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

Under DOE Contract EX-76-C-01-2373

Monitored by

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

For the U. S. Department of Energy

U.S. Department of Energy

Solar Energy

DISCLAIMER

TECHNICAL REPORT STANDARD TITLE PAGE

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DOE/NASA CR-161513		

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This work was done under the technical management of Mr. Charles L. Greer, George C. Marshall Space Flight Center, Alabama 35812.

16. ABSTRACT

This Document is the Final Report of the Solar Energy Heating and Hot Water System installed at the Kansas City Fire Station, Number 24, 2309 Hardesty Street, Kansas City, Missouri. The solar system was designed to provide 47 percent of the space heating, 8,800 square feet area and 75 percent of the domestic hot water (DHW) load. The solar system consists of 2,808 square feet of Solaron, model 2001, air, flat plate collector subsystem, a concrete box storage subsystem which contains 1,428 cubic feet of ½ inch diameter pebbles weighing 71½ tons, a DHW preheat tank, blowers, pumps, heat exchangers, air ducting, controls and associated plumbing. Two 120-gallon electric DHW heaters supply domestic hot water which is preheated by the solar system. Auxiliary space heating is provided by three electric heat pumps with electric resistance heaters and four 30-kilowatt electric unit heaters. There are six modes of system operation.

This project is part of the Department of Energy PON-1 Solar Demonstration Program with DOE cost sharing $154,282 of the $174,372 solar system cost. The Final Design Review was held March 1977, the system became operational March 1979 and acceptance test was completed in September 1979.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
	Unclassified-Unlimited UC59a William A. Brooksbank, Jr. WILLIAM A. BROOKSBANK, JR. Mrg., Solar Energy Applications Proj.

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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 notitied 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

Climate Data:	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 50^{0} was established for the apparatus bay and 70^{0} 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 intergral 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.

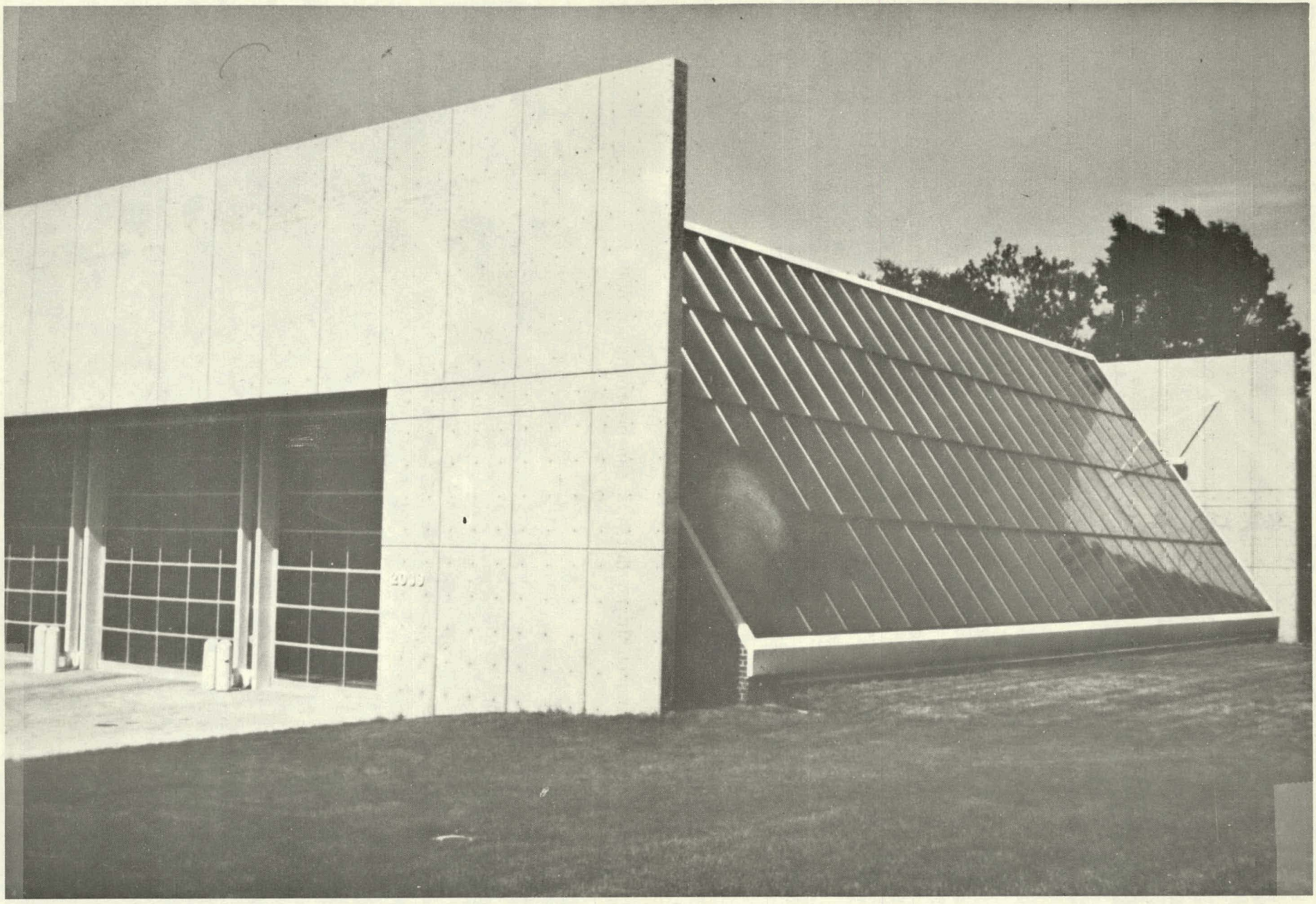
The extent of collector shading caused by the screen walls was measured at Kansas State University with equipment capable of providing sunpath and solar angle information relative to radiant energy and shading calculations. From these measurements, it was established that throughout the entire heating 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

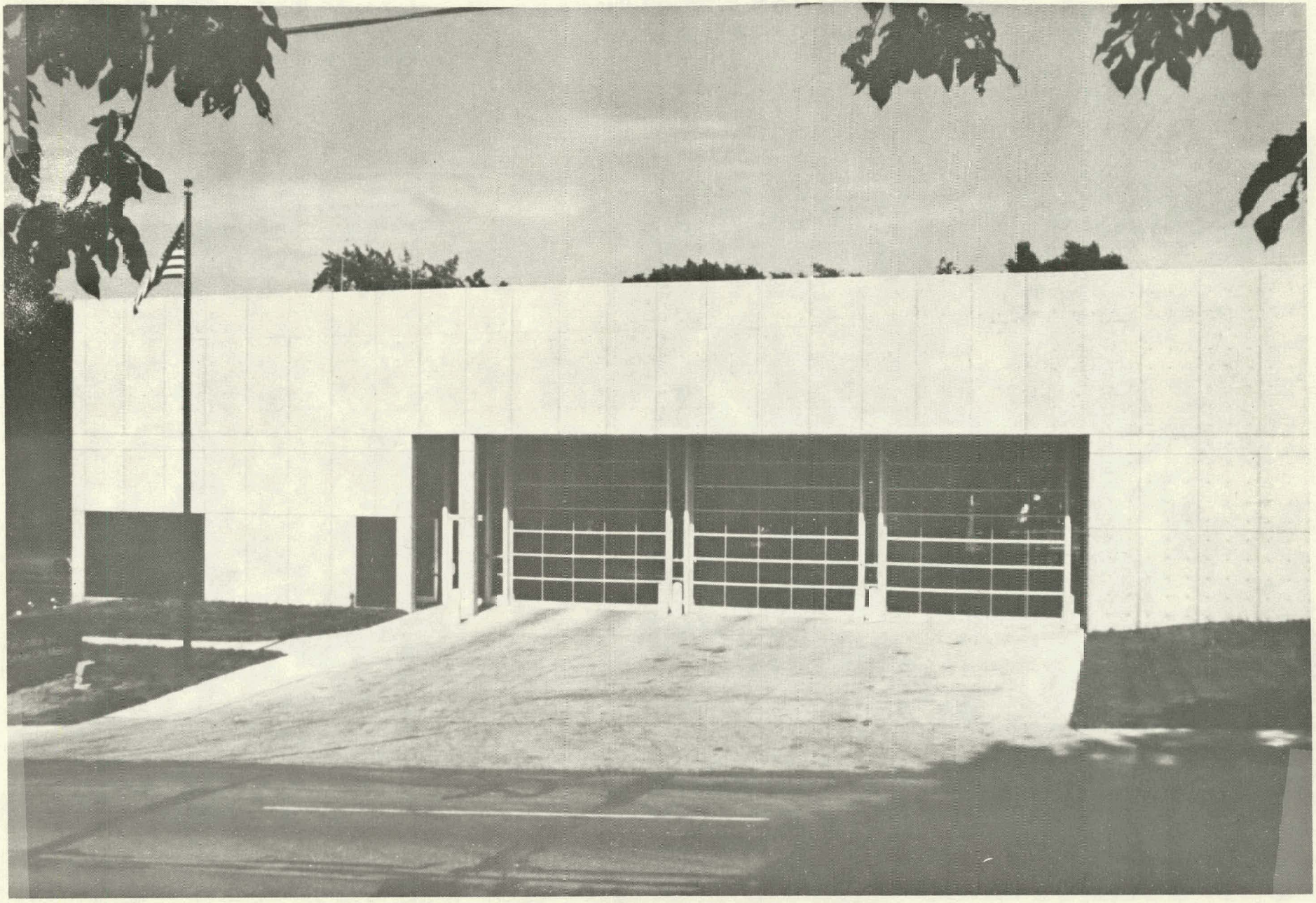
was carefully engineered during the development of construction plans. Other than a few sealant failures that allowed storm water to enter the building through the roof collectors, the installation has proved satisfactory. Vandalism has occurred in that collector glass has been broken. Replacement was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

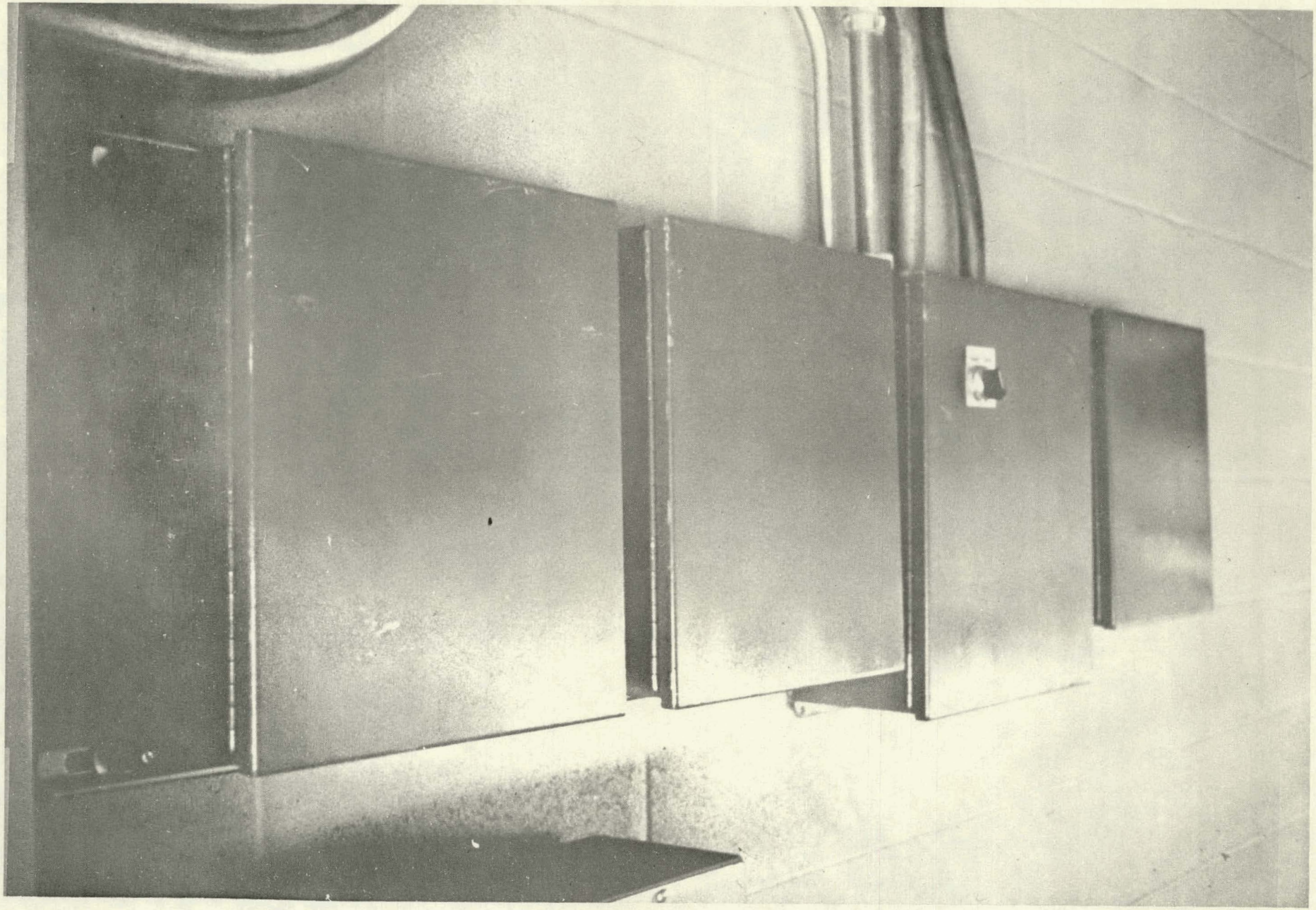
Floor plans and building details can be found in Appendix A.



View of Solaron Collectors

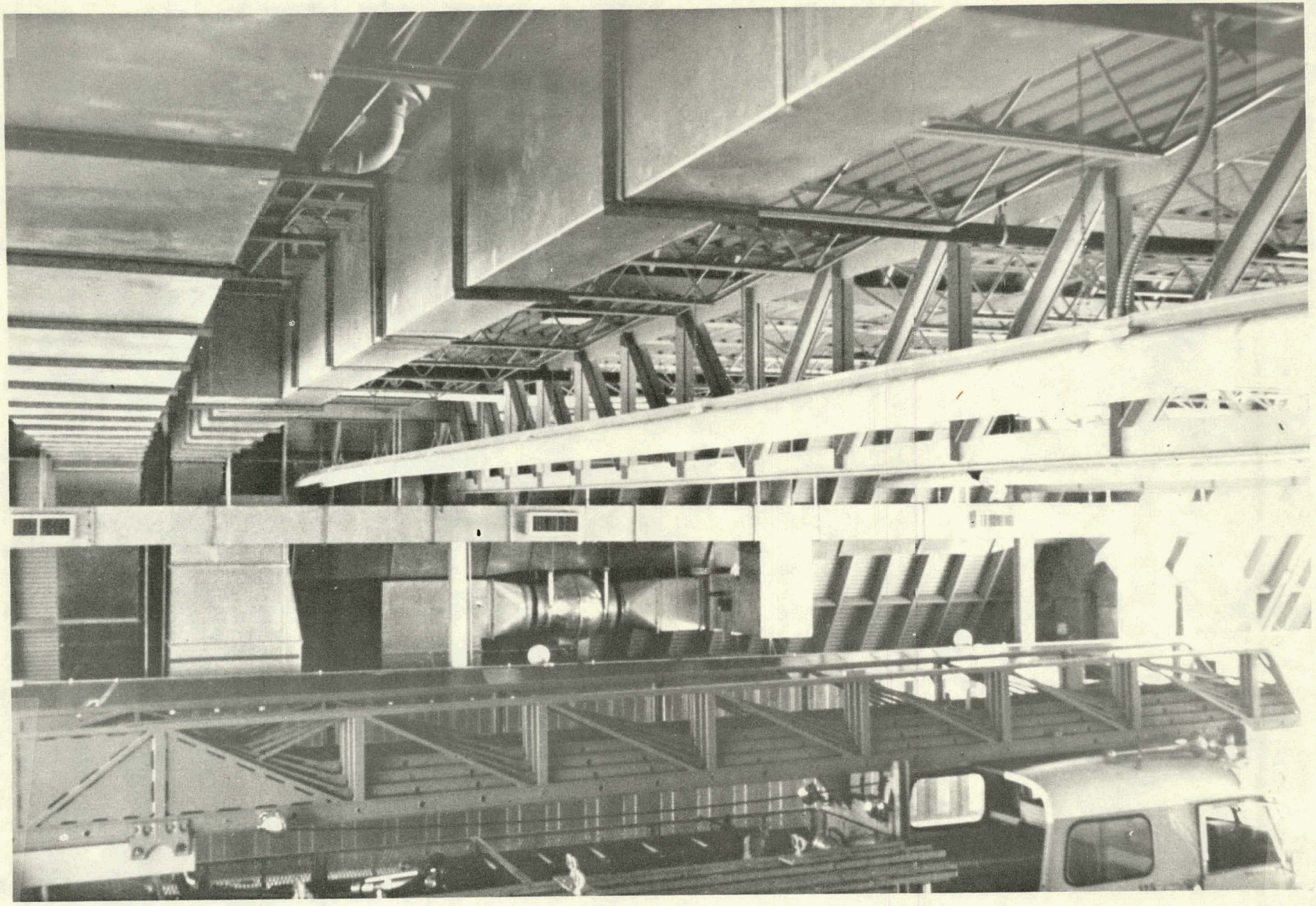


Front View Kansas City Fire Station #24

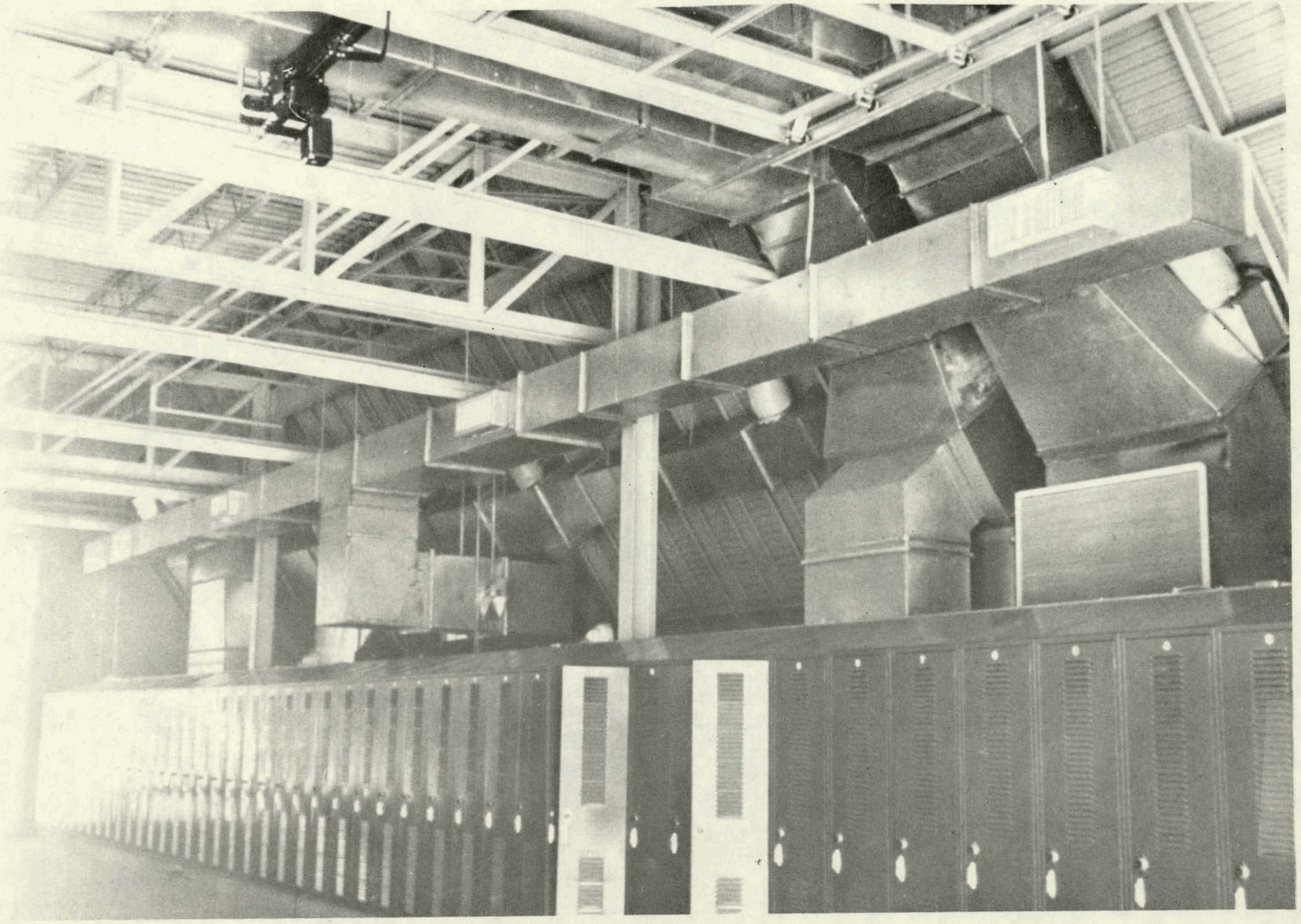


Solaron Control Boxes

Hot Water Heater Storage Tank Area



Solar System Ducting/Air Handler #3



Apparatus Room Heat Distribution Ductwork

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.

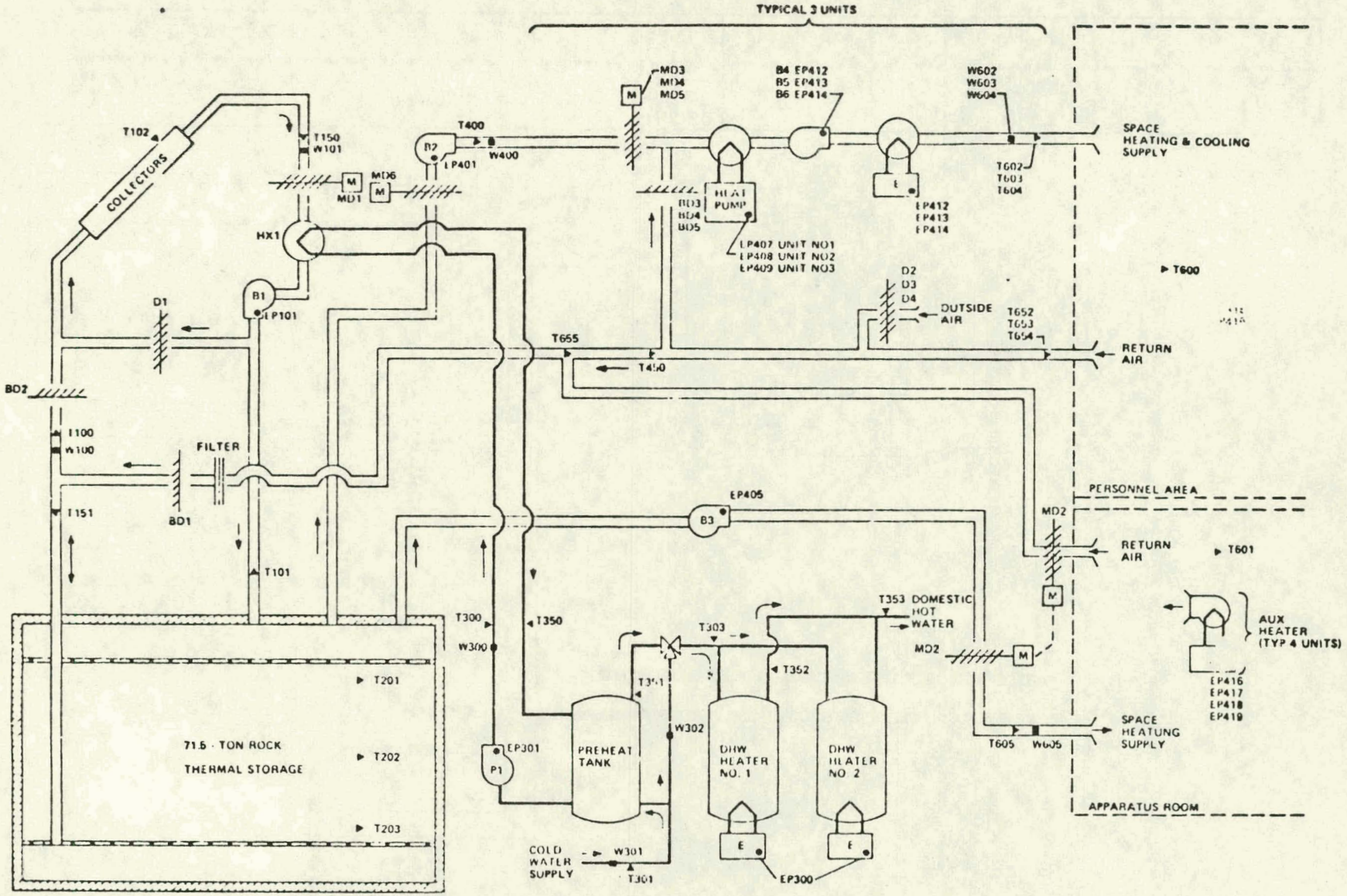
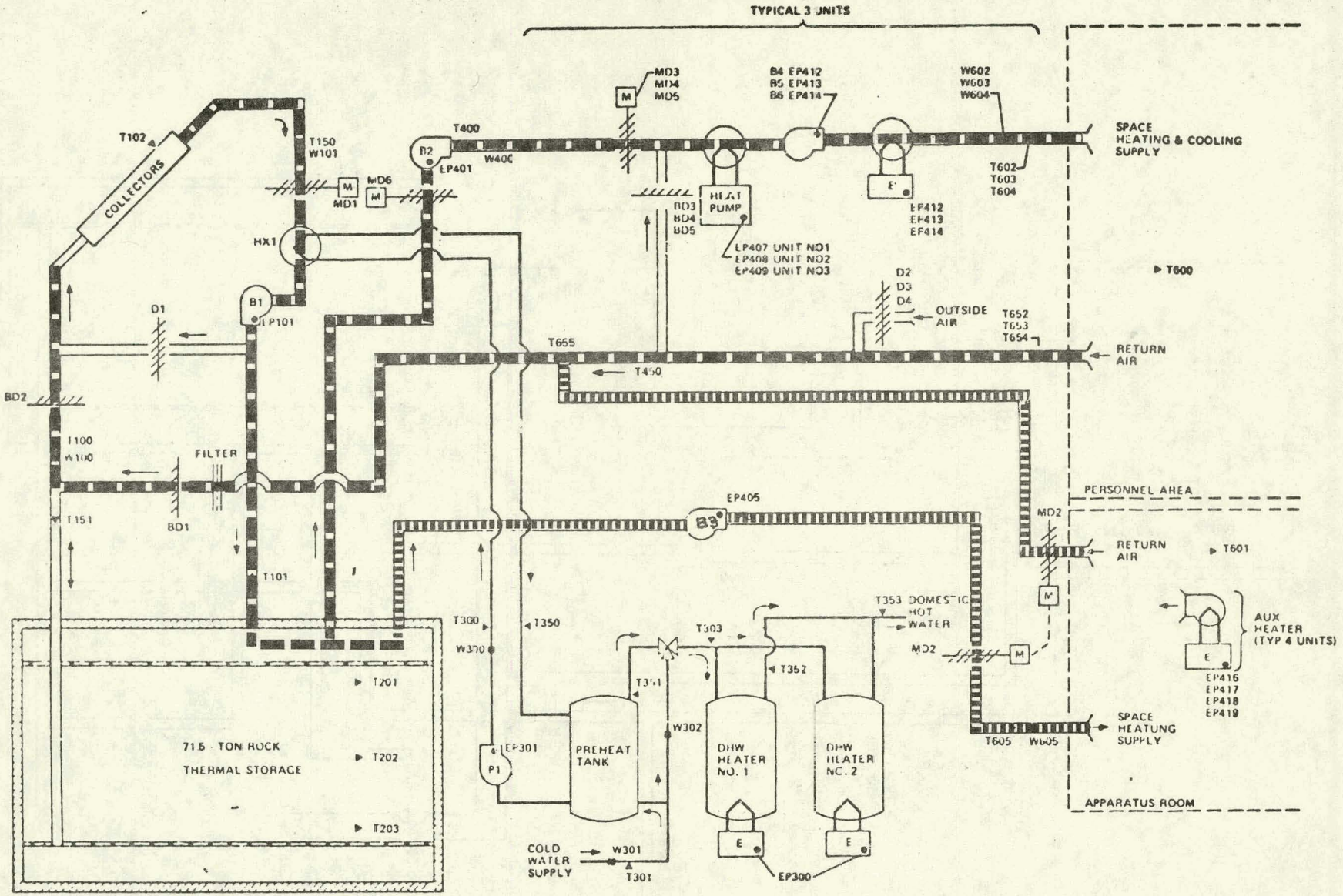
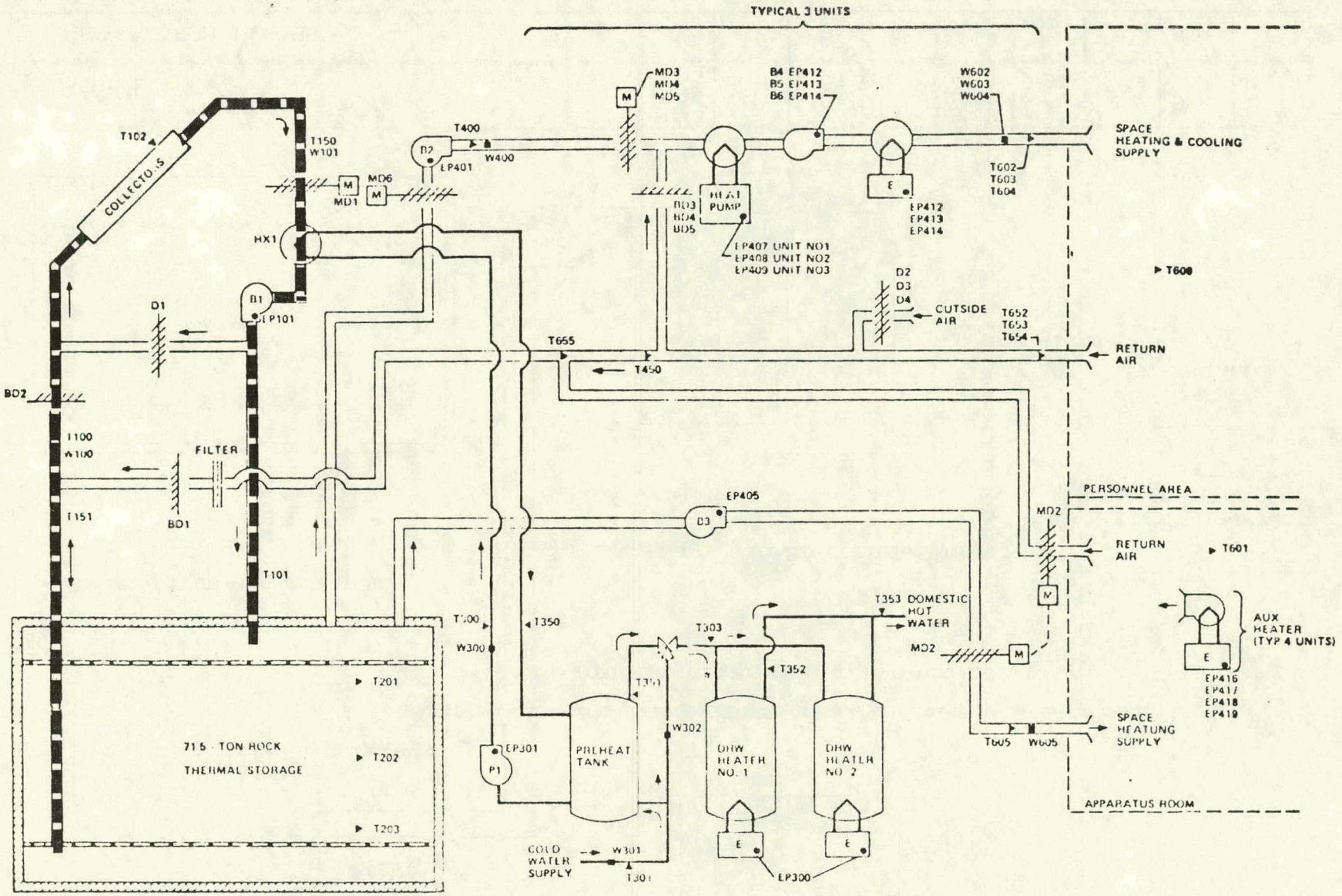


FIGURE 1 SCHEMATIC DRAWING OF SOLAR HEATING SYSTEM



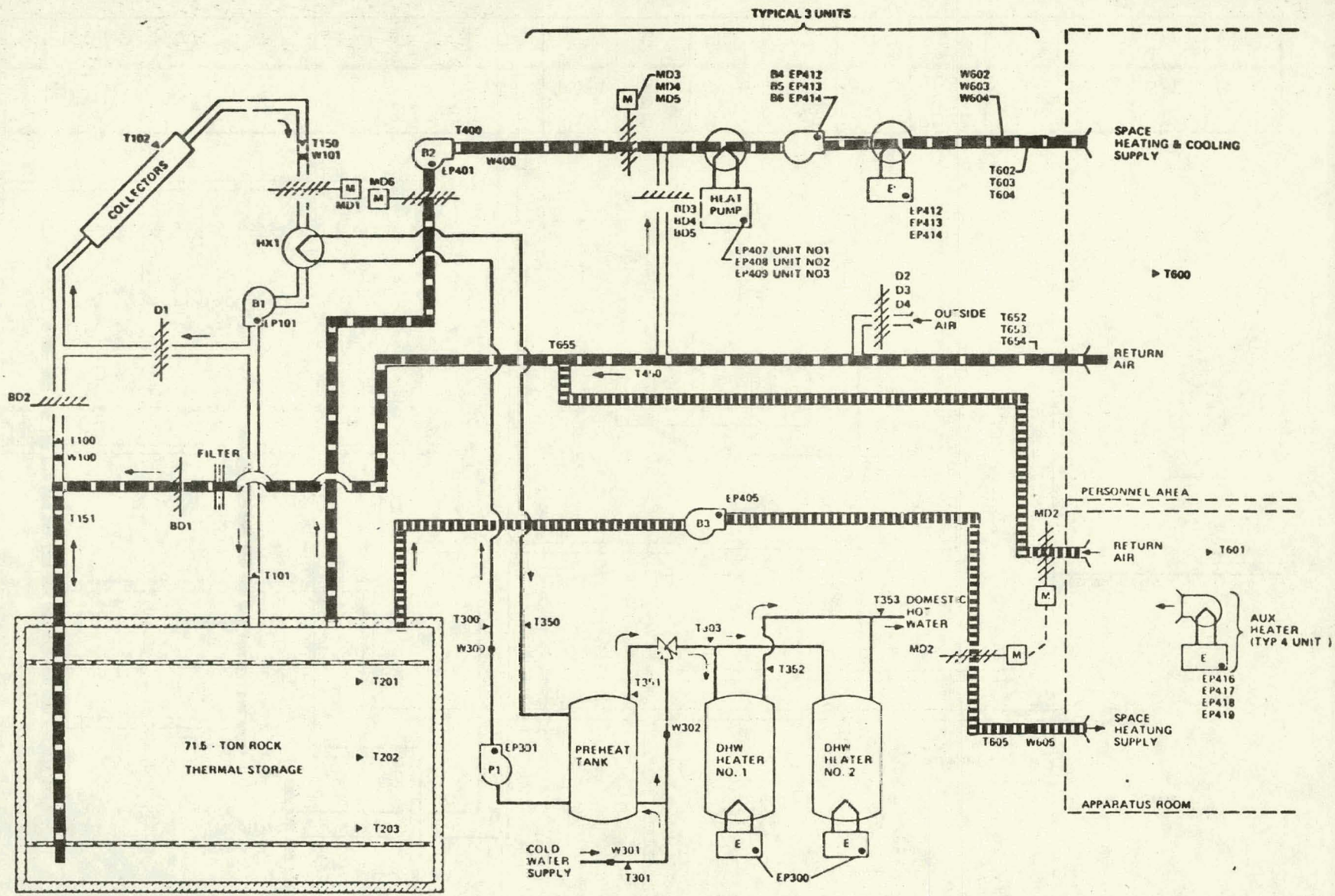
MODE #1	MD-1	MD-2	MD-3 MD-4 MD-5	MD-6	BD-1	BD-2	BD-3 BD-4 BD-5	D-1	B-1	B-2 B-3	B-4 B-5 B-6
HEATING FROM COLLECTOR	O	O	O	O	O	O	C	C	ON	ON	ON

FIGURE 2



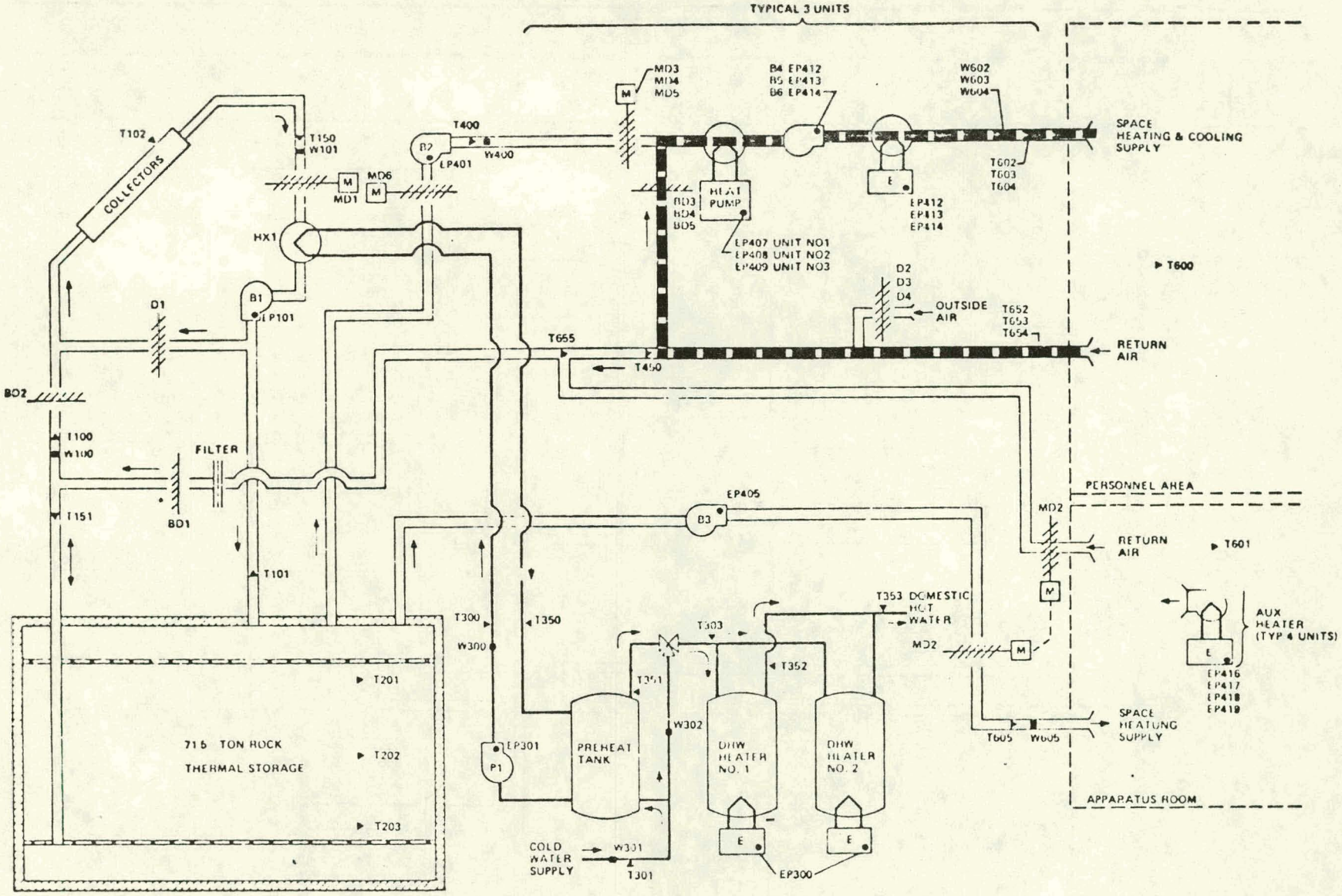
MODE #2	MD-1	MD-2	MD-3 MD-4 MD-5	MD-6	BD-1	BD-2	BD-3 BD-4 BD-5	D-1	B-1	B-2	B-3
STORING HEAT	O	C	C	C	C	O	C	C	ON	OFF	OFF

FIGURE 3



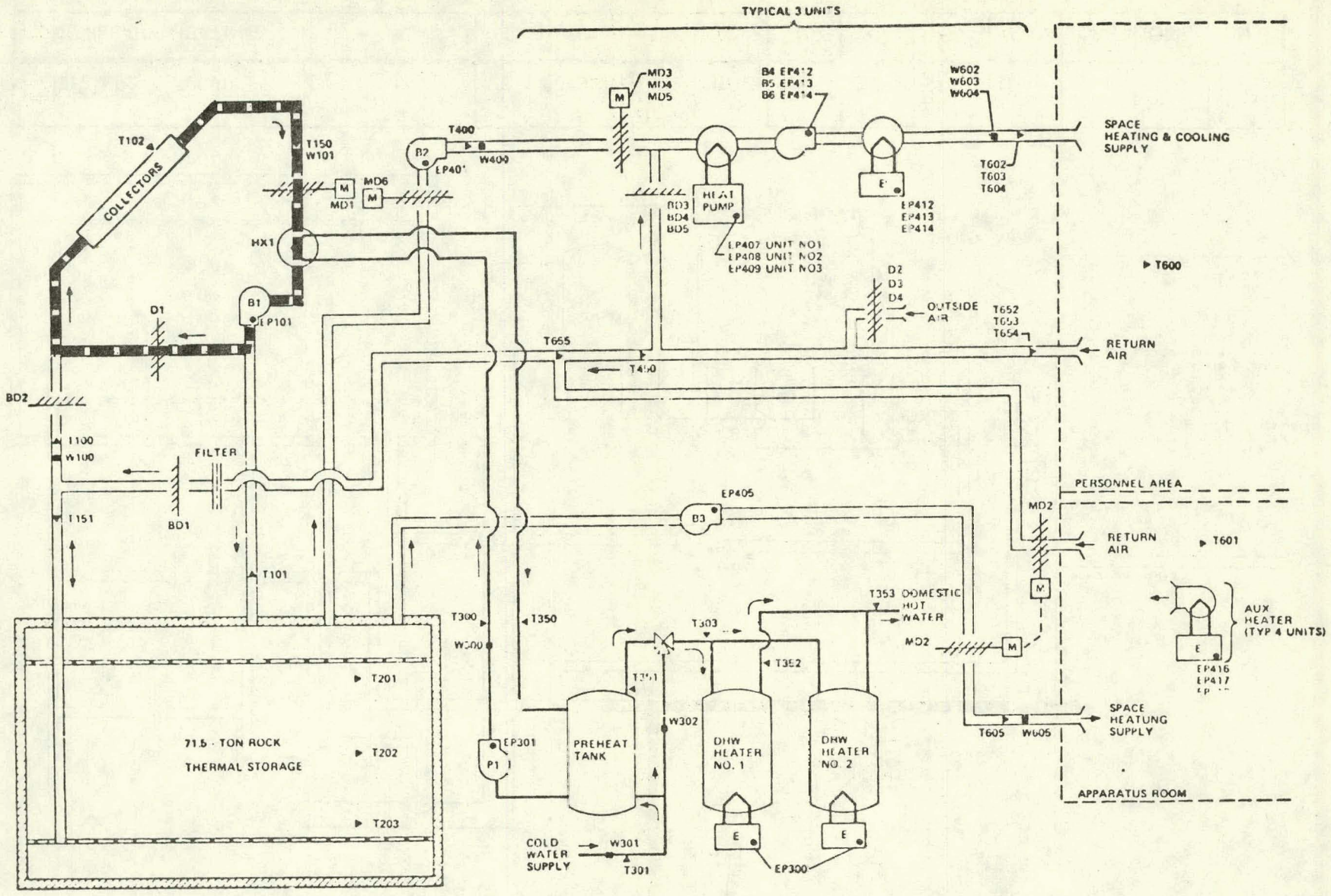
MODE #3	MD-1	MD-2	MD-3 MD-4 MD-5	MD-6	BD-1	BD-2	BD-3 BD-4 BD-5	D-1	B-1	B-2 B-3	B-4 B-5 B-6
HEATING FROM STORAGE	C	O	O	O	O	C	C	C	ON	ON	ON

FIGURE 4



MODE #5 and 6	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
AUXILLARY HEATING	C	C	C	C	C	C	O	C	OFF	OFF	ON

FIGURE 5



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	O	O	ON	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:

Number Sequence	Data Group
001 to 099	climatological
100 to 199	collector
200 to 299	thermal storage
300 to 399	domestic hot water
400 to 299	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

Designation	Measurement
A. Climatological	
I 001	Solar flux
T 001	Outside ambient temperature
B. Collector	
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. Thermal Storage	
T 201	Rock storage temperature - top
T 202	Rock storage temperature - middle
T 203	Rock storage temperature - bottom
D. Domestic Hot Water	
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. Space Heating	
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 88.48% 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

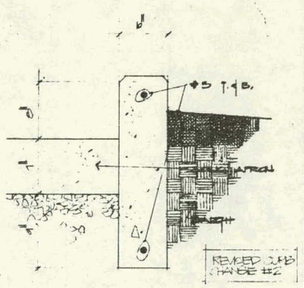
COST OF THE FIRE STATION 24 SOLAR HEATING SYSTEM

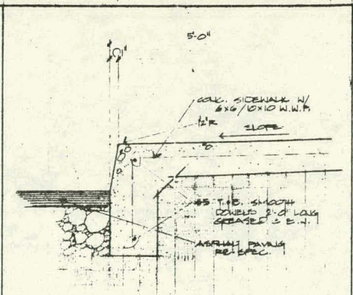
CONSTRUCTION		ESTIMATE	ACTUAL
a.	Solar Equipment		
	1. 96 A units	22,390	
	2. 48 C units	10,857	
	3. Hold down hardware cap strips and butyl seals	4,328	
	4. Controls	6,958	
	5. Field Supervision and testing	5,000	
		49,533	59,195
b.	Solar panel installation		
	1. 144 panels	8,640	8,950
c.	Rock Storage	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)		1,650
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

