

DOE/NASA CONTRACTOR
REPORT

DOE/NASA CR-161271

SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT
SOUTHEAST OF SALINE, UNIFIED SCHOOL DISTRICT 306,
MENTOR, KANSAS

Prepared from documents furnished by

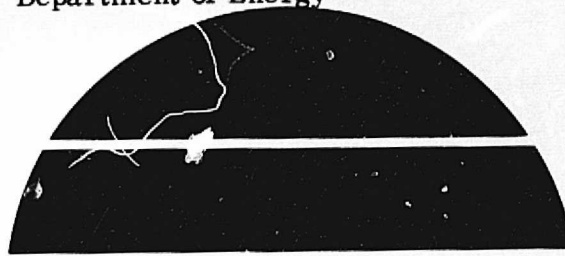
Wilson & Company
Engineerings and Architects
Salina, Kansas 67401

Under DOE Contract EG-77-A-01-4077

Monitored by the

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

For the U. S. Department of Energy



(NASA-CR-161271) SOLAR HEATING AND HOT
WATER SYSTEM INSTALLED AT SOUTHEAST OF
SALINE, UNIFIED SCHOOL DISTRICT 306, MENTOR,
KANSAS (Wilson and Co., Salina, Kans.)
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U.S. Department of Energy



Solar Energy

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I. DESCRIPTION OF BUILDING AND CONTENTS

a. Building Description. The USD #306 school building serves an estimated 750 students ranging in age from Kindergarten to 12th grade with approximately 140,000 s.f. of floor area. General building construction is metal frame with brick fascia. Low heat loss characteristics are incorporated into building construction by the use of double glazed windows with a low ratio of window to wall space and the generous use of batt insulation. Building thermal characteristics are typified by overall U-values of 0.05 and 0.07 for the walls and roof respectively. An aerial photograph including both school and collector field is shown on page 9.

Building heating consists of a closed loop water to air heat pump system with individual heat pumps in each classroom area, as well as roof-mounted heat pumps for the larger areas such as the gymnasium and the auditorium. The auxiliary heating system is all electric. The domestic water heating system consists of electric powered hot water generators which are supplemented by solar pre-heating.

The solar supplemental system was designed to contribute approximately 50 percent of the building's space heating needs and 80 percent of the domestic hot water needs for the year. Early estimates of the power costs savings to the school district are approximately \$10,000-\$11,000 per year.

b. Design Philosophy. In the early design stages of the facility, the school board authorized the design of a system with sufficient flexibility to operate either with or without solar supplemental heat. The solar collectors were to be included only if a grant could be secured to pay for part of the solar installation. Accordingly, these provisions were included in the design for a future solar system. Construction was well underway before the grant application was approved to install the supplemental solar heating system. These provisions for future installation made it relatively easy to incorporate the new solar equipment into the existing building system.

c. Solar System Design Overview. The building heat pump system requires circulation water temperatures between 70° F and 95° F. Because of the relatively low temperatures required the decision was made to use flat-plate collectors for solar energy collection. In comparison with high-temperature collection systems this resulted in lower overall costs, simpler design and greater operational efficiency.

(1) General Description. The entire solar supplemented building heating and cooling system, shown schematically on page 10, consists of four heat transfer loops. In the first loop a glycol/water solution is pumped from a field of solar collectors to the tube side of the solar loop heat exchanger. Water is pumped in the second loop from the shell side of the same heat exchanger to thermal storage tanks each equipped with auxiliary electric heaters required for solar system back-up. In the third loop, water is pumped from the thermal storage tanks to the shell side of a second heat exchanger used for domestic water preheat. Building space

heating and cooling is performed in the fourth loop as water from the thermal storage tanks is pumped to the individual building heat pumps where heat is either pumped out of (room heating) or into (room cooling) the water source. Since each heat pump is capable of independently satisfying its individual load, the cooling of internal heat gains in one area of the building provides heat to other areas requiring heat via the central energy thermal storage tanks.

The physical location of major equipment items is in two areas, the mechanical equipment room and the collector field.

(2) Site Planning. The collector field is located on level ground approximately 120 feet due south of the southeast corner of the main school building. Overall field size is 154 feet by 70 feet with individual collectors facing directly south and tilted at an angle of 53° from the horizontal, optimum for solar energy collection during the winter months.

The collectors are ground mounted due in part to the installation of collectors after the design of the building had been completed and to the belief that ground mounting would allow easier maintenance and better public view of the actual solar hardware and avoidance of roof leakage problems.

Internal headering between individual collectors allows for their arrangement in rows. A structural steel frame, embedded in concrete piers, was used to support each row.

A 4 feet high chain link fence surrounds the collector field at a distance of 10 feet from the field perimeter.

Supply and return piping mains for the collector field were run underground from the main to the field proper. All the piping within the field itself is above ground.

(3) Major Components. The following are brief descriptions of the major solar system components. (See Appendix B for manufacturer's literature.)

(a) The collectors are of the flat-plate type with single tempered glazing and black chromium absorber coating. Internal cross tubes and manifolds are copper and are arranged in a gated flow configuration. Aluminum absorber fins are mechanically bonded to the cross tubes.

(b) The heat exchangers are water-to-water shell and tube type.

(c) Pumps for the circulation loop from the thermal energy storage tanks to the solar heat exchanger are base mounted, centrifugal type. All other pumps in the system are in-line centrifugal type.

(d) The expansion tanks are ASME rated with gauge glass.

(e) The air separator is a pipeline-mounted steel tank with strainer. Tank inlet and outlet are tangentially-mounted.

(f) The three way flow diverting valve is made of cast iron with flanged ports. Two temperature sensitive control elements are internally mounted.

(g) The heat rejector consists of a finned-tube radiator and motorized fan mounted on a steel base.

II. PROJECT COST DATA

<u>Consultants</u>	<u>Costs</u>
Wilson & Company, Engineers & Architects	\$ 15,635
Intertechnology Corp.	1,535
<u>Contractors</u>	
<u>Mechanical</u>	
Buckley, Inc.	163,700
<u>Electrical</u>	
Electrical Equipment Co., Inc.	11,476
<u>General</u>	
J.S. Frank Construction Co., Inc.	<u>87,807</u>
TOTAL CONSTRUCTION COSTS	\$280,153
<u>DOE Funding</u>	<u>\$181,000</u>
PROJECT COST TO OWNER	\$ 99,153

The project, as bid and built, had no cost overruns. However, moneys were not provided for monitoring instrumentation, which will be necessary if extensive performance data collection is ever desired.

III. ACCEPTANCE TEST PLAN DATA

Testing of the solar system, during construction and after, was handled by the contractors involved, under observation of a designated Wilson & Company representative. The following are outlines of the testing performed.

a. Mechanical. With the exception of the solar collector arrays, system piping and components were hydrostatically tested at a pressure equal to that in the water main serving the building, approximately 55 psig. The collector arrays were hydrostatically tested at 30 psig. Each of these test pressures was held for a 24 hour period.

All pump motors were tested for proper rpm, suction pressure, discharge pressure and motor current and voltage.

b. Electrical. The completed wiring system was tested for open circuits, short circuits, and grounds. Load balancing was performed on the electrical distribution system to provide a balanced load on each phase.

The system became operational in September 1978. The collector to heat exchanger loop was first filled with water for testing and balancing under operating conditions. In October 1978 the water was drained and replaced with a solution of 50 percent propylene glycol and 50 percent water.

The temperature, flow rate and manual calculations that have been done indicate that the system is collecting thermal energy as predicted. Since no thermal energy recording instruments were included in the project detailed performance information cannot be provided.

WILSON
& COMPANY
ENGINEERS
ARCHITECTS

913 827-0483

ENGINEERS
ARCHITECTS
PLANNERS

An Equal Opportunity
Employer

Office Location... 831 EAST CRAWFORD AVE. ■ SALINA, KANSAS 67401

Mailing Address... P.O. BOX 1848 ■ SALINA, KANSAS 67401

16 May 1979

Mr. Kenneth D. Sowell
Contracting Officer
National Aeronautics & Space Admin.
George C. Marshall Space Flight Center
Marshall Space Flight Center
Huntsville, AL 35812

Re: DOE Contract EG-77-A-01-4077
Interim Performance Criteria

Sir:

Consider this letter as our letter of certification that the solar heating system under discussion meets the Interim Performance Criteria, where said criteria are applicable.

