walls were poured.
10. Collectors arrived in May and were stored in a warehouse.
11. Structural steel was set in place during July and August.
12. The storage box was completed with the exception of the insulated wood lid in October.

13. Collectors were installed during November.
14. During January and February 1979 completion of the solar system was delayed due to the discovery that the rocks as installed did not meet the sizes as specified.

Approximately 75% of the rock that was installed was 3/8" to 1/2" in diameter in lieu of 3/4" which was specified. After recalculating the static pressure and the contractor agreeing to install larger motors on the fans authorization was given to complete the solar system.

15. In May 1979 the building was completed. However, through the summer months final adjustments were made to the solar system with the acceptance test taking place in July.

VI. DESCRIPTION OF THE DATA ACQUISITION SYSTEM

In order to obtain information necessary for evaluation of the performance and operation of the solar heating system throughout the year, 55 sensors were installed within the system. These sensors were furnished by the government and installed at government expense in accordance with the document, "SHC-1006, August 3, 1976; Instrumentation Installation Guidelines for the National Solar Heating and Cooling Demonstration Program." In Table 2, each sensor is listed by a code designation and by the parameter measured. The number sequence in the code indicates the data groups in accordance with the following table:

<u>Number Sequence</u>	<u>Data Group</u>
001 to 099	climatological
100 to 199	collector
200 to 299	thermal storage
300 to 399	domestic hot water
400 to 499	space heating
500 to 599	space cooling
600 to 699	building/load

Each sensor provides data to a Site Data Acquisition Subsystem (SDAS) every 5 minutes around the clock. The SDAS digitizes the data and stores it on tape. Once a day the data is sent by telephone to a Central Data Processing Facility where it is reduced. Monthly reports are prepared, one of which is sent to the City of Kansas City, Missouri.

The monitoring system will permit the government to determine the following kinds of information:

- * Savings in conventional energy resulting from the use of solar energy for heating and/or cooling.
- * Portion of the total heating and/or cooling load supplied by the solar energy.
- * Efficiency of the system in converting solar radiation into useful thermal energy.

* Thermal performance and reliability of major subsystems or components over the demonstration period.

Table 2 describes each sensor in terms of its general location and the parameter that is being measured. The specific location of each sensor can be found in the as-built drawing of the system found in Section IV Figure 1 Schematic Drawing of Solar Heating System.

TABLE 2

INSTRUMENTATION FOR KANSAS CITY FIRE STATION DATA ACQUISITION SYSTEM

<u>Designation</u>	<u>Measurement</u>
A. <u>Climatological</u>	
I 001	Solar flux
T 001	Outside ambient temperature
B. <u>Collector</u>	
T 100	Collector inlet temp
T 150	Collector array outlet temp
T 101	Rock storage bed inlet temp
T 151	Rock storage bed outlet temp
T 102	Collector absorber temp
W 100	Collector array inlet flow
W 101	Collector array outlet flow
EP 101	Air handler unit 1 power
C. <u>Thermal Storage</u>	
T 201	Rock storage temperature - top
T 202	Rock storage temperature - middle
T 203	Rock storage temperature - bottom
D. <u>Domestic Hot Water</u>	
T 300	Temp inlet HW preheat coil
T 350	Temp outlet preheat coil
T 301	City water temp
T 351	Temp outlet preheat tank
T 303	Temp inlet to DHW tanks 1 & 2
T 352	Temp outlet DHW tank 1
T 353	Temp outlet DHW tank 2
W 300	DHW preheat loop flow
W 301	DHW demand flow
W 302	DHW mixing flow
EP 300	HW heater power DHW 1 & 2
EP 301	HW circulating pump power
E. <u>Space Heating</u>	
T 450	Temp return air
T 400	Temp outlet heat load
W 400	Personnel area heating flow
EP 410	Aux heating panel power
EP 401	Air handler unit 2 power
EP 412	Heat pump resistance heat 1
EP 413	Heat pump resistance heat 2
EP 414	Heat pump resistance heat 3
EP 407	Outdoor unit 1

EP 408	Outdoor unit 2
EP 416	Unit HTR 1 power
EP 417	Unit HTR 2 power
EP 418	Unit HTR 3 power
EP 419	Unit HTR 4 power
EP 409	Outdoor unit 3 power
EP 405	Air handler unit 3 power

F. Building/Load

T 600	Operations PM ambient temp
T 601	Apparatus PM ambient temp
T 602	Supply temp heat pump F1
T 652	Return temp heat pump F1
T 603	Supply temp heat pump F2
T 653	Return temp heat pump F2
T 604	Supply temp heat pump F3
T 654	Return temp heat pump F3
T 655	Return temp apparatus RM
T 605	Supply temp apparatus RM
W 602	Heat pump F1 outlet flow
W 603	Heat pump F2 outlet flow
W 604	Heat pump F3 outlet flow
W 605	Apparatus RM flow

VII. COSTS OF THE FIRE STATION #24 SOLAR HEATING SYSTEM

Given in Table 3 are the estimated and the actual costs of the various phases of the project.

Overall, the construction costs were \$130,369. This figure is \$18,710 or about 16.76% more than the original estimates. Most of the additional cost was for general construction cost, and can be attributed to the lack of detailed drawings and lack of experience to draw on in forming the original estimate.

Costs were shared by the federal government and the city government.

The Department of Energy provided 98.48% of the total costs associated with the solar heating system. Thus, of the total amount of \$174,372, the Department of Energy paid \$154,282 and the City of Kansas City, Missouri, \$20,090. The difference in the two sets of cost data (construction and total) is made up of architects fees, instrumentation cost, travel cost and miscellaneous city personnel costs.

The contract was modified twice to cover cost increases. In May 1978, the dollar amount was increased by \$18,710 (government share, 60.24%) to cover additional costs associated with the construction of the solar heating system. In July 1978, the contract was increased by \$13,526 (government share, 100%) to cover costs associated with the Site Data Acquisition Subsystem. The City is grateful to the Department of Energy for its willingness to bear these additional costs.

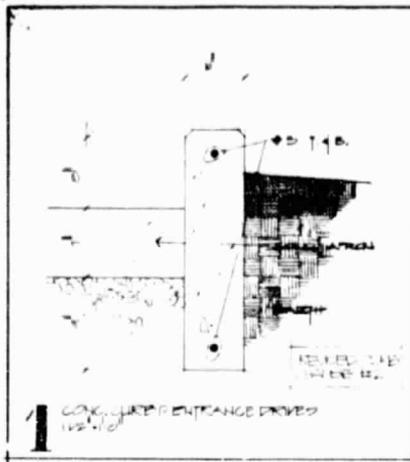
TABLE 3

COST OF THE FIRE STATION 24 SOLAR HEATING SYSTEM

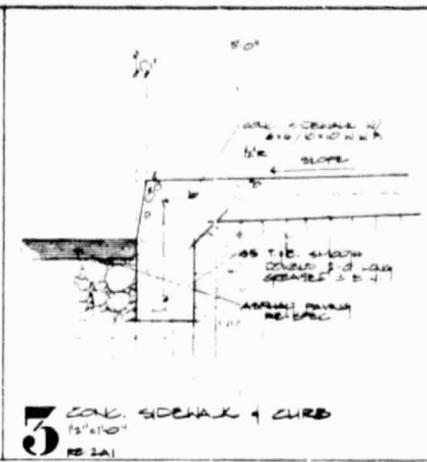
CONSTRUCTION	ESTIMATE	ACTUAL
a. Solar Equipment		
1. 96 A units	22,390	
2. 48 C units	10,857	
3. Hold down hardware cap strips and butyl seals	4,328	
4. Controls	6,958	
5. Field Supervision and testing	5,000	
	<u>49,533</u>	59,195
b. Solar panel installation		
1. 144 panels	8,640	8,950
c. Rock Storage	4,320	4,556
d. Solar Equipment Freight Charges	1,404	included in item a
e. Mechanical Provisions		
1. Lined ductwork	11,232	12,849
2. Fans (2 in original - 3 in final)	5,608	4,590
f. General Construction		
1. Concrete fndn. and slab	2,700	7,778.03
2. Supporting Roof Structure	6,000	16,250.96
3. Vertical enclosure wall const.	3,300	in above
4. Sheet metal flashing	800	2,700
Misc. (steel stair, excavating)		<u>1,650</u>
g. Subtotal	93,537	118,518.99
h. Contractor's Overhead & Profit	7,371	11,850
i. Construction Contingency	3,380	
j. Escalation of costs to 7/77	7,371	
k. Total Construction	111,659	130,368.99
Difference		+ 18,709.99

APPENDIX A
BUILDING DRAWINGS

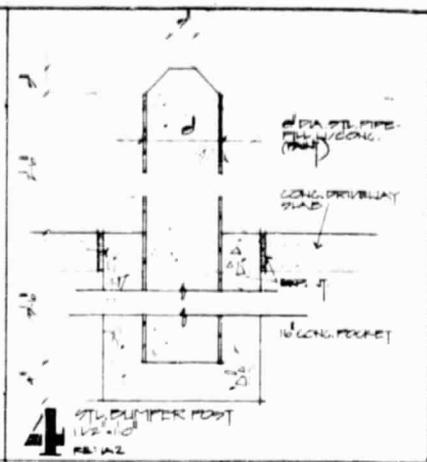
A-1
A-2
A-3
A-4
A-5
A-6
A-7
ME-1
M-1
M-2
E-1
E-2



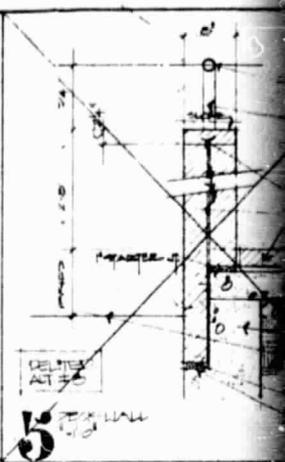
1 CONCRETE ENTRANCE DRIVE
1/2" x 1/2"



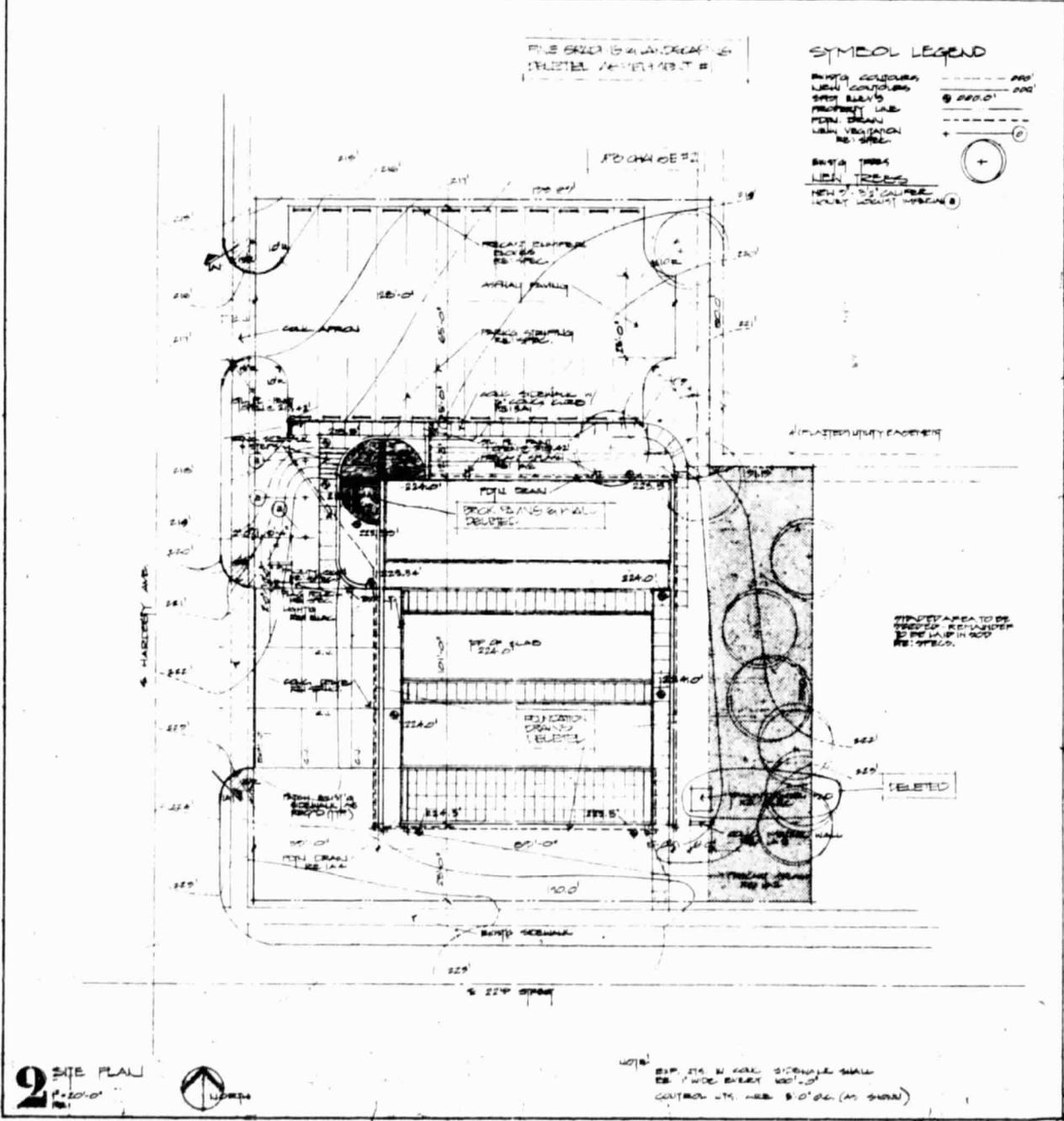
3 CONC. SIDEWALK + CURB
1/2" x 1/2"
RS 2A1



4 STEEL BUTTER POST
1/2" x 1/2"
RS 1A2



5 CONCRETE WALL
1/2" x 1/2"



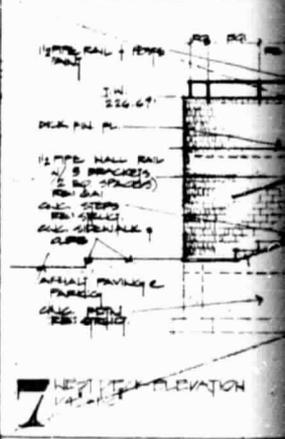
2 SITE PLAN
1/2" x 1/2"
DATE 9/8/77

SYMBOL LEGEND

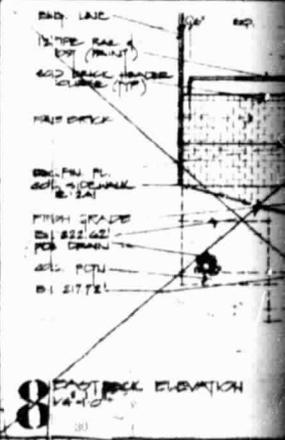
EXISTING CONTOURS	---	100'
NEW CONTOURS	---	200'
EXIST. BLDG.	---	200'
PROPOSED LANE	---	200'
EXIST. DRIVEWAY	---	200'
NEW DRIVEWAY	---	200'
EXIST. VEGETATION	---	200'
NEW VEGETATION	---	200'
EXIST. TREES	---	200'
NEW TREES	---	200'
EXIST. CURB	---	200'
NEW CURB	---	200'
EXIST. DRIVEWAY	---	200'
NEW DRIVEWAY	---	200'



6 CONCRETE YOUTH EDGE
1/2" x 1/2"



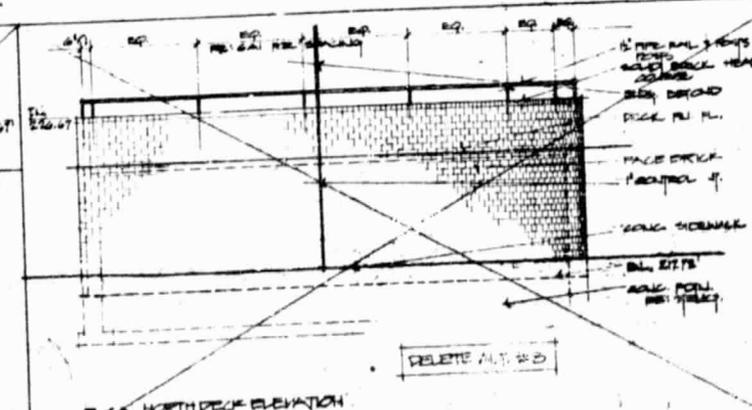
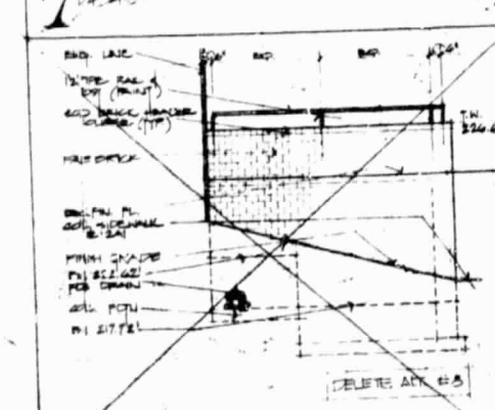
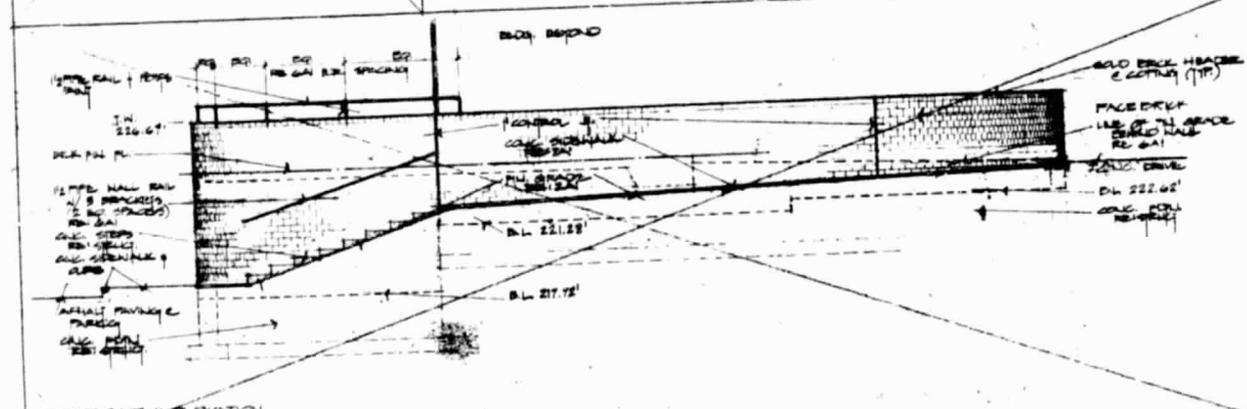
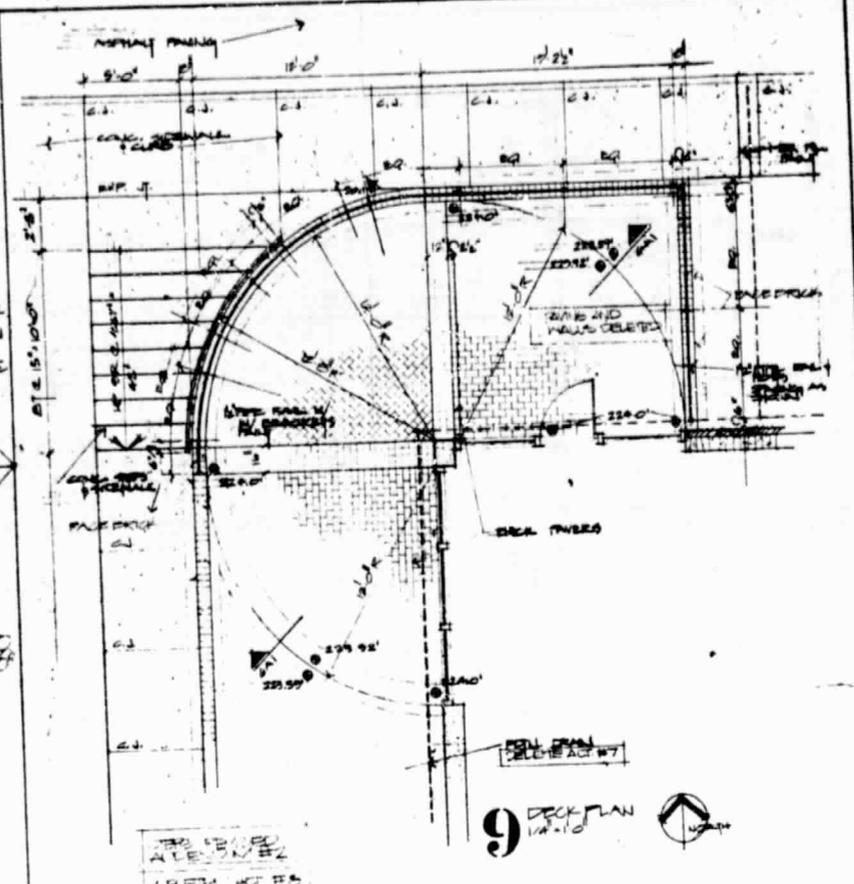
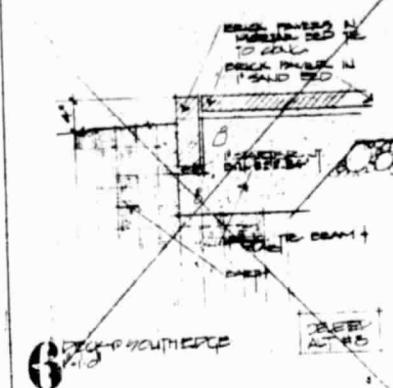
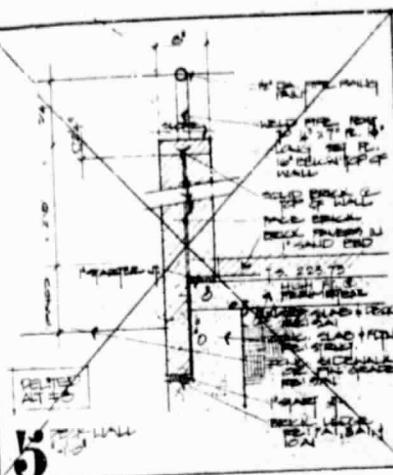
7 WEST SIDE ELEVATION
1/2" x 1/2"



8 EAST SIDE ELEVATION
1/2" x 1/2"

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FOLDOUT FRAMES

PIPE WORK
CONCRETE
FRAMING
ELECTRICAL

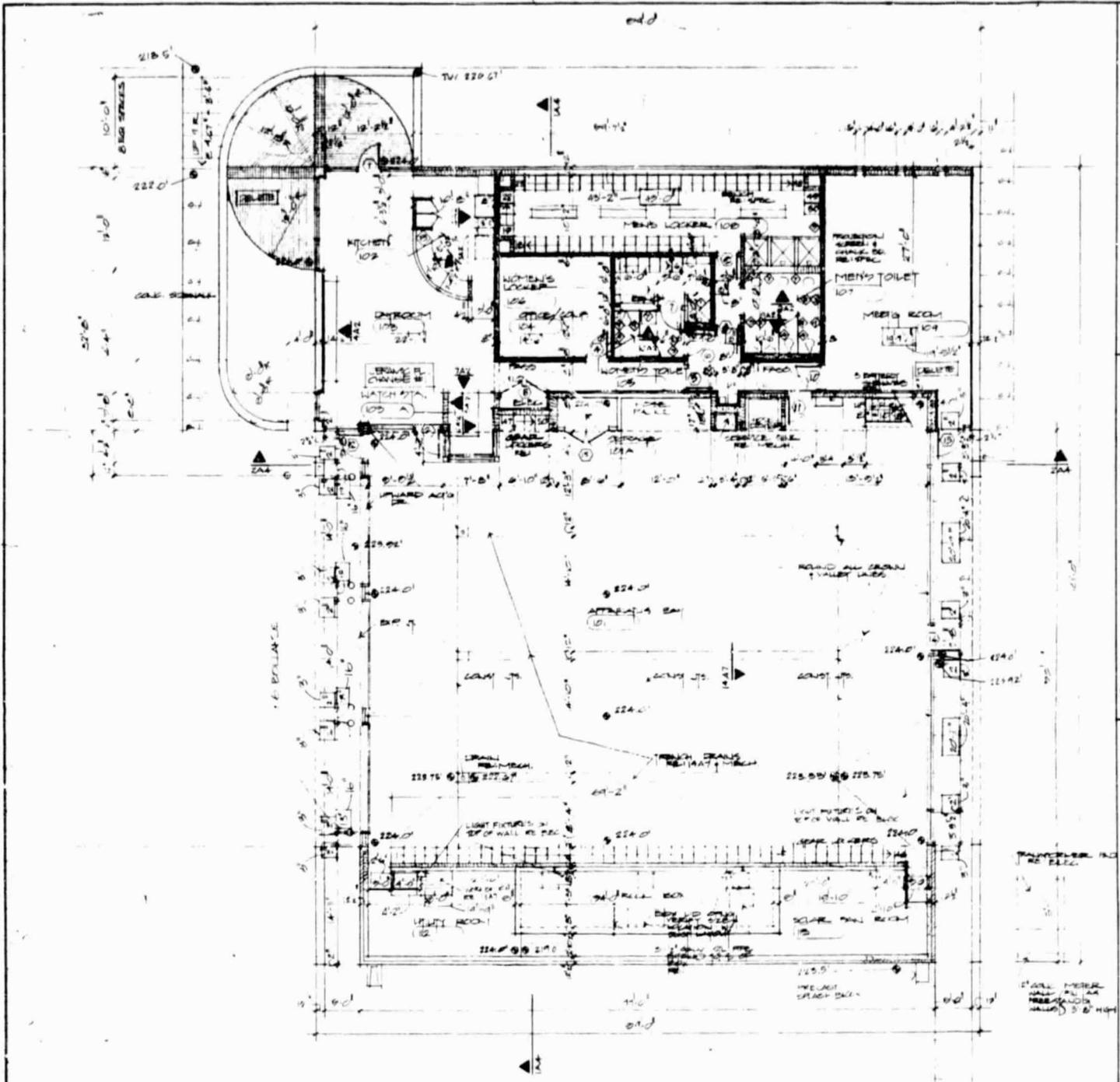


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Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri



OLD OUT FRAMING



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GENERAL NOTES

ALL DIMENSIONS ARE TAKEN FROM FIN SURFACE
TO FIN SURFACE
SHOULD PREVIOUS ARE TO BE TAKEN TO UNDER
SIDE OF THIS SHALL BE SQUARE APPROXIMATE

SYMBOL KEY

- ⊙ ACCESSORY OR ORNAMENTALS
- ROOM NUMBER
- SPOT ELEV'S
- DOOR LEADERS
- CEILING
- INTERIOR ELEV
- CONCRETE
- DRIVE W/ CAR STOPPING
- 4" TH. RE. ON HD. W/ RE.
- 1" TH. FINE SAND. BASTARD
- 4" TH. RE. ON HD. FLOORING

4 FLOOR PLAN
1/8" = 1'-0"



DIRECTOR OF
CIVIL ENGINEERING

FOLLOW

2

3

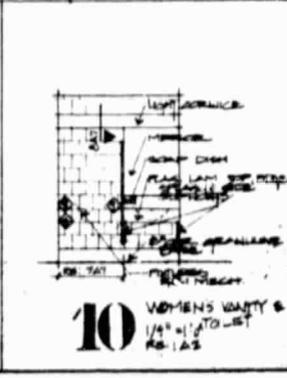
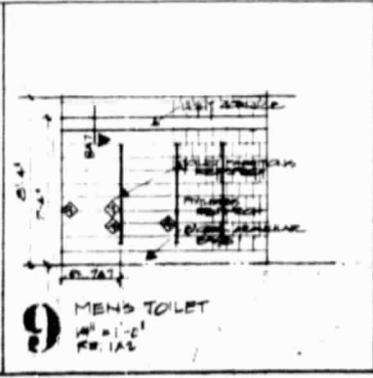
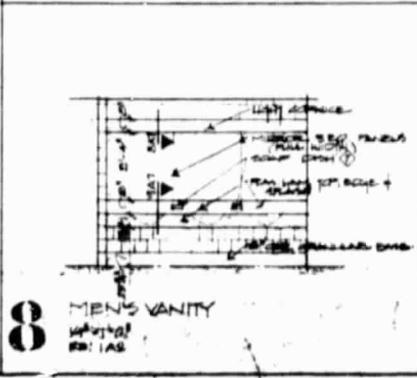
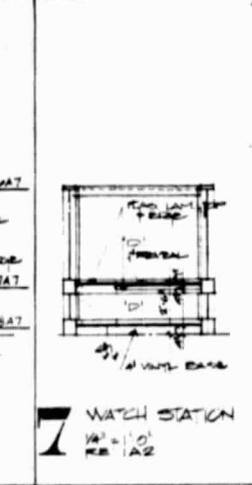
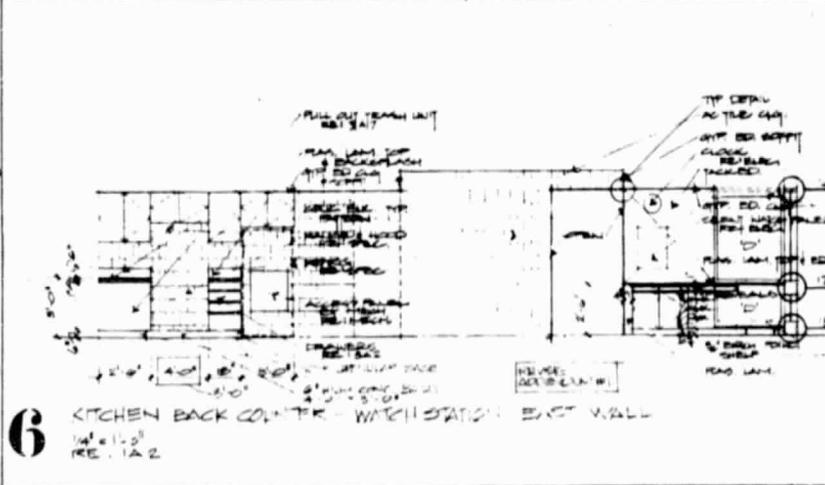
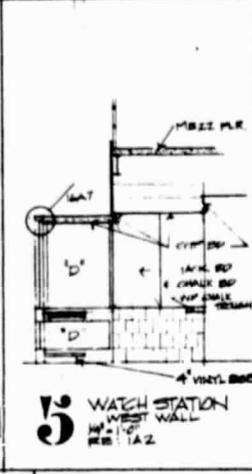
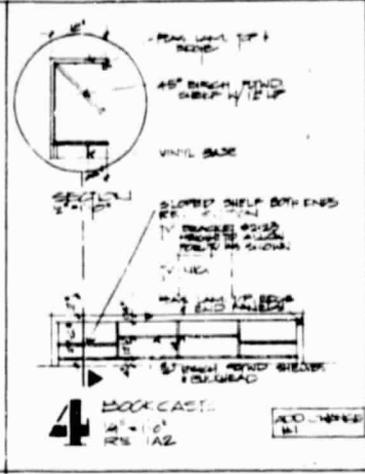
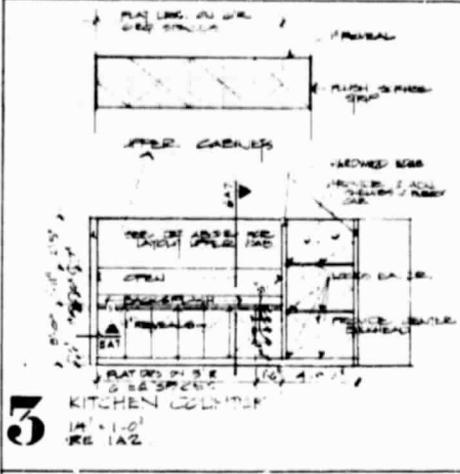
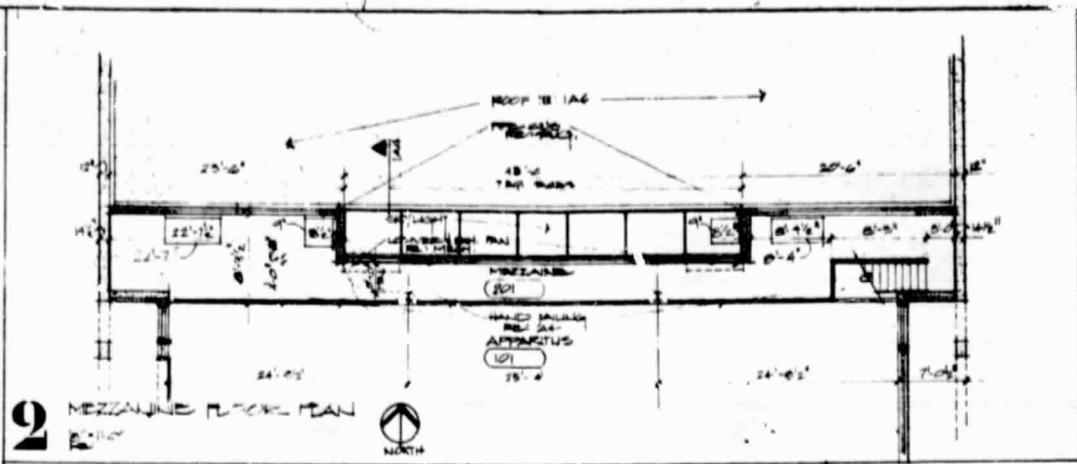
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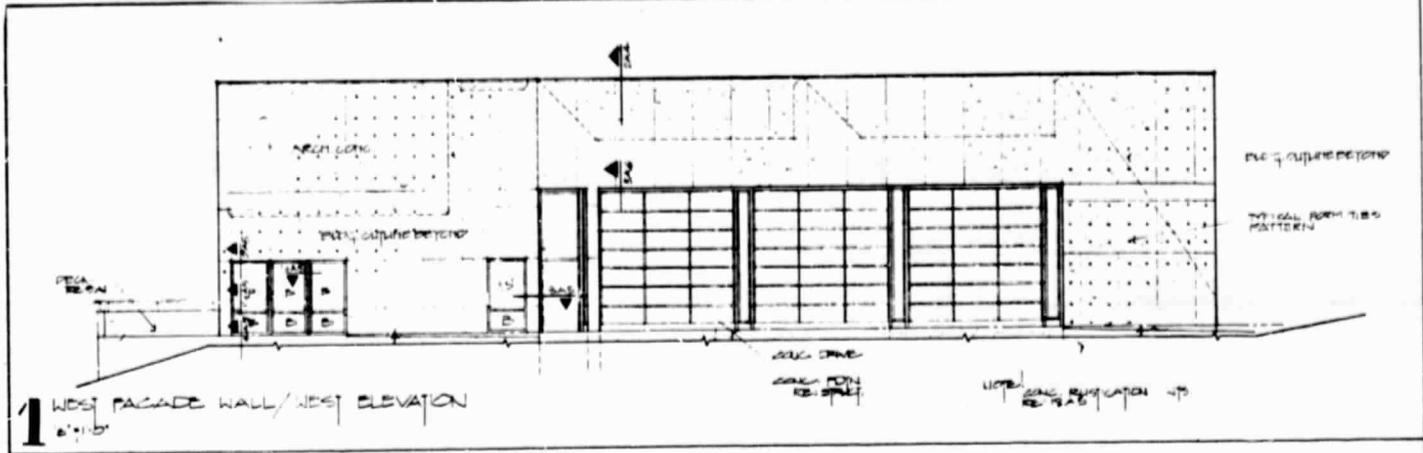
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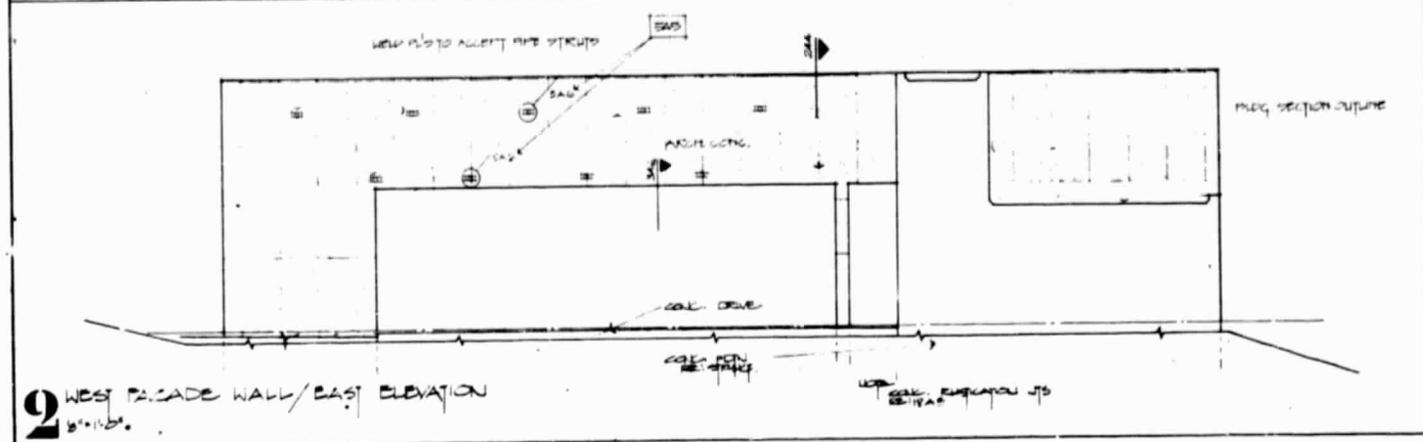
Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri
Floor plan and interior elevations





1 WEST FACADE WALL/WEST ELEVATION
8'-11'-0"

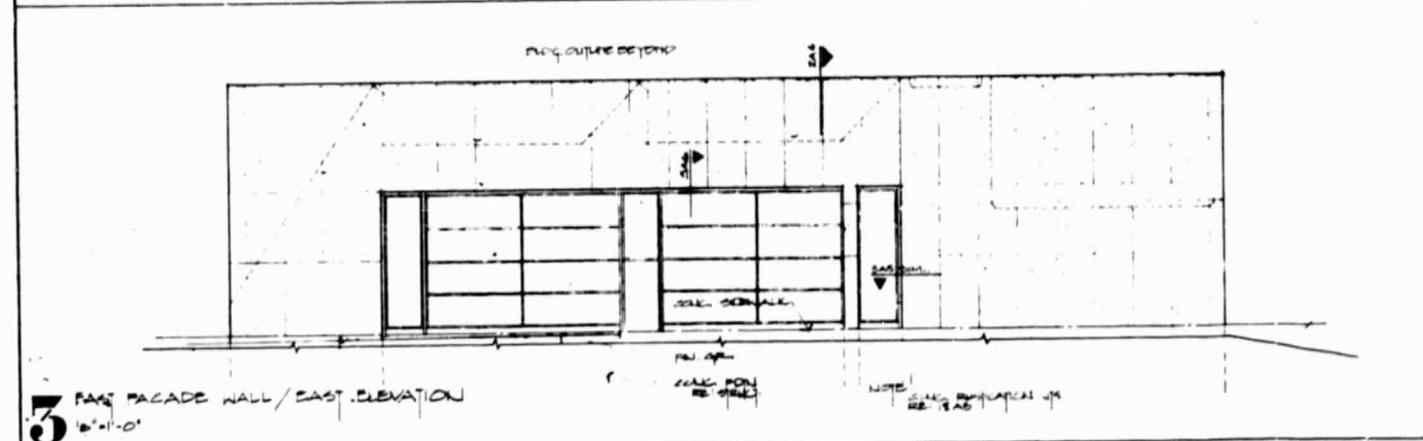
5 WEST ELEVATION
8'-11'-0"



2 WEST FACADE WALL/EAST ELEVATION
8'-11'-0"



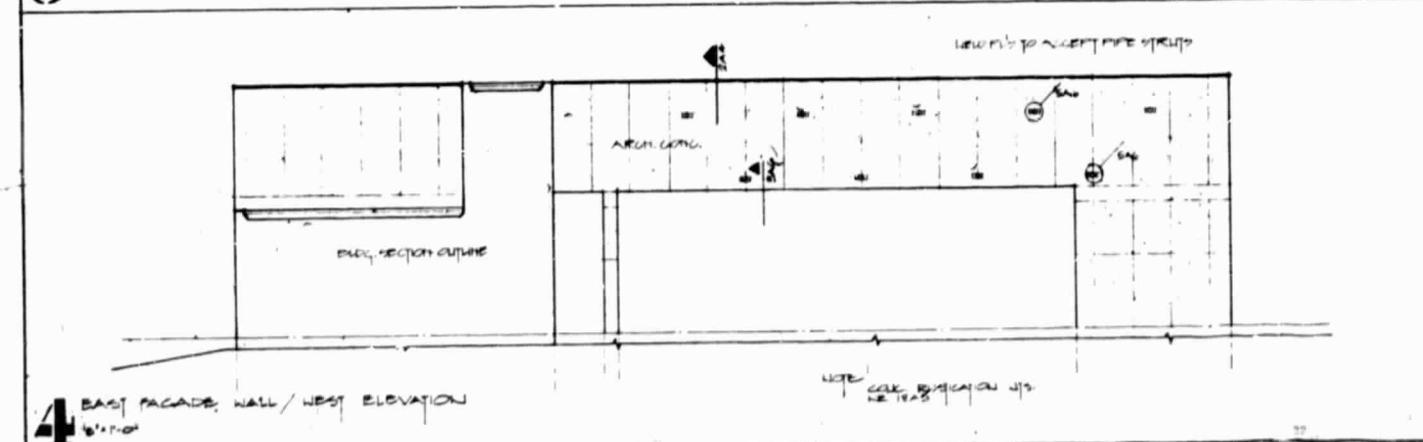
6 NORTH ELEVATION
8'-11'-0"



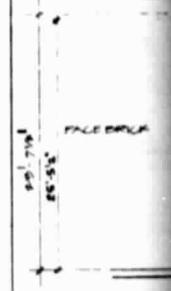
3 EAST FACADE WALL/EAST ELEVATION
8'-11'-0"



7 SOUTH ELEVATION
8'-11'-0"



4 EAST FACADE WALL/WEST ELEVATION
8'-11'-0"



8 EAST ELEVATION
8'-11'-0"

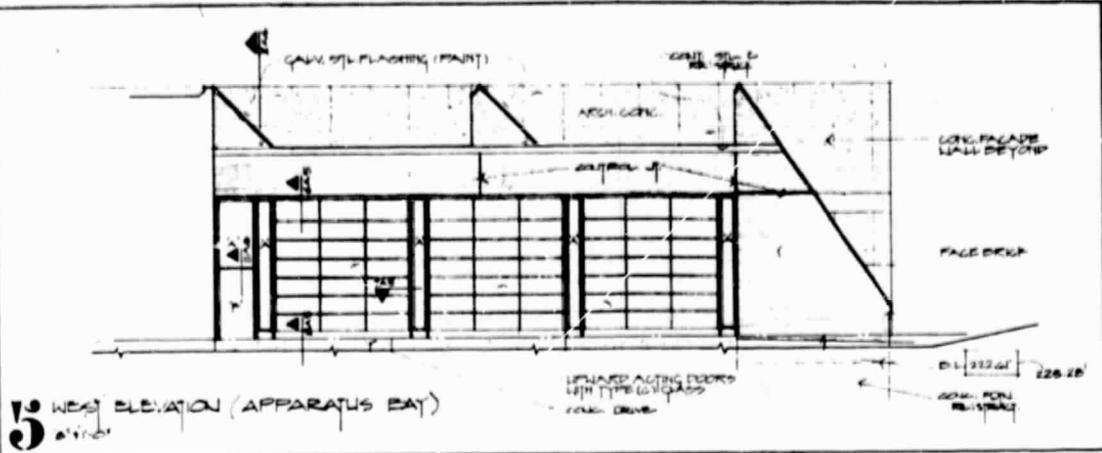
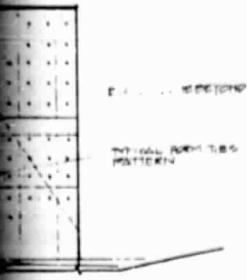
Project no. 01
date 8/15/77

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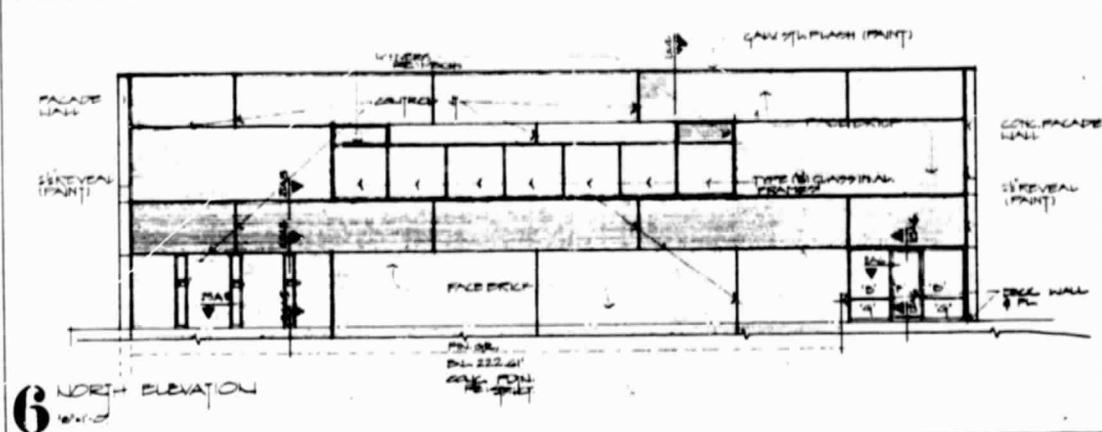
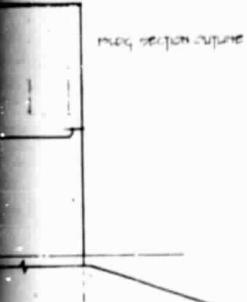
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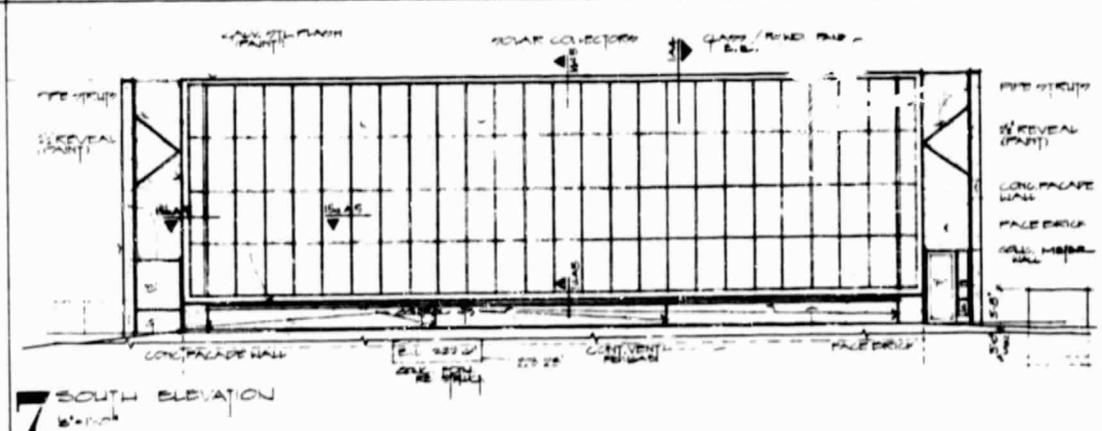
Modjley Shoughnessy Folsa and Scott Architects Inc. / 20 West 9th Street Kansas City, Missouri 64105



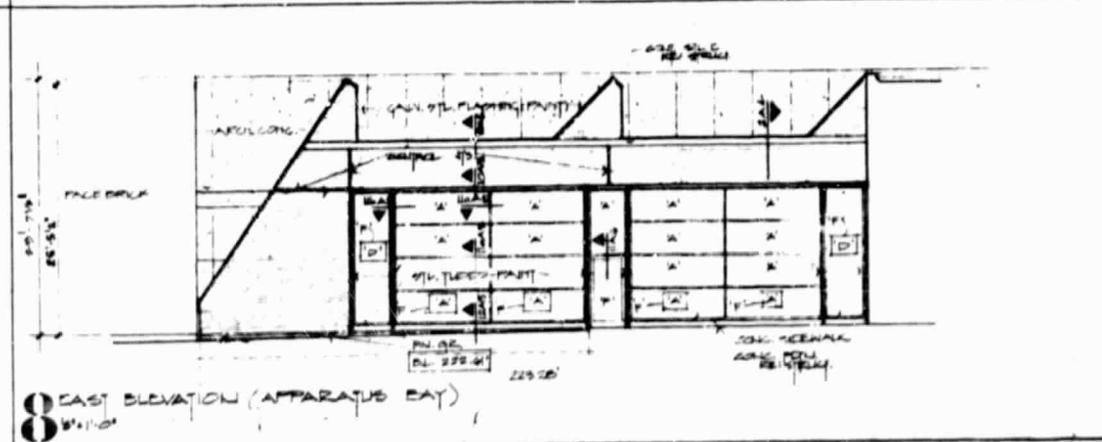
5 WEST ELEVATION (APPARATUS BAY)



6 NORTH ELEVATION

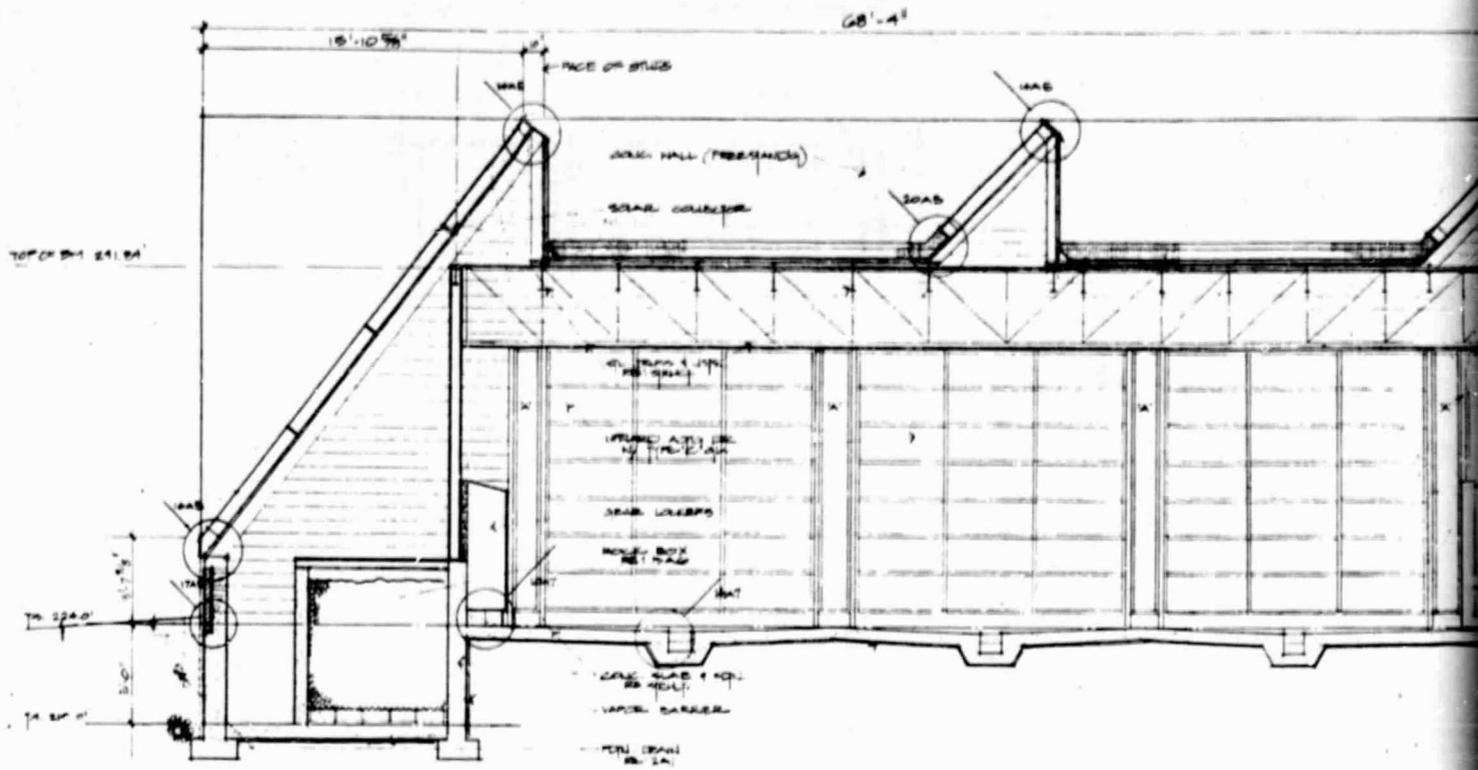


7 SOUTH ELEVATION

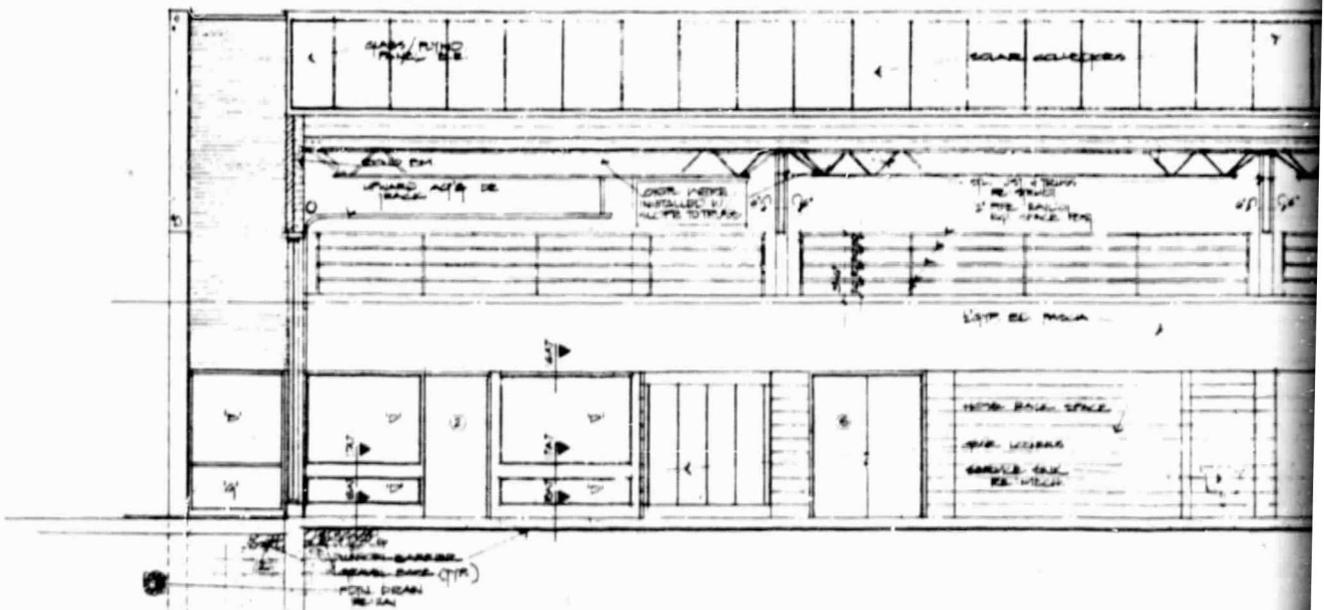


8 EAST ELEVATION (APPARATUS BAY)

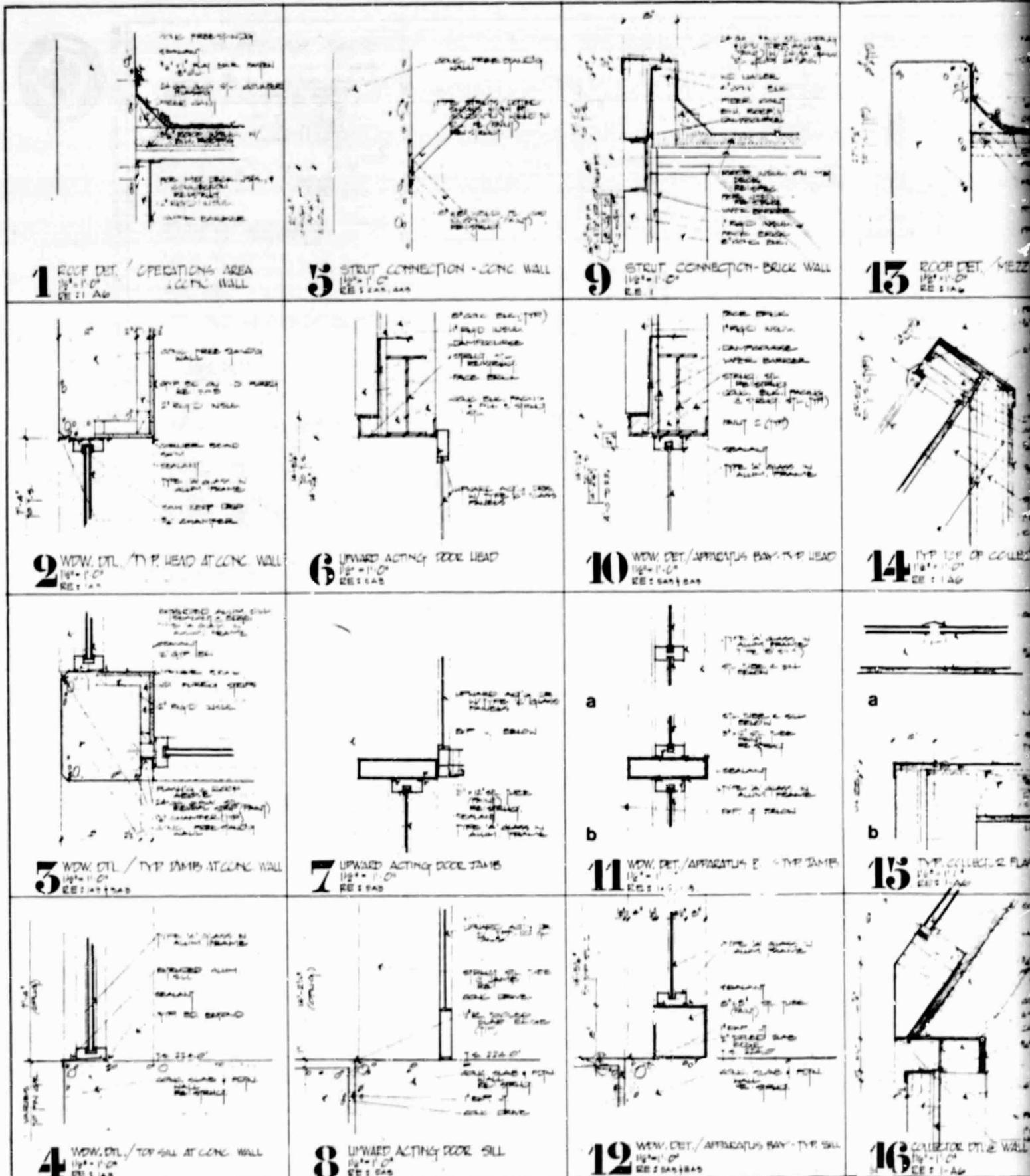
Kansas City Fire Station No. 24, 2039 Hardisty, Kansas City, Missouri



1 LONGITUDINAL BUILDING SECTION
 1/2" = 1'-0"



2 LONGITUDINAL BUILDING SECTION
 1/2" = 1'-0"



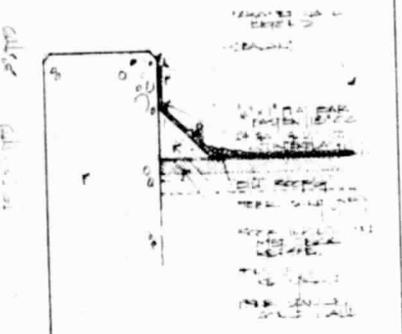
project no. 01
date 9/6/77

FOLDOUT FRAME

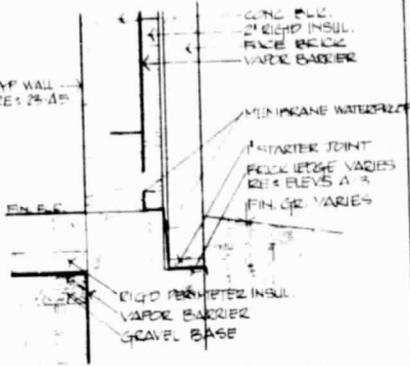
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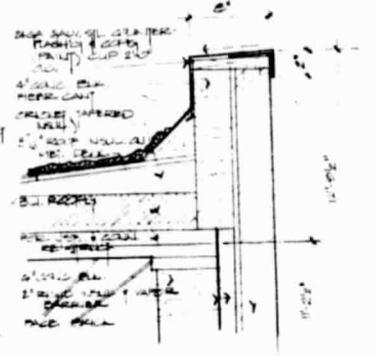
Midgley Shaughnessy Fickel and Scott Architects Inc. 20 West 10th Street Kansas City, Missouri 64105



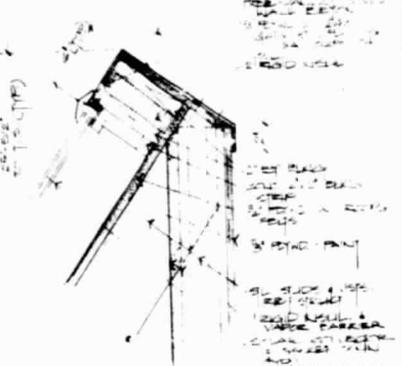
13 ROOF DET. MEZZ ROOF LONG WALL
1/2" = 1'-0"
RE: 1-A6



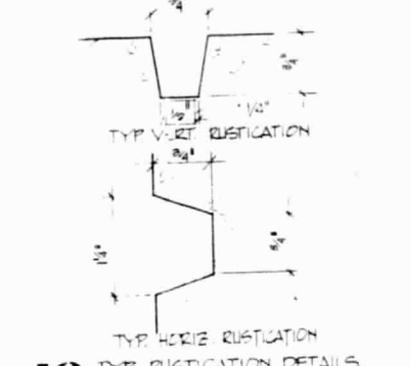
17 TYP WALL SECTION @ BRICK LEDGE
1/2" = 1'-0"
RE: 1-A4



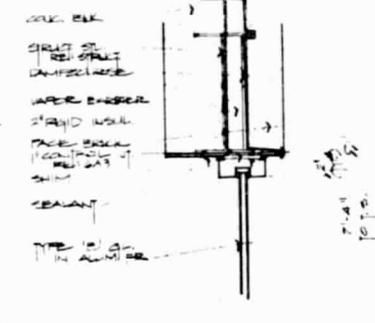
21 TYPICAL PARAPET
1/2" = 1'-0"
RE: 6-A3



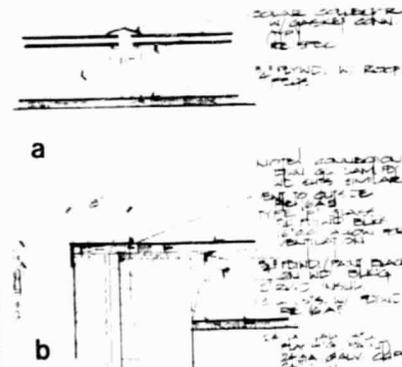
14 TYP TOP OF COLLECTOR FLASHING
1/2" = 1'-0"
RE: 1-A6



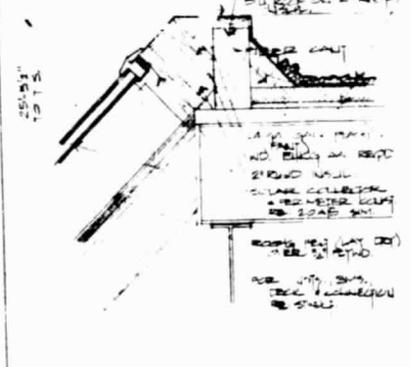
18 TYP RUSTICATION DETAILS
NO SCALE
RE: 2-A3 - A3



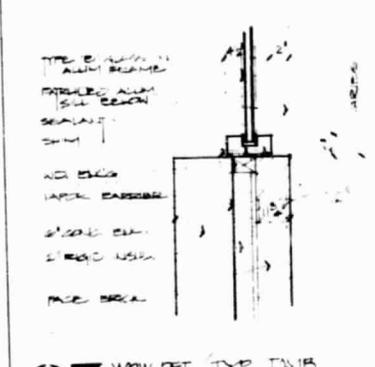
22 WDW DET. / TYP HEAD
1/2" = 1'-0"
RE: 6-A3