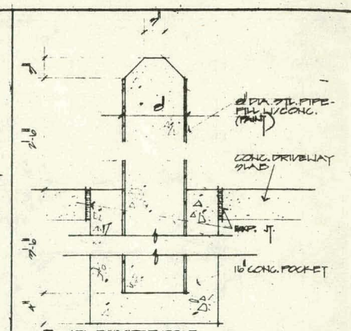
APPENDIX A

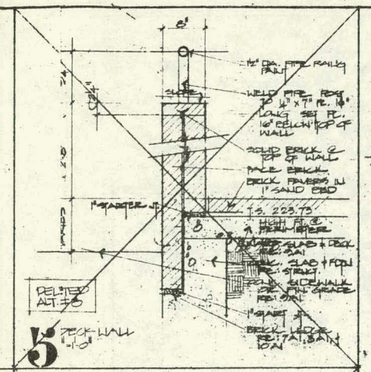
BUILDING DRAWINGS

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 CONC. CURB @ ENTRANCE DRIVES 1½"=1'-0"

3 CONC. SIDEWALK & CURB 1½"=1'-0" RE: 2A1

4 STL. BUMPER POST 1½"=1'-0" RE: 1A2

5 DECK WALL 1"=1'-0"

6 DECK @ SOUTH EDGE 1"=1'-0"

9 DECK PLAN 1/4"=1'-0"

2 SITE PLAN 1"=20'-0"

7 WEST DECK ELEVATION 1/4"=1'-0"

8 EAST DECK ELEVATION 1/4"=1'-0"

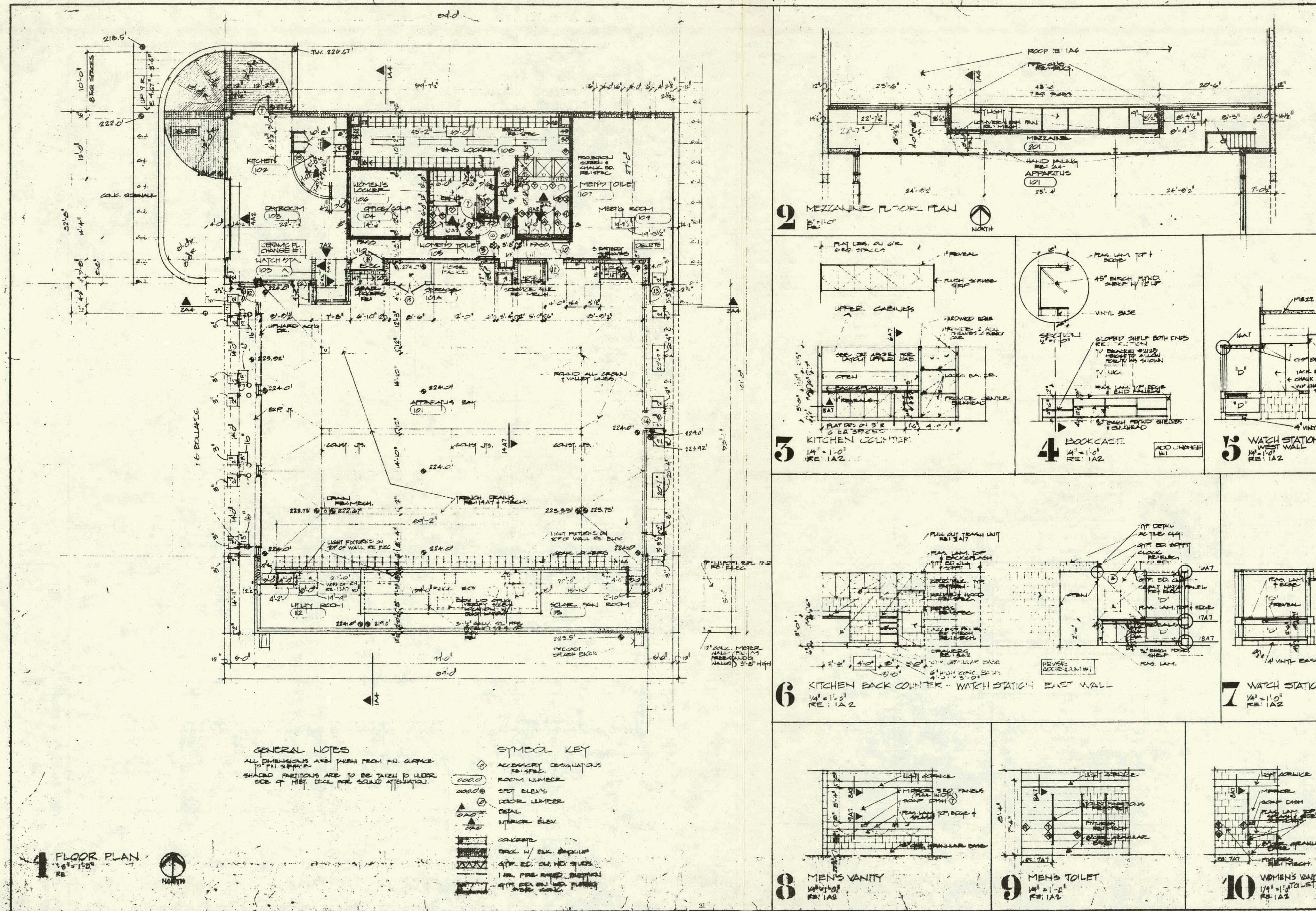
10 NORTH DECK ELEVATION 1/4"=1'-0"

project no: 01
date: 9/8/77

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

Kansas City Fire Station No.24, 2039 Hardesty, Kansas City, Missouri
site plan and details

A1



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

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

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

5 WEST ELEVATION (APPARATUS BAY)
1/8"=1'-0"

2 WEST FACADE WALL/EAST ELEVATION
1/8"=1'-0".

6 NORTH ELEVATION
1/8"=1'-0"

3 EAST FACADE WALL/EAST ELEVATION
1/8"=1'-0"

7 SOUTH ELEVATION
1/8"=1'-0"

4 EAST FACADE WALL/WEST ELEVATION
1/8"=1'-0"

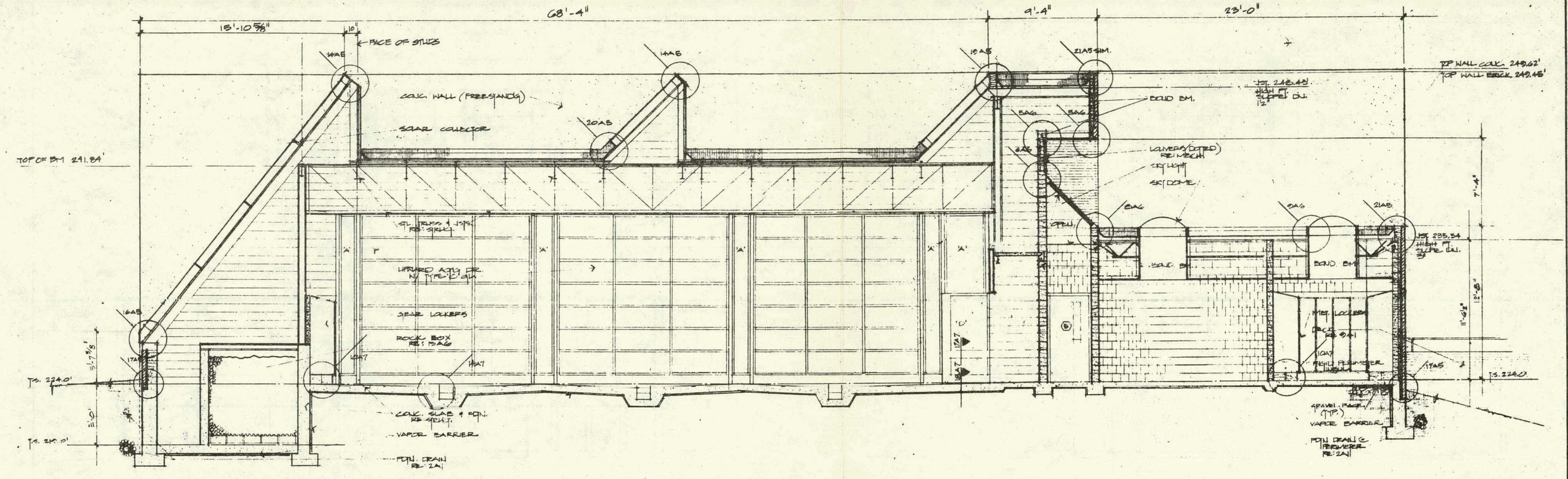
8 EAST ELEVATION (APPARATUS BAY)
1/8"=1'-0"

project no: 01
date: 9/6/77

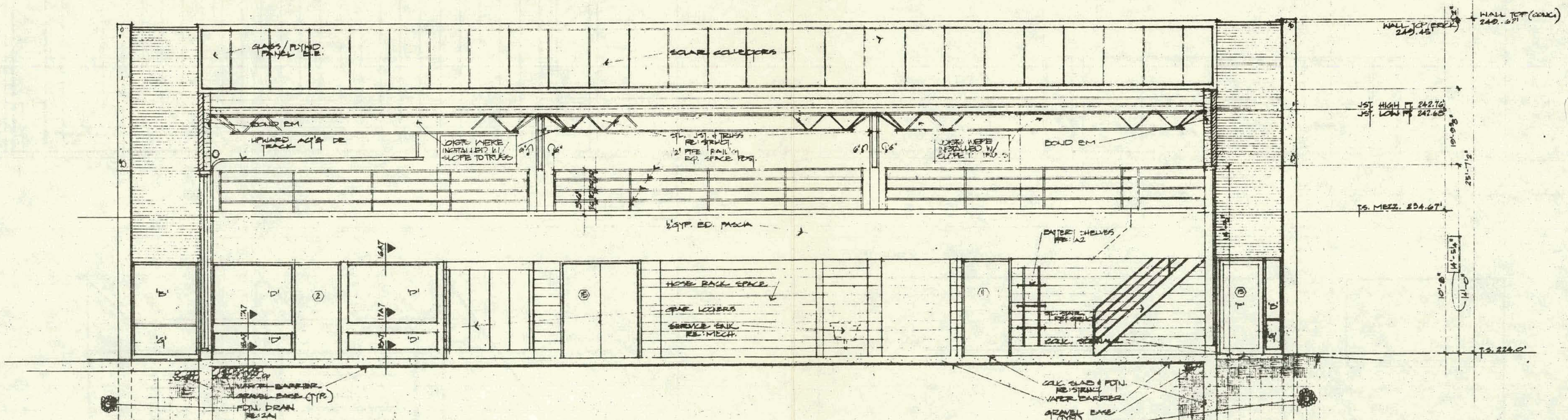
Midgley Shaughnessy Fickel and Scott Architects Inc./20 West 9th Street Kansas City, Missouri 64105

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

A2



1 LONGITUDINAL BUILDING SECTION

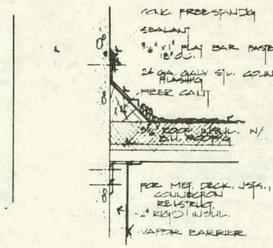


2 LATITUDINAL BUILDING SECTION

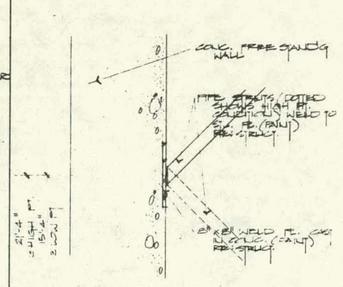
project no. 0
date 9/6/77

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

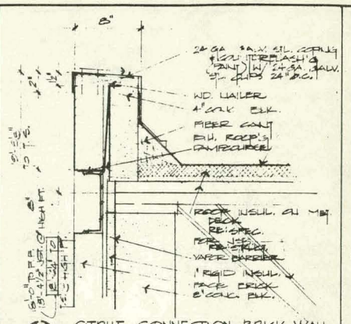
Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri
building sections



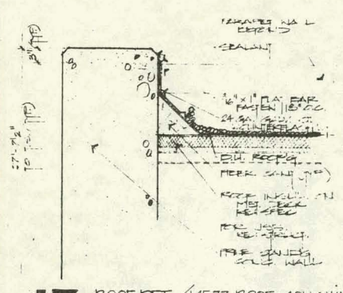
1 ROOF DET. / OPERATIONS AREA & CONC. WALL
1½" = 1'-0"
RE: 1-A6



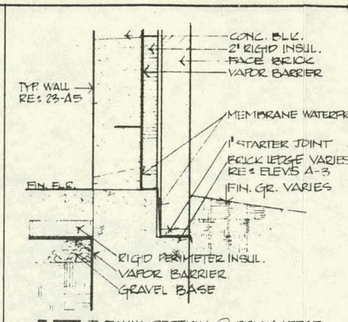
5 STRUT CONNECTION - CONC. WALL
1½" = 1'-0"
RE: 5A3, 4A3



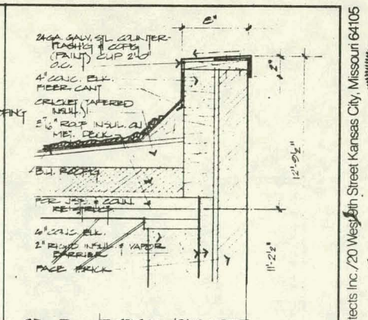
9 STRUT CONNECTION - BRICK WALL
1½" = 1'-0"
R.E.:



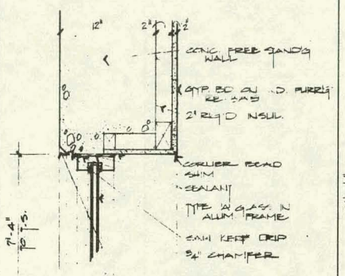
13 ROOF DET. / MEZZ. ROOF & CONC. WALL
1½" = 1'-0"
RE: 1A6



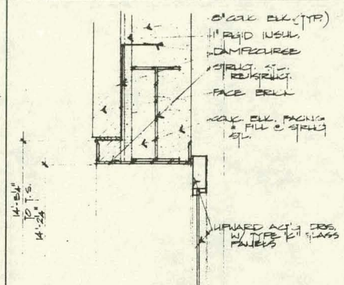
17 TYP. WALL SECTION @ BRICK LEDGE
1½" = 1'-0"
RE: 1 - A4



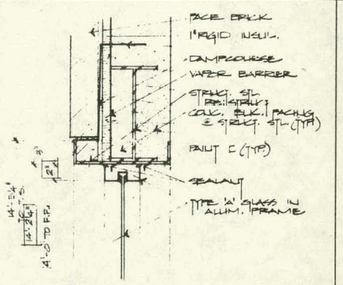
21 TYPICAL PARAPET
1½" = 1'-0"
RE: 6-A3



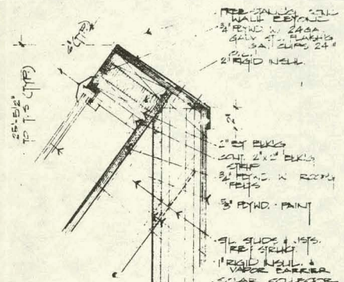
2 WDW. DTL. / TYP. HEAD AT CONC. WALL
1½" = 1'-0"
RE: 1A3



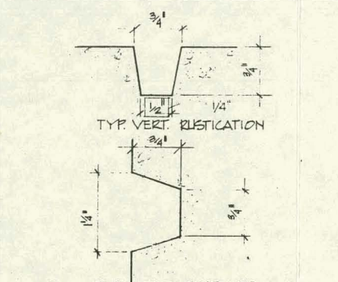
6 UPWARD ACTING DOOR HEAD
1½" = 1'-0"
RE: 5A3



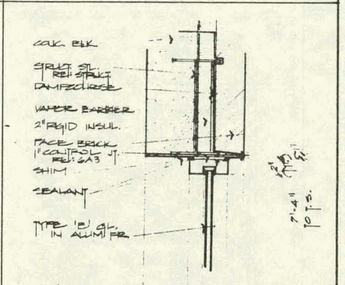
10 WDW. DET. / APPARATUS BAY - TYP. HEAD
1½" = 1'-0"
RE: 5A3 & 8A3



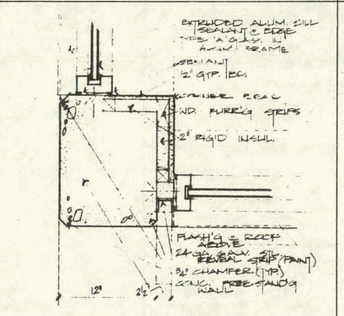
14 TYP. TOP OF COLLECTOR FLASHING
1½" = 1'-0"
RE: 1-A6



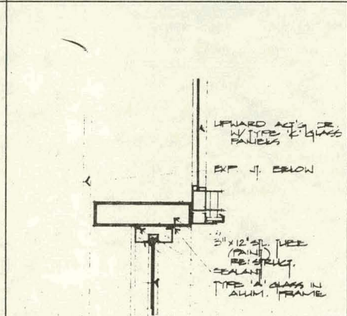
18 TYP. RUSTICATION DETAILS
NO SCALE
RE: 1, 2, 3, 4 - A3



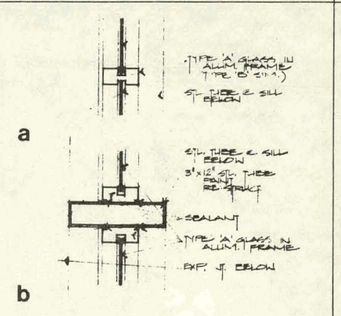
22 WDW. DET. / TYP. HEAD
1½" = 1'-0"
RE: 6-A3



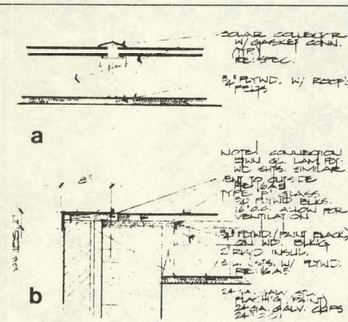
3 WDW. DTL. / TYP. JAMB AT CONC. WALL
1½" = 1'-0"
RE: 1A3 & 5A3



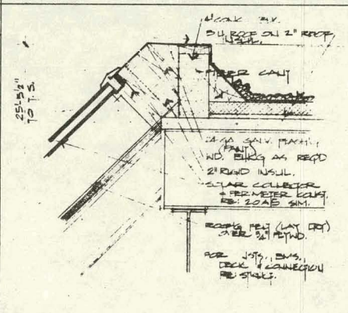
7 UPWARD ACTING DOOR JAMB
1½" = 1'-0"
RE: 5A3



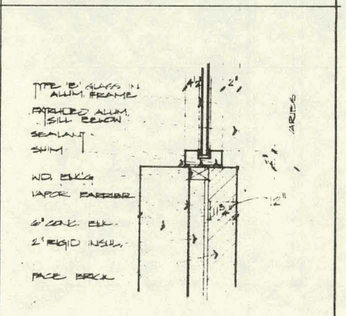
11 WDW. DET. / APPARATUS BAY - TYP. JAMB
1½" = 1'-0"
RE: 5A3,



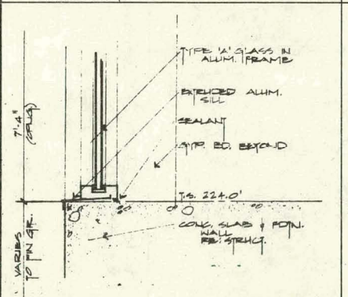
15 TYP. COLLECTOR FLASHING & MULLION DTL
1½" = 1'-0"
RE: 1-A6



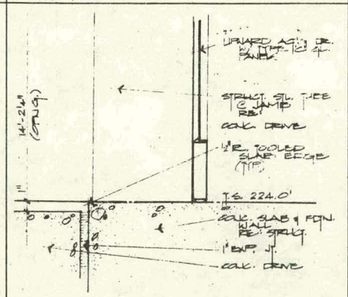
19 TOP OF COLLECTOR AT MEZZ. ROOF
1½" = 1'-0"
RE: 1-A6



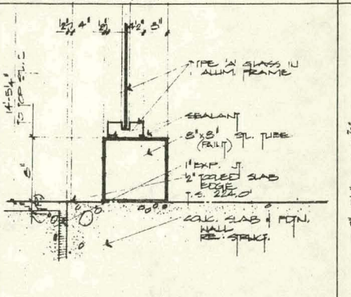
23 WDW. DET. / TYP. JAMB
1½" = 1'-0"
RE: 6-A3



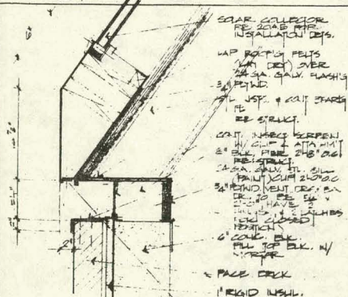
4 WDW. DTL. / TOP SILL AT CONC. WALL
1½" = 1'-0"
RE: 1A3



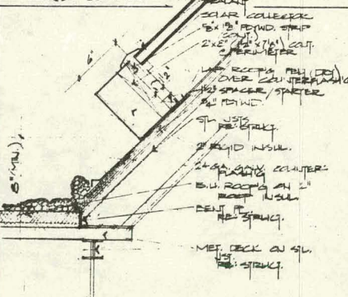
8 UPWARD ACTING DOOR SILL
1½" = 1'-0"
RE: 5A3



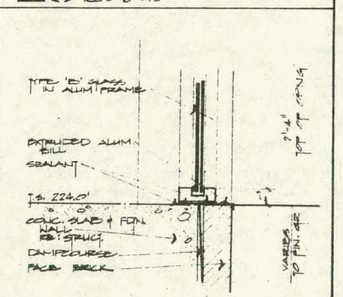
12 WDW. DET. / APPARATUS BAY - TYP. SILL
1½" = 1'-0"
RE: 5A3 & 8A3



16 COLLECTOR DTL @ WALL
1½" = 1'-0"
RE: 1-A6



20 TYP. COLLECTOR AT APPARATUS BAY ROOF
1½" = 1'-0"
RE: 1-A6



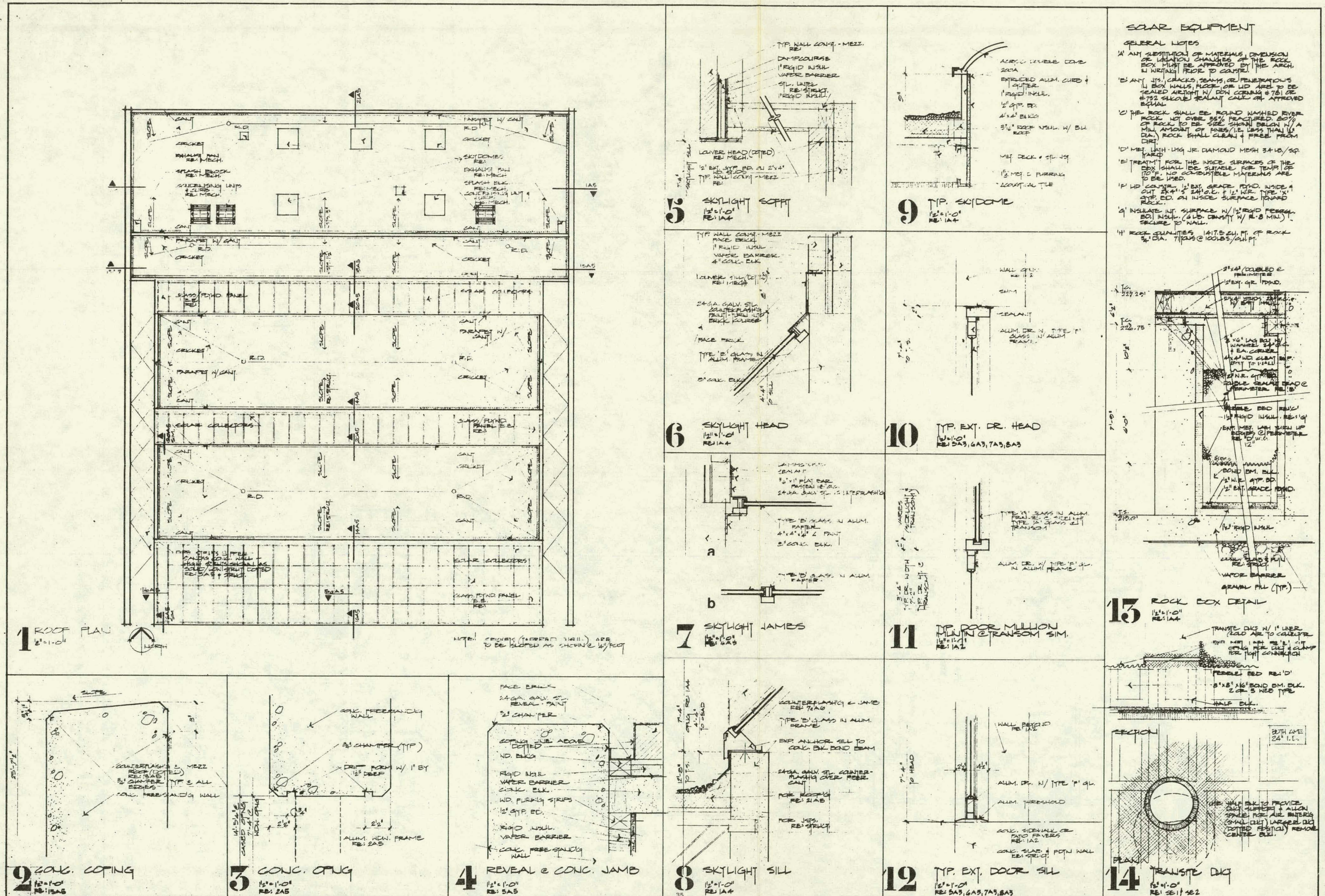
24 WDW. DET. / TYP. SILL
1½" = 1'-0"
RE: 6-A3

project no. 01
date 9/6/77

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

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

details **A5**

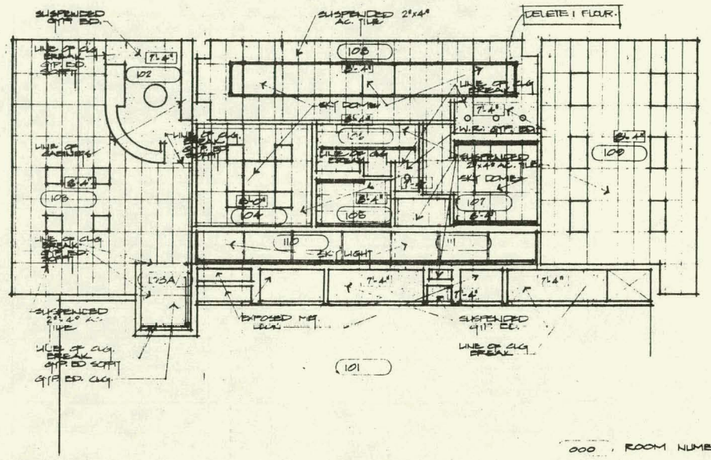


project no. 01
date 9/6/77

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

Kansas City Fire Station No.24, 2039 Hardesty, Kansas City, Missouri
roof plan, exterior and solar details

A6



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

7 TYPICAL HANICAP TOILET
1/4"=1'-0"
RE: 4A3, 10A2

11 H.M. FRAME EL.
NTS
RE: DOOR SCHEDULE

15 TYP. DOOR JAMB (HEAD SIM.)
NTS
RE: DOOR SCHEDULE

8 TYP. VANITY LIGHT
3"=1'-0"
RE: 9, 4, 10A3

a. ALUM. DR. **b.** H.M. DR. **c.** SOLID WD. DR. **d.** WD. DR. W/ GL.

12 DOOR ELEVATIONS
NTS
RE: DOOR SCHEDULE

16 HEAD SECTION @ WATCH STATION
NTS
RE: DOOR SCHEDULE

2 TYP. DRYWALL CEILING
1 1/2"=1'-0"
RE: 1A7

4 TYP. ACOUSTICAL TILE
1 1/2"=1'-0"
RE: 1A7

6 TYP. KITCHEN CABINET
1"=1'-0"
RE: 5A3

9 TYP. VANITY
1 1/2"=1'-0"
RE: 3A3, 10A3

13 WORK BENCH
1"=1'-0"
RE: 1A3

17 TYP. H.M. MULLION @ RMS. 101, 103, 103A
1 1/2"=1'-0"
RE: 1A4, 3A4

3 TRASH BIN
NTS
RE: 6A3

5 TYP. KITCHEN WALL SECTION PLAN
1"=1'-0"
RE: 3A3

10 TYP. LOCKER BASE
1"=1'-0"
RE: 2A4

14 TYP. TRENCH DETAIL
NTS
RE: 1A4

18 TYP. H.M. SILL @ RMS. 101, 103, 103A
1 1/2"=1'-0"
RE: 1A4, 3A4

project no. 01
date 6/6/77

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

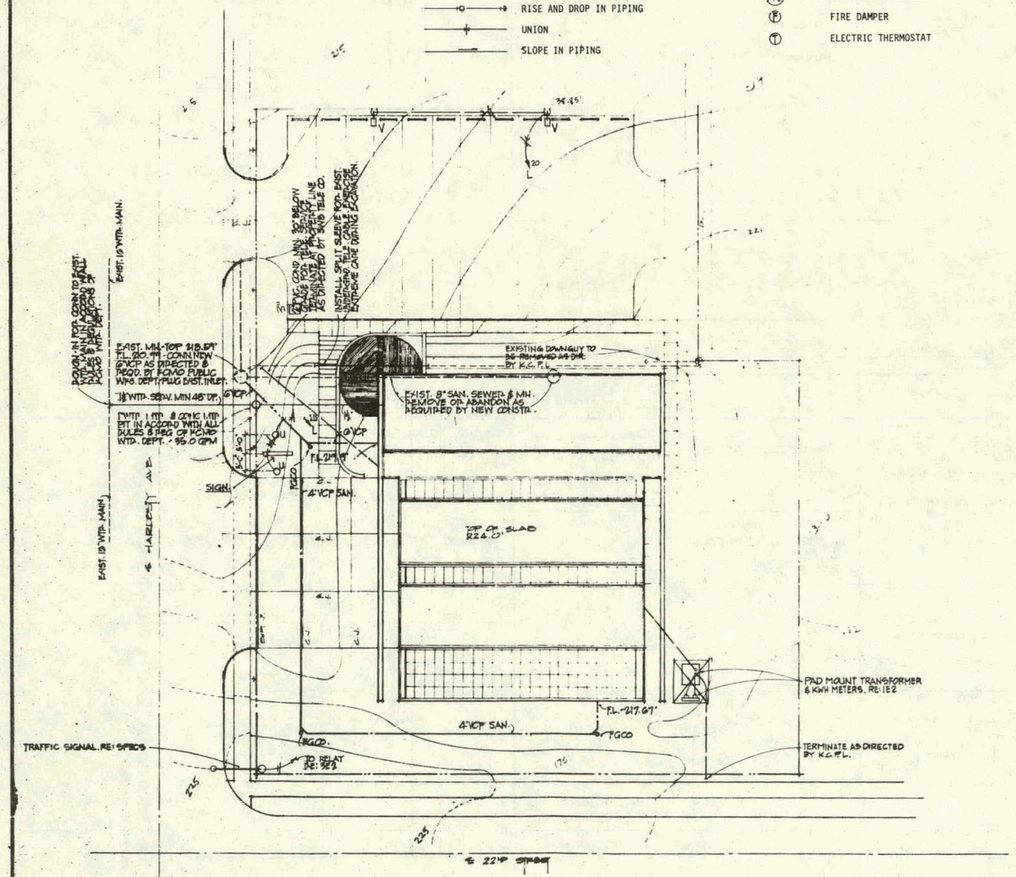
C. MICHAEL SHAUGHNESSY
NUMBER A3111

Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri
reflected ceiling and interior details

A7

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
WH	HANDICAP WATER CLOSET	RB	RETURN BOOT
LI	WALL HUNG LAVATORY	BJ	BETWEEN JOISTS
L	COUNTER TOP LAVATORY	FC	FLEXIBLE DUCT CONNECTIONS
U	URINAL		GLASS FIBER OR SHEET METAL DUCT WORK. SEE SPEC. FIBER DUCT SIZES ARE INSIDE, METAL DUCT SIZES ARE OUTSIDE
S	SINK	UP / DN.	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
FDT	ELECTRIC DRINKING FOUNTAIN	(IDU)	HEAT PUMP-INDOOR UNIT NUMBER
(FA)	FLOOR DRAIN SIZE AND TYPE	(ODU)	HEAT PUMP-OUTDOOR UNIT NUMBER
(2)	PLUMBING STACK NUMBER	(EF)	EXHAUST FAN NUMBER
	CUT OFF VALVE	(F)	FIRE DAMPER
	CHECK VALVE	(T)	ELECTRIC THERMOSTAT
	RISE AND DROP IN PIPING		
	UNION		
	SLOPE IN PIPING		



1 SITE PLAN

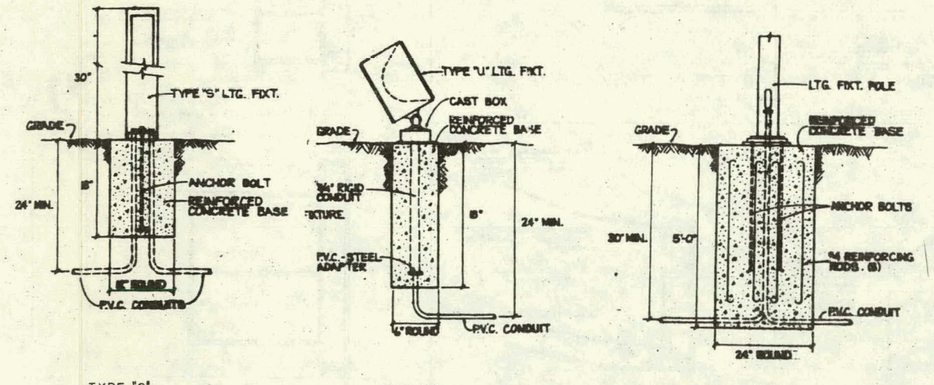
SCALE: 1" = 20'-0"

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
WP	GROUNDING TYPE DUPLEX CONVENIENCE RECEPTACLE WITH WEATHERPROOF COVER.
	WALL MOUNTED TELEPHONE OUTLET
	EXIT LIGHT
	JUNCTION BOX
(V)	VOLUME CONTROL
	CEILING MOUNTED SPEAKER
	WALL MOUNTED SPEAKER. WEATHERPROOF
	ALARM BELL
	GARAGE DOOR PUSHBUTTON STATION
(C)	CLOCK HANGER OUTLET & CLOCK
(T)	ELECTRIC THERMOSTAT. CENTERLINE 5'-0" ABOVE FLOOR.
TV	T.V. ANTENNA OUTLET
	DISCONNECT SWITCH OR MOTOR CONTROL
	MOTOR OUTLET
	SINGLE POLE WALL SWITCH
$_2$	TWO POLE WALL SWITCH
$_3$	THREE WAY WALL SWITCH
$_{2P}$ $_{FL}$	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-F40U CW	PRISMATIC ACRYLIC (.125)	RECESSED	WILLIAMS #5262-RKA	WESTINGHOUSE METALUX CRESCENT PRUDENTIAL
B	FLUORESCENT METAL SIDE 2'x2' RECESS ALUMINUM DOOR	2-F40U CW	PRISMATIC ACRYLIC (.125)	SURFACE	WILLIAMS #1262-RKA	
C	LINEAR FLUORESCENT DIMMING BALLAST	1-F40 CW	WHITE ACRYLIC (.125)	SURFACE	PRUDENTIAL P-1221-48-RS (DIMMING BALLAST)	
D	FLUORESCENT METAL DE 2'x4' RECESSED ALUMUM DOOR	4-F40 CW	PRISMATIC ACRYLIC (.125)	SURFACE	WILLIAMS #1224-RKA	
E	FLUORESCENT INDUSTIAL 15% UPLIGHT	4-F40 CW	-	BTM OF JOISTS	WILLIAMS #8325/RA-82/ED-82	
F	FLUORESCENT INDUSTIAL 15% UPLIGHT	2-F40 CW	-	BTM 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-5101-48-RS-WP	
K	36" DOME FLUORESCENT	4-F30 CW	WHITE ACRYLIC	RECESSED	PRUDENTIAL #P-2934-36-RS	LIGHTOLIER
L	UNDERCABINET LIGHT	1-F20 CW	PRISMATIC	SURFACE	STERLING #324	SOLO
M	PORCELAIN LAMPHOLDER PULL-CHAIN	1-75W A-19	-	SURFACE	GENERAL ELECTRIC #GE5750-7	LEVITON
N	ANGLE INCANDESCENT REFLECTOR	1-150W A-21	-	RE:ARCH.	ABOLITE #AF-200	HUBBELL
P	WALK LIGHT	1-40W T-10	LOUVER	RECESSED	MOLDCAST #V362	
R	BLDG. FLOODLIGHT 120°H x 30°V.	1-175W MERC.DX	CLEAR GLASS	RE*ARCH	SEPCO #5000-30120 175H-120	GEN'L ELECT.
S	BOLLARD-BLACK FINISH	1-100W MERC.-DX	WHITE LEXAN & LOUVER	SEE DTL.	ARCH. AREA LTG. #ALS-170-1FG-100MV-LX	
T	SHOWER LIGHT	1-100W A-19	WHITE	RECESSED	PERFECTLITE #FLS-75	MARCO
U	SIGN LIGHT 100°Hx20°V	1-175W MERC.-DX	CLEAR GLASS	SEE DTL.	SEPCO #5000-20100 175H-120	GEN'L ELECT.
V	PARKING LOT LUMINAIRE	1-400W HPS.	CLEAR GLASS	25'-0" POLE SEE DTL.	KIM #1A/EKG-111 (TYPE III) PTRS-25A	GARDCO
X	EXIT LIGHT	2-20W T6½	RED/ STENCIL	CEILING	PRESCOLITE #75211	MCPHILBEN MARCO



TYPE "S" TYPE "U" TYPE "V"

2 LIGHTING FIXTURE BASE DETAILS

NOT TO SCALE

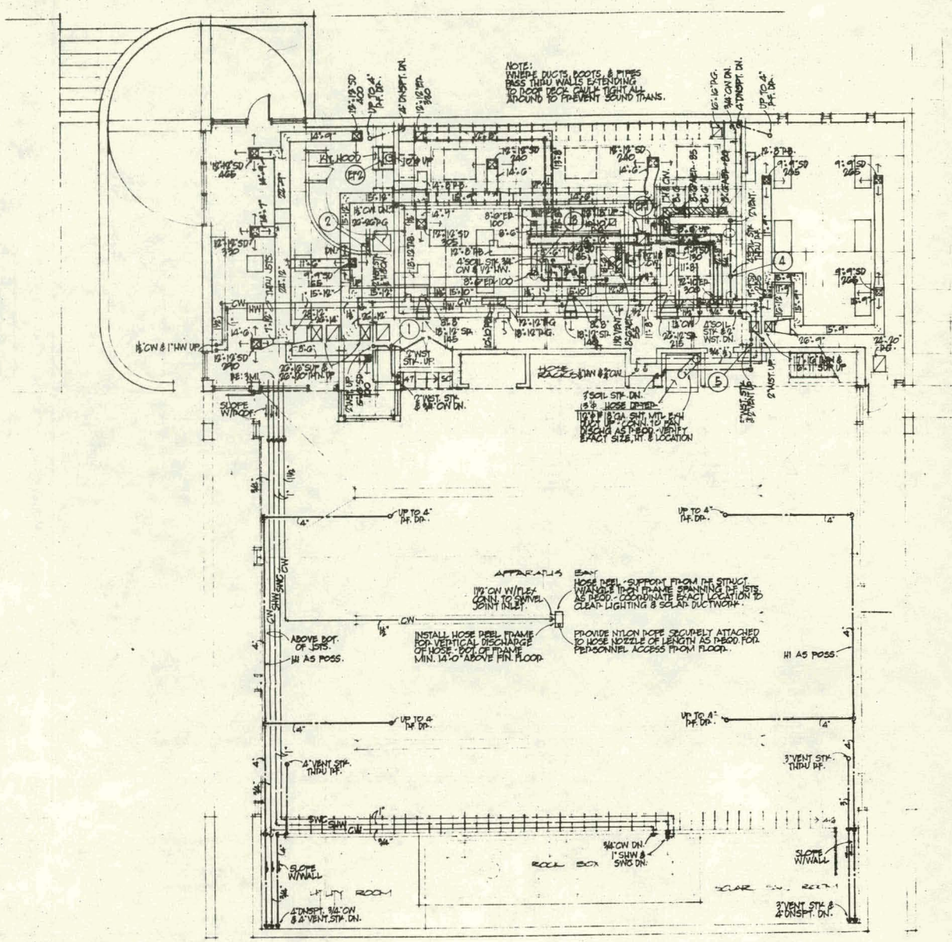
CONTRACTOR SHALL CHECK DIMENSIONS FROM ARCHITECTURAL DRAWINGS AND VERIFY SAME. DIMENSIONS AT SITE. THIS DRAWING IS NOT TO BE SCALED FOR EXACT MEASUREMENTS AND TO BE USED IN ANY MANNER AS A SHOP DRAWING

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

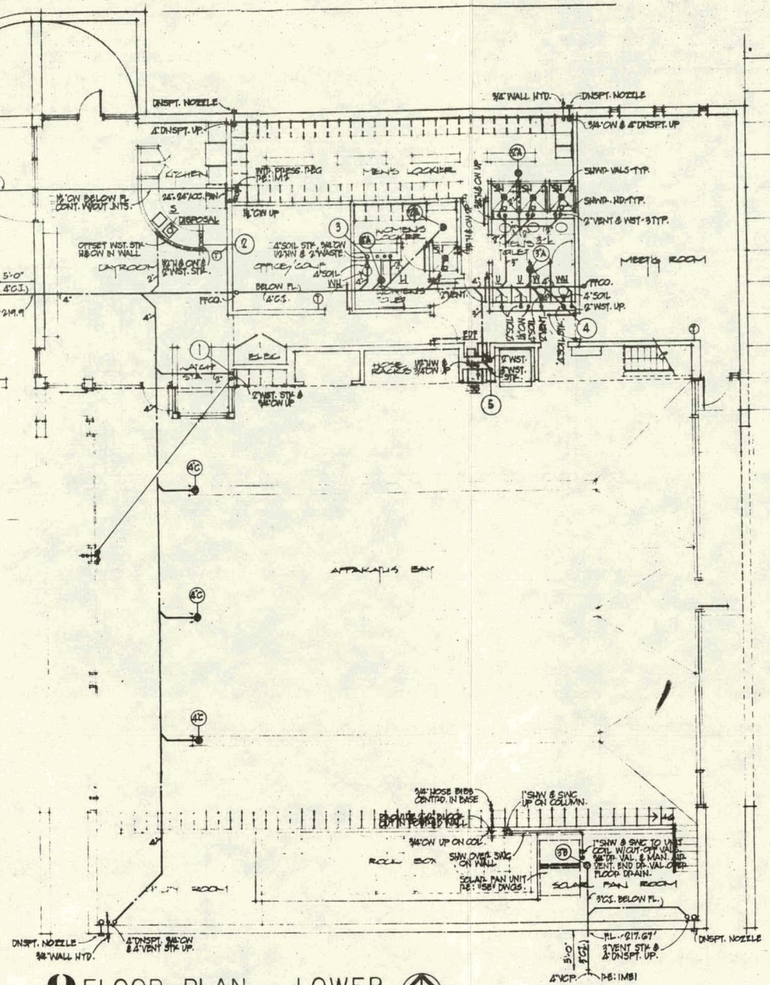
STATE OF MISSOURI MAX E. SNIDER NUMBER E-1434 REGISTERED PROFESSIONAL ENGINEER

ISSUED FOR CONSTRUCTION

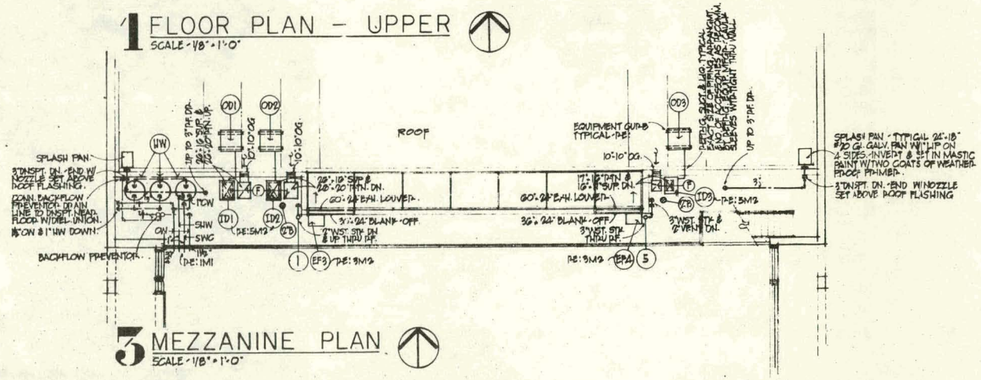
Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri
site plan and details



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



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



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

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date 08/27

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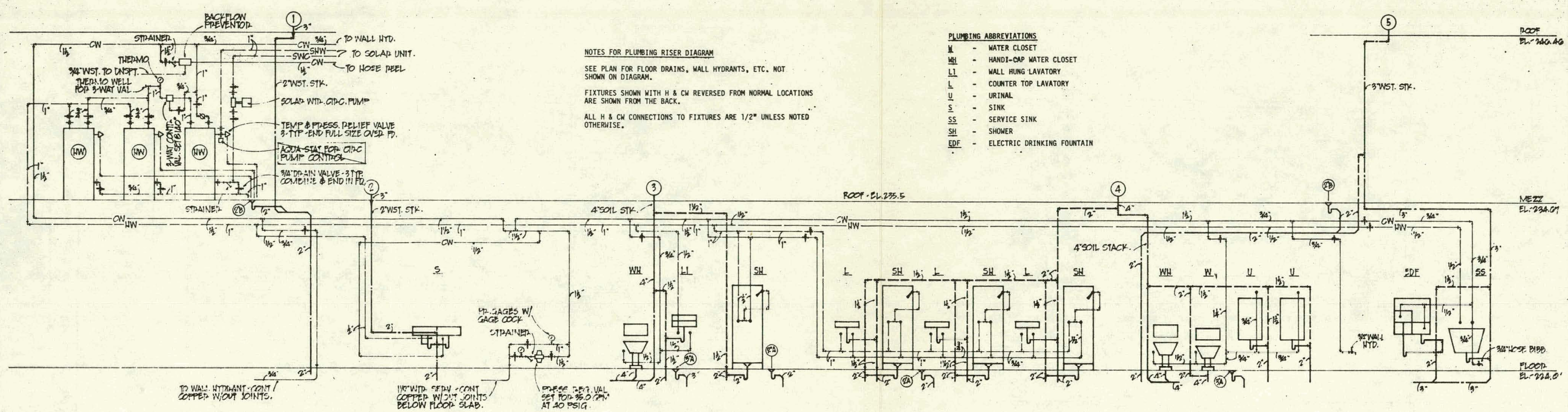


NOTES FOR PLUMBING RISER DIAGRAM

SEE PLAN FOR FLOOR DRAINS, WALL HYDRANTS, ETC. NOT SHOWN ON DIAGRAM.