WILSON & COMPANY

George W. Chitwood

George W. Chitwood

-cu

V. OPERATION AND CONTROL LOGIC

The solar system operation may be divided into two semi-independent control sequences, thermal storage tank heating and domestic water heating. A schematic of the control system is shown in Appendix A drawing M-20, Solar Heating System Schedules and Schematics.

a. Thermal Storage Tank Heating. Heating of the tank is accomplished by differential temperature control of the system pumps. When the collector plate temperature rises 20° F above the water storage temperature a temperature differential switch, TDS-1, will start the collector loop pumps, P-5, 6 and the storage loop pumps, P-3, 4. The pumps will continue to run until the temperature differential, as sensed by TDS-1, decreases to 5° F.

If the differential has been reduced to 5° F but the collector temperature exceeds 190° F a temperature switch, TS-2, will override TDS-1 to keep the collector loop pumps running to provide circulation through the heat rejector. At 210° F an internal sensor starts the heat rejector fan.

b. Domestic Water Heating. Again heating of the tank is accomplished by differential temperature control of the system pumps. When the thermal storage tank temperature rises to 20° F above the domestic water tank temperature a temperature differential switch, TDS-3, will start the domestic water pre-heat pumps, P-7, 8, 9, 10. The pumps will continue to run until the differential decreases to 5° F.

When the domestic water tank temperature reaches 140° F, regardless of the current differential temperature, a temperature switch, TS-4, will override TDS-3 to stop the pumps.

VI. PROBLEMS ENCOUNTERED AND SOLUTIONS

Cost escalation from the time the proposal was prepared to the time that the contracts were actually awarded was responsible for several changes aimed at keeping the project on budget without the sacrifice of any essential items. By deleting the permanent installation of standby pumps (these are stored in shipping crates in the equipment room), shifting from the use of base-mounted to in-line pumps and careful analysis and redesign of the collector structural support system, considerable cost savings were effected.

One of the structural problems encountered was alignment of collectors on the mounting frame. This was solved through the use of slotted holes in the structural framing members allowing some "play" between collector and mounting frame.

The factory supplied pressure cap for the heat rejector was found to have too low a pressure rating. It was replaced with a higher rated cap.

One of the major problems encountered was that of the hose connections between adjacent collectors. The design of these hose connections proved to be extremely tight, allowing very little room to work. The collectors had to be modified in the field by cutting so that installation could

actually be made. These hose connections, although satisfactory now, presented difficulty in securing a leak-free installation, and required considerable effort on the part of the mechanical contractor.

Problems were encountered with some of the solid-state control components and the use of unshielded control cables. Both of these items have been replaced and are now operating satisfactorily.

Glass breakage of some of the collector cover plates occurred on the job. All were immediately replaced. Real-life testing of the tempered glass in a Kansas hail storm has not occurred yet, but the owner has secured insurance coverage for glass coverplate liability.

VII. SUCCESSFUL COMPONENTS OR PROCESSES

The entire project is an overall success and works as it was intended, despite minor start-up problems. Some of the more successful design features which should be mentioned include the use of preinsulated jacketed steel pipe for the underground portion of the piping, tempered glass for the collector covers and metallic jacketing for exterior aboveground insulation. In erecting the structural steel support system, the general contractor used a laser type alignment device which proved helpful by making actual collector installation easier. As previously mentioned, the use of slotted adjustable bolt attachments for the interface between the structural steel frame and the collectors proved very helpful in collector installation.

One of the best design features in the entire project was the use of internal headering between individual collectors. This minimized the connections between the collectors and the supply and return distribution mains and was extremely helpful in controlling the cost of the project. Calibrated balancing valves were used to adjust the flow at each bank of collectors and a reverse return type piping distribution system simplified the job of balancing flows to the collectors.

Incorporation of the future installation of solar supplemental heat into the original system design made the work of interconnecting after the system was well under construction relatively easy. Only minor modifications to piping were required.

VIII. LESSONS LEARNED AND RECOMMENDATIONS

On subsequent projects dealing with supplemental solar heating, the following changes would be desirable:

1. Spare glass coverplates should be ordered for the Owner to have in case of accidental breakage.
2. Brazed or soldered internal heater connections between solar collectors would be more desirable and less time consuming for field installation.

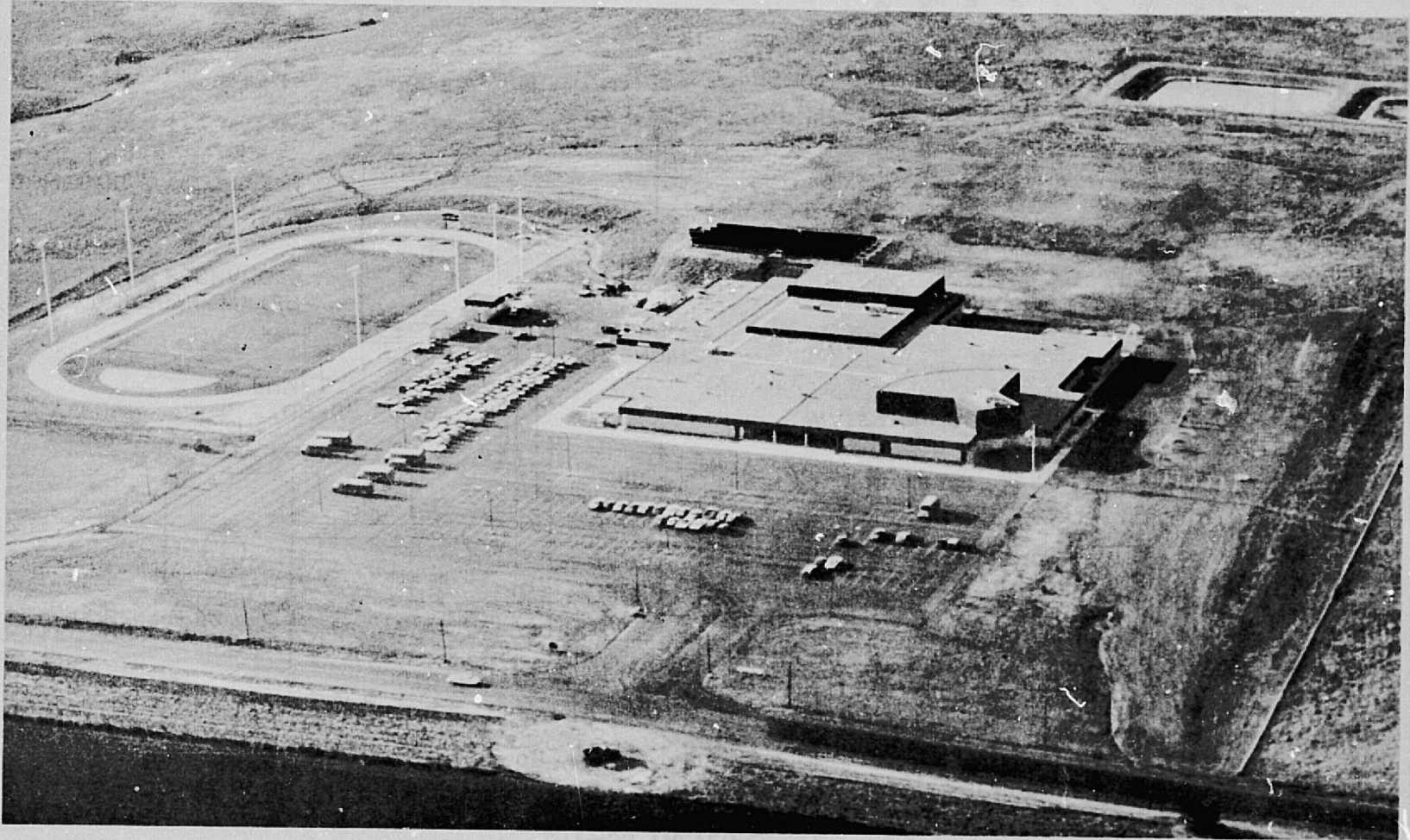
3. From the standpoint of avoiding potential roof leakage problems, ground mounted collectors are preferable to roof mounting provided space is available.

4. The structural steel collector mounting system could probably be improved and installed in a less expensive fashion by incorporating something similar to a Uni-strut system.

5. The heat rejector radiator pressure rating should be high enough to avoid problems with pressure blow-off.

6. A permanent removable cover should be provided for covering of collectors and heat rejector when system is not used during summer months.