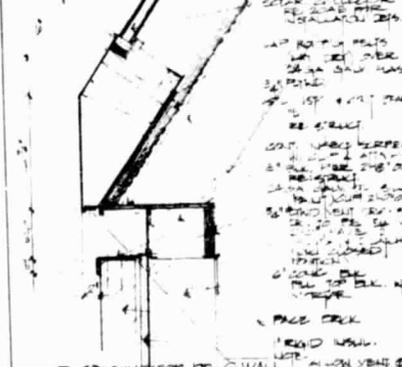
15 TYP. COLLECTOR FLASHING & MULLION DETL
1/2" = 1'-0"
RE: 1-A6



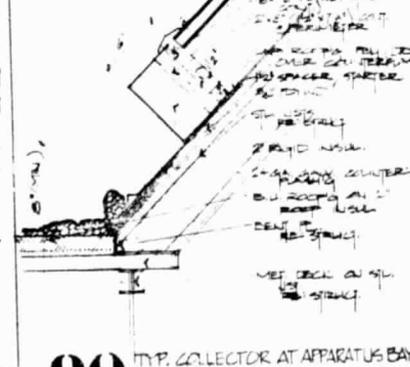
19 TOP OF COLLECTOR AT MEZZ ROOF
1/2" = 1'-0"
RE: 1-A6



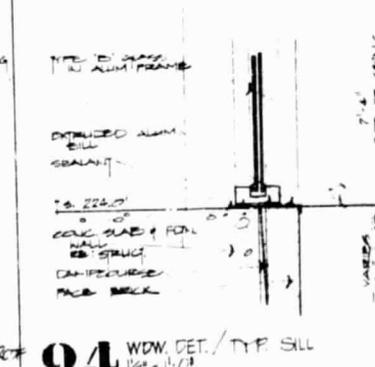
23 WDW DET. TYP JAMB
1/2" = 1'-0"
RE: 6-A3



16 COLLECTOR DETL @ WALL
1/2" = 1'-0"
RE: 1-A6



20 TYP. COLLECTOR AT APPARATUS BAY ROOF
1/2" = 1'-0"
RE: 1-A6



24 WDW DET. / TYP SILL
1/2" = 1'-0"
RE: 6-A3

Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri

details **A5**

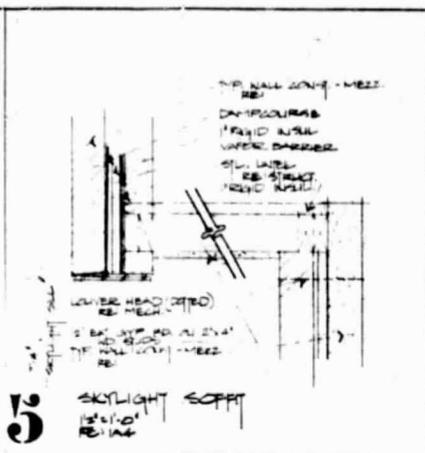
FOLLOWING DRAWING 2



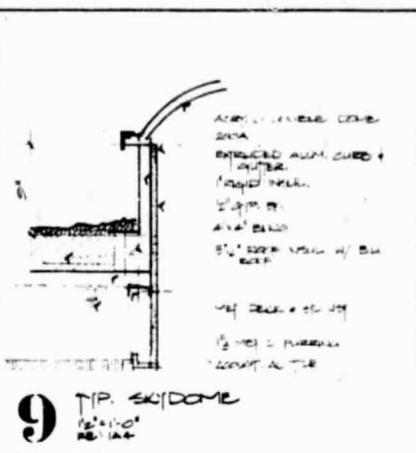
Midgley Staughnessy Finkel and Scott Architects Inc. 720 West 9th Street Kansas City, Missouri 64108

Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri

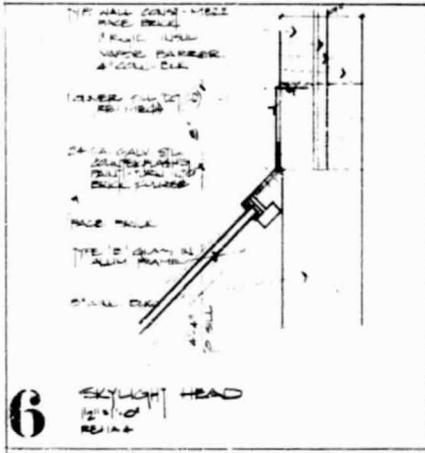
A6



5 SKYLIGHT SOPFIT
12'-0" x 12'-0" RE: 11A



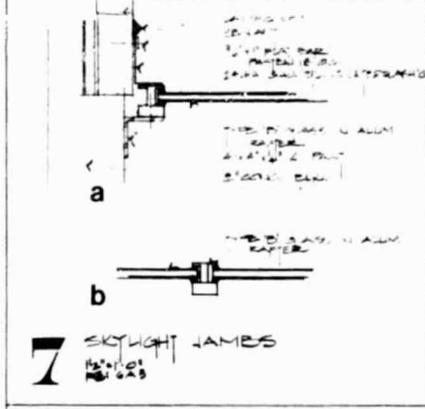
9 TIP. SKI DOME
12'-0" x 12'-0" RE: 11A



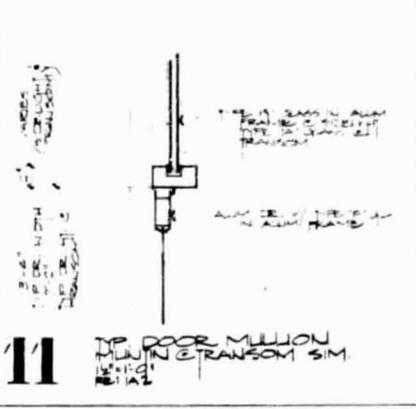
6 SKYLIGHT HEAD
12'-0" x 12'-0" RE: 11A



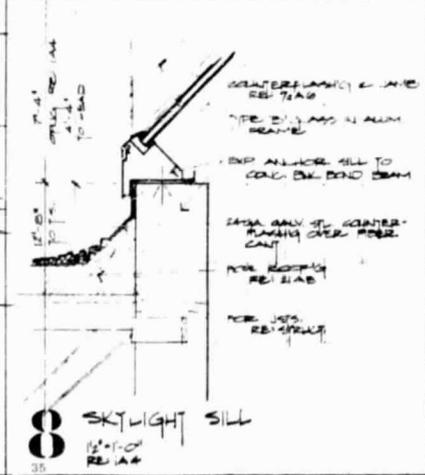
10 TYP. EXT. DR. HEAD
12'-0" x 12'-0" RE: 5A, 6A, 7A, 8A, 9A



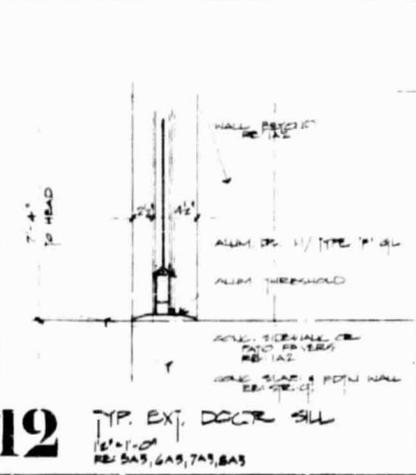
7 SKYLIGHT JAMB
12'-0" x 12'-0" RE: 5A, 6A, 7A, 8A, 9A



11 TYP. DOOR MILLION
12'-0" x 12'-0" RE: 11A



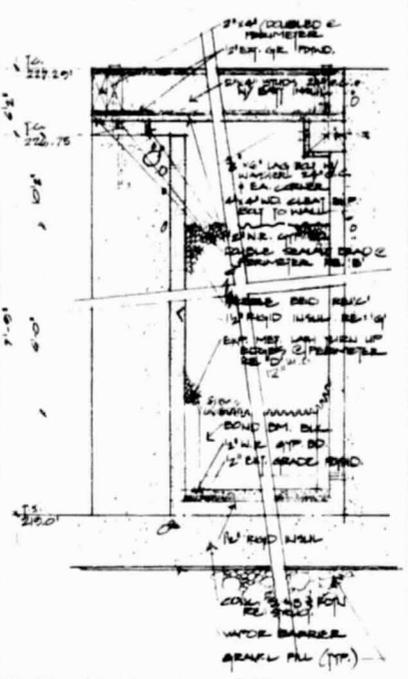
8 SKYLIGHT SILL
12'-0" x 12'-0" RE: 11A



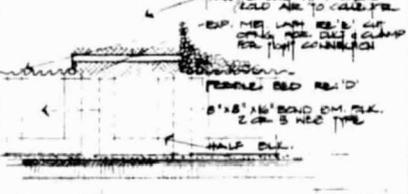
12 TYP. EXT. DOOR SILL
12'-0" x 12'-0" RE: 5A, 6A, 7A, 8A, 9A

SCAR EQUIPMENT

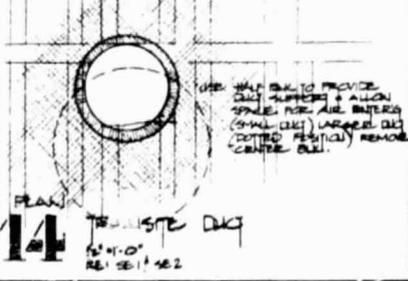
- GENERAL NOTES**
- 1) ANY SUBSTITUTION OF MATERIALS, DIMENSIONS OR LOCATION SHALL BE APPROVED BY THE ARCH. & WRITTEN PRIOR TO CONSTRUCTION.
 - 2) ANY JOINTS, CRACKS, SEAMS, OR PENETRATIONS IN BOX WALLS, FLOOR OR UP ARE TO BE SEALED WITH 1/2" DIA. CONCRETE & 7/8" DIA. 1/2" DIA. SEALANT GROUT OR APPROVED EQUAL.
 - 3) THE ROCK SHALL BE ROUND WASHED RIVER ROCK NOT OVER 95% FRACTURED, 80% OF ROCK TO BE SIZE SHOWN BELOW IN A MIN. AMOUNT OF MASS (1/8" LESS THAN 1/2" DIA.) ROCK SHALL CLEAN & FREE FROM DIRT.
 - 4) THE LINING SHALL BE DIAMOND MESH 3/4" x 3/4" (1/2" MIN. SPACING).
 - 5) TREATMENT FOR THE INSIDE SURFACE OF THE BOX SHALL BE SUITABLE FOR TEMP. OF 100°F. NO ORGANIZABLE MATERIALS ARE TO BE USED.
 - 6) UP TO CORNER 1/2" GRACE FLOOR, NOISE OUT 2" x 4" x 1/2" x 1/2" TYPE 'X' SHEET ON INSIDE SURFACE TOWARD ROCK.
 - 7) INSULATE AT SURFACE W/ 1/2" RIGID FIBERGLASS INSUL. (1/2" DENSITY W/ 1/8" MIN.) SECURE TO WALL.
 - 8) ROCK QUANTITIES @ 1.75 CU. YD. OF ROCK @ 1.0 DIA. TYP. @ 100 LB./CU. YD.



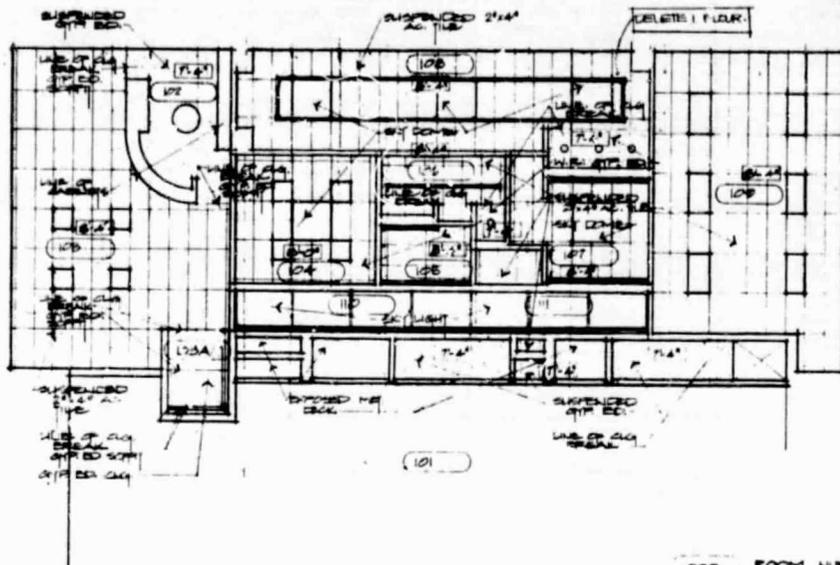
13 ROCK BOX DETAIL
12'-0" x 12'-0" RE: 11A



14 TRANSITE DET.
12'-0" x 12'-0" RE: 11A

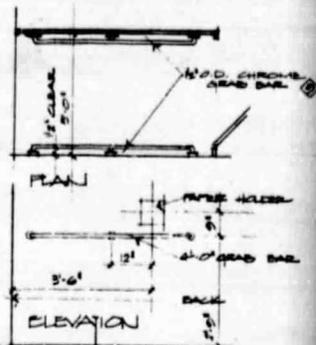


15 SECTION
12'-0" x 12'-0" RE: 11A

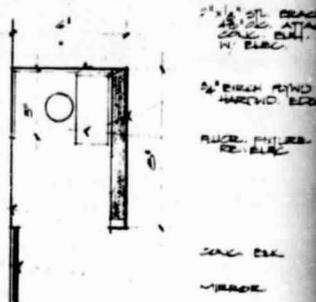


1 REFLECTED CEILING PLAN
1/8" = 1'-0"

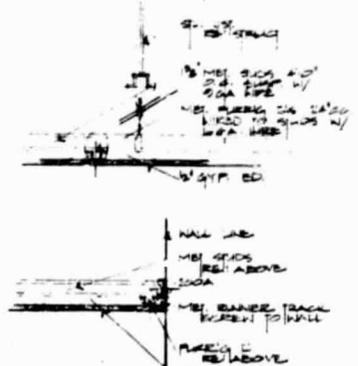
000 ROOM NUMBERS
001 CEILING HEIGHTS



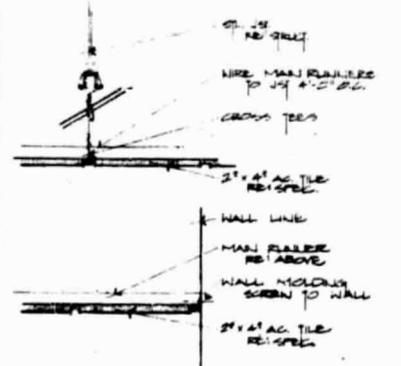
7 TYPICAL HANDICAP TOILET
1/8" = 1'-0"
REF: 043, 1043



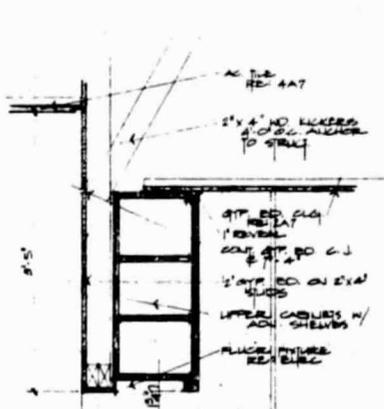
8 TYP. VANITY LIGHT
1/8" = 1'-0"
REF: 019, 1043



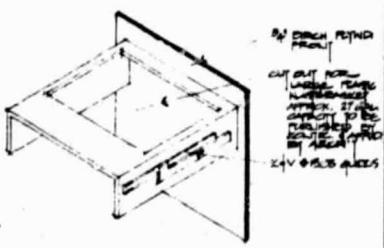
2 TYP. DRYWALL CEILING
1/8" = 1'-0"
REF: 147



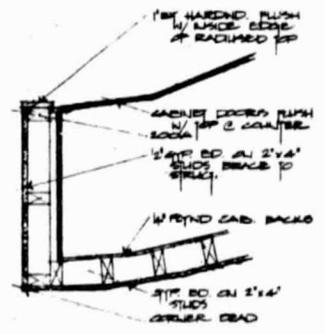
4 TYP. ACOUSTICAL TILE
1/8" = 1'-0"
REF: 147



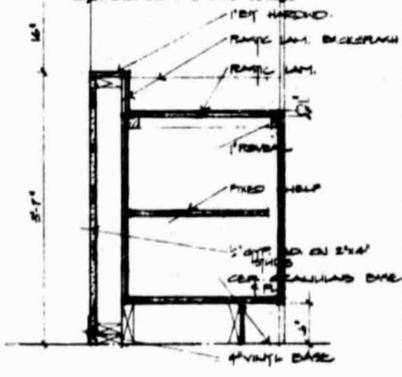
9 TYP. VANITY
1/8" = 1'-0"
REF: 043, 1043



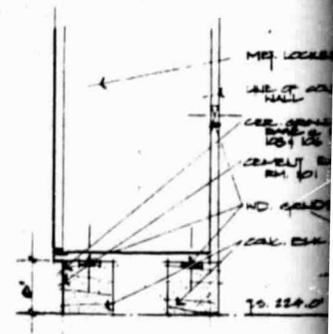
3 TYP. TRASH BIN
1/8" = 1'-0"
REF: 043



5 TYP. KITCHEN WALL SECTION PLAN
1/8" = 1'-0"
REF: 043



6 TYP. KITCHEN CABINET
1/8" = 1'-0"
REF: 043



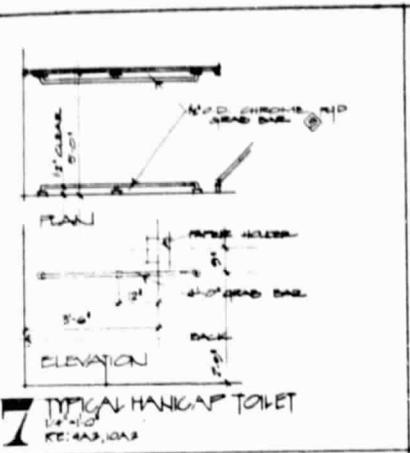
10 TYP. LOCKER BASE
1/8" = 1'-0"
REF: 043



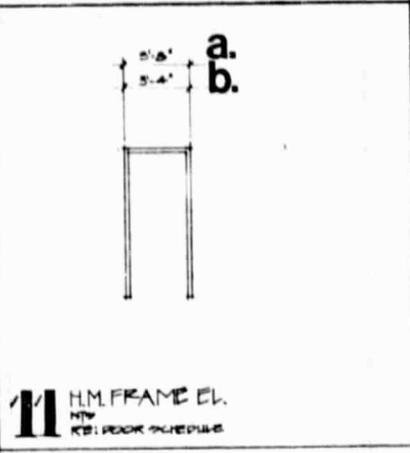
Mogley Straughnessy Fobel and Scott Architects Inc. 720 West 9th Street Kansas City, Missouri 64105

Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri

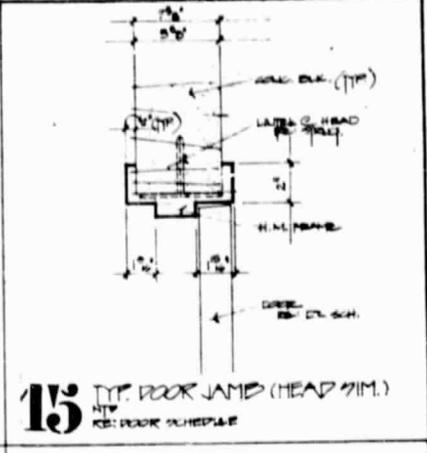
Architect and Interior Designer



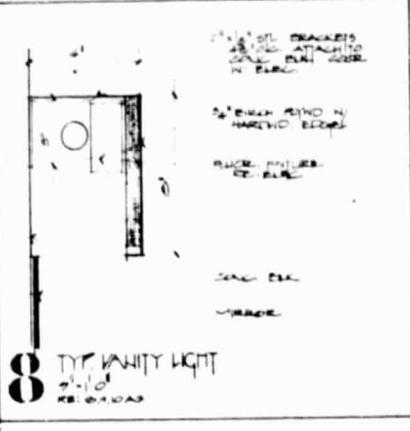
7 TYPICAL HANDICAP TOILET
1/4" = 1'-0"
REF: DAS, OAS



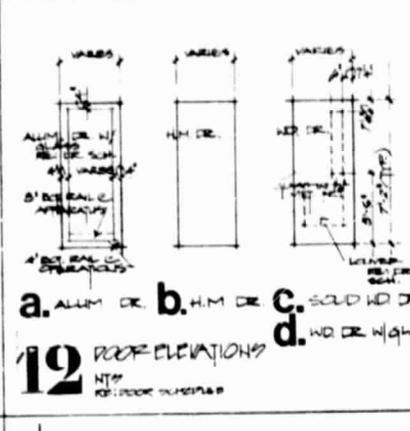
11 H.M. FRAME EL.
NTP
REF: DOOR SCHEDULE



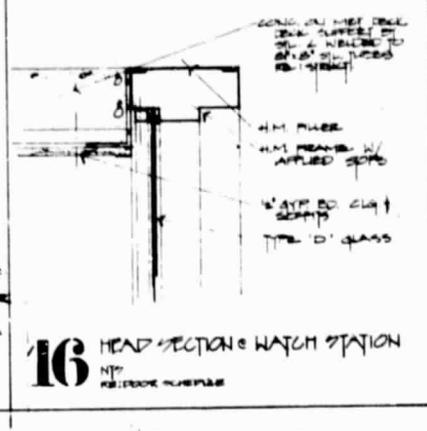
13 TYP. DOOR JAMB (HEAD TRIM)
NTP
REF: DOOR SCHEDULE



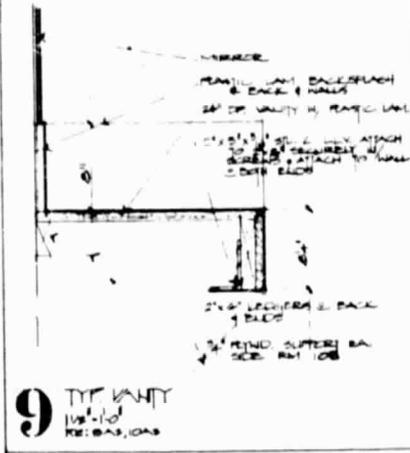
8 TYP. VANITY LIGHT
1/4" = 1'-0"
REF: DAS, OAS



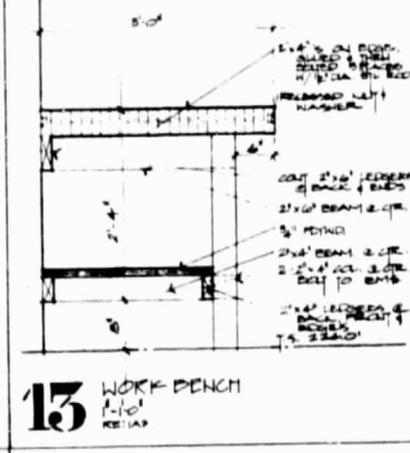
12 DOOR ELEVATIONS
NTP
REF: DOOR SCHEDULE



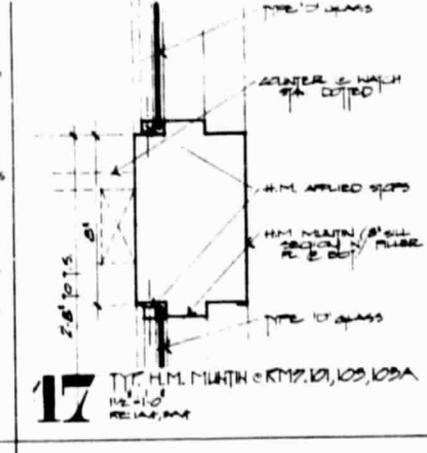
16 HEAD SECTION - WATCH STATION
NTP
REF: DOOR SCHEDULE



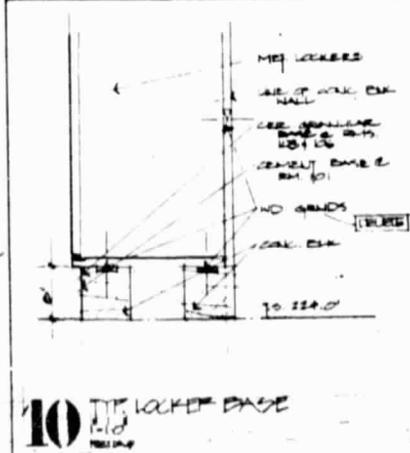
9 TYP. VANITY
1/4" = 1'-0"
REF: DAS, OAS



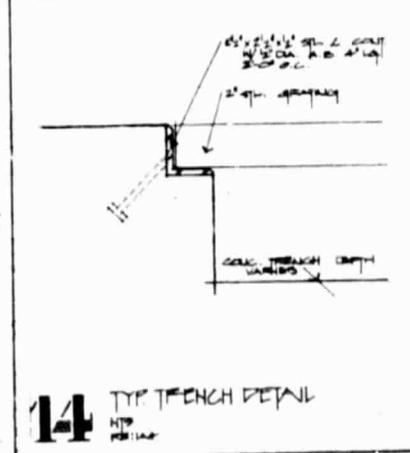
13 WORK BENCH
1/4" = 1'-0"
REF: DAS



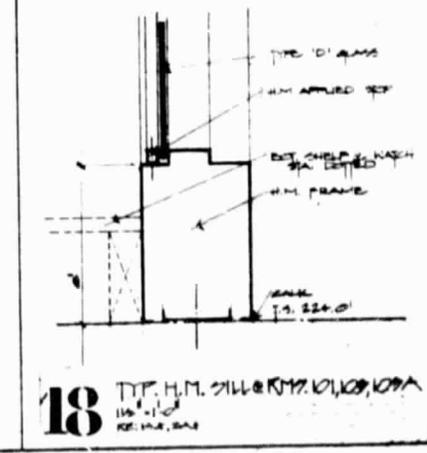
17 TYP. H.M. WINDOW (KMP, OI, OS, OSA)
1/4" = 1'-0"
REF: DAS, OAS



10 TYP. LOCKER BASE
1/4" = 1'-0"
REF: DAS



14 TYP. TRENCH DETAIL
NTP
REF: DAS



18 TYP. H.M. SILL (KMP, OI, OS, OSA)
1/4" = 1'-0"
REF: DAS, OAS

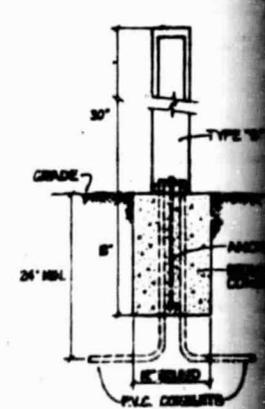
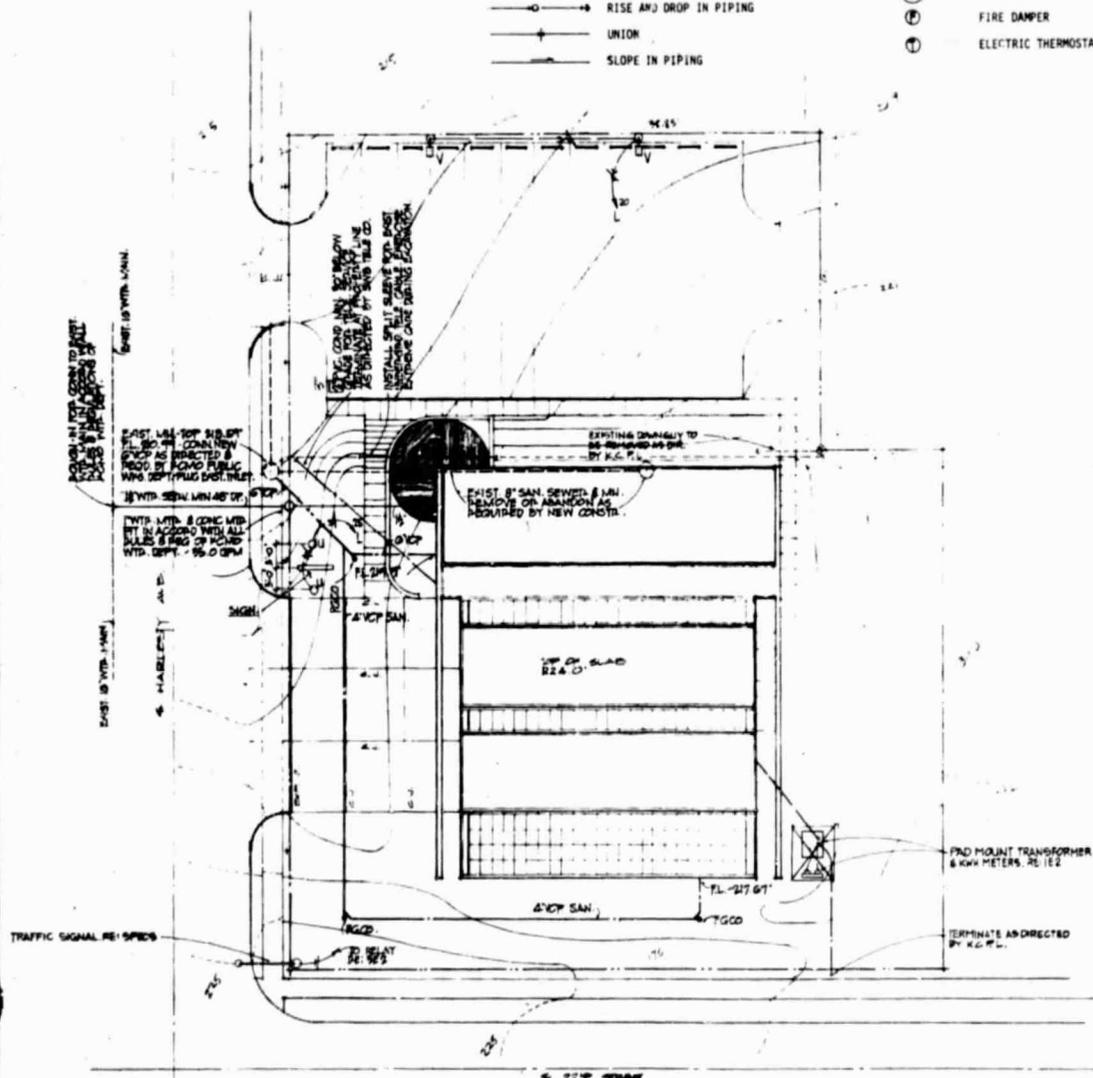
FOLDOUT FRAME

3 MECHANICAL SYMBOLS

---	SOIL, WASTE AND DOWNSPOUT PIPING	FFCO	FLUSH FLOOR CLEANOUT
---	VENT PIPING	(HW)	HOT WATER HEATER
---	CW DOMESTIC COLD WATER PIPING	SD	SUPPLY DIFFUSER
---	HW DOMESTIC HOT WATER PIPING	SR	SUPPLY REGISTER
---	SHW SOLAR HOT WATER PIPING	ER	EXHAUST REGISTER
---	SWC SOLAR HOT WATER CIRCULATING PIPING	AER	ALUMINUM EXHAUST REGISTER
W	WATER CLOSET	OG	OUTSIDE AIR GRILLE
WA	HANDICAP WATER CLOSET	RB	RETURN BOOT
WL	WALL HUNG LAVATORY	BJ	BETWEEN JOISTS
L	COUNTER TOP LAVATORY	FC	FLEXIBLE DUCT CONNECTIONS
U	URINAL		GLASS FIBER OR SHEET METAL DUCTWORK - SEE SPEC. FIBER DUCT SIZES ARE INSIDE, METAL DUCT SIZES ARE OUTSIDE
S	SINK		SLOPE UP OR DOWN IN DUCTWORK.
SS	SERVICE SINK		SHEET METAL EXHAUST DUCTWORK WITH 1/2" ACOUSTICAL LINING - SIZE IS SHEET METAL.
SH	SHOWER		ALUMINUM DUCTWORK SIZE IS SHEET METAL
EDF	ELECTRIC DRINKING FOUNTAIN		HEAT PUMP-INDOOR UNIT NUMBER
(SD)	FLOOR DRAIN SIZE AND TYPE		HEAT PUMP-OUTDOOR UNIT NUMBER
(S)	PLUMBING STACK NUMBER		EXHAUST FAN NUMBER
+	CUT-OFF VALVE		FIRE DAMPER
+	CHECK VALVE		ELECTRIC THERMOSTAT
+	RISE AND DROP IN PIPING		
+	UNION		
---	SLOPE IN PIPING		

4 ELECTRICAL SYMBOLS

---	CONDUIT IN CEILING OR FLOOR
---	CONDUIT IN FLOOR OR CEILING
---	#12 WIRE IN CONDUIT OTHERWISE, SIZE COME LATEST N.E.C.
---	GROUND WIRE IN CONDUIT
---	SOUND SYSTEM CABLE IN CONDUIT
---	CEILING LIGHT OUTLET
---	WALL BRACKET LIGHT OUTLET
---	FLUORESCENT LIGHTING
---	GROUNDING TYPE DUPLEX RECEPTACLE
---	FLUSH FLOOR DUPLEX RECEPTACLE
---	GROUNDING TYPE DUPLEX RECEPTACLE WITH WEATHER CAP
---	WALL MOUNTED TELEPHONE
---	EXIT LIGHT
---	JUNCTION BOX
---	VOLUME CONTROL
---	CEILING MOUNTED SPEAKER
---	WALL MOUNTED SPEAKER
---	ALARM BELL
---	GARAGE DOOR PUSHBUTTON
---	CLOCK HANGER OUTLET & ELECTRIC THERMOSTAT, 5'-0" ABOVE FLOOR.
---	T.V. ANTENNA OUTLET
---	DISCONNECT SWITCH OR MOTOR OUTLET
---	SINGLE POLE WALL SWITCH
---	TWO POLE WALL SWITCH
---	THREE WAY WALL SWITCH
---	MANUAL MOTOR STARTING
---	THERMAL OVERLOADS & MOTOR



1 SITE PLAN
SCALE - 1" = 30'-0"

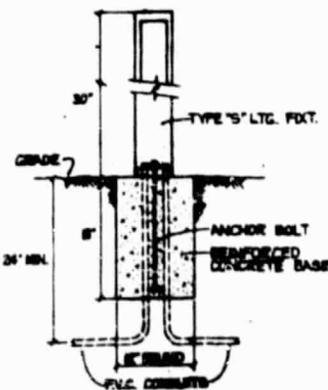
FOLDOUT FRAME

4 ELECTRICAL SYMBOLS

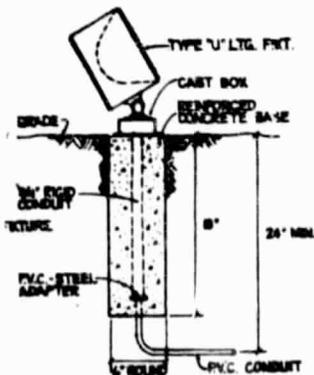
- CONDUIT IN CEILING CONSTRUCTION
- CONDUIT IN FLOOR OR WALL CONSTRUCTION
- #12 WIRE IN CONDUIT UNLESS NOTED OTHERWISE, SIZE CONDUIT PER THE LATEST N.E.C.
- GROUND WIRE IN CONDUIT
- SOUND SYSTEM CABLE IN CONDUIT
- CEILING LIGHT OUTLET
- WALL BRACKET LIGHT OUTLET
- FLUORESCENT LIGHTING FIXTURE
- GROUNDING TYPE DUPLEX CONVENIENCE RECEPTACLE
- FLUSH FLOOR DUPLEX CONVENIENCE RECEPTACLE
- GROUNDING TYPE DUPLEX CONVENIENCE RECEPTACLE WITH WEATHERPROOF COVER
- WALL MOUNTED TELEPHONE OUTLET
- EXIT LIGHT
- JUNCTION BOX
- VOLUME CONTROL
- CEILING MOUNTED SPEAKER
- WALL MOUNTED SPEAKER, WEATHERPROOF
- ALARM BELL
- GARAGE DOOR PUSHBUTTON STATION
- CLOCK HANGER OUTLET & CLOCK
- ELECTRIC THERMOSTAT, CENTERLINE 5'-0" ABOVE FLOOR
- T.V. ANTENNA OUTLET
- DISCONNECT SWITCH OR MOTOR CONTROL
- MOTOR OUTLET
- SINGLE POLE WALL SWITCH
- TWO POLE WALL SWITCH
- THREE WAY WALL SWITCH
- MANUAL MOTOR STARTING SWITCH WITH THERMAL OVERLOADS & PILOT LIGHT

5 SCHEDULE OF LIGHTING FIXTURES

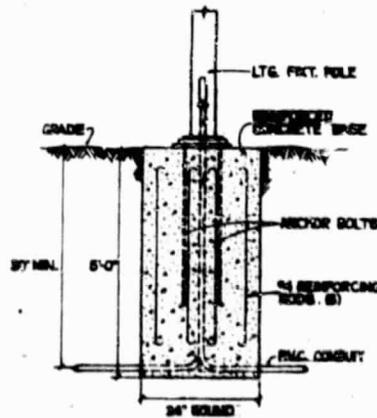
TYPE	DESCRIPTION	NO. & TYPE LAMPS	LENS	MOUNTING	MANUFACTURER & NO.	EQUIVALENT
A	FLUORESCENT GRID TROFFER 2'x2' RECESSED ALUMINUM DOOR	2-F40 CW	PRISMATIC ACRYLIC (.125)	RECESSED	WILLIAMS #5262-RKA	WESTINGHOUSE METALUX PRESIDENT PRUDENTIAL
B	FLUORESCENT METAL SIDE 2'x2' RECESSED ALUMINUM DOOR	2-F40 CW	PRISMATIC ACRYLIC (.125)	SURFACE	WILLIAMS #1262-RKA	
C	LINEAR FLUORESCENT 2'x4' BALLAST	1-F40 CW	WHITE ACRYLIC (.125)	SURFACE	PRUDENTIAL P-1271-62-RS (DINING BALLAST)	
D	FLUORESCENT METAL SIDE 2'x2' RECESSED ALUMINUM DOOR	4-F40 CW	PRISMATIC ACRYLIC (.125)	SURFACE	WILLIAMS #1224-RKA	
E	FLUORESCENT INDUSTRIAL 155 UPLIGHT	4-F40 CW	-	8 1/2" OF JOISTS	WILLIAMS #8325/RA-82/ED-82	
F	FLUORESCENT INDUSTRIAL 155 UPLIGHT	2-F40 CW	-	8 1/2" OF JOISTS	WILLIAMS #8322/RA-82/ED-82	
G	FLUORESCENT STRIP -3'	1-F30 CW	-	SURFACE	WILLIAMS #7510	
H	FLUORESCENT STRIP -4'	1-F40 CW	-	SURFACE	WILLIAMS #7520	
J	ENCLOSED & GASKETED STRIP LIGHT - 4'	1-F40 CW	WHITE ACRYLIC	SURFACE	PRUDENTIAL #P-5101-4B-RS-WP	
K	36" DOME FLUORESCEN	4-F30 CW	WHITE ACRYLIC	RECESSED	PRUDENTIAL #P-2934-36-RS	LIGHTOLIER
L	WYCKCABINET LIGHT	1-F20 CW	PRISMATIC	SURFACE	STERLING #324	SOLO
M	PORCELAIN LAMPHOLDER FULL-CHAIN	1-75W A-19	-	SURFACE	GENERAL ELECTRIC #GE5750-7	LEVITON
N	ANGLE INCANDESCENT REFLECTOR	1-150W T-21	-	RESEARCH	ABOLITE #AF-200	HUBBELL
P	WALK LIGHT	1-40W T-10	LOCVER	RECESSED	MOLDCAST #V362	
R	BLDG FLOODLIGHT 120" X 30" V.	1-175W MERC.-DX	CLEAR GLASS	RESEARCH	SEPCO #5000-30120 175W-120	GEN'L ELECT.
S	BOLLARD-BLACK FINISH	1-100W MERC.-DX	WHITE LEXAN & LOUVER	SEE DTL.	ARCH. AREA LTD. #ALS-170-1FG-100W-LX	
T	SHOWER LIGHT	1-100W A-19	WHITE	RECESSED	PERFECTLITE #FLS-75	MARCO
U	SIGN LIGHT 100" X 20" V.	1-175W MERC.-DX	CLEAR GLASS	SEE DTL.	SEPCO #5000-20100 175W-120	GEN'L ELECT.
V	PARKING LOT LUMINAIRE	1-400W HPS.	CLEAR GLASS	25'-0" POLE SEE DTL.	KIN #1A/EXG-111 (TYPE 111) PTRS-25A	GARCO
X	EXIT LIGHT	2-20W T6	RED/STEEL	CEILING	PRESOLITE #75211	MCPHILBEN MARCO



TYPE 'S'



TYPE 'U'



TYPE 'V'

9 LIGHTING FIXTURE BASE DETAILS

NOT TO SCALE

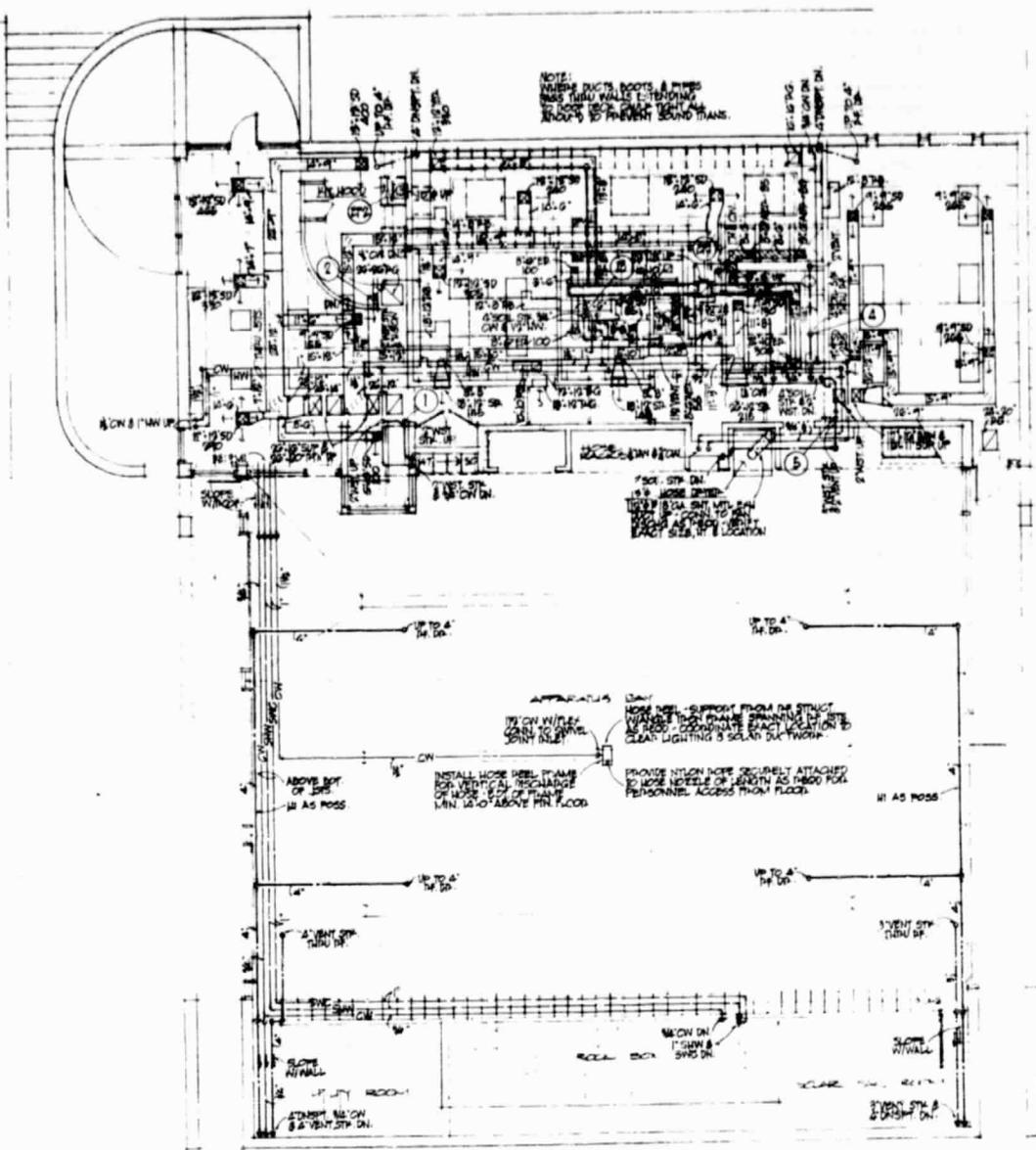
CONTRACTOR SHALL CHECK DIMENSIONS FOR ARCHITECTURAL CHANGES AND VERIFY DIMENSIONS AT SITE. THIS DRAWING IS TO BE SCALED FOR ANY REQUIREMENTS AND TO BE USED TO ANY CHANGE AS A BASIS FOR

McGee Staughnessy Fickel and Scott Architects Inc. 20 West 8th Street Kansas City, Missouri 64105
 Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri
 site plan and details



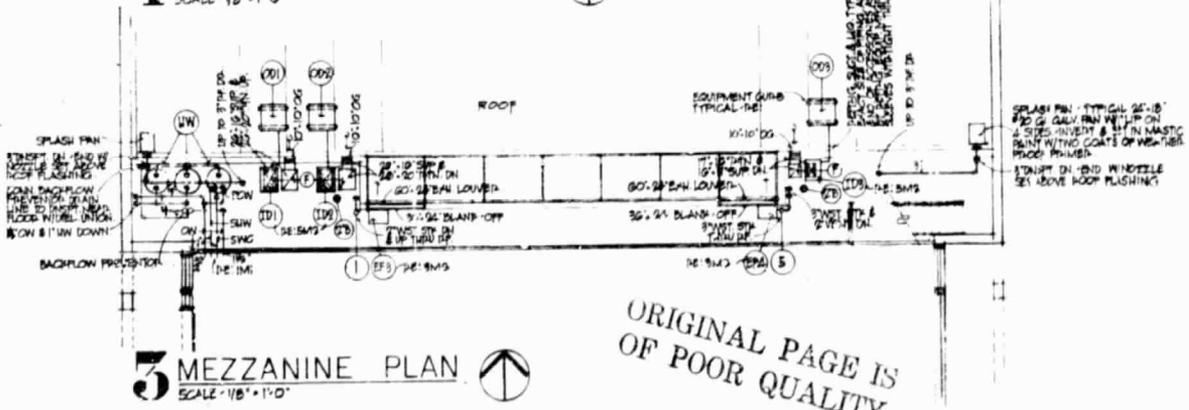
MOLDOUT FRAME





1 FLOOR PLAN - UPPER
SCALE - 1/8" = 1'-0"

2 FLOOR PLAN
SCALE - 1/8" = 1'-0"

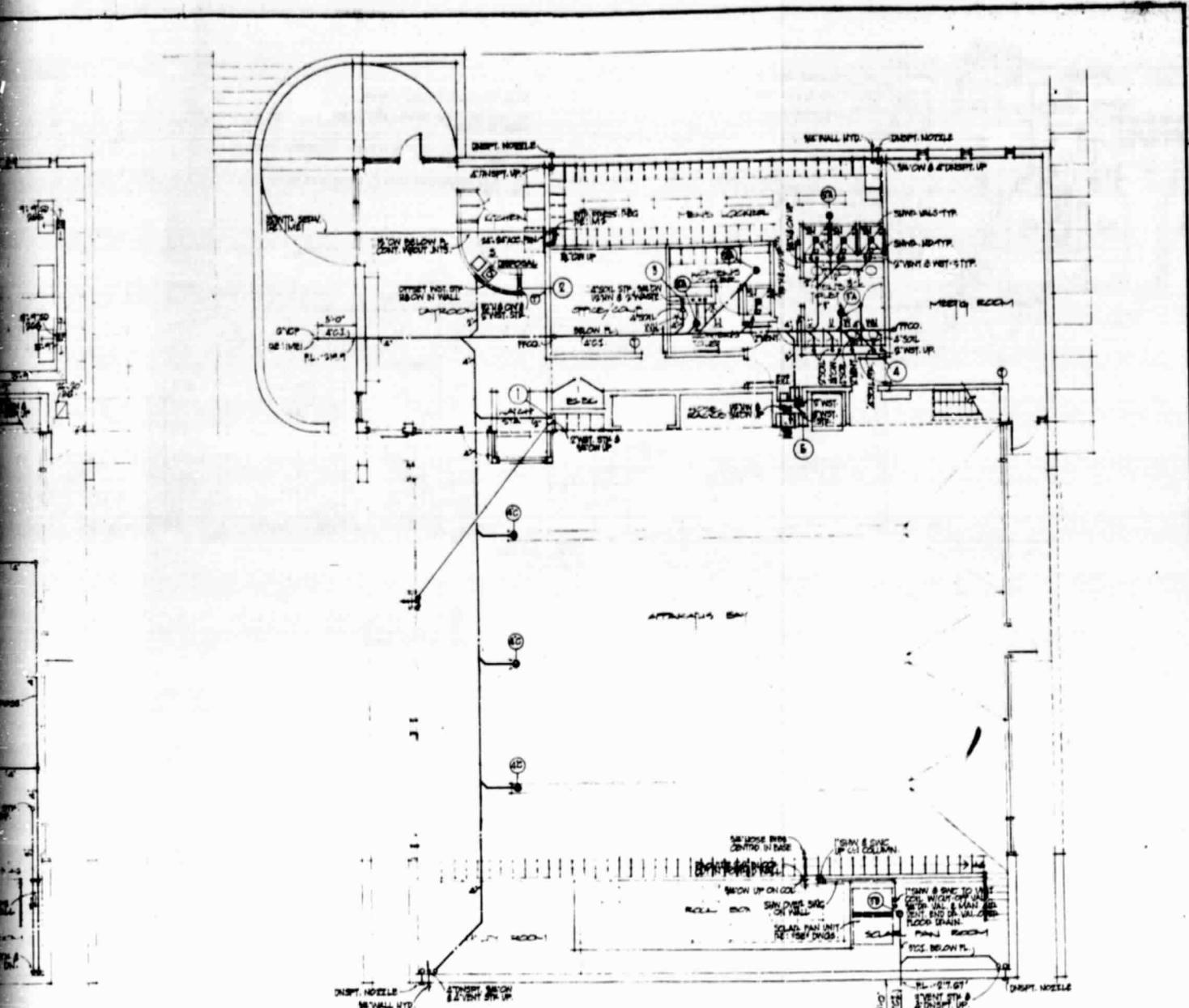


3 MEZZANINE PLAN
SCALE - 1/8" = 1'-0"

ORIGINAL PAGE IS
OF POOR QUALITY

PROJECT NO. 01
DATE 10/27

FOLDOUT FRAME



2 FLOOR PLAN - LOWER
 SCALE - 1/8" = 1'-0"

FLASH PAN - TYPICAL 2'-0" x 2'-0" GALV PAN SET UP ON 2" STEEL STUDS & 1" IN MASSIC BUILT UPING COATS OF WEATHER PROOF PLUMB.

STAIR IN END WINDSILL SET ABOVE ROOF FLASHING

McGhee Shegnessy Foster and Scott Architects Inc. 720 West 9th Street Kansas City, Missouri 64108

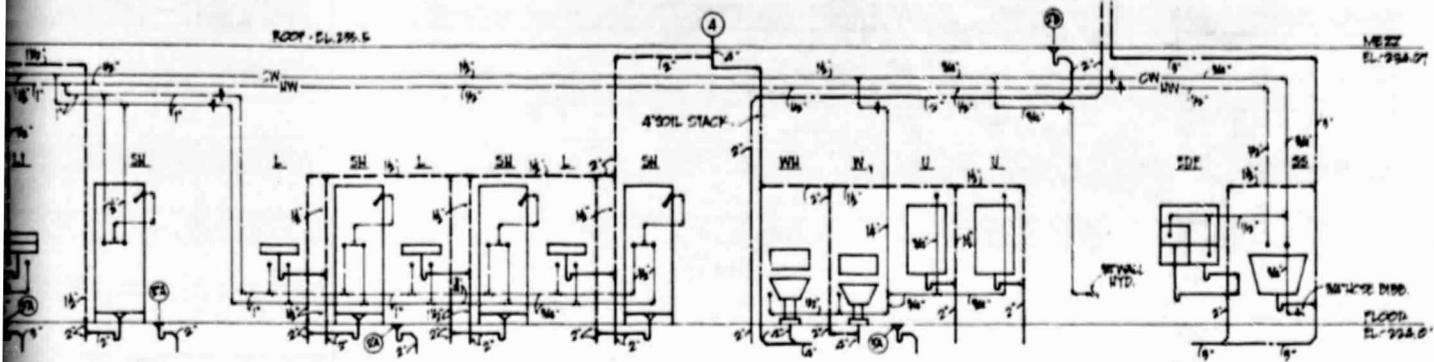


Kansas City Fire Station No. 24, 2039 Hardesty Kansas City, Missouri

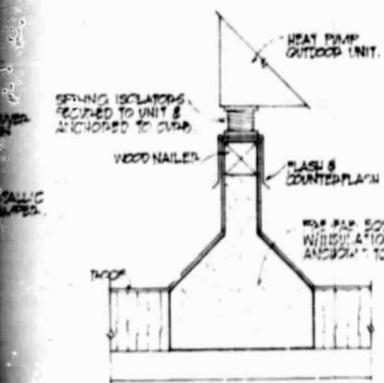
2 FOLDOUT FRAME

DIAGRAM
 1. WALL HYDRANTS, ETC. NOT
 2. REVERSED FROM NORMAL LOCATIONS
 3. FIXTURES ARE 1/2" UNLESS NOTED

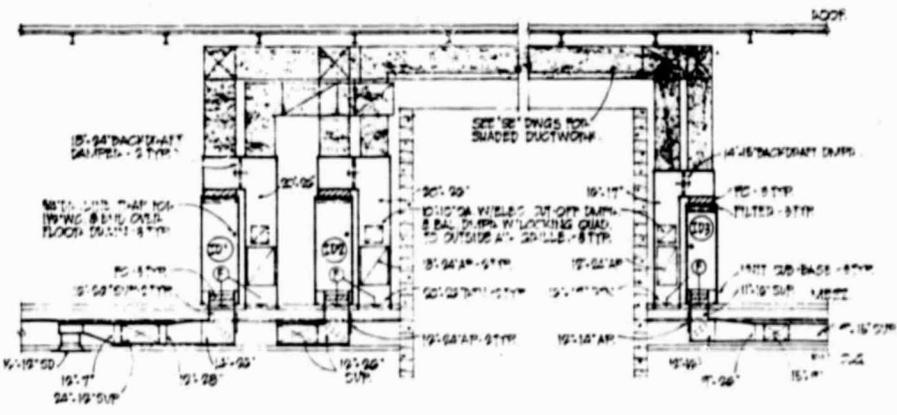
PLUMBING ABBREVIATIONS
 WC - WATER CLOSET
 WWC - HAND-DROP WATER CLOSET
 LL - WALL HUNG LAVATORY
 CL - COUNTER TOP LAVATORY
 U - URINAL
 S - SINK
 SS - SERVICE SINK
 SH - SHOWER
 EDF - ELECTRIC DRINKING FOUNTAIN



PLUMBING RISER DIAGRAM
 1/8" SCALE



4 EQUIPMENT CURB
 NOT TO SCALE



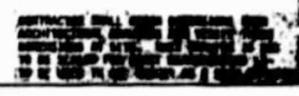
5 ELEVATION OF INDOOR UNITS
 SCALE - 1/4" = 1'-0"

FOLDOUT FRAME

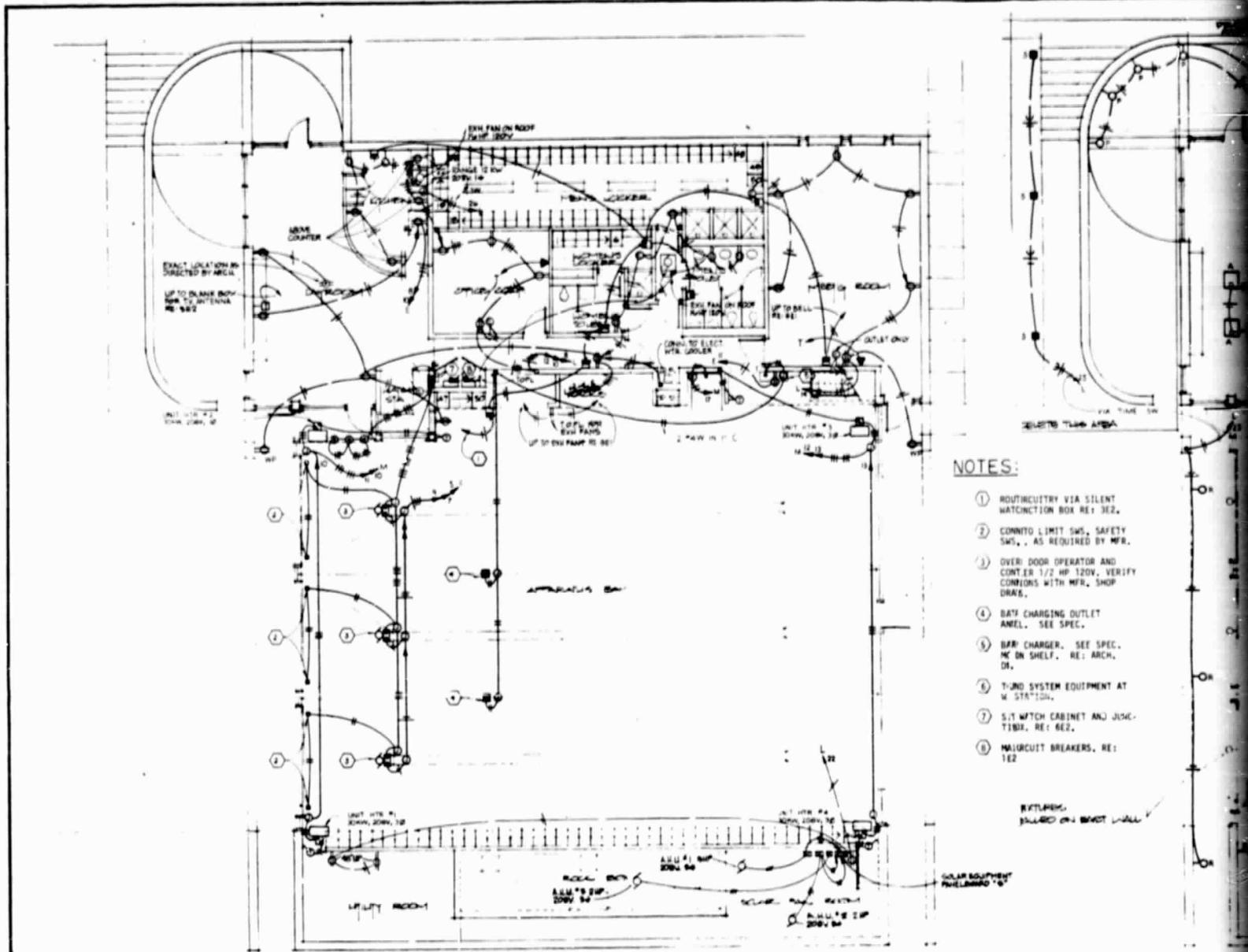
Modjeski Staughnessy Finkel and Scott Architects Inc. 720 West 9th Street Kansas City, Missouri 64105



Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri



M2

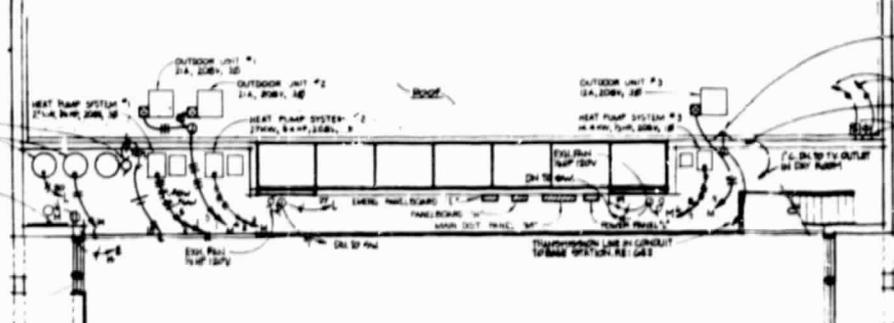


NOTES:

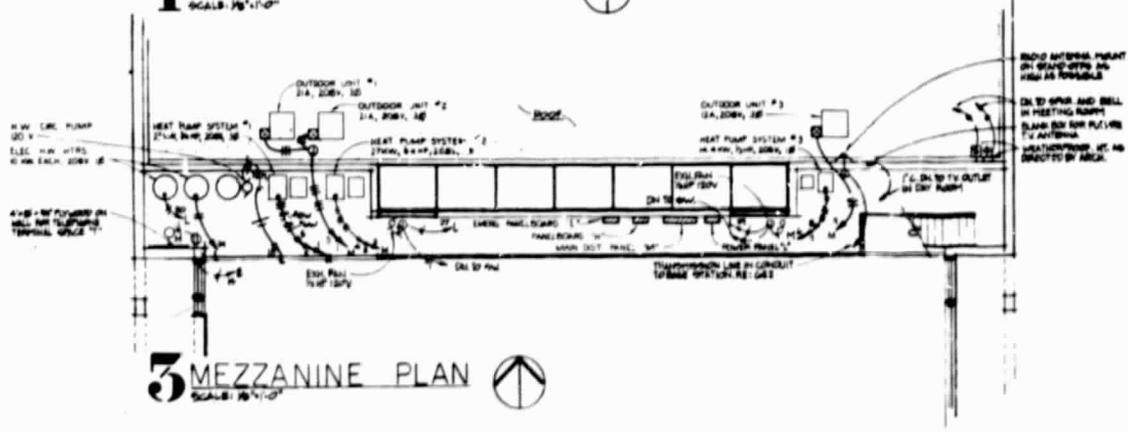
- ① ROUTING VIA SILENT WATCHDOG BOX RE: 3E2.
- ② CONNTO LIMIT SMS, SAFETY SMS, AS REQUIRED BY MFR.
- ③ OVER DOOR OPERATOR AND COUNTER 1/2 HP 120V. VERIFY CONDITIONS WITH MFR. SHOP DRAW.
- ④ BATH CHARGING OUTLET ANCEL. SEE SPEC.
- ⑤ BAR CHARGER. SEE SPEC. MC ON SHELF. RE: ARCH. DR.
- ⑥ T-UND SYSTEM EQUIPMENT AT W. STATION.
- ⑦ S/T SWITCH CABINET AND JUNCTION. RE: 6E2.
- ⑧ CIRCUIT BREAKERS. RE: 1E2

EXTL. PERS. BELLARD ON - BAYOT WALL

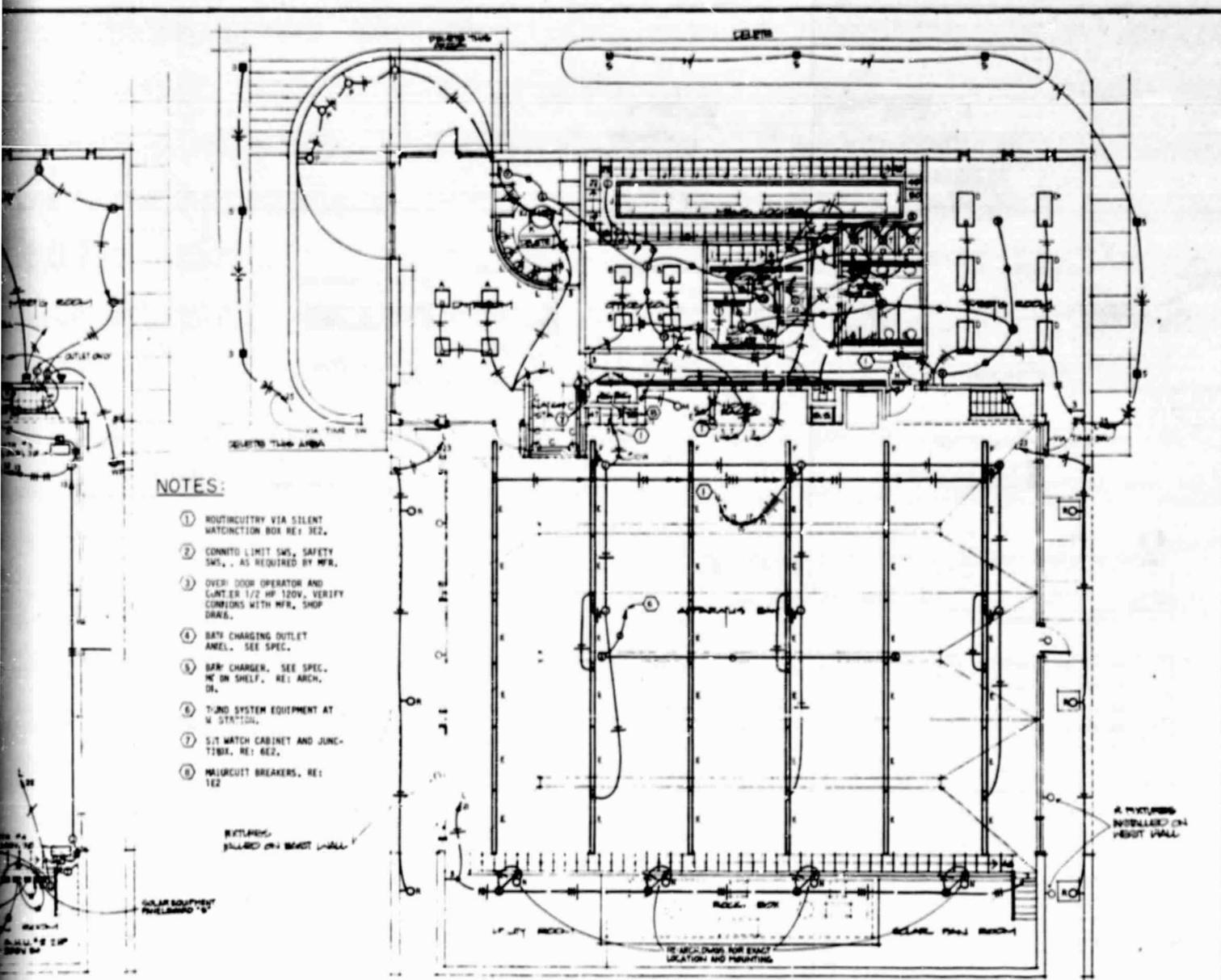
1 FLOOR PLAN - POWER



3 MEZZANINE PLAN

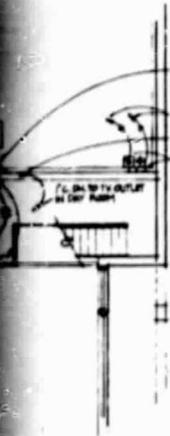


2



- NOTES:**
- ① ROUTING CTRVY VIA SILENT WATCHFUNCTION BOX RE: 302.
 - ② CONNCTD LIMIT SW, SAFETY SW, AS REQUIRED BY MFR.
 - ③ OVER DOOR OPERATOR AND LUMINER 1/2 HP 120V, VERIFY CONDITIONS WITH MFR, SHOP DATA.
 - ④ BATH CHARGING OUTLET ANEL. SEE SPEC.
 - ⑤ BFW CHARGER. SEE SPEC. MC ON SHELF. RE: ARCH. DR.
 - ⑥ T-100 SYSTEM EQUIPMENT AT W. STATION.
 - ⑦ S.T. WATCH CABINET AND JUNCTION BOX. RE: 602.
 - ⑧ MALCIRUIT BREAKERS. RE: 102

2 FLOOR PLAN - LIGHTING 
SCALE 1/8" = 1'-0"



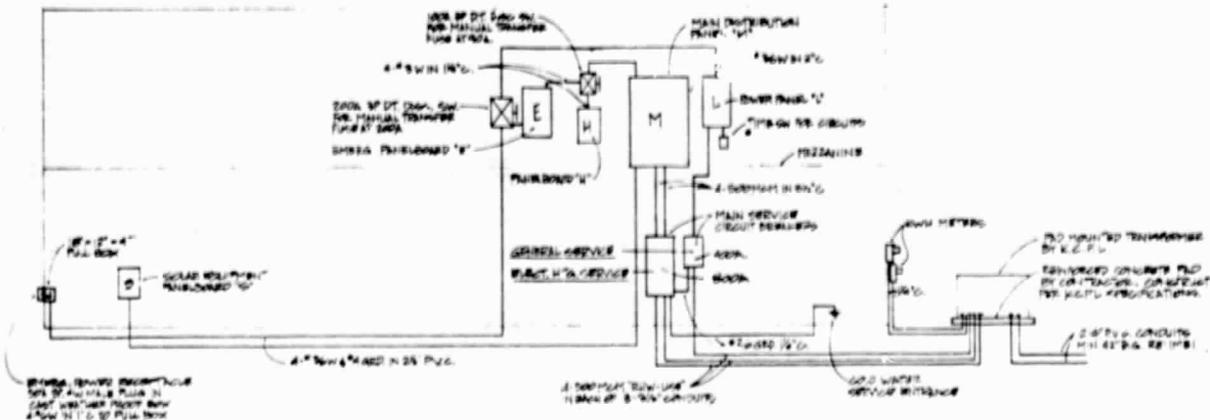
BOLDOUT FRAME 2

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Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri

NOT TO BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN CONSENT OF THE ARCHITECT



1 ELECTRICAL RISER DIAGRAM

SCHEDULE — MAIN DISTRIBUTION PANEL "M"

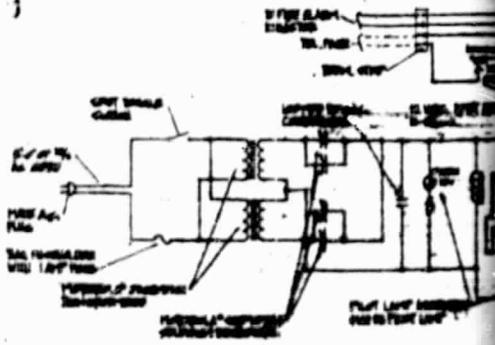
CIRC. NO.	DESIGNATION	HP OR KW	AMPS RUNNING	FRAME TYPE	TRIP AMPS	TYPE BR.	SIZE WIRE & CONDUIT	
1	HEAT PUMP SYS. #1-OUTDOOR UNIT		21	HFB	40	3P	3-ØM. IN 3/4" C.	
2	HEAT PUMP SYS. #2-HEATER CIRC. #1		41	HFB	40	3P	3-ØM	
3	HEAT PUMP SYS. #2-HEATER CIRC. #2		24	HFB	40	3P	3-ØM 1/4" C.	
4	HEAT PUMP SYS. #2-INDOOR UNIT		2.6	HFB	20	3P	2-Ø12N	
5	HEAT PUMP SYS. #2-OUTDOOR UNIT		21	HFB	40	3P	3-ØM IN 3/4" C.	
6	HEAT PUMP SYS. #3-HEATER CIRC. #1		40	HFB	70	2P	2-ØM	
7	HEAT PUMP SYS. #3-HEATER CIRC. #2		20	HFB	40	2P	2-Ø2M IN 1/4" C.	
8	HEAT PUMP SYS. #3-INDOOR UNIT		2.4	HFB	20	2P	2-Ø12N	
9	HEAT PUMP SYS. #3-OUTDOOR UNIT		12	HFB	30	3P	2-Ø10M. IN 1/2" C.	
10	UNIT HEATER #1		30	Ø3	HFB	125	3P	3-Ø1M IN 1/4" C.
11	UNIT HEATER #2		30	Ø3	HFB	125	3P	3-Ø1M IN 1/4" C.
12	UNIT HEATER #3		30	Ø3	HFB	125	3P	3-Ø1M IN 1/4" C.
13	UNIT HEATER #4		30	Ø3	HFB	125	3P	3-Ø1M IN 1/4" C.
14	PANELBOARD "H"		67.6	HFB	100	3P	4-Ø2M IN 1/4" C.	
15	HOSE DRYER		6	Ø2	HFB	50	2P	2-Ø2M IN 3/4" C.
16	PANELBOARD "S"			HFB	60	3P	4-ØM. IN 1" C.	
17	SPACE			HFB		3P		
18	SPACE			HFB		3P		
19	SPACE			HFB		3P		

PANEL TO BE 800A, N.L.O. RATED 50,000 A.T.C. FOR 120/208V. 3Ø 4W SERVICE.