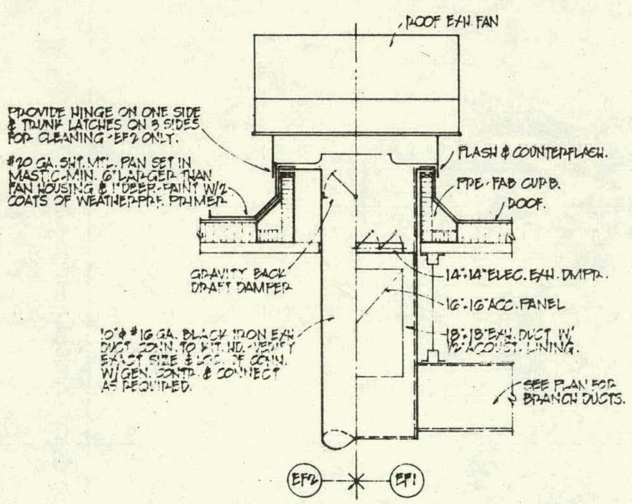
FIXTURES SHOWN WITH H & CW REVERSED FROM NORMAL LOCATIONS ARE SHOWN FROM THE BACK.

ALL H & CW CONNECTIONS TO FIXTURES ARE 1/2" UNLESS NOTED OTHERWISE.

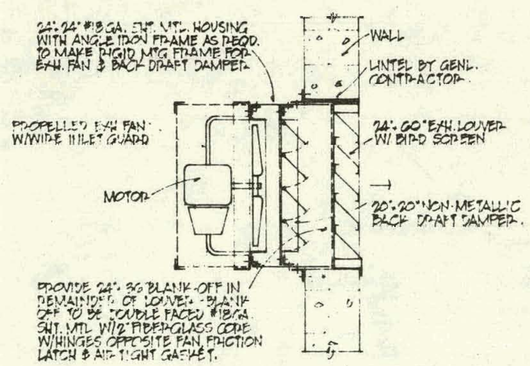
PLUMBING ABBREVIATIONS

W	-	WATER CLOSET
WH	-	HANDI-CAP WATER CLOSET
L1	-	WALL HUNG LAVATORY
L	-	COUNTER TOP LAVATORY
U	-	URINAL
S	-	SINK
SS	-	SERVICE SINK
SH	-	SHOWER
EDF	-	ELECTRIC DRINKING FOUNTAIN

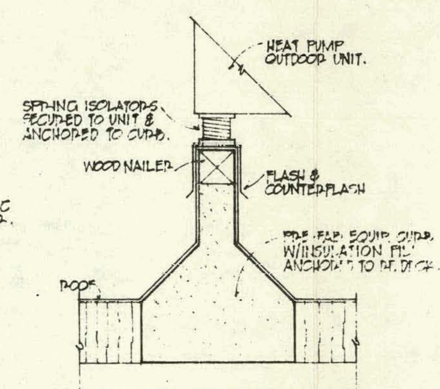
1 PLUMBING RISER DIAGRAM
NOT TO SCALE



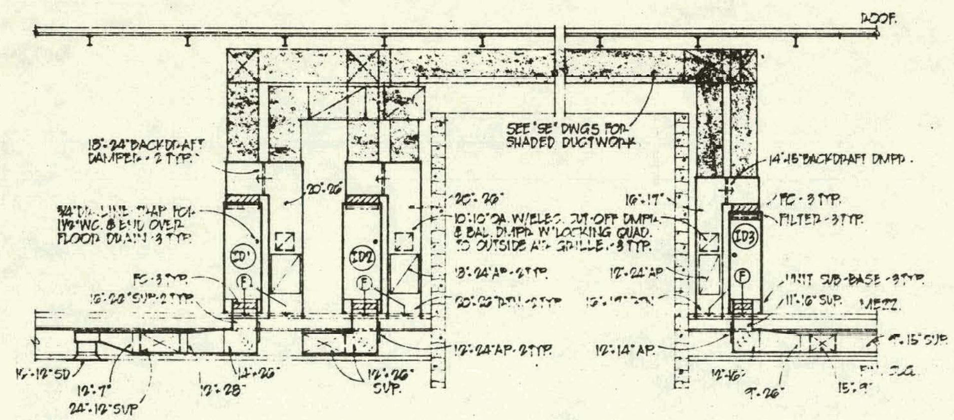
2 ROOF EXHAUST FANS
SCALE - 1" = 1'-0"



3 PROPELLER EXHAUST FAN
SCALE - 1" = 1'-0"



4 EQUIPMENT CURB
NOT TO SCALE



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

39

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date 9/6/77

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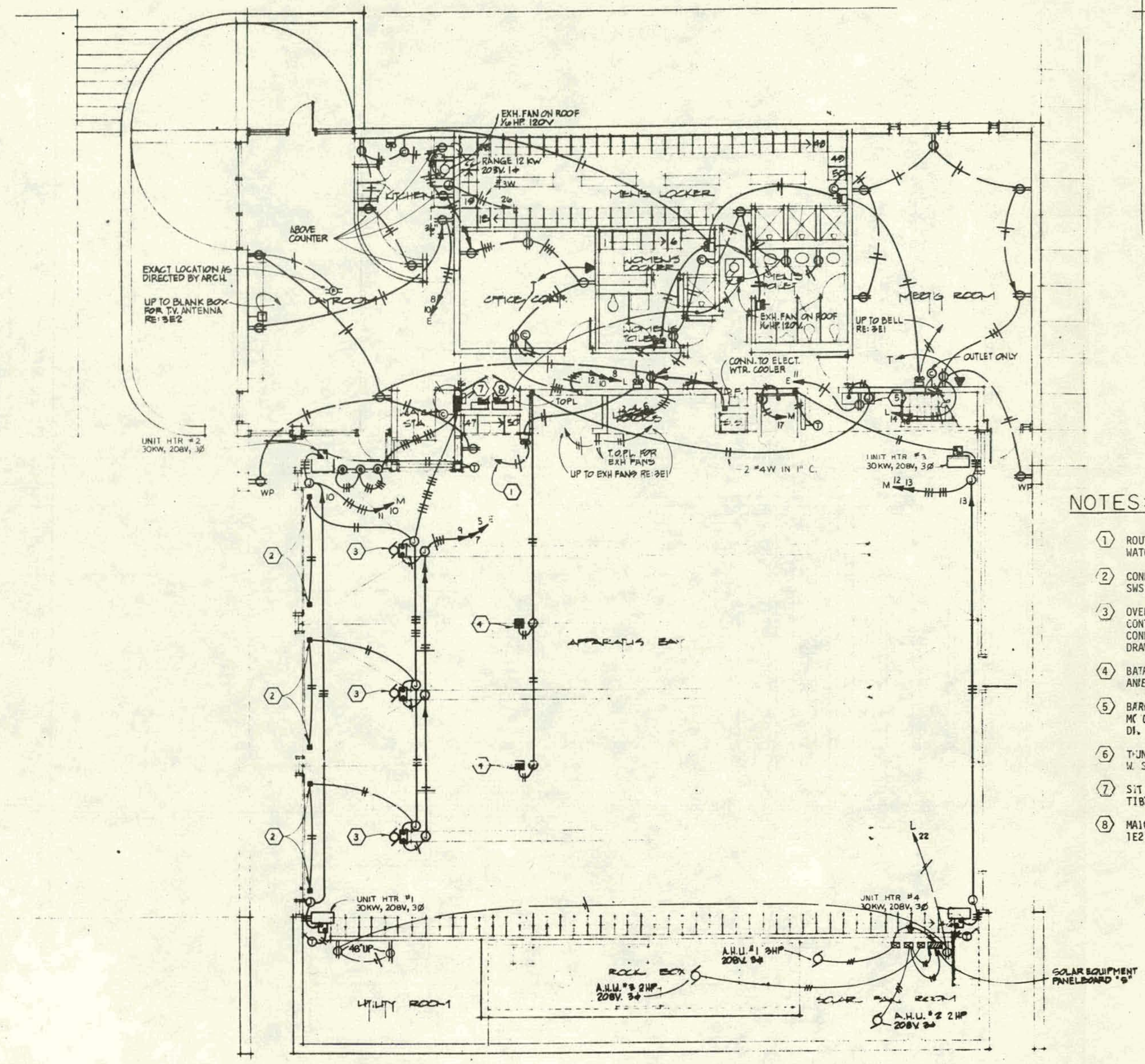
STATE OF MISSOURI S. H. EISMAN NUMBER E-6438 REGISTERED PROFESSIONAL ENGINEER

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

M2

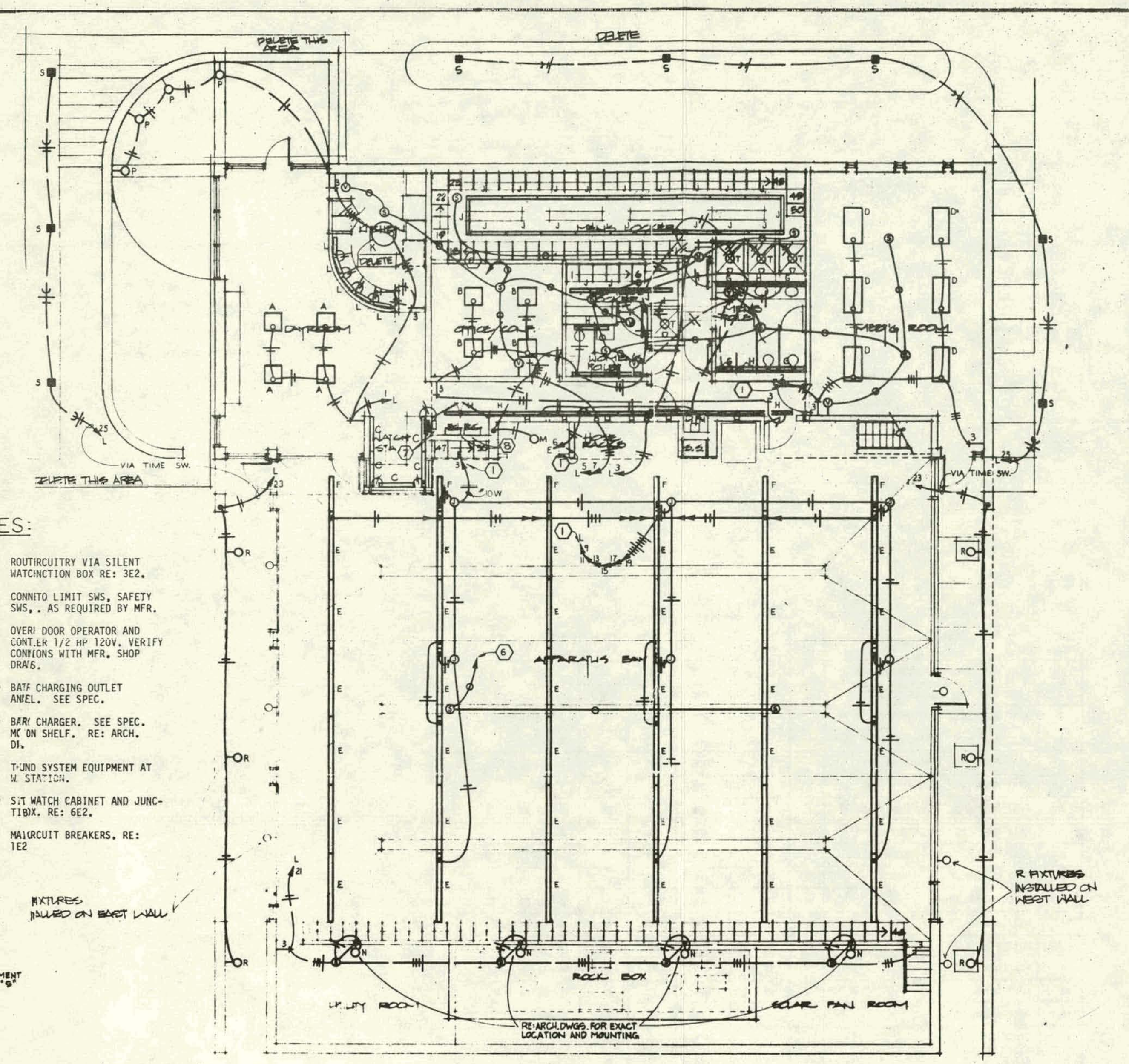


1 FLOOR PLAN - POWER

SCALE: 1/8" = 1'-0"

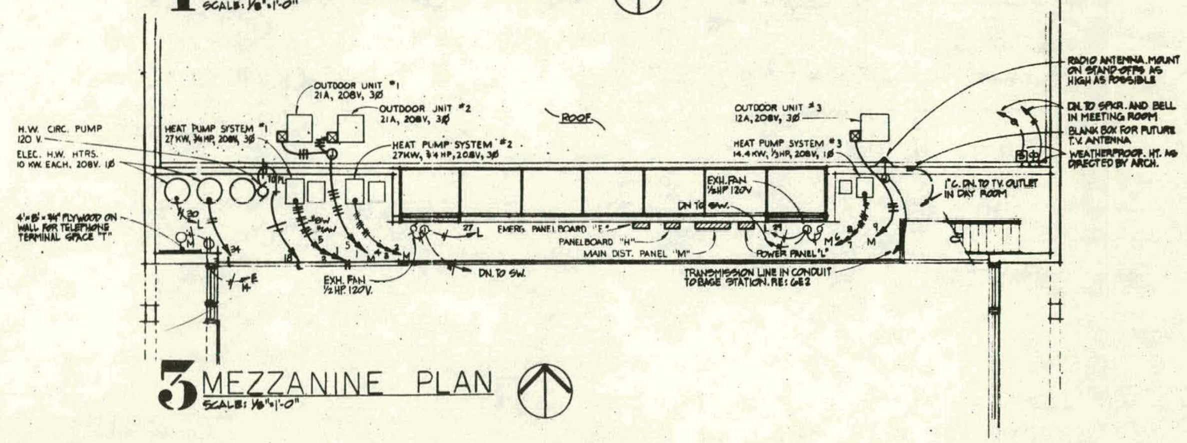
NOTES:

1. ROUTIRCUITRY VIA SILENT WATCINCTION BOX RE: 3E2.
2. CONNITO LIMIT SWS, SAFETY SWS, . AS REQUIRED BY MFR.
3. OVERI DOOR OPERATOR AND CONT.ER 1/2 HP 120V. VERIFY CONIONS WITH MFR. SHOP DRAVS.
4. BATF CHARGING OUTLET ANEL. SEE SPEC.
5. BARY CHARGER. SEE SPEC. MC ON SHELF. RE: ARCH. DI.
6. T'UND SYSTEM EQUIPMENT AT W. STATION.
7. SIT WATCH CABINET AND JUNC-TIBOX. RE: 6E2.
8. MAICRCUIT BREAKERS. RE: 1E2



2 FLOOR PLAN - LIGHTING

SCALE: 1/8" = 1'-0"



3 MEZZANINE PLAN

SCALE: 1/8" = 1'-0"

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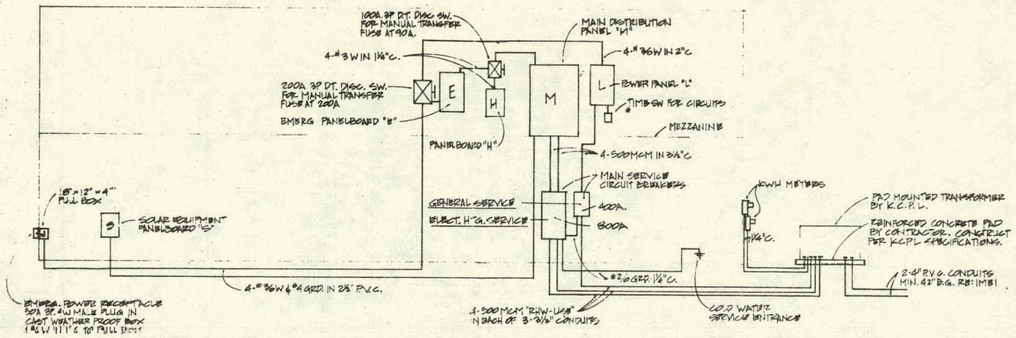
Kansas City Fire Station No. 24, 2039 Hardesty, Kansas City, Missouri

floor plans

project no. 01
date 9/6/77



1 ELECTRICAL RISER DIAGRAM
NOT TO SCALE

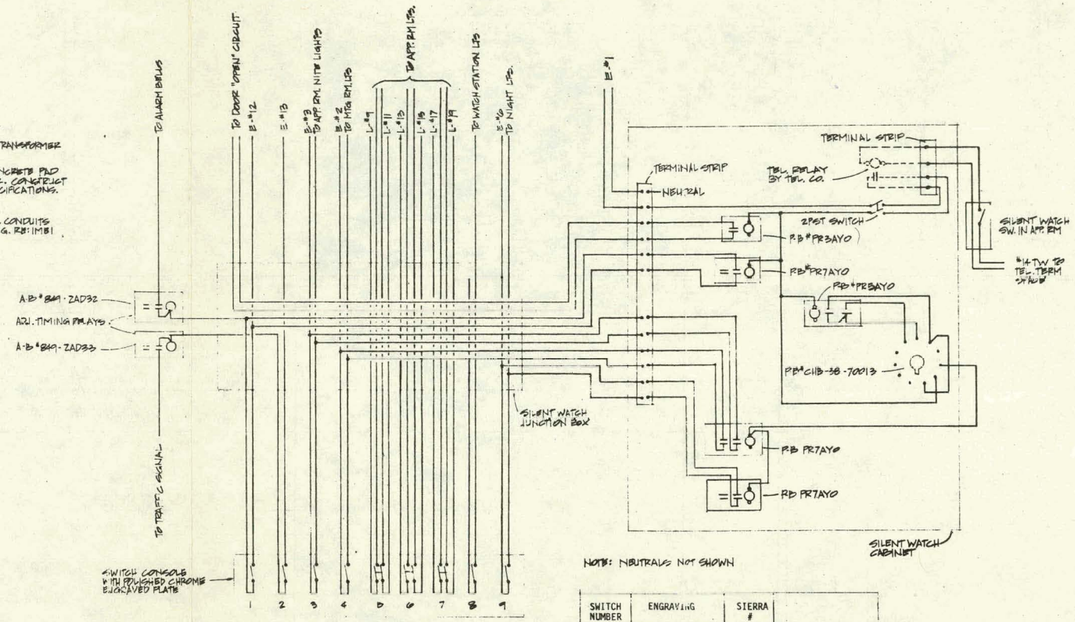
2 SCHEDULE — MAIN DISTRIBUTION PANEL "M"

CIRC. NO.	DESIGNATION	HP OR KW	AMPS RUNNING	FRAME TYPE	TRIP AMPS	TYPE BKR.	SIZE WIRE & CONDUIT
1	HEAT PUMP SYS. #1-OUTDOOR UNIT		21	HFB	40	3P	3-#8W. IN 3/4"C.
2	HEAT PUMP SYS. #2-HEATER CIRC. #1		41	HFB	60	3P	3-#6W
3	HEAT PUMP SYS. #2-HEATER CIRC. #2		24	HFB	40	3P	3-#8W 1¼"C.
4	HEAT PUMP SYS. #2-INDOOR UNIT		2.6	HFB	20	3P	2-#12W
5	HEAT PUMP SYS. #2-OUTDOOR UNIT		21	HFB	40	3P	3-#8W IN 3/4"C.
6	HEAT PUMP SYS. #3-HEATER CIRC. #1		40	HFB	70	2P	2-#4W
7	HEAT PUMP SYS. #3-HEATER CIRC. #2		20	HFB	40	2P	2-#3W IN 1¼"C.
8	HEAT PUMP SYS. #3-INDOOR UNIT		2.4	HFB	20	2P	2-#12W.
9	HEAT PUMP SYS. #3-OUTDOOR UNIT		12	HFB	30	3P	2-#10W. IN 1/2"C.
10	UNIT HEATER #1	30	83	HFB	125	3P	3-#1W IN 1½"C.
11	UNIT HEATER #2	30	83	HFB	125	3P	3-#1W IN 1½"C.
12	UNIT HEATER #3	30	83	HFB	125	3P	3-#1W IN 1½"C.
13	UNIT HEATER #4	30	83	HFB	125	3P	3-#1W IN 1½"C.
14	PANELBOARD "H"		67.6	HFB	100	3P	4-#3W IN 1½"C.
15	HOSE DRYER	6	29	HFB	50	2P	2-#6W IN 3/4"C.
16	PANELBOARD "S"			HFB	60	3P	4-#6W. IN 1"C.
17	SPACE			HFB		3P	
18	SPACE			HFB		3P	
19	SPACE			HFB		3P	

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

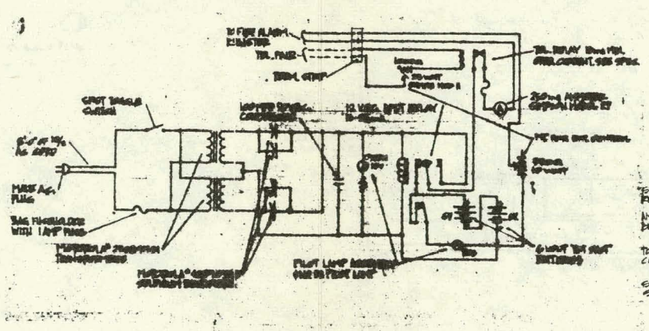
4 SCHEDULE OF PANELBOARDS

PANEL BOARD	MOUNTING	VOLTAGE & PHASE	MAIN SIZE & TYPE	20 AMP SINGLE POLE CIRC.BKR. CIRC. #	70 AMP 2 POLE CIRC. #	90 AMP 2 POLE CIRC#	20 AMP 3 POLE CIRC #	40 AMP 3 POLE CIRC#	60 AMP 3 POLE CIRC#	100 AMP 3 POLE CIRC #	SPACES FOR FUT. SP CIRC. BKRS.
L	SURFACE	120/208V 3Ø,4W	400A. M.L.O.	#1 THRU #24 INCL. & 27	30,34	26				31	6
H	SURFACE	120/208V 3Ø,4W	100A. M.L.O.				5	3	1		9
E	SURFACE	120/208V 3Ø,4W.	225A. M.L.O.	#1 THRU #18 INCL.						20	3
S	SURFACE	120/208V 3Ø,4W.	100A. M.L.O.	2,4,6			1,3,5			20	3

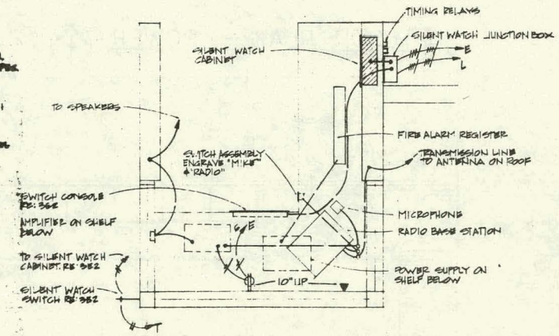


SWITCH NUMBER	ENGRAVING	SIERRA #	
1	BELLS	5120G	—
2	SIGNAL	5120G	—
3	APP. RM.	5027A	—
4	MEETING ROOM	5027R	—
5	APP. ROOM	—	HUBBELL #1222-PLC
6	APP. ROOM	—	HUBBELL #1222-PLC
7	APP. ROOM	—	HUBBELL #1222-PLC
8	WATCH STATION	—	ATMOS LC5F DIMMER
9	NIGHT LTS.	5021W	—

3 SILENT WATCH SYSTEM
NOT TO SCALE



5 POWER SUPPLY



6 WATCH STATION
SCALE ½"=1'-0"

CONTRACTOR SHALL CHECK DIMENSIONS FROM ARCHITECTURAL DRAWINGS AND VERIFY THOSE DIMENSIONS AT SITE. THIS DRAWING IS NOT TO BE SCALED FOR EXACT MEASUREMENTS AS TO BE USED IN ANY MANNER AS A SHOP DRAWING.

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

E2

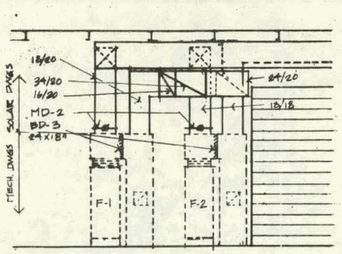
project no. 01
date 9/6/77

APPENDIX B

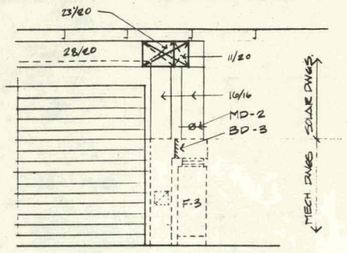
AS BUILT DRAWINGS OF THE

SOLAR HEATING SYSTEM

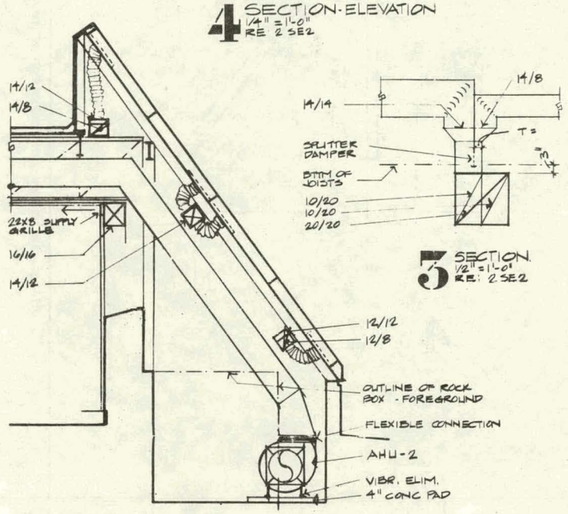
SE-1
SE-2



4 SECTION-ELEVATION
1/4" = 1'-0"
RE 2 SE2



5 SECTION-ELEVATION
1/4" = 1'-0"
RE 2 SE2



2 SECTION
1/4" = 1'-0"
RE: 1SE2 2SE2

3 SECTION
1/2" = 1'-0"
RE: 2 SE2

GENERAL NOTES

DO NOT SCALE MECH. DWGS. 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.

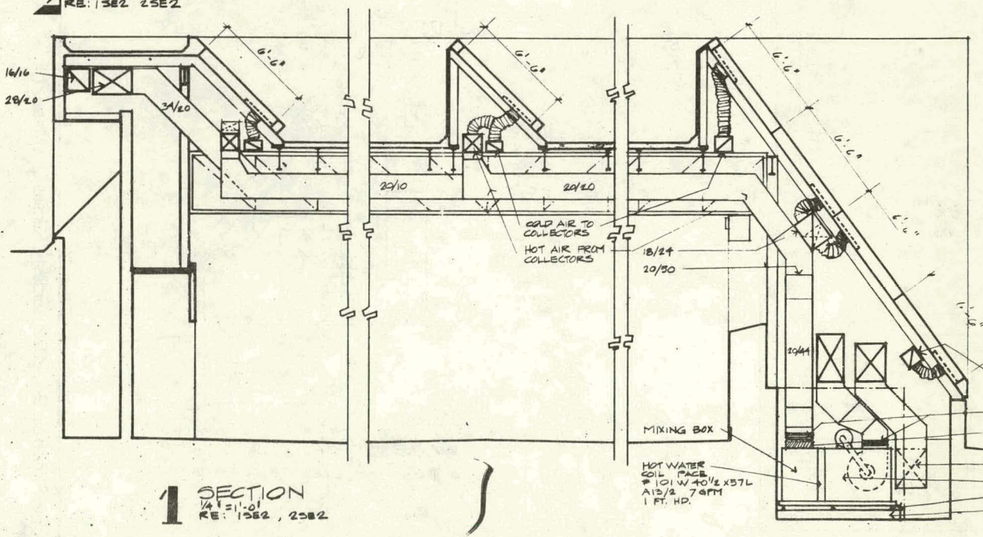
ALL SQUARE DUCT ELBOWS TO HAVE TURNING VANES.

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

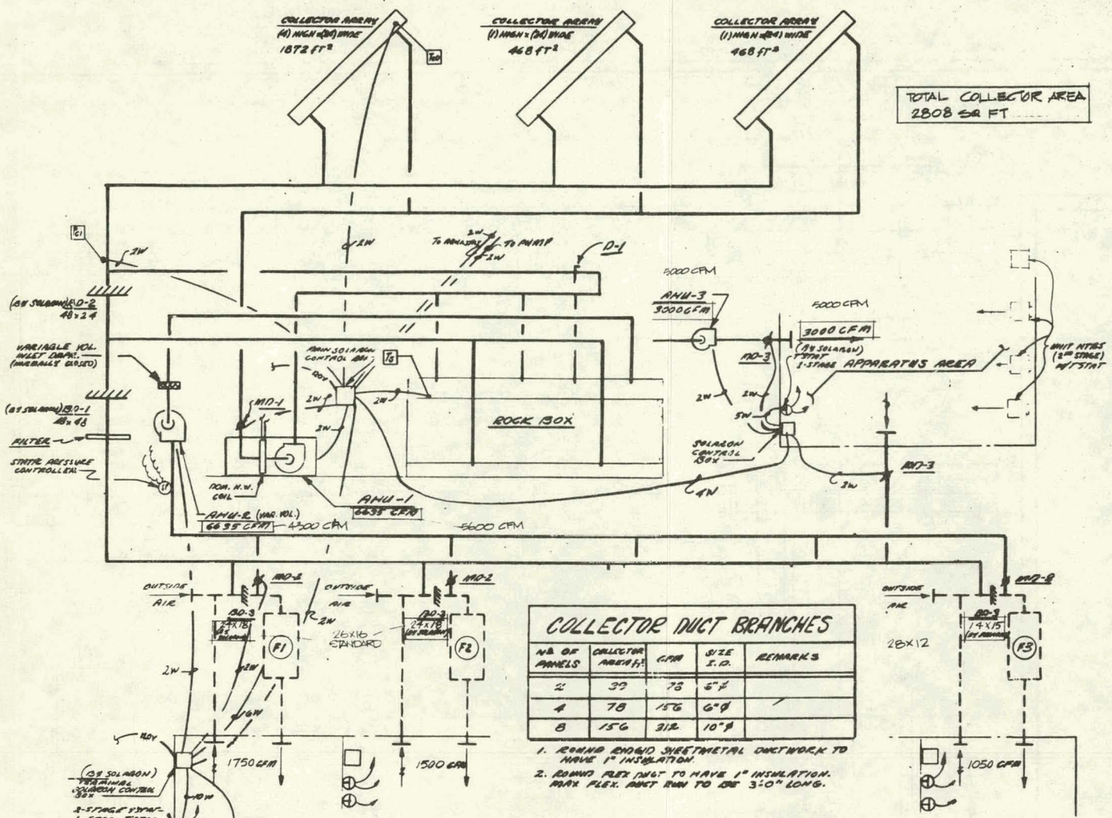
AUXILIARY HEATING UNIT MUST BE SUITABLE FOR RETURN AIR TEMPERATURES OF 150 DEGREES F.

ALL DUCTWORK DIMENSIONS ON DWG. ARE SHEET METAL SIZE (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 OTHERWISF.

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



1 SECTION
1/4" = 1'-0"
RE: 1SE2 , 2SE2



COLLECTOR DUCT BRANCHES

NO. OF PANELS	COLLECTOR AREA ft²	CFM	SIZE I.D.	REMARKS
2	39	78	6"ø	
4	78	156	6"ø	
8	156	312	10"ø	

1. ROUND RIGID SHEETMETAL DUCTWORK TO HAVE 1" INSULATION.
2. ROUND FLEX DUCT TO HAVE 1" INSULATION. MAX FLEX. DUCT RUN TO BE 3'-0" LONG.

SCHEMATIC FLOW DIAGRAM

NO SCALE

SEQUENCE OF OPERATION

	MODE	MD-1	MD-2	BD-1	BD-2	BD-3	MD-3	D-1	FANS AHU-1	FANS AHU-2&3	FANS FI-F	REMARKS
WINTER OPERATION	1ST STAGE HEATING — HEATING FROM COLLECTOR	O	O	O	O	C	O	C	ON	ON	ON	
	1ST STAGE HEATING — 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	
	2ND STAGE HEATING — HEATPUMP WITH HEAT — STORING HEAT	O	C	C	C	O	C	—	C	ON / OFF	OFF	ON
	3RD STAGE HEATING — HEATPUMP WITH ELECT. RESIST. — STORING HEAT	O	C	C	C	O	C	—	C	ON / OFF	OFF	ON
SUMMER OPERATION	SUMMER WATER HEATING	O	C	C	C	C	C	O	ON	OFF	OFF	
	AIR CONDITIONING (H2W-SOLAR)	C	C	C	C	O	C	O	OFF	OFF	ON	

AIR HANDLING UNITS

NO.	AREA SERVED	CFM	OUTLET VEL.	EXT. S.P.	ELECTRIC DATA HP	RPM	VOLT	Ø	TYPE	MFR	MFR. NO.	REMARKS
AHU-1	SOLAR COLLECTOR ROCK BOX LOOP	5000	1450	1½"	3	683	208	3	CENTRAL STATION HORIZ. TYPE	McQUAY	LSL-111	(1)
AHU-2	PERIMETER AREA DISTRIBUTION	4300	1710	1⅛"	2	1380	208	3	SWSI CENTRIFUGAL	COOK	21CHSWSI	WITH INFLATABLE POLYMER INLET CONNECTOR (1) & AIR ROL WHEEL
AHU-3	INTERIOR AREA DISTRIBUTION	3000	1610	⅝"	2	1270	208	3	CENTRIFUGAL INLINE	COOK	24 CV	(1) BELT DRIVE

NOTE: 1. ALL AHU HANDLERS COMPLETE WITH SOLARATION MAGNETIC STARTER / DISCONNECT SWITCH & HAND OFF/AUTO SWITCH ON PANEL. ALT. CONTACTORS AS REQ'D.

MOT. SUPPLIED BY SOLARON

project no. 01

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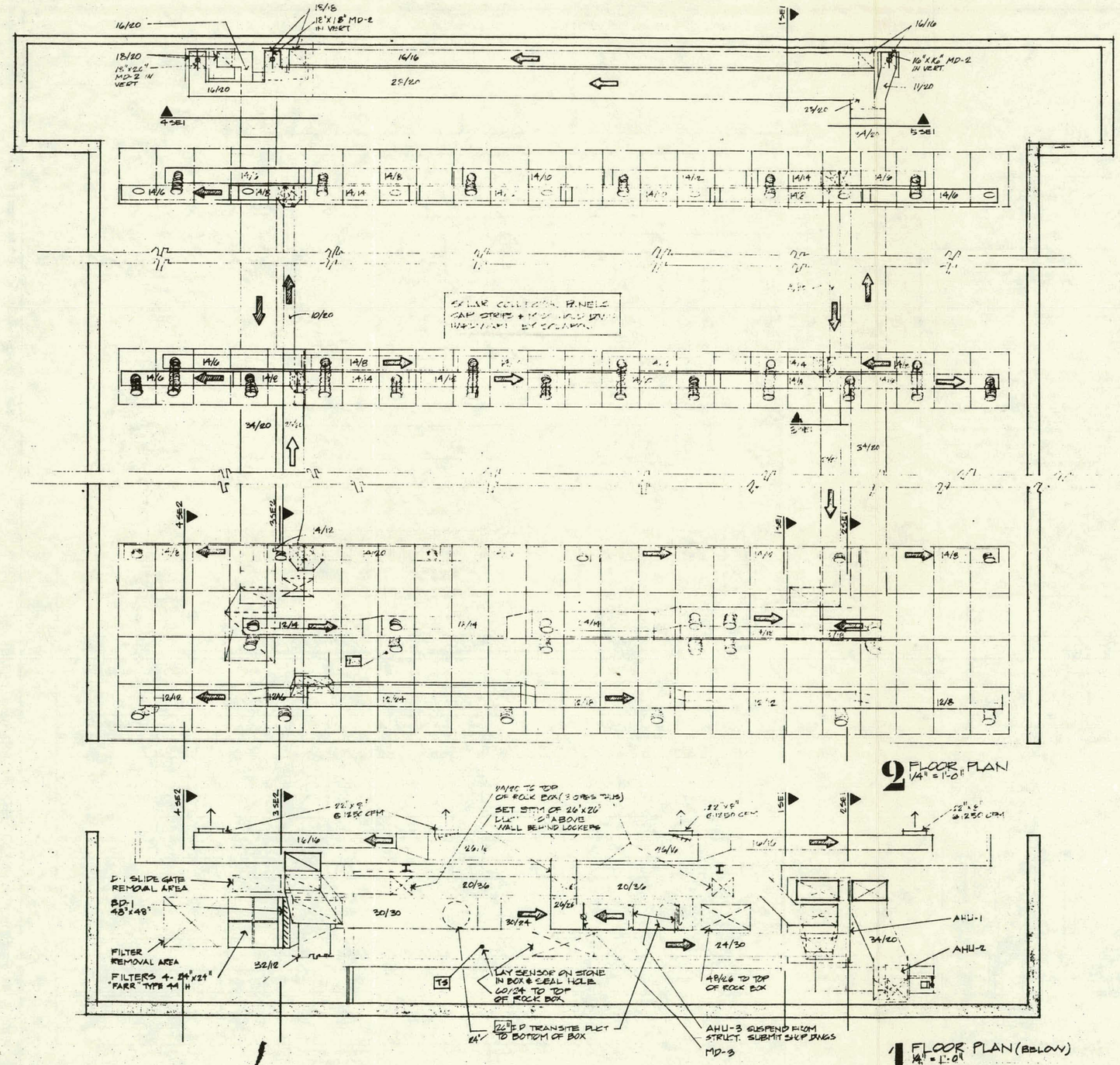
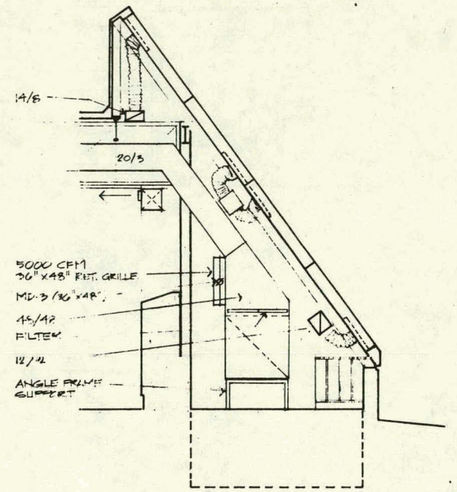
Kansas City Fire Station No.24, 2039 Hardesty, Kansas City, Missouri
schematics and elections

SEI

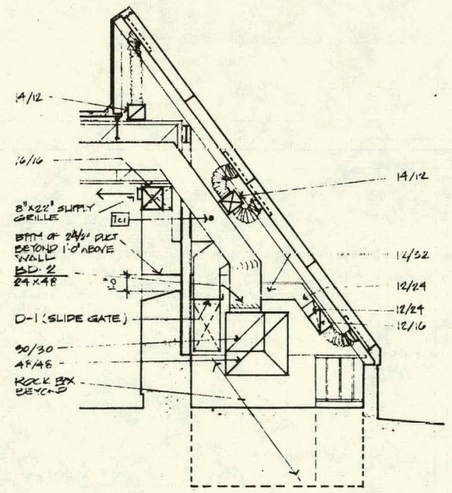


2 FLOOR PLAN
1/4" = 1'-0"

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



4 SECTION
1/4" = 1'-0"
RE: 1 SE2, 2 SE2



3 SECTION
1/4" = 1'-0"
RE: 1 SE2, 2 SE2

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

sections and plans

SE2

project no. .01
date. 9/6/77

APPENDIX C

WIRING DIAGRAM

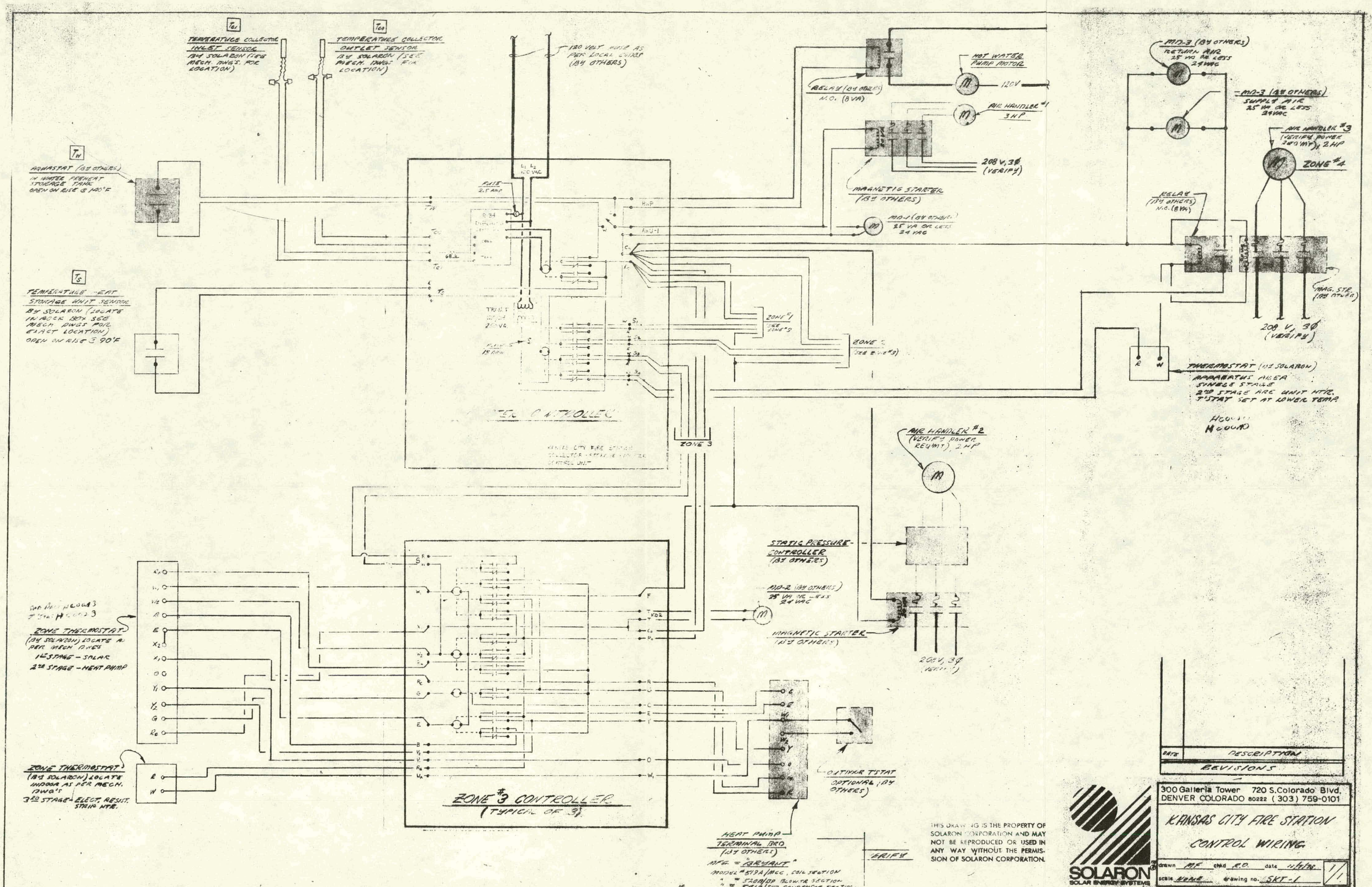
OF THE

SOLAR SPACE HEATING

AND

DHW SYSTEM

SKT-1



TEMPERATURE COLLECTOR INLET SENSOR (BY SOLARON (SEE MECH. DWGS. FOR LOCATION)
TEMPERATURE COLLECTOR OUTLET SENSOR (BY SOLARON (SEE MECH. DWGS. FOR LOCATION)
120 VOLT FUSE AS PER LOCAL CODES (BY OTHERS)
RELAY (BY OTHERS) N.O. (8VA)
HOT WATER PUMP MOTOR
120V
AIR HANDLER #1 3 HP
208 V, 3Ø (VERIFY)
MAGNETIC STARTER (BY OTHERS)
MD-1 (BY OTHERS) 25 VA OR LESS 24 VAC
MD-3 (BY OTHERS) RETURN AIR 25 VA OR LESS 24VAC
MD-3 (BY OTHERS) SUPPLY AIR 25 VA OR LESS 24VAC
AIR HANDLER #3 (VERIFY POWER REQMT) 2 HP
ZONE #4
RELAY (BY OTHERS) N.O. (8VA)
MAG. STR. (BY OTHERS)
208 V, 3Ø (VERIFY)
THERMOSTAT (BY SOLARON) APPARATUS AREA SINGLE STAGE 2ND STAGE ARE UNIT HTR. T'STAT SET AT LOWER TEMP.
AQUASTAT (BY OTHERS) IN WATER PREHEAT STORAGE TANK OPEN ON RISE @ 140°F
TEMPERATURE - EAT STORAGE UNIT SENSOR BY SOLARON (LOCATE IN ROCK BOX SEE MECH. DWGS FOR EXACT LOCATION) OPEN ON RISE @ 90°F
FUSE 2.5 AMP
L1 L2 120 VAC
HWP
AHU-1
ZONE #1 (SEE ZONE #3)
ZONE 2 (SEE ZONE #3)
ZONE 3
MASTER CONTROLLER
AIR HANDLER #2 (VERIFY POWER REQMT) 2 HP
STATIC PRESSURE CONTROLLER (BY OTHERS)
MD-2 (BY OTHERS) 25 VA OR LESS 24 VAC
MAGNETIC STARTER (BY OTHERS)
208V, 3Ø (VERIFY)
ZONE THERMOSTAT (BY SOLARON) LOCATE AS PER MECH. DWGS 1ST STAGE - SOLAR 2ND STAGE - HEAT PUMP
ZONE THERMOSTAT (BY SOLARON) LOCATE INDOOR AS PER MECH. DWG'S 3RD STAGE - ELECT. RESIST. STRIP HTR.
ZONE #3 CONTROLLER (TYPICAL OF 3)
O.STDOOR T'STAT OPTIONAL (BY OTHERS)
HEAT PUMP TERMINAL BRD (BY OTHERS)
MFG. = "BRYANT"
MODEL # 519A/MCC, COIL SECTION
" = 538A/DP BLOWER SECTION
" = 561B/SHP CONDENSOR SECTION
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DATE DESCRIPTION
REVISIONS
SOLARON SOLAR ENERGY SYSTEMS
300 Galleria Tower 720 S.Colorado Blvd. DENVER COLORADO 80222 (303) 759-0101
KANSAS CITY FIRE STATION
CONTROL WIRING
drawn M.F. chkd R.O.
scale NONE drawing no. SKT-1
1/1

APPENDIX C

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 (±7°F) differential is achieved between sensors Tco (in collector) and Tci (in return air duct - see specific plans), the following events take place:

A. Storing Heat - Room thermostat not calling for heat.

1. Differential thermostat in Solaron controller will activate "COLL" (collector) relay.

a. MD1 (motorized damper) - will be energized and powered open to allow air to flow to the inlet of the solar air handler blower (BWR), which is energized at the same time.

b. HWP (hot water pump) is also energized at this time if the Tw sensor (aquastat on water storage tank) is not satisfied (i.e. 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 "HI" are interrupted.

d. Relay contacts close circuit to Ts 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 "W_1" circuit and "R" to W_2 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 Tco and Tci 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 "Y_1" 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	Heat Pump Terminal Strip Equivalent
Y	W_1
W	W_2
O	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 Tw 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 udcts 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 ot storage will simulate the storage temperature dropping to the normal set point of 90^{o} 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 sytem 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.