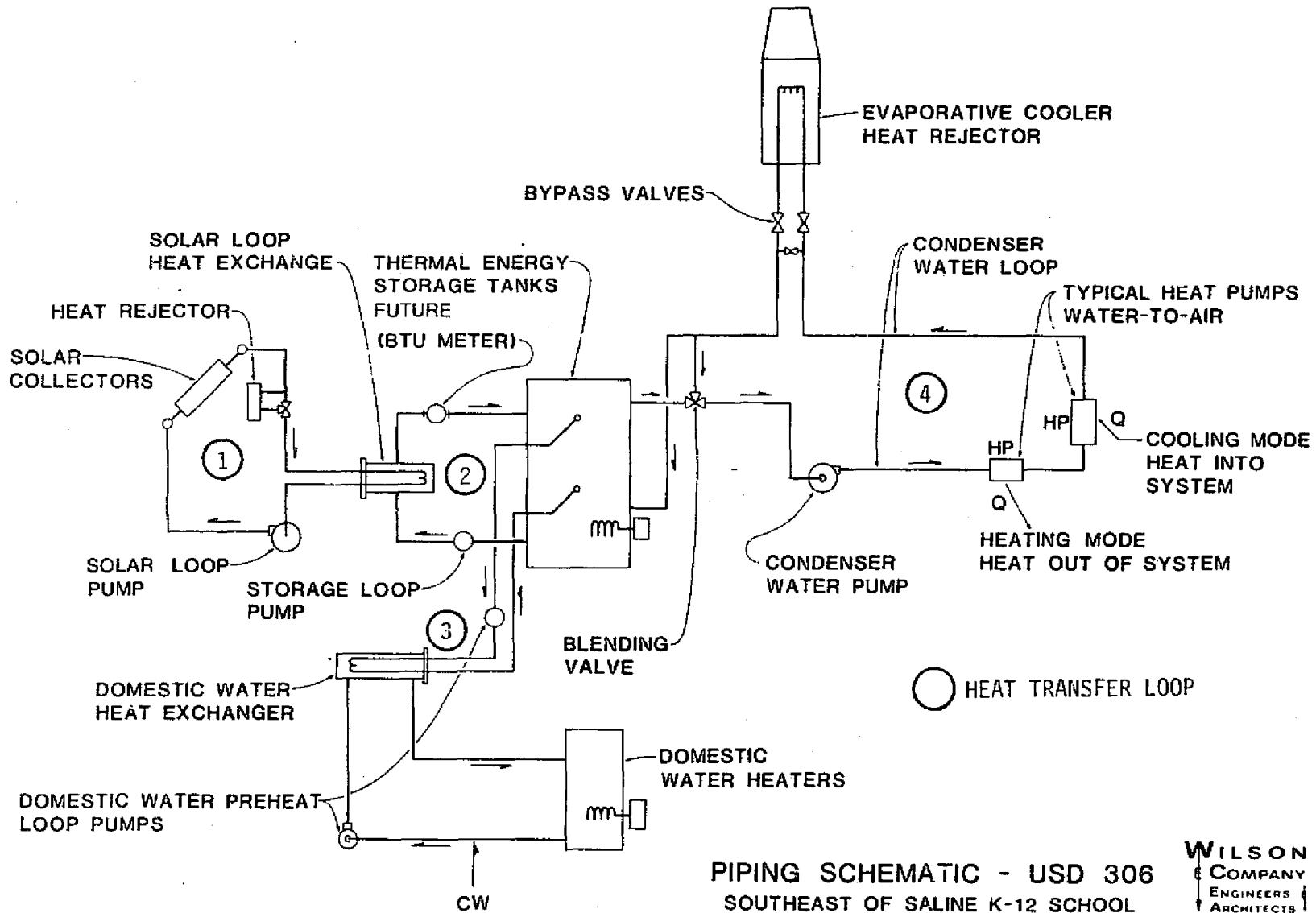
7. On any future project it would be advisable to include some simple basic instrumentation for project monitoring to determine the extent of the solar contribution and its effectiveness.



9

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KANSAS UNIFIED SCHOOL DISTRICT 306
MENTOR, KANSAS
SCHOOL HEATING SOLAR DEMONSTRATION PROJECT
PON DSE-76-2

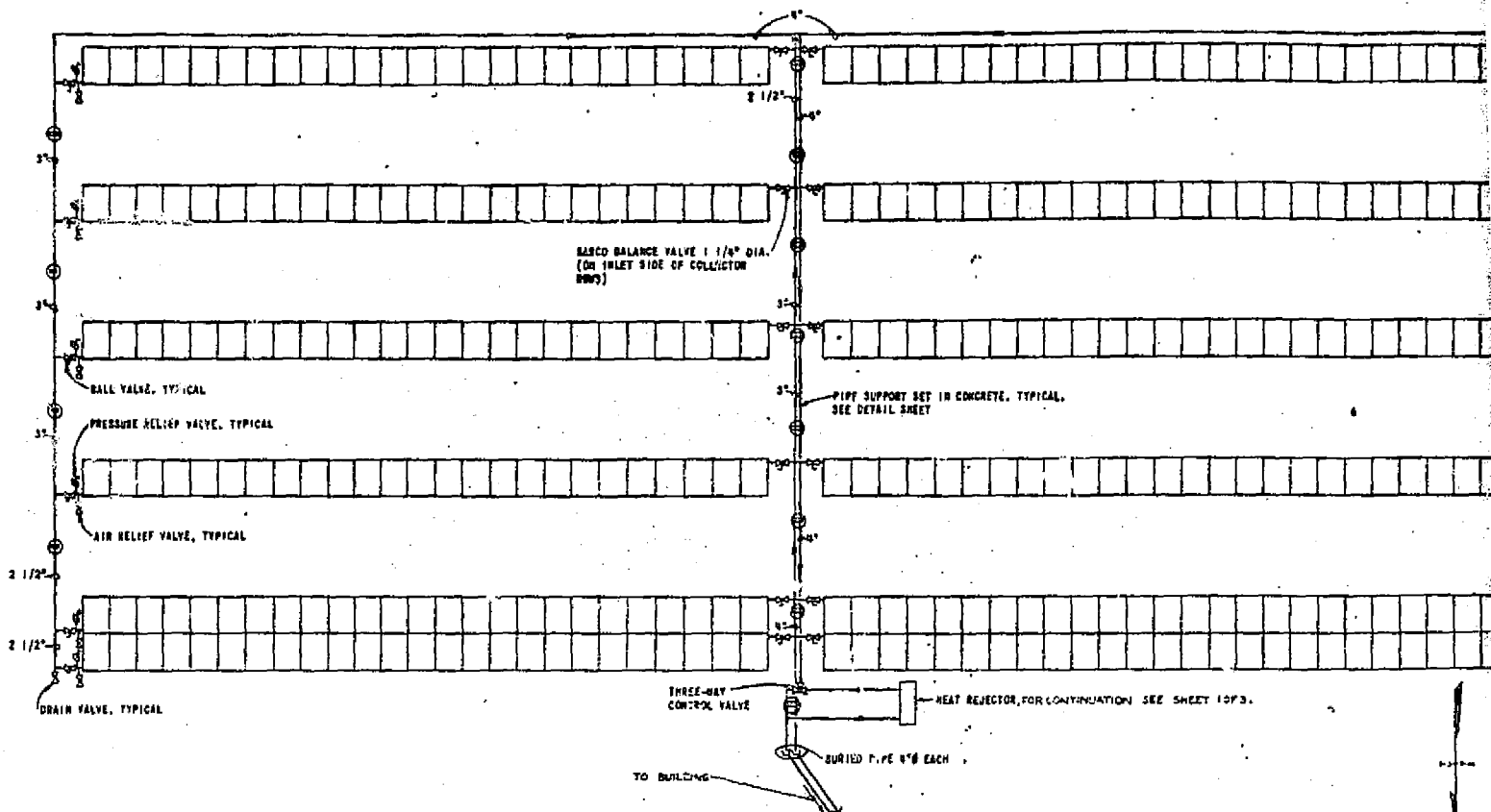


PIPING SCHEMATIC - USD 306
SOUTHEAST OF SALINE K-12 SCHOOL

WILSON
COMPANY
ENGINEERS
ARCHITECTS

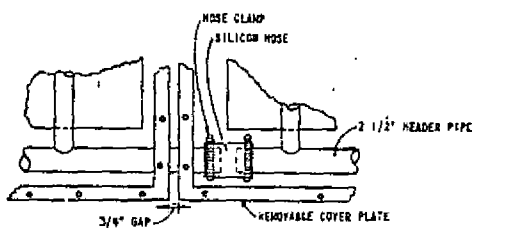
APPENDIX A
AS-BUILT DRAWINGS

A-1	DRAWING M-19	SOLAR COLLECTION INSTALLATION
A-2	DRAWING M-20	SOLAR HEATING SYSTEM-SCHEDULES AND SCHEMATICS
A-3	DRAWING M-15	SOLAR COLLECTION SYSTEM LAYOUT
A-4	DRAWING M-5	DOMESTIC HOT WATER SYSTEM LAYOUT
A-5	DRAWING 1 OF 3	SITE PLAN
A-6	DRAWING S-17	COLLECTOR MOUNT DETAILS
A-7	DRAWING E-1	SITE ELECTRICAL LAYOUT
A-8	DRAWING E-4	BUILDING ELECTRICAL SCHEMATIC
A-9	DRAWING E-19	ELECTRICAL FLOOR PLAN