4 SCHEDULE OF PANELBOARDS

PANEL BOARD	MOUNTING	VOLTAGE & PHASE	MAIN SIZE & TYPE	20 AMP SINGLE POLE CIRC. BR.							SPACES FOR FUTURE CIRC. BR.
				CIRC. #	CIRC. #	CIRC. #	CIRC. #	CIRC. #	CIRC. #	CIRC. #	
L	SURFACE	120/208V 3Ø, 4W	400A, M.L.D.	#1 THRU #24 INCL. & 27	30, 34	26				31	6
H	SURFACE	120/208V 3Ø, 4W	100A, M.L.D.				5	3	1		9
E	SURFACE	120/208V 3Ø, 4W	225A, M.L.D.	#1 THRU #18 INCL.						20	3
S	SURFACE	120/208V 3Ø, 4W	100A, M.L.D.	2, 4, 6				1, 3, 5		20	3

FOLDOUT FRAME

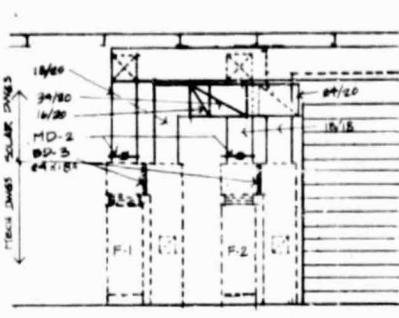


5 POWER SUPPLY

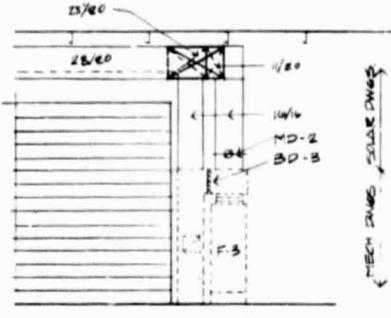
APPENDIX B
AS BUILT DRAWINGS OF THE
SOLAR HEATING SYSTEM

SE-1
SE-2

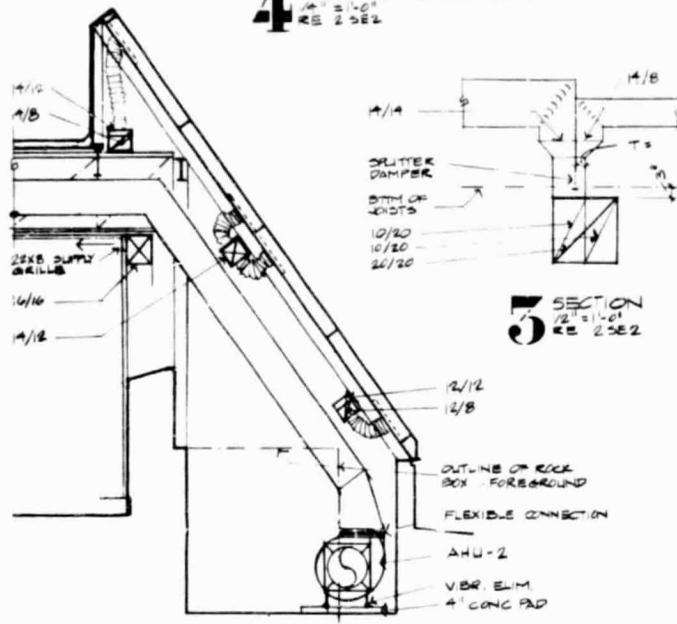
PRECEDING PAGE BLANK NOT FILLED



4 SECTION - ELEVATION
 1/4" = 1'-0"
 RE 1582, 2582



5 SECTION - ELEVATION
 1/4" = 1'-0"
 RE 2582



2 SECTION
 1/4" = 1'-0"
 RE 1582, 2582

GENERAL NOTES

DO NOT SCALE MECH. DIMS. SEE ARCH FOR EXACT LAYOUT DIMENSIONS. THIS CONTRACTOR TO COORDINATE MECHANICAL WORK WITH OTHER TRADES. NO CHANGES THAT COULD AFFECT THE OPERATION OF THE SOLAR & STANDBY SYSTEMS SHALL BE MADE WITHOUT THE APPROVAL OF SOLARON.

ALL SOLAR DUCTWORK JOINTS TO BE SEALED AIRTIGHT WITH DOW CORNING #781 SILICONE SEALANT RATED AT 250° F MIN.

DAMPERS INSTALLED IN DUCTWORK SHALL BE SEALED AIRTIGHT IN THE DUCT.

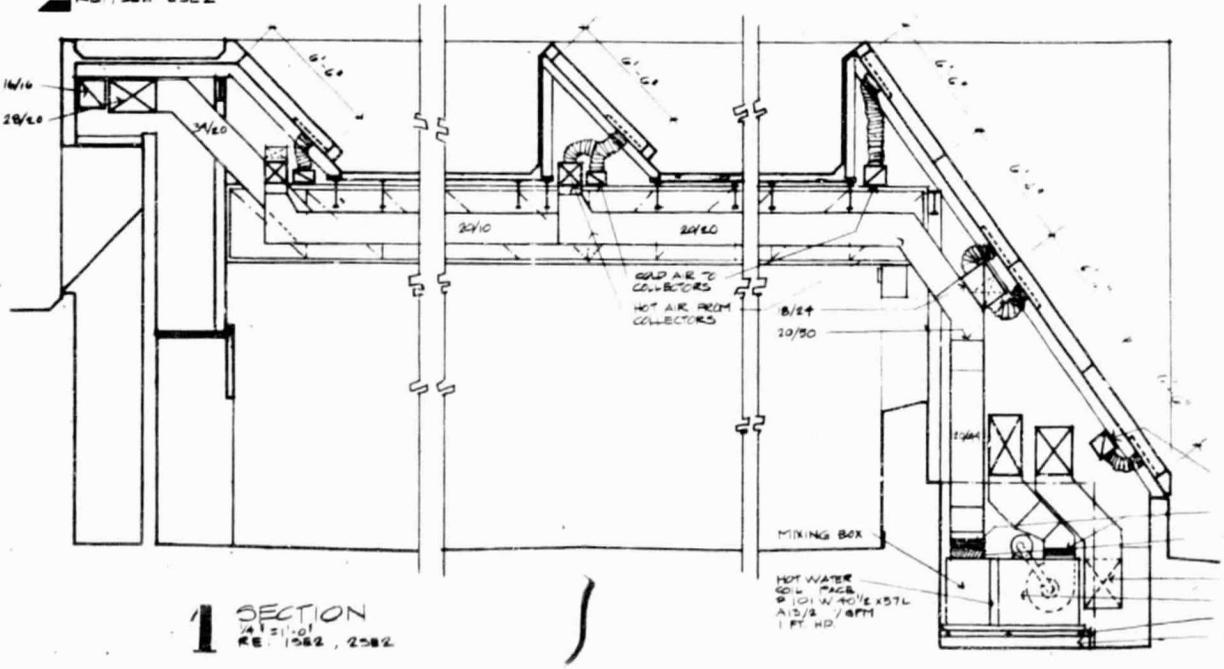
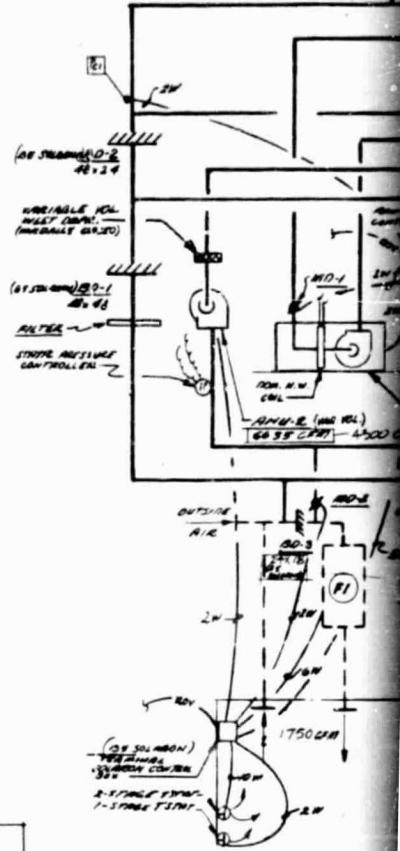
ALL SQUARE DUCT ELBOWS TO HAVE TURNING VANES.

PERIMETER FLASHING SEALANT. WEATHERPROOF SEALANT TAPE 1/2" X 1/8" 3-M WEATHERBAN SEALANT TAPE NO. 1202 T OR EQUAL.

AUXILIARY HEATING UNIT MUST BE SUITABLE FOR RETURN AIR TEMPERATURES OF 150 DEGREES F.

ALL DUCTWORK DIMENSIONS ON DWG. ARE SHEET METAL SIZE 1 I.E. 12/12 SIZE HAS FREE AREA OF 10/10 1" INSULATION (SEE NOTE 2) HAS BEEN ALLOWED FOR IN 12/12 SIZE UNLESS NOTED OTHERWISE!

MAXIMUM RUN OF FLEX. DUCT TO BE 3'-0" LONG.



1 SECTION
 1/4" = 1'-0"
 RE 1582, 2582

WINTER OPERATION	15" STAGE HEATING
	8" STAGE HEATING
SUMMER OPERATION	3" STAGE HEATING
	1" STAGE HEATING

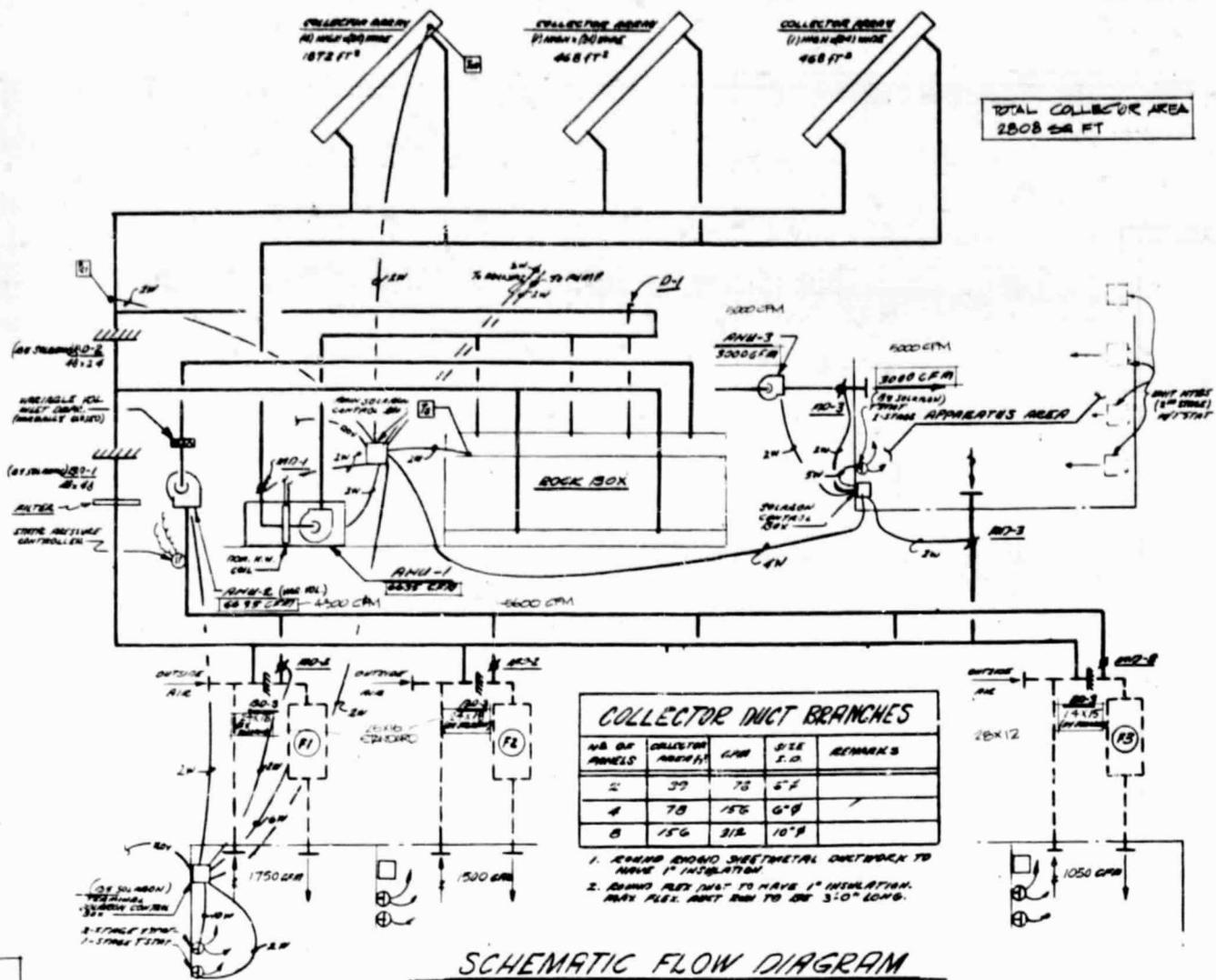
1/2" COLD AIR TO COLLECTOR
 FLEXIBLE CONNECTION
 A-10 DAMPER MD-1
 2 1/2" VBR. ELM
 4" CONC. PAD

NOT SHOWN BE SQUARE

Project no. CI
 10/11/77

FOLDOUT FRAME

SEARCH FOR EXACT
INSTRUCTOR TO COORDINATE
TRADES. NO
OPERATION OF THE
SHALL BE MADE WITHOUT
BE SEALD AIRTIGHT
SEALANT RATED AT
SHALL BE SEALD
HAVE TURNING VANES.
WEATHERPROOF SEA-
LANTHERBAN SEALANT
BE SUITABLE FOR RE-
DEGREES F.
ING. ARE SHEET METAL
STRENGTH AREA OF 10(10)
HAS BEEN ALLOWED FOR
OTHERWISE.
BE 3'-0" LONG.



SCHEMATIC FLOW DIAGRAM
NO SCALE

SEQUENCE OF OPERATION

MODE	NO-1	NO-2	NO-1	NO-2	NO-3	NO-1	D-1	FANS			REMARKS
								NO-1	NO-2	FI-E	
1 ST STAGE HEATING FROM COLLECTOR	O	O	O	O	C	O	C	ON	ON	ON	
HEATING FROM STORAGE	C	O	O	C	C	O	C	OFF	ON	ON	
STORING HEAT	O	C	C	O	C	C	C	ON	OFF	OFF	
HEATING WITH HEAT PUMP	O	C	C	C	O	C	-	C	OFF	OFF	ON
HEATING WITH ELECT RESIST	O	C	C	C	O	C	-	C	OFF	OFF	ON
SUMMER WATER HEATING	O	C	C	C	C	C	O	ON	OFF	OFF	
AIR CONDITIONING (RSH-SOLAR)	C	C	C	C	O	C	O	OFF	OFF	ON	

AIR HANDLING UNITS

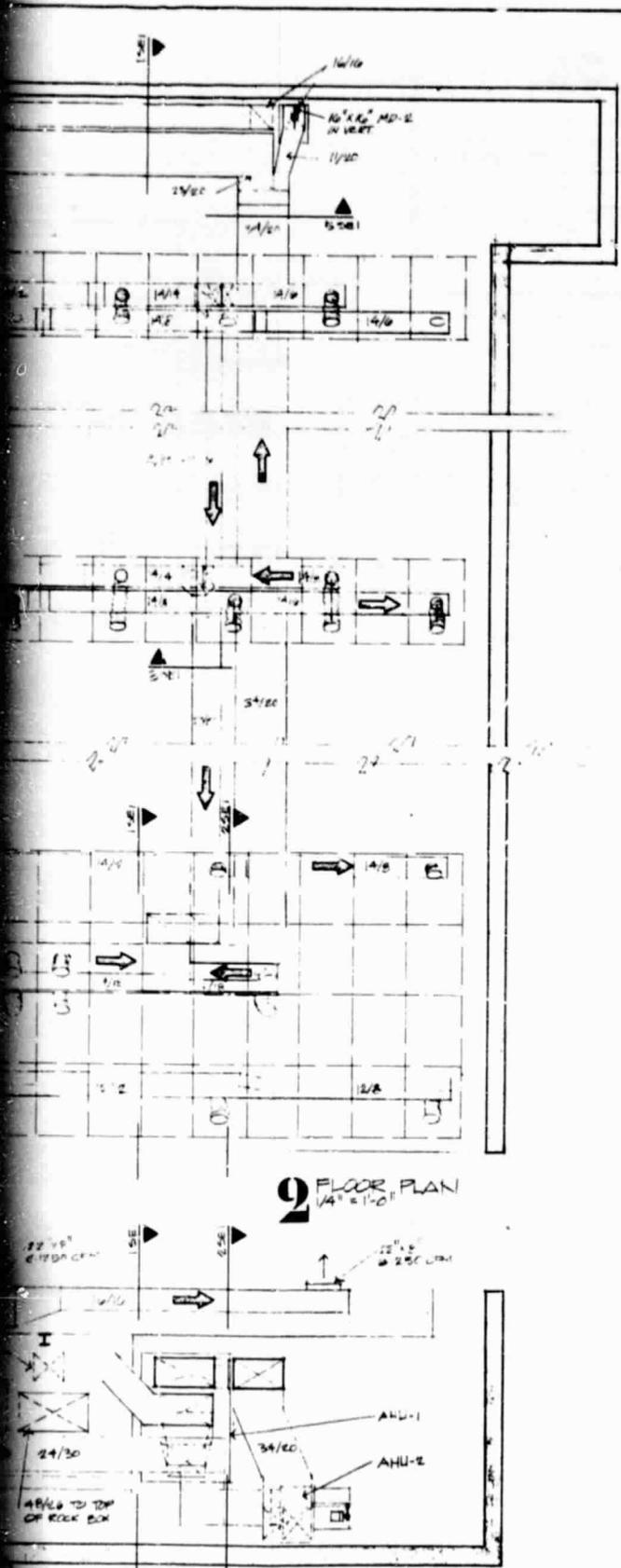
NO	MAKE MODEL	CFM	WHEEL IN.	SP	ELECTRIC DATA			TYPE	HP	HP/CFM	REMARKS
					HP	AMP	PHASE				
AHU-1	SOLAR COLLECTOR EXHAUST	5000	145	1/2"	3	6.85	208	3	CENTRAL SUPPLY	McQUAY	434-111 (1)
AHU-2	PERSONAL AIR DISTRIBUTION	4300	1710	1/2"	2	1.80	208	3	SWIFT CENTRIFUGAL	COOK	1101300 (1) WITH VARIABLE FREQUENCY UNIT MOTOR (2) & A.R. ROLL WHEEL
AHU-3	APPROXIMATE AIR DISTRIBUTION	5000	1610	3/4"	2	1.70	108	3	CENTRIFUGAL	COOK	14 CV (1) BELT DRIVE

NOTE: 1. ALL AIR HANDLERS COMPLETE WITH CONNECTION BRANCHED SPRING/SHUTTER SWITCH & HAND OFF/AUTO SWITCH IN PANEL. AIR CONTROLLER IS 240V.



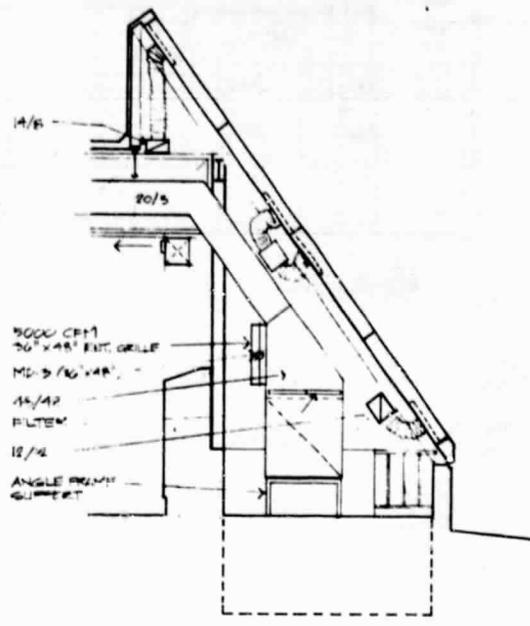
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FOLDOUT FRAME

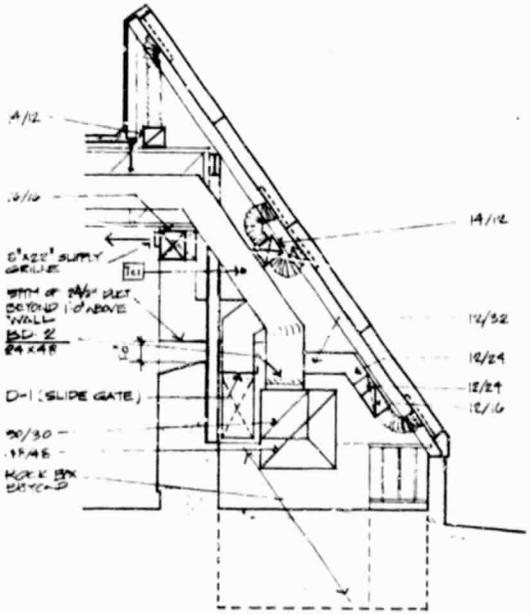


2 FLOOR PLAN
1/4" = 1'-0"

1 FLOOR PLAN (BELOW)
1/4" = 1'-0"



4 SECTION
1/4" = 1'-0"
REV | 252, 2522



3 SECTION
1/4" = 1'-0"
REV | 252, 2522

Midgley Straughness Fickel and Scott Architects Inc. / 20 West 9th Street Kansas City, Missouri 64105

Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri

SE2
sections and plans

FOLDOUT FRAME 2

APPENDIX C
WIRING DIAGRAM
OF THE
SOLAR SPACE HEATING
AND
DHW SYSTEM
SKT-1

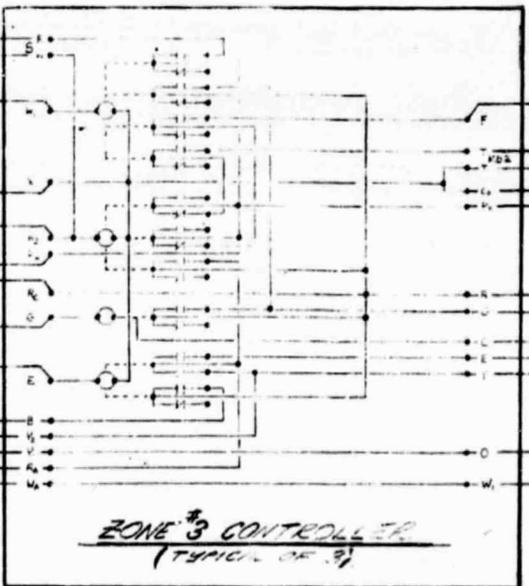
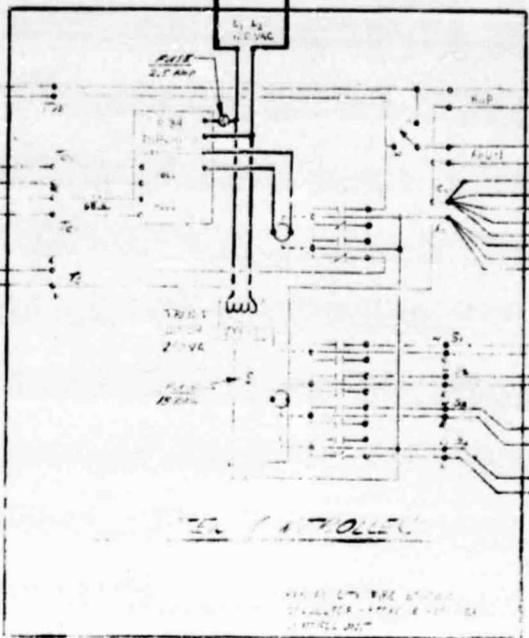
T₁
 TEMPERATURE COLLECTOR
 (100' SOLARON) LOCATE
 IN ROOM AS PER MECH.
 DWG'S FOR EXACT LOCATION

T₂
 TEMPERATURE COLLECTOR
 (100' SOLARON) LOCATE
 IN ROOM AS PER MECH.
 DWG'S FOR EXACT LOCATION

120 VOLT WIRE AS
 PER LOCAL CODE
 (BY OTHERS)

T₃
 THERMOSTAT (100' SOLARON)
 1ST STAGE - HEAT
 STORAGE UNIT
 OPEN IN RILE 3 90' E

T₄
 THERMOSTAT (100' SOLARON)
 2ND STAGE - HEAT
 STORAGE UNIT
 OPEN IN RILE 3 90' E

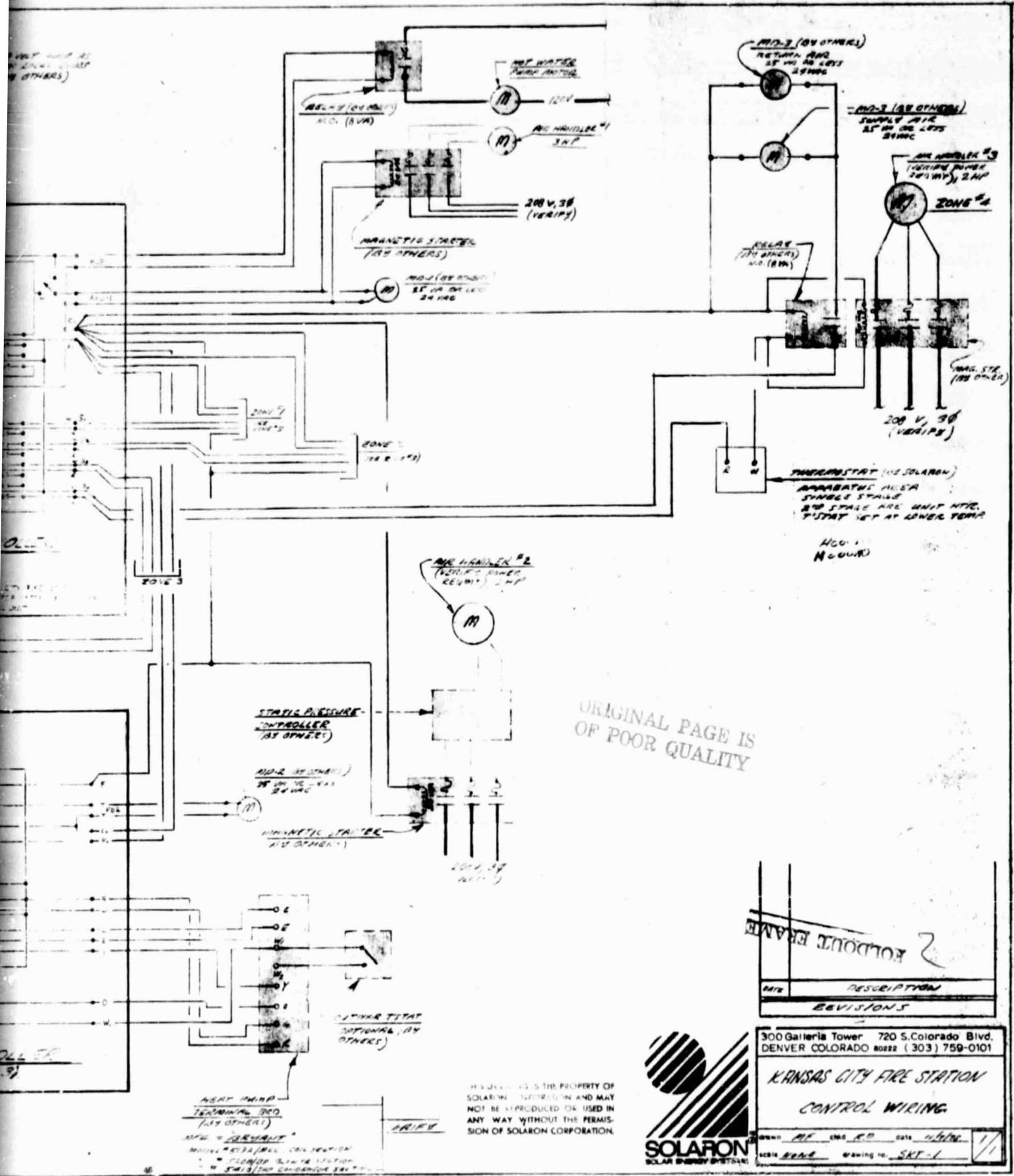


ZONE THERMOSTAT
 (100' SOLARON) LOCATE IN
 ROOM AS PER MECH.
 DWG'S FOR EXACT LOCATION
 1ST STAGE - HEAT
 STORAGE UNIT

ZONE THERMOSTAT
 (100' SOLARON) LOCATE IN
 ROOM AS PER MECH.
 DWG'S FOR EXACT LOCATION
 2ND STAGE - HEAT
 STORAGE UNIT

FOLDOUT FRAME

HEAT PUMP
 TERMINAL
 (BY OTHERS)
 WIRE AS PER
 LOCAL CODE
 (BY OTHERS)



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FOLDOUT FRAME	
REV	DESCRIPTION
REVISIONS	

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

KANSAS CITY FIRE STATION
CONTROL WIRING



Drawn BY: [] Date: 4/8/76
Scale: 1/8"=1'-0" Drawing No.: SKT-1

THIS DRAWING IS THE PROPERTY OF SOLARON CORPORATION AND MAY NOT BE REPRODUCED OR USED IN ANY WAY WITHOUT THE PERMISSION OF SOLARON CORPORATION.

HEAT PUMP TERMINAL BOX (BY OTHER)
MAGNETIC STARTER (BY OTHER)
MODEL # 8734 (SEE CONNECTION SECTION)
* FLUORON 3/4" X 1/2" TUBING
* SWIRL (FOR CONDENSING) 1/2" X 1/2"

APPENDIX D
SEQUENCE OF
OPERATIONS OF THE
SOLAR HEATING SYSTEM

**HEAT PUMP
ENERGIZE F/HEATING OR COOLING**

**SOLARON CONTROL PANEL HC0116
WITH HC0022 OR HC0023 THERMOSTAT AND HC004 SUB-BASE**

SEQUENCE OF OPERATION

- I. **SOLAR ENERGY AVAILABLE** - when 40°F ($\pm 7^{\circ}\text{F}$) differential is achieved between sensors T_{co} (in collector) and T_{ci} (in return air duct - see specific plans), the following events take place:
- A. **Storing Heat** - Room thermostat not calling for heat.
1. Differential thermostat in Solaron controller will activate "COLL" (collector) relay.
 - a. MD1 (motorized damper) - will be energized and powered open to allow air to flow to the inlet of the solar air handler blower (BWR), which is energized at the same time.
 - b. HWP (hot water pump) is also energized at this time if the T_w sensor (aquastat on water storage tank) is not satisfied (i.e. tank is less than 140°F).
 - c. MD2 (motorized damper) will be energized and powered closed to prevent air from flowing to the auxiliary heating unit.
- B. **First Stage Heating** is called for by room thermostat - W_1 & R_H and sub-base system switch is set on "Auto" or "Heat".
1. "H1" (first stage solar heating) relay is energized.
 - a. "G" and "R" (fan auxiliary furnace) are energized, bringing on the heat pump indoor fan.
 - b. MD3 circuit is energized, closing the damper from its fully open position to its partially open or fully closed position (field balancing required).
 - c. MD2 opens as power through N.C. contacts in relay "H1" are interrupted.
 - d. Relay contacts close circuit to T_s sensor which is still in an open circuit via the "COLL" relay contacts position.
- *C. **Second Stage Heating** is called for by room T-stat. First stage is still "made". If solar heat is available (i.e. "COLL" relay energized) when "H2" relay is energized, solar system will store heat while heat pump provides space heat.
1. "H2" (second stage auxiliary heat) relay is energized, completing the following circuits:

- a. MD2 is powered closed.
 - b. MD3 is unpowered - opens full.
 - c. "R_c" circuit is completed to "Y" bringing on compressor in heat pump.
 - d. "R_c" circuit to "G" is still made keeping on auxiliary indoor unit blower.
 - e. "R_c" circuit to "R3" is completed. No additional auxiliary relays are energized at this time.
- D. Third Stage Heating is called for by second room T-stat (or outdoor thermostat). "R3" circuit to "W3" is completed, bringing on resistance electric heating elements in the indoor auxiliary unit ("R" to "W1" circuit and "R" to W2 circuit in HC0116 are "made").
- E. "Emergency Heat" (to be used only if directed to do so by your service repairman, in the unlikely event of a heat pump malfunction). When the sub-base switch is put in this position the "Emergency Heat" relay will be energized.

The "EA" relay will complete the circuit between "R" and "E" allowing the indoor auxiliary unit to bring on the electric resistance heat when there is a call for heat from the heat pump (H2 energized).

- II. SOLAR ENERGY NOT AVAILABLE. When differential between T_{co} and T_{ci} drops to 25°F (-5°F) or less, the following takes place:
- A. "COLL" relay - de-energized.
 - 1. HWP de-energized, pump off.
 - 2. BWR de-energized, solar blower off.
 - 3. MD1 de-energized and closed.
 - 4. MD2 de-energized and open.
 - B. Circuit completed to Ts sensor if "H1" relay is still energized. If Ts sensor is above 90°F set point, system will heat space from heat storage unit. If Ts sensor is below 90°F set point circuit will be completed to "H2" relay and bring on the auxiliary heating unit without the need for the second stage of the T-stat to make.

III. Sub-base Switch Modes.

- A. Fan - "On-Auto".
 - 1. "Auto" position will permit auxiliary indoor unit fan to cycle on and off to meet the heating demands of the system.

2. "On" position will allow the auxiliary indoor unit fan to run constantly and allow MD3 (by-pass) damper to open fully, except when first stage heating is required.

B. Thermostat calling for Cooling (Summer Operation) System
switch on "Auto" or "Cool".

****1. First stage cooling:**

- a. "R_c" circuit to "Y₁" is "made", on heating/cooling thermostat energizing reversing valve in outdoor unit (for units with reversing valve energized for cooling).
- b. "R_c" to "G" made; "R" to "G" made in HC0116 panel, brings on heat pump indoor unit fan.

2. Second stage cooling.

"R" to "Y" contacts close. Compressor circuit is energized to provide cooling.

NOTES

* Heat Pump Systems with reversing valve energized for heating can generally be wired as follows:

HC0116 Terminal Strip

Y
W
O

Heat Pump Terminal Strip Equivalent

W₁
W₂
Y

**Heat pumps where the reversing valve is not energized for cooling use only one stage of cooling.

DOMESTIC WATER
HEATING

Switch "Winter" Position

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

Switch "Summer" Position

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

APPENDIX E
MAINTENANCE INSTRUCTIONS
FOR THE
SOLAR HEATING SYSTEM

MAINTENANCE INSTRUCTIONS

The following items should be performed semi-annually:

1. Inspect V-belt and sheaves for wear, check belt tension.
2. Inspect damper linkage.
3. Clean or replace filters (more frequent if required)
4. Oil pump motor with #20 non-detergent oil - do not over lubricate.
5. Oil AHU blower motor with #20 non-detergent oil - do not over lubricate.
6. All thermostats in the operations area must be placed in either the "heat" or "cool" position appropriate for the season. (If the thermostats are placed in the "auto" position, an undesirable condition can occur in which the solar system is attempting to heat while the A/C is trying to cool if the temperature levers are "jammed together").
7. Slide gate (D-1) is removed for summer operation. The gate is replaced for heating season operation.
8. Switch (summer/winter) on the solaron control box must be placed in the appropriate position for the desired operation of the system.
9. "Walk through" - A total system examination should be conducted at the beginning and at the end of each heating season to determine condition of the following:
 1. Damage to collector glazing
 2. Water in the collectors due to precipitation leaks
 3. Physical damage to thermal insulation of duct work
 4. Cleanliness of collector glazing - Clean if necessary, with mild soap and water solutions using soft window brush and rinse well
 5. DHW leaks under the storage tank, hot water heaters and the heat exchanger.

APPENDIX F
SUBCONTRACTORS
ASSOCIATED WITH THE
SOLAR HEATING PROJECT

SUBCONTRACTORS ASSOCIATED WITH THE CONSTRUCTION OF THE SOLAR
HEATING SYSTEM

1. Solar Solaron, Inc.
300 Galleria Tower
720 South Colorado Boulevard
Denver, Colorado 80222
2. General D.F. Cahill Construction Co.
4721 Denver
Kansas City, Missouri 64130
3. HVAC Environmental Mechanical
Contractors Inc.
11700 West 85th Street
Lenexa, Kansas 66214
4. Electrical Wachter Electric Co.
3027 McGee Trafficway
Kansas City, Missouri 64108

APPENDIX G
ACCEPTANCE TEST
OF THE
SOLAR HEATING SYSTEM

FIRE STATION 24 ACCEPTANCE TEST PLAN

A visual inspection shall be made to assure ducting functionally conforms to the plans. Manual dampers D-1 and motor driven dampers D-2 and D-3 should be closed. Space thermostat heat anticipators shall be set with first stage at 0.10 amp and second stage at 0.10 amp. Set thermostat so there is no call for heat. "Summer-Winter" switch on control panel shall be placed in the "Winter" position. System power shall be turned on. If solar energy is sufficient to activate the ΔT controller the AHU fan and water pump will start and run in the storing heat mode. (If solar energy is not available disconnect Tco lead to simulate). Static pressure and temperature shall be measured in the collector inlet and outlet ducts and at the heat storage inlet and outlet ducts. The collector ΔP will be used to estimate the flow and the fan speed will be adjusted accordingly if required. Fan motor amperage shall be measured.

The space thermostat shall be set to make the first stage of heating. This will reposition the dampers shifting the solar heated air into the building space. Static pressures, temperatures and amperage shall be measured in this mode.

Jumpering Tco terminals (or opening Tci) will simulate no solar energy available at the collector. The system will then go into the heat from storage mode. Static pressures, temperatures and amperage will be recorded. Adjusting the set point of Ts upward to the air temperature out of storage will simulate the storage temperature dropping to the normal set point of 90° F. When Ts switches the solar AHU will stop and the unit heaters will start and maintain the set point of the first stage of the thermostat. Ts shall then be reset down to place system back in the heating from storage mode. Increasing the set point of the space thermostat to make the second stage of heating simulates a further drop in space temperature indicating the heat taken from storage is insufficient to offset the building heat loss. This will shut down the solar AHU and start the unit heaters.

Jumper shall be removed from Tco.

"Summer" operation for preheating water shall be tested by removing manual damper D-1 to by-pass the heat storage unit and placing the "Summer-Winter" switch in the "Summer" position. Static pressures, air temperatures and amperage shall be recorded. The aquastat, Tw, shall be reset down so that the set point is below the water temperature (if water temperature is below the minimum set point a lead can be disconnected). This will simulate the water temperature rising to the set point and will stop the pump and AHU fan.

ACCEPTANCE TEST PLAN DATA SHEET FOR FIRE STATION 24

1. Visual inspection

- A. Ductwork configuration (✓)
- B. Placement of dampers (✓)
- C. Ductwork connections (✓)
- D. Insulation (✓)

2. Heating from collectors (Winter)

- A. A.H.U. #1 operating (✓)
- B. Synchronous operation of water pump (✓)
- C. A.H.U. #2 operating (✓)
- D. Space thermostats operating (✓)
- E. A.H.U. #3 operating (✓)

3. Heating hot water (Winter)

- A. A.H.U. #1 pump operating (✓)
- B. Lower temp setting on storage to verify pump will shut off (✓)
- D. A.H.U. #1 continues to operate (✓)

4. Heating from storage mode (Winter)

- A. Motorized damper #1 closed (✓)
- B. A.H.U. #1 off (✓)
- C. A.H.U. #2 on (✓)
- D. A.H.U. #3 on (✓)

5. Heat pumps

- A. Heat pump operating when stor. temp adjusted (✓)

6. Storing heat (Winter)

- A. A.H.U. #1 operating (✓)
- B. Motorized damper #1 open (✓)

7. Heating from collector (Summer)

- A. A.H.U. #1 operating (✓)
- B. Pump operating (✓)
- C. Damper #1 open (✓)

() means approved



RECTANGULAR DUCT PITOT TUBE TEST REPORT

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PROJECT F.S. 24 SYSTEM/UNIT _____
LOCATION/ZONE _____ ACTUAL AIR TEMP. _____ DUCT S.P. _____

DUCT		REQUIRED		ACTUAL	
SIZE	SQ. FT.	FPM	CFM	FPM	CFM

(SEE REVERSE SIDE FOR INSTRUCTIONS)

POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.135	.13	.11	.12	.136	.1									
2	.13	.12	.12	.115	.11	.1					AH4-1				
3	.11	.15	.12	.125	.115	.1						18 x 34 = 4.25			
4	3358	3348	3177	1337	1388	1266				2320	UP	4.25			9860 CFM
5			13,924												
6	.075	.1	.125	.1	.072	.055	.02	.02	.02						
7	.042	.02	.045	.08	.04	.03	.04	.04	.033			AH4-1			
8	.01	.01	.025	.04	.03	.025	.025	.039	.03			54 x 18 = 6.75			
9	773	744	899	1066	837	755	667	719	662			794	UP	6.75	5360 CFM
10															
11	.045	.04	.034	.04	.04	.05									
12	.048	.042	.039	.044	.048	.05				34 x 18	AH4-2				
13	.04	.04	.037	.046	.05	.05				839	FAN 2	4.25			
14															
15															
VELOCITY SUB-TOTALS	842	808	766	833	858	924									

REMARKS:

The readings were taken with the a501 fan running and a502 fan running with thermostat ID-1 calling for heat. Temperature raised rapidly up to 100° in the room. Damper MD-1 + MD-2 not operational had to be rewired to get it to open.

TEST DATE _____ READINGS BY _____



PITOT TUBE TEST REPORT

PROJECT F.S. 24 SYSTEM/UNIT _____
 LOCATION/ZONE AHV-3 ACTUAL AIR TEMP. _____ DUCT S.P. _____

DUCT		REQUIRED		ACTUAL	
SIZE	SQ. FT.	FPM	CFM	FPM	CFM

(SEE REVERSE SIDE FOR INSTRUCTIONS)

POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.1052	.039	.083	.093											
2	.063	.054	.101	.118			EAST side supply					24 x 14			
3	.059	.102	.14	.081					1130 UP			2.3		2599	
4				1130										CFM	
5															
6															
7	.091	.131	.17	.171											
2	.09	.138	.196	.208			WEST side			2164 UP		2.3		4977	
3	.086	.149	.115	.205											
4										Total CFM				7576	
11				2164											
12															
13															
VELOCITY SUB-TOTALS															

REMARKS:

TEST DATE _____ READINGS BY _____



AIR APPARATUS TEST REPORT

PROJECT _____ SYSTEM/UNIT AHU 2

ADDRESS _____ LOCATION _____

UNIT DATA	
Make & Model No.	<u>Loan Cook 21</u>
Type & Size	<u>C.H.B.</u>
Arrangement & Class	
Discharge	
Sheave Size & Make	<u>4 3/8 Brawley</u>
Sheave Bore Size	<u>1 1/4</u>
No. Belts, Make & Size	<u>2 - Good year 0850 m</u>

MOTOR DATA	
Make & Frame	<u>MARATHON MST</u>
Motor H.P.	<u>2</u>
Volts, Phase, Cycles	<u>200-3-60</u>
Full Load Amps	<u>6.8</u>
Sheave Size & Make	<u>3 3/4 Brawley</u>
Sheave Bore Size	<u>7/8</u>
Sheave Center's Dist.	<u>20 1/2</u>

TEST DATA	DESIGN	ACTUAL
Total CFM		
Total S.P.		
Fan RPM		<u>1350</u>
Motor B.H.P.		
Out. Air CFM		
Ret. Air CFM		
Motor RPM		
Motor Volts $\frac{T_1 T_2 T_3 - T_1 T_2 T_3}{T_3 - T_1}$		<u>200</u>
Motor Amps - T ₁ , T ₂ , T ₃		<u>4.5</u>

TEST DATA	DESIGN	ACTUAL
Discharge S.P.		
Suction S.P.		
Reheat Coil S.P. Drop		
Cooling Coil S.P. Drop		
Preheat Coil S.P. Drop		
Filter S.P. Drop		
Vortex Damper Posit.		
Out. Air Damper Posit.		
Ret. Air Damper Posit.		

REMARKS:

TEST DATE _____ READINGS BY _____ CERTIFIED BY _____

PROJECT _____ SYSTEM/UNIT AH03

ADDRESS _____ LOCATION _____

UNIT DATA	
Make & Model No.	<u>201 4 11</u>
Type & Size	<u>15</u>
Arrangement & Class	
Discharge	
Sheave Size & Make	
Sheave Bore Size	
No. Belts, Make & Size	<u>1 7/8" x 1/2"</u>

MOTOR DATA	
Make & Frame	<u>1451</u>
Motor H.P.	<u>2 hp</u>
Volts, Phase, Cycles	<u>200 volts 3 ph. 60a</u>
Full Load Amps	<u>6.8 amps</u>
Sheave Size & Make	<u>50 5"</u>
Sheave Bore Size	<u>7/8</u>
Sheave Center's Dist.	<u>23 1/2</u>

TEST DATA	DESIGN	ACTUAL
Total CFM		
Total S.P.		
Fan RPM		
Motor B.H.P.		
Out. Air CFM		
Ret. Air CFM		
Motor RPM		
Motor Volts T_1, T_2, T_3		<u>200 volt</u>
Motor Amps T_1, T_2, T_3		<u>6.0</u>

TEST DATA	DESIGN	ACTUAL
Discharge S.P.		
Suction S.P.		
Reheat Coil S.P. Drop		
Cooling Coil S.P. Drop		
Preheat Coil S.P. Drop		
Filter S.P. Drop		
Vortex Damper Posit.		
Out. Air Damper Posit.		
Ret. Air Damper Posit.		

REMARKS:

TEST DATE _____ READINGS BY _____ CERTIFIED BY _____



PROJECT _____ SYSTEM/UNIT AHU 1
 ADDRESS _____ LOCATION _____

UNIT DATA	
Make & Model No.	<u>McQuay LHD1116</u>
Type & Size	
Arrangement & Class	
Discharge	
Sheave Size & Make	<u>11 Brown 14g BK115</u>
Sheave Bore Size	<u>1 1/2</u>
No. Belts, Make & Size	<u>1 Brownline A6.6</u>

MOTOR DATA	
Make & Frame	<u>BALDOR 182T</u>
Motor H.P.	<u>5</u>
Volts, Phase, Cycles	<u>200 3 60</u>
Full Load Amps	<u>10</u>
Sheave Size & Make	<u>12 Brown 14g S 3/4</u>
Sheave Bore Size	<u>1 1/8</u>
Sheave Center's Dist.	<u>21-5/8</u>

TEST DATA	DESIGN	ACTUAL
Total CFM		
Total S.P.		
Fan RPM		<u>610</u>
Motor B.H.P.		
Out. Air CFM		
Ret. Air CFM		
Motor RPM		
Motor Volts $\frac{T_1 T_2 T_3}{T_3 - T_1}$		<u>200</u>
Motor Amps - T ₁ , T ₂ , T ₃		<u>6.5</u>

TEST DATA	DESIGN	ACTUAL
Discharge S.P.		
Suction S.P.		
Reheat Coil S.P. Drop		
Cooling Coil S.P. Drop		
Preheat Coil S.P. Drop		
Filter S.P. Drop		
Vortex Damper Posit.		
Out. Air Damper Posit.		
Ret. Air Damper Posit.		

REMARKS:

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TEST DATE _____ READINGS BY _____ CERTIFIED BY _____



AIR OUTLET TEST REPORT

PROJECT E.S. 24 SYSTEM Heat Pumps
 ADDRESS _____ OUTLET MANUFACTURER _____

AREA SERVED	OUTLET				DESIGN		PRELIMINARY				FINAL		REMARKS
	NO.	TYPE	SIZE	AK	CFM	VEL.	VEL.	VEL.	VEL.	VEL.	VEL.	CFM	
TD1 - Day Room	1	TDC	12x12	.49	400		225					444	
	2	"	"	"	465		900					440	
	3	"	"	"	220		225					420	
	4	"	9x9	.274	765		440					220	
	5	TDC	12x12	.49	290		150					420	
	6	TDC	6x6	.125	100		70					89	
TD 2					1750							1080	1190
	1	TDC	12x12	.49	240		125					226	
	2	TDC	12x12	.49	240		666					216	
	3	TDC	"	"	205		647					217	
	4	TDC	9x9	.274	130		566					150	
	5	271	26x12	.134	215		163					218	
	6	TDC	6x6	.125	85		505					62	
	7	2200	18x12	.915	140		1675					154	
8	271	"	.912	145		200					133		
TD 3					1500							1050	1170
	1	TDC	9x9	.274	265		800					225	
	2	"	"	"	265		225					237	
	3	"	"	"	265		225					279	
	4	"	"	"	265		1500					350	
					1000						203	1130	

REMARKS:

Taken with cool on

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OF POOR QUALITY

TEST DATE _____ READINGS BY _____ CERTIFIED BY _____

F.S.24

ID #3
Bryant

UNIT DATA

ID #2

BRYANTS

R.P.m 1078

Amp 2.4

Direct Drive

Volt 200

PH-1 60 Hz

HP .32

FLA 3.5 D.V 208/230

model 520B42BP

R P m 1025

AMP 2.9

Direct Drive

Volt 200

PH-1 60 Hz

HP .45

FLA 4.5 D.V 208/230

model
520B048BP

ID #1 Bryant

RPM 989

AMP 5.6

DIRECT DRIVE

VOLT 200

PH-1 60 Hz

HP

FLA 5.0 D.V 208/230

MODEL 520B060BP 66

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Associated Engineering Consultants Inc.
20 West 9th St. Kansas City, Mo. 64105
816-474-5450

September 20, 1979

Midgley Shaughnessy Fickel and Scott Architects
20 West 9th Street
Kansas City, Missouri 64105

Attn: Mr. Mike Shaughnessy

RE: K.C. Fire Station No. 24

Gentlemen:

We have reviewed the air balance report submitted for this project and it appears fan numbers 2 and 3 need rpm adjustment to comply with design criteria. Fan no. 2, which serves distribution to operations area units, should be speeded up such that circulated air is plus or minus 5% of 4300 cfm design in lieu of 3560 cfm which is only 82% of design. Motor amp readings included in report indicate this should be possible without changing motor, however motor sheeves may have to be replaced. Fan no. 3, which serves apparatus bay only could be left as is without detrimentally affecting this or other systems operation, however air quantity being supplied, 7575 cfm is approximately 150% of design.

Fan no. 1 serving the solar loop is circulating 7% more air than as designed or the difference between 5000 and 5360 cfm, but this should be satisfactory.

The indoor units nos. 1, 2, and 3 are all delivering more air than design, from 13 to 19% which should not pose any particular problem. There is quite a disparity between the four outlets served by unit no. 3, but all these outlets are in the same room. If these outlets are unusually disturbing to the occupants with regard to noise they should be adjusted but otherwise can remain as is and should function satisfactorily concerning heating or cooling.

Please contact us if you have any questions.

Sincerely,


David A. Davidson

DAD:jlj

APPENDIX H
SYSTEM INSTALLATION
AND
CHECKOUT PROBLEMS

SYSTEM INSTALLATION AND CHECKOUT PROBLEMS

A continuing problem with the instrumentation installation was rainwater seepage into the area where the SDAS was located. The water on the floor made it difficult and dangerous to check out the instrumentation wiring. After various methods had been tried to overcome the seepage problem, it was finally solved primarily by elevating and recontouring the soil outside the wall and installing drain tile at the base of the wall. This was achieved just prior to completion of the Acceptance Testing.

Changes in the instrumentation contractor's personnel after the initiation of this work at the fire station contributed to a major problem of wiring errors between the junction box, transformers, and the SDAS. As with all relatively new developments such as solar energy, much of the technology is conveyed verbally. Consequently, when there is a personnel change, some loss of system understanding is to be expected. The wiring problems were resolved with the assistance of an instrumentation engineer from the Marshall Space Flight Center.

During the acceptance testing, it was noted that one of the collectors had a broken inner glass. The glass was subsequently supplied by the collector system vendor and installed by the city.

The system evaluation test determined that one motor-driven damper was the wrong type. Item should have been spring loaded to shut after power was removed but it was electrically driven in both directions. Device was replaced by proper configuration after the acceptance test.

During the system operational airflow measurements, it was discovered that AH#2 was flowing about 82 percent of the design requirement. The adjustable pulley was changed to give the required system design speed. Additionally, the airflow rate of AH#3 exceeded the design requirements; however, because of the smaller than recommended pebble size in the rock box, it was decided to leave the flow rate at the higher level.

Considerable difficulty has been experienced with fire personnel changing the thermostat settings which causes the control system to bypass the solar heat and go into the heat pump or the electrical heat strip mode. This, of course, plays havoc with system efficiency as determined by the data system. Some thought has been given to placing "locks" on the thermostat to prevent changes to the selected temperature levels. A more expensive change would be to replace the thermostats with the type that would use available solar heat before the auxiliary heat system would be energized.

Some minor insulation discrepancies were noted during the "walk through". The water pipes near the hot water heat exchanger and near the water heaters had not been insulated. This was accomplished at a later date. The "walk through" showed that the overall mechanical work was excellent including duct work placement and insulation workmanship. The solar system was deemed operational and functionally acceptable in September 1979.

APPENDIX I
PRODUCT LITERATURE
FOR COMPONENTS OF
THE SOLAR HEATING SYSTEM



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BRASCH

Electric Unit Heaters

applications

For complete or supplementary heating of entryways, store-rooms, kitchens, garages, shipping rooms, warehouses, factories, hangers, power generating plants, pump houses and stores.

Eliminates piping, valves, traps, freezeups, water leaks, vagrant heat waste, vents, stacks, gas piping and pilot lights.

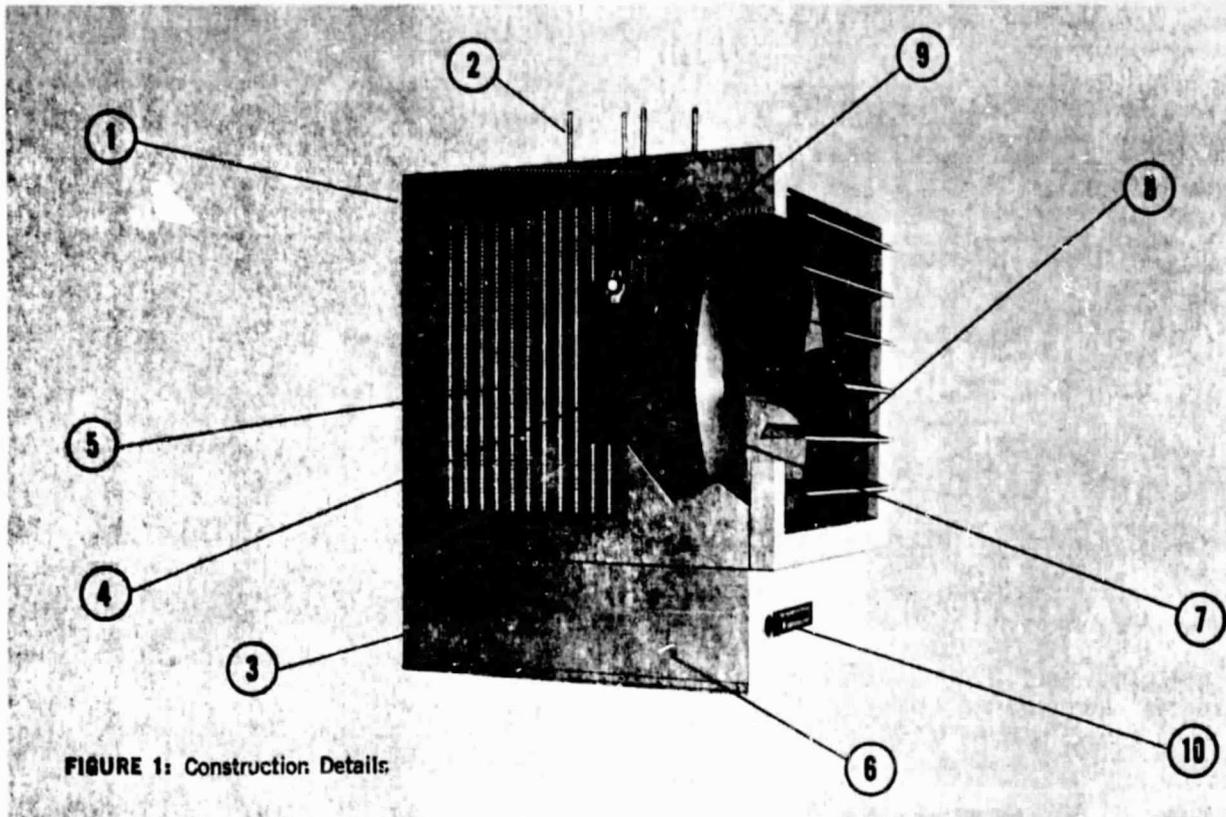


FIGURE 1: Construction Details

construction details

- 1. HEAVY DUTY CONSTRUCTION**—cabinets are made of heavy gauge welded domestic steel for durability and trouble-free operation.
- 2. MOUNTING**—recessed welded fasteners on top and back of housing for threaded rod-type hangers are standard. Optional swivel-type combination wall or ceiling mounting brackets allow up to 180° adjustment of discharge air direction. *All models are suitable for either horizontal or vertical airflow.*
- 3. SUPPLY CONNECTION**—single connection eliminates separate fan motor circuit.
- 4. MOTOR**—fan motors have built-in automatic reset thermal overload protection. Heaters with motors 1/4 hp or greater have permanently lubricated ball bearings. Motor is ventilated with unheated air.
- 5. PLATE FIN ELEMENTS**—rugged, copper plated steel tubular elements are brazed to multiple fins for extra strength and maximum heat dissipation. Fins are protected against corrosion by high temperature paint. Automatic reset thermal cutout protects heater elements from overheating.
- 6. SERVICE COMPARTMENT**—hinged service door allows easy access to line terminals, contactors, fuses and transformers.
- 7. FAN**—dynamically balanced aluminum fan. Draw-through design assures even air distribution over elements and uniform outlet temperatures.
- 8. LOUVERS**—each louver is adjustable for positive control of discharge air.
- 9. HOUSING**—contemporary styling, heavy gauge steel. Tough, durable neutral grey, baked enamel finish resists corrosion and assures long life, even in fume laden industrial atmospheres.
- 10. THERMOSTAT**—optional built-in thermostat for 1 or 2 stage control with knob adjustment.

energy savers

THERMOSTATIC FAN SWITCH — built into each 5 KW and larger unit, dissipates residual heat to recirculate ambient air until temperature drops to 90F.