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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

NEBB®

RECTANGULAR DUCT PITOT TUBE TEST REPORT

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					AHU-1				
3	.11	.15	.12	.125	.115	.1						18 x 34 = 4.25 sq ft			
4	3358	3348	3177	1337	1388	1266			2320	UP.	4.25	=	9860		
5			13,924												CFM
1	.075	.1	.125	.1	.072	.055	.02	.02	.02						
2	.042	.02	.045	.08	.04	.03	.04	.04	.033		AHU-1				
3	.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
10															CFM
11	.045	.04	.034	.04	.04	.05					AHU-2				
12	.048	.042	.039	.044	.048	.05			34 x 18		FAN 2		4.25		
13	.04	.04	.037	.046	.05	.06			839	UP.	4.25	=	3564		
VELOCITY SUB-TOTALS	842	808	766	833	858	924									

REMARKS:

the readings were taken with the aso 1 fan running and aso 2 fan running with thermostatic ID-1 calling for heat. Temperature raised rapidly up to 100° in the room. Damper MD-1 & MD-2 not operational had to remove to get it open.

TEST DATE _____ READINGS BY _____

NEBB®

PITOT TUBE TEST REPORT

PROJECT F. S. 24 SYSTEM/UNIT _____

LOCATION/ZONE AHN - 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	.052	.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											
8	.09	.138	.196	.205			West side			2164 UP. 2.3 = 4977					
9	.086	.149	.115	.205											
10										Total cfm 7576					
11				2164											
12															
13															
VELOCITY SUB-TOTALS															

REMARKS:

TEST DATE _____ READINGS BY _____

FORM TAB 11-76

NATIONAL ENVIRONMENTAL BALANCING BUREAU
REPORT NOT VALID UNLESS STAMPED WITH
NEBB CURRENT CERTIFICATION SEAL

PAGE _____ OF _____

AIR APPARATUS TEST REPORT

PROJECT _____ SYSTEM/UNIT AHU 2

ADDRESS _____ LOCATION _____

UNIT DATA	
Make & Model No.	Loren Cook 21
Type & Size	C.H.B
Arrangement & Class	
Discharge	
Sheave Size & Make	4 3/8 Browning
Sheave Bore Size	1 1/4
No. Belts, Make & Size	2 - Goodyear [illegible]

MOTOR DATA	
Make & Frame	MARATHON K5T
Motor H.P.	2
Volts, Phase, Cycles	200 - 3 - 60
Full Load Amps	6.8
Sheave Size & Make	3 3/4 Browning
Sheave Bore Size	7/8
Sheave Center's Dist.	20 1/2

TEST DATA	DESIGN	ACTUAL
Total CFM		
Total S.P.		
Fan RPM		1350
Motor B.H.P.		
Out. Air CFM		
Ret. Air CFM		
Motor RPM		
Motor Volts T_1-T_2, T_3-T_1, T_2-T_3,		200
Motor Amps–T_1, T_2, T_3		4.5

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 _____

NEBB

PROJECT [illegible] SYSTEM/UNIT AHU 3

ADDRESS _____ LOCATION _____

UNIT DATA	
Make & Model No.	[illegible]
Type & Size	[illegible]
Arrangement & Class	
Discharge	
Sheave Size & Make	
Sheave Bore Size	
No. Belts, Make & Size	[illegible]

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

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-T_1, T_2-T_3,		200 volt
Motor Amps–T_1, T_2, T_3		6.0 [illegible]

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 _____

FORM TBA-4-71 NATIONAL ENVIRONMENTAL BALANCING BUREAU PAGE ____ OF ____

NEBB

PROJECT _____ SYSTEM/UNIT AHU 1

ADDRESS _____ LOCATION _____

UNIT DATA	
Make & Model No.	McQuay LHD111CH
Type & Size	
Arrangement & Class	
Discharge	
Sheave Size & Make	11 Browning BK115H
Sheave Bore Size	1 1/2
No. Belts, Make & Size	1 Browning A46

MOTOR DATA	
Make & Frame	BALDOR 182T
Motor H.P.	5
Volts, Phase, Cycles	200 3 60
Full Load Amps	10
Sheave Size & Make	Browning 5 3/4
Sheave Bore Size	1 1/8
Sheave Center's Dist.	21.5 FR

TEST DATA	DESIGN	ACTUAL
Total CFM		
Total S.P.		
Fan RPM		810
Motor B.H.P.		
Out. Air CFM		
Ret. Air CFM		
Motor RPM		
Motor Volts T_1-T_2, T_2-T_3, T_3-T_1		200
Motor Amps–T_1, T_2, T_3		6.5

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 _____

AIR OUTLET TEST REPORT

PROJECT F. S. 21 SYSTEM Heat Pumps

ADDRESS _____ OUTLET MANUFACTURER _____

AREA SERVED	OUTLET NO.	OUTLET TYPE	OUTLET SIZE	OUTLET AK	DESIGN CFM	DESIGN VEL.	PRELIMINARY VEL.	PRELIMINARY VEL.	PRELIMINARY VEL.	PRELIMINARY VEL.	FINAL VEL.	FINAL CFM	REMARKS
TD-1 -	1	TDC	12x12	.49	400		825					404	
Day Room	2	"	"	"	465		905					444	
	3	"	"	"	330		865					424	
	4	"	9x9	.274	165		840					220	
	5	TDC	12x12	.49	290		1.V.					479	
	6	TDC	6x6	.125	100		710					89	
TD 2					1750							1089	119%
	1	TDC	12x2	.49	240		625					326	
	2	TDC	12x12	.49	240		666					226	
	3	TDC	"	"	305		647					317	
	4	TDC	9.9	.274	130		566					155	
	5	271	26x12	134	215		163					218	
	6	TDC	6x6	.125	85		505					69	
	7	S200	18x12	.918	140		1675					154	
	8	271	"	.918	145		844					183	
TD 3					1500							1752	117%
	1	TDC	9x9	.274	265		857					235	
	2	"	"	"	265		757					237	
	3	"	"	"	265		1283					379	
	4	"	"	"	255		1252					352	
					1060							1203	113%

REMARKS:

Taken with cool on

TEST DATE _____ READINGS BY. _____ CERTIFIED BY _____

NEBB

AIR OUTLET TEST REPORT

PROJECT [illegible] SYSTEM

ADDRESS OUTLET MANUFACTURER

AREA SERVED	OUTLET				DESIGN		PRELIMINARY				FINAL		REMARKS
	NO.	TYPE	SIZE	AK	CFM	VEL.	VEL.	VEL.	VEL.	VEL.	VEL.	CFM	
EF 1													
	1	23	11x11	.15	330								
	2	"	8x6	.117	100								
	3	"	"	"	"								
	4	"	"	"	55								
	5	"	"	"	30								
	6	"	"	"	95								
	7	"	12x10	.324	300								
motor OA fa													
Westinghouse				FI	TAS								
HP .23													
Volt 115													
Single phase				60 cy									

REMARKS:

Not working

TEST DATE READINGS BY CERTIFIED BY

NATIONAL ENVIRONMENTAL BALANCING BUREAU PAGE OF

F.5.24 UNIT DATA

ID #3
Bryant

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 520B 42 B P

ID #2
Bryants
RPM 1025
AMP 2.9
Direct Drive
Volt 200
PH-1 60HZ
HP .45
FLA 4.5 DV 208/230
Model 520B 048BD

ID # 1 Bryant
RPM 987
AMP 5.6
DIRECT DRIVE
VOLT 200
PH-1 60 HZ
HP
FLA 5.0 D.V 208/230
MODEL 520B060BP

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 diffence 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.

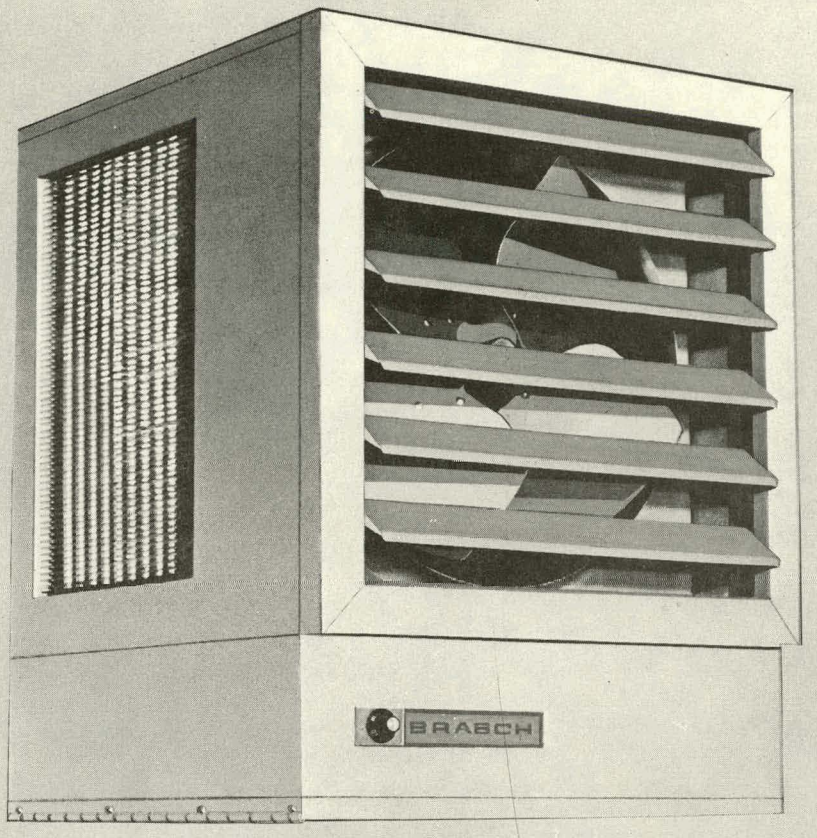
Some minor insulation discrepancies were noted during the "walk through". The water pipes near the hot water heat exchanger and near the water heaters had not been insulated. This was accomplished at a later date. The "walk through" showed that the overall mechanical work was excellent including duct 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



BRASCH

Electric Unit Heaters

72

applications

For complete or supplementary heating of entryways, storerooms, 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.

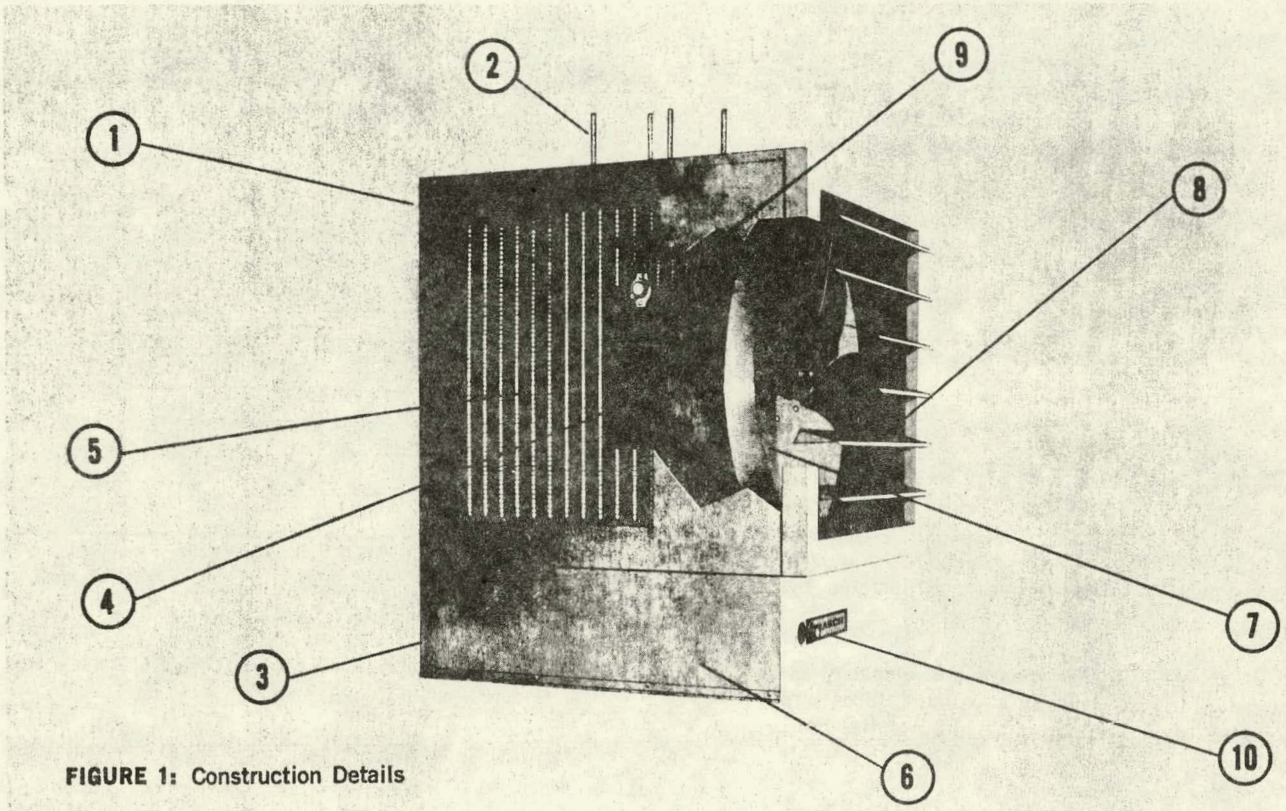


FIGURE 1: Construction Details

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 daytime 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).

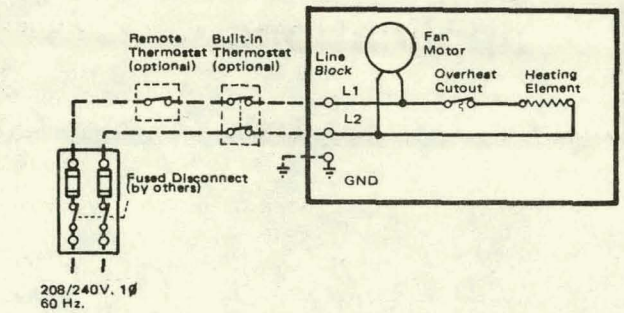


FIGURE 2: 240V, Single Phase, 2.5 KW Circuit Diagram

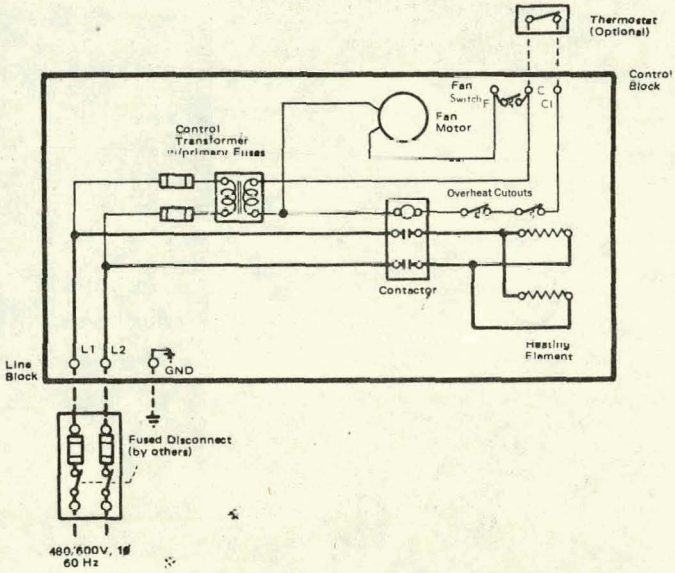
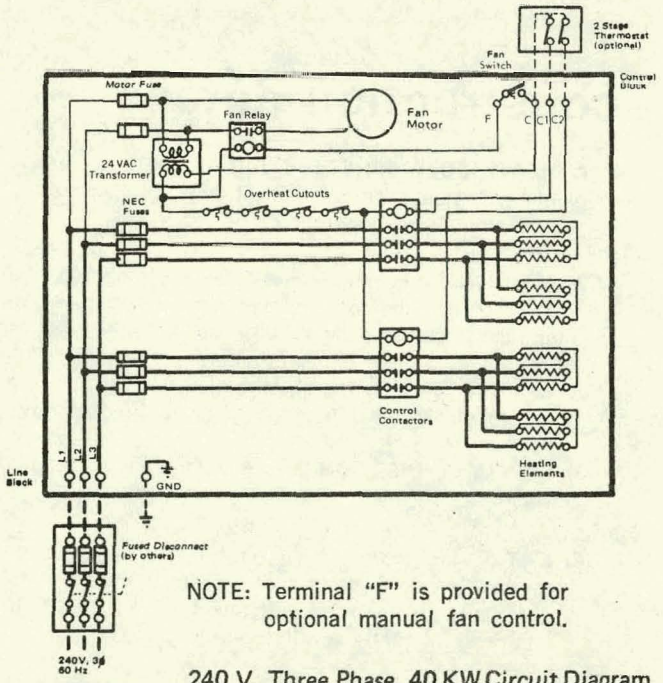


FIGURE 3: 480V, Single Phase, 10 KW Circuit Diagram



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

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 8).

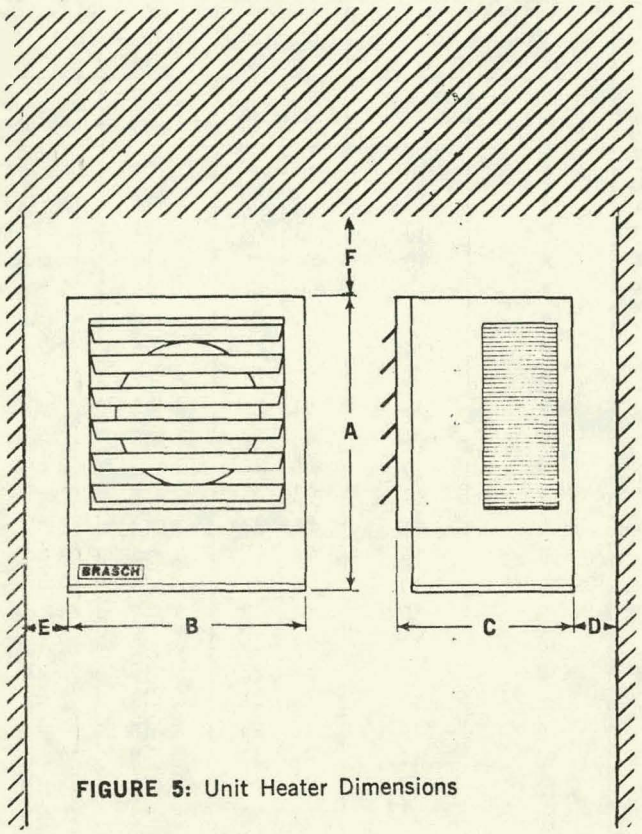


FIGURE 5: Unit Heater Dimensions

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

	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	30	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-#12	3-#10
12	500	625	32	18	0	1	NO	240	8	10	51	23	3-#12	3-#10
12	500	625	32	18	0	1	YES	120	8	10	64	29	3-#14	3-#12
12	500	625	32	18	0	1	YES	120	8	10	64	29	3-#14	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

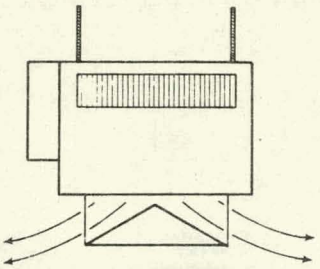


FIGURE 6: Cone Type Diffuser

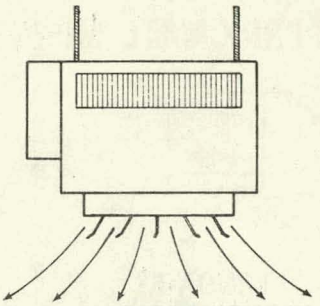


FIGURE 7: Four-Way Louvers

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, ½-13 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 cutout 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 ¼ 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 Subbase
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	W¹	V
2.5—20	26¼	26	7	9	5	17	—	15
25—50	35¼	31	7	9	5	—	22½	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.

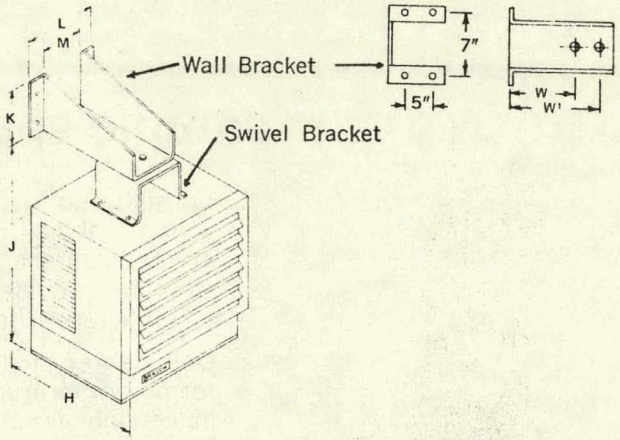


FIGURE 8: Horizontal Discharge

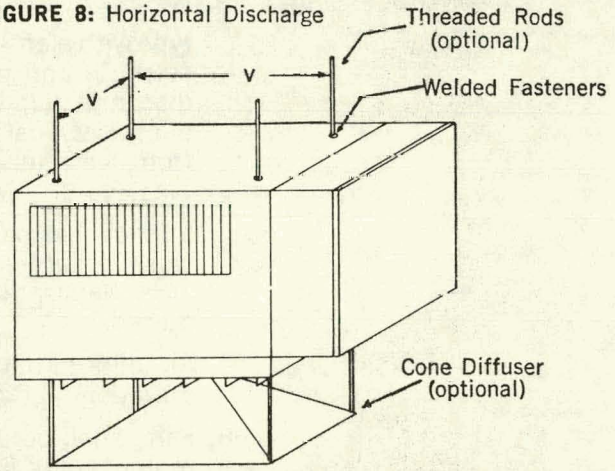


FIGURE 9: Vertical Discharge

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.

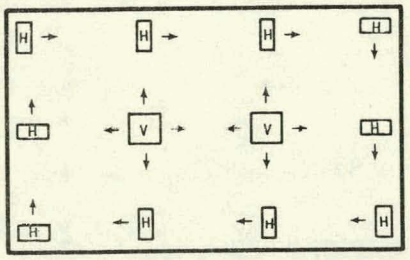


FIGURE 10

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 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.

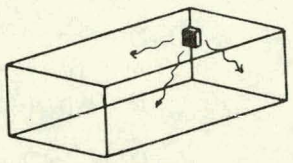


FIGURE 11

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.

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 3600 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.

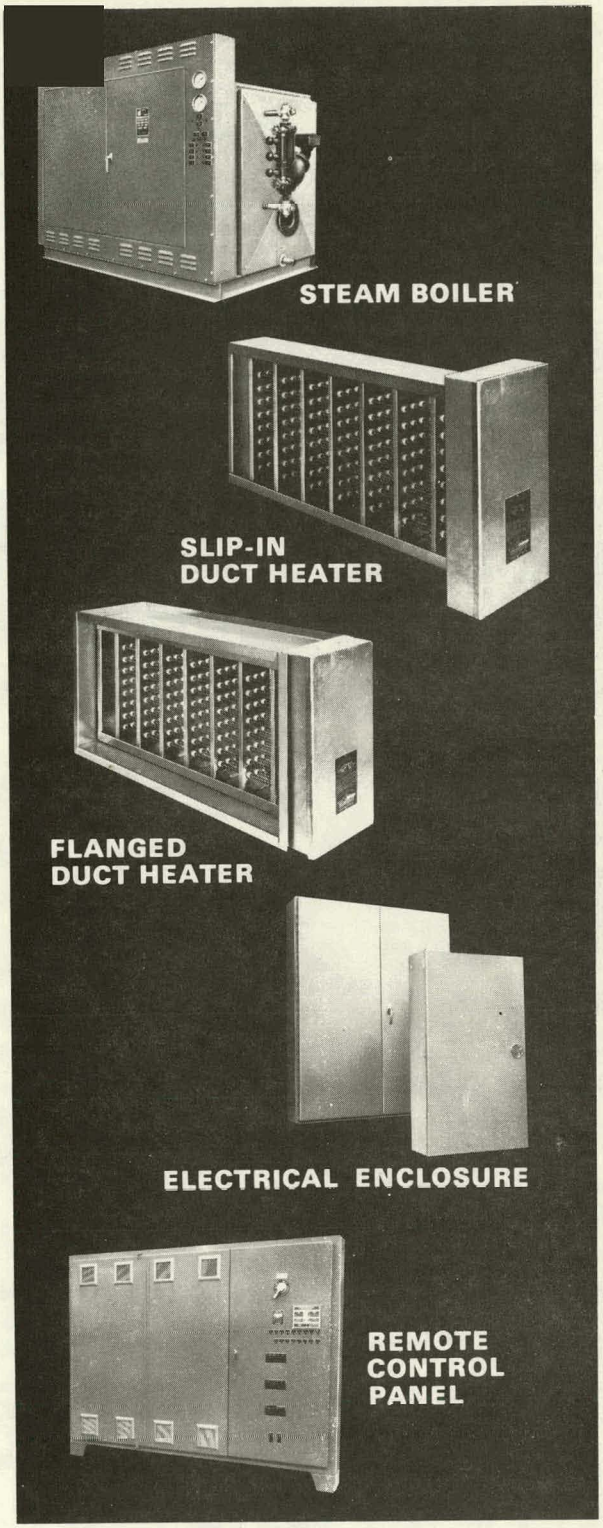
REMOTE CONTROL PANELS – custom designed, UL Listed, used for the control of Electroduct heating coils and many other types of electric heating equipment. The combination of Brasch panels with Brasch heaters assures you of one-source responsibility and a fully coordinated, prewired, factory tested electric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

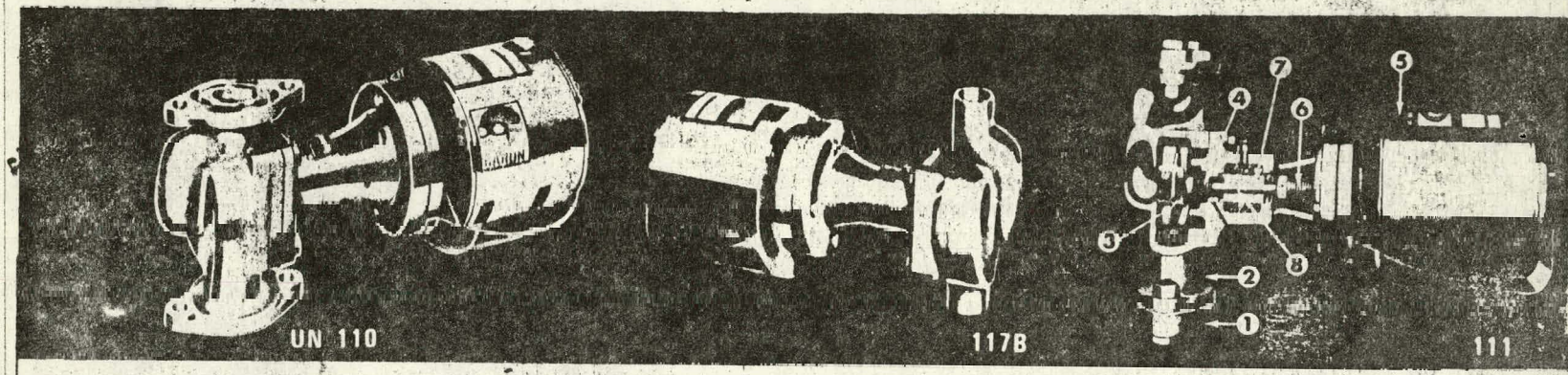


BRASCH
MANUFACTURING COMPANY, INC.
11880 DORSETT ROAD • (314) 291-0440
MARYLAND HEIGHTS, MISSOURI 63043

PRINTED IN U. S. A.

SECTION h

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



Specifications

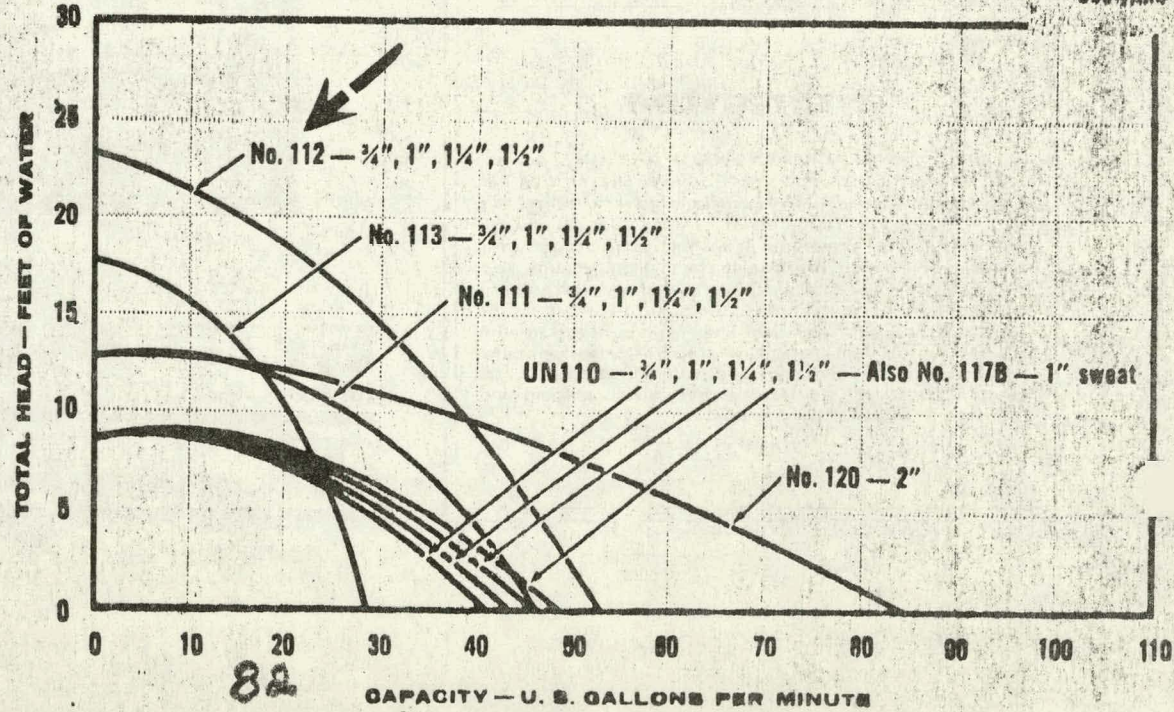
① Flanges	Interchangeable ¾", 1", 1¼" or 1½" for all sizes except 2" and No. 117B. Cast Iron or Bronze[1]
② Body	Cast Iron or Bronze[1] . Note No. 117B furnished in 1" Bronze with Sweat connections only.
③ Impeller	Dynetrically balanced, closed type except No. 110 and No. 117B which are open type.
④ Mechanical Seals	Carbon & Ceramic
⑤ Motor	Selected for quietness, Rubber Mounted, Overload Protected
⑥ Drive Coupling	Smooth, safe flexible steel spring type
⑦ Bearings	Large Porous Bronze
⑧ Shaft	Stainless steel super finished
Maximum operating temperature	240F
Maximum working pressure	100 PSI, 117B/125 PSI UN110

(1) For fresh water circulation, specify bronze construction

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

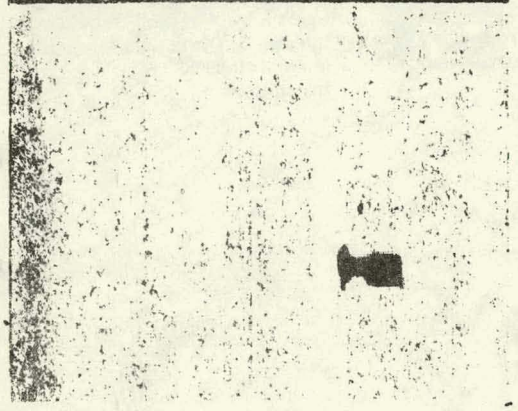
Catalog Number 600-TAX4

Performance Curves



Taco

CIRCULATORS & SPECIALTIES



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

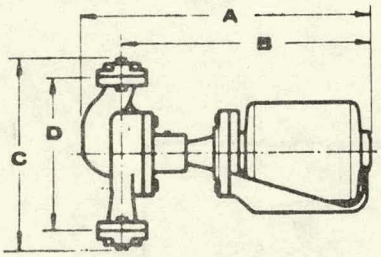
- **Quiet operation**
- **Motor — Rubber Mounted, Overload Protected**
- **One piece, cast impellers for longer life**
- **Leak-proof mechanical seal — two piece type, easily replaced**
- **Stainless steel shaft — hardened and ground**
- **Smooth, safe drive coupling**
- **Easily serviced with ordinary 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.

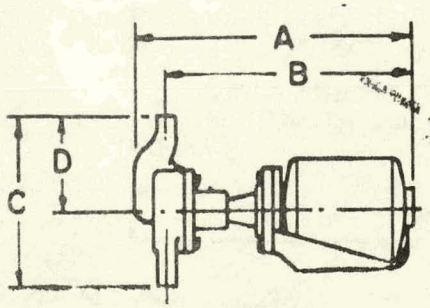
2 When used in conjunction with a Taco Flochek and Water Heater, the same boiler which provides the heating, also supplies domestic hot water all year 'round for kitchen, bath and laundry.

3 For house heating, circulators are available in cast iron construction. For domestic or fresh water circulation, specify bronze construction.



ROTATED FLANGE POSITION ON UN110

UN 110, 111, 112, 113 & 120



No. 117B

Sizes & Dimensions

PRODUCT NUMBER (1)		FLANGE SIZE	MOTOR (2)		DIMENSIONS - INCHES				APPROX WHT LBS
CURRENT(1)	OLD		600-AC-1 PH (2)	RPM	A	B	C	D	
UN110	HC	¾", 1", 1¼", 1½"	1/12HP-115V	1725	14⅜	12⅜	8½	6⅜	21
111	HDH	¾", 1", 1¼", 1½"	1/8HP-115V	1725	15⅞	13⅜	10¼	8½	26
112(3)		¾", 1", 1¼", 1½"	1/3HP 115V	3450	16¾	14¾	9¼	7½	28
113		¾", 1", 1¼", 1½"	1/8HP 115V	1725	16	13¾	10⅛	8½	27
117B(4)		1" Sweat	1/12HP 115V	1725	15⅜	13¼	7¼	4⅝	22
120	HC 20	2"	1/6HP 115V	1725	17⅛	14½	13¼	11	46

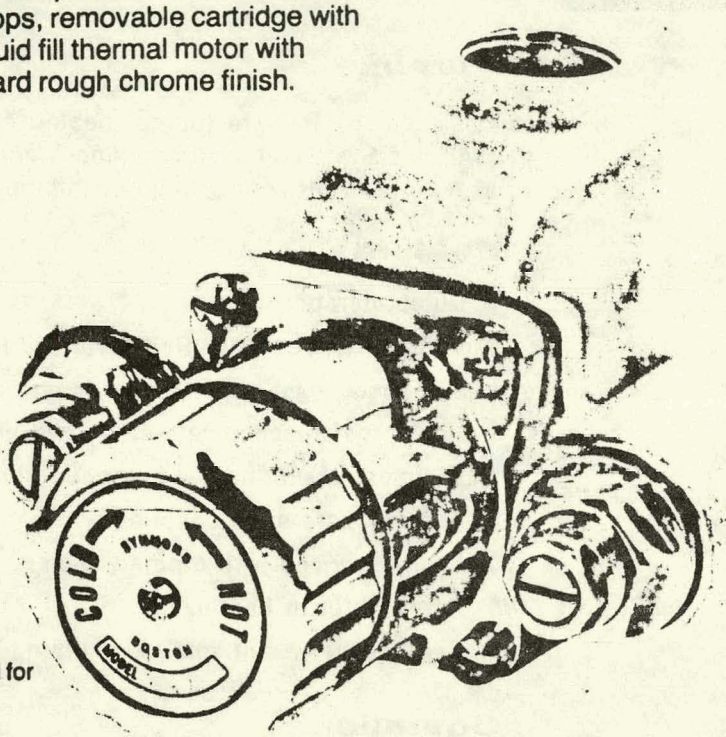
(1) When specified or bronze construction add the letter 'B' at the end of each product number.

ONTROL
Only

1510.7 Mixing Valve

#5 400 (¾) 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.

Model No.	Inlets	Outlet
5-200	¾"	¾"
5-400	¾	1
5-500	1	1¼
5-700	1¼	1½
5-900	1½	1½
5-1000	1½	2



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

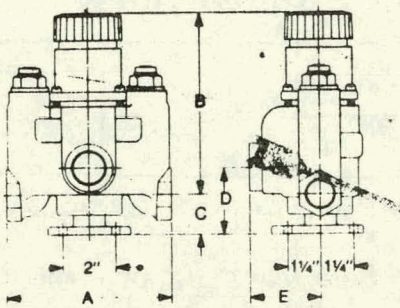
Models 5-900 and 5-1000 have separate check stops

Modifications

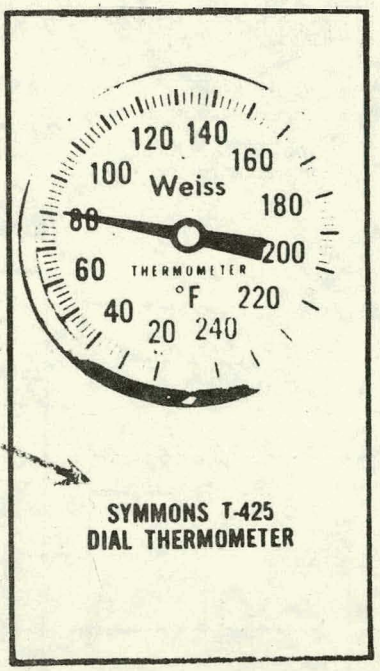
Suffix 1	For use in photographic or x-ray work – available as 5-200-1 or 5-400-1
Suffix P	Polish chrome highlight finish
Suffix W	Wall mounting bracket
Suffix RC	Spare cartridge – recommended for non-interrupted service

Physical Dimensions

Model No.	A	B	C	D	E
5-200	6¼"	5⅜"	1⅞"	2⅝"	2"
5-400	6¼	6⅜	1 1⁄16	2 7⁄16	2⅝
5-500	8	6⅝	1⅝	2⅞	3⅛
5-700	8	6⅝	1⅝	2⅞	3⅛
5-900	12	7½	2⅜	–	3⅝
5-1000	12	7½	2⅜	–	3⅝



5-200 thru 5-700



SYMMONS T-425
DIAL THERMOMETER

Limit capacity rating by P.D.

WATTS BACK FLOW PREVENTERS

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

C.S.A. Certified through 1"

No. 900 Series

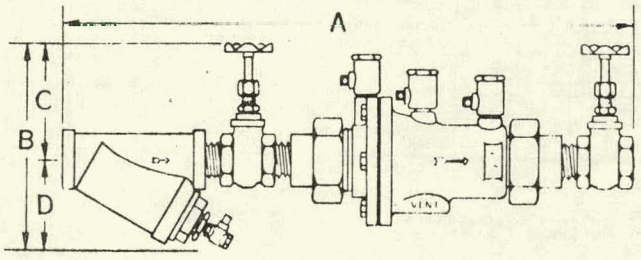
Reduced Pressure Principle Backflow Preventer

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

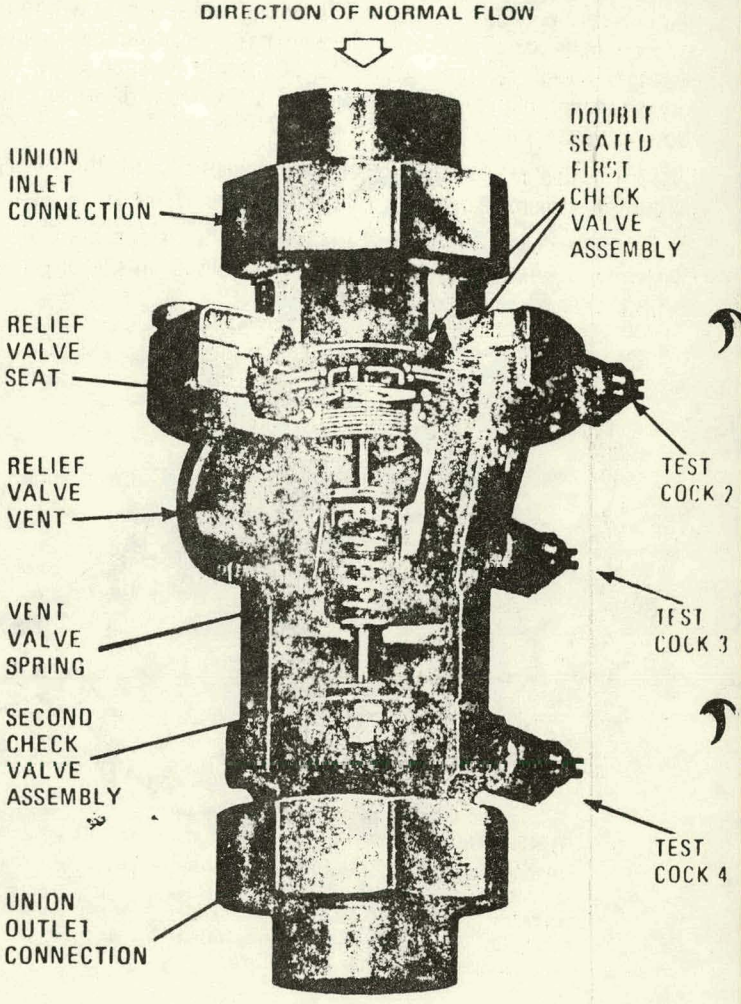


SIZES (In.)	DIMENSIONS (Inches) A	B	C	D	TOTAL WEIGHT (Lbs.)	VENT SIZES (In.)
3/4	19 1/8	8 3/8	4 1/4	4 1/8	20	1
1	20 3/4	9 1/2	4 3/4	4 3/4	22	1
1 1/4	22 1/4	10 3/4	5 1/2	5 1/4	24	1
1 1/2	30	12	6 1/4	5 3/4	56	2
2	32	13 3/4	7	6 3/4	64	2

Maximum Supply Pressure 175 lbs.

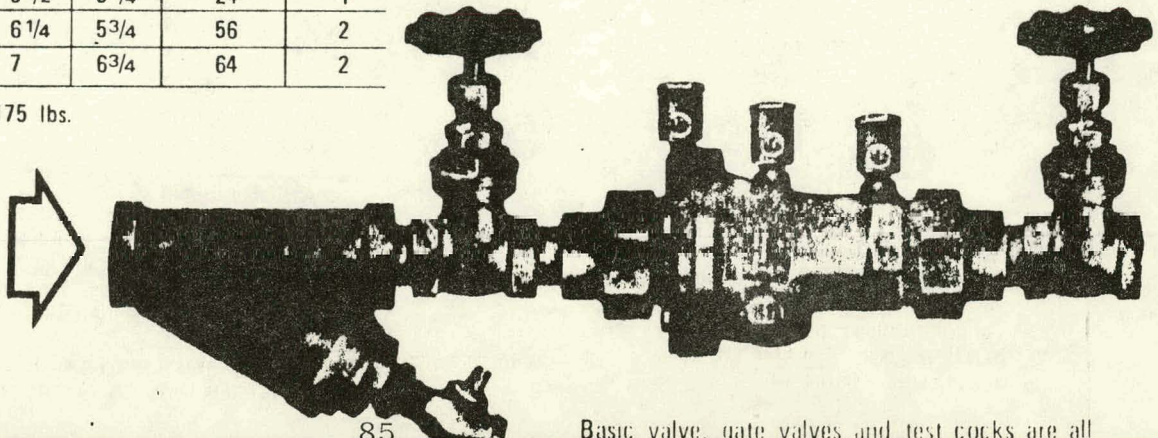
CONSTRUCTION OF BASIC VALVE

(GATE VALVES AND STRAINER NOT SHOWN)



Patent No. 3,636,968
and other Patents Pending

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



Basic valve, gate valves and test cocks are all

FOR LARGER SIZES, SEE PAGE 12

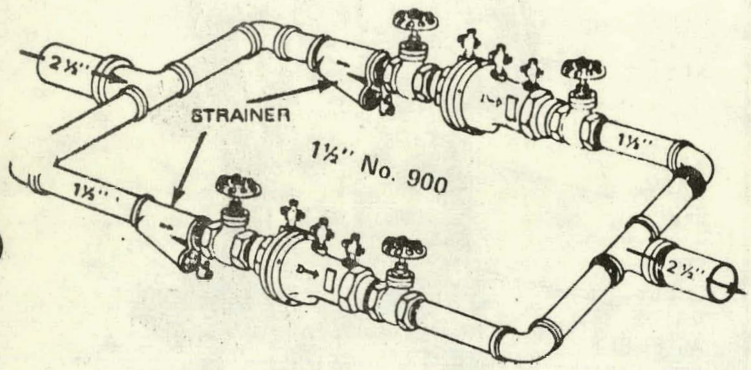
ptional Parallel Installations
using smaller sizes

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.

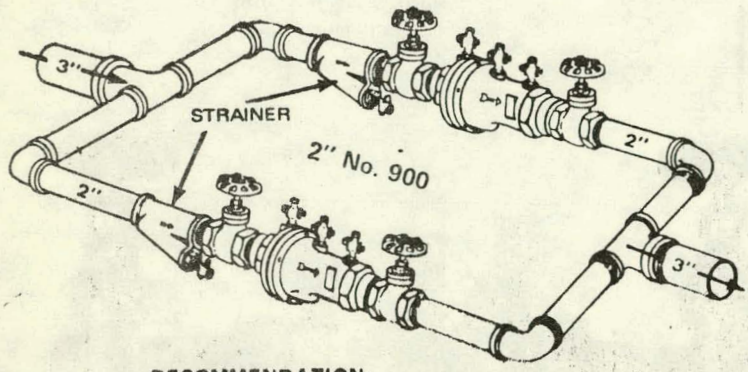
The number of devices and sizes used in parallel should be determined by the engineer's judgement based on the operating conditions of a specific installation.