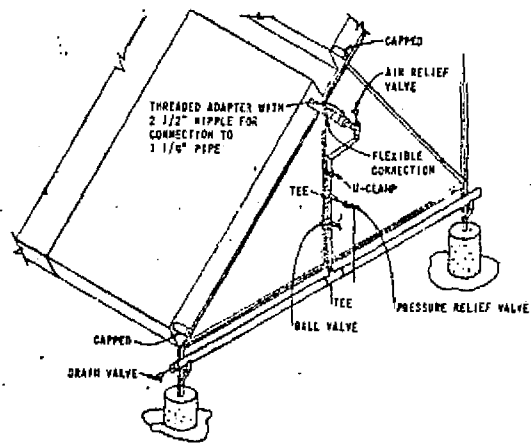


**PLAN VIEW OF COLLECTOR ARRAY FIELD SHOWING
TRANSFER PIPING**
(NO SCALE)

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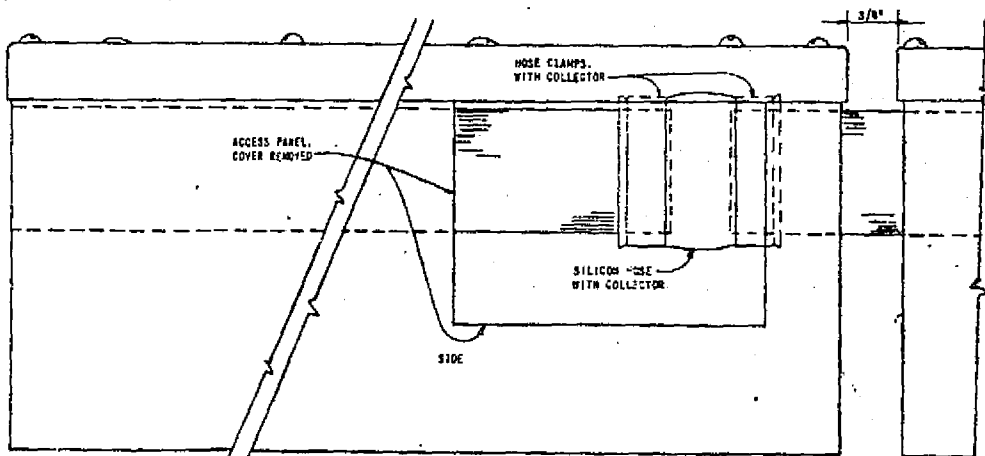


TOP VIEW OF INTERNAL HEADER CONNECTIONS
(NO SCALE)



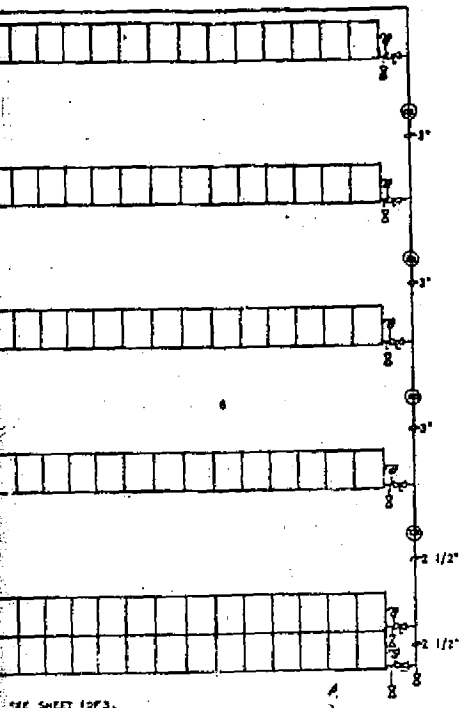
**ISOMETRIC VIEW OF COLLECTOR END
OF ROW RETURN LINE SHOWING
FITTINGS**
(NO SCALE)

FOLDOUT FRAME



**SIDE VIEW OF INTERNAL
HEADER CONNECTIONS**
(NO SCALE)

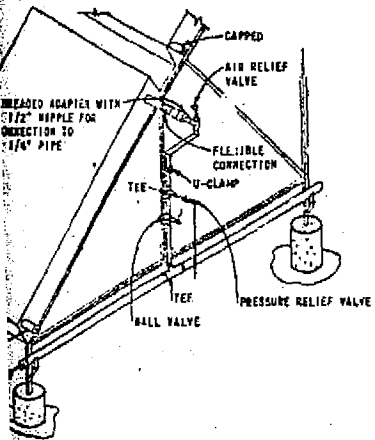
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AND RE**



NOTES:

- ① SEE DETAIL SHEET FOR INFORMATION ON FLEXIBLE CONNECTORS.
- ② PIPE SUPPORTS TO BE PROVIDED EVERY 10' FOR TRANSFER PIPES BETWEEN COLLECTOR ROWS.
- ③ FOR TRANSFER PIPES OUTSIDE OF THE COLLECTOR ROWS PLACE PIPE SUPPORTS BETWEEN EACH ROW.

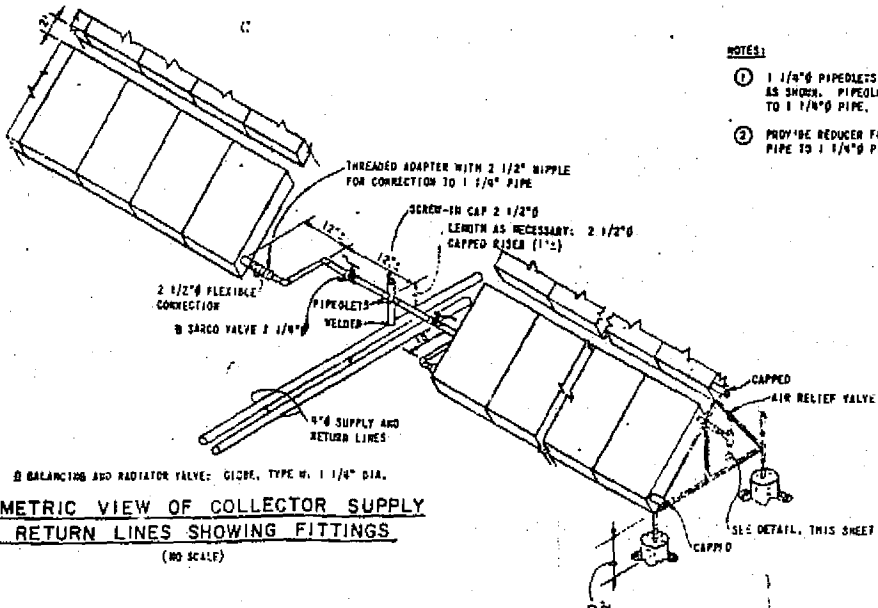
SEE SHEET 1073.



NOTES:

- ① SUPPORT SUPPLY AND RETURN LINES WITH CONCRETE SUPPORTS SPACED EVERY 10'. SEE SITE PLAN.
- ② RELIEF VALVE TO BE LOCATED BETWEEN THE SHUT-OFF VALVES OF EACH COLLECTOR ROW.
- ③ DRAIN VALVE FOR EACH COLLECTOR ROW TO BE LOCATED AT THE UNUSUAL LOWER HEADER PIPE CONNECTION.

**ISOMETRIC VIEW OF COLLECTOR END
AND RETURN LINE SHOWING
FITTINGS**
(NO SCALE)



NOTES:

- ① 1 1/4 inch PIPEOLETS TO BE WELDED INTO THE RISER AS SHOWN. PIPEOLETS TO PROVIDE SCREWED CONNECTION TO 1 1/4 inch PIPE.
- ② PROVIDE REDUCER FOR CONNECTION OF 2 1/2 inch HEADER PIPE TO 1 1/4 inch PIPE.