TWO STEP CONTROL — provides smaller KW steps for finer control and less operating cost (standard on many models).

NIGHT SETBACK THERMOSTAT — conserves energy with separate temperature settings for day-time comfort and nighttime economy (remote horizontal mounting).

built-in controls

MAGNETIC CONTROL CONTACTOR — disconnecting break contactors provided as standard unless heater is single phase and operated by load-carrying thermostat.

SUBCIRCUIT FUSING—when heater ampacity exceeds 48 amps, built-in subcircuit fuses are supplied to meet Paragraph 424-22 of the 1975 NEC.

FAN DELAY — dissipates all residual heat from elements and recirculates entering ambient air until temperature drops to 90F for maximum energy conservation. Provided in 5 KW units and larger.

MOTOR OVERCURRENT PROTECTION — motor fusing is built-in for unit heaters over 40 amperes when the motor is greater than 1/8 HP. All units incorporating a stepdown transformer to drive the fan motor have built-in transformer primary fusing.

CONTROL THERMOSTAT — optional built-in or wall mounted thermostat kits to achieve best area comfort level. Built-in thermostat eliminates control wiring and is adjustable from the front of the heater. (see page 8).

CONTROL TRANSFORMER— Optional 24V control transformer available on all units (see Fig. 4).

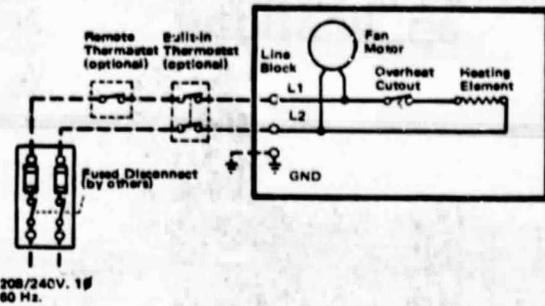


FIGURE 2: 240V, Single Phase, 2.5 KW Circuit Diagram

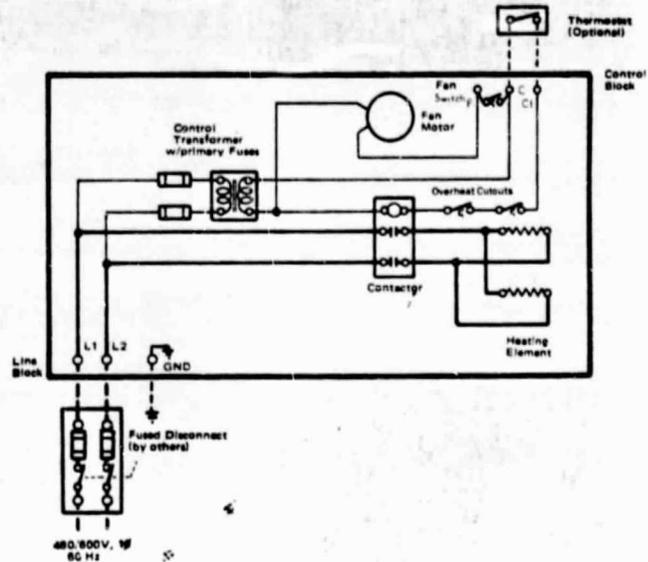
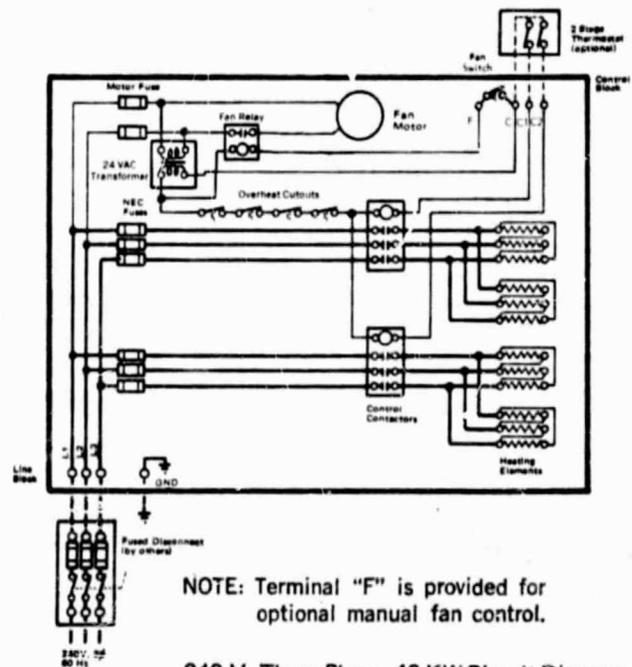


FIGURE 3: 480V, Single Phase, 10 KW Circuit Diagram



NOTE: Terminal "F" is provided for optional manual fan control.

FIGURE 4: 240 V, Three Phase, 40 KW Circuit Diagram with optional 24 V control.

TABLE 2: SPECIFICATIONS

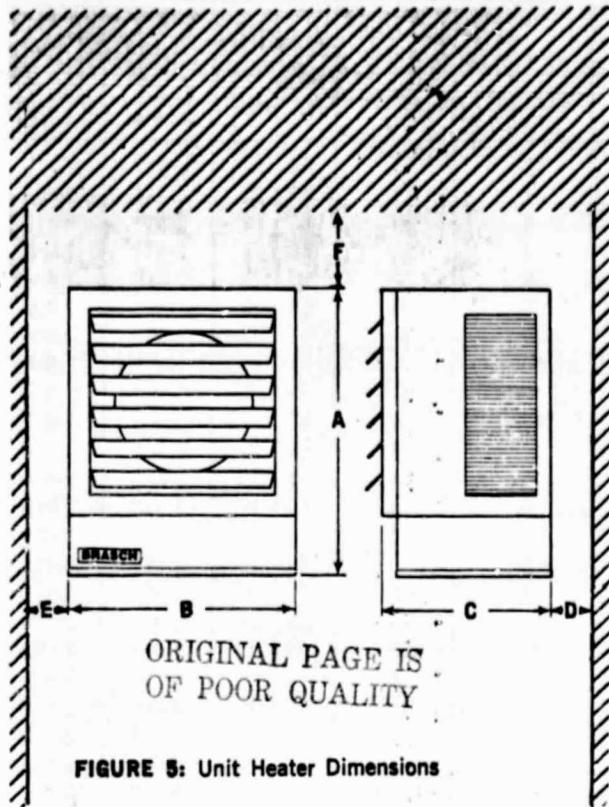


TABLE 1: DIMENSIONS (inches)

HEATER KW	A	B	C	D (min)	E (min)	F (min)
2.5-20	22	17	15½	6	6	4
25-50	27	21	22¼	6	12	4

ul listing

BTU Electric Unit Heaters are UL Listed under File No. E 61887.

how to order

Specify:

1. Model Number
2. Voltage, Phase and KW
3. Accessories (see page 8)
 - A. Mounting Bracket
 - B. Thermostat
 - C. Other

MODEL NO. †† BTU-	ELECTRICAL (60Hz)									
	HEATER						MOTOR			
	KW	BTUH	VOLTS	PHASE	AMPS	STEPS	VOLTS	PHASE	RPM	HP
2.5-2081	2.5	8550	208	1	12	1	208	1	1550	1/10
2.5-2401	2.5	8550	240	1	10	1	240	1	1550	1/10
2.5-2771	2.5	8550	277	1	9	1	120	1	1550	1/10
5-2081	5	17100	208	1	24	1	208	1	1550	1/10
5-2401	5	17100	240	1	21	1	240	1	1550	1/10
5-2771	5	17100	277	1	18	1	120	1	1550	1/10
7.5-2081	7.5	25650	208	1	36	1	208	1	1550	1/10
7.5-2401	7.5	25650	240	1	31	1	240	1	1550	1/10
7.5-2771	7.5	25650	277	1	27	1	120	1	1550	1/10
10-2081	10	34200	208	1	48	1	208	1	1550	1/10
10-2401	10	34200	240	1	42	1	240	1	1550	1/10
10-2771	10	34200	277	1	36	1	120	1	1550	1/10
5-2083	5	17100	208	3	14	1	208	1	1550	1/10
5-2403	5	17100	240	3	12	1	240	1	1550	1/10
5-4803	5	17100	480	3	6	1	120	1	1550	1/10
5-6003*	5	17100	600	3	5	1	120	1	1550	1/10
7.5-2083	7.5	25650	208	3	21	1	208	1	1550	1/10
7.5-2403	7.5	25650	240	3	18	1	240	1	1550	1/10
7.5-4803	7.5	25650	480	3	9	1	120	1	1550	1/10
7.5-6003*	7.5	25650	600	3	7	1	120	1	1550	1/10
10-2083	10	34200	208	3	28	1	208	1	1550	1/10
10-2403	10	34200	240	3	24	1	240	1	1550	1/10
10-4803	10	34200	480	3	12	1	120	1	1550	1/10
10-6003*	10	34200	600	3	10	1	120	1	1550	1/10
12.5-2083	12.5	42750	208	3	35	1	208	1	1550	1/4
12.5-2403	12.5	42750	240	3	30	1	240	1	1550	1/4
12.5-4803	12.5	42750	480	3	15	1	120	1	1550	1/4
12.5-6003*	12.5	42750	600	3	12	1	120	1	1550	1/4
15-2083	15	51300	208	3	42	1	208	1	1550	1/4
15-2403	15	51300	240	3	36	1	240	1	1550	1/4
15-4803	15	51300	480	3	18	1	120	1	1550	1/4
15-6003*	15	51300	600	3	14	1	120	1	1550	1/4
20-2083	20	68400	208	3	56	2	208	1	1550	1/4
20-2403	20	68400	240	3	48	1	240	1	1550	1/4
20-4803	20	68400	480	3	24	1	120	1	1550	1/4
20-6003*	20	68400	600	3	19	1	120	1	1550	1/4
25-2083	25	85500	208	3	69	2	208	1	1550	1/4
25-2403	25	85500	240	3	60	2	240	1	1550	1/4
25-4803	25	85500	480	3	30	1	120	1	1550	1/4
25-6003*	25	85500	600	3	24	1	120	1	1550	1/4
30-2083	30	102600	208	3	83	2	208	1	1550	1/4
30-2403	30	102600	240	3	72	2	240	1	1550	1/4
30-4803	30	102600	480	3	36	1	120	1	1550	1/4
30-6003*	30	102600	600	3	29	1	120	1	1550	1/4
40-2083	37.5	128250	208	3	104	2	208	1	1550	1/4
40-2403	40	136800	240	3	96	2	240	1	1550	1/4
40-4803	40	136800	480	3	48	1	120	1	1550	1/4
40-6003*	40	136800	600	3	37	1	120	1	1550	1/4
50-2083	50	171000	208	3	139	2	208	1	1550	1/4
50-2403	50	171000	240	3	120	2	240	1	1550	1/4
50-4803	50	171000	480	3	60	2	120	1	1550	1/4
50-6003*	50	171000	600	3	48	2	120	1	1550	1/4

*SPECIAL ORDER ONLY

† Throw is the distance air moves until its velocity reduces to 50 fpm.

†† Based on 60C ratings

††† All units, except 2.5 KW, are optionally available with 2 steps for energy savings (see Page 9).

AIRFLOW					STANDARD BUILT-IN CONTROL FEATURES				RECOMMENDED MOUNTING HEIGHT		WEIGHT		RECOMMENDED †† FIELD SUPPLY WIRES	
FAN DIA. (IN.)	CFM @ 70°F.	OUTLET VEL-FPM	TEMP. RISE-°F.	↑ THROW (FT.)	NEC FUSES	CONTACTORS	TRANSFORMER	CONTROL VOLTS	HORIZONTAL DISCHARGE (FT.)	VERTICAL DISCHARGE (FT.)	LBS.	KGMS.	COPPER AWG/MCM	ALUMINUM AWG/MCM
12	500	605	16	18	0	0	NO	208	8	10	50	23	2-#12	2-#10
12	500	605	16	18	0	0	NO	240	8	10	50	23	2-#14	2-#12
12	500	605	16	18	0	0	YES	277	8	10	63	29	2-#14	2-#12
12	500	625	32	18	0	0	NO	208	8	10	50	23	2-#10	2-# 6
12	500	625	32	18	0	0	NO	240	8	10	50	23	2-#10	2-# 8
12	500	625	32	18	0	0	YES	277	8	10	63	29	2-#10	2-#10
12	870	1075	27	26	0	1	NO	208	10	14	51	23	2-# 6	2-# 4
12	870	1075	27	26	0	1	NO	240	10	14	51	23	2-# 6	2-# 4
12	870	1075	27	26	0	1	YES	120	10	14	64	29	2-# 8	2-# 6
12	870	1090	36	26	0	1	NO	208	10	14	60	27	2-# 6	2-# 2
12	870	1090	36	26	0	1	NO	240	10	14	60	27	2-# 6	2-# 4
12	870	1090	36	26	0	1	YES	120	10	14	72	33	2-# 6	2-# 4
12	500	625	32	18	0	1	NO	208	8	10	51	23	3-#2	3-#10
12	500	625	32	18	0	1	NO	240	8	10	51	23	3-#2	3-#10
12	500	625	32	18	0	1	YES	120	8	10	64	29	3-#4	3-#12
12	500	625	32	18	0	1	YES	120	8	10	64	29	3-#4	3-#12
12	870	1075	27	26	0	1	NO	208	10	14	51	23	3-#10	3-# 8
12	870	1075	27	26	0	1	NO	240	10	14	51	23	3-#10	3-#10
12	870	1075	27	26	0	1	YES	120	10	14	64	29	3-#14	3-#12
12	870	1075	27	26	0	1	YES	120	10	14	64	29	3-#14	3-#12
12	870	1090	36	26	0	1	NO	208	10	14	60	27	3-# 8	3-# 6
12	870	1090	36	26	0	1	NO	240	10	14	60	27	3-# 8	3-# 6
12	870	1090	36	26	0	1	YES	120	10	14	72	33	3-#12	3-#10
12	870	1090	36	26	0	1	YES	120	10	14	72	33	3-#14	3-#12
12	1250	1560	32	33	0	1	NO	208	11	21	61	28	3-# 6	3-# 4
12	1250	1560	32	33	0	1	NO	240	11	21	61	28	3-# 8	3-# 6
12	1250	1560	32	33	0	1	YES	120	11	21	73	33	3-#12	3-#10
12	1250	1560	32	33	0	1	YES	120	11	21	73	33	3-#14	3-#12
12	1250	1575	38	33	0	1	NO	208	11	21	61	28	3-# 6	3-# 4
12	1250	1575	38	33	0	1	NO	240	11	21	61	28	3-# 6	3-# 4
12	1250	1575	38	33	0	1	YES	120	11	21	73	33	3-#10	3-#10
12	1250	1575	38	33	0	1	YES	120	11	21	73	33	3-#12	3-#10
12	1250	1615	51	33	6	2	NO	208	11	21	64	29	3-# 3	3-# 2
12	1250	1615	51	33	0	1	NO	240	11	21	61	28	3-# 4	3-# 3
12	1250	1615	51	33	0	1	YES	120	11	21	73	33	3-# 8	3-# 6
12	1250	1615	51	33	0	1	YES	120	11	21	73	33	3-#10	3-#10
16	2050	1440	39	44	6	2	NO	208	13	26	104	47	3-# 2	3-# 0
16	2050	1440	39	44	6	2	NO	240	13	26	104	47	3-# 3	3-# 2
16	2050	1440	39	44	0	1	YES	120	13	26	114	52	3-# 8	3-# 6
16	2050	1440	39	44	0	1	YES	120	13	26	114	52	3-#10	3-# 8
16	2050	1455	46	44	6	2	NO	208	13	26	120	55	3-# 2	3-# 0
16	2050	1455	46	44	6	2	NO	240	13	26	120	55	3-# 2	3-# 0
16	2050	1455	46	44	0	1	YES	120	13	26	130	59	3-# 6	3-# 4
16	2050	1455	46	44	0	1	YES	120	13	26	130	59	3-# 8	3-# 6
16	2050	1490	58	44	9	3	NO	208	13	26	122	55	3-# 0	3-#00
16	2050	1500	62	44	6	2	NO	240	13	26	120	55	3-# 1	3-# 0
16	2050	1500	62	44	0	1	YES	120	13	26	130	59	3-# 4	3-# 3
16	2050	1500	62	44	0	1	YES	120	13	26	130	59	3-# 6	3-# 4
16	2050	1540	77	44	12	4	NO	208	13	26	127	58	3-#00	3-#0000
16	2050	1540	77	44	9	3	NO	240	13	26	122	55	3-#00	3-#000
16	2050	1540	77	44	6	2	YES	120	13	26	133	60	3-# 3	3-# 1
16	2050	1540	77	44	0	2	YES	120	13	26	133	60	3-# 4	3-# 3

accessories

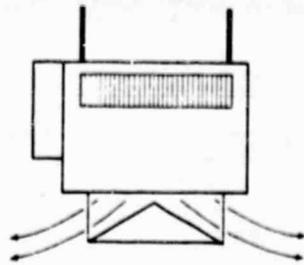


FIGURE 6: Cone Type Diffuser

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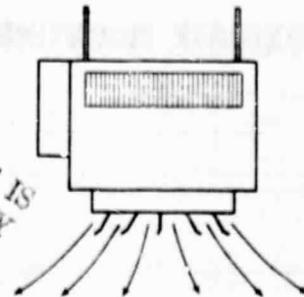


FIGURE 7: Four-Way Louvers

TABLE 4: TEMPERATURE CONTROL KITS

CATALOG NUMBER	DESCRIPTION
TK-1	Integral Thermostat Kit, 1 Stage Heating (SPST, 24-277V) shipped separately as kit
TK-1FM	Same as TK-1, except factory mounted
TK-2	Integral Thermostat Kit, 1 Stage Heating, (DPST, 24-277V) use where full line break is required, shipped separately as kit
TK-2FM	Same as TK-2, except Factory Mounted
TK-3	Integral Thermostat Kit, 2 Stage Heating (S-SPST, 24-277V) shipped separately as kit
TK-3FM	Same as TK-3, except Factory Mounted
TK-4	Wall Thermostat Kit, 1 Stage Heating (SPST, 24-277V)
TK-5	Wall Thermostat Kit, 1 Stage Heating (DPST, 24-277V) use where local codes require a full line break
TK-6	TK-6 Wall Thermostat Kit, 2 Stage Heating, Auto/On and Heat/off/Cool Switches on subbase (2-SPST, 24V only)
TK-8	Wall Thermostat Kit, 1 Stage Heating, 1 Cooling (2-SPST, 24-240V)
TK-9	Subbase for TK-8, Fan/Off/Auto Switch
TK-10	Wall Thermostat, 2 Stages Heating (2-SPST, 24-240V)
TK-11	Summer/Winter Switch Kit, (SPST, 24-277V) shipped separately as kit
TK-11FM	Same as TK-11, except Factory Mounted
TK-12	Wall Thermostat Kit, Night Setback with 24 Hour Timer, 1 Stage Heating (SPST, 24V only), does not require separate power supply
Suffix-24	24V Control With Contactor if Required (add suffix to unit catalog number)
Suffix-2S	Two Step Operation in lieu of single step (add suffix to unit catalog number)
Suffix-MR	Manual Reset Thermal cutout (add suffix to unit catalog number)
Suffix-RC	Remote Control Panel, UL Listed, surface mounted (consult factory) (add suffix to unit catalog number)

TABLE 5: DIFFUSER KITS

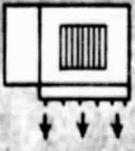
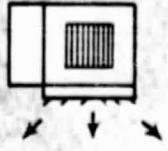
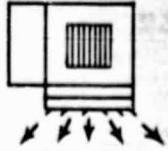
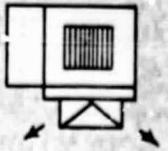
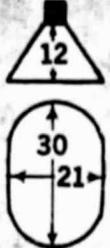
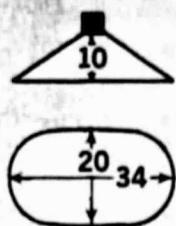
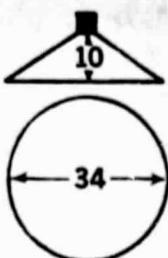
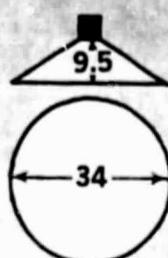
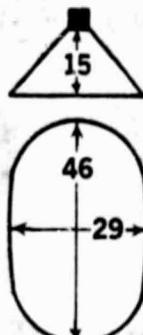
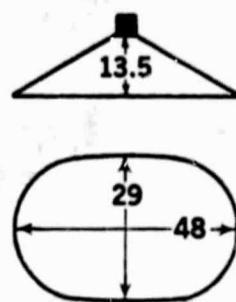
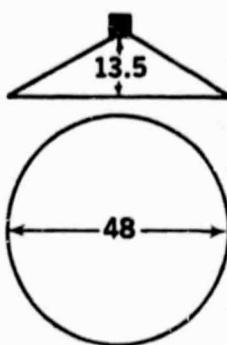
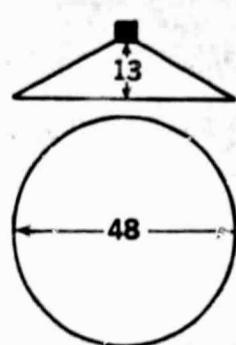
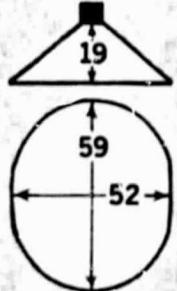
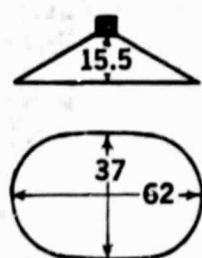
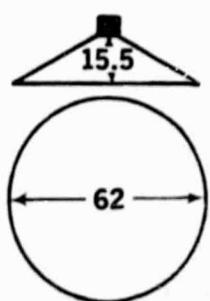
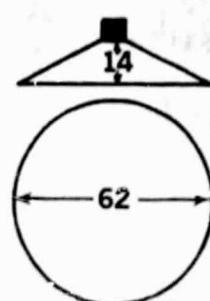
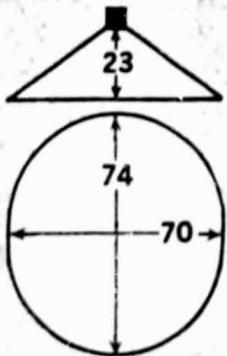
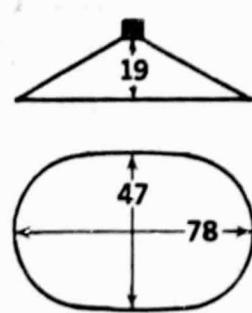
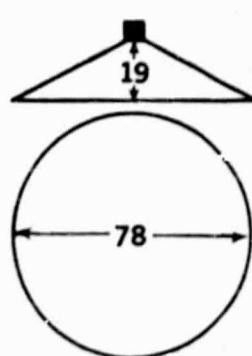
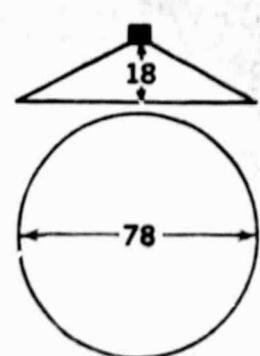
CATALOG NUMBER	DESCRIPTION
CD-1	Diffuser Kit, Cone type for vertical discharge (2.5-20 KW)
CD-2	Diffuser Kit, Cone type for vertical discharge (25-50 KW)
LD-1	Diffuser Kit, Four-Way Louvers (2.5-20 KW)
LD-2	Diffuser Kit, Four-Way Louvers (25-50 KW)

TABLE 6: MOUNTING HARDWARE KITS

CATALOG NUMBER	DESCRIPTION
WB-1	Wall Mount Assembly Kit (for horizontal discharge) wall and swivel brackets
SB-1	Swivel Bracket Kit (for ceiling mounting, horizontal discharge)
TR-1	Rod Hanger Kit, Four, 1/2-13 x 24 (for horizontal or vertical discharge)

TABLE 3: AIR DISTRIBUTION PATTERNS (VERTICAL DISCHARGE)

APPROXIMATE MOUNTING HEIGHT AND FLOOR COVERAGE (FEET)

				
SIZE (KW) BTU-	STANDARD LOUVERS (0°)	STANDARD LOUVERS (45°)	4-WAY LOUVERS (45°)	CONE DIFFUSER
2.5- 5	 12 30 21	 10 20 34	 10 34	 9.5 34
7.5-10	 15 46 29	 13.5 29 48	 13.5 48	 13 48
12.5-20	 19 59 52	 15.5 37 62	 15.5 62	 14 62
25-50	 23 74 70	 19 47 78	 19 78	 18 78

Note: Height is based upon optimum floor coverage with 50 fpm velocity four feet above the floor. Specific boundary pattern is dependent upon obstacles, drafts and mounting arrangements. Drawings are not to scale.

sample specification

1. Furnish and install Brasch UL Listed unit heaters with voltage, phase, number of steps, heating and air delivery capacities as scheduled. Threaded mounting holes shall be provided and each unit shall be universally suitable for vertical or horizontal mounting.
2. Unit heater shall be draw-thru design to provide uniform temperature across heater element and forced air cooling of motor with ambient air.
3. Heater elements shall be corrosion protected, plate fin type with elements brazed to common fins for maximum strength and heat transfer. Contactor(s) shall provide disconnecting line break. Automatic reset thermal cut-out for each element assembly shall provide protection from overtemperature.
4. All motors shall have permanently lubricated bearings, built-in thermal protection and shall be completely enclosed. Motors $\frac{1}{4}$ HP and greater shall have ball bearings. Separate motor supply circuits shall not be required.
5. All units to have single supply circuit with fuses as required by NEC for element and motor protection.
6. Fans shall be aluminum, directly connected to the fan motor. Units 5 KW and larger shall have thermal fan delay to remove residual heat from heater cabinet and recirculate ambient air until temperature drops to 90F for maximum energy savings. All metal surfaces of the cabinet shall be protected by baked epoxy finish.
7. Brackets shall be furnished for wall (or ceiling) mounting where shown on heating schedule.
8. Individually adjustable louvers shall be furnished to direct discharge air as desired. (Optional: Downflow diffusers shall be provided where shown on schedule. Specify: Cone type, or four-way adjustable louver.
9. Thermostat shall be provided where shown on schedule, to match number of heater control steps. (Specify: Built-in or remote room thermostat.)
10. Other options provided shall include:
 - A. 24V Transformer
 - B. Two Step Control
 - C. Summer/Winter Switch for Ventilation Only
 - D. Main Disconnect Switch (Remote)
 - E. Heating/Cooling Thermostat with Fan Switch Sub-base
11. Manufacturer shall provide one year guarantee against defects in workmanship or material.

mounting arrangements

Any Brasch unit heater can be mounted in either a horizontal or vertical discharge position:

HORIZONTAL DISCHARGE—heaters can be mounted horizontally using four 1/2-13NC threaded rods (provided by others) or the optional swivel and wall mounting brackets. The swivel bracket allows heater to be rotated to face various directions and can be ordered separately for use as a ceiling bracket. The wall mounting bracket provides minimum spacing required for the heater in all directions. A 1-8NC threaded bolt with locknut attaches the swivel bracket to the wall bracket. The wall mounting bracket attaches to the wall using four SAE Grade 5, 1/2-13NC bolts and nuts. Bolts and nuts are provided as part of the wall mount and swivel bracket kits.

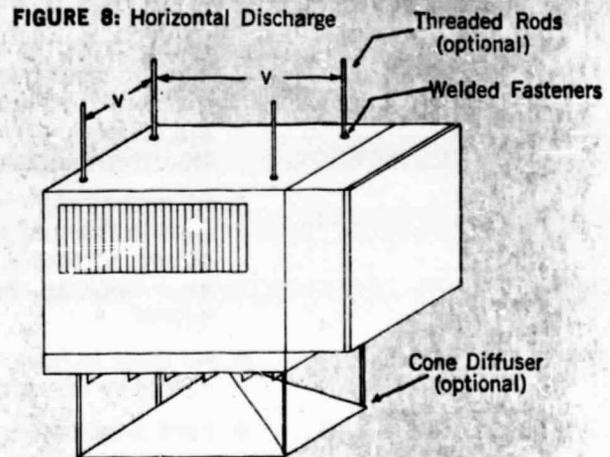
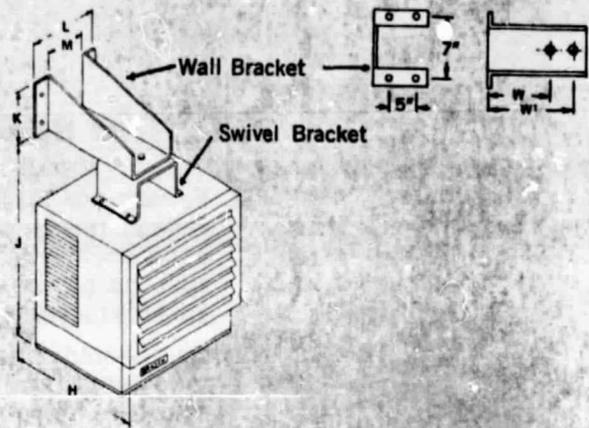


TABLE 7: MOUNTING DIMENSIONS

HEATER KW	H	J	K	L	M	W	W ¹	V
2.5-20	26 1/4	26	7	9	5	17	—	15
25-50	35 1/4	31	7	9	5	—	22 1/2	16

VERTICAL DISCHARGE—heaters are mounted vertically using four 1/2-13NC threaded steel rods (provided by others). Four threaded holes on top of the heater are provided with internal stops to prevent excessive insertion of rods. Additional mounting hardware, if required, is supplied by the installer.

application tips

LIMITATIONS—Unit heaters should not be used in potentially explosive atmospheres, nor should they be located where obstructions might block air inlet, motor cooling vents or discharge.

APPLICATIONS—larger rooms require multiunit installations; arrange units to provide perimeter air circulation.

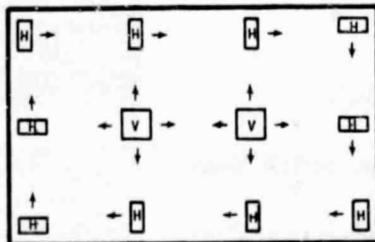


FIGURE 10

To prevent air stratification, the total CFM capacity of all units should circulate the room air volume at least three times per hour.

Unit heaters should be located so their airstreams wipe exposed walls without blowing directly at them. In multiple unit heater installations, it is good practice to locate units so each unit supports the airstream of another, thus setting up a circulatory air movement within

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the space. Distance between unit heaters should not be less than the throw of one heater nor more than twice its throw; for throw data, see page 5. For interior spaces and for high bay areas, additional unit heaters mounted vertically can be used. In warehouse type applications, where maintaining minimum temperatures is the basic requirement, one or more large unit heaters can be used in order to reduce initial installation expense.

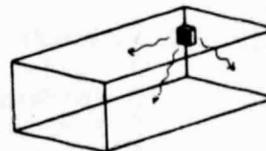


FIGURE 11

Small rooms can be heated by one unit heater. Where two walls are exposed, heater should be mounted as shown. For individual spaces, total heating capacity is calculated in the conventional way, using formulas in the ASHRAE Guide.

When heating capacity for a pedestrian entryway is unknown, a rule of thumb of 4000 watts per door can be used.

Unit heaters are frequently used to combat cold air inrush when loading dock doors are opened. For such applications, one or more units should be arranged to blow warm air across the opening, not toward it.

C-2

other Brasch products

HOT WATER BOILERS—provide hot water for space heating in commercial, industrial and institutional buildings. Recommended for supplying hot water to coils located in hazardous locations. Also used for process applications in industrial plants. UL Listed with ratings to 3600 KW. Ask for Bulletin A120.

STEAM BOILERS—provide steam for space heating in commercial, industrial and institutional buildings or steam for humidification, sterilization and industrial process applications. UL Listed with ratings to 3000 KW, high or low pressure. Ask for Bulletin A124.

ELECTRIC DUCT HEATERS—custom designed for warm air space heating applications in commercial, industrial and institutional buildings, manufactured in unlimited sizes and capacities. Heaters are UL Listed for zero clearance and meet UL and NEC requirements. Ask for Bulletin A102.

ELECTRICAL ENCLOSURES—manufactured to NEMA 1, 3R, 4 and 12 requirements in industry—standard or custom sizes. Available with baked-on epoxy or primer finish. Ask for Bulletin A115.

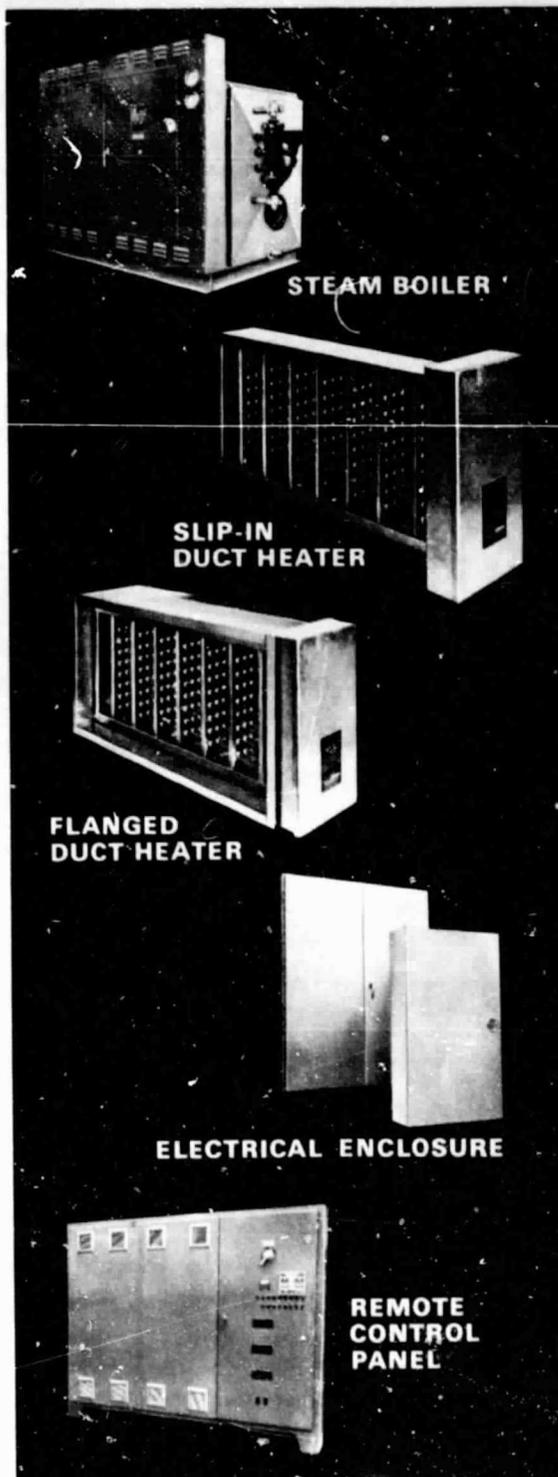
REMOTE CONTROL PANELS—custom designed, UL Listed, used for the control of Electroduct heating coils and many other types of electric heating equipment. The combination of Brasch panels with Brasch heaters assures you of one-source responsibility and a fully coordinated, prewired, factory tested electric heating package. Ask for Bulletin A105.

STORAGE WATER HEATERS—provide domestic hot water. Standard heaters are available in capacities up to 4000 gallons and 990 KW with lined vessels. Ask for Bulletin A125.

ELECTRIC BASEBOARD HEATERS—provide economical supplementary heat, 187 or 250 watts per lineal foot. UL Listed and NEMA constructed units combine aesthetics with efficiency and strength for comfort heating. Ask for Bulletin A123.

guarantee

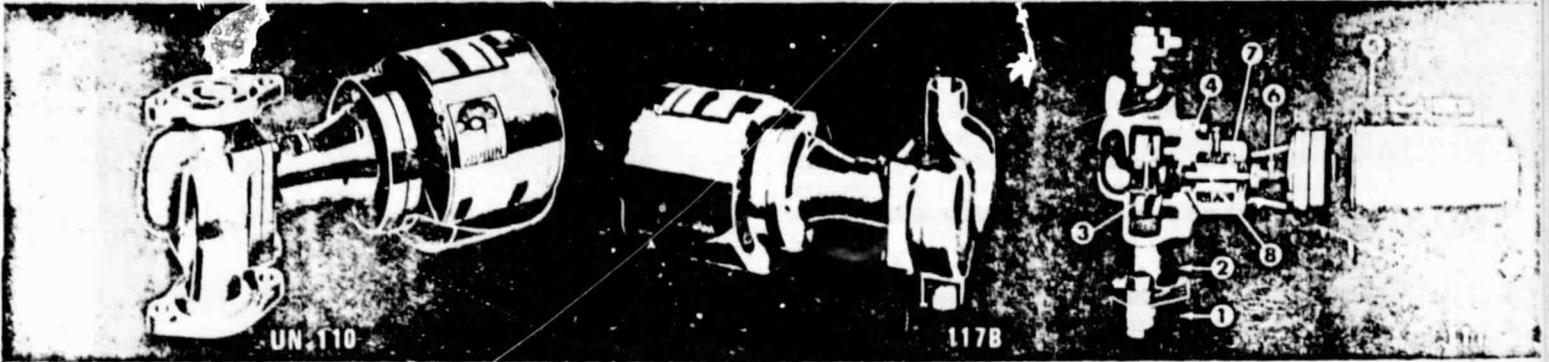
BRASCH MANUFACTURING COMPANY, INC. guarantees all electrical components, cabinet and heating elements against defects in material and workmanship for a period of one year from date of purchase. Should any evidence of defects in material or workmanship occur during the guarantee period, Brasch Manufacturing Company, Inc. will repair or replace the part at its own discretion without charge. Brasch Manufacturing Company, Inc. shall not be held responsible for any field charges in connection with the removal or replacement of allegedly defective equipment, nor for incidental or consequential damage. Parts being returned to the factory must arrive prepaid and upon prior approval by the Company.



BRASCH
MANUFACTURING COMPANY, INC.

11880 DORSETT ROAD • (314) 291-0440
MARYLAND HEIGHTS, MISSOURI 63043

CIRCULATORS - Nos. 110, 111, 112, 113, 117B & 120



Specifications

- ① Flanges
- ② Body
- ③ Impeller
- ④ Mechanical Seals
- ⑤ Motor
- ⑥ Drive Coupling
- ⑦ Bearings
- ⑧ Shaft

Maximum operating temperature
Maximum working pressure

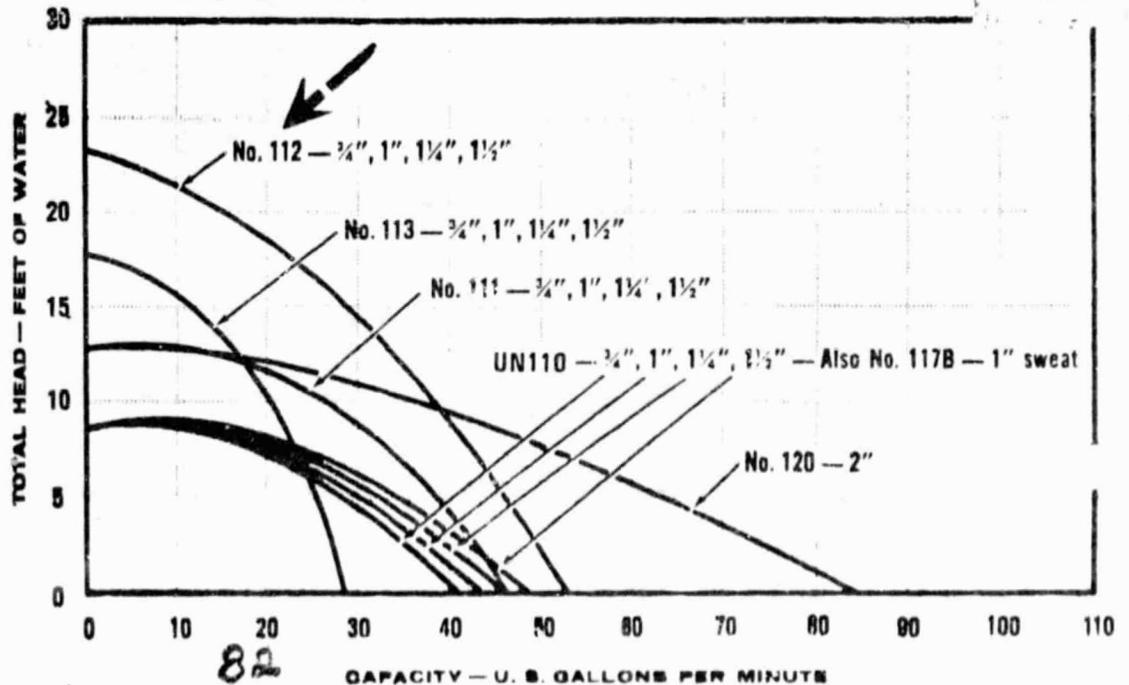
Interchangeable ¾", 1", 1¼" or 1½" for all sizes except 2" and No. 117B. Cast Iron or Bronze¹
Cast Iron or Bronze¹. Note No. 117B furnished in 1" Bronze with Sweat connections only
Dynamically balanced, closed type except No. 110 and No. 117B which are open type
Carbon & Ceramic
Selected for quietness. Rubber Mounted, Overload Protected
Smooth, safe flexible steel spring type
Large Porous Bronze
Stainless steel super finished
240F
100 PSI, 117B/125 PSI UN110

#600-TAX-4 Allen Bradley
manual motor starter,
115V

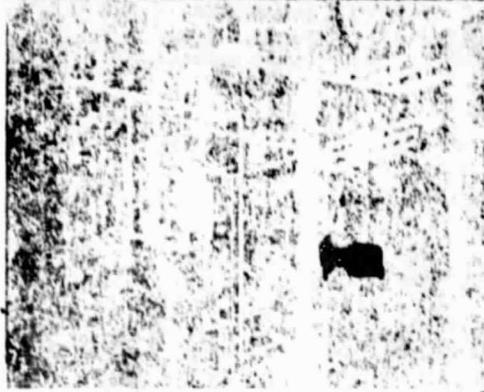


Catalog Number
600-TAX4

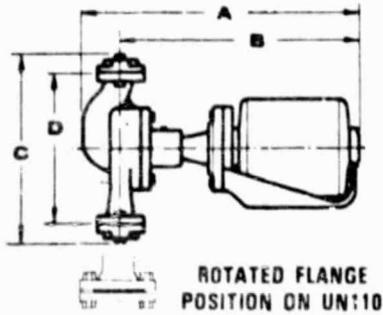
Performance Curves



CAPACITY - U. S. GALLONS PER MINUTE



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Purpose

Designed to circulate (pump) heated or chilled water, quietly and speedily, in Hydronic Systems for all residences and small commercial establishments. May also be used for zoning large installations and in bronze for fresh water service.

Features

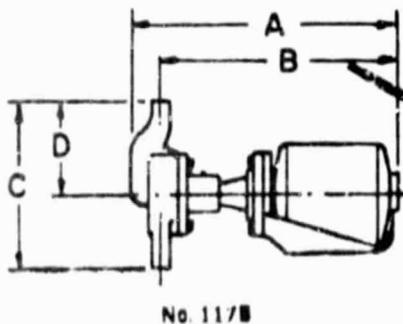
- ◆ Quiet operation
- ◆ Motor — Rubber Mounted, Overload Protected
- ◆ One piece, cast impellers for longer life
- ◆ Leak-proof mechanical seal — two piece type, easily replaced
- ◆ Stainless steel shaft — hardened and ground
- ◆ Smooth, safe drive coupling
- ◆ Easily serviced with ordinary tools
- ◆ Porous bronze bearings
- ◆ Permits the use of small size piping

Operation

- 1 Supplies heat almost instantly upon a call for heat from the room Thermostat. When the Thermostat is satisfied, the circulator stops and no more heat is delivered to the rooms.
- 2 When used in conjunction with a Taco Flochek and Water Heater, the same boiler which provides the heating, also supplies domestic hot water all year 'round for kitchen, bath and laundry.
- 3 For house heating, circulators are available in cast iron construction. For domestic or fresh water circulation, specify bronze construction.

Sizes & Dimensions

UN 110, 111, 112, 113 & 120



PRODUCT NUMBER (1)		FLANGE SIZE	MOTOR (2)		DIMENSIONS - INCHES				APPROX WHT LBS
CURRENT (1)	OLD		800-AC-1 PH (2)	RPM	A	B	C	D	
UN110	HC	3/4", 1", 1 1/4", 1 1/2"	1/12HP-115V	1725	14 3/8"	12 3/8"	8 1/2"	6 3/8"	21
111	HDH	3/4", 1", 1 1/4", 1 1/2"	1/8HP-115V	1725	15 3/8"	13 3/8"	10 3/8"	8 3/8"	26
112 (3)		3/4", 1", 1 1/4", 1 1/2"	1/3HP 115V	3450	16 3/8"	14 3/8"	9 3/8"	7 3/8"	28
113		3/4", 1", 1 1/4", 1 1/2"	1/8HP 115V	1725	16"	13 3/8"	10 3/8"	8 3/8"	27
117B (4)		1" Sweat	1/12HP 115V	1725	15 3/8"	13 3/8"	7 3/8"	4 3/8"	22
120	HC 20	2"	1/6HP 115V	1725	17 3/8"	14 3/8"	13 3/8"	11"	40

(1) When specified as bronze construction, add the letter B at the end of each product number.

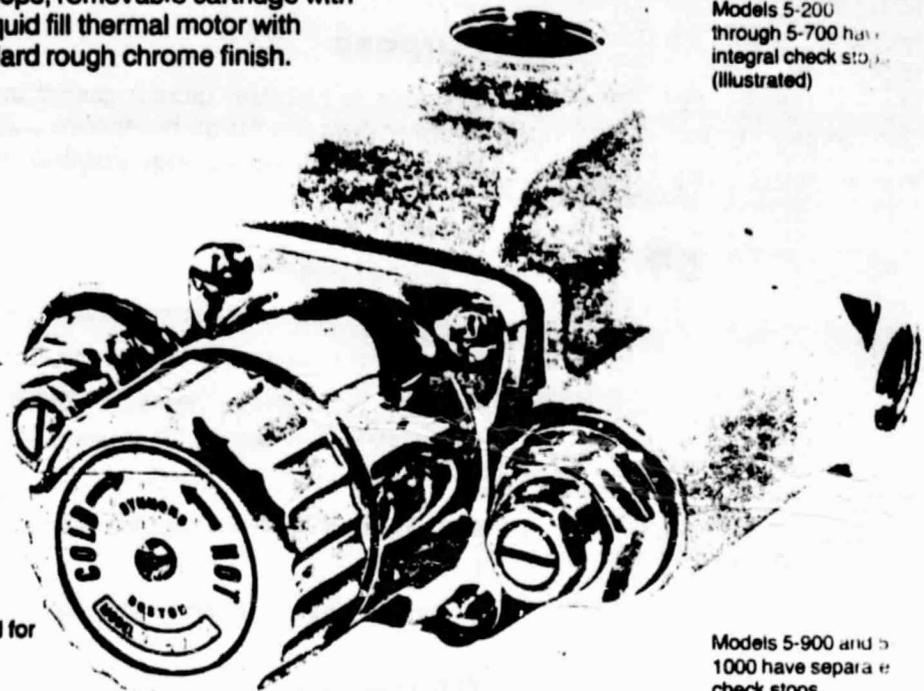
TEMP CONTROL Valve Only

1510.7 Mixing Valve

Model No. 400 (2) inlets (1) outlets. TempControl thermostatic controller with swivel action check stops, removable cartridge with strainer, stainless steel piston and liquid fill thermal motor with bellows mounted out of water. Standard rough chrome finish.

Models 5-200 through 5-700 have integral check stops (illustrated)

Model No.	Inlets	Outlet
5-200	3/4"	3/4"
5-400	3/4"	1"
5-500	1"	1 1/4"
5-700	1 1/4"	1 1/2"
5-900	1 1/2"	1 1/2"
5-1000	1 1/2"	2"



Models 5-900 and 5-1000 have separate check stops

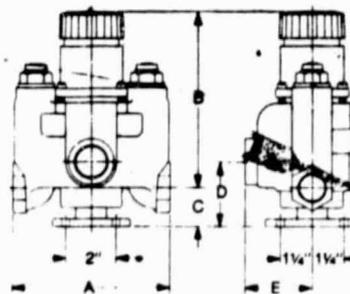
Modifications

- Suffix 1** For use in photographic or x-ray work - available as 5-200-1 or 5-400-1
- Suffix P** Polish chrome highlight finish
- Suffix W** Wall mounting bracket
- Suffix RC** Spare cartridge - recommended for non-interrupted service

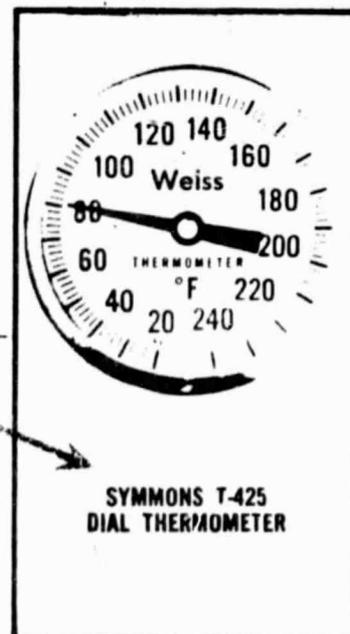
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Physical Dimensions

Model No.	A	B	C	D	E
5-200	6 1/4"	5 1/2"	1 1/2"	2 1/4"	2"
5-400	6 1/4"	6 3/4"	1 1/4"	2 1/4"	2 1/2"
5-500	8"	6 1/2"	1 1/4"	2 1/2"	3 1/4"
5-700	8"	6 1/2"	1 1/4"	2 1/2"	3 1/2"
5-900	12"	7 1/2"	2 1/4"	-	3 1/2"
5-1000	12"	7 1/2"	2 1/4"	-	3 1/2"



5-200 thru 5-700



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Symons

Submit capacity rating w/ P. D.

Tested and Certified under
A.S.S.E. Standard 1013



C.S.A. Certified through 1"

No. 900 Series

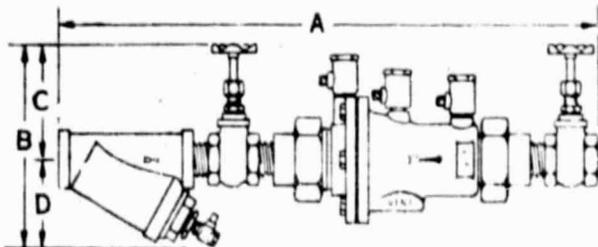
Reduced Pressure Principle Backflow Preventer

Watts No. 900 Series provides the complete concept in cross connection control for the protection of potable water and it is a unique patented design meeting the specifications of A.S.S.E. Standard 1013 for reduced pressure principle backflow preventers. Also, accepted by U.S. Public Health Service.

Beyond its size, weight, and cost advantages, the No. 900 Series offer many other advantages of value to anyone concerned with efficient cross connection control such as design simplicity, low flow resistance, quiet operation, simplified installation, and servicing.

The No. 900 assembly is the only backflow preventer furnished complete with strainer, test cocks, and gate valves. Its compact, well-balanced, practical design now brings complete protection to thousands of installations which were not economically possible before such realistic considerations were proven and available.

- Union Connections
- Stainless steel internal parts
- Standardly furnished with on body strainer
- Maximum flow at low pressure drop
- Compact size for ease of installation
- Maximum total of 10 parts required for complete service
- Patented double seated First Check Valve



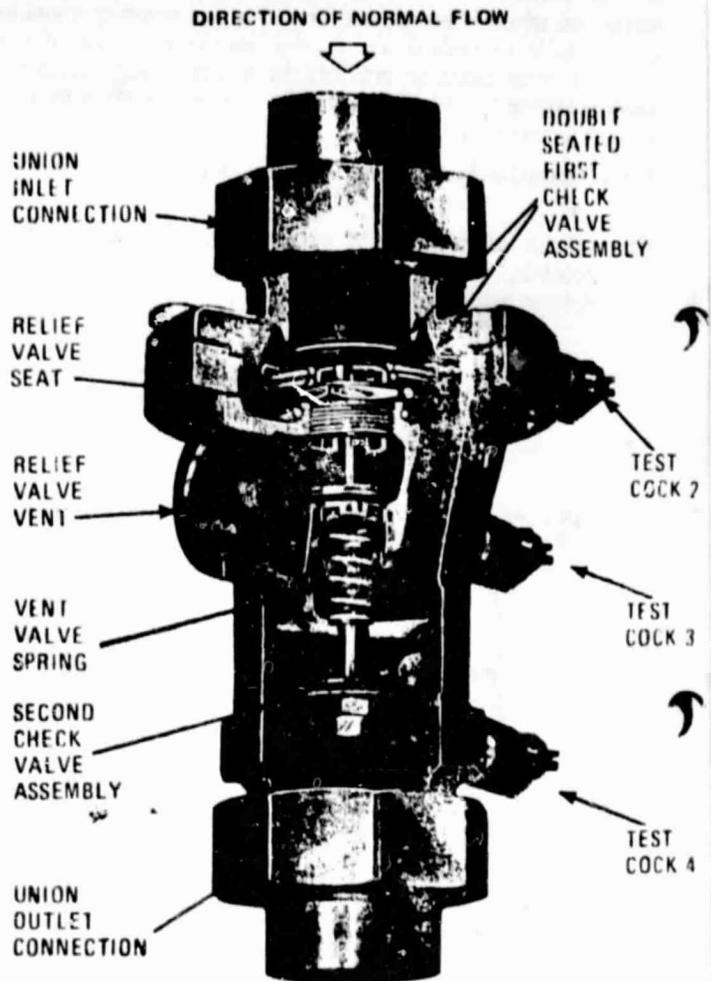
SIZES (In.)	DIMENSIONS (Inches)				TOTAL WEIGHT (Lbs.)	VENT SIZES (In.)
	A	B	C	D		
3/4	13 1/8	8 3/8	4 1/4	4 1/8	20	1
1	20 3/4	9 1/2	4 3/4	4 3/4	22	1
1 1/4	22 1/4	10 3/4	5 1/2	5 1/4	24	1
1 1/2	30	12	6 1/4	5 3/4	56	2
2	32	13 3/4	7	6 3/4	64	2

Maximum Supply Pressure 175 lbs.

No. 900
furnished complete with
gate valves, strainer and
test cocks, as shown



CONSTRUCTION OF BASIC VALVE (GATE VALVES AND STRAINER NOT SHOWN)



Patent No. 3,636,908
and other Patents Pending

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FOR LARGER SIZES, SEE PAGE 12

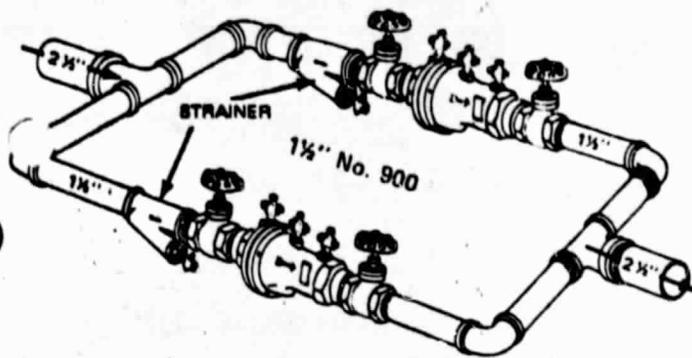
Optional Parallel Installations using smaller sizes

Optional installation of Series 900 Backflow Preventers is the use of two or more smaller size devices piped in parallel to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water and where interruptions for testing and servicing would be unacceptable or undesirable. It also has the advantage of providing a total capacity provided by a single larger valve and permits testing or servicing of an individual valve without shutting down the complete line.

For a two-valve installation, the total capacity of the devices should equal or exceed that required by the system.

The number of devices and sizes used in parallel should be determined by the engineer's judgement based on the operating conditions of a specific installation.

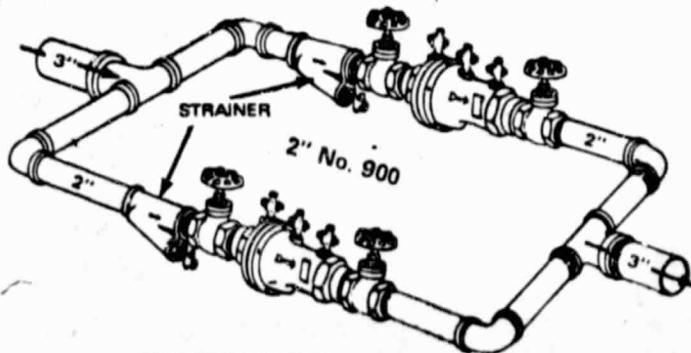
for 2½" Main Line



RECOMMENDATION:

Install two size 1½" No. 900 to provide a total flow up to 260 GPM. This exceeds the required testing capacity for a single 2½" backflow preventer, based on applicable standards referred to.

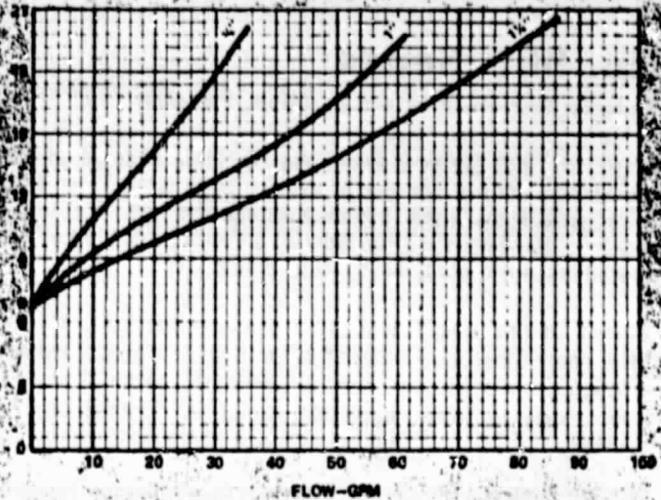
for 3" Main Line



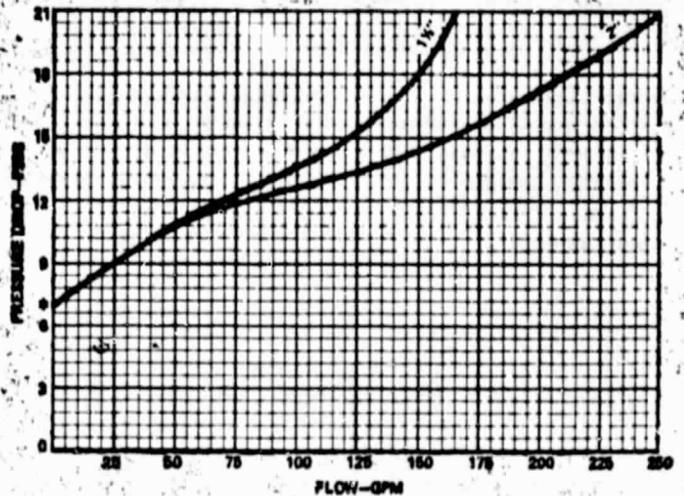
RECOMMENDATION:

Install two size 2" No. 900 to provide a total flow up to 320 GPM. This exceeds the required testing capacity for a single 3" backflow preventer, based on applicable standards referred to.

NO. 900 Capacity SIZES ¾", 1", 1½"



NO. 900 Capacity SIZES 1½", 2"



• OPENING PRESSURE

Size of Device	Rated Flow	Maximum Allowable Pressure Loss at Rated Flow	Actual Capacity Watts No. 900
¾"	30 GPM	20 PSI	35
1"	50 GPM	18 PSI	55
1½"	75 GPM	18 PSI	75
1½"	100 GPM	16 PSI	130
2"	160 GPM	16 PSI	175
*2½"	225 GPM	16 PSI	225+
*3"	320 GPM	15 PSI	320+
4"	500 GPM	14 PSI	540
*6"	1,000 GPM	14 PSI	1,000+

* Available in mid 1975.

Table shows flow that an approved device must deliver based on maximum allowable pressure drops shown. These performance requirements are specified in the University of Southern California "Manual of Cross Connection Control" and A.S.S.B. Standard 1013.

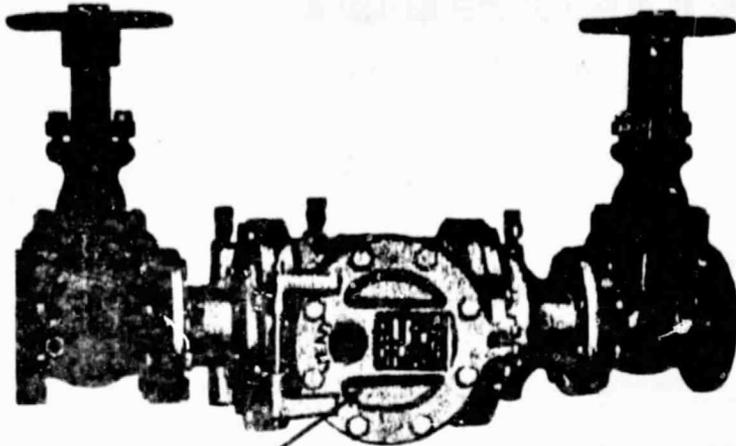
Watts valves have been tested under these provisions and equal or exceed these performance requirements as shown.

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Designed to equal or exceed the requirements of A.S.S.E. Standard
AWWA Standard C-506 and U.S.C. Foundation for Cross Conn-
Control Standard for reduced pressure principle backflow prev-

No. 900 Series $2\frac{1}{2}''$, $3''$, $4''$, $6''$

Reduced Pressure Principle Backflow Preventer



FEATURING "SWING OUT SERVICE"

These four larger sizes of the No. 900 are designed with a Swing Out Access Door which exposes the 1st check valve assembly for quick simplified servicing. Also, the 2nd check valve is easily accessible. All seats are removable.

• Patent Pending

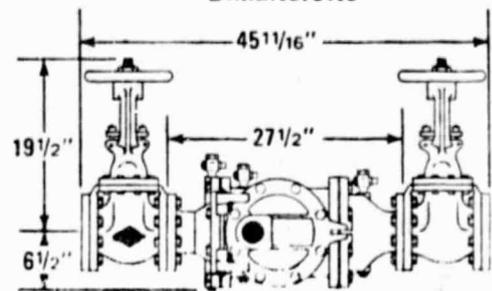


Watts larger size No. 900 Series backflow preventers have the same basic design features as sizes $\frac{1}{2}''$ - $2''$ described on page 10, except they are constructed with a swing out service door as described above. They are furnished with bronze or iron body construction, internal water ways epoxy coated (FDA approved), stainless steel and brass internal parts, and flange bolts, and durable, tight-seating rubber check valve assemblies. Is furnished complete with test cocks and available with and without gate valves. No. 900 Series is suitable for supply pressure up to 175 psi and for water temperature up to 110°F.