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.

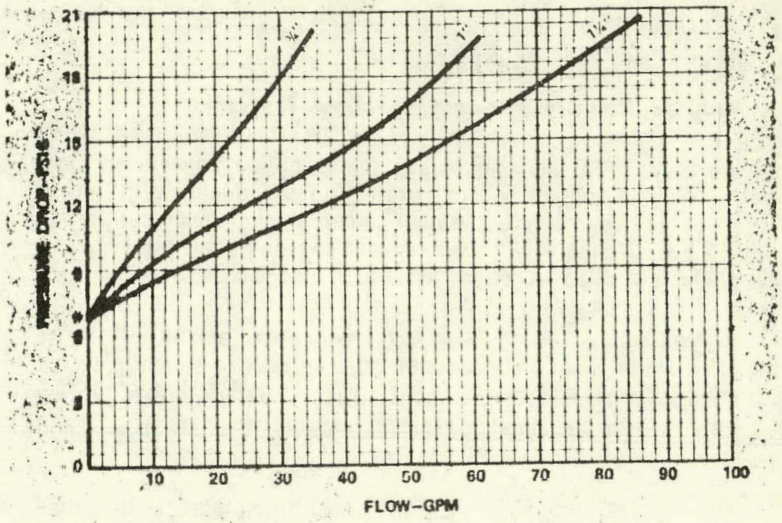
for 3" Main Line



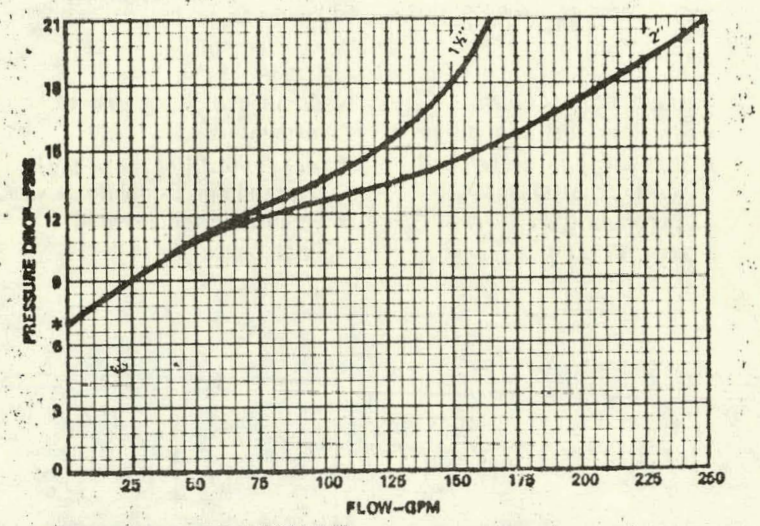
RECOMMENDATION:
Install two size 2" No. 900 to provide a total flow up to 350 GPM. This exceeds the required testing capacity for a single 3" backflow preventer, based on applicable standards referred to.

Capacity

NO. 900
SIZES ¾", 1", 1¼"



NO. 900
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
1¼"	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 1976.

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.E. Standard 1013.

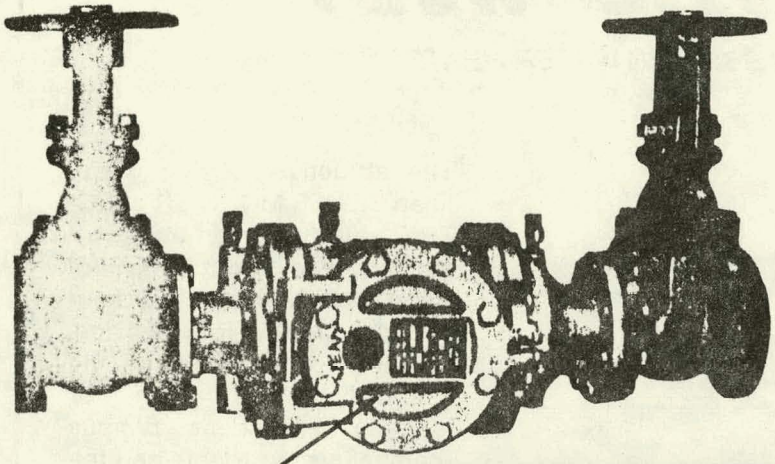
Watts valves have been tested under these provisions and equal or exceed these performance requirements as shown.

WATTS BACKFLOW PREVENTERS

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

No. 900 Series †2½", †3", 4", 6"

Reduced Pressure Principle Backflow Preventer

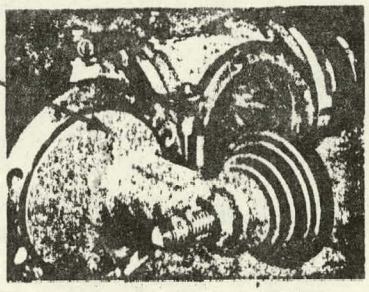


- Stainless steel internal parts
- Standardly furnished with O.S. & Y. gate valves.
- Swing out access door for service simplicity
- Patented double seated first check valve for added safety
- Relief port for maximum back pressure and back siphon venting
- Furnished with flanged connections
- Ball valve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

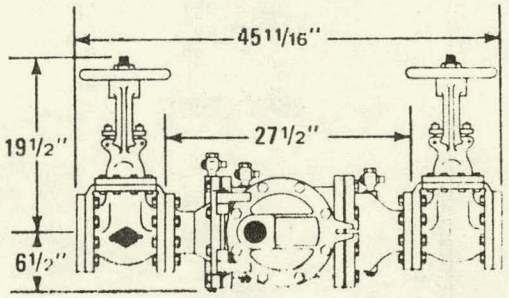
FEATURING "SWING OUT SERVICE"*

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



DIMENSIONS

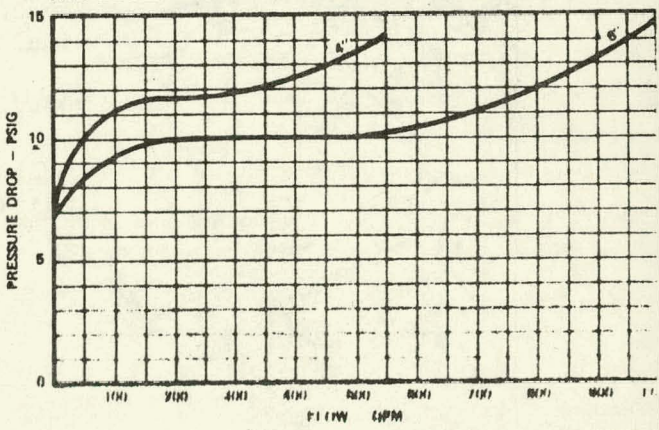


†NOTE: Sizes 2½" and 3" available mid - 1975.

Watts larger size No. 900 Series backflow preventers have the same basic design features as sizes ¾" - 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.

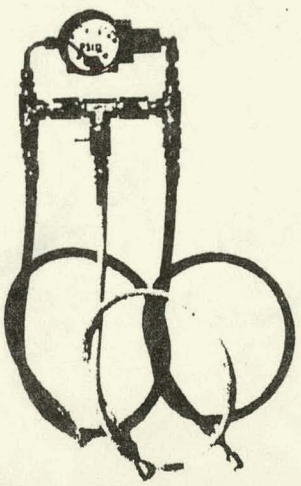
Size	Material	Weight
2½"	Bronze	210 lbs.
3"	Bronze	240 lbs.
4"	Iron	571 lbs.
4"	Bronze	514 lbs.
6"	Iron	1,120 lbs.

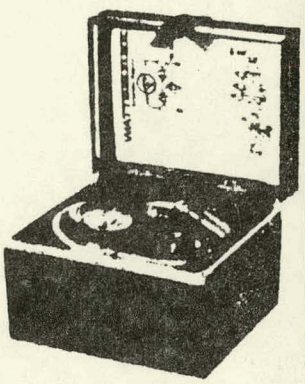
No. 900 4" - 6" CAPACITY



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 ±2% accuracy, full scale
- Hoses – (3) 3' with ¼" female threaded couplers
- Adaptors – (3) ¼" threaded adaptors, (3) ¼" bushings, (3) ¼" bushings
- Moisture resistant instruction guide
- Case – shock resistant molded plastic with special diced foam insert that enables multiple compartment combinations for tools, accessories or
- 16" securing strap

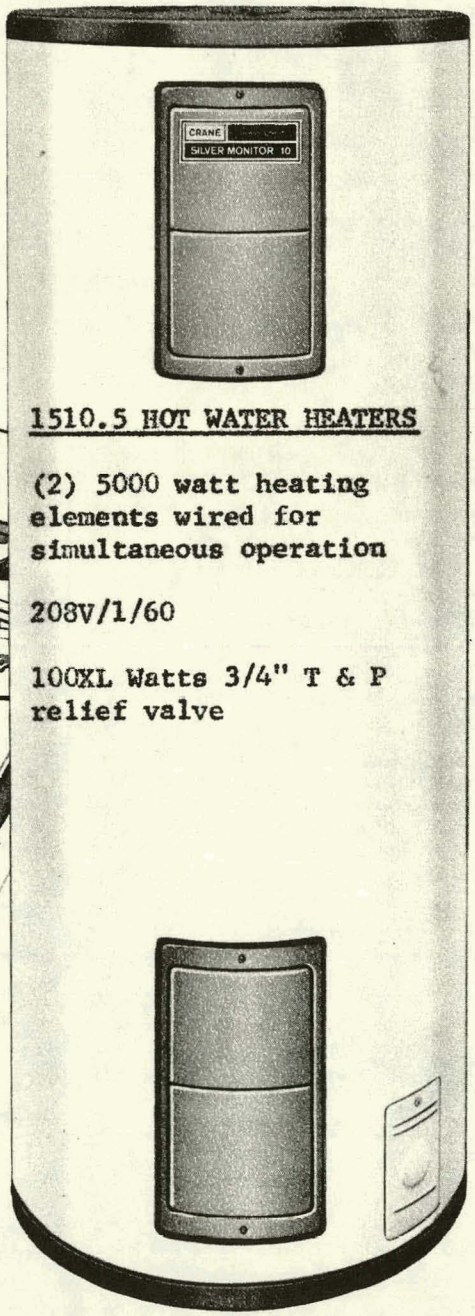
CRANE SUPPLY COMPANY

CRANE®

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	[redacted]	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

Five Nonilo

ELECTRIC GLASSLINED WATER HEATERS

■ **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 ¾" N.P.T. opening provided for installation of Temperature-Pressure relief valve. Maximum Hydrostatic Working Pressure 150 PSI.

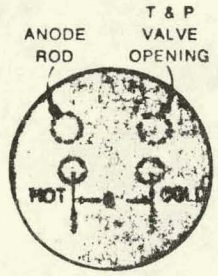
■ **TRIPLE TESTED TANKS** Each tank is carefully tested three times during manufacture.

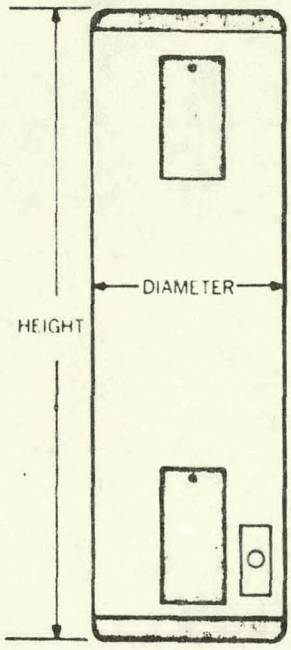
■ **FIBERGLASS INSULATION** An extra dense blanket of non-settling fiberglass surrounds tank and keeps heat loss to minimum — saves fue

■ **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.

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





¾" 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	37½	20	100
C5-30-2RS7	C10-30-2RS7	Double	9,000*	36.9	30	37½	20	100
C5-42-1RS7	C10-42-1RS7	Single	6,000	24.6	42	47½	20	115
C5-42-2RS7	C10-42-2RS7	Double	12,000*	49.2	42	47½	20	120
C5-52-1RS7	C10-52-1RS7	Single	6,000	24.6	52	50½	22	150
C5-52-2RS7	C10-52-2RS7	Double	12,000*	49.2	52	50½	22	150
C5-66-2RS7	C10-66-2RS7	Double	12,000*	49.2	66	52¼	24	180
C5-82-2RS7	C10-82-2RS7	Double	12,000*	49.2	82	58½	24	215
C5-100-2RS7	C10-100-2RS7	Double	12,000*	49.2	100	57¾	28	300
C5-120-2RS7	C10-120-2RS7	Double	12,000*	49.2	120	63	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 4.1 g.p.h. per 1000 watts input.**

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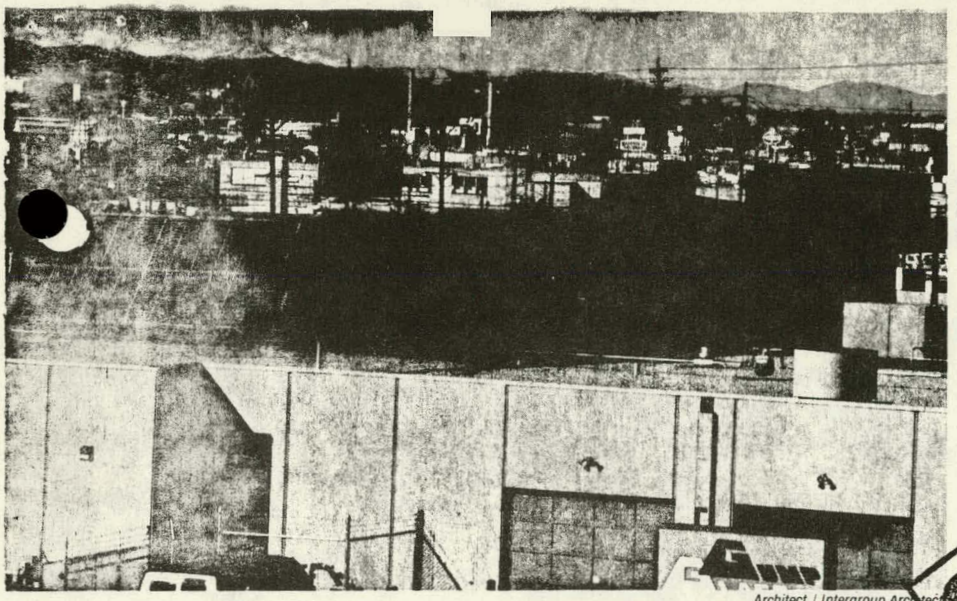
SOLAR PANELS

AND

SYSTEM

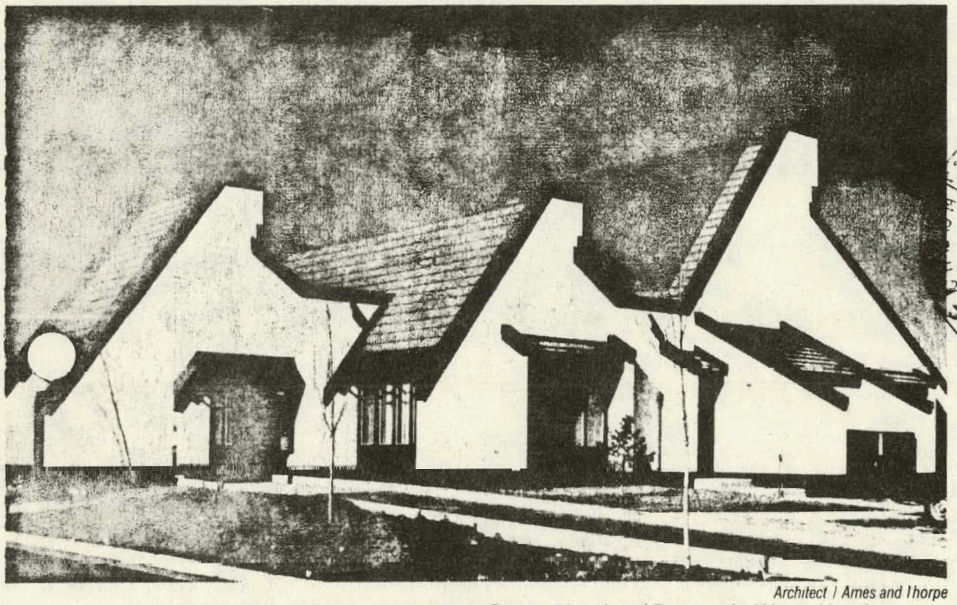
TN-1

13.25/So



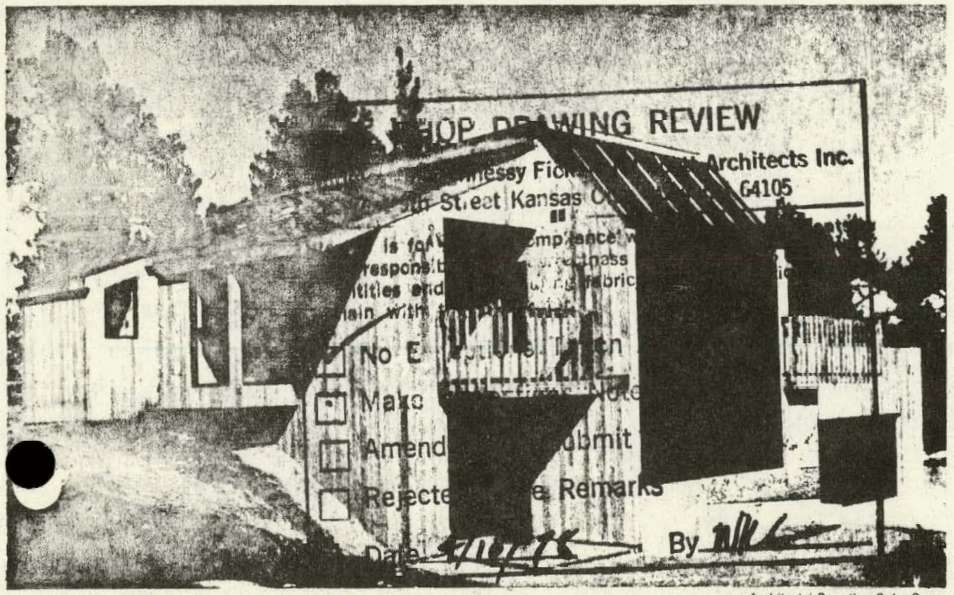
Architect / Intergroup Architects

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



Architect / Ames and Thorpe

COMMERCIAL Space Heating / Domestic Water Heating
Ventilation Air Heating



Architect / Crowther Solar Group

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

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 45 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.

MR—MANUFACTURER

Solaron's business is the practical application of solar energy. We design, manufacture and market solar heating systems for industrial, commercial, agricultural process drying 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 Löf. 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.

The Solar Air Heating System

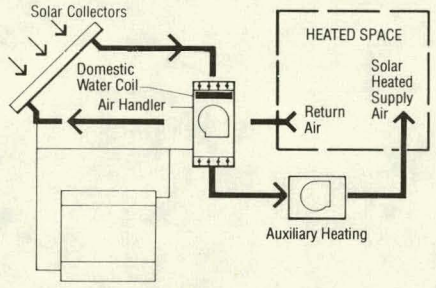
SOLARON CORPORATION T.M.

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.

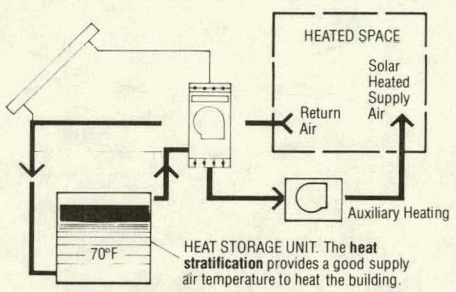
The Solaron collector, air handler and controller and necessary ductwork is installed by the HVAC contractor. The general contractor usually builds the heat storage container. The system is then tested through all of the operating modes and thoroughly checked for proper operation.

OP—OVERALL PRODUCT, IN PLACE

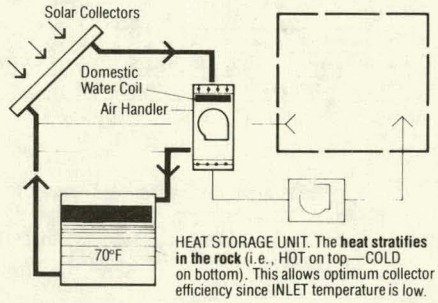
SYSTEM OPERATION



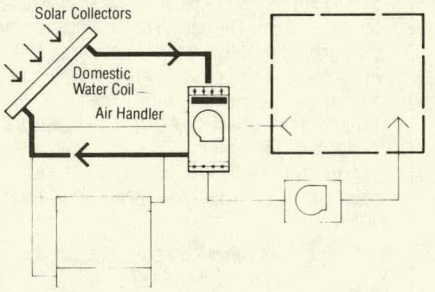
HEATING FROM COLLECTOR Air, the circulating heat transfer medium is drawn through the collector where it is normally heated to about 120-150°F. When the space requires heat, the solar heated air is drawn through the air handling unit in which motorized dampers are automatically opened to direct the hot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

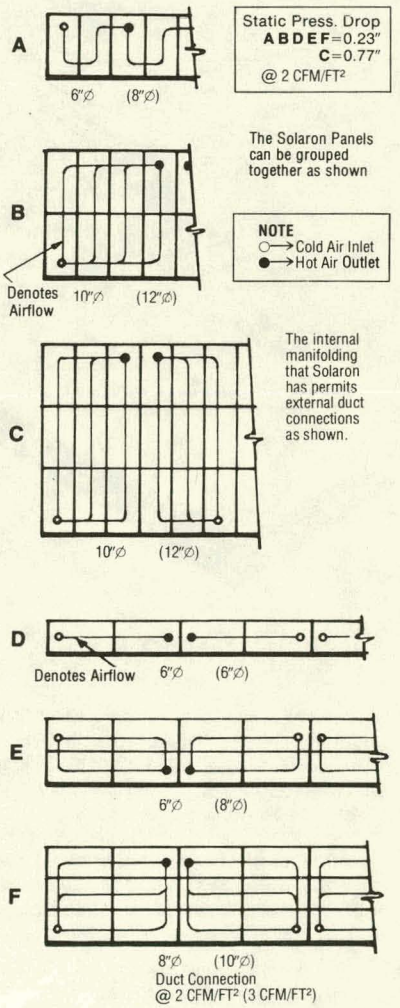


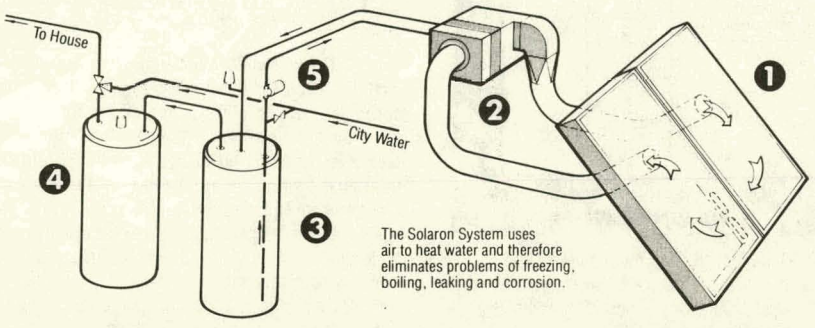
STORING HEAT When the space temperature is satisfied the automatic control system diverts the air into the heat storage unit where the heat is absorbed by the pebble bed. The air returns to the collector where it is heated and this cycle is repeated.



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.

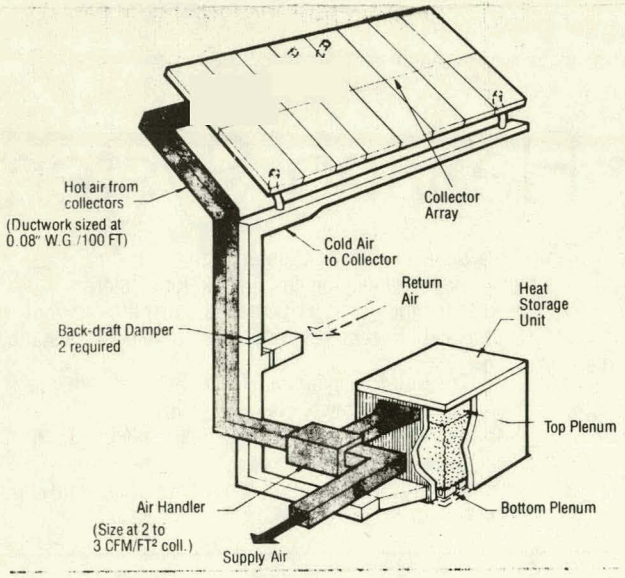
TYPICAL COLLECTOR ARRAYS





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.



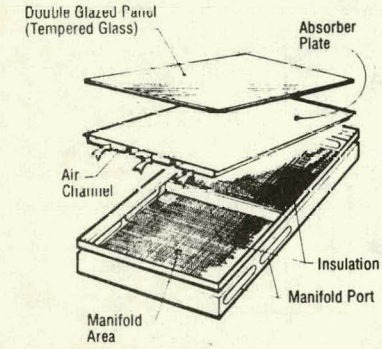
GENERAL SYSTEM DESCRIPTION

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.

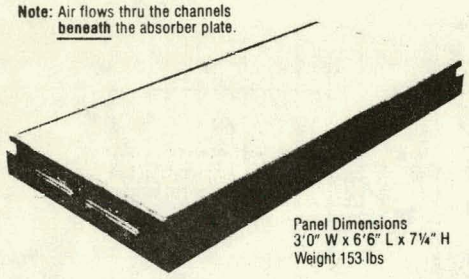
CONTACT SOLARON TO OBTAIN SYSTEM SCHEMATICS SHOWING HOW TO COMBINE SOLAR HEATING WITH:

- 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



Note: Air flows thru the channels **beneath** the absorber plate.



SOLARON COLLECTOR PANEL DETAILS (patents applied for)

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

The Solaron solar collector has the following general construction characteristics:

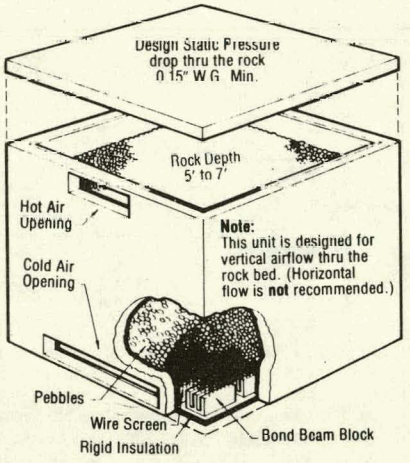
Absorber: 28 gauge steel with porcelain enamel coating.

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

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

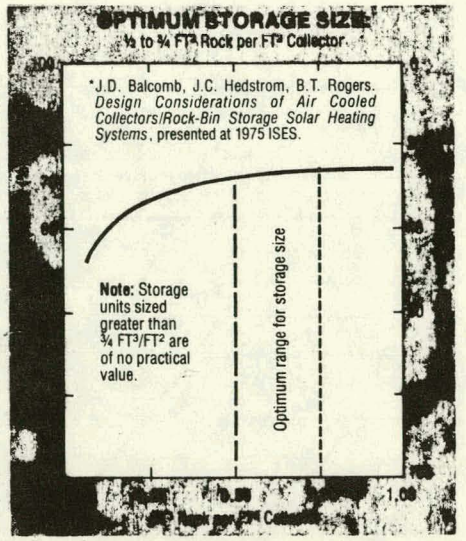
Connection Ports: Unique flange configuration permits tight air seal automatically as modules are installed.

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

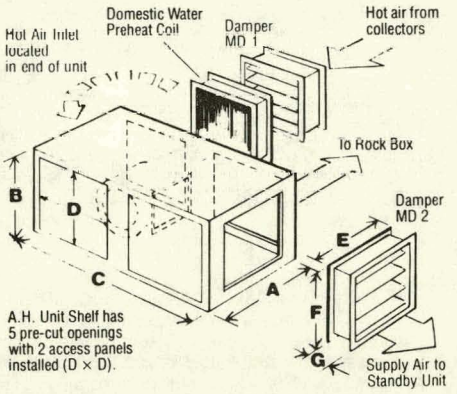


PEBBLE-BED HEAT STORAGE UNIT

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



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



Model No.	Air Handling Unit (in.) A	B	C	D	Dampers & Coil E	F	G	C.F.M. Range at 1.2" S.P.
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.

OP—OVERALL PRODUCT, IN PLACE

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 usuable 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.

$$\frac{Q_U}{A_C} = F_R[\bar{H}_T \tau\alpha - U_L(T_i - T_a)] = \frac{BTU}{Ft.^2\ Day}\ *$$

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.

$$\text{AIR: } \frac{Q_U}{A_C} = 0.69[(300)(0.75) - (0.8)(\mathbf{70}° - 40°)] = 139 \frac{BTU}{Ft^2\text{-}Day}$$

$$\text{LIQUID: } \frac{Q_U}{A_C} = 0.90[(300)(0.75) - (0.8)(\mathbf{130}° - 40°)] = 138 \frac{BTU}{Ft^2\ Day}$$

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 #C00-2868-1. 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 right next to it.

*Ref. Hottel, H.C. and Woertz, B.B. A.S.M.E. Transactions 64, 91 1942 *Performance of Flat Plate Solar-Heat Collectors*

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: ½ to ¾ ft³ rock per ft² of solar collector area. Rock size ¾" to 1½" diameter.

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 = (½ ft³ rock per ft²) × (Collector Area) = (½) × (800) = 400 ft³ rock.

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.

SOLARON CONVERSION FACTORS

Solar collector area = (design heat loss $\frac{BTU}{HR}$) ÷ (S.C.F.) = Ft²

	Location	Design ΔT	Fuel Savings/yr. 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	62	27
	Spokane	70°	170	85	60
Washington D C		51°	149	80	44
Wi	Madison	80°	142	72	38
Wy	Lander	82°	329	171	105
Montreal		80°	119	56	27
Toronto		70°	127	59	32

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.

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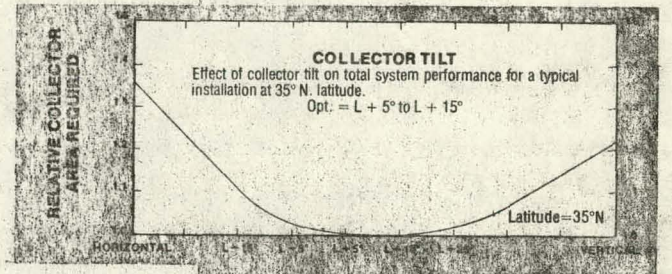
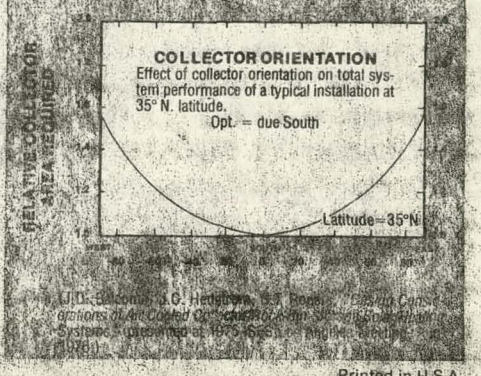




T.M.

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

Printed in U.S.A.

SOLARON CORPORATION ™

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 air or 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 glazing 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:

PAN - 24 gauge steel, fully insulated with 3-3/4" fiberglass 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 - 28 gauge steel with baked on high absorbency 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

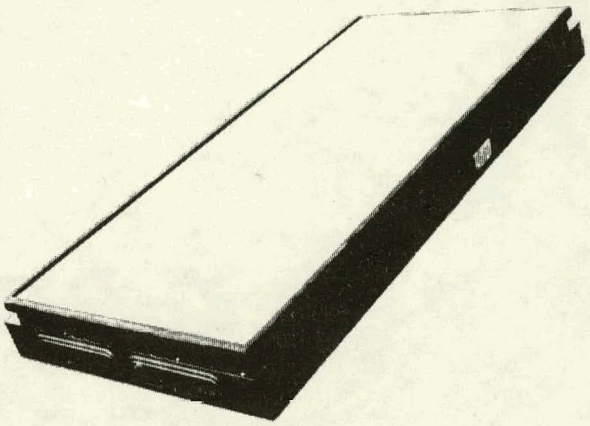
EFFICIENCY - collector efficiency is as high as 64.5% as a function of outlet minus ambient temperature over solar insolation. Where $T_{out} - T_{amb}$ equals 120° and insolation equals 300 BTU's per hour per square foot, a typical operating environment, the Solaron series 2000 collector efficiency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

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

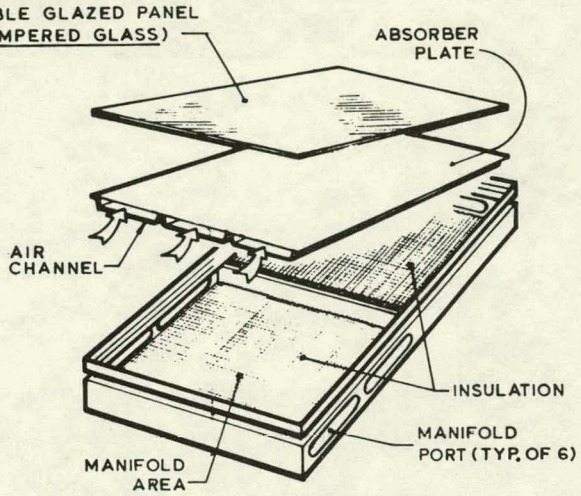
COVER TRANSMITTANCE - the transmittance of the two plate, low iron tempered glass cover is 80 percent from a 0 to 48 degree angle of solar incidence.

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

SOLARON COLLECTOR PANEL DETAILS



COLLECTOR PANEL



PANEL DIMENSIONS
3'-0"W x 6'-6"L x 7¼ H

NOTE: AIR FLOWS THRU THE CHANNELS BENEATH THE ABSORBER PLATE

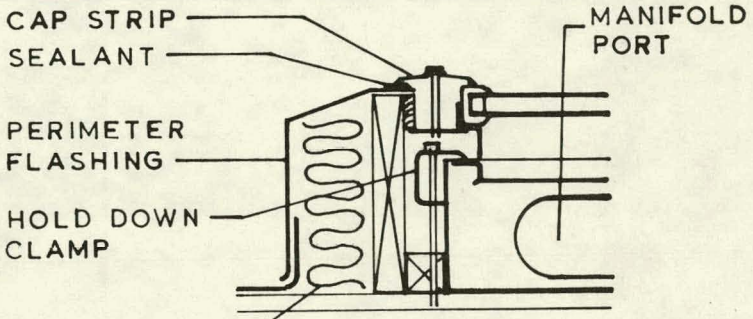
NOTE

THE SERIES 2000 COLLECTOR IS AVAILABLE IN 3 MODELS:

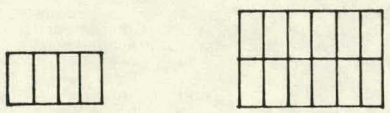
2001 – STD. FOR 2 PANELS HIGH

2002 – OPTIONAL FOR MIDDLE ROW OF 3 HIGH ARRAY AND SPECIAL CONFIGURATION

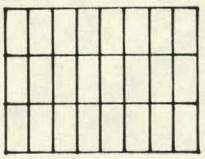
2003 – STD. FOR 1 PANEL HIGH



EXTERIOR MOUNTING SYSTEM



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" × 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:

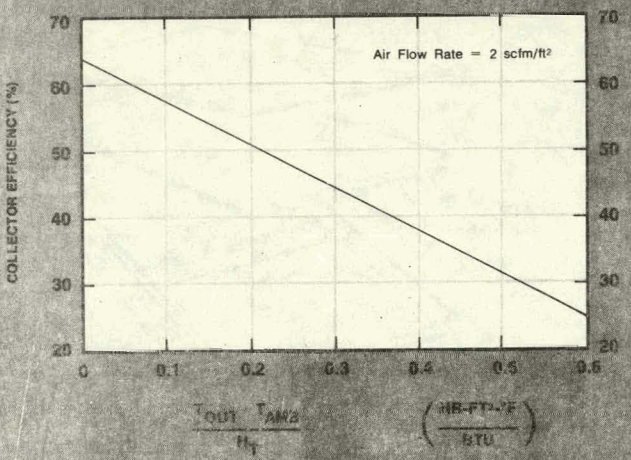
COLLECTOR WEIGHT - 183 pounds

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

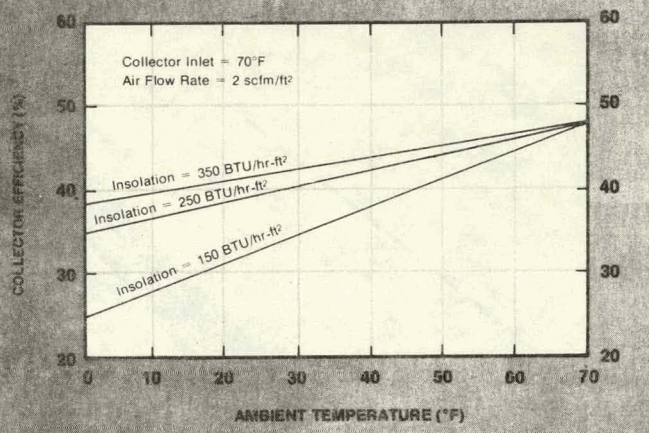
PORT NET FREE AREA - 26.7 square inches each

PORT END CAPS - provided by Solaron as required

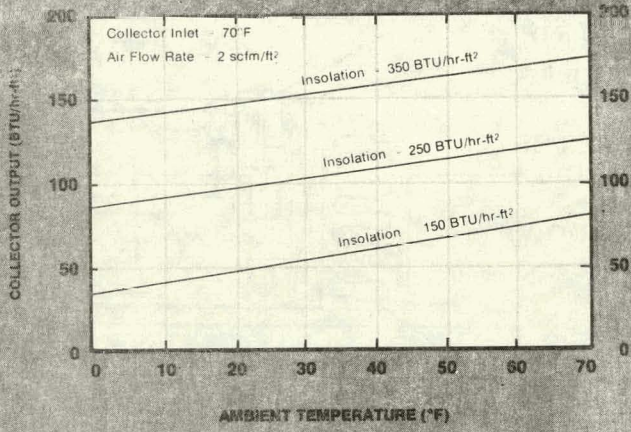
MEASURED*
COLLECTOR PERFORMANCE DATA



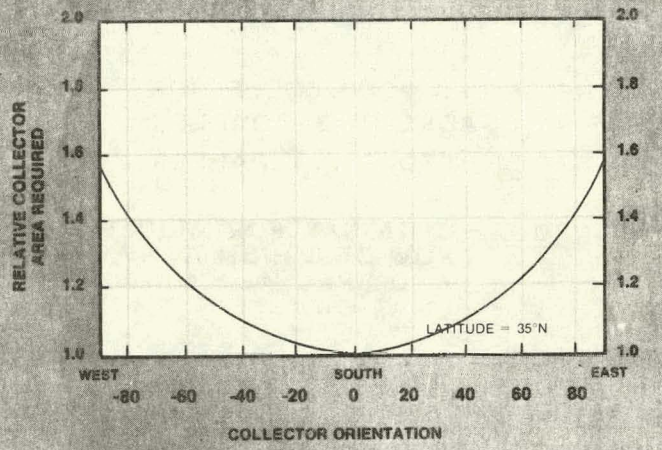
A—Collector efficiency as a function of outlet minus ambient temperature over insolation.



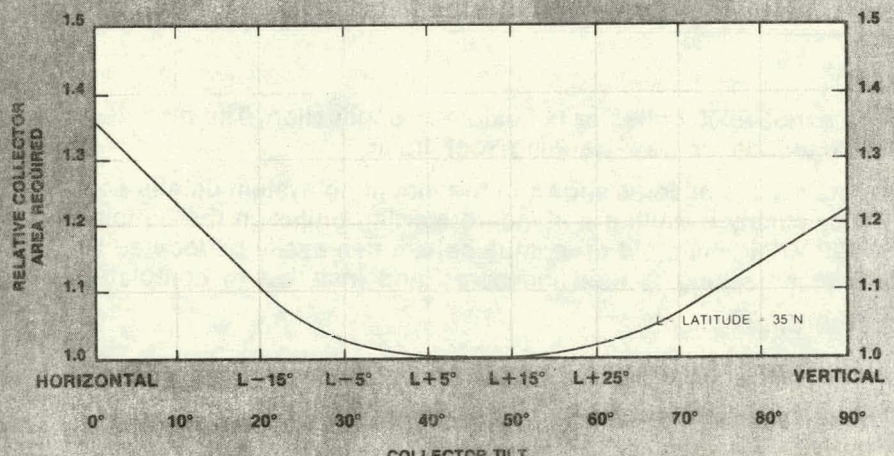
B—Collector efficiency as function of outdoor temperature for various solar inputs.



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



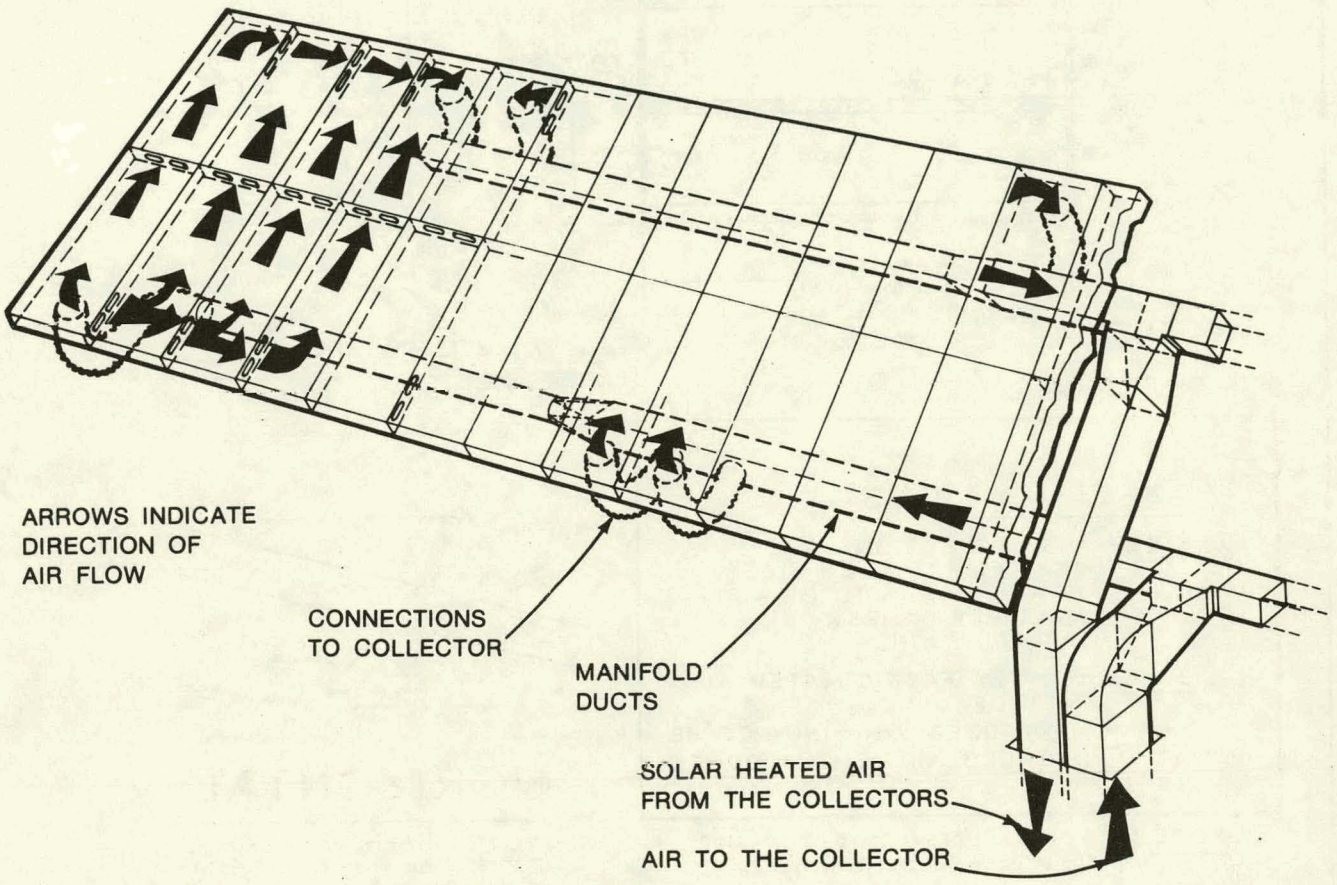
D—Effect of collector orientation on total system performance of a typical installation at 35° N latitude. *(J. D. Balcomb, J. C. Hedstrom, B. T. Rogers "Design Considerations of Air Cooled Collector/Rock-Bin Storage Solar Heating Systems," presented at 1975 ISES Los Angeles Meeting, Aug. 1975)*



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-74-635 "Methods of Testing for Rating Solar Collectors Based On Thermal Performance"

TYPICAL COLLECTOR INSTALLATION



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.

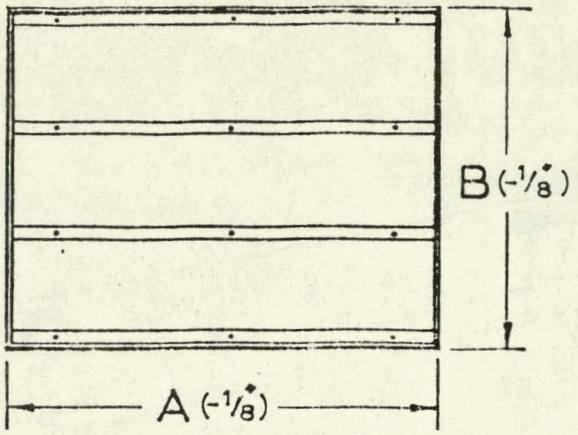
Solaron Corporation provides mechanical engineering and field services to assist the local engineer and HVAC contractor in design and installation.

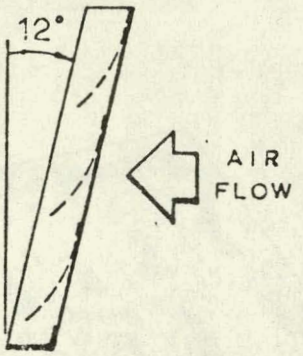
For additional information on the Solaron collector and related Air Handling and Automatic Control systems, contact Solaron Corporation Marketing Services.