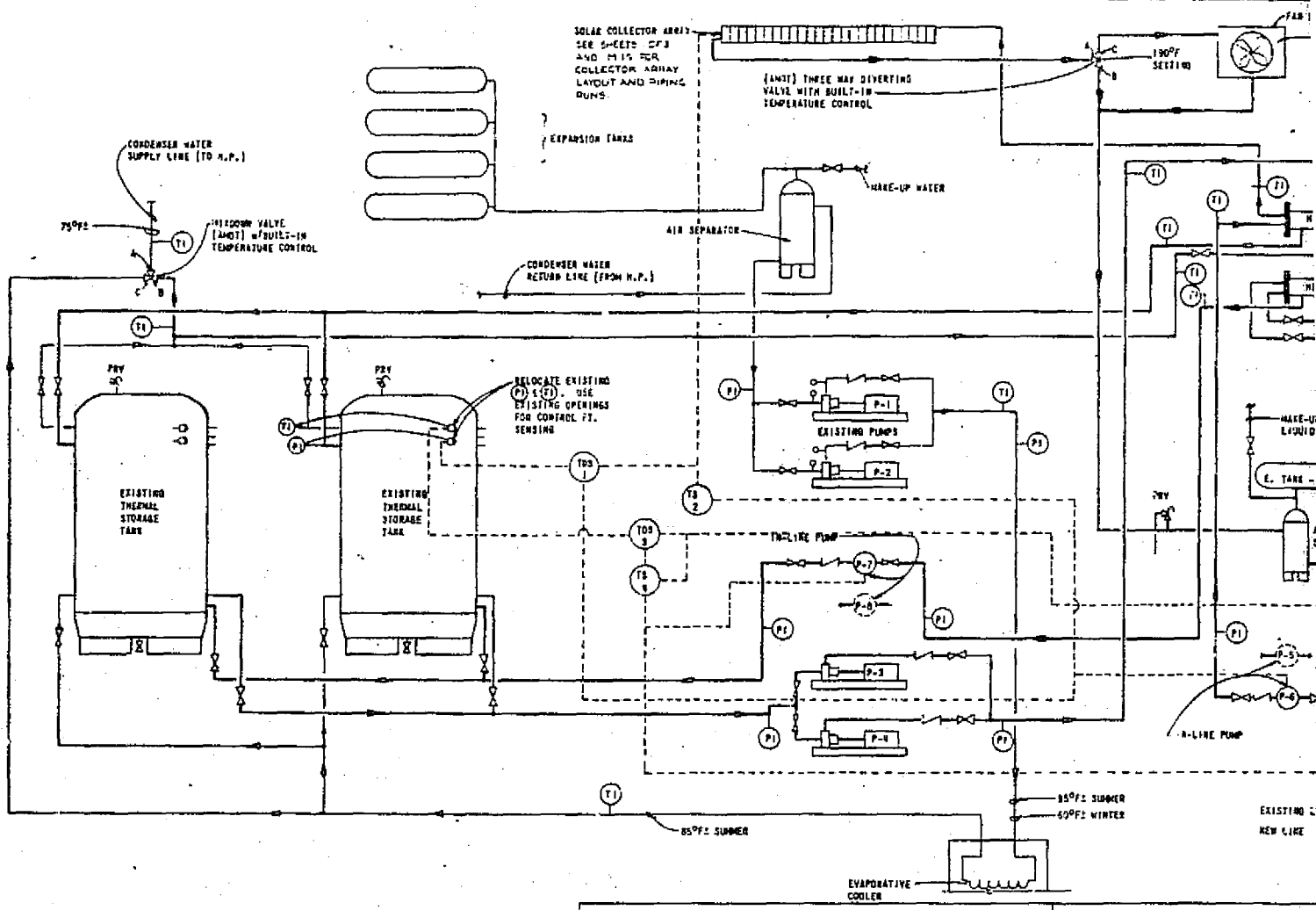
**ISOMETRIC VIEW OF COLLECTOR SUPPLY
AND RETURN LINES SHOWING FITTINGS**
(NO SCALE)

1" TO 1/2" = 1' **FOLDOUT FRAME**

WILSON & COMPANY
SALINA KANSAS

SOUTHWEST OF SALINA
N-12 SCHOOL BUILDING
UNIFIED SCHOOL DISTRICT 305
SALINE COUNTY, KANSAS

DESIGN	GRG
DRAWN	JMG
DATE	JAN. 1970
FILE NO.	73-55
SHEET NO.	M 19



HEAT EXCHANGER SCHEDULE		
HEAT EXCHANGER	HE-1	HE-2
SERVICE	SOLAR LOOP	DOMESTIC WATER
SHELL SIDE		
GPM	150	10
FLUID	WATER	WATER
TEMP. ENT. - °F	150	150
TEMP. LIG. - °F	160	120
ΔP - FT.	8	1
TUBE SIDE		
GPM	150	22
FLUID	PROPYLENE GLYCOL/WATER	WATER
TEMP. ENT. - °F	175	80
TEMP. LIG. - °F	182	70
ΔP - FT.	11	2

PUMP SCHEDULE				
NAME	P-3, 4	P-5, 6	P-7, 8	P-9, 10
FLOW, TB GPM, EACH	150	150	10	10
HEAD, FT.	23	34	16	9
MOTOR				
EST. HP	1 1/2	2	1/4	1/2
RPM	1150	1750	1750	1750
POWER	460/60/3	460/60/3	120/60/1	120/60/1
EFFICIENCY %	72	75	-	-
MOUNTING	BASE-MOUNT	IN-LINE	IN-LINE	IN-LINE

SOLAR SYSTEM CONTROL SEQUENCE:

THERMAL STORAGE TANK HEATING:

WHEN THE COLLECTOR PLATE TEMPERATURE RISES TO 20° ABOVE THE WATER STORAGE TEMPERATURE TDS-1 WILL START P-3, 4 AND P-5, 6. THE PUMPS WILL CONTINUE TO RUN UNTIL THE TEMPERATURE DIFFERENTIAL DECREASES TO 5°.

IF THE DIFFERENTIAL HAS BEEN REDUCED TO 5° BUT THE COLLECTOR TEMPERATURE EXCEEDS 190°, TS-2 WILL OVERRIDE TDS-1 TO KEEP P-5, 6 RUNNING TO PROVIDE CIRCULATION THROUGH THE HEAT REJECTOR.

DOMESTIC WATER HEATING:

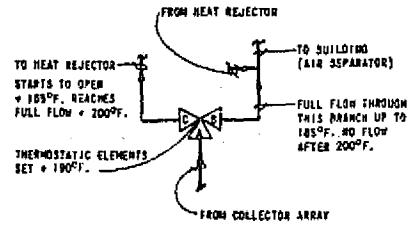
WHEN THE WATER STORAGE TEMPERATURE RISES TO 20° ABOVE THE DOMESTIC WATER TEMPERATURE TDS-3 WILL START PUMP P-7, 8 AND P-9, 10. THE PUMPS WILL CONTINUE TO RUN UNTIL THE TEMPERATURE DIFFERENTIAL DECREASES TO 5°.

WHEN THE D.W.W. TANK TEMPERATURE EXCEEDS 140°F TS-4 WILL OVERRIDE TDS-3 CAUSING PUMPS P-7, 8, AND P-9, 10 TO SHUT DOWN.

EQUIPMENT OPERATOR MODES						
OPERATING MODE - SEE DESCRIPTION	MODE OF EQUIPMENT					
	P-1 OR P-2 (GPM)	P-3 OR P-4 (GPM)	P-5 OR P-6 (GPM)	P-7 OR P-8 (GPM)	P-9 OR P-10 (GPM)	HEAT REJECTOR FAN (GPM)
A	ON	OFF	OFF	-	-	OFF
B	ON	OFF	OFF	-	-	OFF
C	ON	ON	ON	-	-	OFF
D	ON	ON	ON	-	-	OFF
E	ON	ON	ON	-	-	ON
F	OFF	OFF	OFF	OFF	OFF	OFF
G	ON	-	-	ON	ON	-
H	ON	-	-	OFF	OFF	-
I	ON	-	-	OFF	OFF	- [SEE NOTE 1]

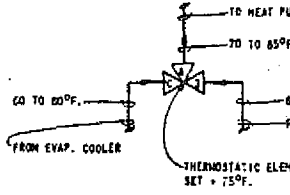
NOTE: THE DASHED LINE INDICATES THAT THE CONDITION DOES NOT CONTROL THAT PIECE OF EQUIPMENT.

- OPERATOR MODE DESCRIPTIONS**
- (A) COLLECTOR ARRAY TEMPERATURE AT OR BELOW STORAGE TANK TEMPERATURE.
 - (B) COLLECTOR ARRAY TEMPERATURE LESS THAN 20° ABOVE STORAGE TANK TEMPERATURE.
 - (C) COLLECTOR ARRAY TEMPERATURE 20° ABOVE STORAGE TANK TEMPERATURE.
 - (D) COLLECTOR ARRAY TEMPERATURE MORE THAN 20° ABOVE STORAGE TANK TEMPERATURE.
 - (E) COLLECTOR ARRAY TEMPERATURE REACHES 200°F.
 - (F) COLLECTOR ARRAY COOLING AND THE FLUID STORED FOR HEATING SEARCH.
 - (G) D.W.W. TANK TEMPERATURE 20° BELOW STORAGE TANK TEMPERATURE.
 - (H) D.W.W. TANK TEMPERATURE 10° BELOW STORAGE TANK TEMPERATURE.
 - (I) D.W.W. TANK TEMPERATURE REACHED 140°F.