Size	Material	Weight
$2\frac{1}{2}''$	Bronze	210 lbs.
$3''$	Bronze	240 lbs.
$4''$	Iron	571 lbs.
$4''$	Bronze	514 lbs.
$6''$	Iron	1,120 lbs.

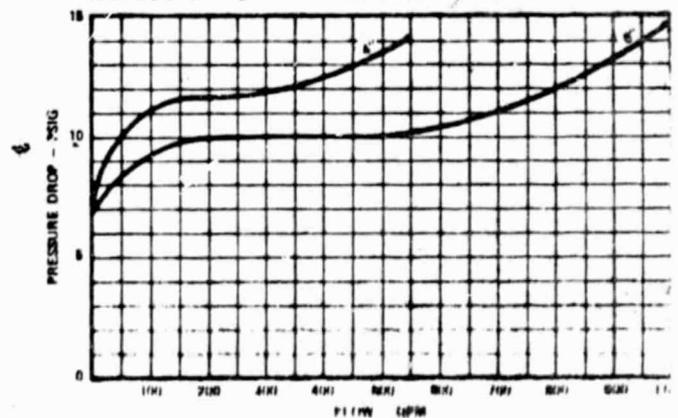
- Stainless steel internal parts
- Standardly furnished with O.S. & Y. gate valves.
- Swing out access door for service simplicity
- Patented double seated first check valve for added safety
- Relief port for maximum back pressure and back-siphonage venting
- Furnished with flanged connections
- Ball valve construction test cocks
- Removable first check valve seat
- Complete removable second check valve assembly module

DIMENSIONS



†NOTE: Sizes $2\frac{1}{2}''$ and $3''$ available mid - 1975.

No. 900 $4''$ - $6''$ CAPACITY

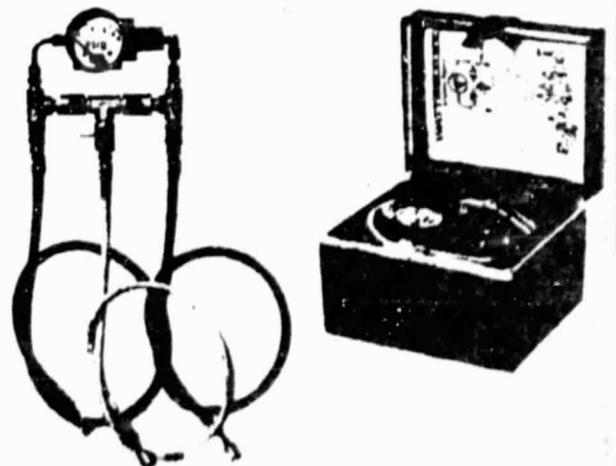


No. TK-9 Backflow Preventer Test Kit

The Watts No. TK-9 Backflow Preventer Test Kit is a compact portable testing device especially made for testing all Reduced Pressure Principle Backflow Prevention Devices. The TK-9 is easily connected to any RPZ device enabling accurate testing of "zone" differential pressure, relief valve opening differential, fouled check valves or similar problems that visual inspections cannot locate. The unit is encased in a rugged carrying case for easy handling and accessibility.

SPECIFICATIONS

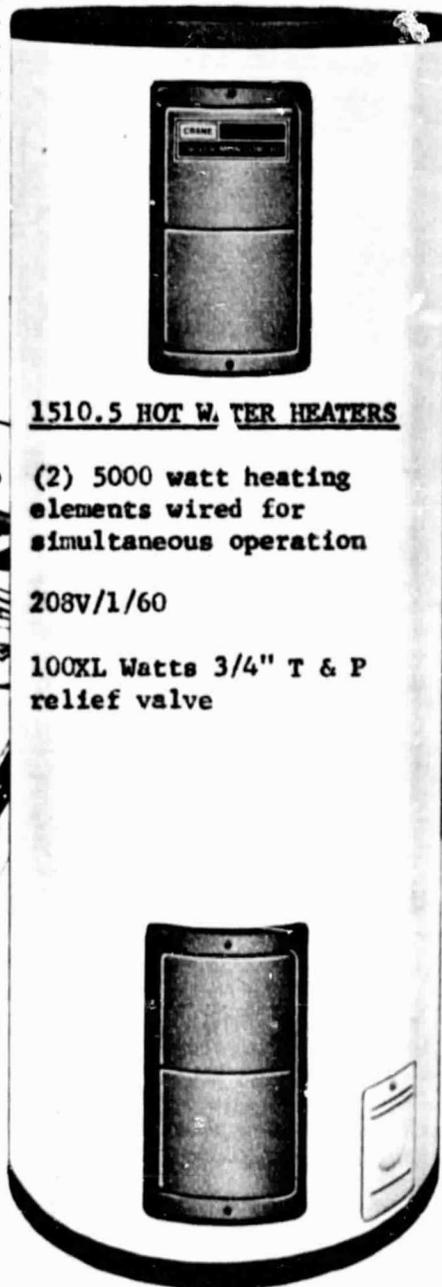
- Maximum working pressure - 300 psi
- Maximum working temperature - 210°F
- Gauge - 0-10 psid with 1% accuracy, full scale
- Hoses - (1) 3' with $\frac{1}{2}''$ female threaded couplers
- Adapters - (3) $\frac{1}{2}''$ threaded adapters, (1) $\frac{1}{4}''$ bushings, (1) $\frac{1}{2}''$ bushing
- Moisture resistant friction guide
- Case - shock resistant molded plastic with special diel base in set that enables multiple compartment combination for tool accessories in
- 1 $\frac{1}{2}''$ securing strap



CRANE® Silver Monitor

ELECTRIC GLASSLINED WATER HEATERS

5 YEAR MODELS	10 YEAR MODELS	CAPACITY
C5-30-1RS7	C10-30-1RS7	30 Gal.
C5-30-2RS7	C10-30-2RS7	30 Gal.
C5-42-1RS7	C10-42-1RS7	42 Gal.
C5-42-2RS7	C10-42-2RS7	42 Gal.
C5-52-1RS7	C10-52-1RS7	52 Gal.
C5-52-2RS7	C10-52-2RS7	52 Gal.
C5-66-2RS7	C10-66-2RS7	66 Gal.
C5-82-2RS7	C10-82-2RS7	82 Gal.
C5-100-2RS7	C10-100-2RS7	100 Gal.
C5-120-2RS7		120 Gal.



1510.5 HOT WATER HEATERS

(2) 5000 watt heating elements wired for simultaneous operation

208V/1/60

100XL Watts 3/4" T & P relief valve

The attractively styled glass-lined SILVER MONITOR ELECTRIC will deliver an abundant supply of clean, piping hot water throughout years of economical trouble-free service. Its quiet operation and no vent design make it perfect for locating in kitchens, rumpus rooms, finished rooms and the like. Check these advantages.

ECONOMY IN OPERATION!

- Immersed HEATING ELEMENTS transfer heat directly into water for maximum efficiency.
- FIBERGLASS INSULATION forms a positive heat barrier . . . saves fuel!
- COMPACT DESIGN takes less space, enables low-cost installation.

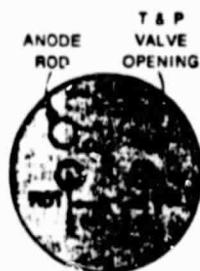
DEPENDABLE LONG-LIFE PERFORMANCE!

- The finest in GLASS LINING for superior tank life and water cleanliness.
- Magnesium ANODE ROD protects tank interior against corrosion.
- Snap-on THERMOSTAT automatically controls water temperature . . . assures continuous trouble-free service.
- UL LISTED All models comply with safety specifications outlined in Underwriters' Laboratories, Inc. Standards for Safety, UL174.
- SUPER STRENGTH TANKS provide long life and that important margin of safety.

CRANE Silver Monitor

ELECTRIC GLASSLINED WATER HEATERS

In keeping with our policy of continuous product improvements, we reserve the right to make minor changes without prior notice.



■ **GLASSLINED TANKS** The complete inner surface of every tank is lined with an extra thick coating of vitrified glass, permanently bonded under intense heat (1600°F.) to insure clean, rust-free water throughout a longer tank life.

■ **SPECIAL ECO (Energy Cut-Off) FEATURE** A special UL listed, factory installed heat sensitive device cuts off ALL power to heater should tank water temperature reach 210 F.

■ **ANODE ROD** Extruded magnesium rod suspended in the tank protects your heater against corrosion.

■ **HIGHLY EFFICIENT THREADED ELEMENTS** Immersion type heating elements put all heat directly into water for greater efficiency. Pressure sealed to prevent leaking.

■ **WELDED STEEL COUPLINGS** No internal threads to cause nipple leaks.

■ **T. & P. VALVE OPENING** Separate 3/4" N.P.T. opening provided for installation of Temperature-Pressure relief valve. Maximum Hydrostatic Working Pressure 150 PSI.

■ **TRIPLE TESTED TANKS** Each tank is carefully tested three times during manufacture.

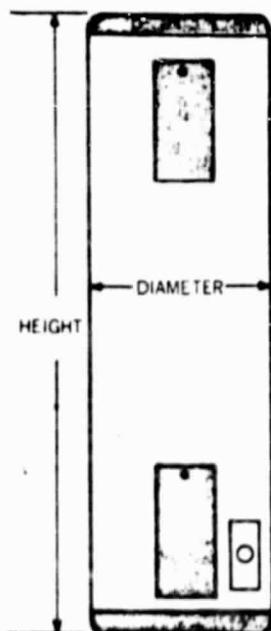
■ **FIBERGLASS INSULATION** An extra dense blanket of non-settling fiberglass surrounds tank and keeps heat loss to minimum — saves fuel.

■ **SET AND FORGET THERMOSTAT CONTROL** Once the thermostat is properly set, you get a constant supply of hot water at your desired temperature.

■ **UL LISTED** All models comply with Safety Specifications outlined in Underwriters' Laboratories, Inc. Standards for Safety, UL174.



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3/4" WATER INLETS & OUTLETS

5 Year Lmt. Warranty Model No.*	10 Year Lmt. Warranty Model No.	Type Element	Wattage Maximum 240V AC 208V AC	Recovery G.P.H. Based On 240V Max.	Cap. Gals.	Dimensions In Inches		Ship. Wt. Lbs.
						Hgt.	Diam.	
C5-30-1RS7	C10-30-1RS7	Single	6,000	24.6	30	37 1/2	20	100
C5-30-2RS7	C10-30-2RS7	Double	9,000*	36.9	30	37 1/2	20	100
C5-42-1RS7	C10-42-1RS7	Single	6,000	24.6	42	47 1/2	20	115
C5-42-2RS7	C10-42-2RS7	Double	12,000*	49.2	42	47 1/2	20	120
C5-52-1RS7	C10-52-1RS7	Single	6,000	24.6	52	50 1/2	22	150
C5-52-2RS7	C10-52-2RS7	Double	12,000*	49.2	52	50 1/2	22	150
C5-66-2RS7	C10-66-2RS7	Double	12,000*	49.2	66	52 1/4	24	180
C5-82-2RS7	C10-82-2RS7	Double	12,000*	49.2	82	58 1/2	24	215
C5-100-2RS7	C10-100-2RS7	Double	12,000*	49.2	100	57 1/4	28	300
C5-120-2RS7	C10-120-2RS7	Double	12,000*	49.2	120	53	28	315

10-Year models include additional Anodic Protection.
Full terms of Limited Warranty may be found in this catalog.

Maximum wattages shown here are available when specified.

* (Double element wattages are based on simultaneous operation and must be specified— otherwise heater elements are wired to operate independently in an interlocking circuit.) All wattages must conform to local codes and utility requirements. Should maximum permissible wattages in your area be less than above, recovery can be determined at the rate of 4.9 g.p.h. per 1000 watts input.

CRANE

CRANE SUPPLY COMPANY 300 PARK AVENUE NEW YORK, N. Y. 10022

**SOLAR PANELS
AND
SYSTEM**

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INDUSTRIAL Space Heating / Domestic Water Heating
Make-Up Air Heating / Process Water Heating

Architect: Intergroup Architects



COMMERCIAL Space Heating / Domestic Water Heating
Ventilation Air Heating

Architect: Ames and Thorpe



RESIDENTIAL Forced Air Space Heating / Pool Water Heating
Domestic Water Heating

Architect: Crowther Solar Group

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TN-1

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FEB 1978
REC'D
D. F. CAHILL
CONST. CO.

ASSEMBLY

4/5/78
JAB

NOTED: REVIEW DATE NOT RELIEVE THE CONTRACTOR FROM ANY RESPONSIBILITY FOR ERRORS OR DEVIATIONS FROM THE CONTRACT REQUIREMENT OR FOR THE QUALITY OF MATERIALS OR EQUIPMENT SUPPLIED AND RESUBMIT CORRECTIONS NOTED NO EXCEPTIONS TAKEN

ASSIGNED ENGINEER'S SIGNATURES INCORPORATED

SOLARON
CORPORATION
Solar Energy Systems

Solar air heating systems produce more usable energy than liquid solar systems. An independent test of side by side air and liquid solar systems at Colorado State University states: "... the air system operated 46 percent longer during the day than the liquid system and collected 38 percent more heat." "This is a consequence of stratified heat storage in the pebble bed for the air system and nearly uniform temperature in the water storage tank of the liquid system." This is described in terms of the solar system performance equation on page four of this brochure.

The SOLARON AIR COLLECTOR offers the following advantages:

- 10 Year performance warranty.
- Safe, reliable and virtually maintenance-free operation.
- Freedom from damage by freezing or boiling.
- Absence of pipes which can corrode and leak.
- Requires no antifreeze or stagnation pressure relief controls.
- Approved by HUD and ERDA for Federally funded projects.

NR—MANUFACTURER

Solaron's business is the practical application of solar energy. We design, manufacture and market solar heating systems for industrial, commercial, agricultural processing and residential buildings. The heart of our system is the air-type solar collector, a design based on over 30 years research and development by Dr. George Lof. To contact the nearest Solaron dealer, call the SWEETS BUYLINE.

Design Assistance: Solaron has a complete design manual covering all aspects of solar system engineering, architectural requirements and economics. Contact Solaron for a copy of the design manual. Experienced and technical personnel are available to assist on any special applications.



PP—PRODUCT PRESENTATION

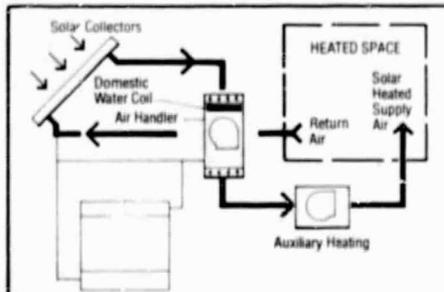
The Solar Air Heating System

The Solaron solar heating system is marketed throughout the U. S. by local distributors and dealers who are well established in the HVAC industry. The Solaron distributors maintain a complete stock of Solaron equipment. The distributors, who also handle major brands of heating and air conditioning equipment, work with dealers who are HVAC installing contractors. The Solaron dealers are established and reliable contractors who are familiar with installing heating equipment and associated ductwork. Both the distributors and dealers are thoroughly trained by

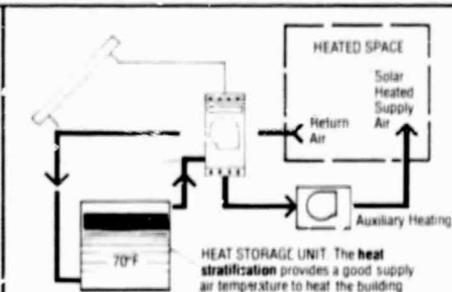
Solaron in all aspects of solar heating, design, equipment application and installation. Solaron engineers and field servicemen support the distributors and dealers as required, and provide on site assistance.

The Solaron collector, air handle, and controller and necessary ductwork is installed by the HVAC contractor. The general contractor usually builds the heat storage container. The system is then tested through all of the operating modes and thoroughly checked for proper operation.

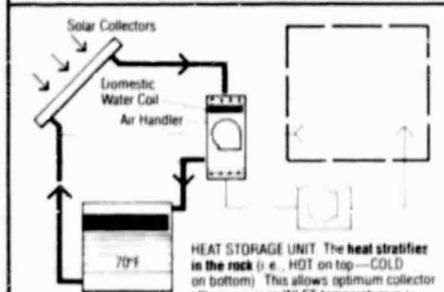
OP—OVERALL PRODUCT, IN PLACE SYSTEM OPERATION



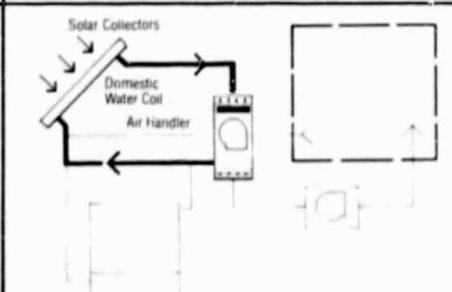
HEATING FROM COLLECTOR Air, the circulating heat transfer medium is drawn through the collector where it is normally heated to about 120-150°F. When the space requires heat, the solar heated air is drawn through the air handling unit in which motorized dampers are automatically opened to direct the hot air to the space. The air then returns to the collector where it is again heated and the cycle repeats itself.



HEATING FROM STORAGE At night or on cloudy days when solar energy is unavailable and when heat is needed in the space, the automatic control system directs the building return air into the bottom of the heat storage unit, up through the pebbles where the air is heated, through the air handling unit and into the space. When the solar heated air does not maintain the space thermostat setting, the automatic control turns on the auxiliary heater to add to the required heat.

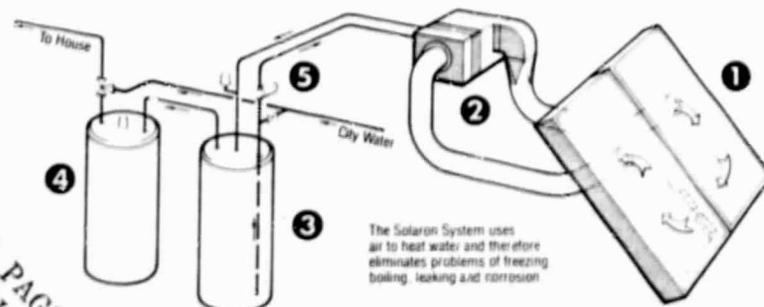
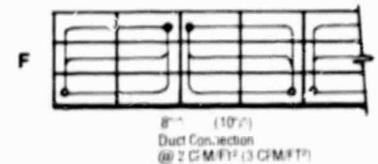
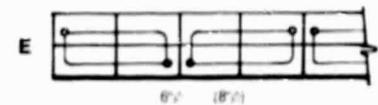
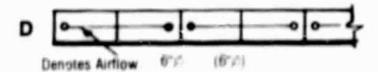
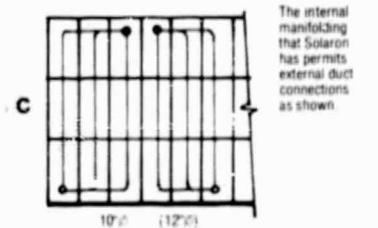
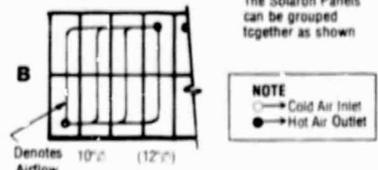
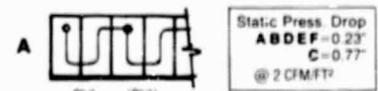


STORING HEAT When the space temperature is satisfied the automatic control system diverts the air into the heat storage unit where the heat is absorbed by the pebble bed. The air returns to the collector where it is heated and this cycle is repeated.



SUMMER WATER HEATING In the summer, when space heating is not required, air is drawn through the collector where it is heated and then through the water heat exchanger coil. The solar heated air transfers its heat to the water which is being circulated through the coil and the air is then returned back to the collector inlet.

TYPICAL COLLECTOR ARRAYS

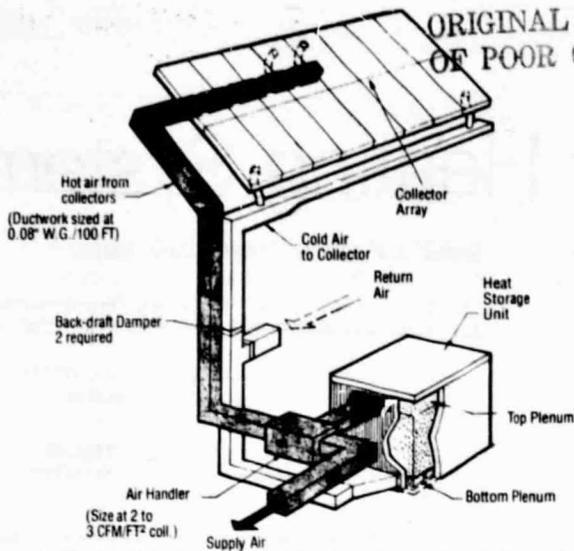


The Solaron System uses air to heat water and therefore eliminates problems of freezing, boiling, leaking and corrosion.

SOLARON DOMESTIC WATER HEATING SYSTEM

The Solaron Domestic Water Heater System involves a very simple operating cycle. Solar energy is collected by the south facing collector 1. Air is circulated by the heat exchange unit 2 where the solar energy is transferred to the water being circulated by the domestic water circulating pump 5. Solar heated water is continuously circulated into the storage tank 3 as long as the Solaron control unit indicates that solar energy is available at the collectors 1 and until tank temperature in the storage tank 3 reaches 160 degrees F. When hot water is required water is drawn from the conventional domestic hot water heater 4 and preheated water is drawn from the storage tank 3 into the conventional domestic water heater.

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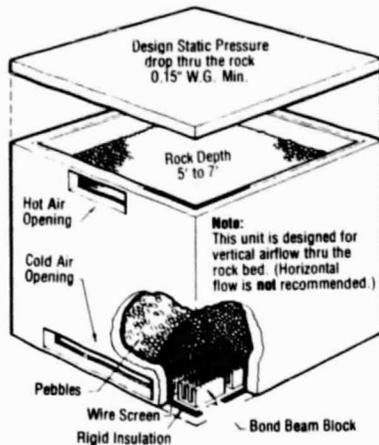
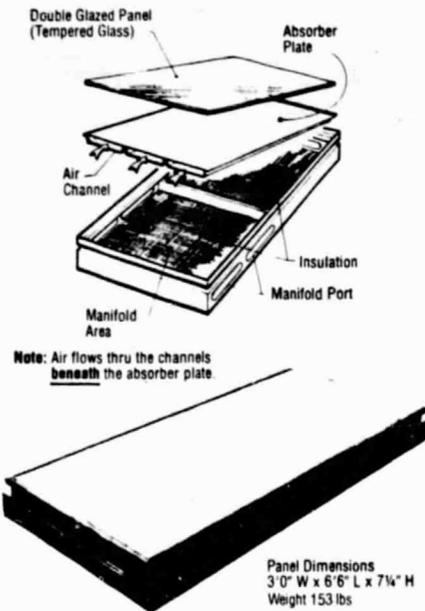
SYSTEM DESCRIPTION

A drawing of a typical installation is shown to the left. The collectors can be grouped as shown or in any of the configurations shown on page 2, Typical Collector Arrays. Due to the Solaron internal manifolding technique (i.e. air flow from one panel to another internally) the external duct connections are minimized as shown above (i.e. one inlet and one outlet for 8 panels, 156 ft.²). This technique reduces field labor and leads to an economical installation.

CONTACT SOLARON TO OBTAIN SYSTEM SCHEMATICS SHOWING HOW TO COMBINE SOLAR HEATING WITH:

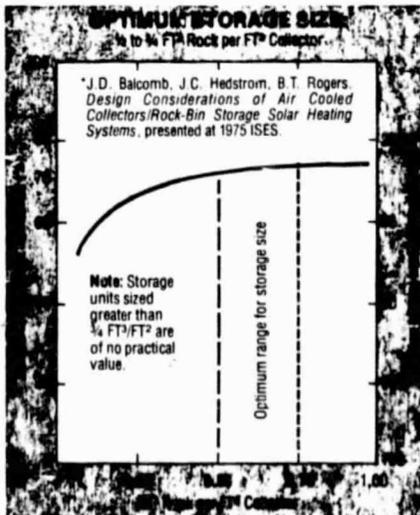
- Heating & air conditioning
- Heat pumps
- V.A.V. systems
- Multiple zones
- Process water heating
- Make-up air heating
- Process air htg.-drying
- Swim pool water htg.
- Industrial & agricultural heating

CP—COMPONENTS, PARTS

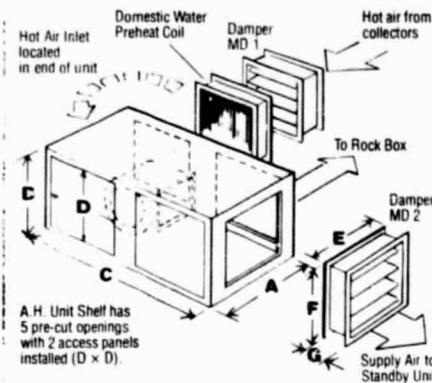


PEBBLE-BED HEAT STORAGE UNIT

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



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



Model No	Air Handling Unit (in.)				Dampers & Coil			C.F.M. Range at 1.2" S.P.
	A	B	C	D	E	F	G	
AU—0400	20	18	42	14	16	16	8	300 to 1400
AU—0500	24	22	51	18	20	20	10	1200 to 2400

Larger, custom built air handlers are also available.

AIR HANDLING UNIT

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

A typical installation for the air handling unit, near the auxiliary heater and heat storage, is shown in the General System Description (upper left). The air handler can be mounted either vertically or horizontally, and with proper orientation and clearance to receive all connecting ducts without interference.

SOLARON AUTOMATIC CONTROL UNIT

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

SOLAR SYSTEM PERFORMANCE COMPARISON

Comparison of various types of solar heating systems can only be done properly if the entire solar system is evaluated over an entire heating season. Collector efficiency is an instantaneous point in time measurement and is not a valid parameter to evaluate the solar system performance. The ideal situation for a solar system is to keep the fluid inlet temperature to the collector as low as possible and have a high usable temperature for space heating. Therefore, the ideal solar system has heat stratified in the storage unit. An air solar system using rocks as the thermal storage provides this stratification. Therefore, the inlet temperature to an air collector is typically 70°F where the liquid collector inlet temperature is 130°F.

$$Q_{Ac} = F_R [H_i \tau \alpha - U_c (T_i - T_a)] = \frac{\text{BTU}}{\text{Ft}^2 \text{ Day}}$$

gains losses

Two collectors of similar construction can be compared using the performance equation. When the average collector inlet temperature (T_i) is used, the liquid systems produce almost the same heat output as the air system

AIR: $Q_{Ac} = 0.69[(300)(0.75) - (0.8)(70^\circ - 40^\circ)] = 139 \frac{\text{BTU}}{\text{Ft}^2 \text{ Day}}$

LIQUID: $Q_{Ac} = 0.90[(300)(0.75) - (0.8)(130^\circ - 40^\circ)] = 138 \frac{\text{BTU}}{\text{Ft}^2 \text{ Day}}$

However, this is still an instantaneous point in time measurement which doesn't take into account the fact that the air system will typically collect for longer periods of time and therefore deliver more total heat output. When these systems are evaluated over an entire season, the results are as reported by the C.S.U. report # COO-2868-1. Because of the stratification, the temperature of the air returning to the collector from the bottom of storage is always near room temperature. Thus, the air collector can deliver useful heat from early morning to late afternoon; the liquid system starts up later in the morning and shuts off earlier in the afternoon. Therefore, when system performance is evaluated over an entire season it shows that AIR solar systems actually produce more usable energy than liquid systems. The C.S.U. tests report that the air solar system delivered considerably more heat output than the same sized liquid system night next to it.

*Ref. Howell, H.C. and Woertz, B.B. A.S.M.E. Transactions 61, 91, 1942 Performance of Flat Plate Solar Heat Collectors

SOLARON CONVERSION FACTORS

Solar collector area: (design heat loss $\frac{\text{BTU}}{\text{HR}}$) / (S.C.F.) = Ft ²		Fuel Savings/yr.			
Location	Design ΔT	30%	50%	70%	
Az	Phoenix	45°	556	293	177
Ar	Little Rock	55°	232	112	68
Ca	Davis	40°	240	113	60
	Los Angeles	30°	421	218	130
	San Francisco	33°	258	127	70
Co	Denver	70°	315	171	104
Fl	Gainesville	38°	458	247	153
Ga	Atlanta	55°	297	150	86
Id	Boise	60°	205	99	52
Il	Lemont	70°	167	83	47
In	Indianapolis	64°	154	71	40
Ia	Ames	77°	195	97	56
Ks	Dodge City	63°	304	158	96
Ky	Lexington	60°	222	106	60
La	New Orleans	35°	267	139	84
Me	Portland	70°	191	97	55
Md	Silver Hill	55°	191	97	55
Ma	Boston	70°	157	80	42
Mi	East Lansing	70°	119	54	29
Mn	St. Cloud	95°	187	108	63
Mo	Columbia	70°	230	114	60
Mt	Great Falls	86°	265	129	74
Ne	Lincoln	70°	225	110	65
Nv	Las Vegas	50°	433	216	135
N.J.	Seabrook	55°	160	74	45
N.M.	Albuquerque	60°	387	209	124
N.Y.	Albany	70°	160	80	59
	N.Y.C.	55°	138	67	39
N.C.	Raleigh	55°	283	141	87
N.D.	Bismark	89°	226	111	63
Oh	Cleveland	63°	127	58	29
	Columbus	63°	141	67	35
Ok	Oklahoma City	60°	319	159	96
Or	Medford	55°	171	80	54
Pa	State College	64°	140	66	35
R.I.	Newport	59°	169	87	50
S.C.	Charleston	40°	313	160	101
S.D.	Rapid City	76°	266	137	81
Tn	Nashville	60°	215	103	60
Tx	Ft. Worth	50°	350	194	118
	Midland	55°	416	211	126
Ut	Salt Lake City	70°	237	120	63
Va	Mt. Weather	60°	177	90	51
Wa	Seattle	55°	168	82	47
	Spokane	70°	170	85	48
Washington D.C.		51°	149	80	44
Wisc.	Madison	80°	142	72	38
Wy	Lander	82°	329	171	105
Montreal		80°	119	56	27
Toronto		70°	177	85	48

Note collector tilt 53°

Heating and Air Conditioning Systems Installation Standards for One and Two Family Dwellings and Multifamily Housing Including Solar. The Better Heating & Cooling Bureau, SMACNA, Third Edition, Feb. 1977. Reprinted by permission. Reprinted by permission.

PRELIMINARY SIZING CRITERIA

- 1 Solar Collector Area: The collector area can be determined by using the Solaron Conversion Factors shown to the right. The design heat loss is divided by the S.C.F. to get ft² of collector. Recommendations—Annual fuel savings for space heating should equal 30% to 70%. Annual fuel savings for applications with a more uniform load throughout the year can be higher than 70%.
- 2 Air Flow Rate: 2 SCFM to 3 SCFM per ft² of solar collector area. Contact Solaron for special applications such as make-up air heating, outside air heating for drying or industrial or agricultural process heating.
- 3 Heat Storage Size: 1/2 to 3/4 ft³ rock per ft² of solar collector area. Rock size 3/4" to 1 1/2" diameter.

CORRECTIONS FOR NON/OPTIMUM CONDITIONS

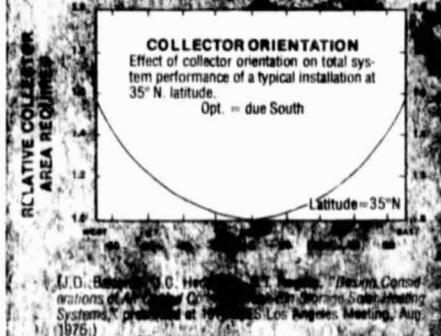
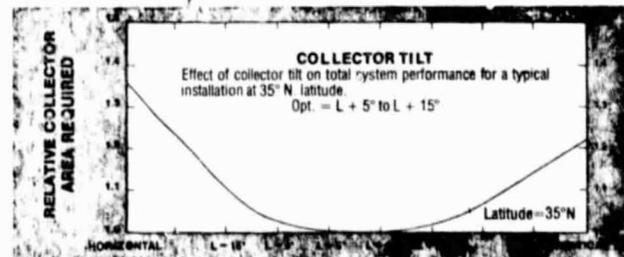
Example: Project at 40° N. Latitude. 500 ft² Collector Area.

- 1 If Orientation is 20° to the West: The relative collector area required to provide the same annual fuel savings as a system at due South is approximately 1.04 times the calculated collector area (1.04) · (500) = 520 ft².
- 2 The optimum collector tilt would be 45 to 55 (i.e. L + 5 to L - 15). If the collectors were at a tilt of 35 (i.e. L - 5) the relative collector area required would be 1.03 · 500ft² = 515ft². If both conditions exist (i.e. 20° West & 35° tilt) the correction would be (1.04) (1.03) (500) = 535.6 ft².

SELECTION EXAMPLE

Given that: A commercial building with a design heat loss 136,800 BTU/HR, the location is Denver, Colorado and the desired annual fuel savings is 50%.

- 1 Collector Area: (Design heat loss) / (S.C.F.) = 136,800 / (171) = 800 ft² collector
- 2 FLOW Rate: (2 SCFM per ft²) · (Collector Area) = (2) · (800) = 1600 SCFM
- 3 Heat Storage Unit: (1/2 ft³ rock per ft²) · (Collector Area) = (1/2) · (800) = 400 ft³ rock



SOLARON CORPORATION
 300 GALLERIA TOWER
 720 SOUTH COLORADO BLVD.
 DENVER, CO 80222
 (303) 759-0101



TECHNICAL DATA

Series 2000

Air Type Solar Collector

PATENTS PENDING

The Solaron series 2000 flat plate air type collector represents the most advanced technology and manufacturing know-how available today in the solar heating field. The collector is based on over thirty years of research and testing and has proven highly efficient, reliable and maintenance free.

The collectors are completely factory pre-assembled to minimize field installation time and assure uniform quality and performance. The exclusive port and manifold system allows the collectors to be simply butted together and bolted in place. No field fittings are required between collectors.

The Solaron series 2000 collector is universal in application. Substantial energy savings can be realized in commercial, industrial and residential applications such as:

- MAKEUP AND FORCED AIR HEATING
- HYDRONIC SPACE HEATING
- DOMESTIC HOT WATER HEATING
- PROCESS HOT WATER APPLICATIONS
- PROCESS HOT AIR DRYING APPLICATIONS

The Solaron System can be used where application temperatures can be satisfied directly by the collectors as well as where the collectors are used to preheat water for high temperature applications.

The Solaron series 2000 collector conforms to the interim performance standards established by the Energy Research and Development Administration for solar collectors. These standards include:

- RESISTANCE TO HAIL, WIND FLUTTERING AND WIND LOAD.
- FREEDOM FROM FREEZING, CORROSION, AND OUTGASSING.
- RESISTANCE TO THERMAL AND SOLAR DEGRADATION.
- CONFORMITY TO NATIONAL SAFETY AND FIRE CODES.

FEATURES

- The Solaron series 2000 air type collector can be used in hydronic applications through the use of a high efficiency air to water heat exchanger. Since the collector uses air as the transfer medium, costly field piping, maintenance, and wear are reduced or eliminated.
- Attractive appearance allows for architecturally pleasing applications, including construction of entire roofs and wall sections with solar panels.
- Factory preassembly includes insulation, manifolding and piping to eliminate field assembly.
- Simple installation system includes all hold down hardware and cap strip necessary for a complete installation. Perimeter flashing, typically field measured is provided by the builder.

CONSTRUCTION

The series 2000 collector module, designed for high efficiency and ease of installation, is constructed of the following materials:

FRN - 24 gauge steel, fully insulated with 3-3/4" fiber-glass batt. Painted external surfaces.

COVER PLATES - Two 1/8" hermetically sealed special low iron tempered glass panels with long life neoprene perimeter gaskets. Plates can be easily removed for service or replacement.

ABSORBER - 26 gauge steel with baked on high absorptivity ceramic enamel coating.

CAP STRIP - Painted steel. Designed to assure weather seal between modules.

CONNECTION PORTS - Unique flange configuration permits tight air seal automatically as modules are installed.

PERFORMANCE

EFFICIENCY - collector efficiency is as high as 64.5% as a function of outlet minus ambient temperature over solar insolation. Where $T_{out} - T_{amb}$ equals 120° and insolation equals 300 BTU's per hour per square foot, a typical operating environment, the Solaron series 2000 collector efficiency exceeds that of flat plate liquid type collector.

REFLECTANCE - the total reflectance of the absorber surface averages only about 5%.

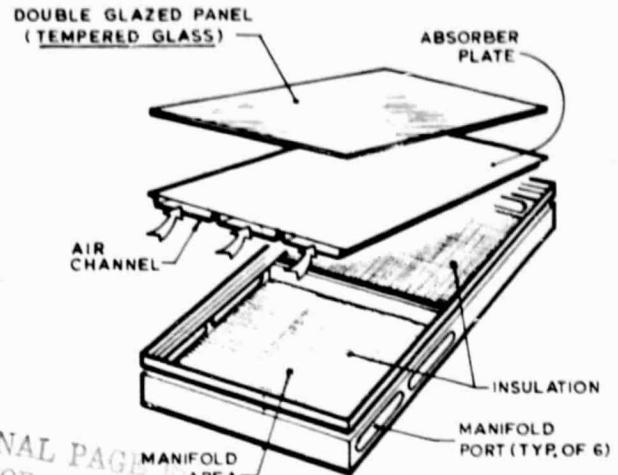
COVER TRANSMITTANCE - the transmittance of the two plate, low iron tempered glass cover is 80 percent from a 0 to 48 degree angle of solar incidence.

HEAT DELIVERY - the excellent heat delivery characteristics of the Solaron series 2000 collector are shown on Figure 3.

SOLARON COLLECTOR PANEL DETAILS



COLLECTOR PANEL



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PANEL DIMENSIONS -
3'-0" W X 6'-6" L X 7/4" H

NOTE: AIR FLOWS THRU THE
CHANNELS BENEATH
THE ABSORBER PLATE

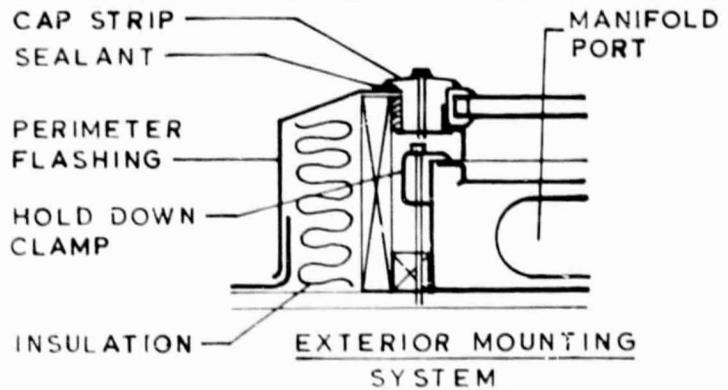
NOTE

THE SERIES 2000 COLLECTOR
IS AVAILABLE IN 3 MODELS :

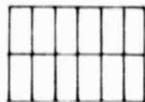
2001 - STD. FOR 2 PANELS
HIGH

2002 - OPTIONAL FOR MIDDLE
ROW OF 3 HIGH ARRAY
AND SPECIAL CONFIG-
URATION

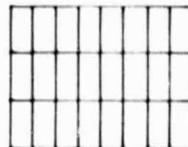
2003 - STD. FOR 1 PANEL
HIGH



2003



2001



2001

2002

2001

COLLECTOR PANELS
MAY ALSO BE GROUPED
IN HORIZONTAL
CONFIGURATION

The Solaron series 2000 collector is flexible in application. The modules can be installed on a roof section, wall section or free standing roof frame.

The collectors are installed as shown in the mounting system details above. Return and supply air is provided by simply installing a standard starting collar on the bottom of the collector anywhere within the 29" x 36" manifold area, thus collars can easily be located to clear roof trusses or wall studs. Perimeter flashing is field measured and installed to complete the system.

Other product information:

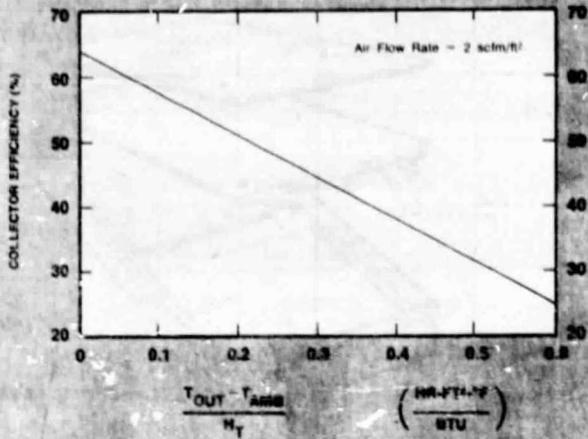
COLLECTOR WEIGHT - 188 pounds

INSTALLED DIMENSIONS - 36" x 78", center to center

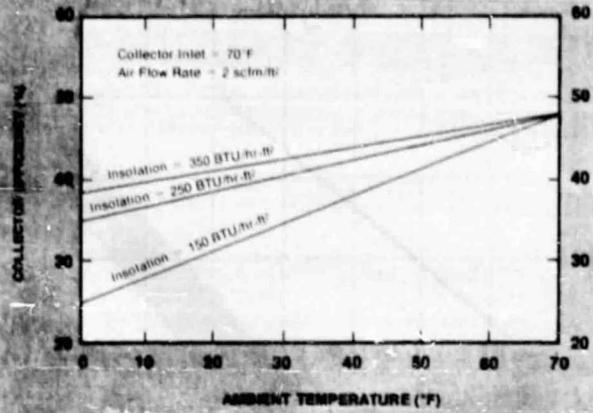
PORT NET FREE AREA - 26.7 square inches each

PORT END CAPS - provided by Solaron as required

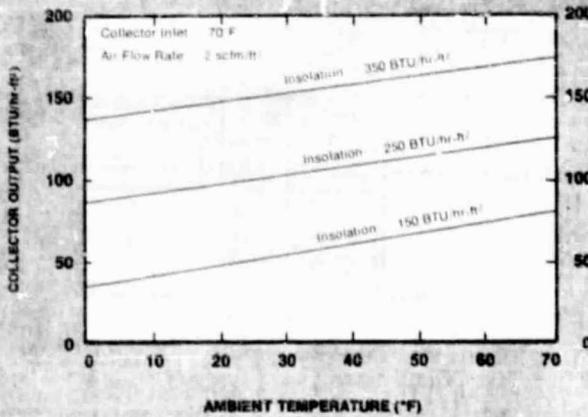
MEASURED* COLLECTOR PERFORMANCE DATA



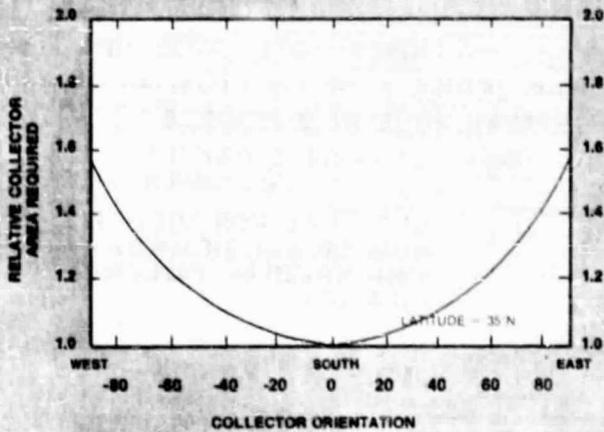
A—Collector efficiency as a function of outlet minus ambient temperature over insolation.



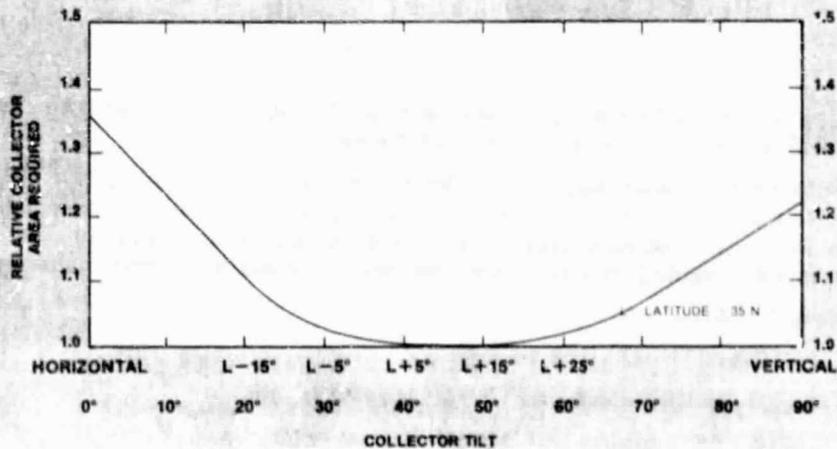
B—Collector efficiency as a function of outdoor temperature for various solar inputs.



C—Collector heat delivery as a function of outdoor temperature for various solar inputs.



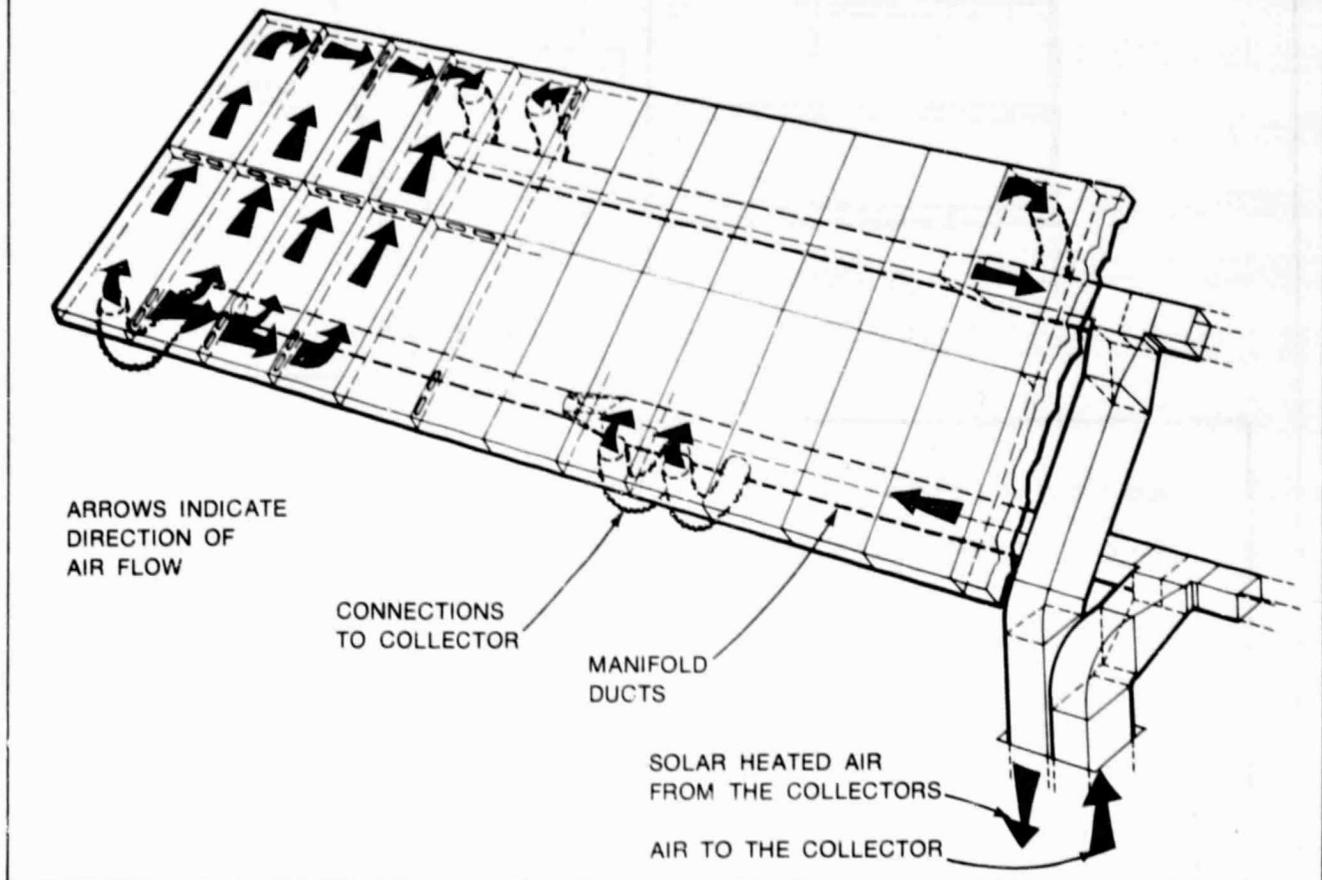
D—Effect of collector orientation on total system performance of a typical installation at 35° N latitude. (J. D. Balcomb, J. C. Hedstrom, B. T. Rogers "Design Considerations of Air Cooled Collector/Rock-Bin Storage Solar Heating Systems," presented at 1975 ISES Los Angeles Meeting, Aug. 1975)



E—Effect of collector tilt on total system performance for a typical installation at 35° N latitude (J. D. Balcomb, J. C. Hedstrom, B. T. Rogers "Design Considerations of Air Cooled Collector/Rock-Bin Storage Solar Heating Systems," presented at 1975 ISES Los Angeles Meeting, Aug. 1975)

*Measured in accordance with NBS IR-74-535 "Methods of Testing for Rating Solar Collectors Based On Thermal Performance"

TYPICAL COLLECTOR INSTALLATION



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The Solaron series 2000 solar collector can be installed in either a horizontal or vertical position. Installation can be efficiently accomplished by a two-man crew. No special tools or installation techniques are required.

The optimal air flow rate through the collector is 2 SCFM/ft.². The design static pressure is 0.23" when the collectors are ducted as shown above.

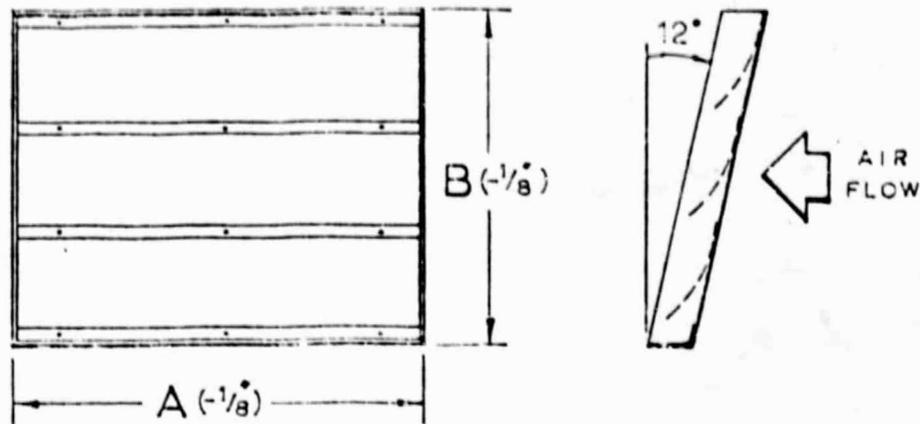
On a special order basis, Solaron can provide collectors with precut manifold openings and manifold ports omitted where specified to further reduce field installation time.

Solaron Corporation provides mechanical engineering and field services to assist the local engineer and HVAC contractor in design and installation.

For additional information on the Solaron collector and related Air Handling and Automatic Control systems, contact Solaron Corporation Marketing Services.

Phone 303 / 289-5971

SOLARON CORPORATION / 4850 OLIVE STREET / COMMERCE CITY, COLORADO 80022



VERTICAL

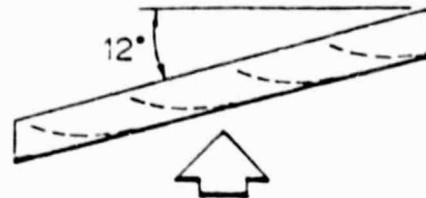
SPECIFICATIONS:

SIZE - MAX DIMENSIONS ARE 36 X 24. IF LARGER SIZE IS REQD. IT IS TO BE A MULTIPLE DAMPER INSTALLATION.

BLADE - COATED FABRIC MATERIAL 4" WIDE.

FRAME - EXTRUDED ALUMINUM (TO BE SEALED AIRTIGHT IN DUCT)

NOTE: Approx. press. drop at design flow rate is 0.10" w.g.



HORIZONTAL

NOTE: Horiz damper must be installed with air flow UP

CFM RANGE	DIMENSIONS-- INCHES		MODEL NO.		MAX FACE VELOCITY (FPM)
	A	B	VERT	HORIZ	
350/560	12	12	DV12	DH32	600
550/900	20	12	DV20	DH40	600
900/1350	28	12	DV28	DH48	650
1350/1900	26	16	DV26	DH46	650

SELECTION EXAMPLE:

GIVEN: 500 FT.² COLLECTOR AREA
 BD-1 IS IN HORIZ. R/A DUCT
 BD-2 IS IN VERT. DUCT GOING UP TO COLLECTOR

SELECTION:

WITH A FLOW RATE OF 2 CFM PER FT.² TOTAL = 1000 CFM

SELECT DV28/DH48

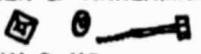
SOLARON BACK-DRAFT DAMPER

specifications subject to change without notice

SOLARON CORPORATION
 303/759-0101
 720 S. COLORADO BLVD.
 DENVER, COLORADO
 80222

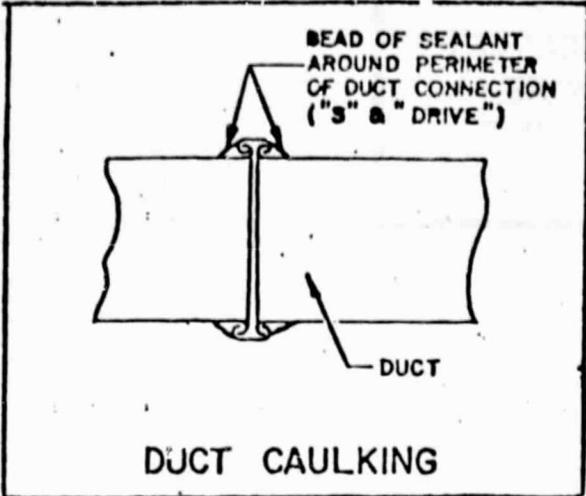
3-77

**SOLARON COLLECTOR
HARDWARE
COMPONENTS**

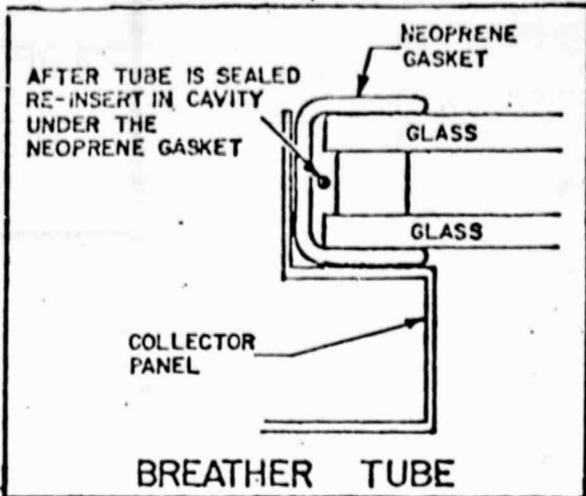
<p>CAP STRIP CS 0033</p>  <p style="text-align: right;">33"</p>
<p>CAP STRIP CS 0075</p>  <p style="text-align: right;">75"</p>
<p>TEE COVER PLATE CS 002T</p> 
<p>CROSS COVER PLATE CS 002X</p> 
<p>ELBOW COVER PLATE CS002L FIELD DRILLED</p> 
<p>HOLD-DOWN BOLTS W/ WASHER & TINNEMAN  FAO 110, 111 & 115</p>

<p>HOLD-DOWN (BRACKET) FAO 330 & 331 (EXTERIOR)</p> 
<p>HOLD-DOWN (PLATE) FAO 220 & 221 (INTERIOR)</p> 
<p>SCREWS BRACKETS CAP STRIP FAO 440 & 441</p> 
<p>END CAP FAO 550 & 551</p> 
<p>SEALANT/ ROLLS PERIMETER FLASHING GB0 70 50' ROLL</p> 
<p>SILICONE PORT GASKETS GB0 160</p> 

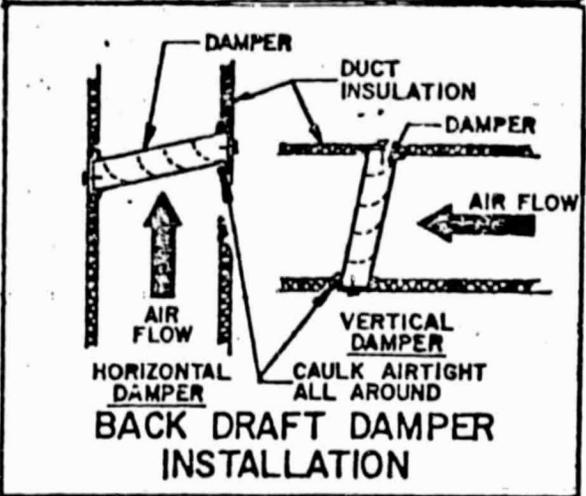
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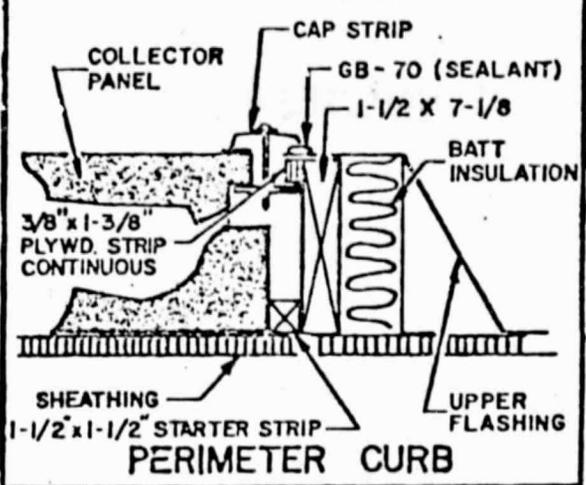
DUCT CAULKING



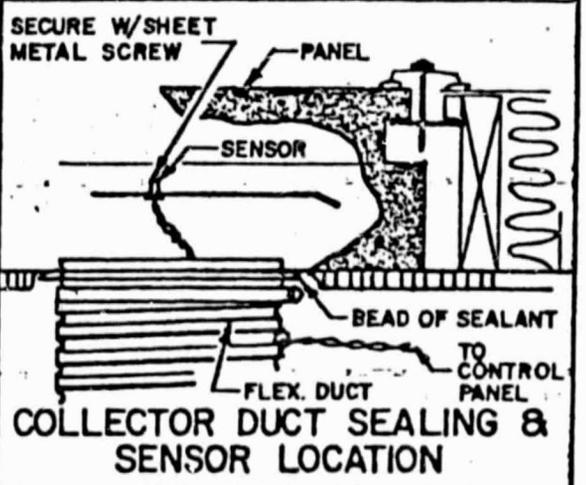
BREATHER TUBE



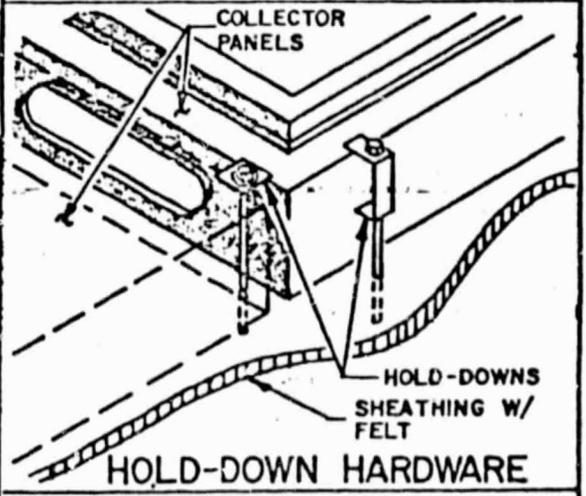
BACK DRAFT DAMPER INSTALLATION



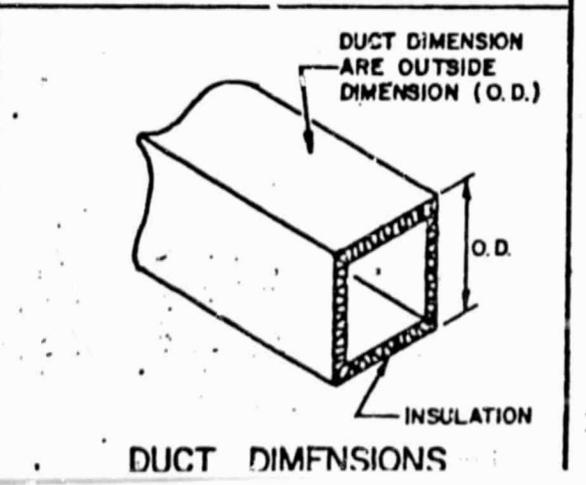
PERIMETER CURB



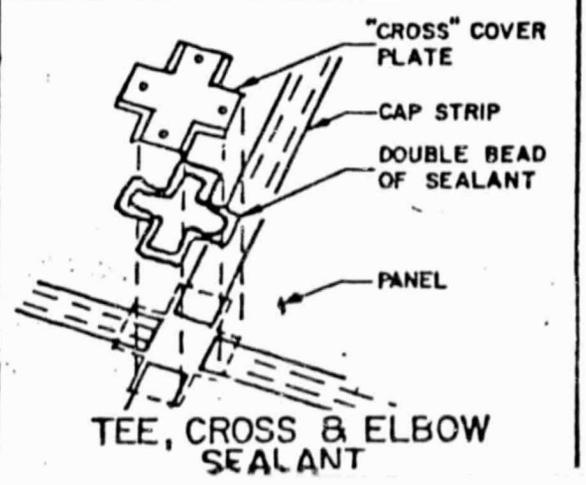
COLLECTOR DUCT SEALING & SENSOR LOCATION



HOLD-DOWN HARDWARE



DUCT DIMENSIONS



TEE, CROSS & ELBOW SEALANT

**EXHAUST FANS
AND AIR
DISTRIBUTION EQUIPMENT**

PROJECT: FIRE STATION No. 24
 LOCATION: KANSAS CITY, MISSOURI
 ARCHITECT: MIDDLEY, SHAUGHNESSY, FICKEL & SATT
 ENGINEERS: AEC INC.
 SUB. CONTR: TRUOG & NICHOLS, INC.



EQUIPMENT SCHEDULE

ROOF EXHAUSTERS (EF-1 & 2)

PENN LC Dynafans, low contour type, aluminum housing, with 115/60/1 motors, adjustable V-belt drive and disconnect switch.

1 - EF-1: LC-16A, 1/4 H.P., single speed, with 115 volt motor operated back-draft damper; 1050 cfm @ .375" S.P., 870 RPM.

1 - EF-2: LC-16A, 1/3 H.P., two speed, with gravity backdraft damper and hinged sub-base; 900 cfm @ .5" S.P., 950 RPM. - *mech conty responsible for connecting to separate spare circ in panelbd.*
 120V.

WALL EXHAUSTERS (EF-3 & 4)

2 - PEERLESS Model PVH-18 direct drive with 1/2 H.P., 115/60/1 motor, aluminum fan blade, wire inlet guard, and 20 x 20 RUSKIN BD2A2 back-draft damper (front flange frame); Capacity: 3825 CFm @ .375" S.P.

CONTROLS

3 - (EF-1, 3 & 4) C-H 9101H92 flush manual starters with overload protection, pilot light and stainless steel flush plate.

1 - (EF-2) C-H 9106H14, flush 2 speed starter, with overload protection on both speeds, pilot light and stainless steel flush plate.

CURBS & EQUIPMENT SUPPORTS

2 - PATE PC-5A, with 2" raised cant, 23.5" square O.D. (EF-1 & 2)

6 - PATE ES-5A, with 2" raised cant, 42" long. - *not reqd. by ch. order.*
 RESUBMIT / CH. ORDER #3

LOUVERS & DAMPERS - RUSKIN MFG. CO.