Phone 303 / 289-5971
SOLARON CORPORATION / 4850 OLIVE STREET / COMMERCE CITY, COLORADO 80022

202-1 8/76

Printed in USA





VERTICAL

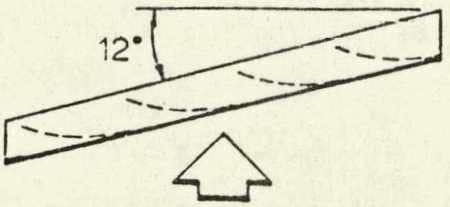
SPECIFICATIONS:

SIZE – MAX DIMENSIONS ARE 36 x 24. IF LARGER SIZE IS REQ'D. 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
	A	B	VERT	HORIZ	(FPM)
350/560	12	12	DV12	DH32	600
550/900	20	12	DV20	DH40	600
900/1350	28	12	DV28	DH48	650
1350/1800	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

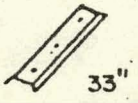
specifications subject to change without notice

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

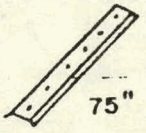
3-77

SOLARON COLLECTOR HARDWARE COMPONENTS

CAP STRIP
CS 0033

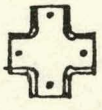


CAP STRIP
CS 0075



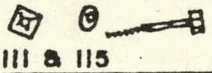
TEE COVER PLATE
CS 002T

CROSS COVER PLATE
CS 002X



ELBOW COVER PLATE
CS 002L
FIELD DRILLED

HOLD-DOWN BOLTS
W/ WASHER & TINNERMAN



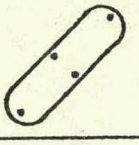
FAO 110, 111 & 115

HOLD-DOWN (BRACKET)
FAO 330 & 331
(EXTERIOR)

HOLD-DOWN (PLATE)
FAO 220 & 221
(INTERIOR)

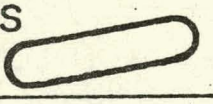
SCREWS BRACKETS
CAP STRIP
FAO 440 & 441

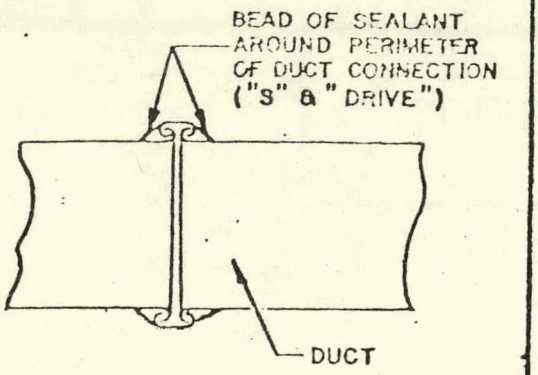
END CAP
FAO 550 & 551



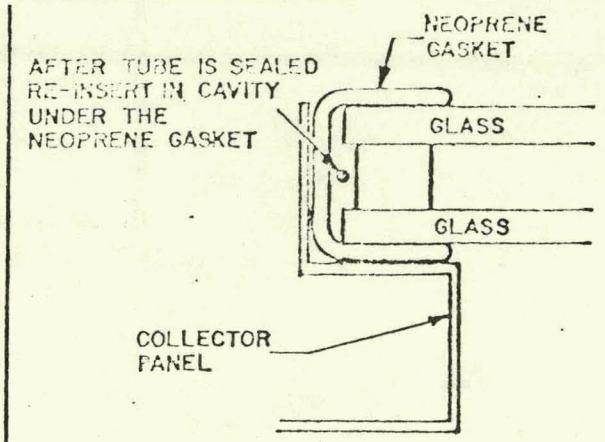
SEALANT/ ROLLS
PERIMETER FLASHING
GBO 70 50' ROLL

SILICONE PORT GASKETS
GBO160

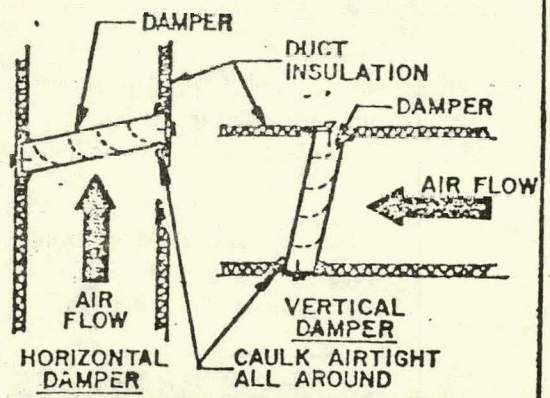




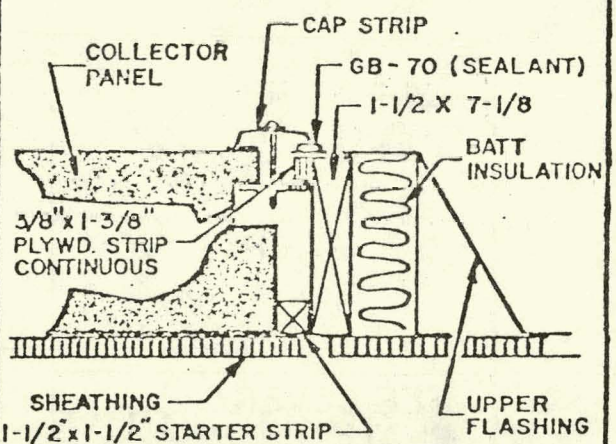
DUCT CAULKING



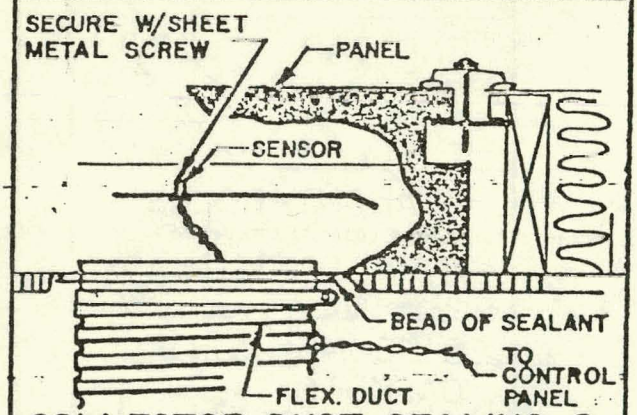
BREATHER TUBE



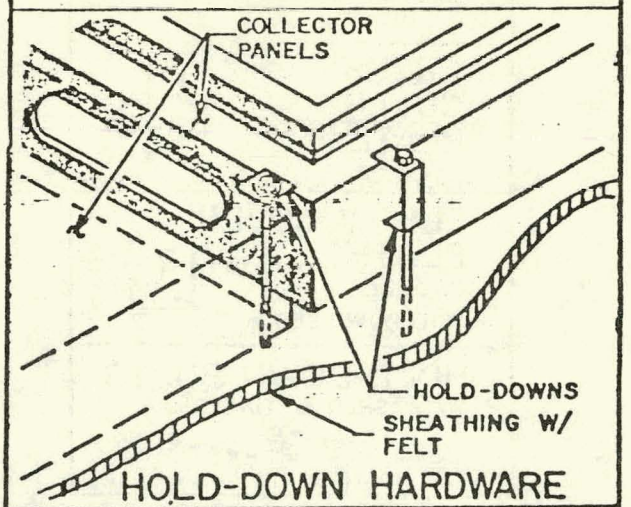
BACK DRAFT DAMPER INSTALLATION



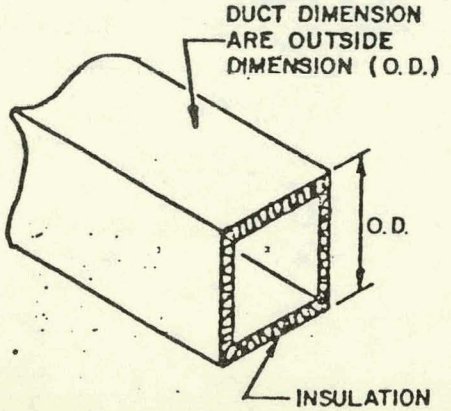
PERIMETER CURB



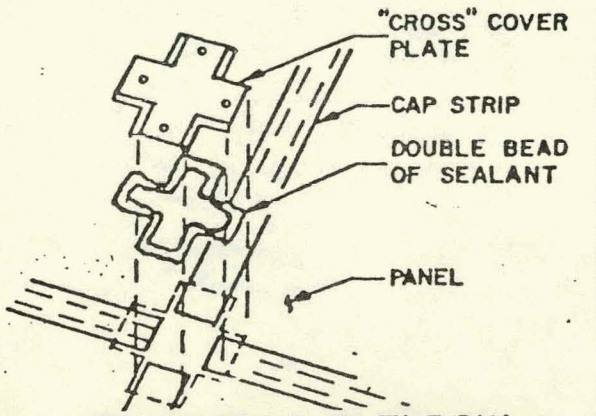
COLLECTOR DUCT SEALING & SENSOR LOCATION



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: MIDGLEY, SHAUGHNESSY, FICKEL & SCOTT
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 contr 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.

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 quadrant.

FIRE DAMPERS - Horinontal
IBD2 - A frame, UL, 212° fusible link.
2 - 26 x 16. 2 - 26 x 20. 1 - 17 x 16. 1 - 16 x

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 12,3S. 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.

RG: 25-RL, #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, #25 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.

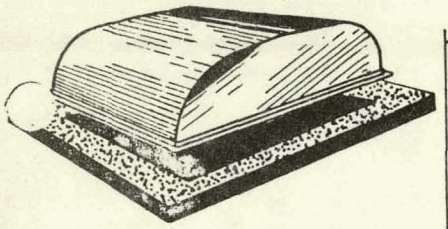
OG: 4-FL, #25 white finish.
3 - 10 x 10.

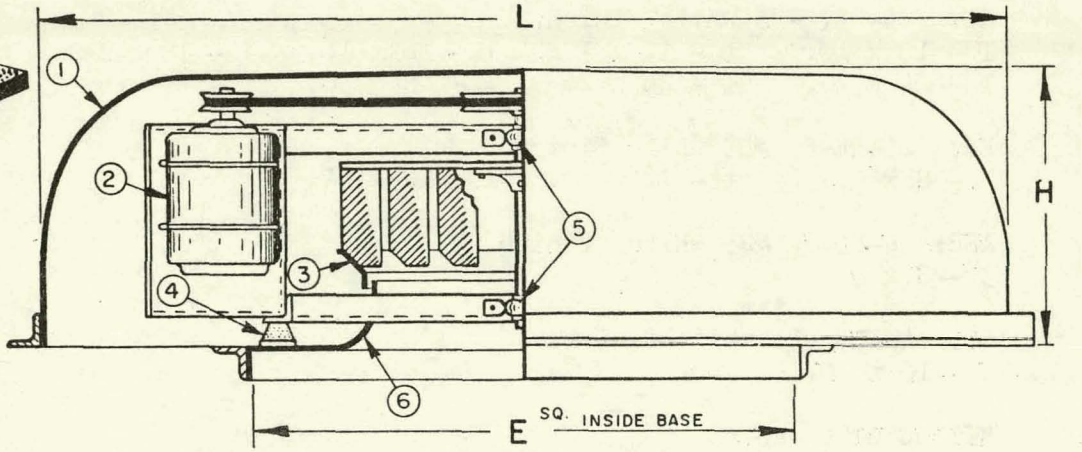
EXTRACTORS: AG-45
#2 operator: 2 - 8 x 6. 2 - 8 x 8. 1 - 11 x 6. 1 - 14 x 6. 2 - 14 x 7.
#1 operator: 2 - 22 x 8.

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

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 [illegible] of dimensions, details, quantities and safety [illegible] fabrication and erection shall remain with the Contractor.
☐ No Exceptions Taken
☑ Make Corrections Noted
☐ Amend and Resubmit
☐ Rejected - See Remarks
Date 6/1/64 By [illegible]

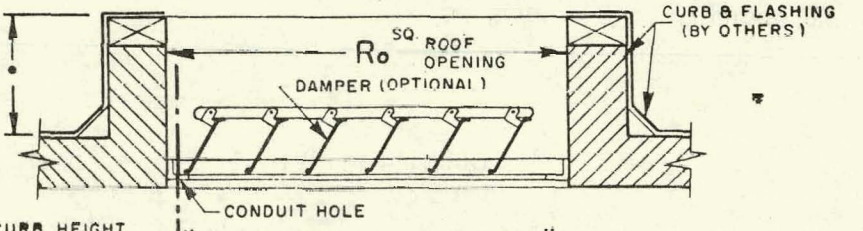
PENN Low Contour DYNAFAN (BELT DRIVE)





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.

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
Ro	12	13	16 1/2	20	25	31	36	50	55*	66

†OUTSIDE DIMENSION OF CURB SHOULD BE 1" TO 1½" 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 & Scoot	SUB-CONTR.	Traog & Nichols, Inc.
DWG. NO.			
DATE			
REV.			

PENN VENTILATOR CO., Inc.
11TH STREET AND ALLEGHENY AVENUE
PHILADELPHIA, PENNSYLVANIA, U.S.A. 19140

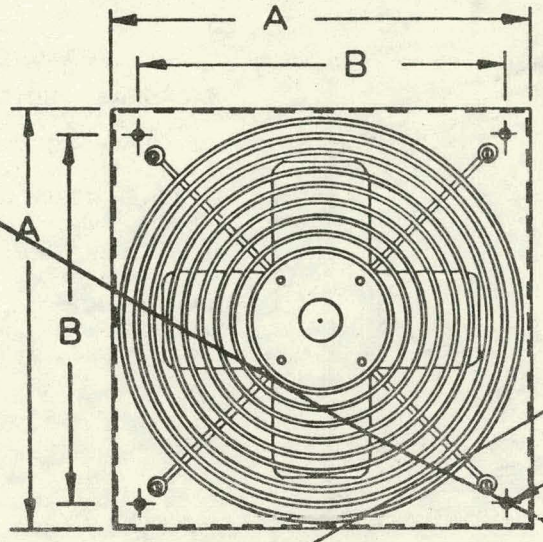
FORM LC-609-R6

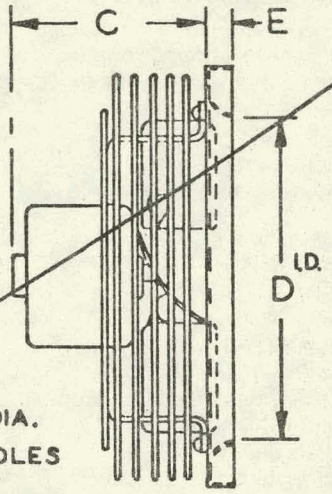
PLATE 112

PEERLESS ELECTRIC

DIRECT DRIVE EXHAUST FANS

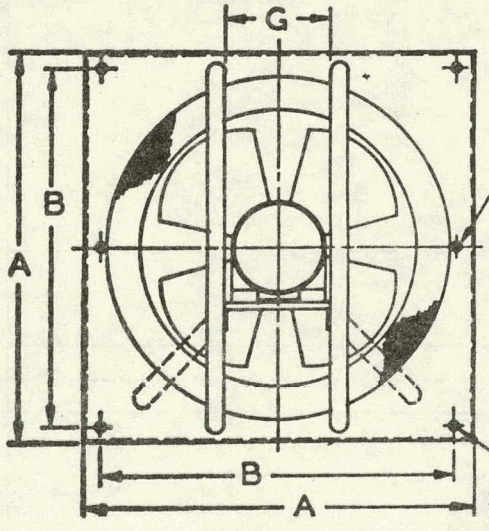
PEERLESS ELECTRIC

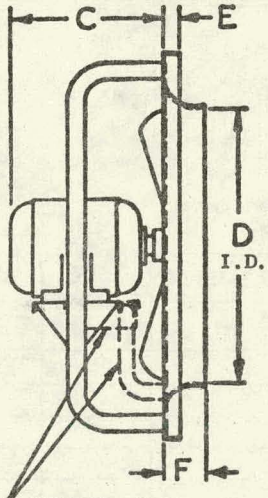




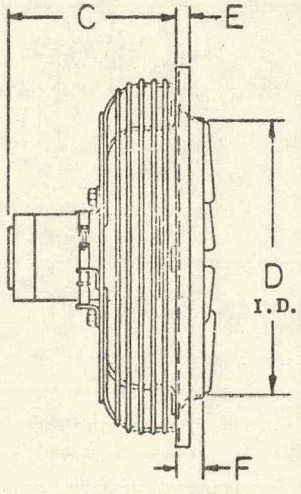
MODEL NO.	BLADE DIA.	A	B	C	D	E
PVL-8	8	13	11-3/4	6	8-3/4	5/8
PVL-10	10	13	11-3/4	6-7/8	10-1/2	5/8
PVL-12	12	20	18	6-7/8	12-1/2	1
PVL-16	16	20	18	6-7/8	16-1/2	1
PVL-12S	12	20	18	6-7/8	12-1/2	1
PVL-16S	16	20	18	6-7/8	16-1/2	1

CERTIFIED RATINGS AIR HVI





PVM-PVH SIZES 24 & 30



PVM-PVH SIZES 16 THRU 20

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	24-1/8	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

CERTIFIED RATINGS AIR HVI

PORTER ELECTRICAL DIVISION
H. K. PORTER COMPANY, INC.

WARREN WORKS
1401 W. Market Street
Warren, Ohio 44485
(216) 399-3651

DRAWING NUMBER
900-00-5006-5

ISSUED 11-76
EW-1619

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:** .025 formed aluminum with extruded vinyl edge seals.~~

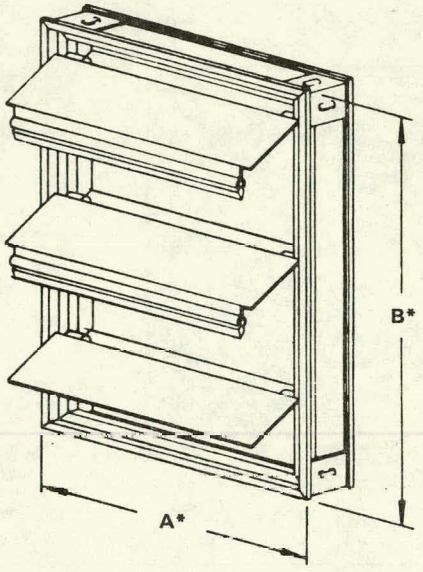
BEARINGS: Valox

BD2/A2
(Spot velocities up to 2500 fpm)

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

BEARINGS: "Cycoloy 800"

Note: When used in fan discharge applications, damper should be located at least ½ fan diameter from fan discharge.



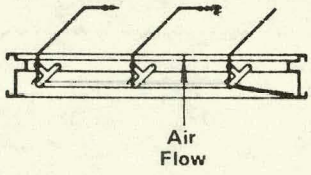
FEATURES

BACKDRAFT PROTECTION:
Low leakage:
Less than 12 CFM/sq. ft. at ½" w.g.

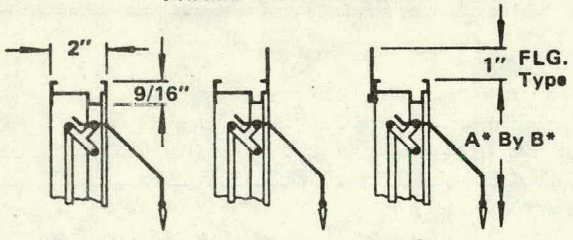
WEATHER RESISTANT:
Blades overlap frame.

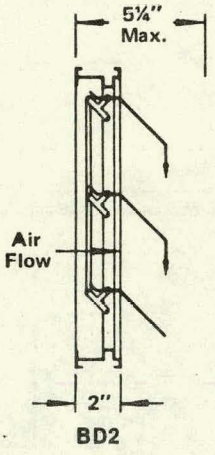
QUIET OPERATING:
Non metalic blade to blade seal.

APPEARANCE:
Good looking — contemporary styling.

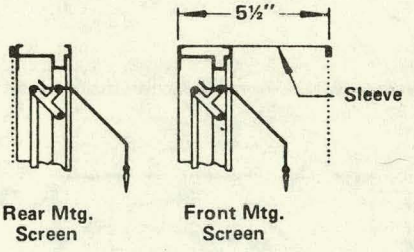


FRAME CONSTRUCTION





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



*Unit furnished approx. ¼" 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

LOCATION

CONTRACTOR

RUSKIN Mfg. Co. **P.O. Box 129** **Grandview, Mo. 64030**

the pacesetter in quality prefab roof products

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

pate® curbs

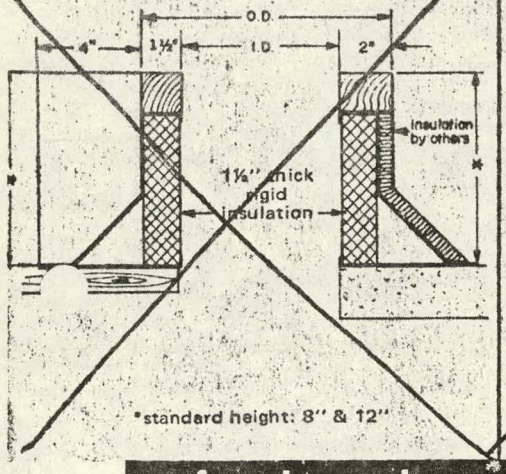
standard construction

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.

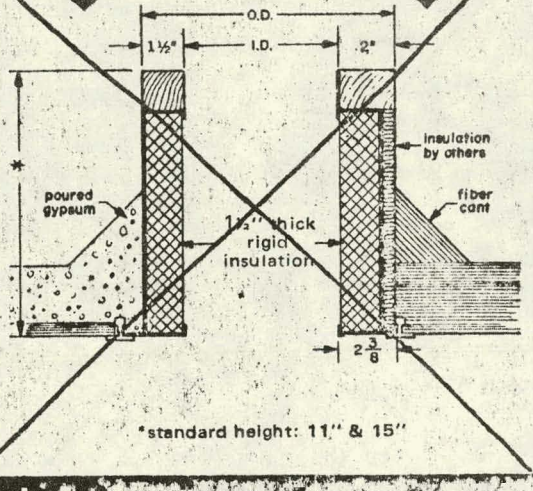
pate curbs

☐ pc-1a ☐ pc-1b



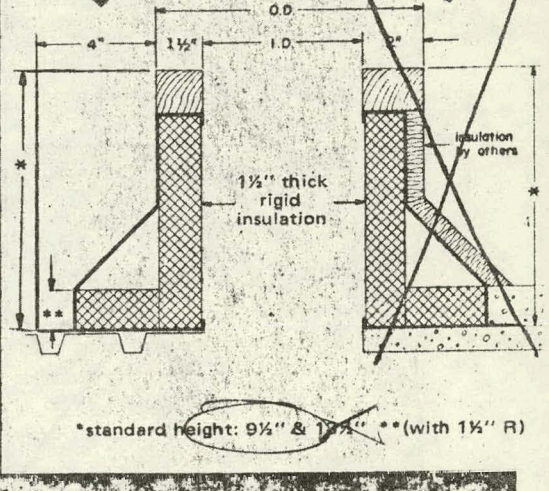
*standard height: 8" & 12"

☐ pc-2a ☐ pc-2b



*standard height: 11" & 15"

☒ pc-5a ☐ pc-5b



*standard height: 9½" & 13½" **(with 1½" R)

roof curb requirements

quantity	style	dimensions (give O.D. or I.D.) O.D.	I.D.	* overall height	nailer over hang b style	** raised cant height	
2	PC5A	23½ x 23½		Std.		2"	For EF-1 & 2

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page

for pate office use only

pate no. _____
entered _____
ship date _____

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b p _____

the pacesetter in quality prefab roof products

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

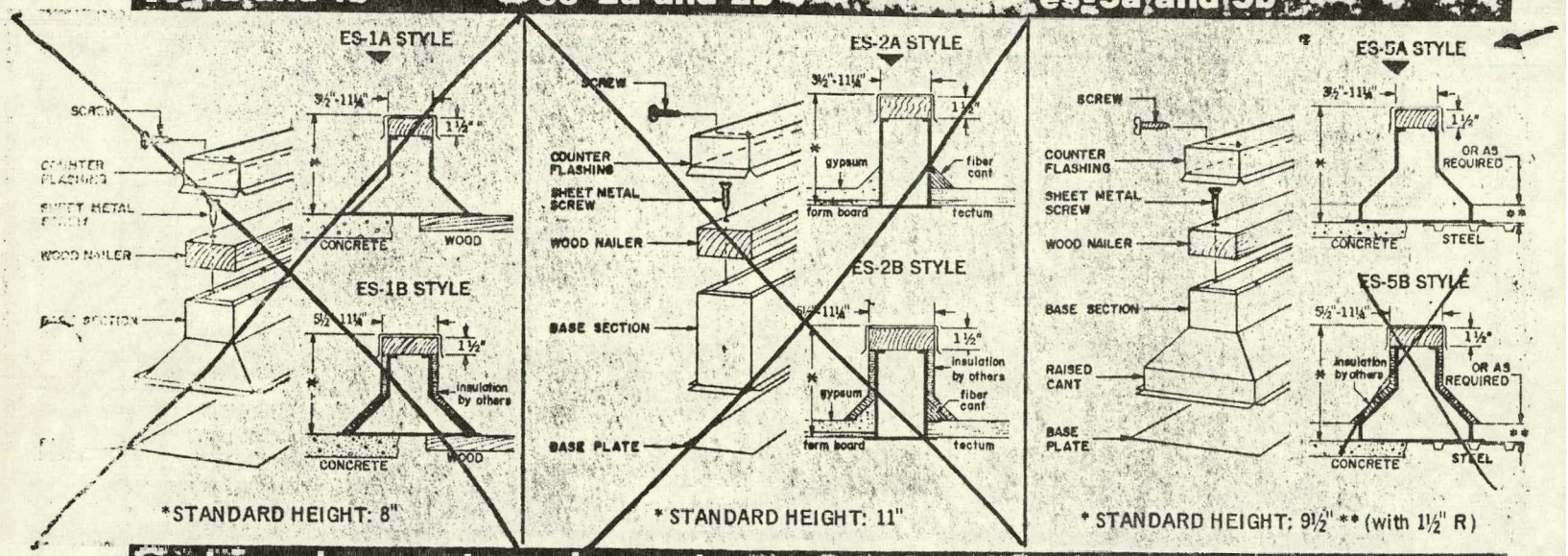
pate®
equipment supports

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 Statinn #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



*STANDARD HEIGHT: 8"

* STANDARD HEIGHT: 11"

* STANDARD HEIGHT: 9½" ** (with 1½" R)

equipment support requirements

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

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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 ½" inverted flanges. (Illustrated below as Frame Construction No. 1)

SCREEN: 19 gage galvanized ½" mesh in removable frame

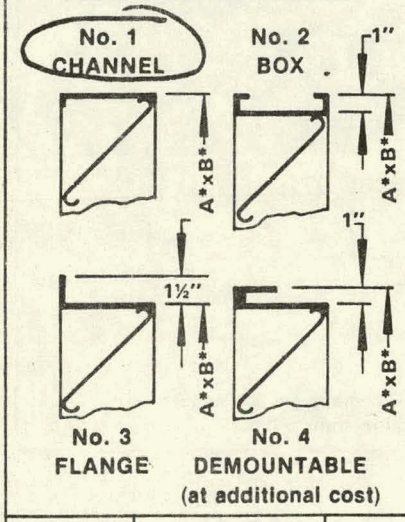
FINISH: Mill galvanized

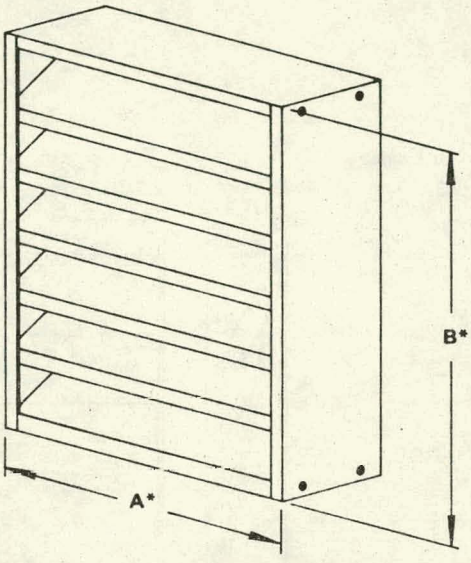
BLADES: 20 ga. galvanized steel
- L2 — Chevron Type on 2½" centers (approx.)
- L3 — J Type on 4" centers (approx.) and 45° angle
- L5 — K Type on 4" centers (approx.) and 45° angle

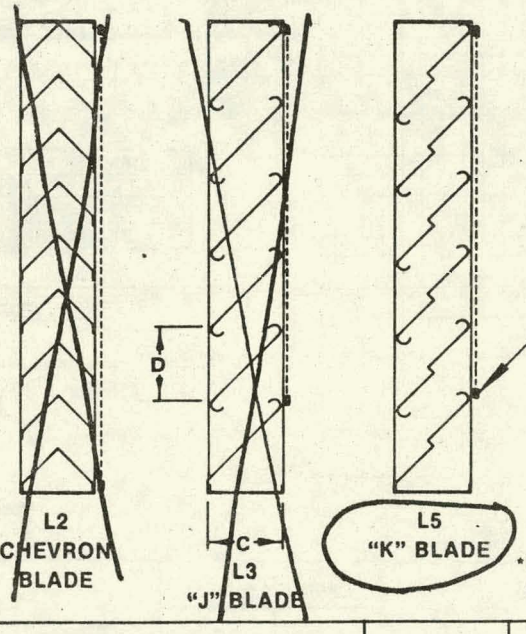
MINIMUM SIZE: 12"w x 12"h

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

FRAME CONSTRUCTION







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

NOTE: Screen adds approx. ½" to depth.

*Unit furnished approx. ¼" 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 LOCATION

CONTRACTOR

RUSKIN Mfg. Co. P.O. Box 129 Grandview, Mo. 64030

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.

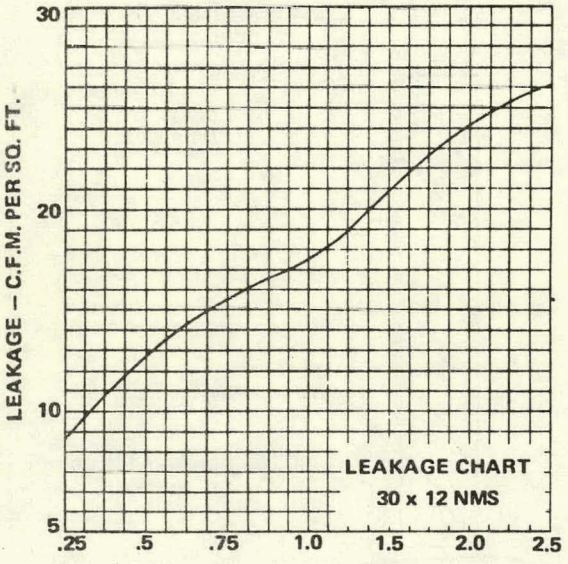
REAR GRILL: Flattened expanded Metal.

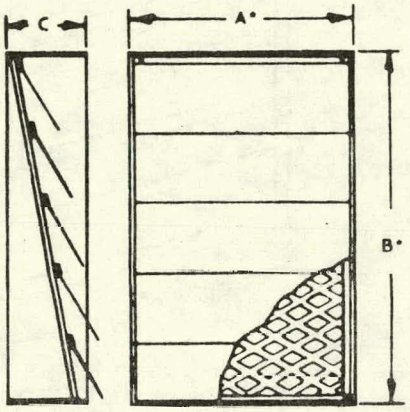
FINISH: Rust inhibitor coating.

NOTE:
1. Damper will be fabricated in 2 or more sections when width or height exceeds 24".
2. Max. velocity 1,200 FPM
3. NMS Not Recommended when exposed to temp. below 40° F.

Minimum size – 6" x 4"

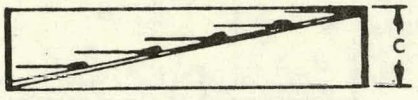
NOTE! DO NOT USE FOR FAN DISCHARGE.





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. Resist 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. ¼" smaller than given 'opening' dimensions.

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

JOB LOCATION

CONTRACTOR

RUSKIN Mfg. Co. P.O. Box 129 Grandview, Mo. 64030

RUSKIN

SPEC NO. MD35—1275
Replaces MD35—775

MANUAL DAMPER

TYPE MD 35

STANDARD CONSTRUCTION

FRAME: 3½" x 7/8" 18 ga. galv. steel channel

BLADES: 6" width 18 ga. galv. steel on approx. 6" centers.

LINKAGE: Concealed in frame.

BEARINGS: Cycoloy 800.

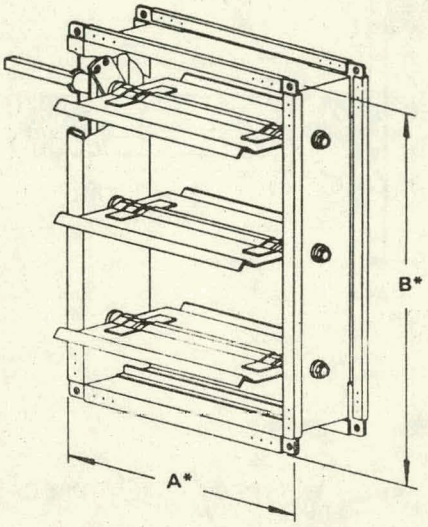
AXLES: ½" Hex.

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: "INTERLOCKING DESIGN" Entire unit locked together without bolts, screws, or rivets to shake loose.

BEARINGS: "Cycoloy 800," non stick and non corrosive, assures long life and ease of operation.

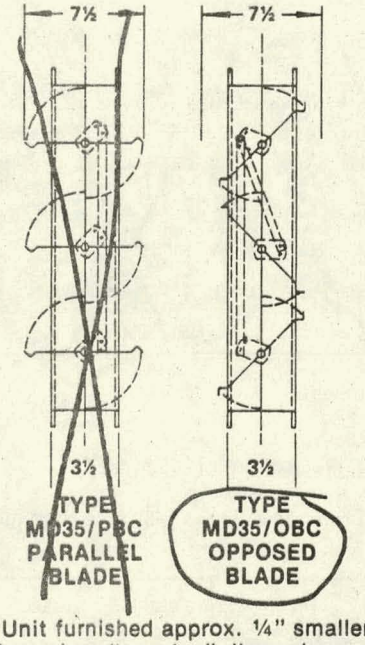
LINKAGE Shake proof. Low maintenance.

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.



*Unit furnished approx. ¼" smaller than given "opening" dimensions.

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

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®

SPEC
NO. IBD2—577
Replaces IBD2—1076

FIRE DAMPER
CURTAIN TYPE INTERLOCKING BLADE

TYPE
IBD2

STANDARD CONSTRUCTION

FRAME: 4½" galvanized steel channel.

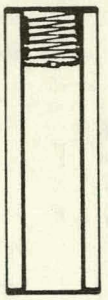
BLADES: Interlocking type galvanized steel.

ENCLOSURES: 18 gage steel (Types B, C, CO, & CR).

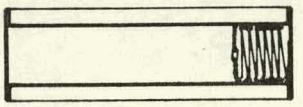
FINISH: Mill galvanized.

FUSIBLE LINK: 212°F Standard. 160°F available at no additional cost.

MOUNTING: Vertical or Horizontal.



VERTICAL MOUNT



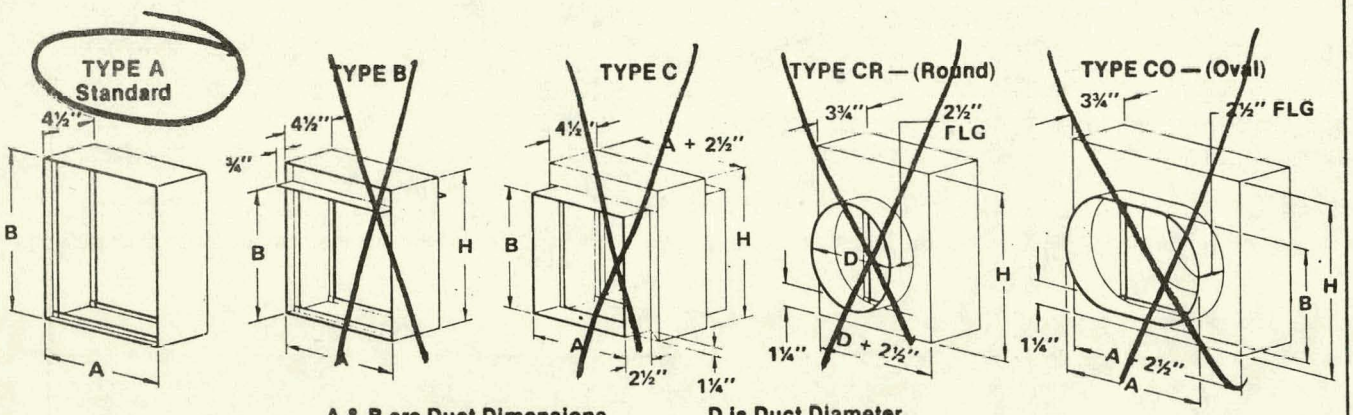
HORIZONTAL MOUNT

FEATURES

Standard model includes 1½ 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.



A & B are Duct Dimensions D is Duct Diameter

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

LOCATION

CONTRACTOR

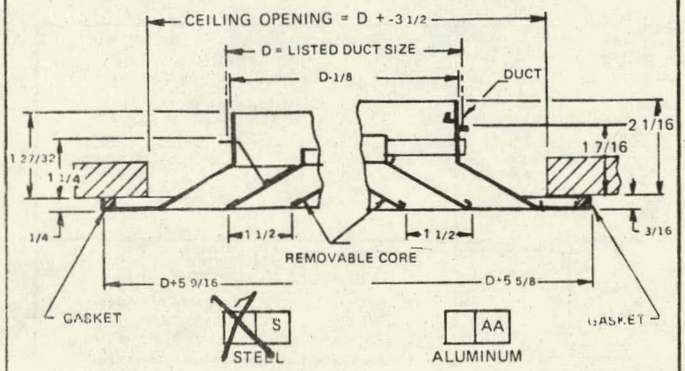
RUSKIN Mfg. Co. P.O. Box 129 Grandview, Mo. 64030

TITUS®

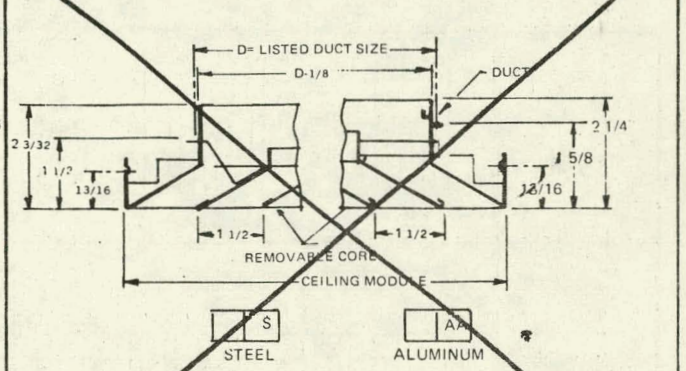
SUBMITTAL SHEET

MODEL TDC CEILING DIFFUSER

STANDARD FLANGE FRAME — TYPE 1

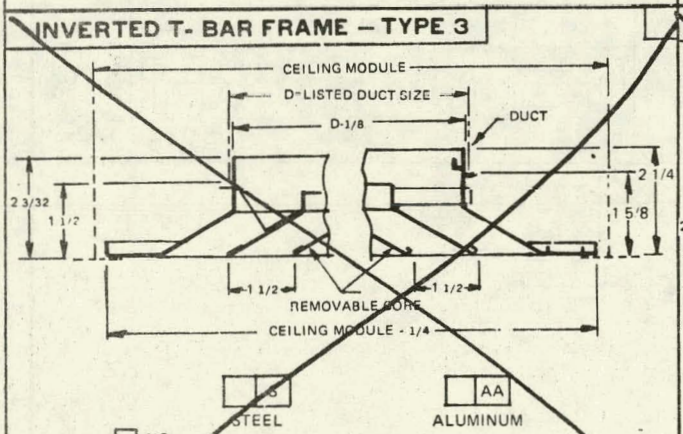


SNAP- IN FRAME —TYPE 2



CEILING MODULE	12 x 12	12 x 24	12 x 48	24 x 24	24 x 48
* MAX. DUCT SIZE	9 x 9	9 x 21	9 x 45	21 x 21	21 x 45

INVERTED T- BAR FRAME — TYPE 3

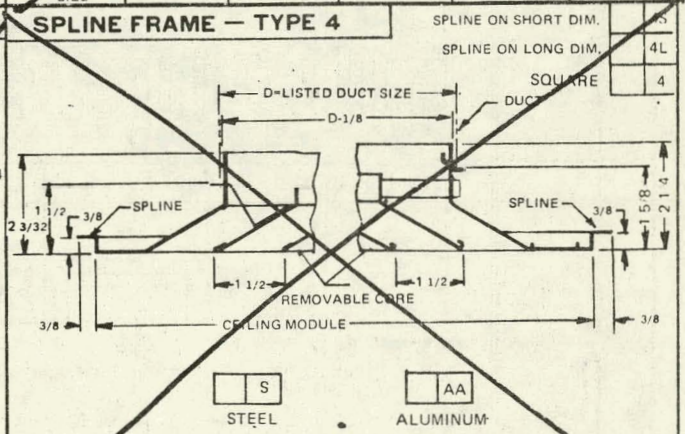


ADJ. VANE ☐ NO ☐ YES

CEILING MODULE	12 x 12	12 x 24	12 x 48	24 x 24	24 x 48
* MAX. DUCT SIZE	7 1/2 x 7 1/2	7 1/2 x 19 1/2	7 1/2 x 43 1/2	19 1/2 x 19 1/2	19 1/2 x 43 1/2

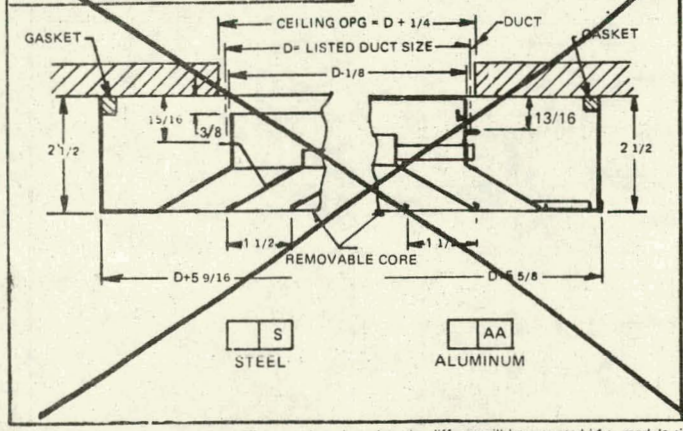
SPLINE FRAME — TYPE 4

SPLINE ON SHORT DIM. 4S
SPLINE ON LONG DIM. 4L
SQUARE 4

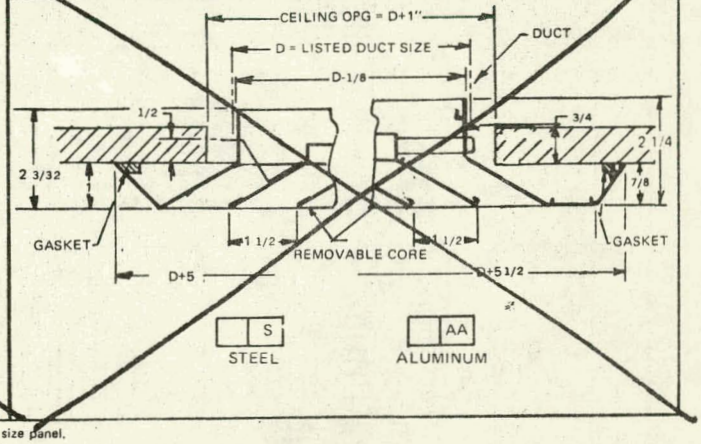


CEILING MODULE	12 x 12	12 x 24	12 x 48	* 24 x 24	24 x 48
* MAX. DUCT SIZE	7 1/2 x 7 1/2	7 1/2 x 19 1/2	7 1/2 x 43 1/2	19 1/2 x 19 1/2	19 1/2 x 43 1/2

DROP FRAME — TYPE 5



BEVELLED DROP FRAME— TYPE 6

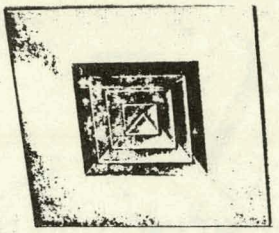


* When module size is more than 3" larger than duct size, the diffuser will be mounted in a module size panel.

FINISH:

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

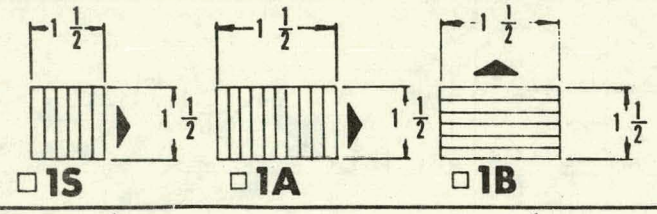
☐ 1 BAKED ALUMITINT ENAMEL (ALTERNATE STD. FOR STEEL) (STD. FOR ALUMINUM)

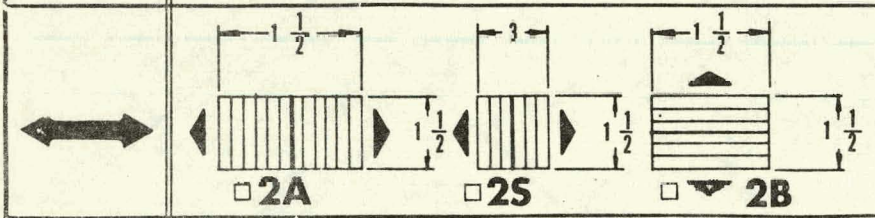


(FRAME TYPES 2, 3, & 4 ONLY)
NOTE: WHEN MODULE SIZE IS MORE THAN 3" LARGER THAN DUCT SIZE, THE DIFFUSER WILL BE MOUNTED IN A MODULE SIZE PANEL AS SHOWN IN ABOVE PICTURE.