NOTE: HEAT REJECTOR FAN SHOULD START UP AT 205°F.

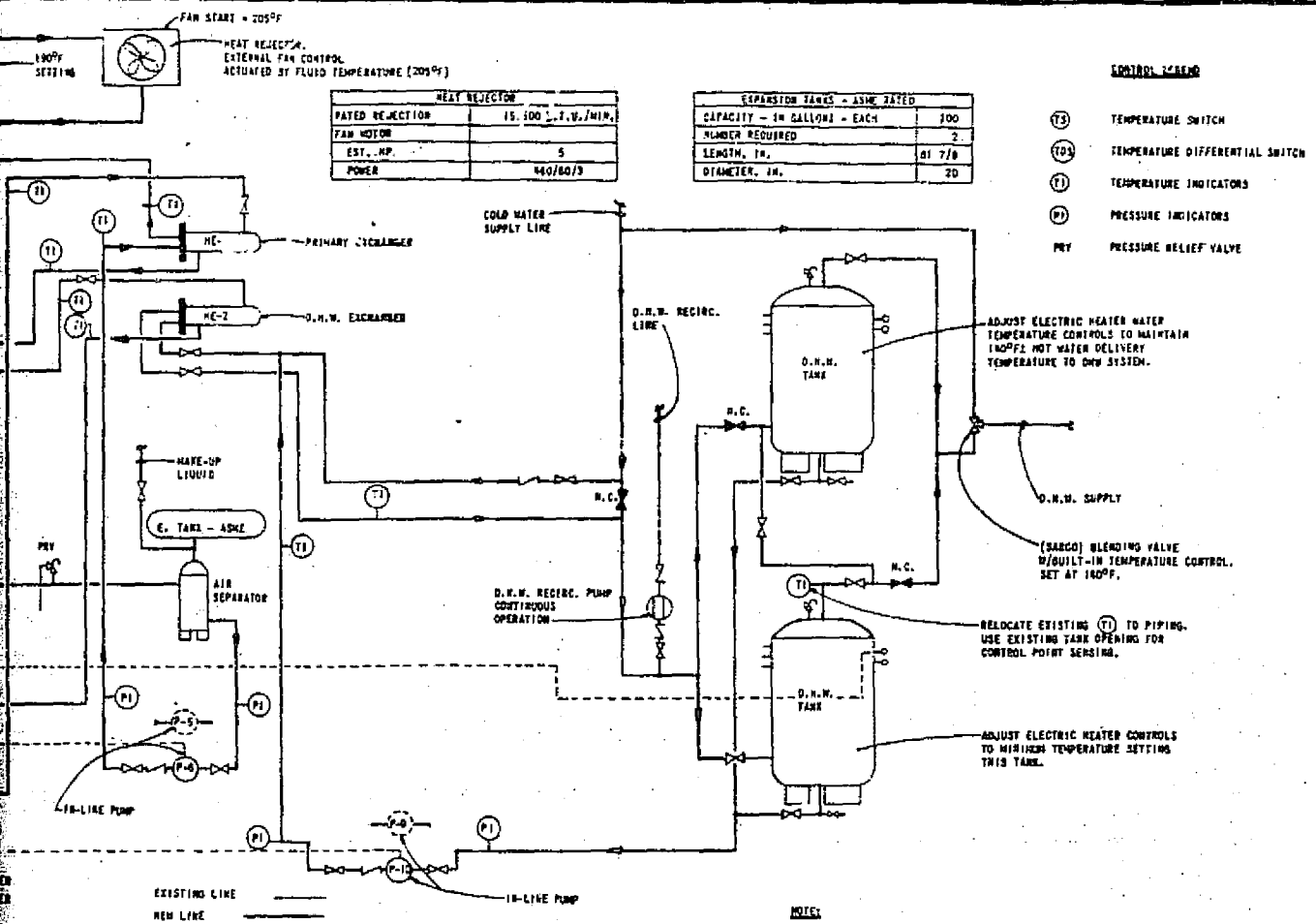
FLOW DIVERSION CONFIGURATION



MIXING CONFIGURATION

SCHEMATIC OF SELF-CONTAINED THREE-WAY VALVE

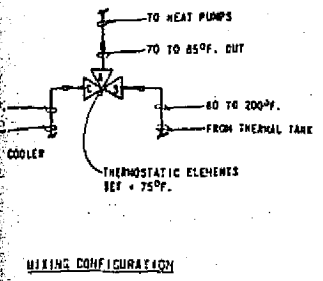
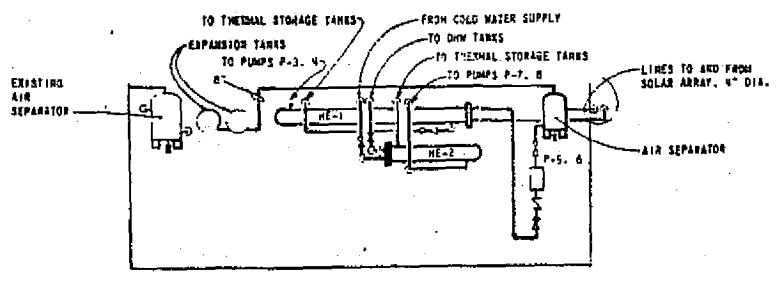
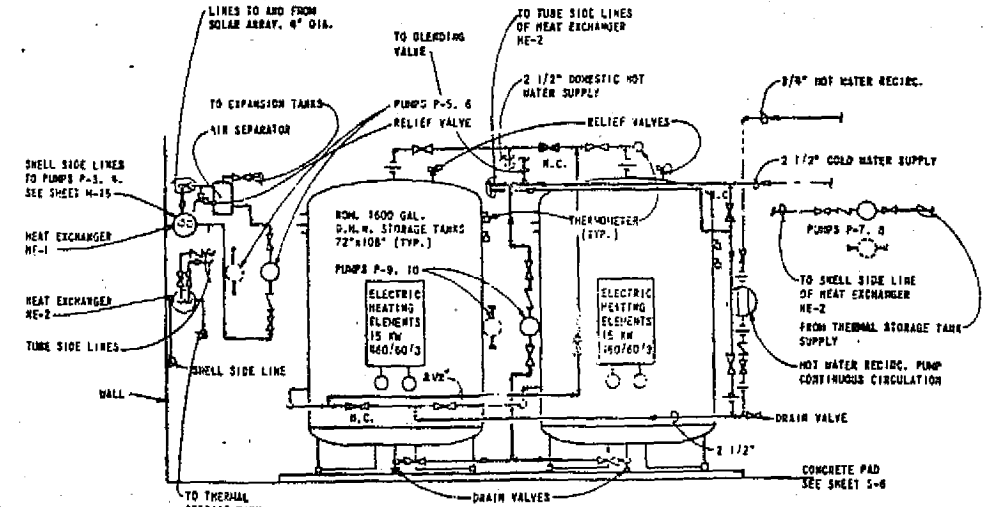
SHOWING USES
NO SCALE



NOTE:
 ALL PUMPS, EXCEPT THE DOMESTIC H.W. RECIRCULATING PUMP, ARE DESIGNED FOR SINGLE PUMP OPERATION, 220 V 100% BACK-UP.
 ALL INLINE BACK-UP PUMPS SHALL BE SHELF MOUNTED.

OPERATOR INSTRUCTIONS

1. WHEN TEMPERATURE AT OR BELOW STORAGE TANK REACHES 140°F.
2. CHECK ARRAY TEMPERATURE LESS THAN 10°F ABOVE 140°F.
3. CHECK ARRAY TEMPERATURE 20°F ABOVE STORAGE TANK REACHES 140°F.
4. CHECK ARRAY TEMPERATURE MORE THAN 10°F ABOVE 140°F.
5. CHECK ARRAY TEMPERATURE REACHES 200°F.
6. CHECK ARRAY COLLIER AND THE FLUID STORED FOR USE IN THE HOT WATER HEATER.
7. WHEN TEMPERATURE 10°F BELOW STORAGE TANK REACHES 140°F.
8. WHEN TEMPERATURE 10°F BELOW STORAGE TANK REACHES 140°F.
9. WHEN TEMPERATURE REACHES 140°F.