2 - 60 x 24 L-5, galv. with 1/2" mesh, 16 ga. galv. birdscreen on rear, channel frame.

BACK-DRAFT DAMPER

NMS non-metallic, steel channel frame.

1 - 15 x 14. 2 - 24 x 18.

MANUAL DAMPERS

3 - 10 x 10 MD-35-OBC, with extended shaft for

FIRE DAMPERS - Horizontal

IBD2 - A frame, UL, 212° fusible link.

2 - 26 x 16. 2 - 26 x 20. 1 - 17 x 16. 1 - 16

AIR DISTRIBUTION EQUIPMENT - TITUS PRODUCTS

SD: TDC-S1, #25 white finish, with AG-95 damper.

2 - 6 x 6, 1S. 4 - 9 x 9, 3A. 1 - 9 x 9, 2G.
 1 - 9 x 9, 4A. 2 - 12 x 12, 2S. 3 - 12 x 12, 4A.
 1 - 12 x 12, 1S. 1 - 12 x 12, 2G.

SR: 272-RS-5, #25 white finish.

2 - 18 x 12. 4 - 22 x 8. 1 - 26 x 12.



DATE: 4/5/78
 BY: [Signature]
 ASSOCIATED ENGINEERING CONSULTANTS, INCORPORATED
 NO EXCEPTIONS TAKEN
 MAKE CORRECTIONS NOTED
 AMEND AND RESUBMIT
 REJECTED - SEE REMARKS
 NOTE: REVIEW DOES NOT RELIEVE THE CONTRACTOR FROM ANY RESPONSIBILITY FOR ERRORS OR DEVIATIONS FROM THE CONTRACT REQUIREMENT OR FOR ANY DEFICIENCIES OF EQUIPMENT, WORK OR MATERIALS.

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RG: 25-U, #25 white finish.

1 - 10 x 10. 1 - 12 x 12. 1 - 16 x 16. 1 - 18 x 12.

1 - 24 x 20. 1 - 26 x 26. 1 - 48 x 36.

ER: 25-RL-5, #05 white finish.

2 - 8 x 6. 1 - 12 x 10. 1 - 12 x 12.

AER: 4-FL-5, #25 white finish.

3 - 8 x 6.

OG: 4-FL, #25 white finish.

3 - 10 x 10.

EXTRACTORS: AG-45

#2 operator: 2 - 8 x 6. 2 - 8 x 8. 1 - 11 x 6. 1 - 14 x 6. 2 - 14 x 7.

#1 operator: 2 - 22 x 8.

Submitted By: Triangle Sales, Inc.
P.O. BOX 159
Shawnee Mission, Kansas, 66201

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SHOP DRAWING REVIEW

Midgley Shaughnessy Fickel and Scott Architects Inc.
20 West 9th Street Kansas City, Missouri 64105

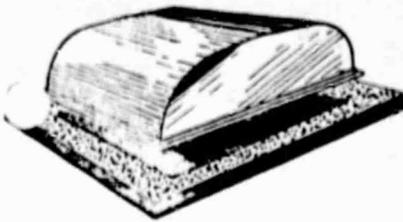
Review is for general compliance with contract documents.
Sole responsibility for correctness of dimensions, details,
quantities and shop drawings for fabrication and erection shall
remain with the Contractor.

- No Errors or Omissions
- Make Corrections Noted
- Amend and Resubmit
- Rejected - See Remarks

Date

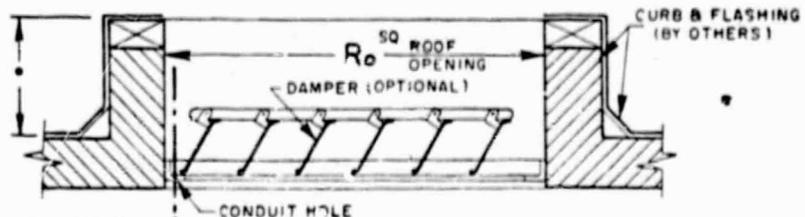
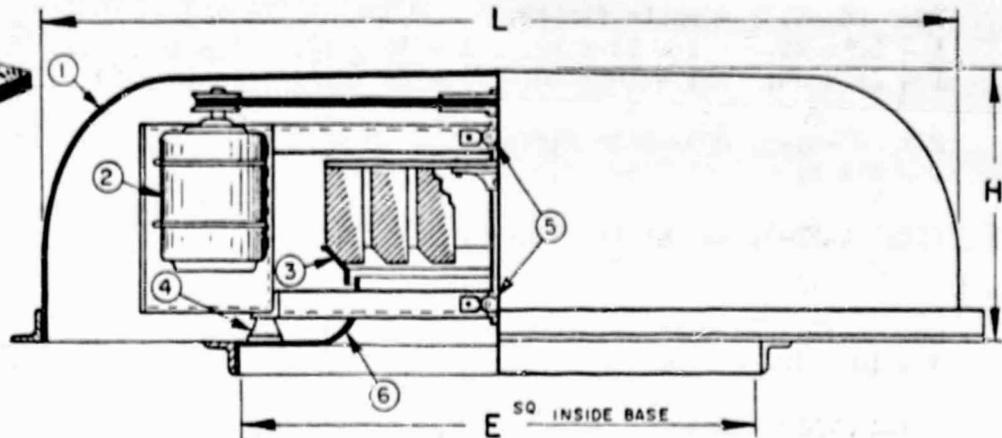
By

PENN Low Contour DYNAFAN (BELT DRIVE)



LEGEND

- ① ACCESS HOOD *UNITS SHIPPED WITH HOOD IN TWO SECTIONS
- ② BALL BEARING MOTOR
- ③ CENTRIFUGAL FAN WHEEL
- ④ VIBRATION ELIMINATORS
- ⑤ BALL BEARING PILLOW BLOCKS
- ⑥ FAN INLET VENTURI



*MINIMUM CURB HEIGHT OF 12" ON THESE UNITS.

"Field Built Curb Detail"

Quan.	Unit No.	CFM	SP	FAN RPM	HP	ELECTRICAL CHARACTERISTIC	Tag
1	LC-16A	1050	.375"	870	1/4	115/60/1	EF-1
1	LC-16A	900	.5"	950	1/3	115/60/1	EF-2

EF-1 with 115 volt motor operated back-draft damper. EF-2 with gravity backdraft damper and hinged sub-base.

Both units with adjustable V-belt drive and disconnect switch.

DAMPERS:-

MATERIAL:- aluminum housing.

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Dimensional Table

ALL DIMENSIONS IN INCHES

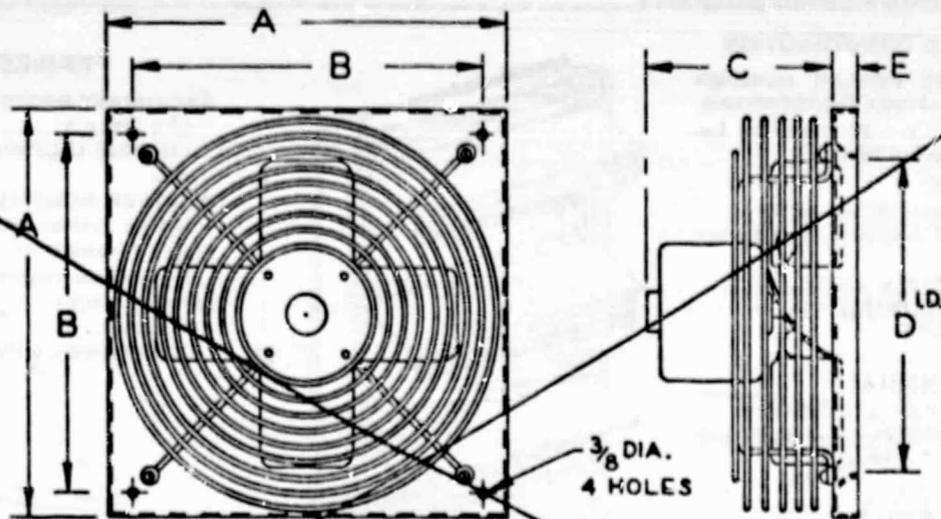
UNIT NO.	12A	14A	16A	20A	24A	30A	40A	48A*	54A*	72A*
L	30 x 34	30 x 34	37 x 45	37 x 45	43 x 55	48 x 64	54 x 76	75 x 84	80 x 114	98 x 120
H	16	16	18	19 1/2	19 1/2	23	26	33	36	36
E	20 1/2	21 1/2	25	28 1/2	33 1/2	39 1/2	44 1/2	58 1/2	63 1/2	79
R _o	12	13	16 1/2	20	25	31	36	50	55	66

*OUTSIDE DIMENSION OF CURB SHOULD BE 1" TO 1 1/2" LESS THAN "E" DIMENSION DEPENDING ON THICKNESS OF FLASHING MATERIAL.

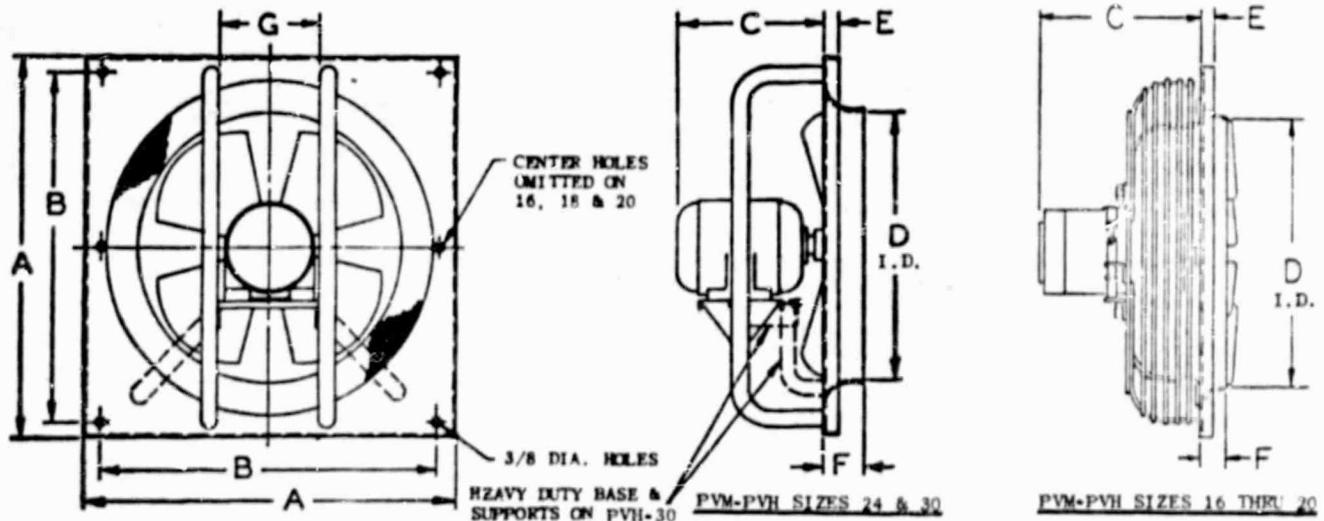
PROJECT	Fire Station #24	ENGINEER	AEC Inc.
LOCATION	Kansas City, Mo.	CONTRACTOR	
ARCHITECT	Midgley, Shaughnessy, Fickel & Scott	SUB-CONTR.	Traug & Nichols, Inc.
DWG. NO.		 <p>PENN VENTILATOR CO., Inc. 11TH STREET AND ALLEGHENY AVENUE PHILADELPHIA, PENNSYLVANIA, U.S.A. 19140</p>	
DATE			
REV.			

THIS PRINT AND DRAWING REPRESENTS THE DESIGN AND PROPERTY OF PENN VENTILATOR CO., INC. IT IS UNLAWFUL TO COPY, REPRODUCE, OR USE THIS DRAWING FOR ANY PURPOSE OTHER THAN INTENDED BY THE COMPANY.

FORM LC-609-R6



MODEL NO.	BLADE DIA.	A	B	C	D	E
PVL-8	8	13	11-3/4	6	8-3/4	5/8
PVL-10	10	13	11-3/4	6-7/8	10-1/2	5/8
PVL-12	12	20	18	6-7/8	12-1/2	1
PVL-16	16	20	18	6-7/8	16-1/2	1
PVL-12S	12	20	18	6-7/8	12-1/2	1
PVL-16S	16	20	18	6-7/8	16-1/2	1



MODEL NO.	MODEL NO.	BLADE DIA.	A	B	C	D	E	F	G
PVM-16	PVH-16	16	24	22-1/8	10-1/4	16-3/4	1	2-7/16	--
PVM-18	PVH-18	18	26	24-1/2	11-3/16	18-3/4	1	2-3/4	--
PVM-20	PVH-20	20	28	26-1/8	12-5/8	20-3/4	1	3	--
PVM-24	PVH-24	24	34	31-3/4	13-3/4	24-3/4	1	3-5/8	12
PVM-30	PVH-30	30	40	37-5/8	14-3/4	30-3/4	1	3-3/4	12



RUSKIN

SPEC
NO. BD2-1275
 Replaces BD2-1075

BACKDRAFT DAMPER
 Aluminum

TYPE
~~BD2/A1~~
BD2/A2

STANDARD CONSTRUCTION

FRAME: 6063T5 extruded aluminum .090" wall thickness. Mitered corners.

LINKAGE: 1/8" x 1/2" aluminum tie-bars concealed in frame.

MAXIMUM SIZE:

Single section — 40" w x 48" h
 Assembly of sections — size unlimited.

MINIMUM SIZE: 6" w x 6" h

TEMPERATURE LIMITS:

-40°F to +200°F

FINISH: Mill

BD2/A1

(Spot velocities up to 1500 fpm)

BLADES: 6063 formed aluminum with extruded vinyl edge seals.

BEARINGS: Valox

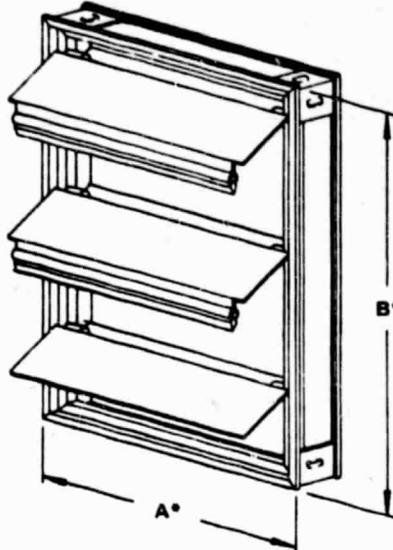
BD2/A2

(Spot velocities up to 2500 fpm)

BLADES: 6063T5 extruded aluminum .050" wall thickness with extruded vinyl edge seals.

BEARINGS: "Cyclooy 800"

Note: When used in fan discharge applications, damper should be located at least 1/2 fan diameter from fan discharge.



FEATURES

BACKDRAFT PROTECTION:

Low leakage:
 Less than 12 CFM/sq. ft. at 1/2" w.g.

WEATHER RESISTANT:

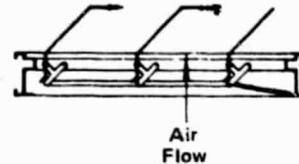
Blades overlap frame.

QUIET OPERATING:

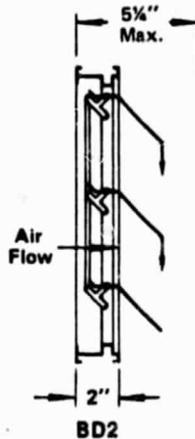
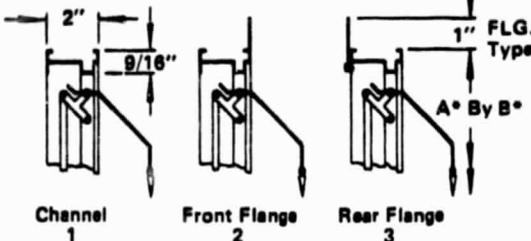
Non metallic blade to blade seal.

APPEARANCE:

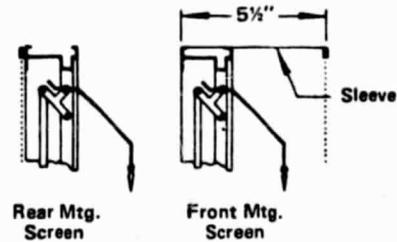
Good looking — contemporary styling.



FRAME CONSTRUCTION



HORIZONTAL MOUNT — AIR FLOW UP
 (Not available in air flow down)



*Unit furnished approx. 1/4" smaller than given 'opening' dimensions.

QUAN.	TYPE	OPENING DIMENSION		TYPE FRAME 1, 2 or 3	MOUNTING	
		A*	B*		VERT.	HORIZ.
1	BD2A2	20	20	2	X	

JOB
CONTRACTOR

LOCATION

RUSKIN Mfg. Co.

P.O. Box 129

Grandview, Mo. 64030

© RUSKIN MFG. CO. 1975

the pacesetter in quality prefab roof products



the pate company

2625 south 21st avenue • broadview, illinois 60153
312 • 681-1920

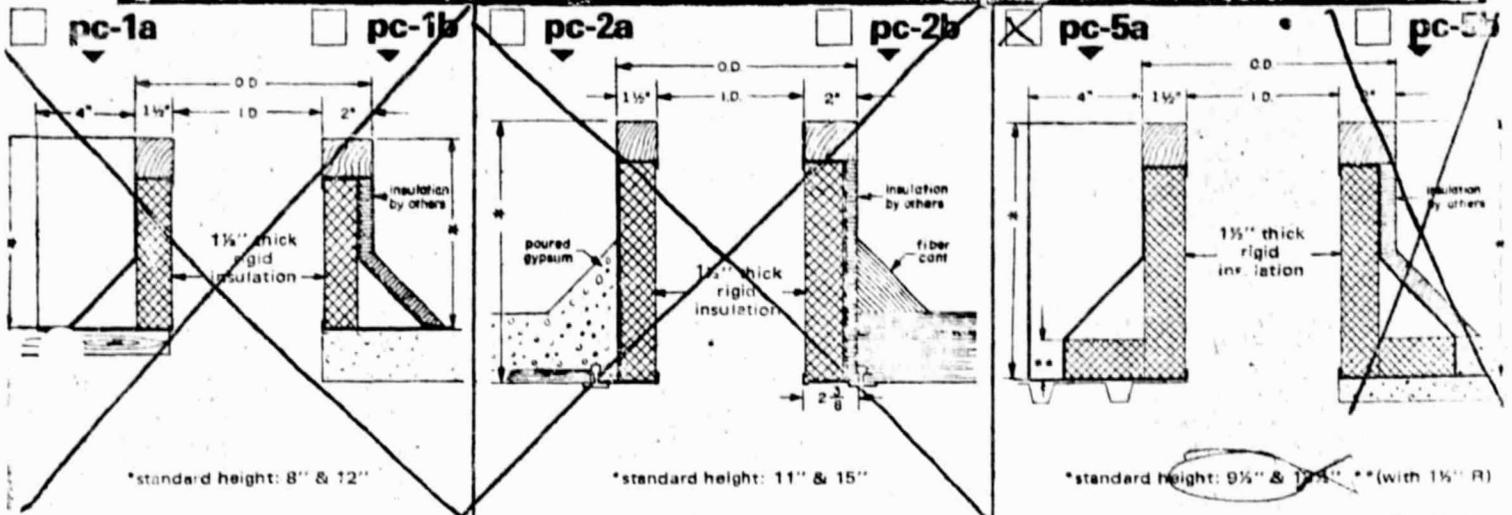
**pate®
curbs**

standard construction

Heavy ga. galvanized steel, unitized, full mitered corners, all seams welded, 1½" thick rigid fiberglass insulation, wood nailer strip. All curbs are internally reinforced in larger size dimensions. On B style curbs overhang is ½" unless otherwise specified.

p. o. no. _____
customer Truog & Nichols, Inc.
project Fire Station #24
location K. C. Mo.
architect Midgley, Sahughnessy, Fickel & Scott
engineer AEC Inc.

*** pate curbs ***



roof curb requirements

quantity	style	dimensions (give O.D. or I.D.)		overall height	nailer overhang b style	** raised cant height	
		O.D.	I.D.				
2	PC5A	23 1/2	23 1/2	Std.		2"	For EF-1 & 2

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page _____ of _____

for pate office use only

file _____
pate no. _____ shear _____
entered _____ w/i _____
ship date _____ b p _____

the pacesetter in quality prefab roof products



2625 south 21st avenue • broadview, illinois 60153
312 • 681-1920

**pate®
equipment supports**

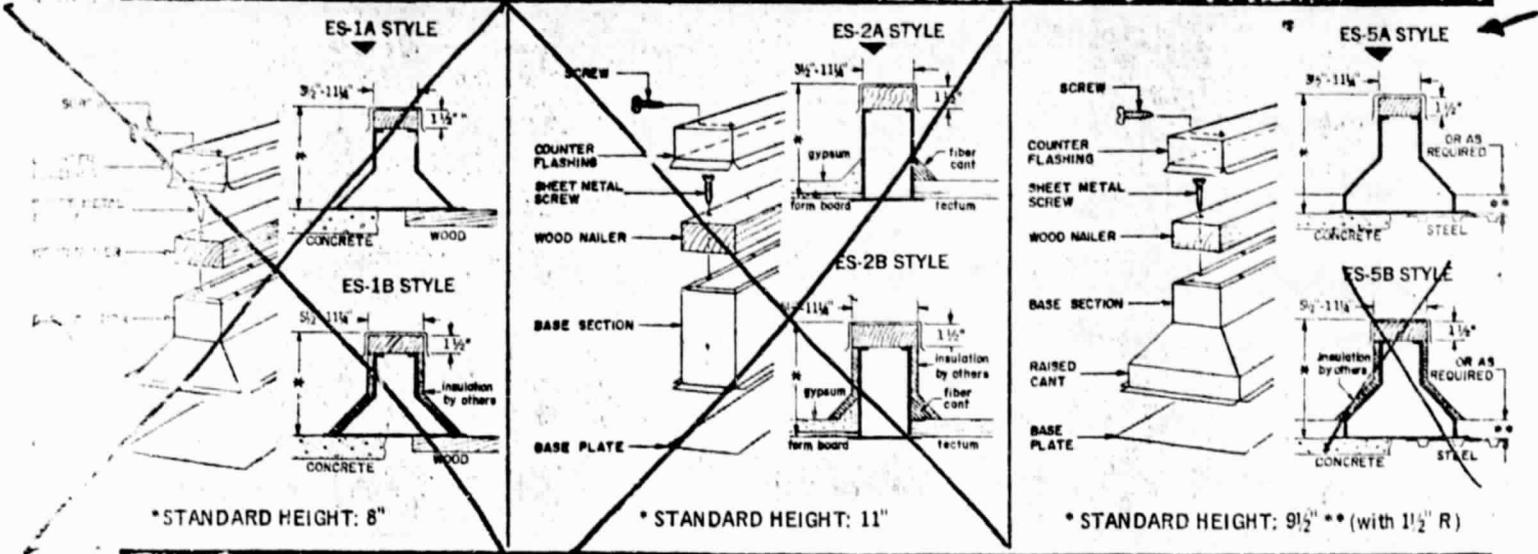
standard construction

18 ga. galvanized steel, unitized construction with integral base plate, continuous welded corner seams, wood nailer, counterflashing with lag screws. Internally re-inforced to conform with *pate* load bearing factors.

On B style supports, standard wood nailer has 1" overhang unless otherwise specified.

p. o. no. _____
customer Truog & Nichols
project Fire Station #24
location K. C. Mo.
architect Midgley, Shaughnessy, Fickel & Scott
engineer AEC Inc.

es-1a and 1b es-2a and 2b es-5a and 5b



Equipment support requirements

quantity	style	nailer length	nailer width	overall height	nailer overhang	** raised cant height
6	ES-5A	42"		std		2"

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page

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file _____
pate no. _____ shear _____
entered _____ w/i _____
ship date _____ .b p _____

RUSKIN®

SPEC
NO. L235-877
Replaces L235-1275

LOUVER
FIXED DIE FORMED

TYPES
L2-L3-L5

STANDARD CONSTRUCTION

FRAME: 20 ga. galvanized 4" steel channel with 1/2" inverted flanges. (Illustrated below as Frame Construction No. 1)

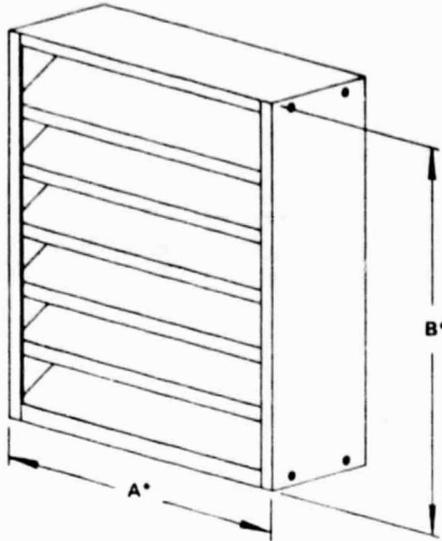
SCREEN: 19 gage galvanized 1/2" mesh in removable frame

FINISH: Mill galvanized
BLADES: 20 ga. galvanized steel

- L2 - Chevron Type on 2 1/2" centers (approx.)
- L3 - J Type on 4" centers (approx.) and 45° angle
- L5 - K Type on 4" centers (approx.) and 45° angle

MINIMUM SIZE: 12"w x 12"h

MAXIMUM SIZE:
Single section 96"w x 120"h or 120"w x 96"h
Assembly of sections - size unlimited.



FEATURES

EXCELLENT WEATHER PROTECTION at lowest cost.

APPEARANCE: Symmetrical design with level accurately spaced blades blends well with all types of architecture

VARIATIONS

(at additional cost)

FRAME DEPTH: 2" through 8" (4" standard)

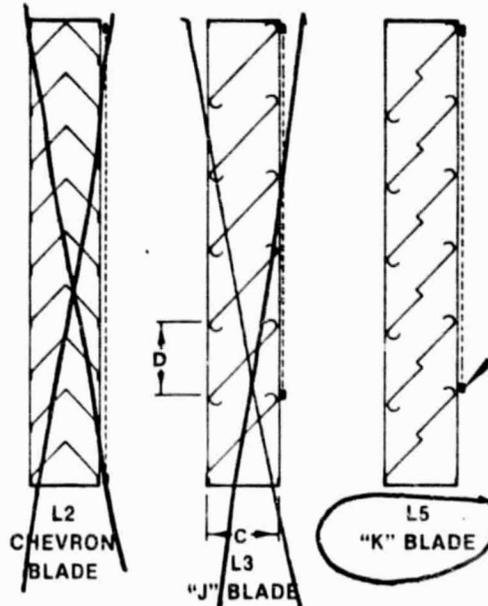
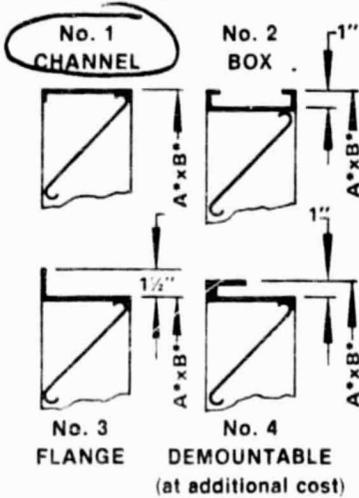
SPECIAL MATERIALS: Aluminum, Stainless Steel, Copper. Heavier gage materials.

BLADES: Material gage, spacing, and angle.

SCREENS: Many variations available.

FINISH: Enamel
Baked Enamel
Epoxy
Prime Coat

FRAME CONSTRUCTION



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SCREEN ON REAR

NOTE: Screen adds approx. 1/2" to depth.

*Unit furnished approx. 1/4" smaller than given "opening" dimensions.

QUAN.	TYPE	DIMENSIONS				FRAME	SCREEN
		A*	B*	C 4" Std.	D		
2	L-5	60	24			1	1/2" mesh, 16 ga. galv. birdscreen on rear.

JOB
CONTRACTOR

LOCATION

RUSKIN Mfg. Co.

P.O. Box 129

Grandview, Mo. 64030

© RUSKIN MFG. CO. 1977

RUSKIN

SPEC
NO. NMS-1275
 Replaces NMS-275

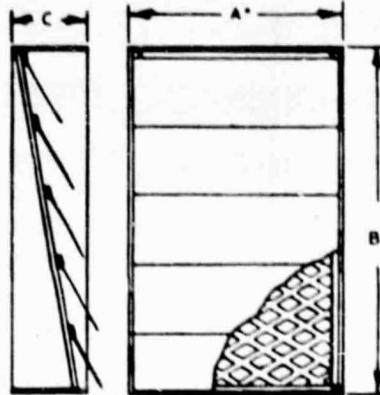
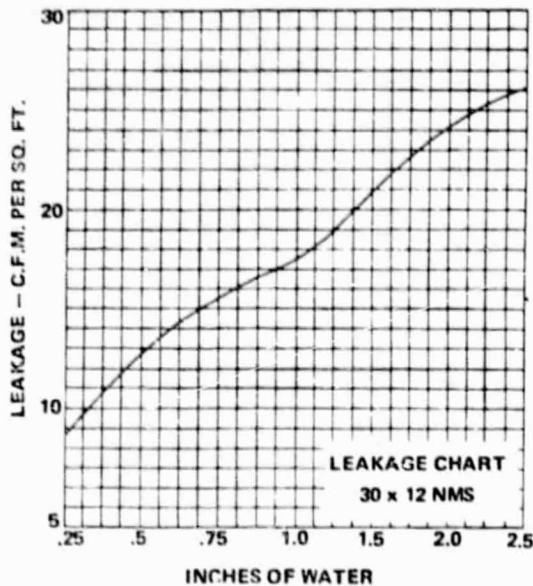
BACKDRAFT DAMPER
 (Non Metallic)

TYPE
NMS

STANDARD CONSTRUCTION

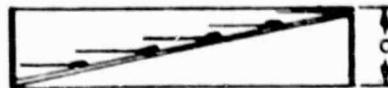
- FRAME:** 16 gage Steel.
BLADES: Vinyl laminated Nylon in Galv. "U" clamp riveted to frame.
REAR GRILL: Flattened expanded Metal.
FINISH: Rust inhibitor coating.
NOTE:
- Damper will be fabricated in 2 or more sections when width or height exceeds 24".
 - Max. velocity 1,200 FPM
 - NMS Not Recommended when exposed to temp. below 40° F.
 Minimum size - 6" x 4"

NOTE! DO NOT USE FOR FAN DISCHARGE.



VERTICAL DAMPER

DAMPER HEIGHT	C
OVER 6" TO & INCL. 12"	2"
13" TO & INCL. 20"	3"
21" TO & INCL. 24"	4"



HORIZONTAL DAMPER

FEATURES

BLADES: Exceptionally strong & tear resistance.
 Virtually Inert—is unaffected by mildew or rot.
 Fire resistant—self extinguishing. Will not support combustion.
 Waterproof—does not absorb moisture. Resists most oils, chemicals & grease.
 Temperature range: 40°F to 190°F.

SUPER-SENSITIVE ACTION: Opens on slightest movement of air.

QUIET: No metallic noises.

SEALS EASILY: For the best back draft protection.

NO MECHANICAL PIVOTS: Means long dependable operations.

OVER 60% FREE AREA.

*Unit furnished approx. 1/8" smaller than given 'opening' dimensions.

QUAN.	TYPE	SIZE		SPECIFY MTG.	
		A-WIDE	B-HIGH	VERT.	HORIZ.
1	NMS	15	14		
2	"	24	18		

JOB

LOCATION

CONTRACTOR

RUSKIN Mfg. Co.

P.O. Box 129

Grandview, Mo. 64030

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RUSKIN

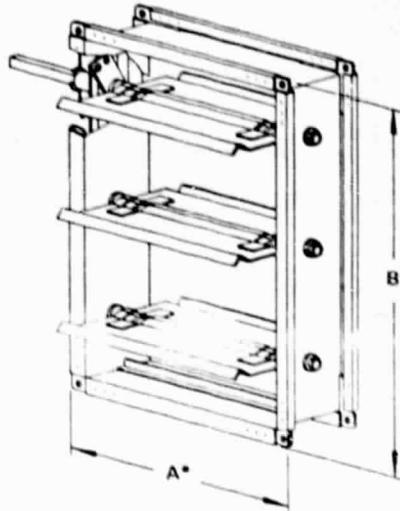
SPEC
NO. MD35-1275
 Replaces MD35-775

MANUAL DAMPER

TYPE
MD 35

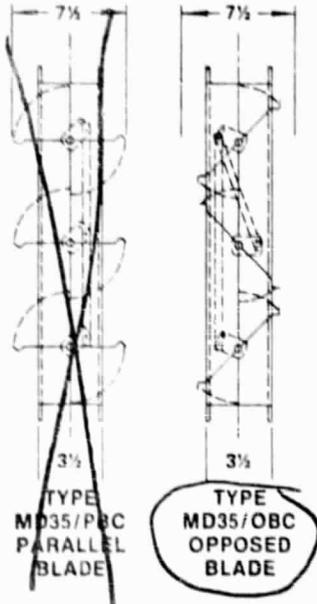
STANDARD CONSTRUCTION

- FRAME:** 3 1/2" x 7/8" 18 ga. galv. steel channel
- BLADES:** 6" width 18 ga. galv. steel on approx. 6" centers.
- LINKAGE:** Concealed in frame.
- BEARINGS:** Cycloloy 800.
- AXLES:** 1/2" Hex.
- CONTROL SHAFT:** 3" x 3/8" sq. plated steel.
- MAXIMUM SIZE:** 48"w x 46"h
- MINIMUM SIZE:** OB-6"w x 11"h (2 blades) PB-6"w x 8"h (1 blade)
- For sizes larger than maximum or smaller than minimum, use Model CD-35.



FEATURES

- STEEL CONSTRUCTION:** "INTER-LOCKING DESIGN" Entire unit locked together without bolts, screws, or rivets to shake loose.
 - BEARINGS:** "Cycloloy 800," non stick and non corrosive, assures long life and ease of operation.
 - LINKAGE** Shake proof. Low maintenance
 - AXLES:** Positively locked to blade. No screws or welds used, will not shake loose.
 - FRAME CORNERS:** Internally braced to reduce racking.
 - CUSTOM TAILORED:** To fit any size opening.
- Standard construction only available.



NOTE:
 For proper operation all dampers must be installed square & free from racking.

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*Unit furnished approx. 1/4" smaller than given "opening" dimensions.

QUAN	TYPE	DIMENSIONS		
		A*	B*	
3	MD-35-OBC	10	10	w/ extended shaft for quadrant.

JOB _____ **LOCATION** _____
CONTRACTOR _____

RUSKIN Mfg. Co. **P.O. Box 129** **Grandview, Mo. 64030**
 © RUSKIN MFG. CO. 1975

RUSKIN

SPEC
NO. IBD2-577
 Replaces IBD2-1076

FIRE DAMPER
CURTAIN TYPE
INTERLOCKING BLADE

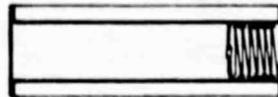
TYPE
IBD2

STANDARD CONSTRUCTION

- FRAME:** 4 1/2" galvanized steel channel.
- BLADES:** Interlocking type galvanized steel.
- ENCLOSURES:** 18 gage steel (Types B, C, CO, & CR).
- FINISH:** Mill galvanized.
- FUSIBLE LINK:** 212°F Standard. 160°F available at no additional cost.
- MOUNTING:** Vertical or Horizontal.



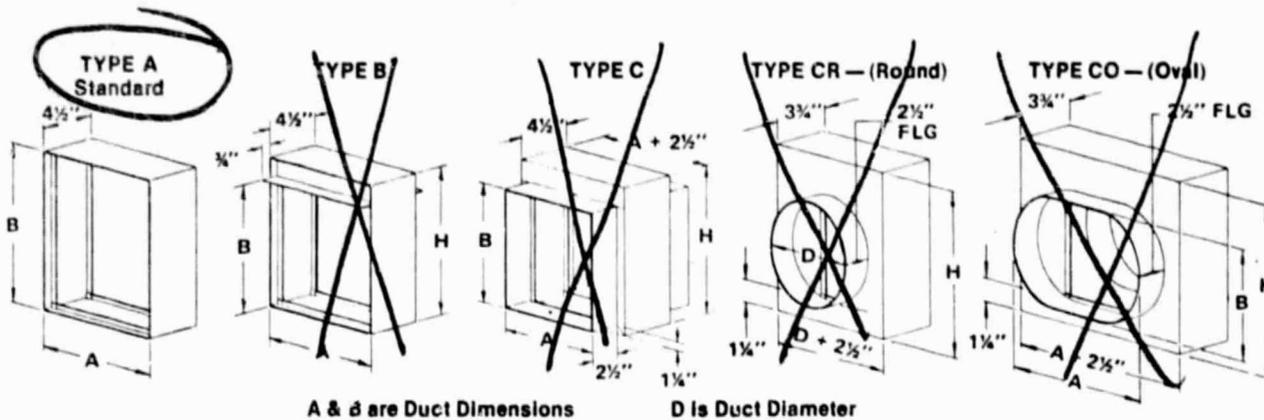
VERTICAL MOUNT



HORIZONTAL MOUNT

FEATURES

Standard model includes 1 1/2 hour UL Fire Damper Label. Approved for use in Fire Partitions with ratings up to 2 hours. Meets all UL and NFPA requirements for PRIMARY FIRE DAMPERS. Gravity operated for Vertical Installation. Available with closure springs and latches for horizontal installation.



NOTE: For overall Frame Dim. on type B, C, CR, & CO see appropriate IBD2 Spec. sheet.

TYPE A & B will be furnished approx. 1/4" less than given duct dims. TYPE C's will be furnished approx. 1/8" less than given duct dims.

QUAN.	MODEL	SIZE		DUCT DIAM.	TYPE					FUSE LINK TEMP	MTG.		UL
		A-WIDE	B-HIGH		A	B	C	CR	CO		V	H	
2	IBD2	26	16		X					212	X	X	
2	"	26	20		X					"	X	X	
1	"	17	16		X					"	X	X	
1	"	16	11		X					"	X	X	

JOB
 CONTRACTOR

LOCATION

RUSKIN Mfg. Co.

P.O. Box 129

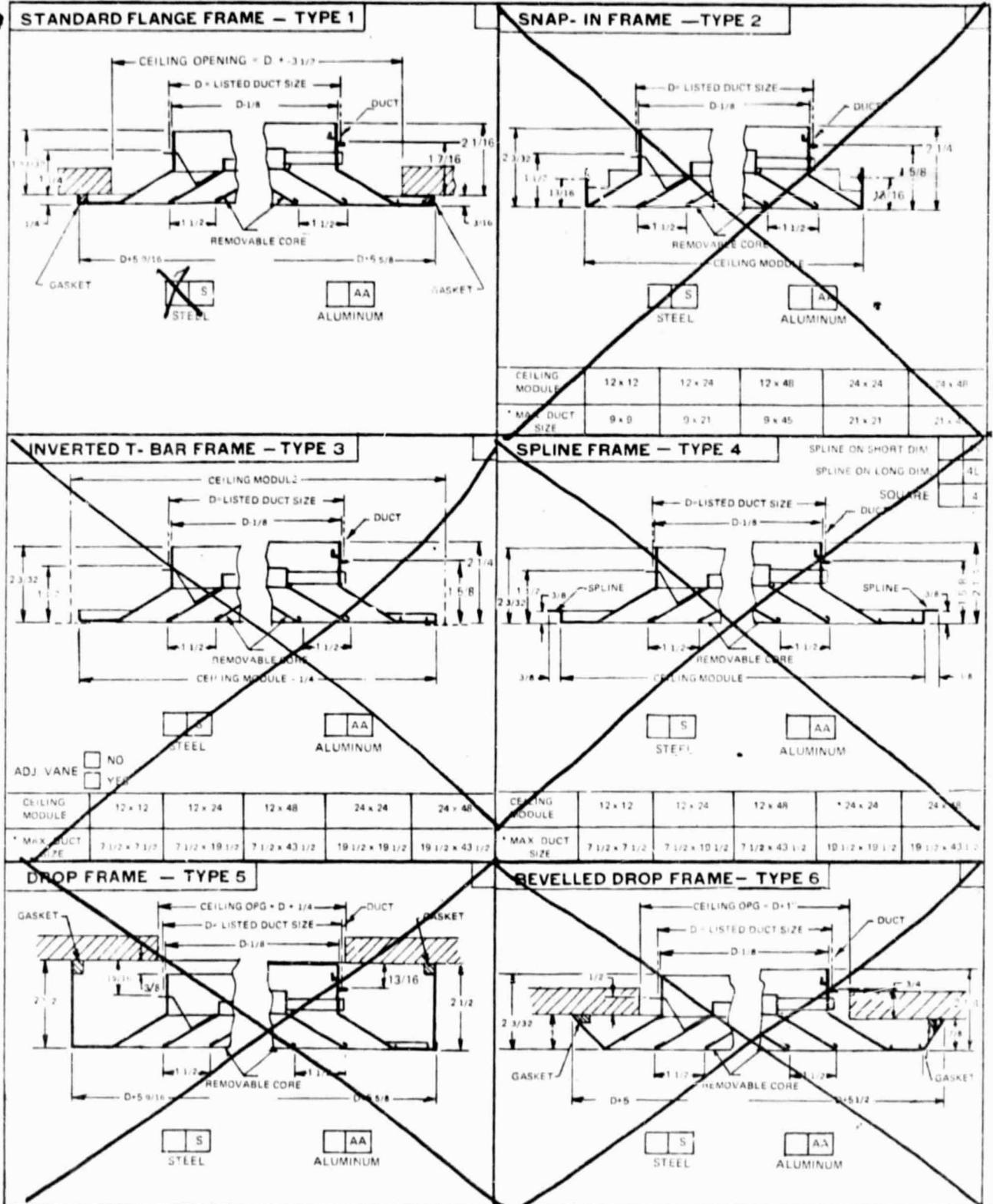
Grandview, Mo. 64030

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TITUS[®]

SUBMITTAL SHEET

MODEL TDC CEILING DIFFUSER



* When module size is more than 3" larger than duct size, the diffuser will be mounted on a module size panel.

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WATERLOO, IOWA 50704

3-75

LITHO IN U.S.A.

Submittal B 83-2

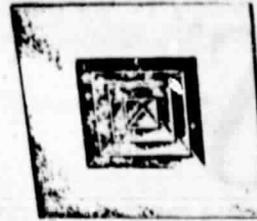
FINISH:



(W-1) BAKED OFF-WHITE ENAMEL
(STD. FOR STEEL)



BAKED ALUMITINT ENAMEL
(ALTERNATE STD. FOR STEEL)
(STD. FOR ALUMINUM)



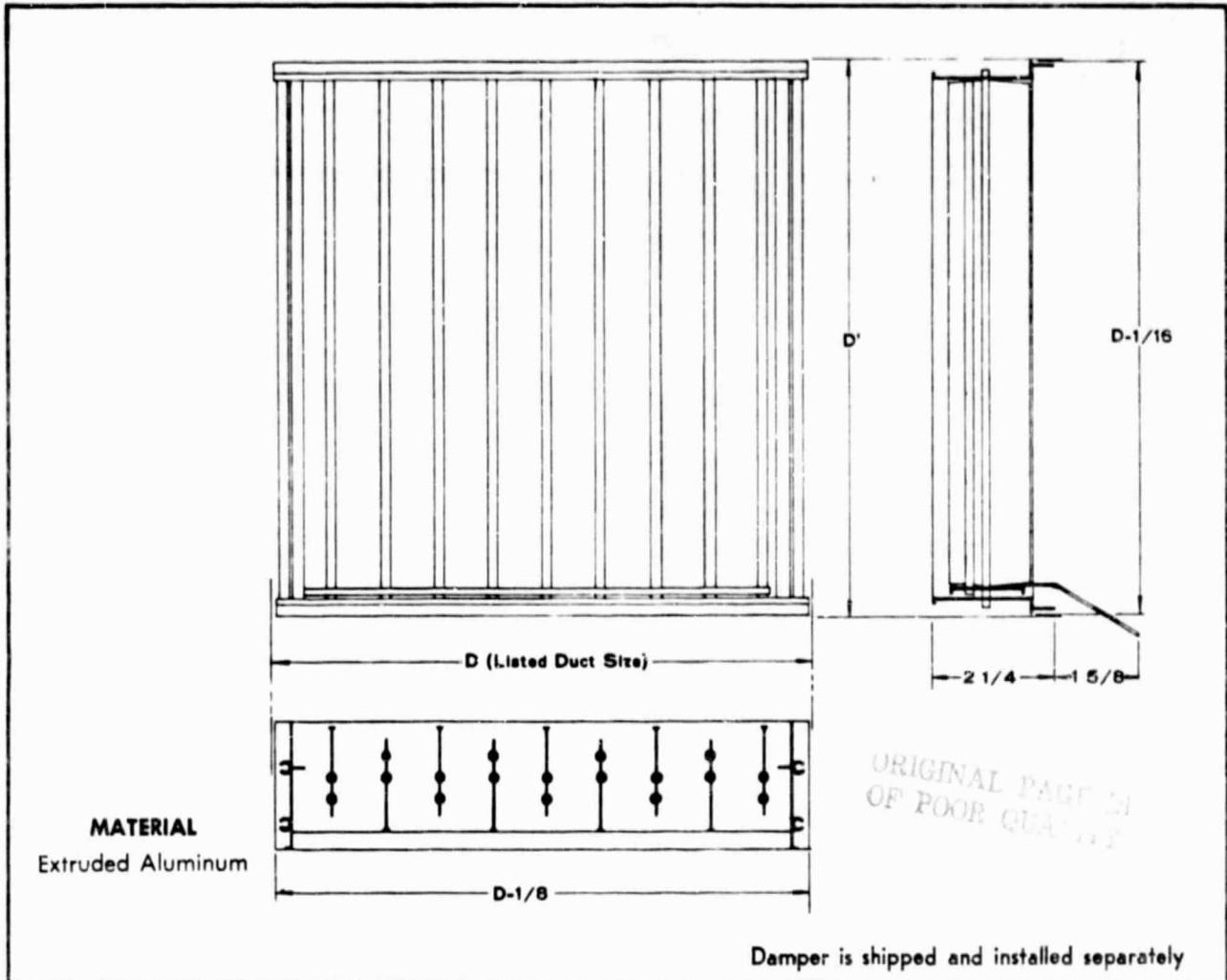
(FRAME TYPES 2, 3, & 4 ONLY)
NOTE: WHEN MODULE SIZE IS MORE THAN
3" LARGER THAN DUCT SIZE, THE DIFFUSER
WILL BE MOUNTED IN A MODULE SIZE PANEL
AS SHOWN IN ABOVE PICTURE.

	<p>□ 1S □ 1A □ 1B</p>	<p>CORE STYLES (PLAN VIEWS)</p>
	<p>□ 2A □ 2S □ 2B</p>	<p>NOTES</p> <ol style="list-style-type: none"> 1. Dimensions listed are duct size multiples. 2. All X & Y dimensions must be specified if not specified on core styles 4E & 3C cores will be sized to provide the flow shown in catalog.
	<p>□ 2C □ 2D □ 2E □ 2F □ 2G</p>	
	<p>□ 3A (B IS EQUAL TO OR GREATER THAN A)</p> <p>□ 3A2 (B IS LESS THAN 'A' BUT GREATER THAN A/2)</p> <p>□ 3B (B = A/2)</p> <p>□ 3C</p> <p>□ 3D</p> <p>□ 3E (B IS LESS THAN A/2)</p>	
	<p>□ 4A □ 4B □ 4C □ 4D</p> <p>□ 4E □ 4F □ 4G</p>	

TITUS

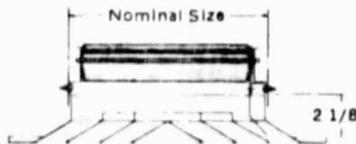
SUBMITTAL SHEET

MODEL AG-95 Opposed Blade Damper for TDC, TXS and TXR

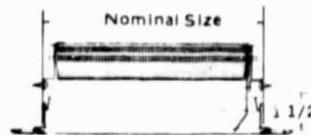


APPLICATIONS

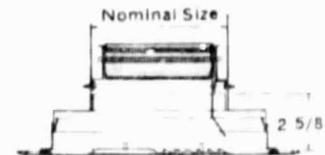
AG-95 used with TDC



AG-95 used with TXR



AG-95 used with TXS



TITUS MANUFACTURING CORPORATION

12-74

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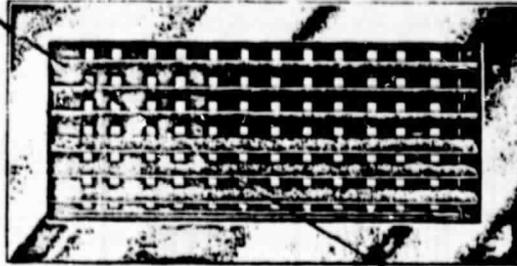
WATERLOO, IOWA 50704

Submittal B-128-1

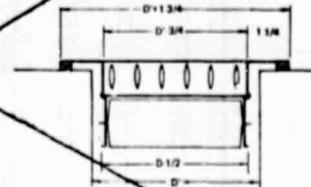
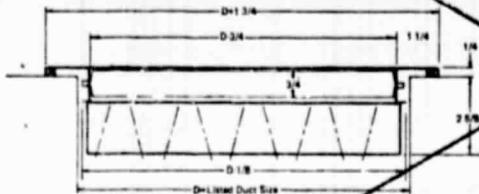
REV E

Apply Registers

(STEEL) Core Styles 271 & 272

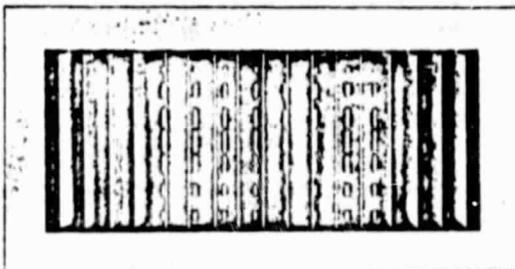


- Model 271-RL-5** One set of AIRFOIL LOUVERS parallel to long dimension and individually adjustable to any degree of deflection in the vertical plane.
- Model 271-RS-5** One set of AIRFOIL LOUVERS parallel to short dimension and individually adjustable to any degree of deflection in the horizontal plane.

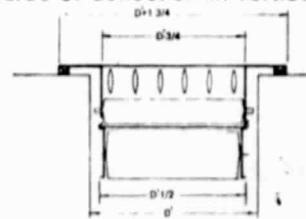
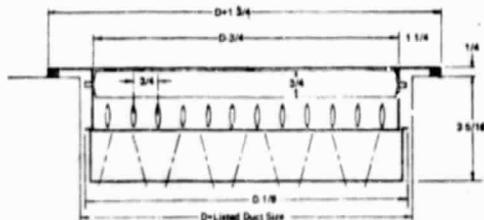


LOUVERS: One set of individually adjustable AIRFOIL louvers. Extruded aluminum — solid section.
LOUVER DEPTH: 3/4". Assures positive air deflection.
DAMPER: Opposed Blade. Opposed acting blades are always parallel to short dimension and operated by standard screwdriver.

FINISH: Baked Aluminum Enamel.
GASKET: Polyurethane Foam
SIZES: Stocked in many standard sizes. Any size made to order.
BORDER: Cold Rolled Steel



- Model 272-RL-5** Two sets of AIRFOIL LOUVERS. Front set parallel to long dimension and individually adjustable to any degree of deflection in vertical plane. Second set parallel to short dimension and individually adjustable to any degree of deflection in the horizontal plane.
- Model 272-RS-5** Two sets of AIRFOIL LOUVERS. Front set parallel to short dimension and individually adjustable to any degree of deflection in horizontal plane. Second set parallel to long dimension and individually adjustable to any degree of deflection in vertical plane.



LOUVERS: Two sets of individually adjustable Airfoil louvers. Extruded aluminum — solid section.
LOUVER DEPTH: 3/4" Assures positive air deflection.
DAMPER: Opposed blade. Screwdriver operated from face of register

BORDER: cold-rolled steel.
FINISH: Baked Aluminum Enamel.
GASKET: Polyurethane Foam

TITUS

SUBMITTAL SHEET

Steel Return Grilles

<p>Finish: Baked Aluminum Enamel.</p>	<p><input type="checkbox"/> MODEL 23-RL Features one set of fixed blades parallel to long dimension.</p> <p><input type="checkbox"/> MODEL 23-RS Features one set of fixed blades parallel to short dimension.</p> <p><input type="checkbox"/> Model 13-RL Same as above except 0° deflection.</p> <p><input type="checkbox"/> Model 13-RS Same as above 0° deflection</p> <p>Border — 20 Gage Blades — 22 Gage</p> <p>Countersunk screw holes for No. 8 SMS per factory Standard.</p>
<p>Finish: Baked Aluminum Enamel.</p>	<p><input checked="" type="checkbox"/> MODEL 25-RL Features one set of fixed blades parallel to long dimension.</p> <p><input checked="" type="checkbox"/> MODEL 25-RS Features one set of fixed blades parallel to short dimension.</p> <p><input checked="" type="checkbox"/> Model 15-RL Same as above except 0° deflection.</p> <p><input checked="" type="checkbox"/> Model 15-RS Same as above except 0° deflection.</p> <p>Border — 20 Gage Blades — 22 Gage</p> <p>Countersunk screw holes for No. 8 SMS per factory Standard.</p>
<p>HEAVY DUTY GYM GRILLE</p> <p>Countersunk screw holes for No. 8 SMS per factory Standard.</p>	<p><input type="checkbox"/> MODEL 30-GL Features one set of fixed blades parallel to long dimension.</p> <p><input type="checkbox"/> MODEL 30-GS Features one set of fixed blades parallel to short dimension.</p> <p><input type="checkbox"/> Model 33-GL Same as above except 30° deflection & 1/2" blade spacing</p> <p><input type="checkbox"/> Model 33-GS Same as above except 30° deflection & 1/2" blade spacing</p> <p><input type="checkbox"/> Model 34-GL Same as above except 45° deflection & 1/2" blade spacing</p> <p><input type="checkbox"/> Model 34-GS Same as above except 45° deflection & 1/2" blade spacing</p> <p>Border — 16 Gage Blades — 14 Gage</p> <p>Finish: Baked Aluminum Enamel.</p> <p>Support Bars on 6" Centers.</p>
<p>PERFORATED RETURN</p>	<p>FACE</p> <p><input type="checkbox"/> MODEL 8-F Features a steel perforated plate mounted in an extruded aluminum frame. Finish: #25-(W-1) Baked Off-White Enamel.</p> <p>Countersunk screw holes for No. 8 SMS per factory Standard.</p>

TITUS MANUFACTURING CORPORATION

WATERLOO, IOWA 50704

1-74

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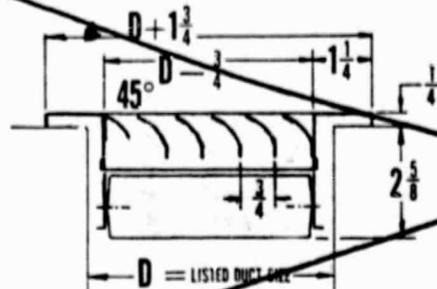
Submittal C-35-4

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TITUS[®]

Steel Return Registers

SUBMITTAL SHEET



Finish: Baked Aluminum Enamel.

MODEL 23-RL5

Features one set of fixed blades parallel to long dimension and an attached opposed blade damper.

MODEL 23-RS5

Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

Model 13-RL5

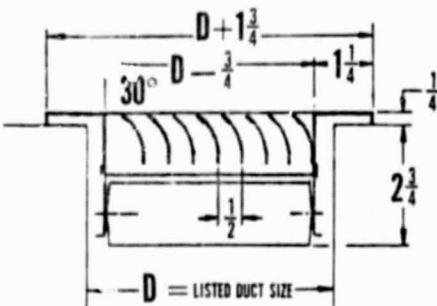
Same as above except 0° deflection.

Model 13-RS5

Same as above except 0° deflection.

Border - 20 Gage
Blades - 22 Gage

Countersunk screw holes for No. 8 SMS per factory Standard.



Finish: Baked Aluminum Enamel.

MODEL 25-RL5

Features one set of fixed blades parallel to long dimension and an attached opposed blade damper.

MODEL 25-RS5

Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

Model 15-RL5

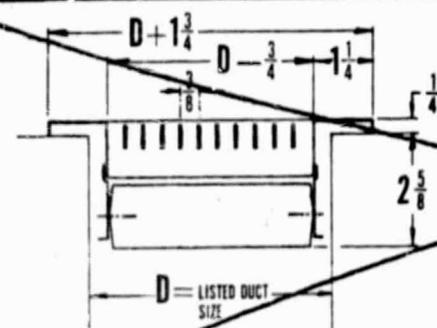
Same as above except 0° deflection.

Model 15-RS5

Same as above except 0° deflection.

Border - 20 Gage
Blades - 22 Gage

Countersunk screw holes for No. 8 SMS per factory Standard.



HEAVY DUTY GYM REGISTER

Finish: Baked Aluminum Enamel.

MODEL 30-GL5

Features one set of fixed blades parallel to long dimension and an attached opposed blade damper.

MODEL 30-GS5

Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

Model 33-GL5

Same as above except 30° deflection & 1/2" blade spacing

Model 33-GS5

Same as above except 30° deflection & 1/2" blade spacing

Model 34-GL5

Same as above except 45° deflection & 1/2" blade spacing

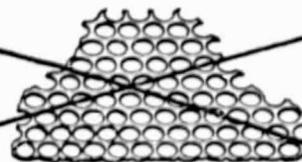
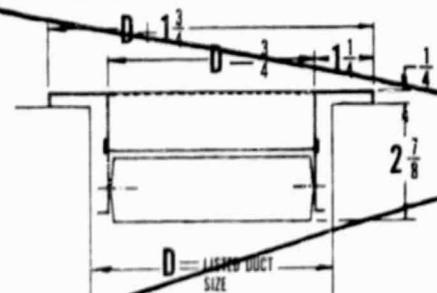
Model 34-GS5

Same as above except 45° deflection & 1/2" blade spacing

Borders - 16 Gage
Blades - 14 Gage

Countersunk screw holes for No. 8 SMS per factory Standard.

Support Bars on 6" Centers



FACE

MODEL 8-F5

Features a steel perforated plate mounted in an extruded aluminum frame and an attached opposed blade damper. Finish: 25-(W-1) Baked Off-White Enamel.

Countersunk screw holes for No. 8 SMS per factory Standard.

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WATERLOO, IOWA 50704

Submittal C-35-5

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SUBMITTAL SHEET

Aluminum Return Registers

	<input type="checkbox"/> MODEL 3-FL5 Features one set of fixed blades parallel to long dimension and an attached opposed blade damper. <input type="checkbox"/> Model 56-FL5 Same as above except 0° deflection.	<input type="checkbox"/> MODEL 3-F55 Features one set of fixed blades parallel to short dimension and an attached opposed blade damper. <input type="checkbox"/> Model 56-F55 Same as above except 0° deflection.
Finish: Baked Aluminint Enamel.		
Countersunk screw holes for No. 8 SMS per factory Standard.		
	<input checked="" type="checkbox"/> MODEL 4-FL5 Features one set of fixed blades parallel to long dimension and an attached opposed blade damper. <input type="checkbox"/> Model 55-FL5 Same as above except 0° deflection.	<input type="checkbox"/> MODEL 4-F55 Features one set of fixed blades parallel to short dimension and an attached opposed blade damper. <input type="checkbox"/> Model 55-F55 Same as above except 0° deflection.
Finish: Baked Aluminint Enamel.		
Countersunk screw holes for No. 8 SMS per factory Standard.		
	<input type="checkbox"/> MODEL 50-F5 Features 1/2 x 1/2 x 1/2 fabricated aluminum louvers, and an attached opposed blade damper. <input type="checkbox"/> Model 52-F5 1/2 x 1/2 x 1 Aluminum Louvers	<input type="checkbox"/> Model 51-F5 1/2 x 1/2 x 1/2 Plastic Louvers
Finish: Baked Aluminint Enamel.		
Countersunk screw holes for No. 8 SMS per factory Standard.		
	<input type="checkbox"/> MODEL 10-F5 Features 1 x 1 x 1 fabricated aluminum louvers and an attached opposed blade damper. <input type="checkbox"/> Model 10-F5 Features 1 x 1 x 1 fabricated aluminum louvers and an attached opposed blade damper.	<input type="checkbox"/> MODEL 10-F5 Features 1 x 1 x 1 fabricated aluminum louvers and an attached opposed blade damper. <input type="checkbox"/> Model 10-F5 Features 1 x 1 x 1 fabricated aluminum louvers and an attached opposed blade damper.
Finish: Baked Aluminint Enamel.		
Countersunk screw holes for No. 8 SMS per factory Standard.		

TITUS MANUFACTURING CORPORATION

Litho In U.S.A.

WATERLOO, IOWA 50704

TITUS[®]

SUBMITTAL SHEET

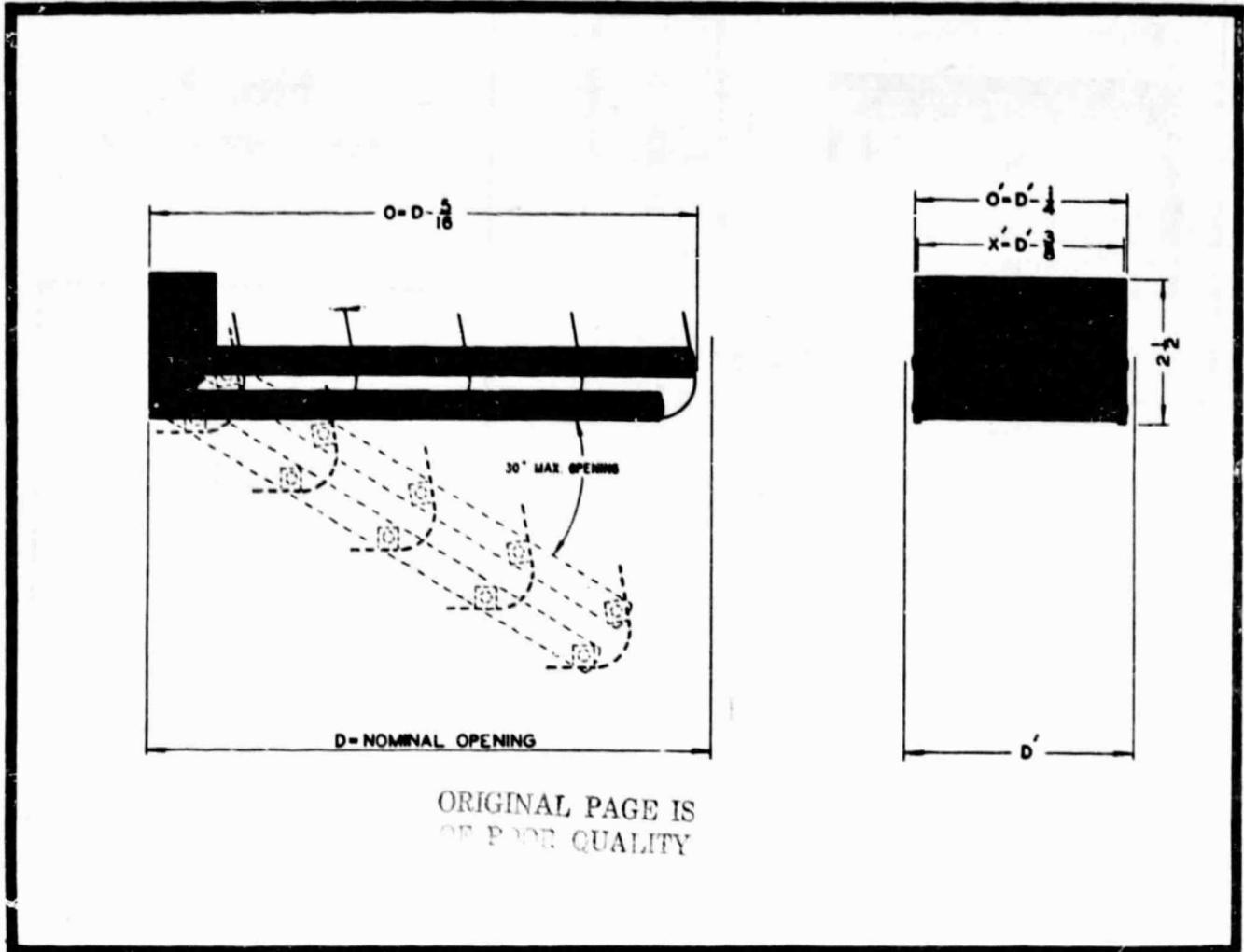
Aluminum Return Grilles

	<input type="checkbox"/> MODEL 3-FL Features one set of fixed blades parallel to long dimension. 45° deflection. <input type="checkbox"/> Model 56-FL Same as above except 0° deflection.	<input type="checkbox"/> MODEL 3-FS Features one set of fixed blades parallel to short dimension. 45° deflection. <input type="checkbox"/> Model 56-FS Same as above except 0° deflection.
Finish: Baked Alumitint Enamel. Countersunk screw holes for No. 8 SMS per factory Standard.		
	<input checked="" type="checkbox"/> MODEL 4-FL Features one set of fixed blades parallel to long dimension. 45° deflection. <input type="checkbox"/> Model 55-FL Same as above except 0° deflection.	<input type="checkbox"/> MODEL 4-FS Features one set of fixed blades parallel to short dimension. 45° deflection. <input type="checkbox"/> Model 55-FS Same as above except 0° deflection.
Finish: Baked Alumitint Enamel. Countersunk screw holes for No. 8 SMS per factory Standard.		
		<input type="checkbox"/> MODEL 50-F Features 1/2 x 1/2 x 1/2 fabricated aluminum louvers. Provides maximum free area with minimum see-thru. Finish: Baked Alumitint Enamel. Countersunk screw holes for No. 8 SMS per factory Standard.
Model 51-F 1/2 x 1/2 x 1/2 Plastic Louver	Model 52-F 1/2 x 1/2 x 1 Aluminum Louver	
		<input type="checkbox"/> MODEL 10-F Features 1 x 1 x 1 fabricated aluminum louvers. Provides maximum free area with minimum see-thru. Finish: Baked Alumitint Enamel. Countersunk screw holes for No. 8 SMS per factory Standard.