CORE STYLES

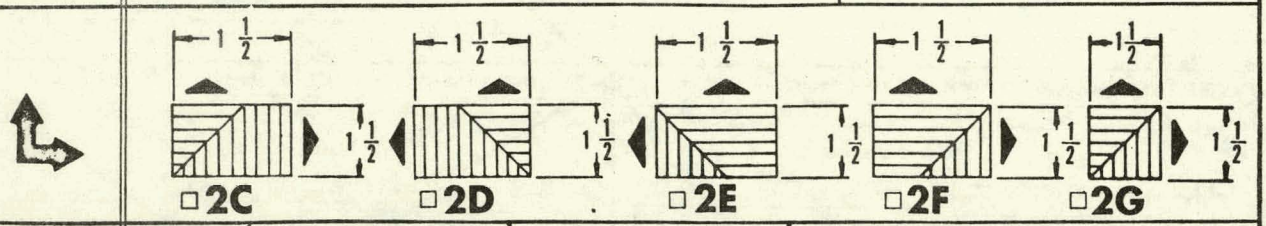
(PLAN VIEWS)

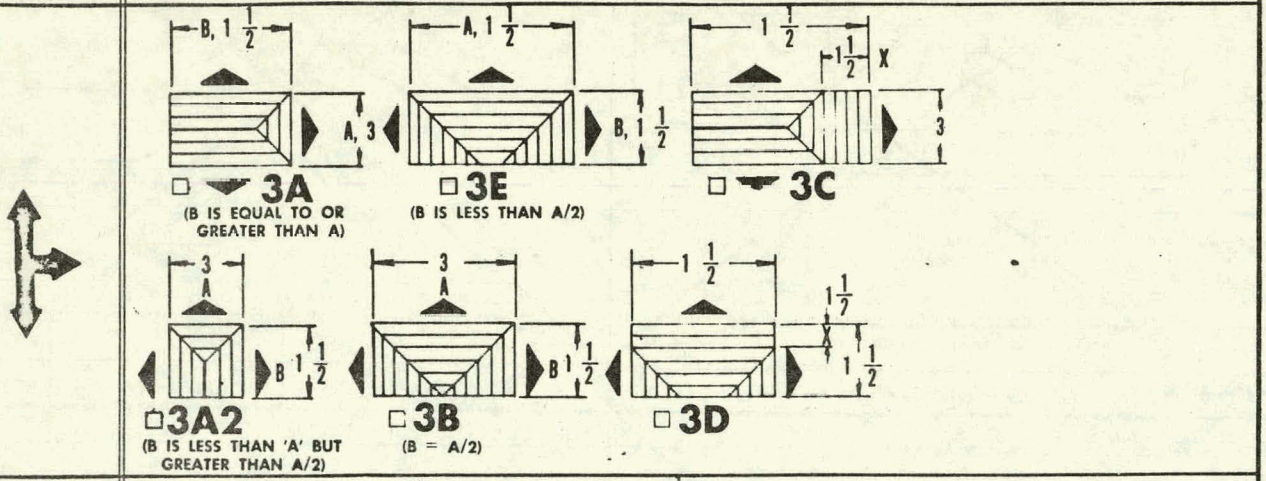


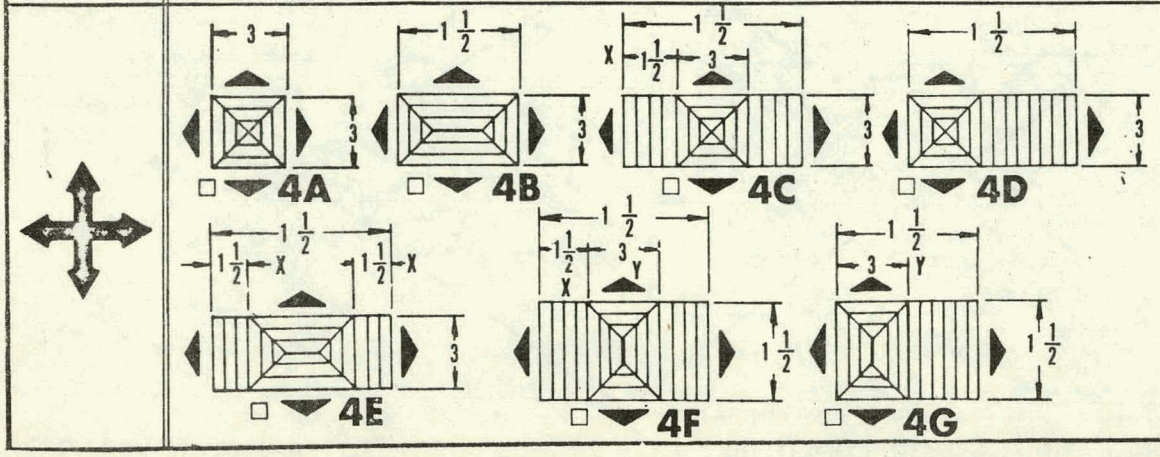


NOTES

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.



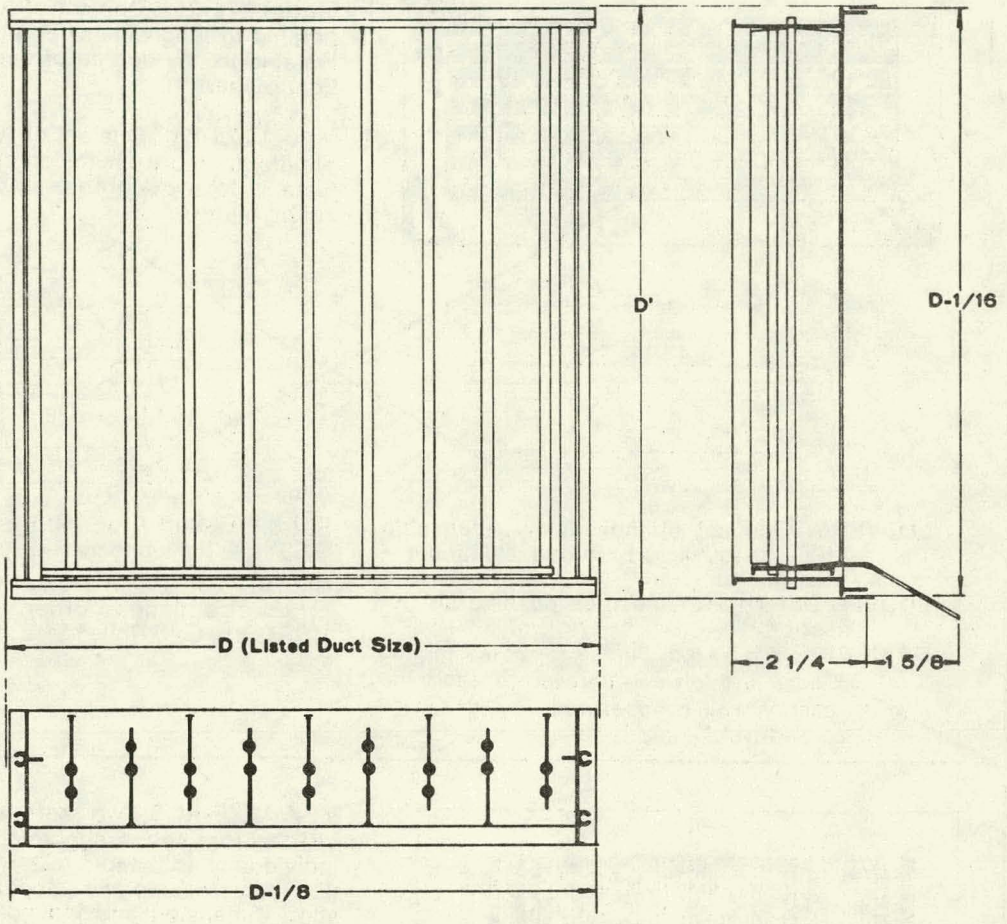




TITUS

SUBMITTAL SHEET

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

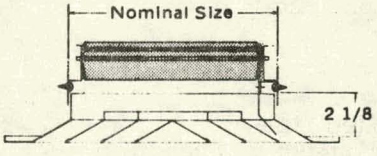


MATERIAL
Extruded Aluminum

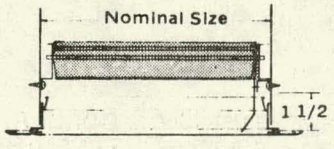
Damper is shipped and installed separately

APPLICATIONS

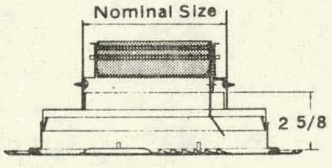
AG-95 used with TDC



AG-95 used with TXR



AG-95 used with TXS



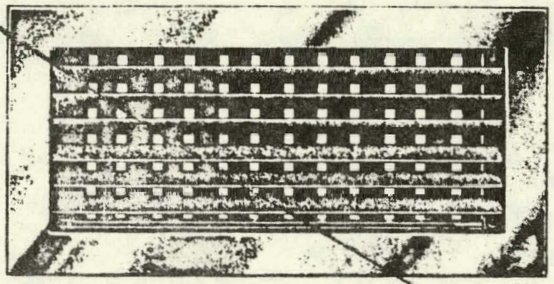
ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

TITUS® PRODUCTS

SUBMITTAL SHEET

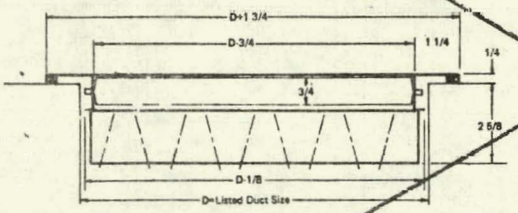
Supply Registers

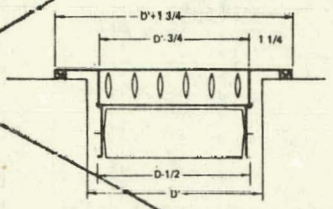
(STEEL) Core Styles 271 & 272



☐ **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.

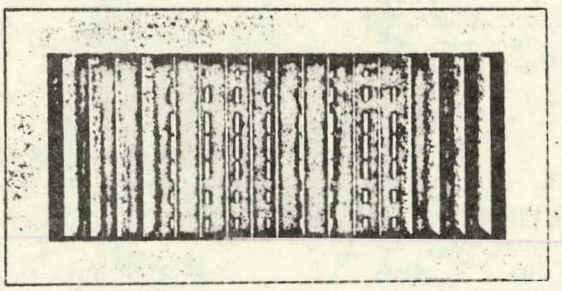
☐ **Model 271-RS-5** One set of AIRFOIL LOUVERS parallel to short dimension and individually adjustable to any degree of deflection in the horizontal plane.





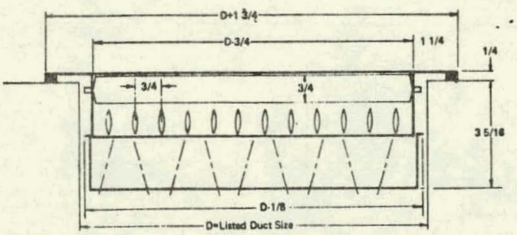
LOUVERS: One set of individually adjustable AIRFOIL louvers. Extruded aluminum — solid section.
LOUVER DEPTH: ¾". Assures positive air deflection.
DAMPER: Opposed Blade. Opposed acting blades are always parallel to short dimension and operated by standard screwdriver.

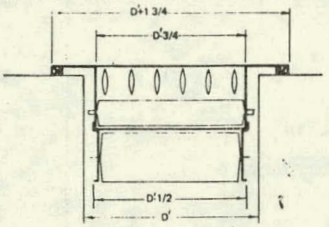
FINISH: Baked Aluminum Enamel.
GASKET: Polyurethane Foam
SIZES: Stocked in many standard sizes. Any size made to order.
BORDER: Cold Rolled Steel



☐ **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: ¾" Assures positive air deflection.
DAMPER: Opposed blade, Screwdriver operated from face of register

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

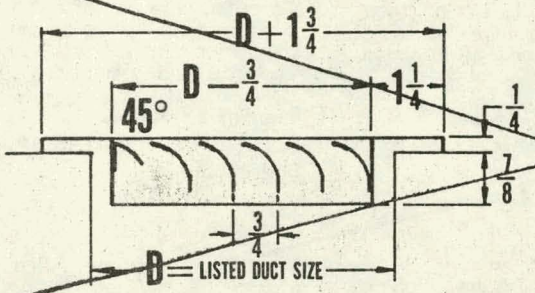
ENVIRONMENTAL ELEMENTS CORPORATION
TITUS PRODUCTS Dallas, Texas

Submittal C-70-4
Rev. C

TITUS

SUBMITTAL SHEET

Steel Return Grilles



Finish: Baked Aluminum Enamel.

☐ **MODEL 23-RL**
Features one set of fixed blades parallel to long dimension.

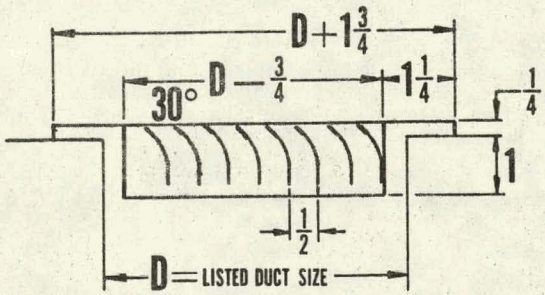
☐ **Model 13-RL**
Same as above except 0° deflection.

Border — 20 Gage
Blades — 22 Gage

☐ **MODEL 23-RS**
Features one set of fixed blades parallel to short dimension.

☐ **Model 13-RS**
Same as above 0° deflection

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



Finish: Baked Aluminum Enamel.

☒ **MODEL 25-RL**
Features one set of fixed blades parallel to long dimension.

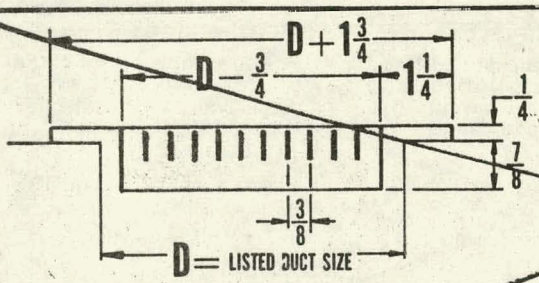
☐ **Model 15-RL**
Same as above except 0° deflection.

Border — 20 Gage
Blades — 22 Gage

☐ **MODEL 25-RS**
Features one set of fixed blades parallel to short dimension.

☐ **Model 15-RS**
Same as above except 0° deflection.

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



HEAVY DUTY GYM GRILLE

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

☐ **MODEL 30-GL**
Features one set of fixed blades parallel to long dimension.

☐ **Model 33-GL**
Same as above except 30° deflection & ½" blade spacing

☐ **Model 34-GL**
Same as above except 45° deflection & ½" blade spacing

Border — 16 Gage
Blades — 14 Gage

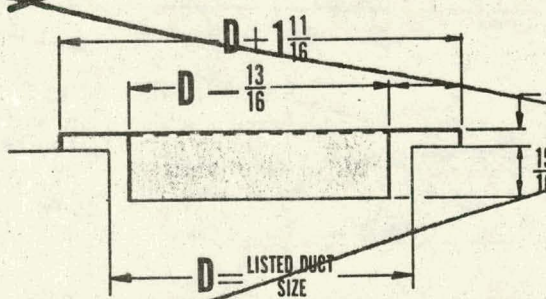
☐ **MODEL 30-GS**
Features one set of fixed blades parallel to short dimension.

☐ **Model 33-GS**
Same as above except 30° deflection & ½" blade spacing

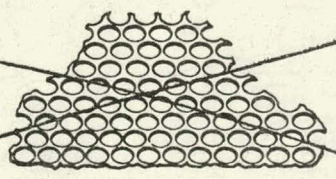
☐ **Model 34-GS**
Same as above except 45° deflection & ½" blade spacing

Finish: Baked Aluminum Enamel.

Support Bars on 6" Centers.



PERFORATED RETURN



FACE

☐ **MODEL 8-F**
Features a steel perforated plate mounted in an extruded aluminum frame. Finish: #25-(W-1) Baked Off-White Enamel.

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

TITUS MANUFACTURING CORPORATION **WATERLOO, IOWA 50704**

1-74

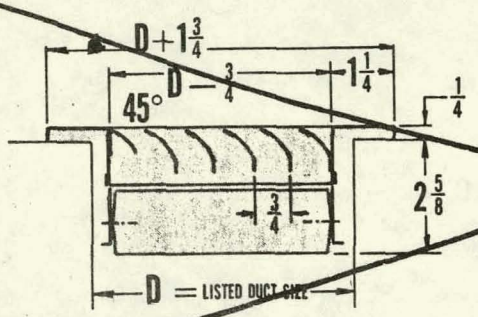
Litho in U.S.A.

Submittal C-35-4

TITUS®

SUBMITTAL SHEET

Steel Return Registers



Finish: Baked Aluminum Enamel.

☐ **MODEL 23-RL5**
Features one set of fixed blades parallel to long dimension and an attached opposed blade damper.

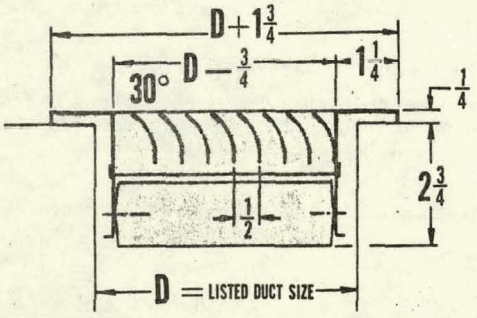
☐ **Model 13-RL5**
Same as above except 0° deflection.

☐ **MODEL 23-RS5**
Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

☐ **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.

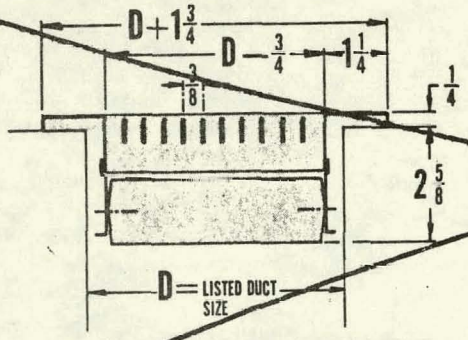
☐ **Model 15-RL5**
Same as above except 0° deflection.

☐ **MODEL 25-RS5**
Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

☐ **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 33-GL5**
Same as above except 30° deflection & ½" blade spacing

☐ **Model 34-GL5**
Same as above except 45° deflection & ½" blade spacing

☐ **MODEL 30-GS5**
Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

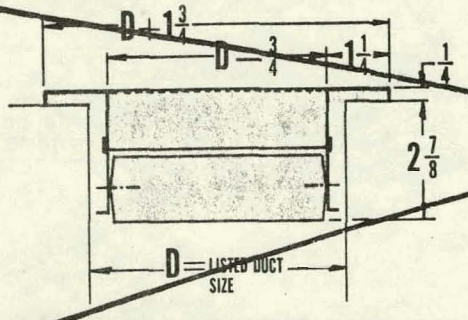
☐ **Model 33-GS5**
Same as above except 30° deflection & ½" blade spacing

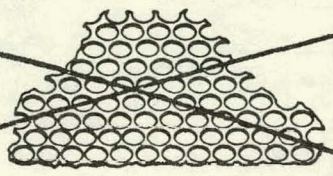
☐ **Model 34-GS5**
Same as above except 45° deflection & ½" blade spacing

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 alumnium 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.

TITUS MANUFACTURING CORPORATION **WATERLOO, IOWA 50704**

1-74 Litho In U.S.A. Submittal C-35-5

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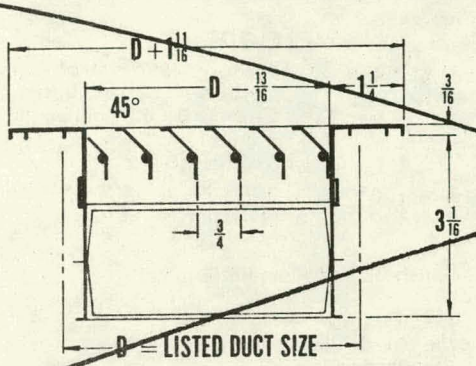
SUBMITTAL SHEET

Aluminum Return Registers



☐ **MODEL 3-FL5**
Features one set of fixed blades parallel to long dimension and an attached opposed blade damper.

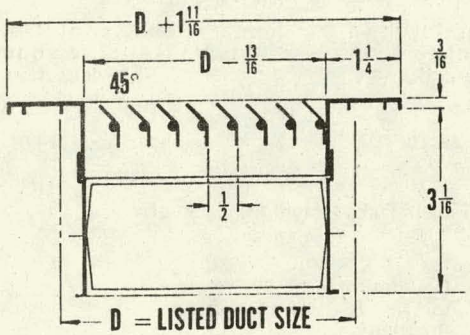
☐ **MODEL 3-FS5**
Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

☐ **Model 56-FL5**
Same as above except 0° deflection.

☐ **Model 56-FS5**
Same as above except 0° deflection.

Finish: Baked Alumitint Enamel.

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



☒ **MODEL 4-FL5**
Features one set of fixed blades parallel to long dimension and an attached opposed blade damper.

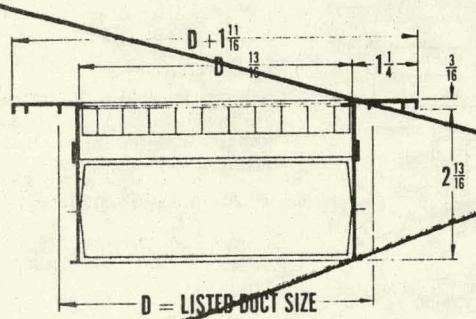
☐ **MODEL 4-FS5**
Features one set of fixed blades parallel to short dimension and an attached opposed blade damper.

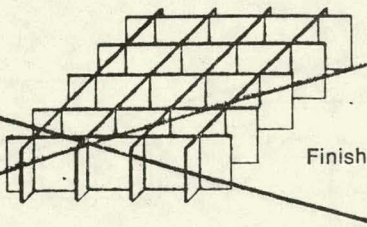
☐ **Model 55-FL5**
Same as above except 0° deflection.

☐ **Model 55-FS5**
Same as above except 0° deflection.

Finish: Baked Alumitint Enamel.

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





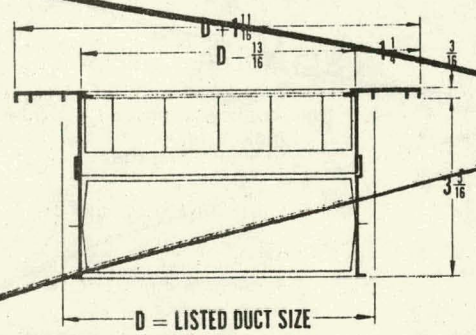
☐ **MODEL 50-F5**
Features ½ x ½ x ½ fabricated aluminum louvers. and an attached opposed blade damper.

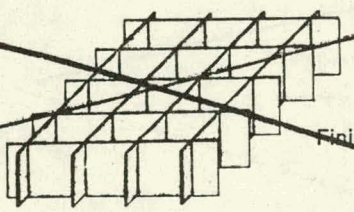
Finish: Baked Alumitint Enamel.

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

☐ **Model 52-F5**
½ x ½ x 1 Aluminum Louvers

☐ **Model 51-F5**
½ x ½ x ½ Plastic Louvers





☐ **MODEL 10-F5**
Features 1 x 1 x 1 fabricated aluminum louvers and an attached opposed blade damper.

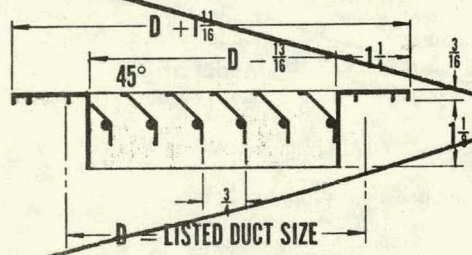
Finish: Baked Alumitint Enamel.

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

TITUS®

SUBMITTAL SHEET

Aluminum Return Grilles



☐ **MODEL 3-FL**
Features one set of fixed blades parallel to long dimension. 45° deflection

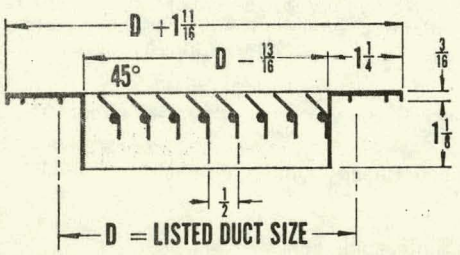
☐ **MODEL 3-FS**
Features one set of fixed blades parallel to short dimension. 45° deflection

☐ **Model 56-FL**
Same as above except 0° deflection.

☐ **Model 56-FS**
Same as above except 0° deflection.

Finish: Baked Alumitint Enamel.

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



☒ **MODEL 4-FL**
Features one set of fixed blades parallel to long dimension. 45° deflection

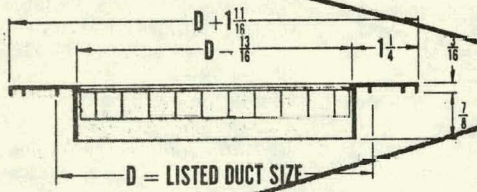
☐ **MODEL 4-FS**
Features one set of fixed blades parallel to short dimension. 45° deflection

☐ **Model 55-FL**
Same as above except 0° deflection.

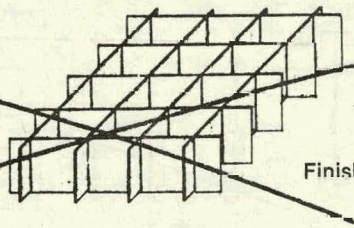
☐ **Model 55-FS**
Same as above except 0° deflection.

Finish: Baked Alumitint Enamel.

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



Model 51-F
½ x ½ x ½ Plastic Louver

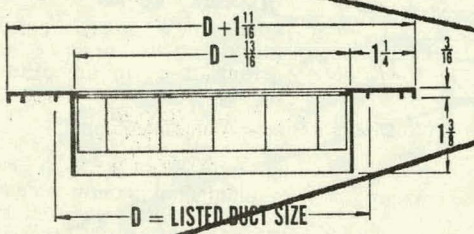


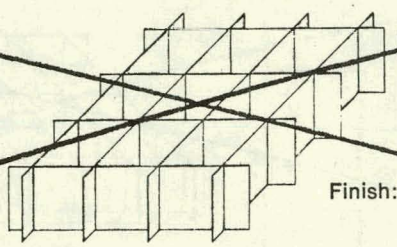
Model 52-F
½ x ½ x 1 Aluminum Louver

☐ **MODEL 50-F**
Features ½ x ½ x ½ 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 10-F**
Features 1 x 1 x 1 fabricated aluminum louvers. Provides maximum free area with minimum see-thru.

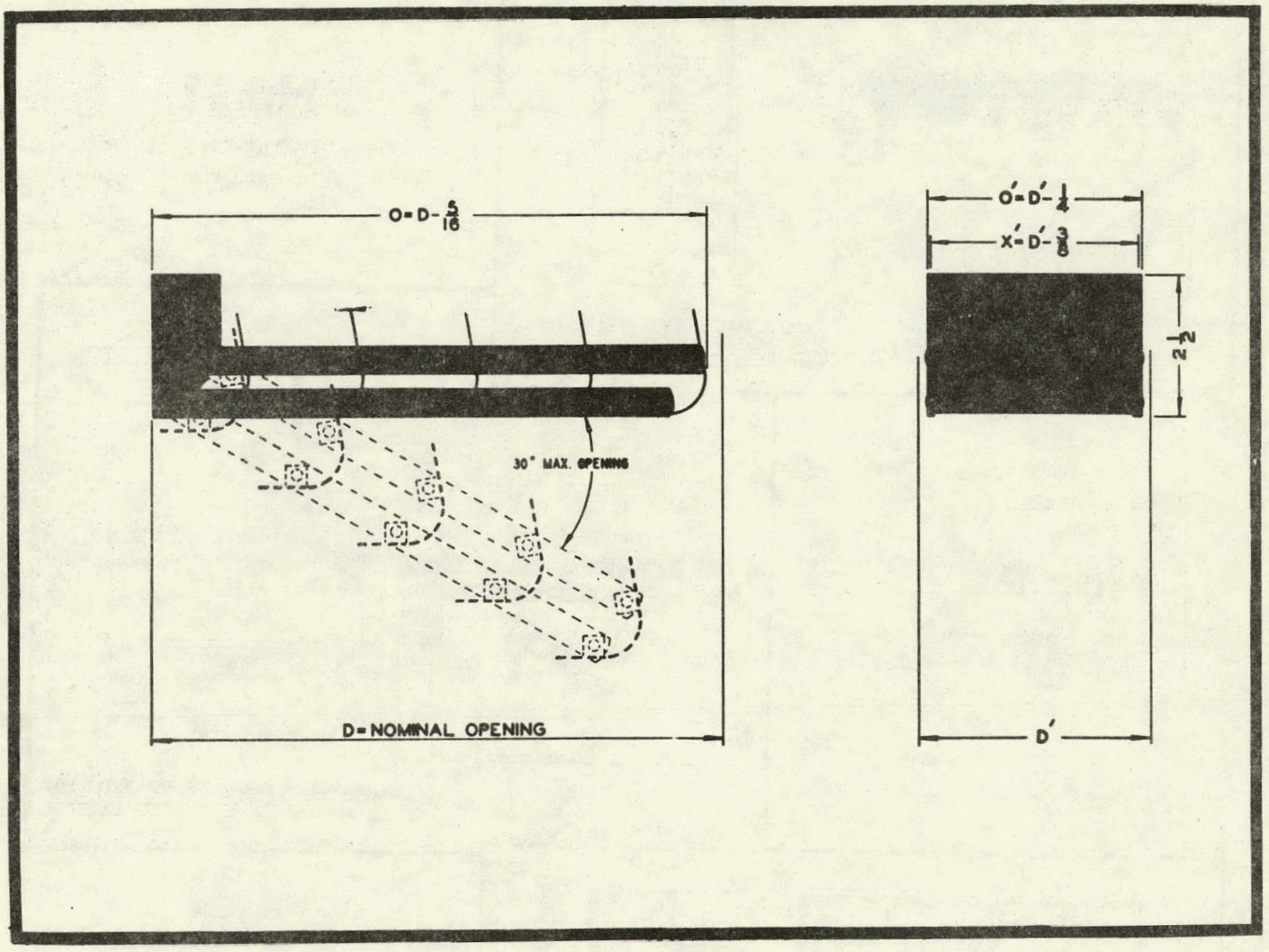
Finish: Baked Alumitint Enamel.

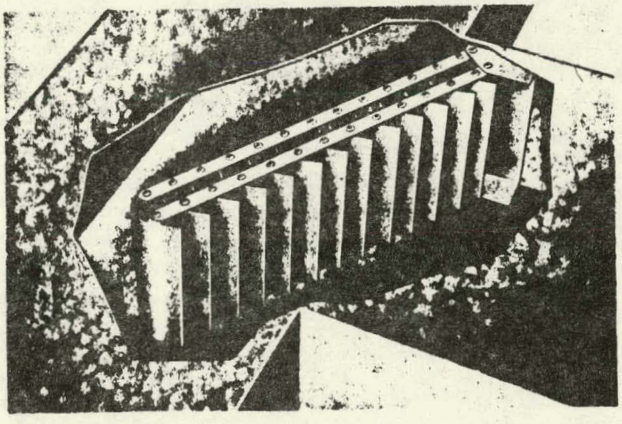
Countersunk screw holes for No. 8 SMS per factory Standard.

TITUS

SUBMITTAL SHEET

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





AG-45 — TURNING VANES ON 1" CENTERS

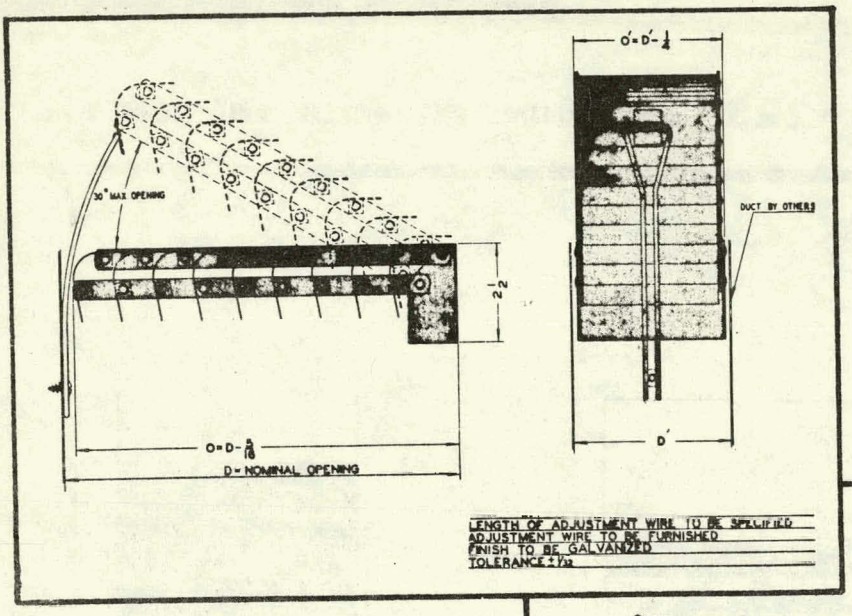
AG-225 — TURNING VANES ON 2" CENTERS

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.

TITUS MANUFACTURING CORPORATION **WATERLOO, IOWA 50704**

OPERATORS

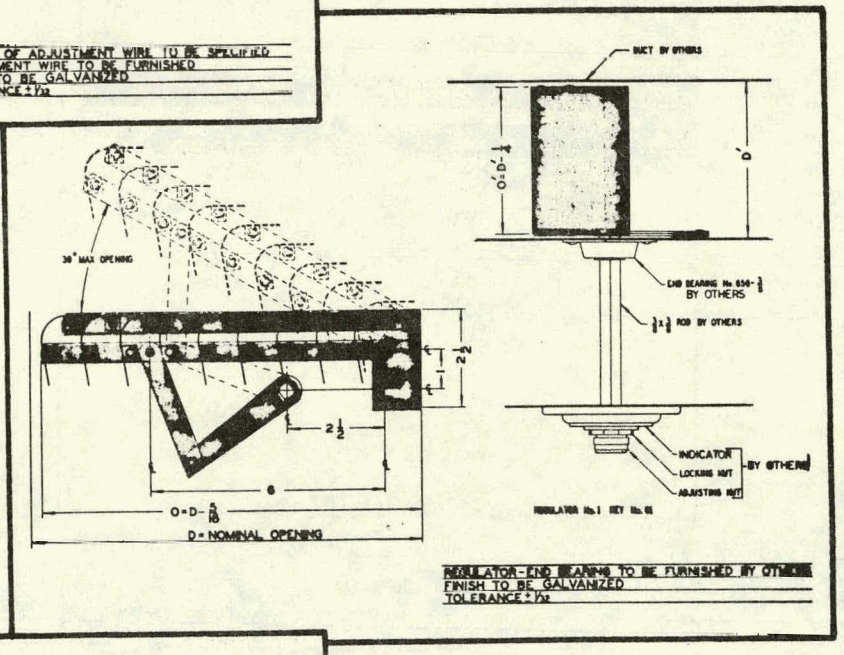


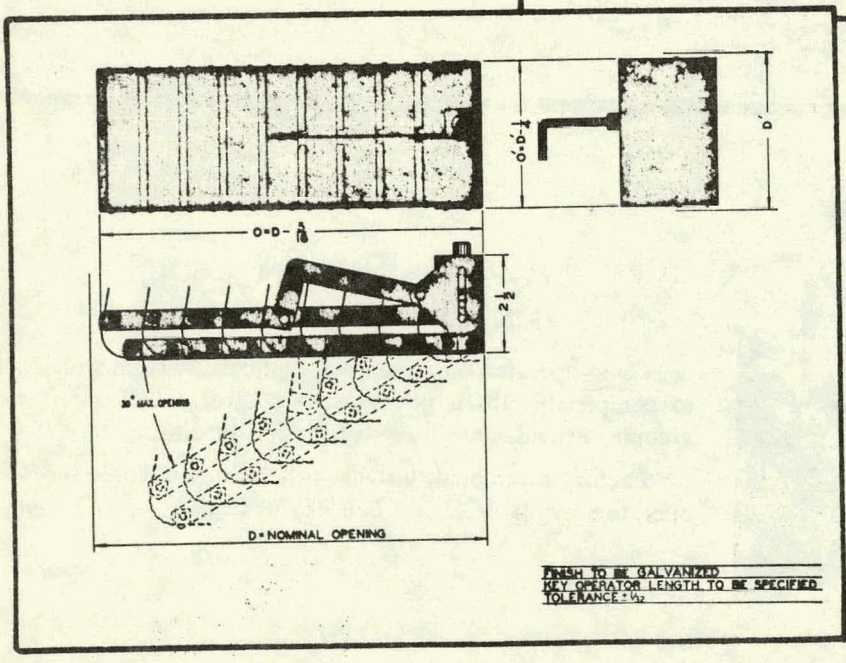
No. 1

MANUAL ADJUSTING LEVER furnished at no extra cost if specified.

No. 2

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





No. 3

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

AIR HANDLING

UNIT #2 AND #3

LOREN COOK COMPANY

SPRINGFIELD, MISSOURI   BEREA, 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 Damper
1	AHU-2	21CH	CH	2	1380	3	60	208	4300	1½					X	X		X
[illegible]	AHU-3	24CV	CV	~~3~~ 2	1270	3	60	208	5000	~~2~~ 3/4					X		X	

ASSOCIATED ENGINEERING CONSULTANTS, INCORPORATED
DATE: 4/3/78
BY: DAH
☐ 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.

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. [illegible]
☐ [illegible]
☒ [illegible]
☐ Amend and Resubmit
☐ Rejected - See Remarks
Date [illegible] By [illegible]

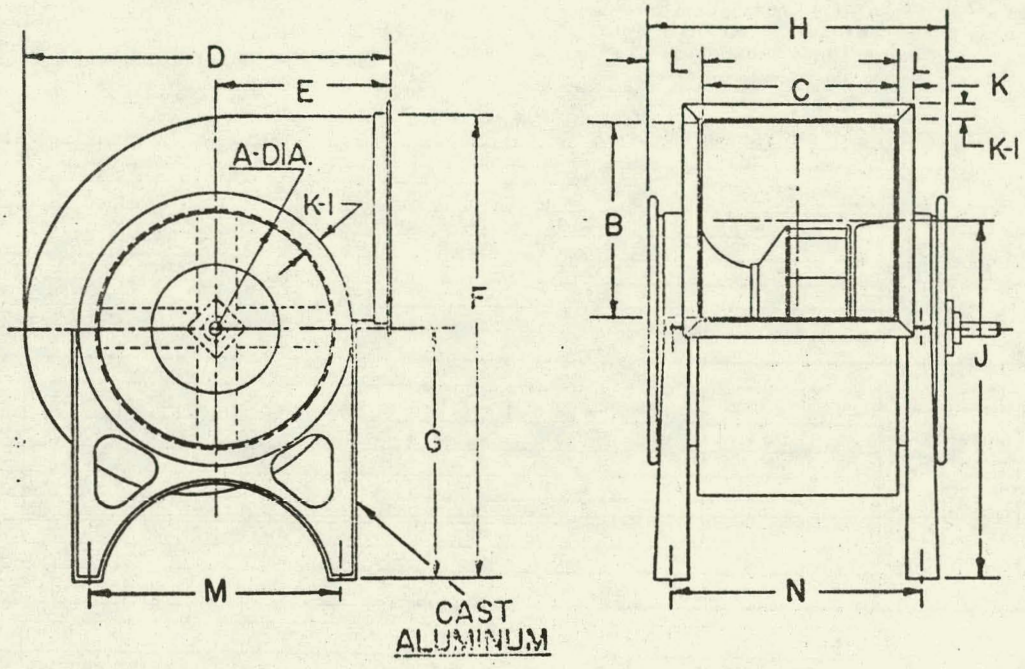
When U.L. listing is required, add a U after the UNIT TYPE. When C.S.A. listing is required, add a C after the UNIT TYPE.

NOTES:

FM-40-A

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	18	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	38-3/4	18-9/16	42-15/16	30	28 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	32-3/4	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	24-3/8	35 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	686
42	43	38-1/2	37-3/4	66-1/16	30-11/16	73-1/4	33-1/8	46 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

REVISED DRAWING 1/11/72

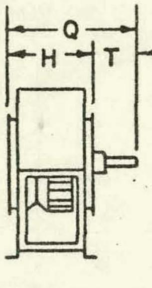
CH-I-A

TYPE CH- CENTRIFUGAL BLOWERS
ENGINEERING DATA

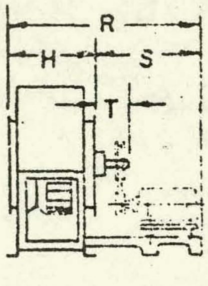
Note: Please specify rotation & Discharge on approved submittals

AHU-2

DRIVE ARRANGEMENTS FOR CENTRIFUGAL FANS



ARR. 1 SWSI Standard
For belt drive. Wheel overhung, two bearings.



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

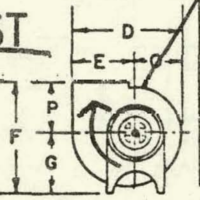
UNIT	Q	R	H	S	T
12	24	32	18	14	6
15	27-1/4	36-3/4	20-3/4	16	6-1/2
18	29	43-1/2	23-1/2	20	5-1/2
21	31-5/8	49-1/3	26-1/8	23	5-1/2
[illegible]	34-1/2	53-3/4	28-3/4	25	5-3/4
[illegible]	38-3/4	58	32-3/4	25-1/4	6
[illegible]	41-3/4	61	35-1/2	25-1/2	6-1/4
[illegible]	48-1/4	68-3/4	41	27-3/4	7-1/4
42	55-7/8	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

MOTOR BASE ASSEMBLY

ARR. 9
MAXIMUM 25 H.P.

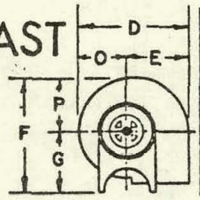
drive side

UPBLAST



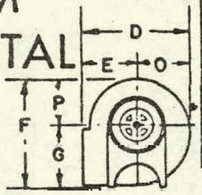
UNIT	12	15	18	21	24	27	30	36	42	48
D	20-1/4	25-3/8	30-1/2	35-1/2	40-3/8	45-1/2	50-1/2	60-5/8	70-3/4	81
O	8-3/4	11	13-1/4	15-3/8	17-1/2	19-3/4	21-7/8	26-1/4	30-5/8	35-1/8
E	11-1/2	14-3/8	17-1/4	20-1/8	22-7/8	25-3/4	28-5/8	34-3/8	40-1/8	45-7/8
F	22-1/2	29	[illegible]	41-3/8	44	49-1/4	53-1/8	63-1/8	73-3/8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

DOWNBLAST



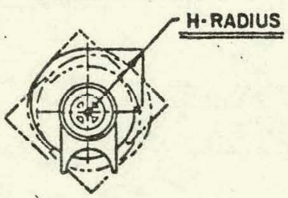
UNIT	12	15	18	21	24	27	30	36	42	48
D	20-1/4	25-3/8	30-1/2	35-1/2	40-3/8	45-1/2	50-1/2	60-5/8	70-3/4	81
O	8-3/4	[illegible]	[illegible]	15-3/8	17-1/2	19-3/4	21-7/8	26-1/4	30-5/8	35-1/8
E	11-1/2	14-3/8	[illegible]	20-1/8	22-7/8	25-3/4	28-5/8	34-3/8	40-1/8	45-7/8
F	23-7/8	[illegible]	[illegible]-3/4	42-3/4	40-1/4	45-1/8	49-5/8	59-1/8	68-1/2	78
P	10-1/8	[illegible]	15-1/4	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	[illegible]	18	21	24	27	30	36	42	48
D	18-7/8	24-[illegible]	[illegible] 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	[illegible]-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	28	[illegible]	40-3/8	42-7/8	48-1/8	53	63-1/8	73-1/4	83-3/8
P	8 3/4	11	[illegible]	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, air [illegible] design. Fan Housing shall be all aluminum of the gauge stan[illegible] with the manufacturer for the size unit specified. Housing will [illegible] throughout with the spun aluminum venturi inlet bolted to the housing for access to the wheel. Blower wheel shaft will be stainless [illegible].

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 RATINGS

Loren Cook Company certifies that the Type C[illegible] Blow[illegible] shown herein have been tested, and rated, in accor[illegible] the applicable AMCA Standard Test [illegible] Ratings Program and are licensed to bear the A[illegible] Ratings Seal. Performance shown is for Ty[illegible] Outlet duct. The AMCA Certified Rat[illegible]s [illegible]

The Type CH blower shown here has been [illegible] by the Canadian Standards Association [illegible] Laboratories. When [illegible]

LOREN COOK COMPANY

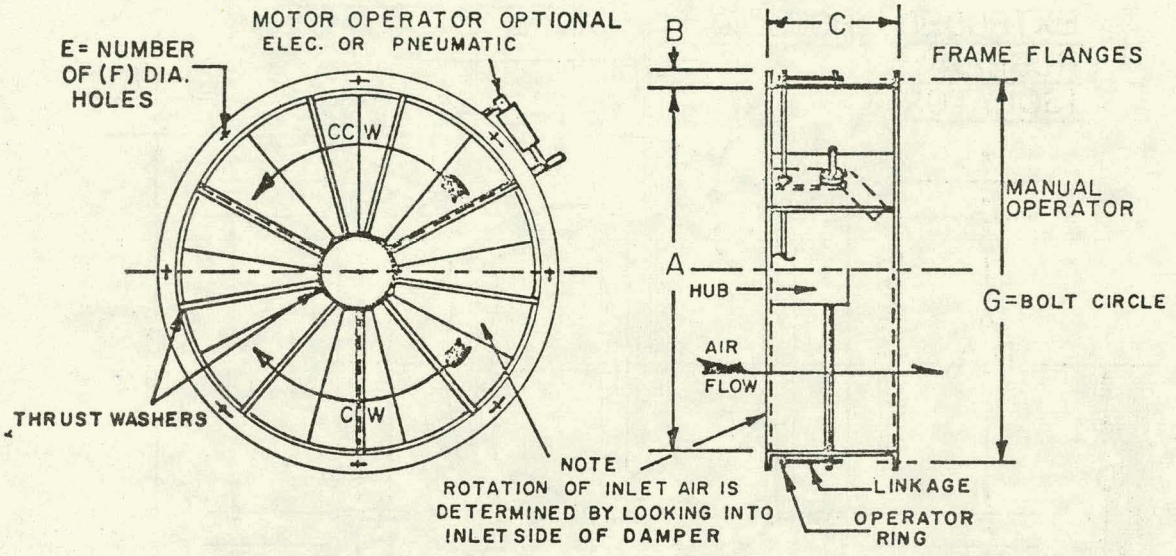
SPRINGFIELD, MISSOURI BEREA, OHIO

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	1¼	9	8	7/16	14-1/8	2.18
15	15-5/8	1¼	9	8	7/16	17-1/8	3.33
18	18-5/8	1½	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	80.85

AHU-2

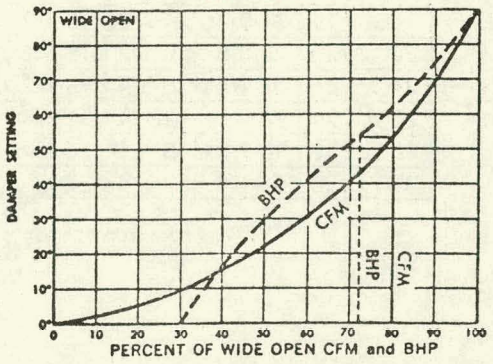
Note: Custom Plotted Performance Data for Inlet Vane Damper Equipped Fans may be obtained upon request. Please state fan type, size, arrangement, desired point of operation (S.P. & C.F.M.) or Fan R.P.M. when custom I.V.D./Fan plots are requested.