SCHEMATICS

REVISION	DATE	BY

WILSON & COMPANY
SALINA KANSAS

SOUTHEAST OF SALINE
 R-12 SCHOOL BUILDING
 UNIFIED SCHOOL DISTRICT 300
 SALINE COUNTY, KANSAS

DESIGN	GRC
DRAWN	JMG
DATE	OCT. 1977
FILE NO.	73-59
SHEET NO.	M20

ORIGINAL PAGE IS
 OF POOR QUALITY

2 FOLDOUT FRAME

AAP - AMERPULSE - MODEL 8-32-240
 DUST COLLECTOR. PROVIDE 4" POLY-
 PROPYLENE BAGS AND LUG EXTEN-
 SIONS TO PROVIDE 3" CLEAR
 BENEATH ZOPPER DOORS.

AAP TYPE II EXHAUSTED, 4000 CFM
 @ 19" W.G. PROVIDE W/ACCESS
 DOORS, HOISTING DEBRIS, FLANGED INLET &
 OUTLET. SUITABLE FOR OUTDOOR MOUNTING.
 MOTOR SHALL BE TFC. TO N.P.,
 650/40/3.

NOMINAL 5" x 8" CONCRETE PAD,
 SEE SHEET M-17 FOR DETAIL.

FILTERS-SEE DETAIL
 SHEET M-17

SEE FINISH RM. HOOD
 DETAIL SHEET M-17

HOOD SEE WELDING HOOD
 DETAIL ON SHEET M-17.

AIR FILTER
 SEE DETAIL
 SHEET M-17

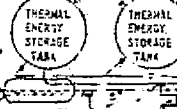
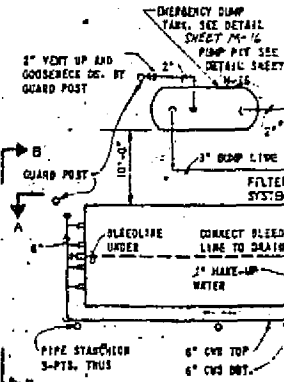
SEE FAN EXHAUST
 HOOD DETAIL SHEET M-17

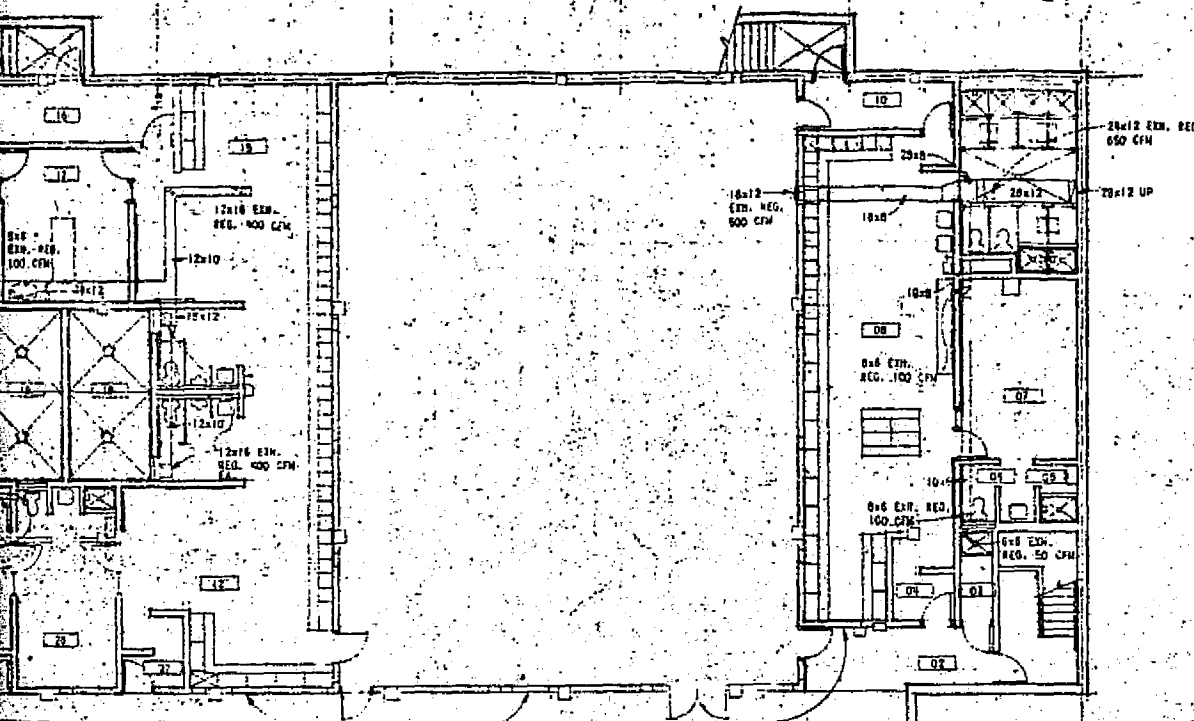
EXPANSION
 TANKS

CONNECTIONS TO
 1 EA. TANK

32" x 24" LOUVER W/MOTORIZED
 DAMPER. CONNECT TO EF-17
 TO OPEN WHEN FAN IS OPEN

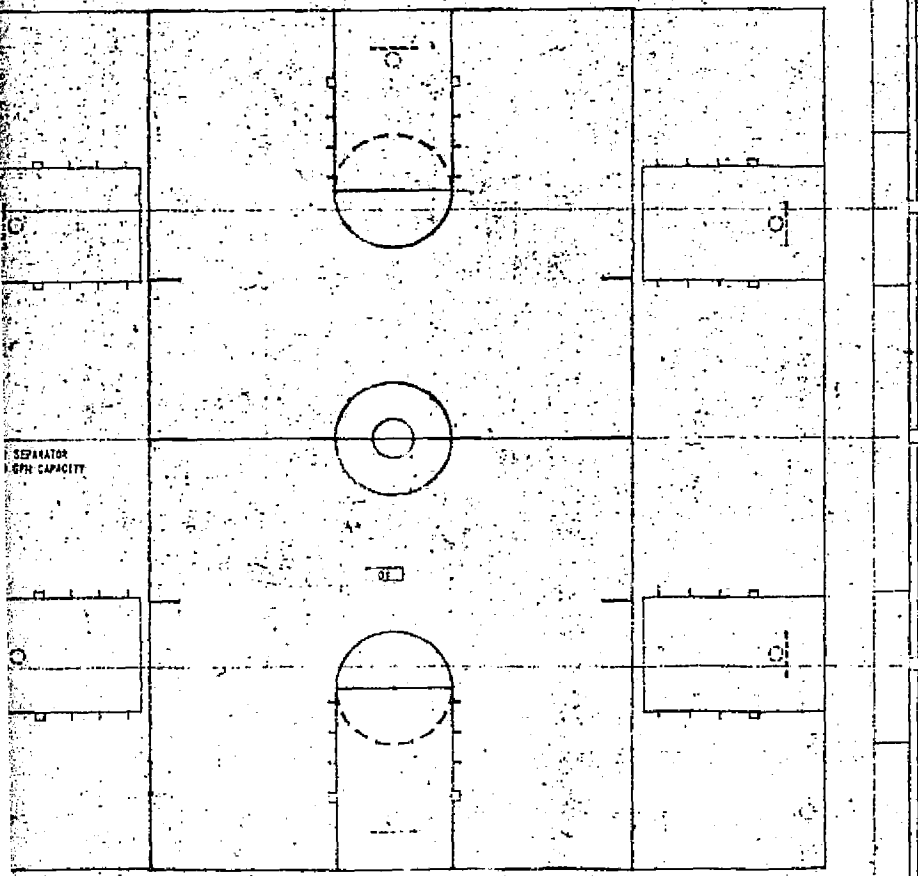
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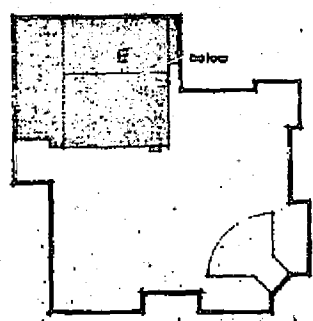


40x16 TRANSFER GRILLE
 MOUNT JUST BELOW S INTEL
 PACK/DE WIRE DAMPER AT
 UPERS.

- NOTES: M-15
1. SEE SHEET M-17 FOR HVAC LEGEND & TYPICAL DETAILS.
 2. SEE SHEET M-18 FOR SCHEDULES.
 3. SEE SHEET M-19 FOR CONFIGURATION OF PIPING.
 4. SEE SHEET M-17 FOR COOLING TOWER SUPPORT DETAILS, SECTIONS A-A & B-B.
 5. SEE SHEET M-18 FOR COOLING TOWER PIPING ELEVATION, PUMP PIPING DETAILS, PIPE STANCHION DETAIL, & GUARD POST DETAIL.
 6. SEE SHEET M-5 FOR MAKE-UP WATER PIPING & FOR COOLING TOWER DRAIN, OVERFLOW & DREGDOWN PIPING.