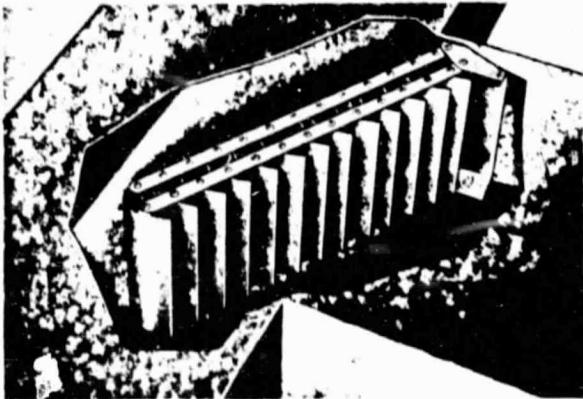
TITUS

SUBMITTAL SHEET

Model AG-45 & AG-225 AIR VOLUME EXTRACTOR AND CONTROLLER



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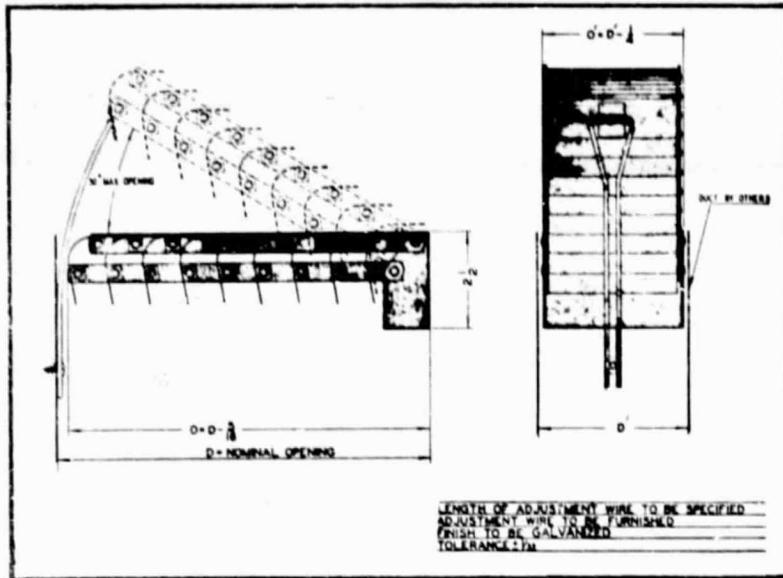


- AG-45 — TURNING VANES ON 1" CENTERS
- AG-225 — TURNING VANES ON 2" CENTERS

Gang-operated blades are fully adjustable from wide open to completely closed positions to control air direction and volume. Provides even air distribution to diffuser face.

Factory assembled, installs with 2 screws. Three types of operators available. . . . SEE REVERSE SIDE.

OPERATORS

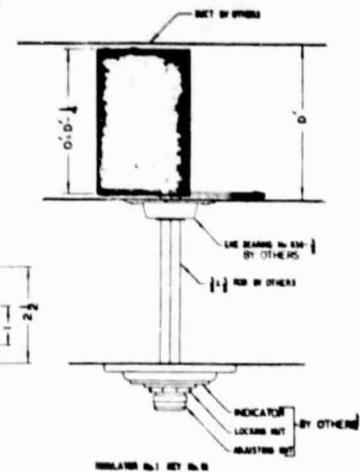
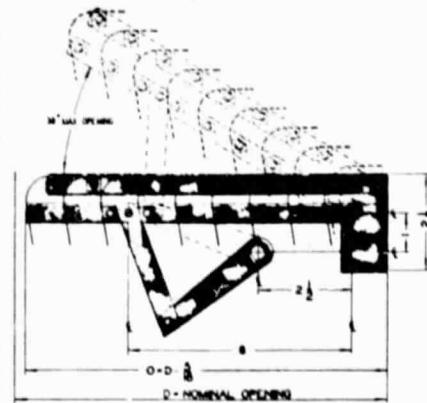


No. 1

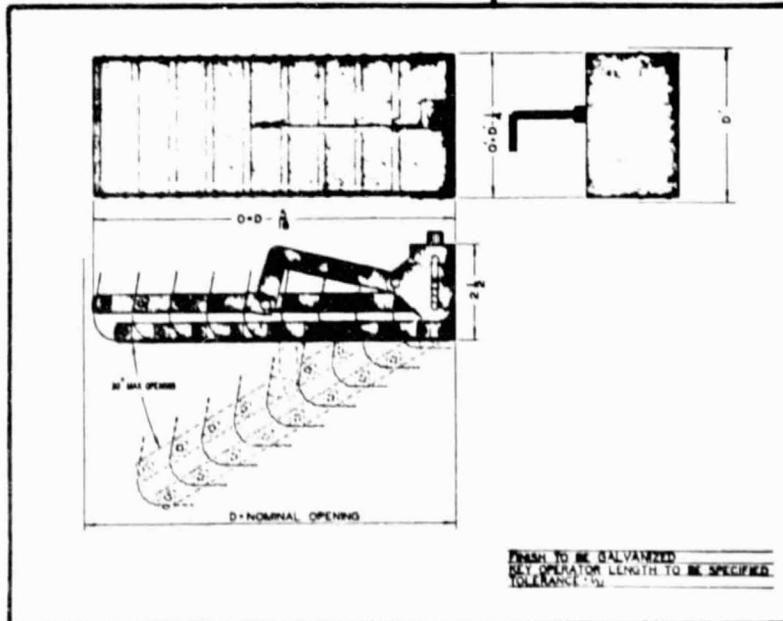
MANUAL ADJUSTING LEVER furnished at no extra cost if specified.

No. 2

Adaptor for regulator control for operation from a knob located at ceiling.



REGULATOR END BEARING TO BE FURNISHED BY OTHERS
FINISH TO BE GALVANIZED
TOLERANCE +/-



No. 3

Key operated mechanism for operation through face of grille. Full adjustment possible without removing face of grille.

TITUS MANUFACTURING CORPORATION

WATERLOO, IOWA 50704

Submittal E-33-1

Rev. B

**AIR HANDLING
UNIT #2 AND #3**

LOREN COOK COMPANY
 SPRINGFIELD, MISSOURI BERA, OHIO

TN-3

SPECIFICATION SHEET

JOB Fire Station #24
Kansas City, MO

DATE 1/27/78 PAGE _____ OF _____
 CUSTOMERS ORDER NO. 17589

ARCHITECT _____

ENGINEER _____

APPROVED BY _____

APPROVED BY _____

CONTRACTOR Truog Nichols

SUBMITTED BY Loren Cook Company

APPROVED BY Kansas City, MO

Springfield, MO

QTY.	MARK NO.	CATALOG NO.	UNIT TYPE	MTR. HP	FAN RPM	PH	CY	VOLT	CFM	SP	Disconnect Switch	Bird Screen	Automatic Louver	Motorized Louver	Belt Guard	Vib Base	Sprg Hangers	Vane Inlet
1	AHU-2	21CH	CH	2	1380	3	60	208	4300	1 1/2					X	X		X
1	AHU-3	24CV	CV	2 2	1270	3	60	208	5000	2 1/2 2 1/4					X	X		
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> <p>DATE: <u>4/13/78</u></p> <p>BY: <u>DAB</u></p> <p><input type="checkbox"/> NO EXCEPTIONS TAKEN</p> <p><input checked="" type="checkbox"/> MAKE CORRECTIONS NOTED</p> <p><input type="checkbox"/> APPROVED AND RESUBMIT</p> <p><input type="checkbox"/> REJECTED - SEE REMARKS</p> <p>NOTE: REVIEW DOES NOT BELIEVE THE CONTRACTOR FROM ANY RESPONSIBILITY FOR ERRORS OR DEVIATIONS FROM THE CONTRACT REQUIREMENT OR FOR ANY DEFICIENCIES OF EQUIPMENT, WORK OR MATERIALS.</p> </div>																		
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> <p>SHOP DRAWING REVIEW</p> <p>Midway Street, Leassey Fickel and Scott Architects Inc. 20 West 5th St. Kansas City, Missouri 64105</p> <p>Return for review 21 days from date of receipt of shop drawings. 30 days for final approval of shop drawings.</p> <p>Approved: _____ Rejected: _____ See Remarks: _____ Date: _____</p> </div>																		

When U.L. listing is required, add a U after the UNIT TYPE. When C.S.A. listing is required, add a C after the UNIT TYPE.

NOTES:

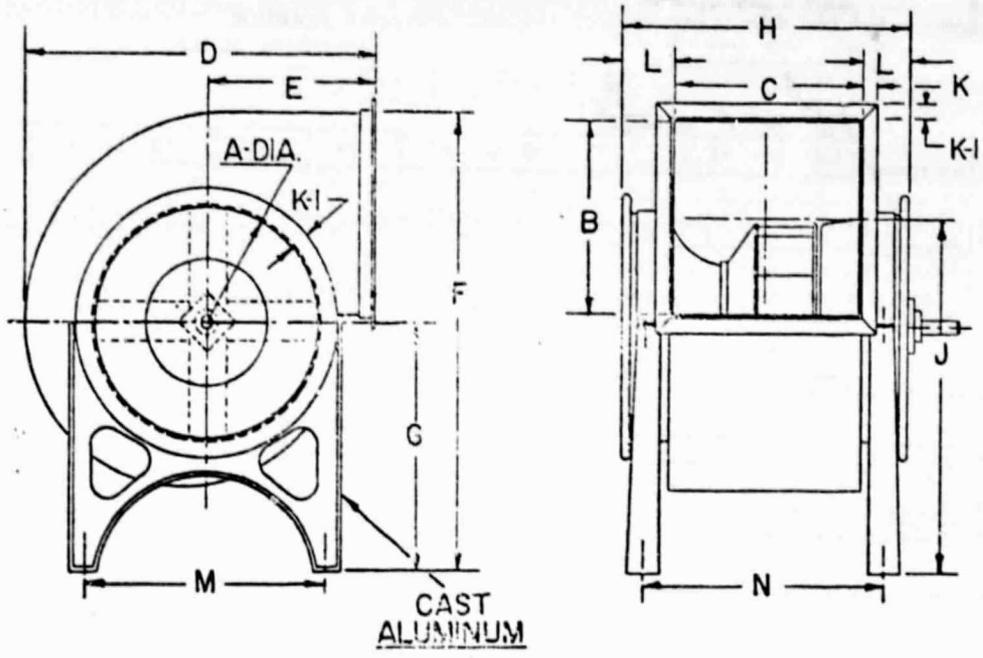
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LOREN COOK COMPANY
 SPRINGFIELD, MISSOURI BEREA, OHIO

TYPE CH- CENTRIFUGAL BLOWERS
SINGLE WIDTH-SINGLE INLET

CLASS I

CLASS II



AHU-2

DIMENSION DATA

Size	A Dia. I.D.	"B" I.D.	"C" I.D.	D	E	F	G	H	J	K	K-1	L	M	N	Shaft Size	Mat'l.	Net Wt. Lbs.	Shipping Wt. Lbs.
12	12-5/8	11-1/8	10-3/4	18-7/8	9-1/16	25-1/4	13-3/4	12	19-7/16	1-1/2	1-1/2	3-5/8	13-3/8	17	3/4	.081	33	60
15	15-5/8	13-3/4	13-1/2	24-5/8	12-1/4	31-3/8	17	20-3/4	21-1/4	1-1/2	1-1/2	3-5/8	17	18-3/4	3/4	.081	37	115
18	18-5/8	16-1/2	16-1/4	29-5/16	14-1/8	38-11/16	21-1/2	23-1/2	30-3/8	1-1/2	1-1/2	3-5/8	20	21-1/2	1-1/4	.090	100	196
21	22	19-1/4	18-7/8	34	16-5/16	45-1/16	25	25-1/8	35-5/16	1-1/2	1-1/2	3-5/8	22-7/8	25	1-1/4	.090	132	242
24	25	22	21-1/2	33-3/4	18-9/16	42-15/16	20	23-3/4	31-13/16	1-1/2	1-1/2	3-5/8	25-7/8	27-3/4	1-1/4	.100	157	284
27	28	24-3/4	24-1/4	43-5/8	20-13/16	48-3/16	22-1/4	30-3/4	35-11/16	1-1/2	1-3/4	4-1/4	29	31-3/4	1-7/16	.100	198	363
30	31	27-1/2	27	47-3/16	21-15/16	53-1/16	24-5/8	33-1/2	39-3/16	1-1/2	1-3/4	4-1/4	31	35	1-7/16	.125	258	445
36	37	33	32-3/8	56-1/2	26-3/16	63-1/8	28-3/4	41	46-7/16	1-1/2	1-3/4	4-5/16	37	40-1/2	1-15/16	.190	416	685
42	43	38-1/2	37-3/4	66-1/16	30-11/16	73-1/4	33-1/8	43-3/8	53-13/16	2	1-3/4	4-5/16	43-1/2	43-3/8	2-3/16	.190	625	965
48	49	44	43-1/8	75-1/2	35-1/16	83-5/16	37-1/2	51-3/4	61-1/8	2	1-3/4	4-5/16	49-1/2	48-3/4	2-7/16	.190	840	1250

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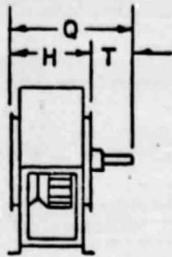
REVISED DRAWING 1/11/72

CH-I-A

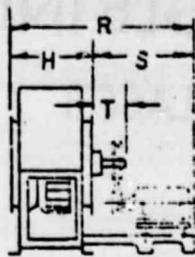
TYPE CH- CENTRIFUGAL BLOWERS ENGINEERING DATA

Note: Please specify rotation & Discharge on approved submittals

AHU-2



DRIVE ARRANGEMENTS FOR CENTRIFUGAL FANS



UNIT	Q	R	H	S	T
12	24	32	18	14	6
15	27-1/4	36-3/4	20-3/4	16	6-1/2
18	29	43-1/2	23-1/2	20	5-1/2
21	31-5/8	49-1/8	26-1/8	23	5-1/2
24	34-1/2	53-3/4	28-3/4	25	5-3/4
27	36-3/4	58	32-3/4	25-1/4	6
30	41-3/4	61	35-1/2	25-1/2	6-1/4
36	48-1/4	68-3/4	41	27-3/4	7-1/4
42	55-7/8	76-7/8	46-3/8	30-1/2	9-1/2
48	61-1/4	83-3/4	51-3/4	32	9-1/2

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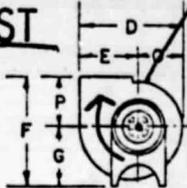
ARR. 1 SWSI Standard
For belt drive. Wheel over-
hung, two bearings.

ARR. 9 SWSI Optional
For belt drive. Wheel over-
hung. Two bearings with
prime mover outside base.

MOTOR BASE ASSEMBLY

ARR. 9
MAXIMUM 25 H.P.

UPBLAST



UNIT	12	15	18	21	24	27	30	36	42	48
D	20-1/4	25-3/8	30-1/2	35-1/2	40-3/8	45-1/2	50-1/2	60-5/8	70-3/4	81
O	8-3/4	11	13-1/4	15-3/8	17-1/2	19-3/4	21-7/8	26-1/4	30-5/8	35-1/8
E	11-1/2	14-3/8	17-1/4	20-1/8	22-7/8	25-3/4	28-5/8	34-3/8	40-1/8	45-7/8
F	22-1/2	29	35-3/8	41-3/8	44	49-1/4	53-1/8	63-1/8	73-3/8	83-3/8
P	8-3/4	12	15-1/8	18-5/8	20-7/8	22	26-1/4	30-3/4	35-1/8	
G	13-3/4	17	21-1/2	25	28-3/8	31-1/8	36-7/8	42-5/8	48-1/4	

DOWNBLAST



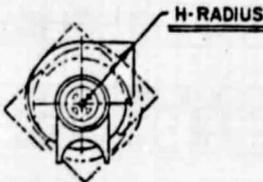
UNIT	12	15	18	21	24	27	30	36	42	48
D	20-1/4	25-3/8	30-1/2	35-1/2	40-3/8	45-1/2	50-1/2	60-5/8	70-3/4	81
O	8-3/4	11	13-1/4	15-3/8	17-1/2	19-3/4	21-7/8	26-1/4	30-5/8	35-1/8
E	11-1/2	14-3/8	17-1/4	20-1/8	22-7/8	25-3/4	28-5/8	34-3/8	40-1/8	45-7/8
F	22-7/8	29	35-3/8	42-3/4	40-1/4	45-1/8	49-5/8	59-1/8	68-1/2	78
P	10-1/2	15	19-1/4	17-3/4	20-1/4	22-7/8	25-1/4	30-3/8	35-3/8	40-1/2
G	13-3/4	17	21-1/2	25	20	22-1/4	24-3/8	28-3/4	33-1/8	37-1/2

BOTTOM
HORIZONTAL



UNIT	12	15	18	21	24	27	30	36	42	48
D	13-7/8	21	28-3/8	34-1/8	38-7/8	43-3/4	47-1/4	56-5/8	66-1/8	75-5/8
O	10-1/8	12-5/8	15-1/4	17-3/4	20-1/4	22-7/8	25-1/4	30-3/8	35-3/8	40-1/2
E	8-3/4	12	14-1/8	16-3/8	18-5/8	20-7/8	22	26-1/4	30-3/4	35-1/8
F	22-1/2	29	35-3/8	40-3/8	42-7/8	48-1/8	53	63-1/8	73-1/4	83-3/8
P	8-3/4	11	14-1/4	15-3/8	17-1/2	19-3/4	21-7/8	26-1/4	30-5/8	35-1/8
G	13-3/4	17	21-1/2	25	25-3/8	28-3/8	31-1/8	36-7/8	42-5/8	48-1/4

H-RADIUS



UNIT SIZE	12	15	18	21	24	27	30	36	42	48
H RADIUS	15-3/4	21-5/8	23-1/2	27-1/8	31-5/8	34-1/2	37-3/8	44-1/2	52-1/4	59-3/8

SPECIFICATION DATA

Furnish and install Cook type CH (SWSI) centrifugal blower, airfoil design. Fan Housing shall be all aluminum of the gauge specified with the manufacturer for the size unit specified. Housing will be bolted throughout with the spun aluminum venturi inlet bolted to the housing for access to the wheel. Blower wheel shaft will be stainless steel.

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Blower wheel shall be all aluminum with extruded airfoil blades and cast aluminum back plate having an integral hub. Housing assembly will be supported on cast aluminum legs as shown on the drawing.

Split ring mounting bracket shall be an integral part of the blower to permit the blower housing to be rotated into any desired position (360 degree rotation) by loosening four bolts located at the support brackets to properly line up the discharge with the existing duct work.

Each unit shall be licensed by AMCA to bear the certified rating seal. Fan speed and horsepower shall be as shown on the drawing.

CERTIFIED
RATING

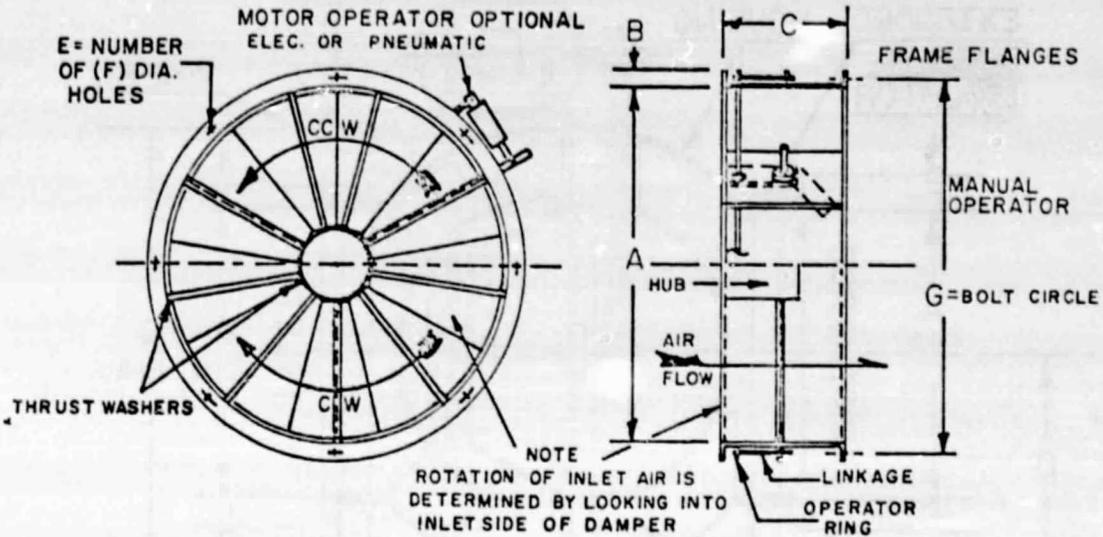
Loren Cook Company certifies that the Type CH Blowers shown herein have been tested, and rated, in accordance with the applicable AMCA Standard Test Method and the AMCA Rating Program and are licensed to bear the AMCA Certified Rating Seal. Performance shown is for Type CH Blowers. Blower Outlet duct. The AMCA Certified Rating Seal is a mark of certification.



The Type CH blower shown here has been tested and rated by the American Standards Association, Inc. in accordance with the AMCA Standard Test Method and the AMCA Rating Program. When the blower is tested, it shall be tested in accordance with the AMCA Standard Test Method and the AMCA Rating Program.

INLET VANE DAMPER

FOR
CH, DCH-3, TSC, TDSC
12-48 18-73

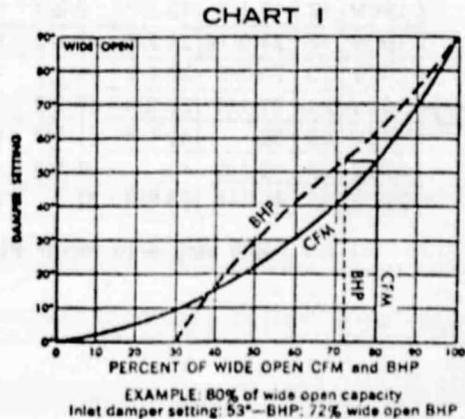


SIZE	A	B	C	E	F	G	TR
12	12-5/8	1 1/4	9	8	7/16	14-1/8	2.18
15	15-5/8	1 1/4	9	8	7/16	17-1/8	3.33
18	18-5/8	1 1/4	9	8	7/16	20-7/8	4.73
21	22	2	9	8	7/16	24-1/4	6.58
24	25	2	9	16	7/16	27-1/4	8.52
27	28	2	9	16	7/16	30-1/4	10.69
30	31	2	9	16	7/16	33-1/4	13.10
33	34	2	9	16	7/16	36-1/4	15.38
36	37	2	9	16	7/16	39-1/4	17.67
42	43	2	10	16	7/16	45-1/4	25.21
48	49	2	10	16	7/16	51-1/4	32.74
54	58	2	10	16	7/16	60	45.87
60	64	2	10	16	7/16	66	55.85
66	70	2	11	16	7/16	72	66.82
73	77	2	12	16	7/16	79	80.35

AHU-2

Torque Requirement:
 TR = 2.5 in. lb./sq. ft.

STD. CONSTRUCTION
 Frame .125 Alum., Hub .125 Alum., Blades .100 Alum., Axles 1/2 Dia. Alum., Blade - Axle - Bearings - Thrust Washers - St'l Steel, Operator Ring 5/16 Dia. Zinc Plated Steel, Operator Linkage St'l Steel.



Note: Custom Plotted Performance Data for Inlet Vane Damper Equipped Fans may be obtained upon request. Please state fan type, size, arrangement, desired point of operation (S.P. & C.F.M.) or Fan R.P.M. when custom I.V.D./Fan plots are requested.

LOREN COOK COMPANY

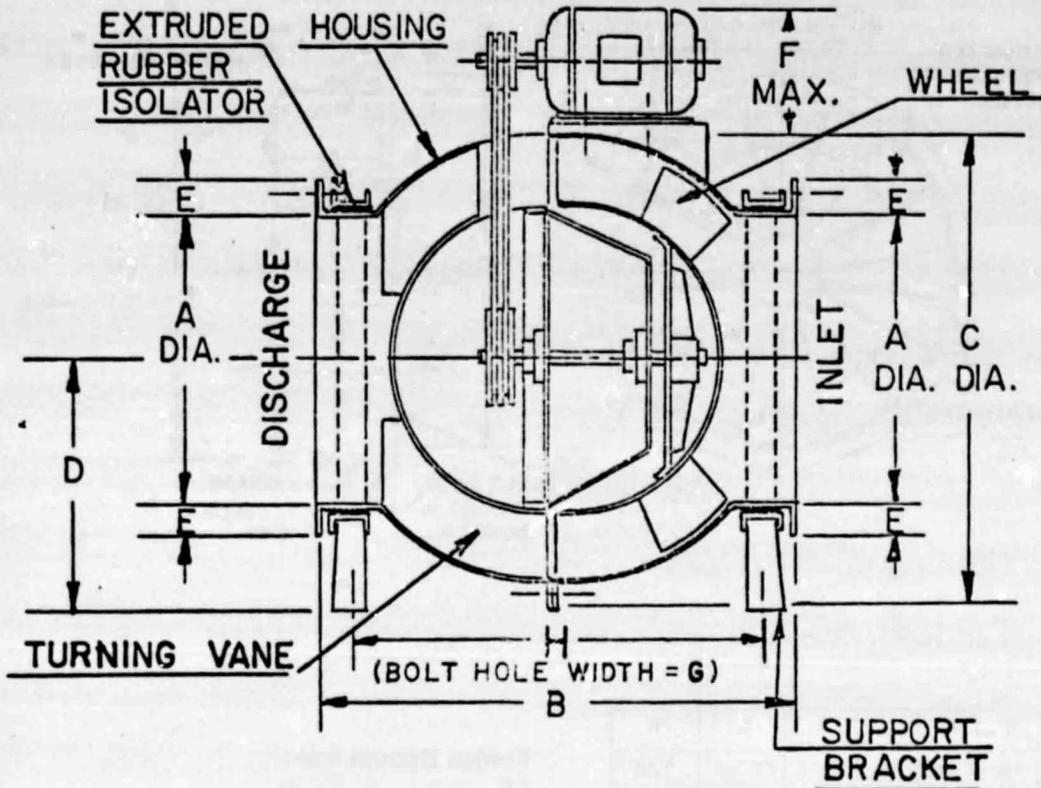
SPRINGFIELD, MISSOURI

BEREA, OHIO

TYPE CV STRAIGHT THRU CENTRIFUGAL BLOWER

CENTRI-VANE

BELT DRIVE



DIMENSION CHART

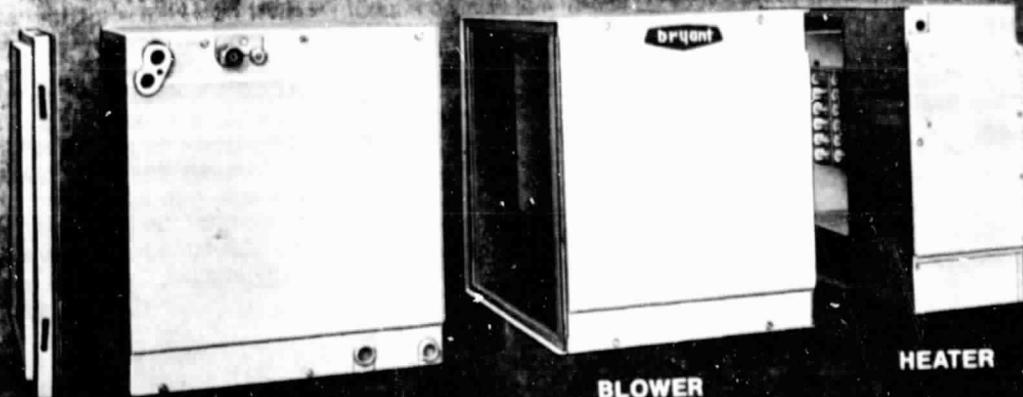
Cat. No.	A	B	C	D	E	*F Max.	G	H	Wheel Dia.	Gauge of Aluminum
12CV	12	17-1/8	19-1/4	9-3/4	1-1/4	11-1/4	12-3/4	14-1/8	15-9/16	.100
16CV	16	21-9/16	24-7/8	12-1/2	1-1/4	11-1/4	16-3/4	18-9/16	20-15/16	
20CV	20	26-3/8	30-1/2	15-1/2	1-1/4	13-1/4	20-7/8	22-3/8	26-1/4	
AHU-3 → 24CV	24	31-1/4	36-3/4	18-1/2	1-1/2	13-1/4	25	27-1/4	31-9/16	
28CV	28	36	42-1/4	21-1/4	1-1/2	15-1/2	29	32	36-7/8	
32CV	32	40-7/8	48	24-1/4	1-1/2	15-1/2	33	36-7/8	42-3/16	
36CV	36	44-1/4	53-5/8	27	1-1/2	15-1/2	37	40-1/4	47-1/2	

*Will vary with motor size

HEAT PUMPS

MODULAR FAN-COIL UNITS

Models 519A/MCC & 520B/BP



FILTER

COIL

BLOWER

HEATER



The modular fan coil consists of a 519A/MCC Coil Section, a 520B/BP Blower Package section, and a heater section. These components can be used individually or in combination with each other. The 519A/MCC Modular Cased Coil is specifically designed for heat-pump-duty operation in combination with the 541B/SHP Outdoor Heat Pump sections. These coils can also be used for conventional air conditioning applications when combined with standard or deluxe condensing units. The 520B/BP Blower Package can be combined with the electric heater packages for conventional heating applications. Later, they can be combined with the modular-cased coil for either heat pump or conventional air conditioning installations. Modular fan-coil components can be used in upflow, horizontal, or downflow installations.

Modular fan coils are available in 36,000-, 42,000-, 48,000-, and 60,000-Btuh nominal sizes. Electric heater packages range in nominal capacity from 8 to 30 KW. Heaters are available with either standard overcurrent protection or disconnecting circuit breakers. The fused and circuit breaker models provide overcurrent protection for both the heaters and the blower motor.

The versatility of the modular fan-coil components permits installation in a multitude of applications. Fan-coil sections are constructed of heavy-duty steel, with an attractive baked-enamel malibu-beige exterior. All cabinets are fully insulated for thermal and acoustic isolation.

FEATURES

519A/MCC DESIGN—Coils are computer-designed to provide optimum heat transfer during heating and cooling. Refrigerant and condensate connections are

bryant

Bryant
Air Conditioning

Indianapolis, Indiana
La Puente, California

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made on front of units for ease of installation. Flare refrigerant connections provide quick, leak-proof connections with matching refrigerant tube sets. Primary and secondary drain connections permit either vertical or horizontal applications.

CHECK-FLO-RATER—The 519A/MCC Coil includes the unique Check-Flo-Rater refrigerant metering device which eliminates potential serviceability requirements of check valves and expansion devices used in conventional heat pump fan coils. Because it is external, the Check-Flo-Rater is readily serviceable. For added reliability, a liquid-tube strainer assures clean, unrestricted operation.

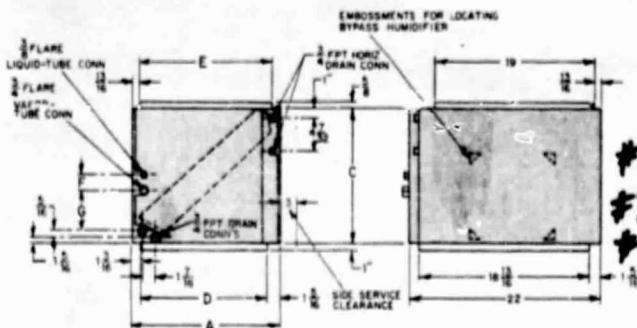
520B/BP DESIGN—The blower package includes a permanent, washable air filter and filter rack. High-static, multispeed, direct-drive PSC blower motors provide proper air performance during heating and cooling. The

motor is mounted on rubber isolators to prevent vibration and sound transmission.

ELECTRIC HEAT PACKAGES—Either disconnecting circuit breaker models or standard heater packages are available in all KW ratings. A low-voltage terminal block simplifies installation. The use of simplified low-voltage wiring systems increases the reliability of the field electrical hookup. Sequencers permit incremental energization and deenergization of the heating elements.

ACCESSORIES

Optional outdoor thermostats are available to energize incrementally the heating elements as a function of outdoor temperature. A uniquely designed automatic changeover room thermostat, with emergency heat switch and light, is available for the heat pump application of these modular fan coils. Optional return air plenums simplify their installation.



A77139

519A/MCC DIMENSIONS (In Inches)

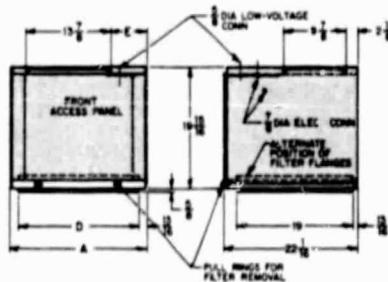
MODEL	A	C	D	E	F	G	Ship. Wt
519A036MCC	21	19-5/8	18-3/8	19-3/8	1-3/4	4-1/4	39
519A042MCC	21	26-5/16	18-3/8	19-3/8	1-3/4	4-3/8	43
519A048MCC	24-1/2	25-3/16	21-7/8	22-7/8	1-3/4	4-3/8	45
519A060MCC	24-1/2	27-1/4	21-7/8	22-7/8	2-11/16	6-1/2	51

#3
#2
#1

MODEL 520B/BP DIMENSIONS (In Inches)

MODEL	A	D	E	Ship. Wt
520B042BP	21-3/16	19-9/16	4-3/8	62
520B048BP	24-11/16	23-1/16	7-7/8	67
520B060BP	24-11/16	23-1/16	7-7/8	72

#3
#2
#1



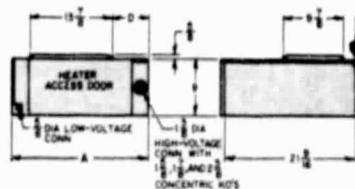
A77140

SUPPLEMENTAL HEATER DIMENSIONS (In Inches)

Heater P/N	KW	A	D	Ship. Wt*
301499-401 & -406	8	21-3/16	4-3/8	35
301499-402 & -407	10	21-3/16	4-3/8	35
301499-403 & -408	15	21-3/16	4-3/8	38
301499-404 & -409	20	21-3/16	4-3/8	39
301499-405 & -412	25 & 30	21-3/16	4-3/8	41
301499-421 & -426	10	24-11/16	7-7/8	36
301499-422 & -427	15	24-11/16	7-7/8	39
301499-423 & -428	20	24-11/16	7-7/8	42
301499-424 & -429	25	24-11/16	7-7/8	44
301499-425 & -430	30	24-11/16	7-7/8	45

#3
#2

* Shipping weights are for heaters with circuit breakers when applicable. Heaters with fuses weigh 1 to 3 pounds less.



A77141

DIMENSIONS WHEN ASSEMBLED (In Inches)

Size 541B/SHP Used With	520B/BP Size	519A/MCC Size	Heater KW	Total Height*	Total Weight
028 & 034	042	036	8 thru 25	47-13/16	142
041	042	042	8 thru 25	54-7/16	146
047	048	048	10 thru 30	51-5/16	157
057	060	060	10 thru 30	51-5/16	168

Add 5/8 in. when installed in downflow position. Dimensions include filter section supplied with Model 520B/BP Blower Section.

SPECIFICATIONS

MODEL	519A036MCC	#2 519A042MCC	#2 519A048MCC	#1 519A060MCC
PERFORMANCE DATA				
Rated Cooling Capacity Btuh (Nominal)	36,000	42,000	48,000	60,000
Static Pressure Drop—Wet Coil*	0.25	0.24	0.32	0.46
Ft ³ /Min (Nominal)	1200	1400	1600	2000
COIL DATA AND REFRIGERANT				
Coil Area (Sq Ft)	2.5	3.8	3.8	4.0
Rows Deep & Fins per Inch	3 & 13	3 & 13	5 & 13	4 & 12
Metering Device	Check-Flo-Rater	Check-Flo-Rater	Check-Flo-Rater	Check-Flo-Rater
Refrigerant	R-22	R-22	R-22	R-22
Liquid-Tube Connection	3/8 Flare	3/8 Flare	3/8 Flare	3/8 Flare
Vapor-Tube Connection	3/4 Flare	3/4 Flare	3/4 Flare	3/4 Flare
Condensate Drain Conn—Prim & Sec	3/4 FPT	3/4 FPT	3/4 FPT	3/4 FPT
OPTIONAL EQUIPMENT				
Check-Flo-Rater Piston†	300498-202	—	—	—
Swivel Ellis Liquid/Vapor Tubes	IBN1616R/IBN2424R	IBN1616R/IBN2424R	IBN1616R/IBN2424R	IBN1616R/IBN2424R

*See coil static pressure drop table
 †When used with Model 541B028SHP Outdoor Unit.

SPECIFICATIONS

MODEL	#3 520B042BP	#2 520B048BP	#1 520B060BP
BLOWER AND FILTER			
Motor—Type—HP—Speeds—Full Load Amps	PSC—1/2—4—3.5	PSC—3/4—4—4.5	PSC—1—3—5.0
Blower Wheel—Width x Diameter	8 x 10	10 x 10	9 x 12
Nominal Ft ³ /Min @ 240 Volts—ESP Inches wc*	1400—0.8	1600—0.9	2000—1.4
Blower Watts @ High Speed and Nominal Ft ³ /Min	650	750	1000
Filter—Permanent Washable	20 x 20-3/4 x 1	21 x 24-1/4 x 1	21 x 24-1/4 x 1
OPTIONAL EQUIPMENT			
Return Air Plenum	302153-101	302153-102	302153-102

*With filter, no heater.

SPECIFICATIONS

SIZE	8KW	10KW	15KW	20KW	25KW	25KW	30KW	36KW
ELECTRICAL								
Unit Voltage—Phase	208/240-1	208/240-1	208/240-1	208/240-1	208/240-1	208/240-3	208/240-1	208/240-3
Operating Voltage Range	187/253	187/253	187/253	187/253	187/253	187/253	187/253	187/253
Heater—Nominal KW @ 240 volts	8	10	15	20	25	25	30	30
Heater Full Load Amps	28.9/33.3	36.1/41.6	54.2/62.5	72.2/83.3	90.3/104.2	52.2/60.2	108.4/125.0	62.5/72.2
Power Supply—Heater and Blower Motor								
With 520B042BP—Ampacity	40/45	49/56	72/82	95/108	117/135	70/80	—	—
Max Overcurrent Protection	40/50	50/60	80/90	100/110	125/150	70/80	—	—
Minimum Wire Size AWG*	6/6	6/4	3/2	2/2†	1†/0†	4/3	—	—
With 520B048BP—Ampacity	—	50/58	73/84	96/110	119/136	71/81	141/162	84/96
Max Overcurrent Protection	—	60/60	80/90	100/110	125/150	80/90	150/175	90/100
Minimum Wire Size AWG*	—	6/4	3/2	1/2†	1†/0†	3/2	0†/00†	2/1
With 520B060BP—Ampacity	—	51/58	74/84	97/110	119/137	72/82	142/163	84/97
Max Overcurrent Protection	—	60/60	80/90	100/110	125/150	80/90	150/175	90/100
Minimum Wire Size AWG*	—	6/4	3/2	1/2†	1†/0†	3/2	0†/00†	2/1
CONTROLS								
Transformer 208/230-24-Volt 60-VA	Std	Std						
Blower Relay	Std	Std						
Sequencer	Std	Std						
Limit Switches	Std	Std						
Fuse Block and Fuses/Circuit Breakers	—	—	Std	Std	Std	Std	Std	Std
Low-Voltage Terminal Strip	Std	Std						
OPTIONAL EQUIPMENT								
Combustible Floor Base— Flame	302152-101	302152-101	302152-101	302152-101	302152-101	302152-101	302152-101	302152-101

*Use copper wire only. If other than 90°C copper wire is used, size can be determined from unit ampacity given in above table applicable table of National Electrical Code. Wire size must not create a voltage drop between service panel and unit in excess of 2% of unit rated voltage.

†Use 75°C copper wire

‡Required for downflow applications.

NOTE: Circuit breakers of disconnect models are UL listed as disconnects for heater and blower when approved combinations are installed

519A/MCC COMBINATIONS AND ADAPTER REQUIREMENTS*

Furnace Size	Furnace Width (in.)	519A/MCC COIL SIZE & CASING WIDTH (in.)			
		036	042	048	060
		21	21	24-1/2	24-1/2
UPFLOW GAS FURNACES					
036080†	14-3/16	F/A	—	—	—
036100	17-1/2	X	—	—	—
042100	17-1/2	X	X	—	—
048100	21	Match	Match	X	—
036125	21	Match	Match	X	—
048125	21	Match	Match	X	—
060125	21	—	Match	X	X‡
048150	24-1/2	F/A	F/A	Match	Match‡
060150	24-1/2	—	F/A	Match	Match‡
060175	31-1/2	—	F/A	V	V‡
060200	31-1/2	—	—	V	V‡
520B/BP BLOWER PACKAGE—UPFLOW, DOWNFLOW, AND HORIZONTAL					
042	21	Match	Match	—	—
048	24-1/2	—	—	Match	—
060	24-1/2	—	—	—	Match
ELECTRIC FURNACE—UPFLOW, DOWNFLOW, AND HORIZONTAL					
042	17-1/2	Y	Y	—	—
048	24-1/2	X	X	Match	—
060	24-1/2	—	X	Match	Match‡

*See table below for letters V, X, and Y used in above table.

†Standard furnace only. For 036080-size deluxe furnace, refer to 036100 furnace size information in this table.

‡The 519A060MCC coil has a high static air pressure drop. Before using it with a gas or electric furnace, check total static pressure drop of coil, ductwork, and the air handling capability of the furnace. (The 060-size blower package is specifically designed for use with the 519A060MCC.)

F/A Field-fabricated adapter required.

—Combination not recommended

Kit Model	Kit P/N*	Description
V	76579-4A	Adapter
X	78036-2A	Side Support
Y	301479-702	Adapter

*Ordering number.

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SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

UNIT MUST BE INSTALLED IN ACCORDANCE
WITH INSTALLATION INSTRUCTIONS

AIR DELIVERY — 520B/BP BLOWER WITH 519A/MCC COIL, HEATER, AND FILTER INSTALLED*

Model	Blower Speed	Application	External Static Pressure — Inches wc																			
			0.1		0.2		0.3		0.4		0.5		0.6		0.7		0.8		0.9		1.0	
			208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V
520B042BP/ 519A036MCC	High	Heating	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		Cooling	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Medium	Heating	1220	1325	1170	1270	1110	1205	1040	1130	965	1050	892	970	805	875	—	—	—	—	—	—
		Cooling	1180	1280	1127	1225	1065	1160	1010	1100	940	1020	875	950	790	860	—	—	—	—	—	—
	Low	Cooling	1050	1140	1010	1100	960	1045	900	980	830	905	—	—	—	—	—	—	—	—	—	—
		Heating	1380	1500	1315	1430	1250	1360	—	1290	—	1225	—	—	—	—	—	—	—	—	—	—
520B042BP/ 519A042MCC	High	Cooling	1325	1440	1270	1380	1210	1315	—	1250	—	1185	—	—	—	—	—	—	—	—	—	—
		Heating	1250	1360	1205	1310	—	1250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
520B048BP/ 519A048MCC	High	Cooling	1225	1330	1175	1280	—	1220	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Heating	—	1920	1663	1750	1590	1675	1520	1600	1435	1510	1355	1425	—	—	—	—	—	—	—	—
520B060BP/ 519A060MCC	High	Cooling	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Heating	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
520B060BP/ 519A060MCC	Medium	Cooling	1625	1710	1560	1640	1490	1570	1415	1490	1330	1400	—	—	—	—	—	—	—	—	—	—
		Heating	1550	1630	1470	1545	1425	1500	1355	1425	1270	1340	—	—	—	—	—	—	—	—	—	—
520B060BP/ 519A060MCC	Low	Cooling	1730	1880	1720	1870	1700	1850	1665	1810	—	1775	—	—	—	—	—	—	—	—	—	—
		Heating	1700	1850	1685	1830	1655	1800	1610	1760	—	1710	—	—	—	—	—	—	—	—	—	—

NOTES:

Heating — Dry Coil; Cooling — Wet Coil

*Static Pressure Drop of factory-supplied air filter is 0.13 in. wc.

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AIR DELIVERY — 520B/BP BLOWER WITH HEATER AND FILTER INSTALLED*

Model	Blower Speed	External Static Pressure — Inches wc																			
		0.1		0.2		0.3		0.4		0.5		0.6		0.7		0.8		0.9		1.0	
		208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V	208V	230V
520B042BP	High	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		1470	1600	1425	1550	1365	1485	1300	1415	1220	1325	1135	1235	—	—	—	—	—	—	—	—
	Medium	1305	1420	1275	1385	1230	1335	1175	1275	—	1200	—	—	—	—	—	—	—	—	—	—
520B048BP	High	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		1940	2040	1870	1970	1800	1895	1720	1810	1635	1720	—	1625	—	—	—	—	—	—	—	—
	Medium	1780	1875	1735	1825	1670	1760	1595	1680	1510	1590	—	—	—	—	—	—	—	—	—	—
520B060BP	High	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		2190	2380	2155	2340	2110	2290	2060	2240	2000	2175	1941	2110	1870	2030	1795	1950	1715	1865	1630	1700
	Low	1750	1900	1740	1890	1715	1865	1690	1835	1650	1795	1605	1745	1550	1685	—	1610	—	—	—	—

*Static pressure drop of factory-supplied air filter is 0.13 in. wc.

SUPPLEMENTAL HEATER DATA

Size 520B/BP Used With	Heater P/N	Nominal KW @ 240 Volts				Supplemental Heater Btuh*		Factory-Supplied Overcurrent Protection
		Total	1st Bank	2nd Bank	3rd Bank	208V	230V	
042	301499-401	8	8	—	—	20,500	25,100	—
042	301499-402	10	10	—	—	25,600	31,300	—
042	301499-403	15	10	5	—	38,400	47,000	Fuse
042	301499-404	20	10	10	—	51,300	62,700	Fuse
042	301499-405	25	15	10	—	64,100	78,400	Fuse
042	301499-406†	8	8	—	—	20,500	25,100	Cir Brk
042	301499-407†	10	10	—	—	25,600	31,300	Cir Brk
042	301499-408	15	10	5	—	38,400	47,000	Cir Brk
042	301499-409	20	10	10	—	51,300	62,700	Cir Brk
042	301499-410	25	15	10	—	64,100	78,400	Cir Brk
042, 048, & 060	301499-411†‡	25	15	10	—	64,100	78,400	Fuse
048 & 060	301499-412†‡	30	20	10	—	76,900	94,000	Fuse
048 & 060	301499-421	10	10	—	—	25,600	31,300	—
048 & 060	301499-422	15	10	5	—	38,400	47,000	Fuse
048 & 060	301499-423	20	10	10	—	51,300	62,700	Fuse
048 & 060	301499-424	25	15	10	—	64,100	78,400	Fuse
048 & 060	301499-425	30	20	10	10	76,900	94,000	Fuse
048 & 060	301499-426†	10	10	—	—	25,600	31,300	Cir Brk
048 & 060	301499-427†	15	10	5	—	38,400	47,000	Cir Brk
048 & 060	301499-428†	20	10	10	—	51,300	62,700	Cir Brk
048 & 060	301499-429†	25	15	10	—	64,100	78,400	Cir Brk
048 & 060	301499-430†	30	20	10	10	76,900	94,000	Cir Brk

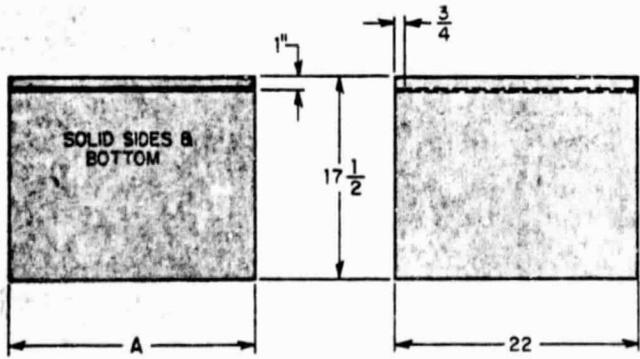
*Btuh does not include blower motor heat. It is included in the heat pump performance chart of outdoor unit Product Data Sheet. If used in conventional heating application, add blower motor heat: Btuh = watts x 3.413 (watts from specification table).
 † Special order only. Consult factory for required lead time.
 ‡ Voltage, frequency, and phase of these heaters is 208/240-60-3; all others are 208/240-60-1.

** - Brkgs in distr. Panel to be changed to 2-50A-2P & wire to #6-ang cont is resp of Mech Contr.* *o - wired to separate circuits in distr. panel*

COIL STATIC PRESSURE DROP (Inches wc)

519A/MCC Size	Application*	Airflow (Ft ³ /Min)							
		800	1000	1200	1400	1600	1800	2000	2200
036	Heating	0.07	0.12	0.18	0.25	0.33	—	—	—
	Cooling	0.09	0.17	0.25	0.35	0.49	—	—	—
042	Heating	—	0.08	0.13	0.17	0.22	0.28	—	—
	Cooling	—	0.10	0.17	0.24	0.32	0.42	—	—
048	Heating	—	—	0.13	0.17	0.22	0.28	0.34	—
	Cooling	—	—	0.17	0.24	0.32	0.42	0.52	—
060	Heating	—	—	—	0.15	0.21	0.25	0.30	0.36
	Cooling	—	—	—	0.25	0.30	0.37	0.46	0.55

*Heating—Dry Coil; Cooling—Wet Coil



DIMENSIONS (In Inches)

Blower Size	A
042	21
048 and 060	24

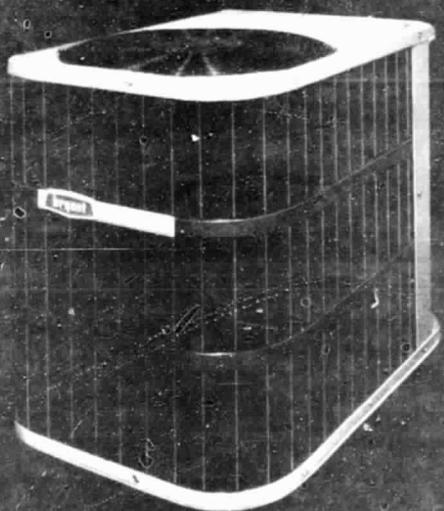
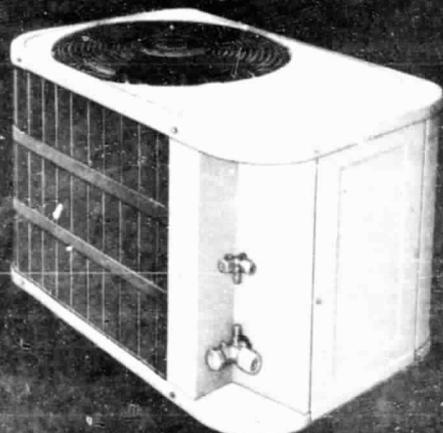
Return Air Plenum

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SPLIT-SYSTEM HEAT PUMP UNITS

Model 541B/SHP



The 541B/SHP Outdoor Sections of split-system heat pumps, are designed for quiet, reliable heating during the winter, and cooling during the summer. These heat pump systems provide economy of operation through energy conservation. The energy utilization efficiency of these heat pump systems during the heating season, is in many areas, more than double that of conventional electric space heating equipment. These units recover heat for indoor comfort from outdoor air during the heating season and, by automatically reversing the refrigerant system, remove indoor heat and excess humidity during the cooling season. All models have an ARI-certified cooling energy efficiency of 7.0 Btuh/Watt or better, with heating coefficient of performance of 2.6 or better and 1.5 or better, respectively, at the 47°F and 17°F outdoor temperature rating points. The COP for all the units is 1.0 or better at -5°F outdoor temperature.

FEATURES

COMPRESSOR—Designed specifically for heat pump duty, with high energy efficiency during heating and cooling operation. Each compressor is hermetically sealed against contamination to assure long life and trouble-free performance. They are internally sprung and externally mounted on rubber isolators for quiet, vibration-free operation. Continuous, reliable operation can be achieved down to -40°F. All models include a discharge-tube muffler to prevent sound transmission of the compressor pulsations to the indoors or outdoors.

BUILT-IN RELIABILITY COMPONENTS—Include a suction-tube accumulator that keeps liquid refrigerant from reaching the compressor; low-pressure switch that stops the compressor if refrigerant charge is lost; a crankcase heater to keep the compressor oil warm and free of refrigerant for maximum lubricity; compressor relief valve for high-pressure protection; and compressor quick-start components to assure reliable operation of the units during brownout conditions and low outdoor temperatures.

WEATHER-PROTECTIVE CABINET—The low-profile design of the 541B/SHP units, with the pleasing malibu beige and jade exterior, blends in well with plants and shrubbery. Galvanized steel, coated with a layer of zinc phosphate to which a coat of alkyd, melamine enamel is applied and baked on, is used throughout. This provides a hard, smooth finish that lasts for many years. All screws on the cabinet exterior are stainless steel for a durable, rust-free, quality appearance.

ORIGINAL PART
OF BOOK 40A

bryant

Bryant
Air Conditioning

Indianapolis, Indiana
La Puente, California

UNIT DESIGN—All units are equipped with totally enclosed fan motors for greater reliability under rain and snow conditions. The large, wraparound coil is designed for optimum heat transfer during heating and cooling. The vertical air discharge carries the sound and air up and away from adjacent patio areas and foliage. Sufficient space is provided between rows of composite coils so they can be cleaned with a common garden hose. A divider panel is installed between the compressor and coil section so that the unit can be checked and serviced while operating.

EXTERNAL SERVICE VALVES—Both brass refrigerant service valves are externally located so that refrigerant tube connections can be made quickly and easily. Each valve has a service port for ease of checking operating refrigerant pressures. The valves are designed for flare refrigerant tube connections.

HEAT-SAVING REVERSING VALVE—The operation of the reversing valve is designed so that when the room thermostat is satisfied, the reversing valve locks the hot refrigerant in the indoor coil. With the room thermostat set for continuous blower operation, this locked-in heat will be distributed through the living area after the outdoor unit has shut down—for additional energy conservation and reduced electrical bills.

TIME/TEMPERATURE DEFROST—The defrost cycle is initiated by a time/temperature control to clear the coil of frost and ice. The cycle is started only if the defrost thermostat senses ice buildup on the outdoor coil. After a few minutes, the control automatically returns the unit to the heating cycle.

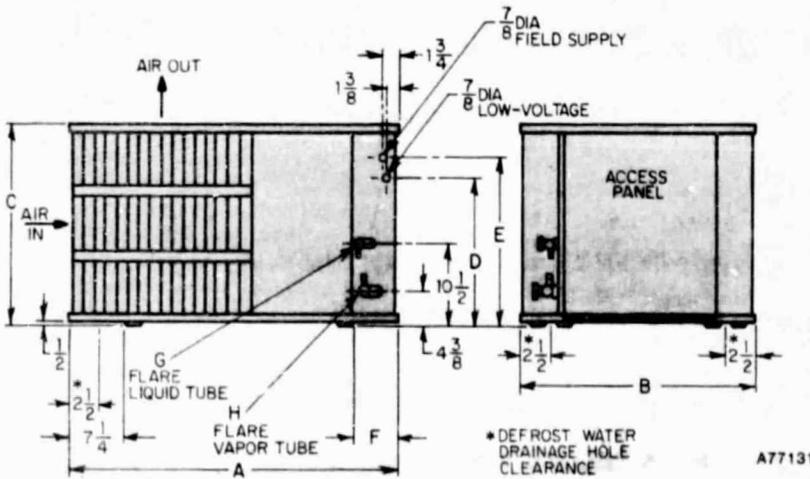
UNIQUE CHECK-FLO-RATER—The refrigerant metering for the outdoor and indoor units is done with the unique CHECK-FLO-RATER which eliminates the potential servicability requirements of check valves and expansion devices used in conventional heat pumps. For added reliability, a liquid-tube strainer assures clean unrestricted operation.

ACCESSORIES

A uniquely designed automatic changeover room thermostat, with emergency heat switch and light, is available for this line of heat pumps. Only the first bank of supplemental electric heaters is circuited through the second-stage heat anticipator to assure that the current flow always matches the anticipator setting. This minimizes the room temperature swing. Because of the simplified low-voltage circuitry, only the 30-KW units require an emergency heat relay to obtain the emergency heat function.

The outdoor thermostat kit includes a mounting bracket and thermostat for systems with 12- through 25-KW supplemental electric heaters. The thermostat, which mounts inside the Model 541B/SHP, is easily wired to the nearby low-voltage terminal board. An additional outdoor thermostat kit is available with a thermostat and emergency heat relay for use with systems having 30-KW supplemental electric heat.

A convenient unit mounting base kit is available to raise the 541B/SHP 8 inches above ground level. This kit is ideal for installation in areas where the snow level normally does not exceed 2 inches.



Clearance Requirements (In Inches)

- Bottom of unit to ground or normal snow level..... 6
- Inlet air (both sides and coil end)..... 12
- Discharge air (top)..... 48
- Service Clearance (compressor end)..... 30

NOTE: Unit can be installed with 6 in. clearance on LH side (facing control end of unit) when 24-in. clearance is maintained from RH side and coil end.

DIMENSIONS (In Inches)

Size	A	B	C	D	E	F	G	H	Ship. Wt
021	32-3/4	22-1/4	19-5/16	13-7/16	15-9/16	5-3/4	3/8	5/8	160
028	32-3/4	22-1/4	19-5/16	13-7/16	15-9/16	5-3/4	3/8	3/4	165
034	32-3/4	22-1/4	25-5/16	18-3/4	21-1/4	5-3/4	3/8	3/4	190
041	42	30	25-5/16	18-3/4	21-1/4	6	3/8	3/4	260
047	42	30	25-5/16	18-3/4	21-1/4	6	3/8	3/4	275
057	42	30	31-5/16	24	26-5/16	6	3/8	3/4	295



CERTIFICATION APPLIES ONLY WHEN USED WITH PROPER COMPONENTS AS DESIGNATED BY MANUFACTURER

SPECIFICATIONS

MODEL	541B021SHP		541B026SHP				541B034SHP		
SERIES	A		A				A		
ELECTRICAL									
Unit Volts-Hertz-Phase	208-230-60-1		208-230-60-1				208-230-60-1		
Operating Voltage Range	197-253		197-253				197-253		
Unit Ampacity for Wire Sizing	16.2		21.3				28.6		
Min Wire Size (60°C Copper) (AWG)*	12		10				10		
Max Branch Circuit Fuse Size (Amps)	25		30				45		
Total Unit Amps	13.2		17.3				23.1		
Compressor Rated Load Amps	11.9		16.0				21.8		
Locked Rotor Amps	65		72				88		
Fan Motor	1/6 HP, PSC		1/6 HP, PSC				1/6 HP, PSC		
Full Load Amps	1.3		1.3				1.3		
PERFORMANCE DATA									
ARI Sound Rating Number†	19		19				19		
517B/HPFC	024		030	036	—	—	036	—	—
519A/MCC	—		—	—	036	036	—	036	036
520B/BP	—		—	—	042	—	—	042	—
Rated Heating Capacity—47°F‡	21,000		27,500	28,500	28,500	28,000	34,500	34,500	34,000
Watts	2400		3100	3200	3150	3050	3950	3900	3850
COP	2.6		2.6	2.6	2.7	2.7	2.6	2.6	2.6
Rated Heating Capacity—17°F‡	10,000		13,500	14,000	14,000	13,500	19,000	19,000	18,500
Watts	1900		2500	2600	2550	2450	3200	3150	3100
COP	1.5		1.6	1.6	1.6	1.6	1.7	1.8	1.8
Rated Cooling Capacity (Btuh)‡	18,500		25,000	25,500	25,500	25,500	32,000	32,000	32,500
Watts	2550		3550	3650	3600	3550	4500	4450	4400
EER	7.3		7.0	7.0	7.1	7.2	7.1	7.2	7.4
COMPRESSOR & REFRIGERANT									
Compressor	Hermetic		Hermetic				Hermetic		
High-Pressure Protection (IPRV)	Std		Std				Std		
Compressor Motor Protection	Std		Std				Std		
Refrigerant Charge—Type & Amount**	R-22 & 5 lbs-5 oz		R-22 & 5 lbs-10 oz				R-22 & 6 lbs-12 oz		
OUTDOOR COIL & FAN									
Coil Face Area (Sq Ft)	7.9		7.9				10.6		
Rows & Fins Per Inch	2 & 20		2 & 20				2 & 20		
Fan Diameter & No. of Blades	18 & 4		18 & 4				18 & 4		
Rated Airflow (Ft ³ /Min)‡	2100		2100				2200		
Liquid-Tube Connection	3/8 Flare		3/8 Flare				3/8 Flare		
Vapor-Tube Connection	5/8 Flare		3/4 Flare				3/4 Flare		
STANDARD EQUIPMENT									
Heat-Saving Reversing Valve	Std		Std				Std		
Defrost Control (time/temp)	Std		Std				Std		
Accumulator	Std		Std				Std		
Crankcase Heater	Std		Std				Std		
Liquid-Tube Strainer	Std		Std				Std		
Totally Enclosed Outdoor Fan Motor	Std		Std				Std		
Low-Pressure Switch	Std		Std				Std		
Check-Flow-Rater	Std		Std				Std		
Discharge-Tube Muffler	Std		Std				Std		
Compressor Quick-Start Components	Std		Std				Std		
Brass Refrigerant Service Valves	Std		Std				Std		
Outdoor Coil Grille Guard	Std		Std				Std		
Compressor Vibration Isolators	Std		Std				Std		
OPTIONAL EQUIPMENT									
Unit Mounting Base	301392-701		301392-701				301392-701		
Room Thermostat w/Emergency Heat Switch	34427DP99		34427DP99				34427DP99		
Room Thermostat w/Manual Changeover Switch	34427DP87		34427DP87				34427DP87		
High-Pressure Switch	301619-701		301619-701				301619-701		
Quick-Start Capacitor-Relay Kit	301593-701		301593-701				301593-701		
2-Way Flow Filter-Drier—Liquid-Tube	301399-701		301399-701				301399-701		
Filter-Drier—Vapor-Tube	54871D12		54871D12				54871D13		
Outdoor Thermostat and Mtg Bracket	301380-701		301380-701				301380-701		
COMPROTEC®	301600-701		301600-701				301600-701		
Swivel Elts—Liquid/Vapor Tubes	IBN1616R/IBN2020R		IBN1616R/IBN2424R				IBN1616R/IBN2424R		

*If other than 60°C copper wire is used, size can be determined from unit ampacity given in above table and applicable table of National Electric Code. Wire size selected must have current capacity not less than that of copper wire specified and must not create a voltage drop between service panel and unit in excess of 2% of unit rated voltage.