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

STD. CONSTRUCTION

Frame .125 Alum., Hub .125 Alum., Blades .100 Alum., Axles ½ Dia. Alum., Blade - Axle - Bearings - Thrust Washers - St'l Steel, Operator Ring 5/16 Dia. Zinc Plated Steel, Operator Linkage St'l Steel.

CHART I



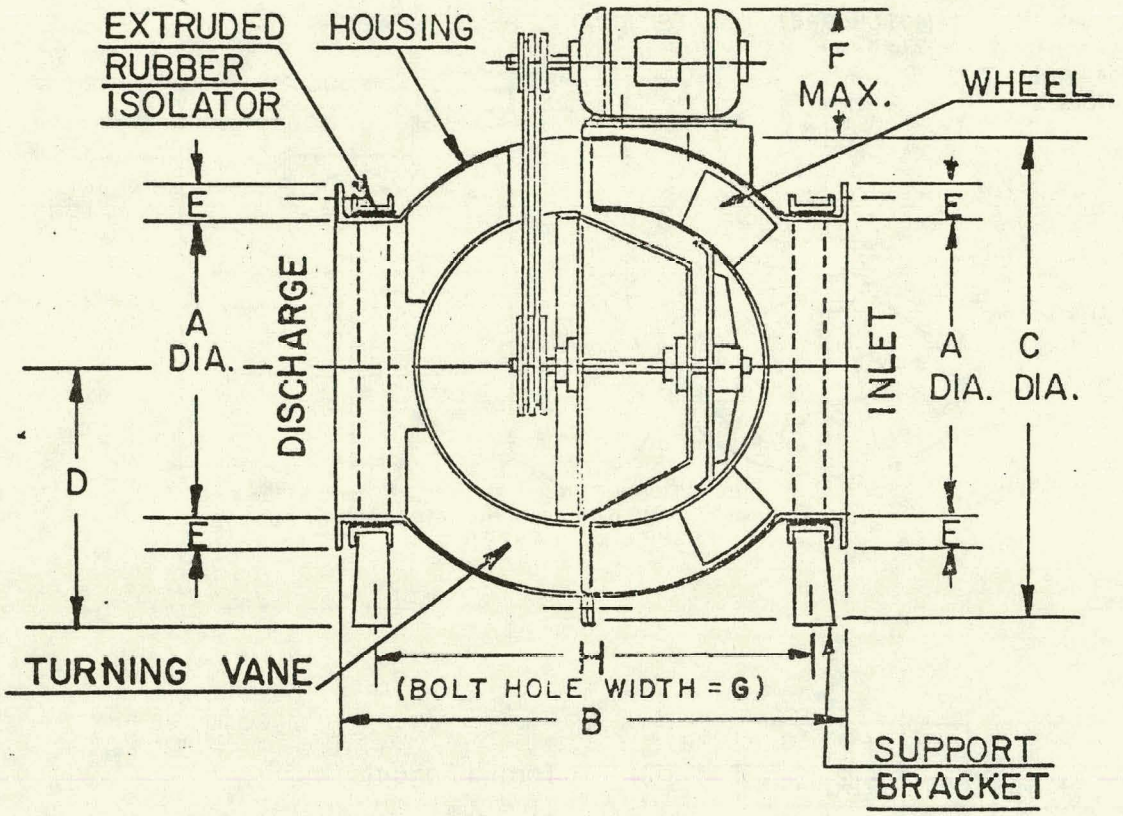
EXAMPLE: 80% of wide open capacity
Inlet damper setting: 53°—BHP: 72% wide open BHP

LD-94-A

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	
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	.100
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

INT

JOB: FIRE STATION NO. 24

CONTRACTOR: TRUOG-NICHOLS, INC.

ENGINEER: ASSOCIATED ENGINEERING CONSULTANTS

EQUIPMENT: SYSTEM NO. 1 (Bryant)

519A-060 Indoor Section
541B-057 Outdoor Section
520B-060 Blower Package
301499-~~425~~ 412 Supplemental Heat Package

SYSTEM NO. 2 (Bryant)

519A-048 Indoor Section
541B-047 Outdoor Section
520B-048 Blower Package
301499-~~424~~ 412 Supplemental Heat Package

SYSTEM NO. 3 (Bryant)

519A-042 Indoor Section
541B-041 Outdoor Section
520B-042 Blower Package
301499-~~405~~ 404 Supplemental Heat Package

APR 1978
RECD
D. F. CAHILL CONST. CO.

MAR 1978
RECD

ASSOCIATED ENGINEERING CONSULTANTS, INCORPORATED

DATE: 4/5/78
BY: [illegible]

- ☐ 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.

SHOP DRAWING REVIEW

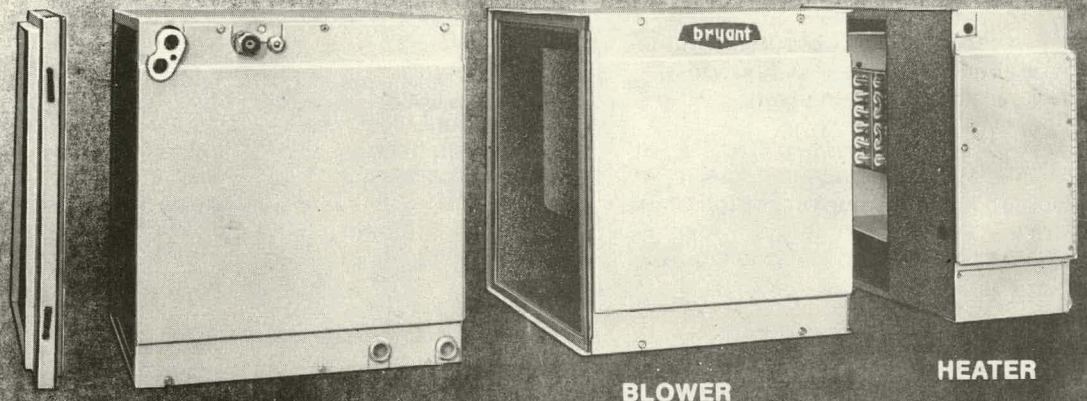
Midgley Straughnessy Fickel and Scott Architects Inc.
20 West 9th Street Kansas City, Missouri 64105

Review is for general conformance with contract documents. Sole responsibility for completeness of drawings, details, quantities and safety during fabrication and erection shall remain with the Contractor.

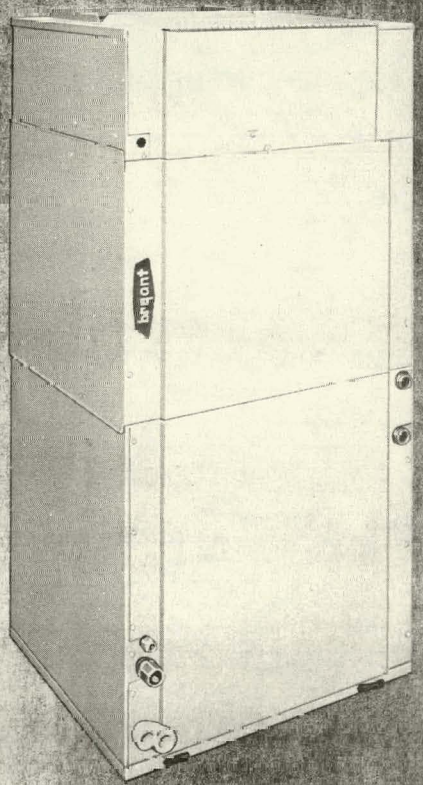
- ☐ No Exceptions Taken
- ☑ Make Corrections Noted
- ☐ Amend and Resubmit
- ☐ Rejected - See Remarks

Date 4/12/78 By MK

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 accoustic 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

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.

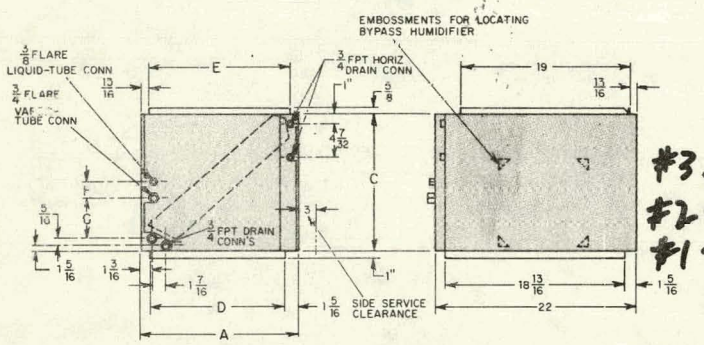
CHECK-FLO-RATER—The 519A/MCC Coil includes the unique Check-Flo-Rater refrigerant metering device which eliminates potential serviceability requirements of check valves and expansion devices used in conventional heat pump fan coils. Because it is external, the Check-Flo-Rater is readily serviceable.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



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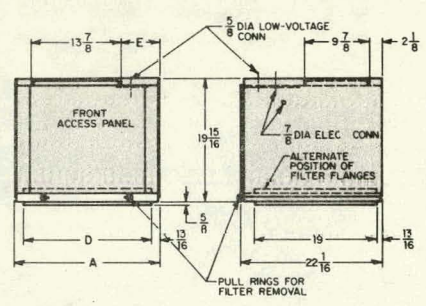
519A/MCC DIMENSIONS (In Inches)

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	23-3/16	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



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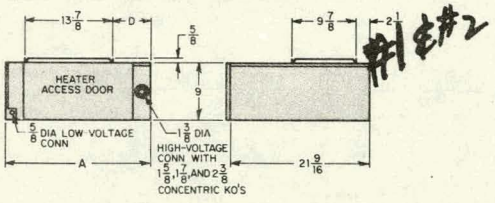
MODEL 520B/BP DIMENSIONS (In Inches)

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



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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, -410, -411 & -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

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

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	519A042MCC	519A048MCC	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	3 & 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 Ells 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	520B042BP	520B048BP	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	30KW
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	Std	Std	Std	Std	Std	Std
Blower Relay	Std	Std	Std	Std	Std	Std	Std	Std
Sequencer	Std	Std	Std	Std	Std	Std	Std	Std
Limit Switches	Std	Std	Std	Std	Std	Std	Std	Std
Fuse Block and Fuses/Circuit Breakers	—	—	Std	Std	Std	Std	Std	Std
Low-Voltage Terminal Strip	Std	Std	Std	Std	Std	Std	Std	Std
OPTIONAL EQUIPMENT								
Combustible Floor Base‡	302152-101	302152-101	302152-101	302152-101	302152-101	302152-101	302152-101	302152-101

*Use copper wire only. If other than 60°C copper wire is used, size can be determined from unit ampacity given in above table applicable table of National Electric 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	76570 4A	Adapter
X	78036-2A	Side Support
Y	301479-702	Adapter

*Ordering number.

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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	—	—	—	—	1205	1310	1140	1240	1070	1165	1000	1090	940	1020	870	945	800	870	—	800
		Cooling	—	—	—	—	1155	1255	1100	1195	1035	1125	975	1060	920	1000	855	930	971	860	—	790
	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	Heating	1070	1165	1030	1120	985	1070	925	1005	845	920	—	830	—	—	—	—	—	—	—	—
		Cooling	1050	1140	1010	1100	960	1045	900	980	830	905	—	825	—	—	—	—	—	—	—	—
520B042BP/ 519A042MCC	High	Heating	1380	1500	1315	1430	1250	1360	—	1290	—	1225	—	—	—	—	—	—	—	—	—	—
		Cooling	1325	1440	1270	1380	1210	1315	—	1250	—	1185	—	—	—	—	—	—	—	—	—	—
	Medium	Heating	1250	1360	1205	1310	—	1250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Cooling	1225	1330	1175	1280	—	1220	—	—	—	—	—	—	—	—	—	—	—	—	—	—
520B048BP/ 519A048MCC	High	Heating	—	1820	1663	1750	1590	1675	1520	1600	1435	1510	1355	1425	—	—	—	—	—	—	—	—
		Cooling	—	1725	1575	1660	1510	1590	1445	1520	1370	1440	1290	1360	—	—	—	—	—	—	—	—
	Medium	Heating	1625	1710	1560	1640	1490	1570	1415	1490	1330	1400	—	—	—	—	—	—	—	—	—	—
		Cooling	1550	1630	1470	1545	1425	1500	1355	1425	1270	1340	—	—	—	—	—	—	—	—	—	—
520B060BP/ 519A060MCC	High	Heating	—	—	—	—	—	—	—	—	—	2300	2095	2275	2015	2190	1930	2100	1850	2010	1755	1910
		Cooling	—	—	—	—	—	—	—	—	—	2190	1940	2110	1865	2030	1795	1950	1720	1870	1630	1770
	Medium	Heating	—	—	2060	2240	2024	2200	1980	2150	1925	2090	1870	2030	1785	1940	1740	1890	1665	1810	—	1730
		Cooling	—	—	1780	2150	1930	2100	1885	2050	1830	1990	1775	1930	1720	1870	1655	1800	1585	1725	—	1650
	Low	Heating	1730	1880	1720	1870	1700	1850	1665	1810	—	1775	—	1725	—	—	—	—	—	—	—	—
		Cooling	1700	1850	1685	1830	1655	1800	1610	1760	—	1710	—	1665	—	—	—	—	—	—	—	—

NOTES:
Heating—Dry Coil; Cooling—Wet Coil
*Static Pressure Drop of factory-supplied air filter is 0.13 in. wc.

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	—	1150	—	—	—	—	—	—
	Medium	1305	1420	1275	1385	1230	1335	1175	1275	—	1200	—	—	—	—	—	—	—	—	—	—
	Low	1120	1215	1095	1190	1065	1155	—	—	—	—	—	—	—	—	—	—	—	—	—	—
520B048BP	High	1940	2040	1870	1970	1800	1895	1720	1810	1635	1720	—	1625	—	—	—	—	—	—	—	—
	Medium	1780	1875	1735	1825	1670	1760	1595	1680	1510	1590	—	—	—	—	—	—	—	—	—	—
	Low	—	1600	—	1555	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
520B060BP	High	—	—	—	—	—	—	2400	2610	2330	2530	2295	2495	2160	2350	2110	2290	1960	2130	1840	2000
	Medium	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~~	~~10~~	~~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	10	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.

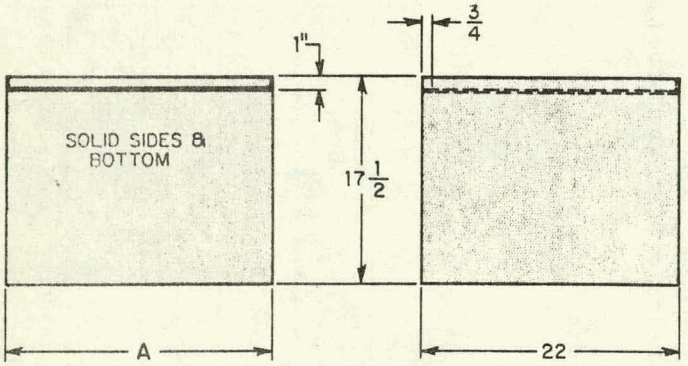
*- Brkr in distr. Panel to be changed to 2-50A-2P & wire to #6-any Cat is resp of Mech Contr.

•- 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



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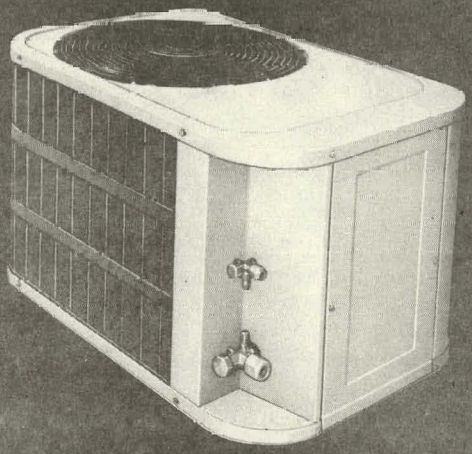
Return Air Plenum

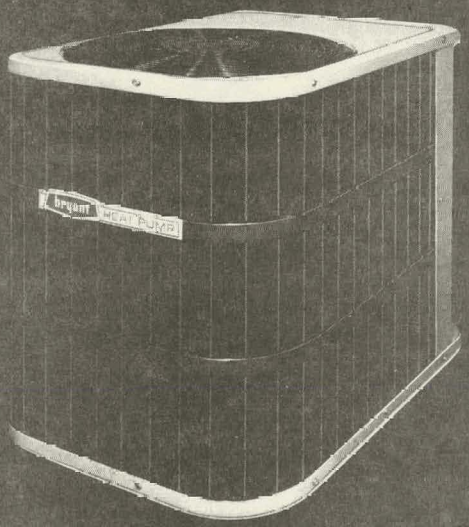
DIMENSIONS (In Inches)

Blower Size	A
042	21
048 and 060	24

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 coefficiency 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.

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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.

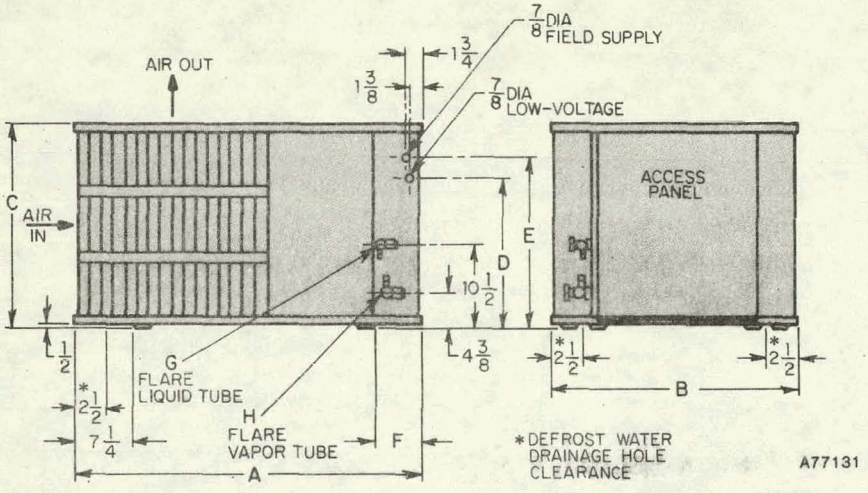
UNIQUE CHECK-FLO-RATER—The refrigerant metering for the outdoor and indoor units is done with the unique CHECK-FLO-RATER which eliminates the potential servicability requirements of check valves and expansion devices used in conventional heat pumps. For added reliability, a liquid-tube strainer assures 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	541B028SHP				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°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-Flo-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 Ells—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.

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°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 (Ft^3/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	Heating Btuh	KW	COP	Heating Btuh	KW	COP	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	Heating Btuh	KW	COP	Heating Btuh	KW	COP	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 Ft^3/Min and indoor coil entering air temperature adjustments.

HEAT PUMP HEATING PERFORMANCE

#1

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 Ft^3/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		
	°F	Net Capacity MBtuh		Total System	Net Capacity MBtuh		Total System	Net Capacity MBtuh		Total System	Net Capacity MBtuh		Total System
Ft^3/Min	EWB	Total	Sens	KW	Total	Sens	KW	Total	Sens	KW	Total	Sens	KW
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 #3													
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 Ft^3/Min of indoor coil air for each degree below 80°F, or add 835 Btuh per 1000 Ft^3/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.

DETAILED COOLING CAPACITIES

Indoor Coil Air		OUTDOOR COIL ENTERING AIR TEMPERATURE °F											
		85			95			105			115		
	°F	Net Capacity MBtuh		Total System	Net Capacity MBtuh		Total System	Net Capacity MBtuh		Total System	Net Capacity MBtuh		Total System
Ft^3/Min	EWB	Total	Sens	KW	Total	Sens	KW	Total	Sens	KW	Total	Sens	KW
541B047SHP Outdoor Section With 519A048MCC/520B048BP or 519A048MCC Indoor Section #2													
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 #1													
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 Ft^3/Min of indoor coil air for each degree below 80°F, or add 835 Btuh per 1000 Ft^3/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.

bryant

Bryant
Air Conditioning

BDP Company
Indianapolis, Indiana
La Puente, California

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

UNIT MUST BE INSTALLED IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS

HP-14h FORM NO. PDS 541B/SHP.21.1B PRINTED IN U.S.A. 5-77

AIR HANDLING

UNIT #1

McQuay DIVISION

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

CERTIFIED PERFORMANCE DATA

Seasonmaster AND *Seasonvent* CENTRAL STATION AIR HANDLING UNITS

SOLD TO: Truog-Nichols, Inc.

JOB: Fire Station #24

CONSULTING ENGINEER: Associated Engineering Consultants

McQUAY ORDER NO. GO. 652926 | DATE DR. 3/2/78

CUST. P.C. 97-17584

REP. Thermal Components

REP. P.O. 78L26

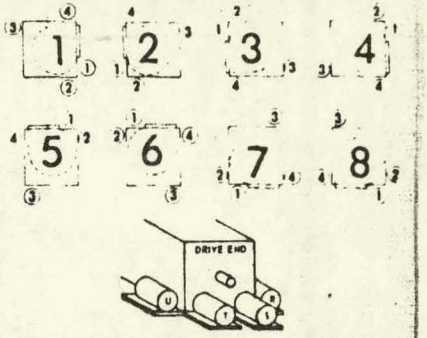
COPIES | FOR APPR'L | FOR RECORD

REV. NO.	BY	DATE	WAS

SCHEDULE FOR CERTIFIED DIMENSIONS

UNIT TYPE	DWG. NO.
HMH	281182Y
HWL	281193Y
HSH	281181Y
LML, MMM	265540Y
LSL, MSL-HORIZ.	265538Y
LWL, MWL	281191Y
LSL, MSL-VERT.	265539Y
LYF	281183Y
LHD HORIZ.	281184Y
LHD VERT.	281185Y
LHA HORIZ.	281187Y
LHA VERT.	281190Y
LWL, MWL	281192Y

FAN DISCHARGE & MOTOR LOCATIONS (VIEWED FROM DRIVE END)



McQUAY ITEM #	TAG	QTY.	UNIT MODEL NUMBER	UNIT ARRANGT.	FAN DISC NO.	MTR. LOC. NO.	UNIT MTG. TOP	UNIT MTG. BOT.	FAN TYPE	CFM	OUTLET VELOCITY	RPM	BHP	MOTOR DATA H.P.	MOTOR DATA RPM	MOTOR DATA VOLTAGE	MOTOR DATA NEMA FRAME	MOTOR DATA FURN. BY
										~~5600~~	~~1600~~	?	?					
010		1	LHD111	H111	5	1		X	FC	~~6000~~	~~1714~~	~~732~~	~~2.9~~	3	1800	208-60-3		McQ

McQUAY ITEM #	COIL MODEL NUMBER	COIL* POS.	COIL FACE AREA	COIL FACE VEL.	TOTAL BTUH	SENSIBLE BTUH	ENTERING AIR D.B.	ENTERING AIR W.B.	LEAVING AIR D.B.	LEAVING AIR W.B.	GPM ~~STEAM PRESSURE OR REF.~~	ENT. H_2O ~~OR SUCT. TEMP.~~	LVG. H_2O TEMP.	WATER PRESSURE DROP	CONNECT LOCATION DRIVE END	CONNECT LOCATION OPP. DRIVE END	SUPPLY CONNECT. NO.	SUPPLY CONNECT. SIZE	RETURN CONNECT. NO.	RETURN CONNECT. SIZE
				530	?	?			?				?							
010	5WH1202	21	10.6	~~570~~	~~333,192~~	~~333,192~~	250	-	~~199~~	-	~~5.2~~ 7	55	~~182~~	0.1	X		1	2½ NPT	1	2½ NPT

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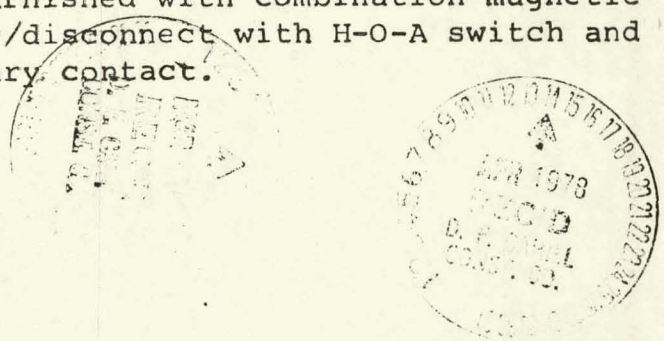
McQUAY ITEM #	ACCESSORY ARRANGEMENT ARR. NO.	ACCESSORY ARRANGEMENT FILTER TYPE	OVERALL LENGTH	"X" DIMENSION	DRIVE TYPE	MULTI ZONE DAMPER SHAFT EXT.
010			43-3/8		Adj.	

AIR FRICTION ITEM #	
HTG. COIL	0.41
CLG. COIL	
COIL	
MIX. BOX	
FILTERS	
CASING	
EXTERNAL	1.25
TOTAL	1.66

McQUAY ITEM #	VIBRATION ISOLATOR SET NUMBER	McQUAY ITEM #	VIBRATION ISOLATOR SET NUMBER
	Furnished by others		

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



*COIL POS. = COIL POSITION CODE: 18 = in auxiliary coil section; 21 = 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 = Preheat (before 1st std. sect. of unit); RH = Reheat (before fan section).

FORM NO. 281188A
REV. 1-74

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 safety during fabrication and erection shall remain with the Contractor.

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

Date 4/6/78 By

ASSOCIATED ENGINEERING CONSULTANTS, INCORPORATED

DATE: 4/6/78
BY:
- ☐ 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 DIVISION, McQUAY-PERFEX INC.
P.O. BOX 1551, MINNEAPOLIS, MINNESOTA 55440

SEASONVENT
CENTRAL STATION HEATING AND VENTILATING UNITS HORIZONTAL DRAW THRU

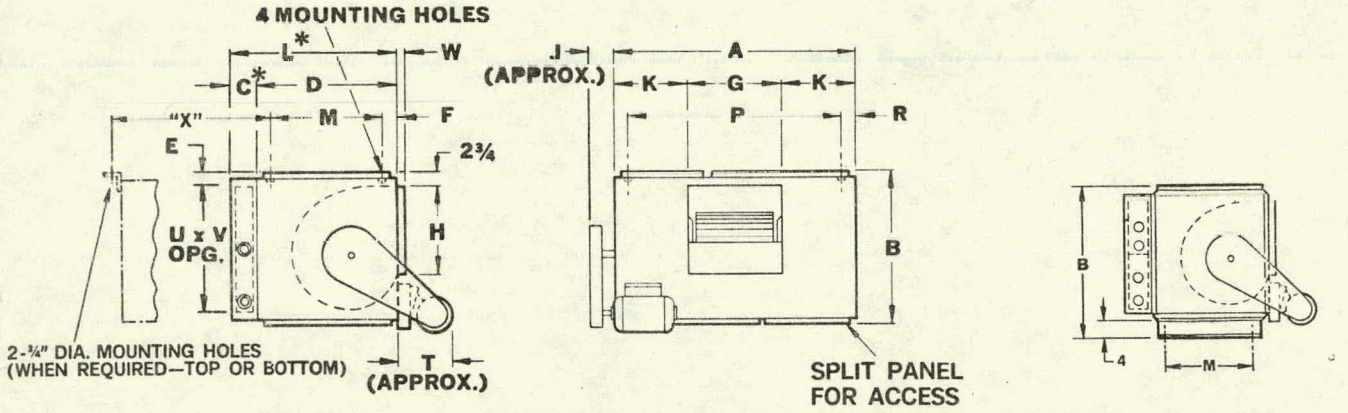
CERTIFIED DRAWING
281184Y

TYPE LHD

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.

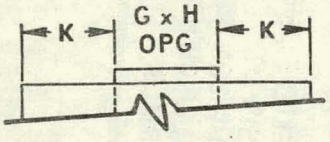
GENERAL SPECIFICATIONS

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.



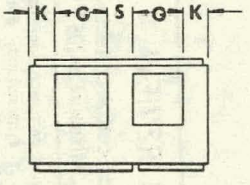
NOTE:
1. MOUNTING HOLE DATA:
   UNIT SIZES 103-228:
   5/8 V.C. TAPPED TOP OR BOTTOM
   UNIT SIZES 237-164:
   3/4 DIA. BOTTOM ONLY
2. UNIT SIZE 130-228 ARE SUITABLE FOR INVERTED MOUNTING.
3. FOR CEILING SUSPENSION, UNIT SIZES 237-164 MUST BE PLATFORM MOUNTED.
4. UNIT SIZES 237-164 WITH NO'S. 5, 6, 7 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	29⅜	29⅜	35⅝	35⅝	43⅜
H	23¼	23¼	28⅝	28⅝	35⅝
K	24⅜	31⅞	30¾	42¼	39⅜

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



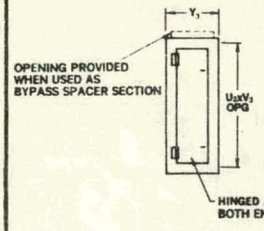
PHYSICAL DIMENSIONS (Inches)

UNIT SIZE	A	B	C*	D	E	F	G	H	J	K	L*	M	P	Q	R	S	T	U	V	W
103	34	22¾	6½	21¾	2⅝	2⅞	11¾	10¼	6½	11⅛	28⅜	16⅛	28½	—	2¾	—	15	17½	29⅞	1
104	40	25¾	6½	24¾	2⅝	2⅞	12¼	13½	6½	13⅞	31⅜	19⅛	34½	—	2¾	—	15	20½	35⅞	1
106	50	29	6½	28	2⅝	2⅞	17¼	15⅞	6½	16⅜	34⅝	22⅜	44½	—	2¾	—	16	23¾	45⅞	1
206	69	22¾	6½	21¾	2⅝	2⅞	13⅛	10¼	6½	13¼	28⅜	16⅛	63½	—	2¾	16¼	18	17½	64⅞	1
108	48	37¾	6½	36¾	2⅝	2⅞	21⅛	19⅜	8	13⅜	43⅜	31⅛	42½	—	2¾	—	18	32½	43⅞	1
209	83	25¾	6½	24¾	2⅝	2⅞	17⅜	15⅞	6½	15	31⅜	19⅛	77½	—	2¾	18¼	18	20½	78⅞	1
111	63	37¾	6½	36¾	2⅝	2⅞	23¼	21⅝	8	19⅞	43⅜	31⅛	57½	—	2¾	—	18	32½	58⅞	1
214	78	37¾	6½	36¾	2⅝	2⅞	19	17⅞	8	10	43⅜	31⅛	72½	—	2¾	20	21	32½	73⅞	1
217	93	37¾	6½	36¾	2⅝	2⅞	21⅛	19⅜	8	12¾	43⅜	31⅛	87½	—	2¾	25⅜	21	32½	88⅞	1
222	97	44¾	7	43¾	2⅝	2⅞	23¼	21⅝	9	12⅝	50⅞	38⅛	91½	—	2¾	25¼	21	39½	92⅞	1
228	120	44¾	7	43¾	2⅝	2⅞	28¼	26½	9	15⅞	50⅞	38⅛	114½	—	2¾	31¾	23	39½	115⅞	1
237	122⅛	61⅜	7	45⅝	3⅜	3⅜	31½	28¾	11½	15⅛	52¾	39½	117⅞	11¾	2⅛	29	25	51¼	115½	1
141	122⅛	69⅝	7	59⅛	3⅜	3⅜	46⅜	43¼	11½	37⅞	66¼	53	117⅞	6½	2⅛	—	25	59½	115½	1½
150	122⅛	79⅜	7	66⅝	3⅜	3⅛	51½	47¼	11½	35⅜	73¾	60½	117⅞	8¾	2⅛	—	25	69¼	115½	1½
164	122⅛	97⅜	7	72⅝	3⅜	3⅜	56¾	52⅜	11½	32⅝	79¾	66½	117⅞	20¾	2⅛	—	25	87¼	115½	1½

*Add 3½ inches for 3 or 4-row coils.

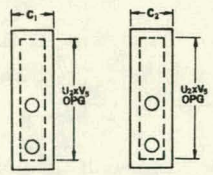
ACCESSORIES

ACCESS BY-PASS SPACER SECTION



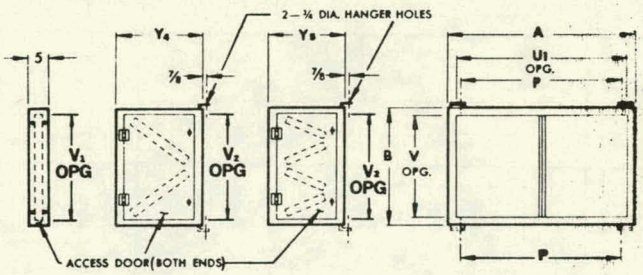
HEATING COIL SECTIONS

1 & 2 ROW COILS — 3 & 4 ROW COILS



FILTER SECTIONS

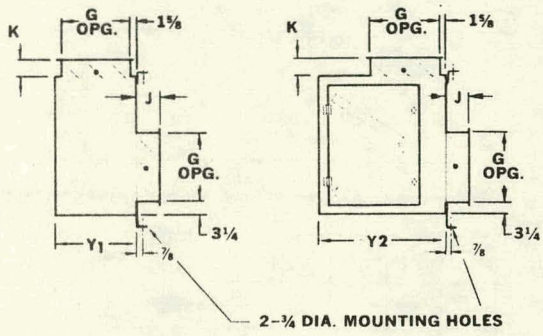
FLAT — ANGULAR — HEAVY DUTY*

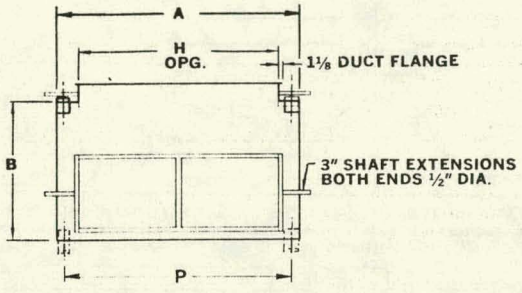


*AVAILABLE IN UNIT SIZES 209 THRU 164 ONLY

MIXING BOXES

STANDARD — COMBINATION

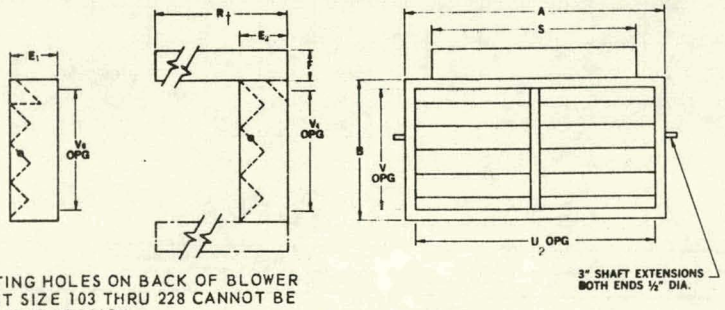




NOTE: WHEN BACK AND BOTTOM OPENINGS ARE REQUIRED, MIXING BOX IS INVERTED (TOP AND BOTTOM OPENINGS ALSO AVAILABLE)

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.

DIMENSIONS

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

UNIT SIZE	DIMENSIONS (Inches)																											
	A	B	C_1	C_2	E_1	E_2	F	G	H	J	K	P§	R	S	T*	U_1	U_2	V_1	V_2	V_3	V_4	V_5	V_6	Y_1	Y_2	Y_3	Y_4	Y_5
103	34	21⅜	6½	10	6¾	7⅞	6	12⅜	25⅜	6¼	4⅝	28½	21	33⅜	25½	30⅝	29⅞	17⅜	18¼	17½	17⅜	17½	18¼	15¾	22½	18	19½	N.A.
104	40	24⅜	6½	10	8	8⅛	6⅝	12⅜	31⅜	6¼	4⅝	34½	21⅞	39⅜	20½	36⅝	35⅞	20	21¼	20½	20⅜	20½	21¼	15¾	23	18	19	N.A.
106	50	27⅞	6½	10	9	9⅛	7⅛	12⅜	41⅜	6¼	4⅝	44½	23½	49⅜	22	46⅝	45⅞	23⅛	24½	23¾	23	23¾	24½	15¾	27¼	18	22¼	N.A.
206	69	21⅜	6½	10	6¾	7⅞	6	12⅜	60⅜	6¼	4⅝	63½	21	68⅜	20½	65⅝	64⅞	17⅜	18¼	17½	17⅜	17½	18¼	15¾	22½	18	19½	N.A.
108	48	36⅜	6½	10	9	11	9⅝	18⅜	39⅜	6¼	4⅝	42½	27¾	47⅜	25½	44⅝	43⅞	32½	33¼	32½	30⅞	32½	33¼	21¾	33½	18	26	N.A.
209	83	24⅝	6½	10	8	8⅛	6⅝	12⅜	74⅜	6¼	4⅝	77½	21⅞	82⅝	23	79⅝	78⅞	20	21¼	20½	20⅜	20½	21¼	15¾	23	18	19	23¼
111	63	36⅜	6½	10	9	11	9⅝	18⅜	54⅜	6¼	4⅝	57½	27¾	62⅜	25½	59⅝	58⅞	32½	33¼	32½	30⅞	32½	33¼	21¾	33½	18	26	23½
214	78	36⅜	6½	10	9	11	9⅝	18⅜	69⅜	6¼	4⅝	72½	27¼	77⅜	25½	74⅝	73⅞	32½	33¼	32½	30⅞	32½	33¼	21¾	33½	18	26	23½
217	93	36⅜	6½	10	9	11	9⅝	18⅜	84⅜	6¼	4⅝	87½	27¾	92⅜	25½	89⅝	88⅞	32½	33¼	32½	30⅞	32½	33¼	21¾	33½	18	26	23¼
222	97	43⅜	7	10½	8¼	13⅜	11¼	24⅛	88⅜	7¼	5⅝	91½	32¼	96⅜	23	93⅜	92⅞	40⅛	40¼	39½	37¾	39½	33¼	27½	32½	18	23	23¼
228	120	43⅜	7	10½	8¼	13⅜	11¼	24⅛	111⅜	7¼	5⅝	114½	32¼	119⅜	23	116⅜	115⅞	40⅛	40¼	39½	37¾	39½	40¼	27½	32½	18	23	23¼
237	119⅜	55⅛	7	10½	10	18	15⅛	31⅞	112⅜	7¼	5⅝	117⅞	40	110⅜	28	115⅛†	116¾‡	50⅛	51¾	52½	50⅛	51¼	52½	35¼	39⅝	18	22¼	27¼
141	119⅜	63⅜	7	10½	9⅝	19⅜	16¼	39⅜	112⅜	7¼	5⅝	117⅞	43	110⅜	23½	115⅛†	116¾‡	60⅛	60	60¾	57	59½	60¾	43	47½	19⅝	21⅛	23¼
150	119⅜	73⅛	7	10½	10	21½	20	39⅜	112⅜	7¼	5⅝	117⅞	48⅜	110⅜	28	115⅛†	116¾‡	70⅛	69¾	70½	67⅝	69¼	70½	43	47½	22⅞	25½	28¼
164	119⅜	91⅛	7	10½	10	27⅝	24⅜	47⅝	112⅜	7¼	5⅝	117⅞	59	110⅜	27	115⅛†	116¾‡	85¼	87¾	88½	86¾	87¼	88½	51	55½	27⅛	27¼	27½

N.A.—Not Available. *Maximum Clearance required for filter removal. †Add 1½" for flat filter. ‡Subtract 1¼" 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	*H111 H101 L		*H113 H103 L_1		*H211 H201 L_8	*H213 H203 L_9
INT. F & B. P.	*H151 H141 L_2		*H154 H144 L_3		*H251 H241 L_{10}	*H254 H244 L_{11}
EXT. F & B. P. TOP DUCT	*H171 H161 L_4	*H172 H162 L_5	*H173 H163 L_6	*H175 H165 L_7	*H271 H261 L_{12}	*H273 H263 L_{12}
EXT. F & B. P. BOT. DUCT	*H191 H181 L_4	*H192 H182 L_5	*H193 H183 L_6	*H195 H185 L_7		
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	L_1*	L_2	L_3*	L_4	L_5	L_6*	L_7*	L_8	L_9*	L_{10}	L_{11}*	L_{12}	L_{13}*
103	28⅜	35	35¼	60	36⅜	54½	43	61⅛	—	—	—	—	—	—
104	31⅜	38	39½	64¼	39⅜	57¾	46¼	64⅜	—	—	—	—	—	—
106	34⅜	41¼	43¾	68½	43⅜	62	50½	68⅜	—	—	—	—	—	—
206	28⅜	35	35¼	60	36⅜	54½	43	61⅛	—	—	—	—	—	—
108	43⅜	50	52½	77¼	54½	72⅝	61⅛	79¼	—	—	—	—	—	—
209	31⅜	38	39½	64¼	39⅜	57¾	46¼	64⅜	—	—	—	—	—	—
111	43⅜	50	52½	77¼	54½	72⅝	61⅛	79¼	—	—	—	—	—	—
214	43⅜	50	52½	77¼	54½	72⅝	61⅛	79¼	—	—	—	—	—	—
217	43⅜	50	52½	77¼	54½	72⅝	61⅛	79¼	—	—	—	—	—	—
222	50⅞	58	59¼	84½	64⅜	82½	71½	89⅜	—	—	—	—	—	—
228	50⅞	58	59¼	84½	64⅜	82½	71½	89⅜	—	—	—	—	—	—
237	52¾	59⅞	62⅞	88⅛	70⅞	89	78	96⅛	64½	71⅝	74⅝	99⅞	82⅝	89¾
141	66¼	73⅜	76	102⅞	85¾	105½	92⅞	112⅝	72¾	79⅞	82½	109⅜	92¼	99⅜
150	73¾	80⅞	83⅞	114	95⅜	118⅜	102½	125½	82½	89⅝	92⅝	122¾	104⅛	111¼
164	79¾	86⅞	89⅞	124½	107½	135	114⅝	142⅛	100½	107⅝	110⅝	145¼	128¼	135⅜

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

* ADD 3½" FOR EACH 3 OR 4 ROW COIL

ACCESSORY ARRANGEMENTS

	FILTER SECTION ONLY	FILTER SECTION AND MIXING BOX					
		WITH DAMPERS			WITHOUT DAMPERS		
MIXING BOX ONLY		B00	C00	D00	E00	F00	G00
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*

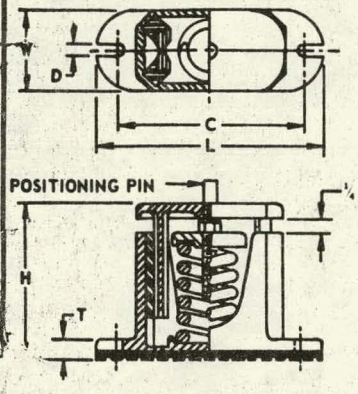
Replace asterisk with a "0" for no filters, "1" for throwaway filters, "2" for cleanable filters or "3" for **cleanable** high velocity filter.

FILTER DATA

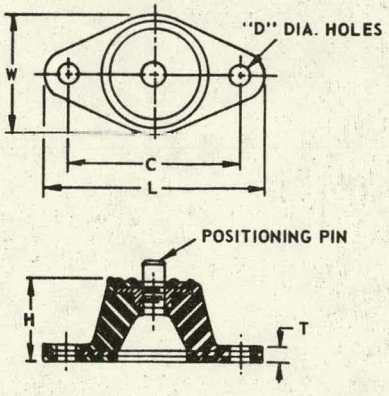
UNIT SIZE	FLAT		ANGULAR		HEAVY DUTY	
	QUANTITY	AREA	QUANTITY	AREA	QUANTITY	AREA
103	2–16 × 20 × 2	4.4	2–16 × 25 × 2	5.6	–	–
104	2–20 × 20 × 2	5.6	4–16 × 20 × 2	8.9	–	–
106	3–16 × 25 × 2	8.4	6–16 × 20 × 2	13.3	–	–
206	3–20 × 20 × 2	8.3	6–16 × 20 × 2	13.3	–	–
108	2–16 × 20 × 2	–	–	–	–	–
	2–16 × 25 × 2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

VIBRATION ISOLATORS

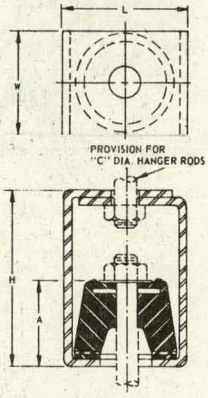
SPRING MOUNTS
TYPES "BP" & "CP"



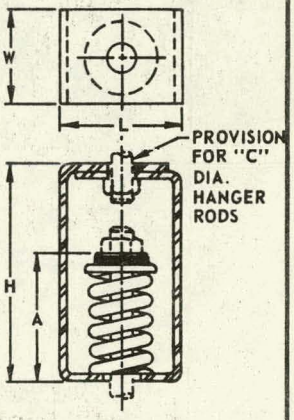
RUBBER-IN-SHEAR
MOUNTS
TYPE "RP"



RUBBER-IN-SHEAR
HANGER
TYPE "RH"



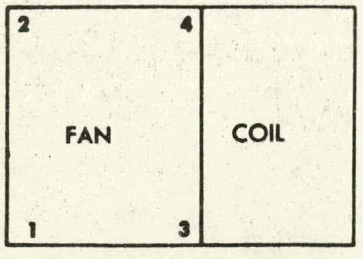
SPRING HANGER
TYPE "SH"



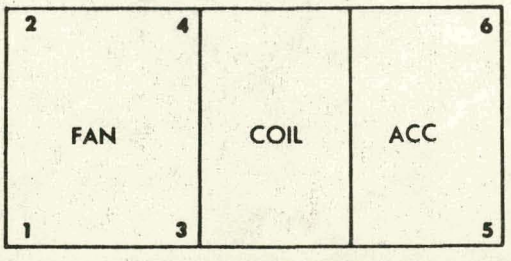
ENSIONS	ISOLATORS										
	BP	CP1	CP2	RP1	RP2	RP3	RP4	RH2	RH3	RH4	SH
A	–	–	–	–	–	–	–	1 3/8	2	2	4 3/8
C	5	6 1/2	9 1/4	2 3/8	3	4 1/8	5	5/8	3/4	1	3/4
D	3/8	5/8	5/8	11/32	11/32	9/16	9/16	–	–	–	–
*H	3 3/8	5	5 1/4	1	1 1/4	1 3/4	1 3/4	4 1/2	5 3/4	8	7
L	5 5/8	7 1/2	10 1/4	3	3 3/4	5 3/8	6 1/4	3	3 3/4	4 3/4	3 3/4
T	1/2	5/8	5/8	1/4	1/4	1/4	1/4	–	–	–	–
W	2 1/8	2 3/4	2 3/4	1 5/8	2 1/4	3 1/4	4	2 1/4	3 1/4	4	3

*OPERATING HEIGHT.

ISOLATOR LOCATIONS



WITHOUT ACCESSORIES



WITH ACCESSORIES

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