†Rated in accordance with ARI Standard 270-75.

‡Rated in accordance with ARI Standard 240-76.

**The factory refrigerant charge is sufficient for systems requiring up to 30 ft of innerconnecting tubing. For tubing lengths greater than 30 ft see Installation Instructions for additional refrigerant requirements.

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SPECIFICATIONS

MODEL	#3 541B041SHP				#2 541B047SHP				#1 541B057SHP			
SERIES	A				A				A			
ELECTRICAL												
Unit Volts & Phase	208 & 1*	208 & 3	230 & 1	230 & 3	208 & 1*	208 & 3	230 & 1	230 & 3	208 & 1*	208 & 3	230 & 1	230 & 3
Operating Voltage Range	187-229		207-253		187-229		207-253		187-229		207-253	
Unit Ampacity for Wire Sizing	32.7	19.7	29.9	18.1	36.5	22.0	33.2	20.0	41.0	24.6	37.3	22.5
Min Wire Size (60°C Copper) (AWG)†	8	12	10	12	8	10	8	12	6	10	8	10
Max Branch Circuit Fuse Size (Amps)	60	35	50	30	60	35	60	35	70	40	60	35
Total Unit Amps	26.6	16.2	24.3	14.9	29.6	18.0	27.0	16.4	33.3	20.2	30.3	18.5
Compressor Rated Load Amps	24.6	14.2	22.3	12.9	27.6	16.0	25.0	14.4	31.0	17.9	28.0	16.2
Locked Rotor Amps	109	79	94	67	126	87	106	70	175	113	150	98
Fan Motor	1/4-HP, PSC				1/4-HP, PSC				1/3-HP, PSC			
Full Load Amps	2.0				2.0				2.3			
PERFORMANCE DATA												
ARI Sound Rating Number‡	19				19				19			
519A/MCC	042		042		048		048		060		060	
520B/BP	042		—		048		—		060		—	
Rated Heating Capacity—47°F**	42,000		42,000		48,000		48,000		58,000		56,000	
Watts	4800		4700		5200		5100		6600		6300	
COP	2.6		2.6		2.7		2.8		2.6		2.6	
Rated Heating Capacity—17°F**	22,000		22,000		25,000		24,500		32,000		31,000	
Watts	3600		3500		4100		4000		5300		5100	
COP	1.8		1.8		1.8		1.8		1.8		1.8	
Rated Cooling Capacity (Btuh)**	39,000		39,000		43,000		43,000		54,000		54,000	
Watts	5600		5500		5900		5800		7500		7200	
EER	7.0		7.1		7.3		7.4		7.2		7.5	
COMPRESSOR & REFRIGERANT												
Compressor	Hermetic				Hermetic				Hermetic			
High-Pressure Protection (IPRV)	Std				Std				Std			
Compressor Motor Protection	Std				Std				Std			
Refrigerant Charge—Type & Amount††	R-22 & 6 lbs—14 oz				R-22 & 8 lbs—4 oz				R-22 & 8 lbs—14 oz			
OUTDOOR COIL & FAN												
Coil Face Area (Sq Ft)	11.4				11.4				14.3			
Rows & Fins Per Inch	2 & 20				2 & 20				2 & 20			
Fan Diameter & No. of Blades	22 & 4				22 & 4				22 & 3			
Rated Airflow (Ft³/Min)**	2700				2700				3500			
Liquid-Tube Connection	3/8 Flare				3/8 Flare				3/8 Flare			
Vapor-Tube Connection	3/4 Flare				3/4 Flare				3/4 Flare			
STANDARD EQUIPMENT												
Heat-Saving Reversing Valve	Std				Std				Std			
Defrost Control (time/temp)	Std				Std				Std			
Accumulator	Std				Std				Std			
Crankcase Heater	Std				Std				Std			
Liquid-Tube Strainer	Std				Std				Std			
Totally Enclosed Outdoor Fan Motor	Std				Std				Std			
Low-Pressure Switch	Std				Std				Std			
Check-Flo-Rater	Std				Std				Std			
Discharge-Tube Muffler	Std				Std				Std			
Compressor	Std				Std				Std			
Brass Refrigerant Service Valves	Std				Std				Std			
Outdoor Coil Grille Guard	Std				Std				Std			
Compressor Vibration Isolators	Std				Std				Std			
OPTIONAL EQUIPMENT												
Unit Mounting Base	301392-702				301392-702				301392-702			
Room Thermostat w/Emergency Heat Switch	34427DP99				34427DP99				34427DP99			
Room Thermostat w/Manual Changeover Switch	34427DP87				34427DP87				34427DP87			
High-Pressure Switch	301619-701				301619-701				301619-701			
2-Way Flow Filter-Drier—Liquid Tube	301399-701				301399-701				301399-701			
Filter-Drier—Vapor Tube	54871D14				54871D14				54871D14			
Outdoor Thermostat and Mtg Bracket	301380-701				310380-701				301380-701			
Second Outdoor Thermostat and Emergency Heat Relay‡‡	—				301380-702				301380-702			
COMPROTEC*	301600-701				301600-701				301600-701			
Swivel Ells—Liquid/Vapor Tubes	IBN1616R/IBN2424R				IBN1616R/IBN2424R				IBN1616R/IBN2424R			
Vapor Tube Adapter 3/4 Flare x 1-1/8 Tube (Pkg of 6)	—				301892-704				301892-704			

*Special order unit—consult factory for lead time required.

†If other than 60°C copper wire is used, size can be determined from unit ampacity given in above table and applicable table of National Electric Code. Wire size selected must have current capacity not less than that of copper wire specified and must not create a voltage drop between service panel and unit in excess of 2% of unit rated voltage.

‡Rated in accordance with ARI Standard 270-75.

**Rated in accordance with ARI Standard 240-76.

††The factory refrigerant charge is sufficient for systems requiring up to 30 ft of innerconnecting tubing. For tubing lengths greater than 30 ft see Installation Instructions for additional refrigerant requirements.

‡‡Required only for systems with 30-KW supplemental heat.

HEAT PUMP HEATING PERFORMANCE

Outdoor Ambient°F	541B021SHP & 517B024HPFC			541B028SHP & 517B030HPFC			541B028SHP & 517B036HPFC			541B034SHP & 517B036HPFC		
	Heating Btuh	KW	COP									
62	29,300	2.7	3.2	36,800	3.4	3.2	38,200	3.5	3.2	43,900	4.3	3.0
57	26,300	2.6	3.0	33,500	3.3	3.0	34,800	3.4	3.0	40,700	4.2	2.8
52	23,500	2.5	2.8	30,400	3.2	2.8	31,500	3.3	2.8	37,600	4.0	2.7
47	21,000	2.4	2.6	27,500	3.1	2.6	28,500	3.2	2.6	34,500	3.9	2.6
42	18,700	2.3	2.4	24,700	3.0	2.4	25,600	3.1	2.4	31,600	3.8	2.4
37	16,600	2.2	2.2	22,100	2.9	2.2	22,900	2.9	2.2	28,800	3.7	2.3
32	14,700	2.1	2.0	19,700	2.7	2.1	20,400	2.8	2.1	26,100	3.5	2.1
27	12,900	2.0	1.9	17,500	2.7	1.9	18,100	2.7	1.9	23,600	3.4	2.0
22	11,400	1.9	1.7	15,400	2.6	1.7	16,000	2.7	1.7	21,200	3.3	1.9
17	10,000	1.9	1.5	13,500	2.5	1.6	14,000	2.6	1.6	19,000	3.2	1.7
12	8,800	1.8	1.4	11,800	2.4	1.4	12,200	2.5	1.4	16,900	3.0	1.6
7	7,700	1.7	1.3	10,300	2.3	1.3	10,600	2.4	1.3	14,900	2.9	1.5
2	6,700	1.7	1.1	8,900	2.2	1.2	9,200	2.3	1.2	13,200	2.8	1.4
-3	5,900	1.6	1.0	7,600	2.1	1.0	7,900	2.2	1.0	11,600	2.7	1.3
-8	5,200	1.6	0.9	6,500	2.0	0.9	6,800	2.1	0.9	10,200	2.5	1.2
-13	4,600	1.5	0.8	5,600	1.9	0.8	5,900	2.0	0.8	9,000	2.4	1.1
-18	4,000	1.5	0.8	4,900	1.8	0.8	5,100	1.9	0.8	8,000	2.3	1.0
-23	3,500	1.5	0.7	4,300	1.7	0.7	4,500	1.9	0.7	7,200	2.2	0.9
-28	3,100	1.4	0.6	3,800	1.7	0.7	4,100	1.8	0.7	6,700	2.0	0.9

Outdoor Ambient°F	541B028SHP & 519A036MCC/ 520B042BP			541B034SHP & 519A036MCC/ 520B042BP			541B041SHP & 519A042MCC/ 520B042BP #3			541B047SHP & 519A048MCC/ 520B048BP #2		
	Heating Btuh	KW	COP	Heating Btuh	KW	COP	Heating Btuh	KW	COP	Heating Btuh	KW	COP
62	38,200	3.4	3.2	43,900	4.2	3.0	55,400	5.6	2.9	62,500	6.1	3.0
57	34,800	3.3	3.0	40,700	4.1	2.9	50,700	5.3	2.8	57,500	5.7	2.9
52	31,500	3.2	2.8	37,600	4.0	2.7	46,200	5.0	2.7	52,600	5.4	2.8
47	28,500	3.1	2.7	34,500	3.9	2.6	42,000	4.8	2.6	48,000	5.2	2.7
42	25,600	3.0	2.5	31,600	3.7	2.5	38,000	4.5	2.4	43,600	4.9	2.6
37	22,900	2.9	2.3	28,800	3.6	2.3	34,300	4.3	2.3	39,400	4.7	2.4
32	20,400	2.8	2.1	26,100	3.5	2.2	30,900	4.1	2.2	35,400	4.5	2.3
27	18,100	2.7	1.9	23,600	3.4	2.0	27,700	3.9	2.1	31,700	4.3	2.1
22	16,000	2.6	1.8	21,200	3.2	1.9	24,700	3.7	1.9	28,200	4.2	2.0
17	14,000	2.5	1.6	19,000	3.1	1.8	22,000	3.6	1.8	25,000	4.1	1.8
12	12,200	2.4	1.5	16,900	3.0	1.6	19,600	3.4	1.7	22,100	3.9	1.6
7	10,600	2.3	1.3	14,900	2.9	1.5	17,300	3.3	1.5	19,400	3.8	1.5
2	9,200	2.2	1.2	13,200	2.7	1.4	15,300	3.2	1.4	17,000	3.7	1.3
-3	7,900	2.1	1.1	11,600	2.6	1.3	13,500	3.1	1.3	14,900	3.6	1.2
-8	6,800	2.1	0.9	10,200	2.5	1.2	11,900	3.0	1.1	13,100	3.5	1.1
-13	5,900	2.0	0.9	9,000	2.4	1.1	10,600	3.0	1.0	11,500	3.5	1.0
-18	5,100	1.9	0.8	8,000	2.2	1.0	9,500	3.0	0.9	10,300	3.4	0.9
-23	4,500	1.8	0.7	7,200	2.1	0.9	8,500	2.9	0.8	9,400	3.3	0.8
-28	4,100	1.7	0.7	6,700	2.0	0.9	7,800	2.9	0.8	8,700	3.2	0.8

Outdoor Ambient°F	541B028SHP & 519A036MCC			541B034SHP & 519A036MCC			541B041SHP & 519A042MCC			541B047SHP & 519A048MCC		
	Heating Btuh	KW	COP									
62	37,600	3.3	3.3	43,000	4.2	3.0	54,300	5.5	2.9	64,000	5.7	3.3
57	34,200	3.2	3.1	39,900	4.1	2.9	50,000	5.2	2.8	58,400	5.5	3.1
52	31,000	3.1	2.9	36,900	3.9	2.7	45,900	4.9	2.7	53,000	5.3	2.9
47	28,000	3.0	2.7	34,000	3.8	2.6	42,000	4.7	2.6	48,000	5.1	2.8
42	25,100	2.9	2.5	31,100	3.7	2.4	38,200	4.4	2.5	43,300	4.8	2.6
37	22,400	2.8	2.3	28,400	3.6	2.3	34,600	4.2	2.4	38,900	4.7	2.4
32	19,900	2.7	2.1	25,700	3.4	2.2	31,200	4.0	2.3	34,900	4.5	2.3
27	17,600	2.6	2.0	23,200	3.3	2.0	27,900	3.8	2.1	31,100	4.3	2.1
22	15,500	2.5	1.8	20,800	3.2	1.9	24,900	3.6	2.0	27,600	4.1	1.9
17	13,500	2.4	1.6	18,500	3.1	1.8	22,000	3.5	1.8	24,500	4.0	1.8
12	11,800	2.3	1.5	16,400	2.9	1.6	19,400	3.3	1.7	21,600	3.8	1.6
7	10,200	2.2	1.3	14,500	2.8	1.5	17,000	3.2	1.5	19,000	3.7	1.5
2	8,700	2.1	1.2	12,700	2.7	1.4	14,800	3.1	1.4	16,700	3.5	1.4
-3	7,500	2.0	1.1	11,100	2.6	1.2	12,900	3.0	1.2	14,700	3.4	1.2
-8	6,400	2.0	0.9	9,700	2.4	1.1	11,200	2.9	1.1	13,100	3.3	1.1
-13	5,500	1.9	0.8	8,400	2.3	1.1	9,800	2.9	1.0	11,600	3.2	1.0
-18	4,800	1.8	0.8	7,500	2.2	1.0	8,700	2.8	0.9	10,500	3.2	0.9
-23	4,300	1.7	0.7	6,700	2.1	0.9	7,800	2.8	0.8	9,700	3.1	0.9
-28	3,900	1.6	0.7	6,200	1.9	0.9	7,200	2.8	0.7	9,100	3.0	0.9

NOTES:

1. The Btuh heating capacity values shown are net "integrated" values from which the defrost effect has been subtracted. The Btuh heating from supplemental heaters should be added to these values to obtain total system capacity.
2. The KW values include the compressor, outdoor fan motor, and indoor blower motor. The KW from supplemental heaters should be added to these values to obtain total system KW.
3. See the Heating Performance Correction Factors Table for Ft³/Min and indoor coil entering air temperature adjustments.

HEAT PUMP HEATING PERFORMANCE

Outdoor Ambient °F	541B057SHP & 519A060MCC/520B060BP			541B057SHP & 519A060MCC		
	Heating Btuh	KW	COP	Heating Btuh	KW	COP
62	73,600	7.3	2.9	70,700	6.9	3.0
57	68,200	7.1	2.8	65,600	6.7	2.9
52	63,000	6.8	2.7	60,700	6.5	2.7
47	58,000	6.6	2.6	56,000	6.3	2.6
42	53,100	6.3	2.4	51,400	6.1	2.5
37	48,500	6.1	2.3	46,900	5.9	2.3
32	44,100	5.9	2.2	42,700	5.7	2.2
27	39,800	5.7	2.0	38,600	5.5	2.1
22	35,800	5.4	1.9	34,700	5.3	1.9
17	32,000	5.3	1.8	31,000	5.1	1.8
12	28,500	5.1	1.6	27,600	4.9	1.6
7	25,200	4.9	1.5	24,300	4.7	1.5
2	22,100	4.8	1.4	21,300	4.5	1.4
-3	19,300	4.6	1.2	18,500	4.2	1.3
-8	16,800	4.5	1.1	16,000	4.0	1.1
-13	14,500	4.4	1.0	13,700	3.8	1.0
-18	12,600	4.3	0.9	11,700	3.6	0.9
-23	10,900	4.2	0.8	10,000	3.4	0.8
-28	9,500	4.1	0.7	8,500	3.2	0.8

NOTES:

1. The Btuh heating capacity values shown are net "integrated" values from which the defrost effect has been subtracted. The Btuh heating from supplemental heaters should be added to these values to obtain total system capacity.
2. The KW values include the compressor, outdoor fan motor, and indoor blower motor. The KW from supplemental heaters should be added to these values to obtain total system KW.
3. See the Heating Performance Correction Factors Table for Ft³/Min and indoor coil entering air temperature adjustments.

HEATING PERFORMANCE CORRECTION FACTORS

Indoor Coil Ft ³ /Min per 12,000 Btuh of ARI Cooling Capacity	Correction Factors	
	Capacity	Power
400	0.98	0.99
450	1.00	1.00
500	1.02	1.01
Indoor Coil Entering Air Temp °F (DB)		
65	1.02	0.99
70	1.00	1.00
75	0.98	1.01

HEAT PUMP REFRIGERANT TUBING KITS*

Kit P/N	For Use With 541B/SHP Size	Length (Feet)	Tube OD		Flare Conn		Ship. Wt
			Liquid	Vapor	Liquid	Vapor	
301376-301	021	10	3/8	5/8	3/8	5/8	8
301376-302		20	3/8	5/8	3/8	5/8	12
301376-304		30	3/8	5/8	3/8	5/8	17
301376-305		40	3/8	5/8	3/8	5/8	22
301376-306		50	3/8	5/8	3/8	5/8	26
301376-307	028 and 034	10	3/8	3/4	3/8	3/4	9
301376-308		20	3/8	3/4	3/8	3/4	14
301376-310		30	3/8	3/4	3/8	3/4	20
301376-311		40	3/8	3/4	3/8	3/4	26
301376-312		50	3/8	3/4	3/8	3/4	32
301376-313	041	10	3/8	7/8	3/8	3/4	11
301376-314		20	3/8	7/8	3/8	3/4	17
301376-316		30	3/8	7/8	3/8	3/4	24
301376-317		40	3/8	7/8	3/8	3/4	30
301376-318		50	3/8	7/8	3/8	3/4	37
301376-319	047 and 057	30	3/8	1-1/8	3/8	3/4	42
301376-320		40	3/8	1-1/8	3/8	3/4	50
301376-321		50	3/8	1-1/8	3/8	3/4	60

NOTE: The vapor tube insulation is 1/2 inch thick and the R value is 2.0.

*These tubing kits are vapor charged. Refer to Model 541B/SHP Installation Instructions for additional refrigerant requirements.

DETAILED COOLING CAPACITIES

Indoor Coil Air		OUTDOOR COIL ENTERING AIR TEMPERATURE °F															
		85				95				105				115			
		Ft ³ /Min	°F EWS	Net Capacity MBtuh		Total System KW	Net Capacity MBtuh		Total System KW	Net Capacity MBtuh		Total System KW	Net Capacity MBtuh		Total System KW		
Total	Sens			Total	Sens		Total	Sens		Total	Sens						
541B021SHP Outdoor Section With 517B024HPFC Indoor Section																	
600	71	20.9	11.5	2.6	19.4	11.0	2.7	18.1	10.5	2.8	16.7	10.1	2.9				
600	67	19.3	13.8	2.4	18.0	13.3	2.5	16.7	12.8	2.6	15.4	12.4	2.7				
600	63	17.7	16.0	2.2	16.5	15.5	2.3	15.2	15.1	2.4	14.0	14.0	2.5				
600	59	15.9	15.9	2.0	14.7	14.7	2.0	13.5	13.5	2.1	12.3	12.3	2.2				
700	71	21.5	12.3	2.7	19.9	11.7	2.7	18.6	11.3	2.9	17.1	10.8	3.0				
700	67	19.9	14.9	2.5	18.5	14.4	2.6	17.2	13.9	2.7	15.8	13.5	2.8				
700	63	18.2	17.5	2.3	16.9	16.9	2.3	15.7	15.7	2.4	14.3	14.3	2.5				
700	59	16.3	16.3	2.0	15.1	15.1	2.1	13.9	13.9	2.2	12.6	12.6	2.3				
800	71	22.0	13.0	2.7	20.4	12.5	2.8	19.0	12.0	2.9	17.4	11.5	3.0				
800	67	20.4	16.0	2.5	18.9	15.4	2.6	17.6	15.0	2.7	16.1	14.5	2.8				
800	63	18.6	18.6	2.3	17.3	17.3	2.4	16.0	16.0	2.5	14.6	14.6	2.6				
800	59	16.7	16.7	2.1	15.4	15.4	2.1	14.1	14.1	2.2	12.8	12.8	2.3				
541B028SHP Outdoor Section With 517B030HPFC, 517B036HPFC, 519A036MCC/520B042BP, or 519A036MCC Indoor Section.																	
800	71	28.2	15.6	3.5	26.6	15.0	3.7	24.9	14.4	3.8	23.1	13.8	4.0				
800	67	26.5	18.9	3.2	24.7	18.2	3.4	23.1	17.6	3.6	21.5	17.0	3.7				
800	63	24.6	22.1	2.9	22.7	21.3	3.1	21.2	20.7	3.3	19.6	19.6	3.4				
800	59	22.5	22.5	2.5	20.4	20.4	2.8	18.9	18.9	2.9	17.4	17.4	3.0				
1000	71	29.2	17.1	3.6	27.5	16.6	3.9	25.8	16.0	4.0	23.9	15.4	4.1				
1000	67	27.4	21.1	3.4	25.7	20.5	3.6	24.0	19.9	3.7	22.2	19.3	3.8				
1000	63	25.5	25.0	3.0	23.6	23.6	3.3	21.9	21.9	3.4	20.3	20.3	3.5				
1000	59	23.3	23.3	2.7	21.1	21.1	2.9	19.5	19.5	3.0	18.0	18.0	3.1				
1200	71	29.9	18.6	3.8	28.3	18.1	4.0	26.4	17.5	4.1	24.5	16.9	4.2				
1200	67	28.1	23.2	3.5	26.3	22.6	3.7	24.6	21.9	3.8	22.7	21.3	3.9				
1200	63	26.1	26.1	3.1	24.2	24.2	3.4	22.5	22.5	3.5	20.8	20.8	3.6				
1200	59	23.8	23.8	2.8	21.6	21.6	3.0	20.0	20.0	3.1	18.4	18.4	3.2				
NOTE: When used with 517B030HPFC, deduct 0.5 MBtuh; with 517B036HPFC, add 0.1KW.																	
541B034SHP Outdoor Section With 517B036HPFC, 519A036MCC/520B042BP, or 519A036MCC Indoor Section.																	
1000	71	35.6	19.3	4.5	33.8	18.7	4.6	31.9	18.0	4.8	30.1	17.4	4.9				
1000	67	33.3	23.3	4.1	31.6	22.7	4.3	29.8	22.0	4.4	28.0	21.3	4.5				
1000	63	30.8	27.1	3.7	29.1	26.4	3.9	27.4	25.7	4.0	25.7	25.1	4.1				
1000	59	28.1	28.1	3.3	26.4	26.4	3.4	24.7	24.7	3.6	23.1	23.1	3.7				
1200	71	36.7	20.8	4.6	34.8	20.2	4.8	32.8	19.5	4.9	30.9	18.9	5.0				
1200	67	34.3	25.4	4.3	32.5	24.8	4.4	30.6	24.1	4.5	28.8	23.4	4.7				
1200	63	31.7	29.9	3.9	30.0	29.2	4.0	28.2	28.2	4.1	26.4	26.4	4.3				
1200	59	28.9	28.9	3.4	27.1	27.1	3.6	25.4	25.4	3.7	23.7	23.7	3.8				
1400	71	37.5	22.2	4.7	35.5	21.5	4.9	33.5	20.9	5.0	31.5	20.2	5.1				
1400	67	35.1	27.4	4.4	33.2	26.7	4.5	31.2	26.0	4.6	29.4	25.3	4.8				
1400	63	32.4	32.4	4.0	30.6	30.6	4.1	28.8	28.8	4.2	27.0	27.0	4.4				
1400	59	29.4	29.4	3.5	27.7	27.7	3.6	25.9	25.9	3.8	24.2	24.2	3.9				
NOTE: When used with 517B036HPFC, add 0.1 KW and deduct 0.5 MBtuh; with 519A036MCC/520B042BP, deduct 0.5 MBtuh																	
541B041SHP Outdoor Section With 519A042MCC/520B042BP or 519A042MCC Indoor Section																	
1200	71	43.5	23.5	5.6	40.8	22.5	5.8	37.8	21.5	6.0	34.9	20.5	6.2				
1200	67	40.6	28.2	5.2	38.0	27.2	5.3	35.3	26.2	5.6	32.5	25.2	5.8				
1200	63	37.4	32.7	4.7	35.0	31.8	4.9	32.4	30.7	5.1	29.8	29.7	5.3				
1200	59	33.8	33.8	4.2	31.7	31.7	4.3	29.2	29.2	4.5	26.7	26.7	4.7				
1400	71	44.7	25.0	5.8	41.8	24.0	5.9	38.7	23.0	6.2	35.7	22.0	6.4				
1400	67	41.7	30.3	5.3	39.0	29.4	5.5	36.1	28.3	5.7	33.2	27.3	5.9				
1400	63	38.4	35.5	4.9	35.9	34.5	5.0	33.2	33.2	5.2	30.5	30.5	5.4				
1400	59	34.7	34.7	4.3	32.4	32.4	4.5	29.8	29.8	4.6	27.3	27.3	4.8				
1600	71	45.6	26.4	5.9	42.6	25.4	6.1	39.5	24.4	6.3	36.3	23.4	6.5				
1600	67	42.6	32.3	5.5	39.8	31.3	5.6	36.8	30.3	5.8	33.8	29.2	6.0				
1600	63	39.2	38.1	5.0	36.6	36.6	5.1	33.8	33.8	5.3	31.0	31.0	5.5				
1600	59	35.4	35.4	4.4	33.0	33.0	4.5	30.4	30.4	4.7	27.7	27.7	4.9				
NOTE: When used with 519A042MCC/520B042BP, add 0.1 KW																	

1. Total and sensible capacities are net capacities. Blower motor heat has been subtracted.
2. Sensible capacities shown are based on 80°F entering air at the indoor coil. For sensible capacities at other than 80°F, deduct 835 Btuh per 1000 Ft³/Min of indoor coil air for each degree below 80°F, or add 835 Btuh per 1000 Ft³/Min of indoor coil air per degree above 80°F.
3. Detailed cooling capacities are based on indoor and outdoor unit at the same elevation and connected by 30 feet of tubing. If other than 30 feet of tubing is used and/or indoor unit is located above outdoor unit, a slight variation in capacity may occur.
4. Unit KW is total of indoor and outdoor unit KW's.

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DETAILED COOLING CAPACITIES

Indoor Coil Air		OUTDOOR COIL ENTERING AIR TEMPERATURE °F															
		85				95				105				115			
		Net Capacity MBtuh		Total System KW	Net Capacity MBtuh		Total System KW	Net Capacity MBtuh		Total System KW	Net Capacity MBtuh		Total System KW				
Ft ³ /Min	°F	Total	Sens		Total	Sens		Total	Sens		Total	Sens					
541B047SHP Outdoor Section With 519A048MCC/520B048BP or 519A048MCC Indoor Section																	
1400	71	47.7	26.0	5.9	45.1	25.1	6.1	42.9	24.4	6.3	39.6	23.3	6.6				
1400	67	44.6	31.4	5.5	42.1	30.5	5.7	39.9	29.7	5.9	36.9	28.6	6.1				
1400	63	41.2	36.6	5.0	38.8	35.7	5.2	36.6	34.8	5.4	33.9	33.7	5.6				
1400	59	37.5	37.5	4.4	35.2	35.2	4.6	32.9	32.9	4.8	30.4	30.4	5.0				
1600	71	48.8	27.4	6.1	46.1	26.5	6.3	43.7	25.8	6.5	40.4	24.7	6.7				
1600	67	45.6	33.4	5.6	43.0	32.5	5.8	40.7	31.7	6.0	37.6	30.6	6.2				
1600	63	42.1	39.2	5.1	39.7	38.2	5.3	37.4	37.3	5.5	34.5	34.5	5.7				
1600	59	38.3	38.3	4.5	35.9	35.9	4.7	33.5	33.5	4.9	30.9	30.9	5.1				
1800	71	49.6	28.7	6.2	46.8	27.8	6.4	44.4	27.1	6.6	41.0	26.0	6.8				
1800	67	46.3	35.3	5.7	43.7	34.4	5.9	41.4	33.5	6.1	38.2	32.4	6.3				
1800	63	42.8	41.6	5.2	40.3	40.3	5.4	38.0	38.0	5.6	35.0	35.0	5.8				
1800	59	38.9	38.9	4.6	36.4	36.4	4.8	34.1	34.1	5.0	31.4	31.4	5.1				
NOTE: When used with 519A048MCC/520B048BP, add 0.1 KW																	
541B057SHP Outdoor Section With 519A060MCC Indoor Section																	
1600	71	61.0	32.0	7.5	57.9	30.9	7.8	54.7	29.8	8.0	51.8	28.8	8.3				
1600	67	57.0	38.2	6.9	54.0	37.1	7.2	51.0	35.9	7.5	48.1	34.8	7.7				
1600	63	52.8	44.2	6.3	49.8	42.9	6.6	46.9	41.8	6.8	44.0	40.6	7.1				
1600	59	48.1	48.1	5.6	45.2	45.2	5.9	42.4	42.4	6.1	39.4	39.4	6.3				
1800	71	62.2	33.4	7.7	59.0	32.4	8.0	55.7	31.2	8.2	52.7	30.2	8.5				
1800	67	58.1	40.3	7.1	55.0	39.2	7.4	51.9	38.0	7.6	49.0	36.9	7.9				
1800	63	53.8	46.9	6.5	50.8	45.7	6.7	47.8	44.5	6.9	44.9	43.3	7.2				
1800	59	49.0	49.0	5.8	46.0	46.0	6.0	43.1	43.1	6.2	40.1	40.1	6.4				
2000	71	63.2	34.9	7.8	59.9	33.8	8.1	56.6	32.7	8.3	53.5	31.7	8.6				
2000	67	59.0	42.3	7.2	55.9	41.2	7.5	52.7	40.0	7.7	49.7	38.9	8.0				
2000	63	54.6	49.5	6.6	51.5	48.3	6.8	48.5	47.1	7.1	45.5	45.5	7.3				
2000	59	49.7	49.7	5.9	46.7	46.7	6.1	43.7	43.7	6.3	40.7	40.7	6.5				
541B057SHP Outdoor Section With 519A060MCC/520B060BP Indoor Section																	
1800	71	60.3	32.8	7.7	57.2	31.7	8.0	54.0	30.7	8.3	51.1	29.7	8.6				
1800	67	56.3	39.6	7.1	53.4	38.5	7.4	50.3	37.4	7.7	47.5	36.4	7.9				
1800	63	52.1	46.2	6.5	49.2	45.0	6.7	46.3	43.9	7.0	43.5	42.8	7.3				
1800	59	47.5	47.5	5.8	44.6	44.6	6.0	41.8	41.8	6.2	38.9	38.9	6.5				
2000	71	61.2	34.2	7.9	58.1	33.2	8.1	54.8	32.1	8.4	51.9	31.1	8.7				
2000	67	57.2	41.7	7.3	54.2	40.5	7.5	51.1	39.4	7.8	48.2	38.4	8.1				
2000	63	53.0	48.8	6.6	50.0	47.6	6.9	47.0	46.5	7.1	44.1	44.1	7.4				
2000	59	48.2	48.2	5.9	45.2	45.2	6.1	42.4	42.4	6.3	39.4	39.4	6.6				
2200	71	62.0	35.6	8.0	58.9	34.5	8.3	55.5	33.5	8.5	52.5	32.5	8.8				
2200	67	58.0	43.6	7.4	54.9	42.5	7.6	51.8	41.4	7.9	48.8	40.3	8.2				
2200	63	53.7	51.3	6.7	50.6	50.2	7.0	47.6	47.6	7.2	44.7	44.7	7.5				
2200	59	48.8	48.8	6.0	45.8	45.8	6.2	42.9	42.9	6.4	39.9	39.9	6.7				

1. Total and sensible capacities are net capacities. Blower motor heat has been subtracted.
2. Sensible capacities shown are based on 80°F entering air at the indoor coil. For sensible capacities at other than 80°F, deduct 835 Btuh per 1000 Ft³/Min of indoor coil air for each degree below 80°F, or add 835 Btuh per 1000 Ft³/Min of indoor coil air per degree above 80°F.
3. Detailed cooling capacities are based on indoor and outdoor unit at the same elevation and connected by 30 feet of tubing. If other than 30 feet of tubing is used and/or indoor unit is located above outdoor unit, a slight variation in capacity may occur.
4. Unit KW is total of indoor and outdoor unit KW's.



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

UNIT MUST BE INSTALLED IN ACCORDANCE
WITH INSTALLATION INSTRUCTIONS

AIR HANDLING

UNIT #1

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OF POOR QUALITY**

McQuay
DIVISION

McQUAY-PEREX INC.
13600 INDUSTRIAL PARK BLVD.
P.O. BOX 1551
MINNEAPOLIS, MINNESOTA 55440

CERTIFIED PERFORMANCE DATA

Central Station
Air Handling Units

SOLD TO:
Truog-Nichols, Inc.

McQuay Order No. GO. 652926

DATE 3/2/78

CUST. P.O. 9-17584

REP. Thermal Components

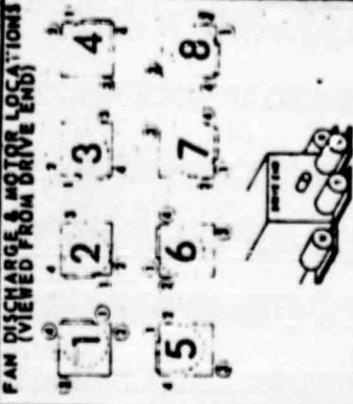
REP. P.O. 78L26

JOB:
Fire Station #24

CONSULTING ENGINEER:
Associated Engineering
Consultants

COPIES FOR APPR'L FOR RECORD

REV. NO. BY DATE WAS



McQUAY ITEM #	TAG	QTY.	UNIT MODEL NUMBER	UNIT ARRANGT.	FAN DISC. NO.	FAN MTR. LOC. NO.	UNIT MTR. TOP BOT.	CFM	OVLFT VELOCITY	RPM	BHP	MOTOR DATA		WATER PRESSURE DROP	CONNECT LOCATION DRIVE END	SUPPLY CONNECT. NO. SIZE	RETURN CONNECT. NO. SIZE
												VOLTAGE	H.P.				
010	LHD111	1	H111	H111	5	1	X	5600	1600	782	2.9	3	1800	208-60-3			MCQ
010	5WH1202	21	10.6	530	570	332-192	332-192	250	199	55	0.1	7	182	X	I 2 1/2	NPT	NPT

McQUAY ITEM #	ACCESSORY ARRANGEMENT NO.	VIBRATION ISOLATOR SET NUMBER	OVERALL LENGTH	"X" DIMENSION	DRIVE TYPE	AIR FRICTION			MULTI-TONE DAMPER SHAFT EXT.	ENTERING AIR D.B. W.B.	LEAVING AIR D.B. W.B.	GPM	ENT. H2O TEMP.	L.V.G. H2O TEMP.				
						ITEM #	MTG. COIL	CLG. COIL										
010			43-3/8		Adj.		0.41											
McQUAY ITEM #	VIBRATION ISOLATOR SET NUMBER	McQUAY ITEM #	VIBRATION ISOLATOR SET NUMBER		OTHERS		CASING INTERNAL	TOTAL										
							1.25	1.66										

NOTES:
Unit furnished with combination magnetic starter/disconnect with H-O-A switch and auxiliary contact.



*COIL POS. - COIL POSITION CODE: 18 - 1st coil in std. coil sect. or coil in cold deck of blow-thru unit; 24 - 2nd coil in std. coil sect. or coil in hot deck of blow-thru unit; 27 - 3rd coil in std. coil sect.; PH - Proheat (before 1st std. sect. of unit); RM - Reheat (before fan section)

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SHOP DRAWING REVIEW
Midgley Sheughnessy Fickel and Scott Architects Inc.
20 West 9th Street Kansas City, Missouri 64108

Review is for general compliance with contract documents.
Sole responsibility for correctness of dimensions, details,
quantities and safety e.g. fabrication and erection shall
remain with the Contractor.

No Exceptions Noted
 Make Corrections Noted
 Amend and Resubmit
 Rejected - See Remarks

Date: 10/17/77 By: [Signature]

DATE: 10/17/77
BY: [Signature]

ASSOCIATED ENGINEERING CONSULTANTS, INCORPORATED

NO EXCEPTIONS TAKEN
 MAKE CORRECTIONS NOTED
 AMEND AND RESUBMIT
 REJECTED - SEE REMARKS

NOTE: REVIEW DOES NOT RELIEVE THE CONTRACTOR FROM ANY RESPONSIBILITY FOR ERRORS OR DEVIATIONS FROM THE CONTRACT REQUIREMENT OR FOR ANY DEFICIENCIES OF EQUIPMENT, WORK OR MATERIALS.

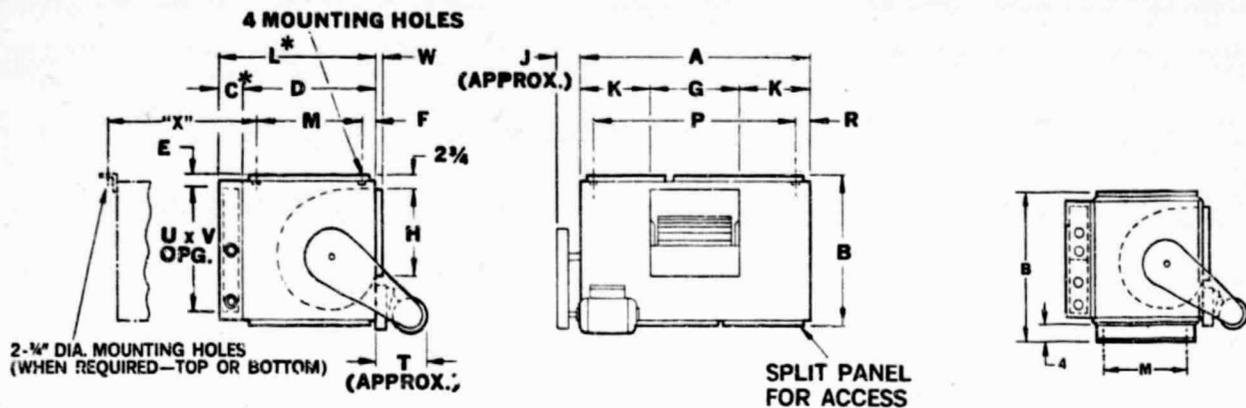
McQuay certifies that it will furnish equipment in accordance with this drawing and specifications, and subject to its published warranty. Purchaser's approval of this drawing signifies that the equipment is acceptable

under the provisions of the job specifications. Any change made hereon by any person whomsoever is subject to acceptance by McQuay at its home office.

GENERAL SPECIFICATIONS

CABINET - GALVANIZED STEEL STRUCTURAL FRAME AND PANELS. ACCESS DOORS AND REMOVABLE PANELS PROVIDE COMPLETE ACCESSIBILITY TO INTERIOR.
FANS - GALVANIZED STEEL DYNAMICALLY BALANCED. BLADES RIVETED TO RIMS AND CENTER PLATE. CAST IRON HUBS.
HOUSINGS - GALVANIZED STEEL, DIE FORMED WITH SPOT WELDED SEAMS.
SHAFTS - SOLID HIGH CARBON STEEL SIZED SO THAT THE OPERATING SPEED IS WELL BELOW THE FIRST CRITICAL

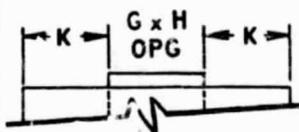
SPEED.
SHEAVES - MACHINED CAST IRON, "V" GROOVE TYPE, KEY SEATED TO SHAFT.
MOTOR MOUNT - ADJUSTABLE FOR VARYING BELT TENSION.
BEARINGS - SELF ALIGNING, BALL TYPE WITH GREASE FITTINGS AND EXTENDED LUBE LINES.
BELT GUARDS - GALVANIZED STEEL WITH FAN SHAFT TACHOMETER OPENING.



- NOTE:**
1. MOUNTING HOLE DATA:
UNIT SIZES 103-228:
5/8 V.C. TAPPED TOP OR BOTTOM
UNIT SIZES 237-164:
3/4 DIA. BOTTOM ONLY
 2. UNIT SIZE 130-228 ARE SUITABLE FOR INVERTED MOUNTING.
 3. FOR CEILING SUSPENSION, UNIT SIZES 237-164 MUST BE PLATFORM MOUNTED.

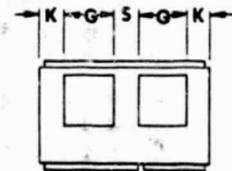
4. UNIT SIZES 237-164 WITH NO'S. 5, 6, 7 OR 8 FAN DISCHARGES REQUIRE SQUARED BLOWER SECTIONS. FOR SQUARED BLOWER SECTIONS ADD "Q" TO "D", "L" AND "M" DIMENSIONS.
5. "X" DIMENSION IS FOUND BY ADDING DIMENSION OF THE OPTIONAL SECTIONS USED PLUS 10-1/4" THRU UNIT SIZE 217 AND 10-3/4" THRU UNIT SIZE 164. INCLUDE 1/8" FOR GASKETING WHERE SECTIONS BOLT TOGETHER. IF 3 OR 4 ROW COIL USED ADD 3-1/2" TO THESE DIMENSIONS.

**CABINETS WITH OPTIONAL
A.F. FAN WHEELS
UNIT SIZES 214, 217, 222, 228, 237**



	214	217	222	228	237
G	29 3/4	29 3/4	35 1/2	35 3/4	43 3/4
H	23 1/4	23 3/4	28 3/8	28 3/8	35 3/8
K	24 3/8	31 1/8	30 3/4	42 1/4	39 3/8

**CABINET WITH TWO F.C. FAN WHEELS
UNIT SIZES 206, 209, 214, 217, 222, 228 & 237**



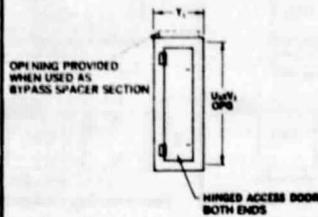
PHYSICAL DIMENSIONS (Inches)

UNIT SIZE	A	B	C*	D	E	F	G	H	J	K	L*	M	P	Q	R	S	T	U	V	W
103	34	22 1/2	6 1/2	21 1/4	2 1/2	2 1/2	11 1/4	10 1/4	6 1/2	11 1/2	28 3/8	16 1/2	28 1/2	-	2 1/4	-	15	17 1/2	29 3/8	1
104	40	25 1/2	6 1/2	24 1/4	2 1/2	2 1/2	12 1/4	13 1/2	6 1/2	13 3/8	31 1/8	19 1/2	34 1/2	-	2 1/4	-	15	20 1/2	35 3/8	1
106	50	29	6 1/2	28	2 1/2	2 1/2	17 1/4	15 3/4	6 1/2	16 3/8	34 1/8	22 3/4	44 1/2	-	2 1/4	-	16	23 3/4	45 3/8	1
206	69	22 3/4	6 1/2	21 3/4	2 1/2	2 1/2	13 3/8	10 3/4	6 1/2	12 3/4	28 3/8	16 1/2	63 1/2	-	2 1/4	16 1/4	18	17 1/2	64 3/8	1
108	48	37 3/4	6 1/2	36 3/4	2 1/2	2 1/2	21 1/4	19 3/8	8	13 3/8	43 3/8	31 1/2	42 1/2	-	2 1/4	-	18	32 1/2	43 3/8	1
209	83	25 1/4	6 1/2	24 1/4	2 1/2	2 1/2	17 3/8	15 3/8	6 1/2	15	31 3/8	19 1/2	77 1/2	-	2 1/4	18 1/4	18	20 1/2	78 3/8	1
111	63	37 3/4	6 1/2	36 3/4	2 1/2	2 1/2	23 1/4	21 3/8	8	19 3/8	43 3/8	31 1/2	57 1/2	-	2 1/4	-	18	32 1/2	58 3/8	1
214	78	37 3/4	6 1/2	36 3/4	2 1/2	2 1/2	19	17 3/8	8	10	43 3/8	31 1/2	72 1/2	-	2 1/4	20	21	32 1/2	73 3/8	1
217	93	37 3/4	6 1/2	36 3/4	2 1/2	2 1/2	21 1/4	19 3/8	8	12 1/4	43 3/8	31 1/2	87 1/2	-	2 1/4	25 1/4	21	32 1/2	88 3/8	1
222	97	44 1/4	7	43 3/4	2 1/2	2 1/2	23 1/4	21 3/8	9	12 1/2	50 3/8	38 1/2	91 1/2	-	2 1/4	25 1/4	21	39 1/2	92 3/8	1
228	120	44 1/4	7	43 3/4	2 1/2	2 1/2	28 1/4	26 1/2	9	15 1/2	50 3/8	38 1/2	114 1/2	-	2 1/4	31 1/4	23	39 1/2	115 3/8	1
237	122 1/2	61 1/2	7	45 3/4	3 1/2	3 1/2	31 1/2	28 3/4	11 1/2	15 1/2	52 1/4	39 1/2	117 3/4	11 3/4	2 1/2	29	25	51 1/4	115 1/2	1
141	122 1/2	69 3/4	7	59 3/4	3 1/2	3 1/2	46 3/4	43 3/4	11 1/2	37 3/8	66 1/4	53	117 3/4	6 1/2	2 1/2	-	25	59 1/2	115 1/2	1 1/2
150	122 1/2	79 3/4	7	66 3/4	3 1/2	3 1/2	51 1/2	47 1/4	11 1/2	35 3/8	73 1/4	60 1/2	117 3/4	8 1/2	2 1/2	-	25	69 1/4	115 1/2	1 1/2
164	122 1/2	97 3/4	7	72 3/4	3 1/2	3 1/2	56 1/4	52 3/4	11 1/2	32 3/4	79 3/4	66 1/2	117 3/4	20 1/4	2 1/2	-	25	87 1/4	115 1/2	1 1/2

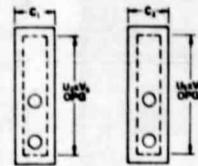
*Add 3/2 inches for 3 or 4-row coils.

ACCESSORIES

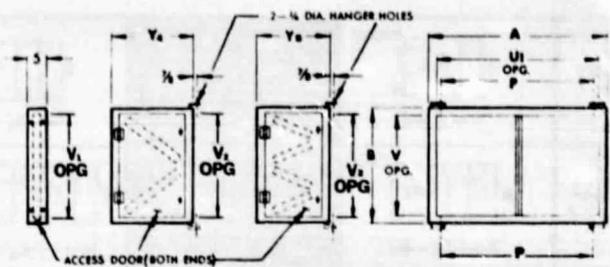
ACCESS BY-PASS SPACER SECTION



HEATING COIL SECTIONS 1 & 2 ROW COILS 3 & 4 ROW COILS

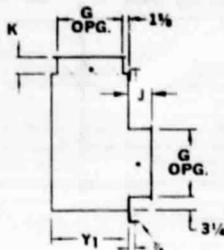


FILTER SECTIONS FLAT ANGULAR HEAVY DUTY *

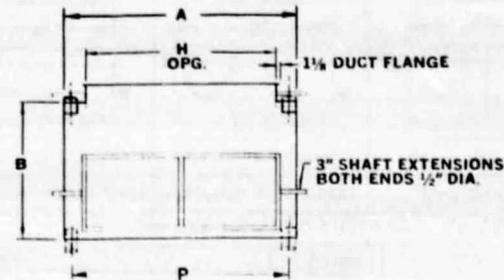
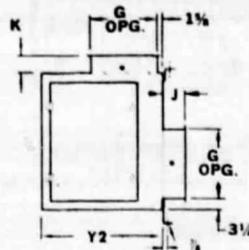


*AVAILABLE IN UNIT SIZES
209 THRU 164 ONLY

STANDARD



COMBINATION

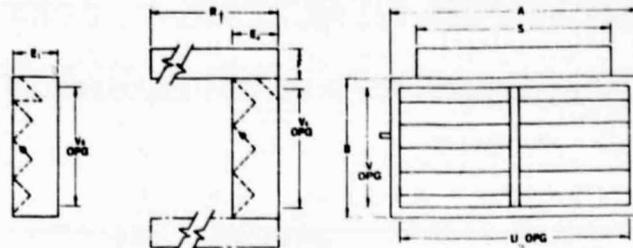


NOTE: WHEN BACK AND BOTTOM OPENINGS ARE
REQUIRED, MIXING BOX IS INVERTED
(TOP AND BOTTOM OPENINGS ALSO AVAILABLE)

FACE AND BYPASS DAMPER SECTIONS

INTERNAL

EXTERNAL



† TOP MOUNTING HOLES ON BACK OF BLOWER
CASING UNIT SIZE 103 THRU 228 CANNOT BE
USED WITH THIS SECTION.

3" SHAFT EXTENSIONS
BOTH ENDS 1/2" DIA.

ORIGINAL PAGE IS
OF POOR QUALITY

DIMENSIONS

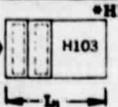
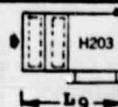
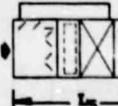
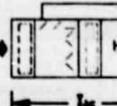
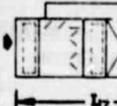
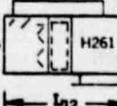
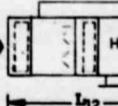
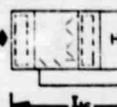
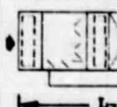
NOTE: WHEN SECTIONS ARE BOLTED TOGETHER ADD 1/8" FOR GASKETING.

UNIT SIZE	DIMENSIONS (Inches)																											
	A	B	C1	C2	E1	E2	F	G	H	J	K	P1	R	S	T*	U1	U2	V1	V2	V3	V4	V5	V6	Y1	Y2	Y3	Y4	Y5
103	34	21 1/2	6 1/2	10	6 1/4	7 3/4	6	12 1/2	25 1/4	6 1/4	4 1/2	28 1/2	21	33 1/2	25 1/2	30 1/2	29 1/2	17 1/2	18 1/4	17 1/2	17 3/4	17 1/2	18 1/4	15 1/4	22 1/2	18	19 1/2	24 1/2
104	40	24 1/2	6 1/2	10	8	8 1/4	6 1/2	12 1/2	31 3/4	6 1/4	4 1/2	34 1/2	21 1/2	39 1/2	20 1/2	36 1/2	35 1/2	20	21 1/4	20 1/2	20 1/2	21 1/4	15 1/4	23	18	19	24 1/2	24 1/2
106	50	27 3/4	6 1/2	10	9	9 1/4	7 1/2	12 1/2	41 1/2	6 1/4	4 1/2	44 1/2	23 1/2	49 1/2	22	46 1/2	45 1/2	23 1/2	24 1/2	23 1/4	23	23 1/2	24 1/2	15 1/4	27 1/2	18	22 1/2	24 1/2
206	69	21 1/2	6 1/2	10	6 1/4	7 3/4	6	12 1/2	60 3/4	6 1/4	4 1/2	63 1/2	21	68 1/2	20 1/2	65 1/2	64 1/2	17 1/2	18 1/4	17 1/2	17 3/4	17 1/2	18 1/4	15 1/4	22 1/2	18	19 1/2	24 1/2
108	48	36 1/2	6 1/2	10	9	11	9 1/2	18 1/2	39 1/2	6 1/4	4 1/2	42 1/2	27 1/2	47 1/2	25 1/2	44 1/2	43 1/2	32 1/2	33 1/4	32 1/2	30 1/2	32 1/2	33 1/4	21 1/4	33 1/2	18	26	26 1/2
209	83	24 1/2	6 1/2	10	8	8 1/4	6 1/2	12 1/2	74 1/2	6 1/4	4 1/2	77 1/2	21 1/2	82 1/2	23	79 1/2	78 1/2	20	21 1/4	20 1/2	20 1/2	21 1/4	15 1/4	23	18	19	24 1/2	24 1/2
111	63	36 1/2	6 1/2	10	9	11	9 1/2	18 1/2	54 1/2	6 1/4	4 1/2	57 1/2	27 1/2	62 1/2	25 1/2	59 1/2	58 1/2	32 1/2	33 1/4	32 1/2	30 1/2	32 1/2	33 1/4	21 1/4	33 1/2	18	26	26 1/2
214	78	36 1/2	6 1/2	10	9	11	9 1/2	18 1/2	69 1/2	6 1/4	4 1/2	72 1/2	27 1/2	77 1/2	25 1/2	74 1/2	73 1/2	32 1/2	33 1/4	32 1/2	30 1/2	32 1/2	33 1/4	21 1/4	33 1/2	18	26	26 1/2
217	93	36 1/2	6 1/2	10	9	11	9 1/2	18 1/2	84 1/2	6 1/4	4 1/2	87 1/2	27 1/2	92 1/2	25 1/2	89 1/2	88 1/2	32 1/2	33 1/4	32 1/2	30 1/2	32 1/2	33 1/4	21 1/4	33 1/2	18	26	26 1/2
222	97	43 1/2	7	10 1/2	8	13 1/4	11 1/4	24 1/2	88 1/2	7 1/2	5 1/2	91 1/2	32 1/2	96 1/2	23	93 1/2	92 1/2	40 1/2	40 1/4	39 1/2	37 1/4	39 1/2	33 1/4	27 1/2	32 1/2	18	23	23 1/2
228	120	43 1/2	7	10 1/2	8 1/4	13 1/4	11 1/4	24 1/2	111 1/2	7 1/2	5 1/2	114 1/2	32 1/2	119 1/2	23	116 1/2	115 1/2	40 1/2	40 1/4	39 1/2	37 1/4	39 1/2	40 1/4	27 1/2	32 1/2	18	23	23 1/2
237	119 1/2	55 1/2	7	10 1/2	10	18	15 1/2	31 1/2	112 1/2	7 1/2	5 1/2	117 1/2	40	110 1/2	28	115 1/2	116 1/4	50 1/2	51 1/2	52 1/2	50 1/2	51 1/2	52 1/2	35 1/2	39 1/2	18	22 1/2	22 1/2
141	119 1/2	63 1/2	7	10 1/2	9 1/2	19 1/2	16 1/2	39 1/2	112 1/2	7 1/2	5 1/2	117 1/2	43	110 1/2	23 1/2	115 1/2	116 1/4	60 1/2	60 1/2	57	59 1/2	60 1/2	43	47 1/2	19 1/2	21 1/2	21 1/2	21 1/2
150	119 1/2	73 1/2	7	10 1/2	10	21 1/2	20	39 1/2	112 1/2	7 1/2	5 1/2	117 1/2	48 1/2	110 1/2	28	115 1/2	116 1/4	70 1/2	69 1/2	70 1/2	67 1/2	69 1/2	70 1/2	43	47 1/2	22 1/2	25 1/2	25 1/2
164	119 1/2	91 1/2	7	10 1/2	10	27 1/2	24 1/2	47 1/2	112 1/2	7 1/2	5 1/2	117 1/2	59	110 1/2	27	115 1/2	116 1/4	85 1/2	87 1/2	88 1/2	86 1/2	87 1/2	88 1/2	51	55 1/2	27 1/2	27 1/2	27 1/2

N.A. - Not Available. *Maximum Clearance required for filter removal. †Add 1 1/2" for flat filter. ‡Subtract 1 1/4" for heating section.
§Mounting holes are available on the bottom only on Unit Sizes 237 thru 164.

UNIT ARRANGEMENTS

LEFT HAND AIR INTAKE SHOWN RIGHT HAND OPPOSITE

UNIT SIZES 103 THRU 164				SQUARED BLOWER SECTION UNIT SIZE 237 THRU 164		
BASIC UNIT						
INT. F & B. P.						
EXT. F & B. P. TOP DUCT						
EXT. F & B. P. BOT. DUCT						
SECT:	BASIC UNIT	BASIC UNIT W/ACCESS	BASIC UNIT W/PREHEAT	BASIC UNIT W/ACCESS & PREHEAT	BASIC UNIT	BASIC UNIT W/PREHEAT

*ARRANGEMENT NO. FOR RIGHT HAND AIR INTAKE.

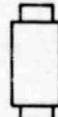
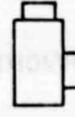
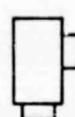
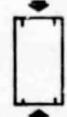
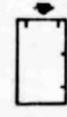
UNIT SIZE	DIMENSIONS (Inches)														
	L	L1*	L2	L3*	L4	L5	L6*	L7*	L8	L9*	L10	L11*	L12	L13*	
103	28½	35	35½	60	36½	54½	43	61¼	—	—	—	—	—	—	
104	31½	38	39½	64½	39½	57½	46½	64½	—	—	—	—	—	—	
106	34½	41½	43½	68½	43½	62	50½	68½	—	—	—	—	—	—	
206	28½	35	35½	60	36½	54½	43	61¼	—	—	—	—	—	—	
108	43½	50	52½	77½	54½	72½	61½	79½	—	—	—	—	—	—	
209	31½	38	39½	64½	39½	57½	46½	64½	—	—	—	—	—	—	
111	43½	50	52½	77½	54½	72½	61½	79½	—	—	—	—	—	—	
214	43½	50	52½	77½	54½	72½	61½	79½	—	—	—	—	—	—	
217	43½	50	52½	77½	54½	72½	61½	79½	—	—	—	—	—	—	
222	50½	58	59½	84½	64½	82½	71½	89½	—	—	—	—	—	—	
228	50½	58	59½	84½	64½	82½	71½	89½	—	—	—	—	—	—	
237	52½	59½	62½	88½	70½	89	78	96½	64½	71½	74½	99½	82½	89½	
141	66½	73½	76	102½	85½	105½	92½	112½	72½	79½	82½	109½	92½	99½	
150	73½	80½	83½	114	95½	118½	102½	125½	82½	89½	92½	122½	104½	111½	
164	79½	86½	89½	124½	107½	135	114½	142½	100½	107½	110½	145½	128½	135½	

NOTE: FOR OVERALL UNIT LENGTH ADD DIMENSIONS OF ACCESSORIES NOT INCLUDED IN "L" DIMENSION.

* ADD 3/4" FOR EACH 3 OR 4 ROW COIL

ORIGINAL PAGE IS OF POOR QUALITY

ACCESSORY ARRANGEMENTS

	FILTER SECTION ONLY	FILTER SECTION AND MIXING BOX					
		WITH DAMPERS			WITHOUT DAMPERS		
		B00	C00	D00	E00	F00	G00
MIXING BOX ONLY							
FLAT FILTER	A1*	B1*	C1*	D1*	E1*	F1*	G1*
ANGULAR FILTER	A4*	B4*	C4*	D4*	E4*	F4*	G4*
HEAVY DUTY FILTER	A5*	B5*	C5*	D5*	E5*	F5*	G5*

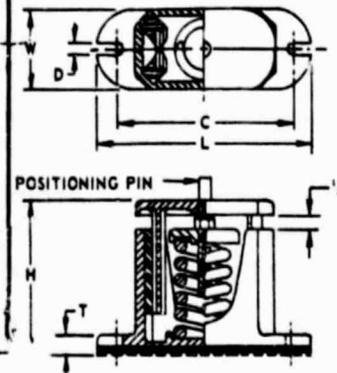
Replace asterisk with a "0" for no filters, "1" for throwaway filters, "2" for cleanable filters or "3" for cleanable high velocity filter.

FILTER DATA

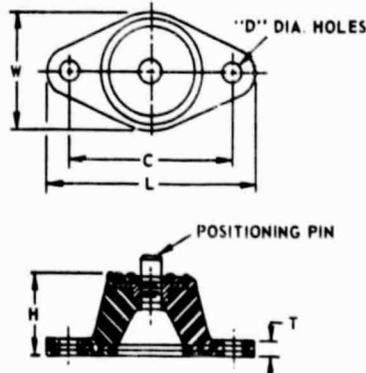
UNIT SIZE	FLAT		ANGULAR		HEAVY DUTY	
	QUANTITY	AREA	QUANTITY	AREA	QUANTITY	AREA
103	2-16 x 20 x 2	4.4	2-16 x 25 x 2	5.6	-	-
104	2-20 x 20 x 2	5.6	4-16 x 20 x 2	8.9	-	-
106	3-16 x 25 x 2	8.4	6-16 x 20 x 2	13.3	-	-
206	3-20 x 20 x 2	8.3	6-16 x 20 x 2	13.3	-	-
108	2-16 x 20 x 2	-	-	-	-	-
	2-16 x 25 x 2	10.0	6-16 x 25 x 2	16.7	-	-
209	4-20 x 20 x 2	11.1	8-16 x 20 x 2	17.8	8-20 x 20 x 2	22.2
111	6-16 x 20 x 2	13.3	6-20 x 25 x 2	20.8	9-20 x 20 x 2	25.0
214	6-16 x 25 x 2	16.7	4-16 x 25 x 2	-	-	-
	-	-	4-20 x 25 x 2	24.9	9-20 x 25 x 2	31.2
217	4-16 x 20 x 2	20.0	8-20 x 25 x 2	27.8	9-20 x 20 x 2	-
	4-16 x 25 x 2	-	-	-	6-16 x 20 x 2	38.3
222	12-16 x 20 x 2	26.7	12-16 x 25 x 2	33.4	24-16 x 20 x 2	53.3
228	12-20 x 20 x 2	33.4	12-20 x 25 x 2	41.8	24-20 x 20 x 2	66.6
237	12-20 x 25 x 2	41.6	16-20 x 25 x 2	55.5	24-20 x 25 x 2	83.3
141	18-20 x 20 x 2	50.2	24-20 x 20 x 2	66.7	36-20 x 20 x 2	100.0
150	12-20 x 25 x 2	-	-	-	-	-
	6-20 x 20 x 2	58.4	24-20 x 25 x 2	83.2	36-20 x 25 x 2	125.0
164	6-20 x 25 x 2	-	-	-	-	-
	18-20 x 20 x 2	70.6	30-20 x 25 x 2	104.0	36-20 x 25 x 2	125.0

VIBRATION ISOLATORS

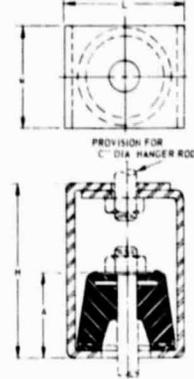
SPRING MOUNTS
TYPES "BP" & "CP"



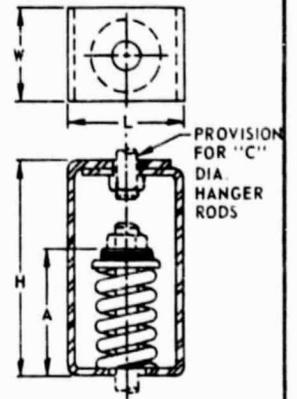
RUBBER-IN-SHEAR
MOUNTS
TYPE "RP"



RUBBER-IN-SHEAR
HANGER
TYPE "RH"



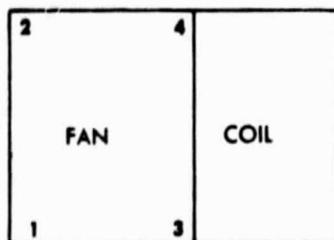
SPRING HANGER
TYPE "SH"



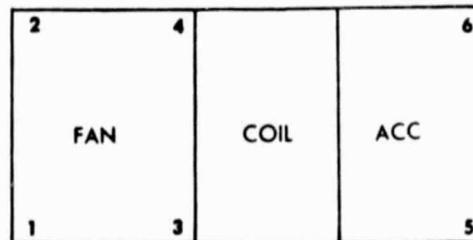
DIMENSIONS	ISOLATORS										
	BP	CP1	CP2	RP1	RP2	RP3	RP4	RH2	RH3	RH4	SH
A	-	-	-	-	-	-	-	1 3/8	2	2	4 3/8
C	5	6 1/2	9 1/4	2 3/4	3	4 1/4	5	9	3 1/4	1	3 1/4
D	3/8	3/8	3/8	1 1/32	1 1/32	9/16	9/16	-	-	-	-
*H	3 3/8	5	5 1/4	1	1 1/4	1 3/4	1 3/4	4 1/2	5 3/4	8	7
L	5 1/2	7 1/2	10 1/4	3	3 3/4	5 3/8	6 1/4	3	3 3/4	4 3/4	3 3/4
T	1/2	3/8	3/8	1/4	1/4	1/4	1/4	-	-	-	-
W	2 1/4	2 3/4	2 3/4	1 3/4	2 1/4	3 1/4	4	2 1/4	3 3/4	4	3

*OPERATING HEIGHT.

ISOLATOR LOCATIONS



WITHOUT ACCESSORIES



WITH ACCESSORIES

ORIGINAL PAGE IS
OF POOR QUALITY