FOLDOUT FRAME 2



N - AREA 'E'

Lower Gym & Shops

PLAN REV.

A-3

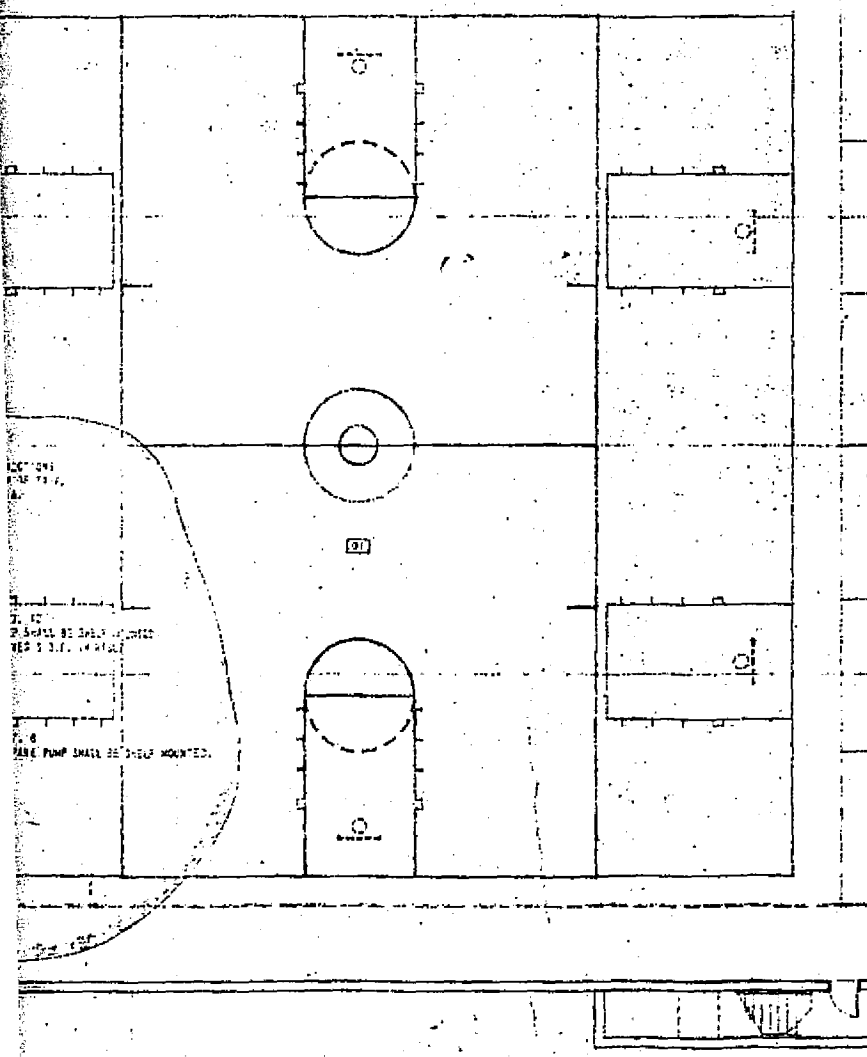
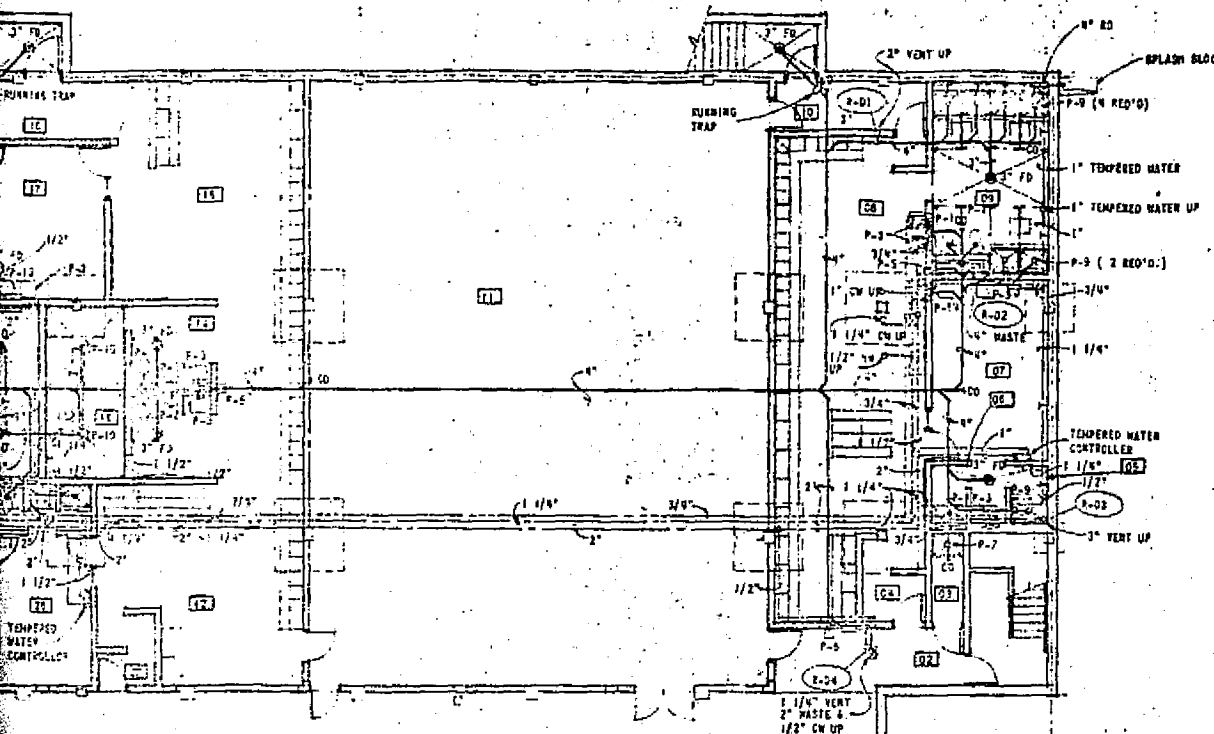
DATE	11-2-77	BY	GLD
REVISION			
DATE			
REVISION			

WILSON & COMPANY
 KANSAS
 SALINA

SOUTHEAST OF SALINA
 K-12 SCHOOL BUILDING
 UNIFIED SCHOOL DISTRICT 308
 SALINA COUNTY, KANSAS

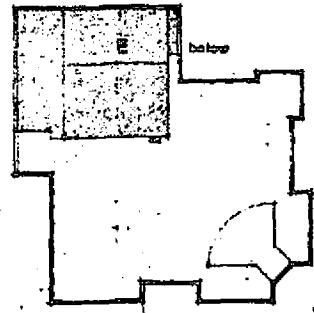


DESIGN	WRD
DRAWN	WAA
DATE	UAR. 1976
FILE NO.	73-59
SHEET NO.	M 15



- NOTES:
1. SEE SHEET H1 FOR PLUMBING LEGEND.
 2. SEE SHEET H7 FOR PLUMBING FIXTURE CONNECTION SCHEDULE.
 3. SEE SHEET H10 FOR PLUMBING RISER DIAGRAMS.
 4. SEE SHEET H11 FOR PIPING DIAGRAM OF ELEC. WATER HEATER, AND MAKE-UP WATER PIPING DIAGRAM.

FOLDOUT FRAME 2



AREA E

Lower Gym & Shops

A-4

DATE	BY
11-3-77	CLK
REVISION	
Drawn	Approved
by	by

WILSON & COMPANY
SALINA KANSAS

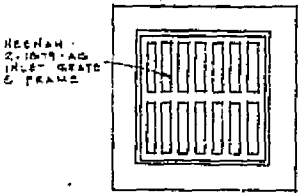
SOUTHEAST OF SALINE
H-12 SCHOOL BUILDING
UNIFIED SCHOOL DISTRICT 308
SALINE COUNTY, KANSAS



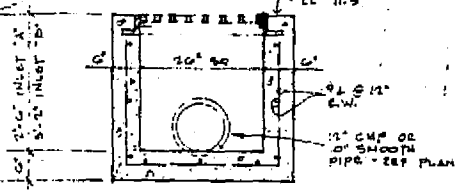
DESIGN	JCK
DRAWN	JCK
DATE	MAR, 1976
FILE NO.	73-50
SHEET NO.	M 5

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OF POOR QUALITY

COLLECTOR APPROX. SIZE
OF FIELD APPROX. 10' x 30'
SEE SHEET 5-17 FOR DETAILS.



PLAN

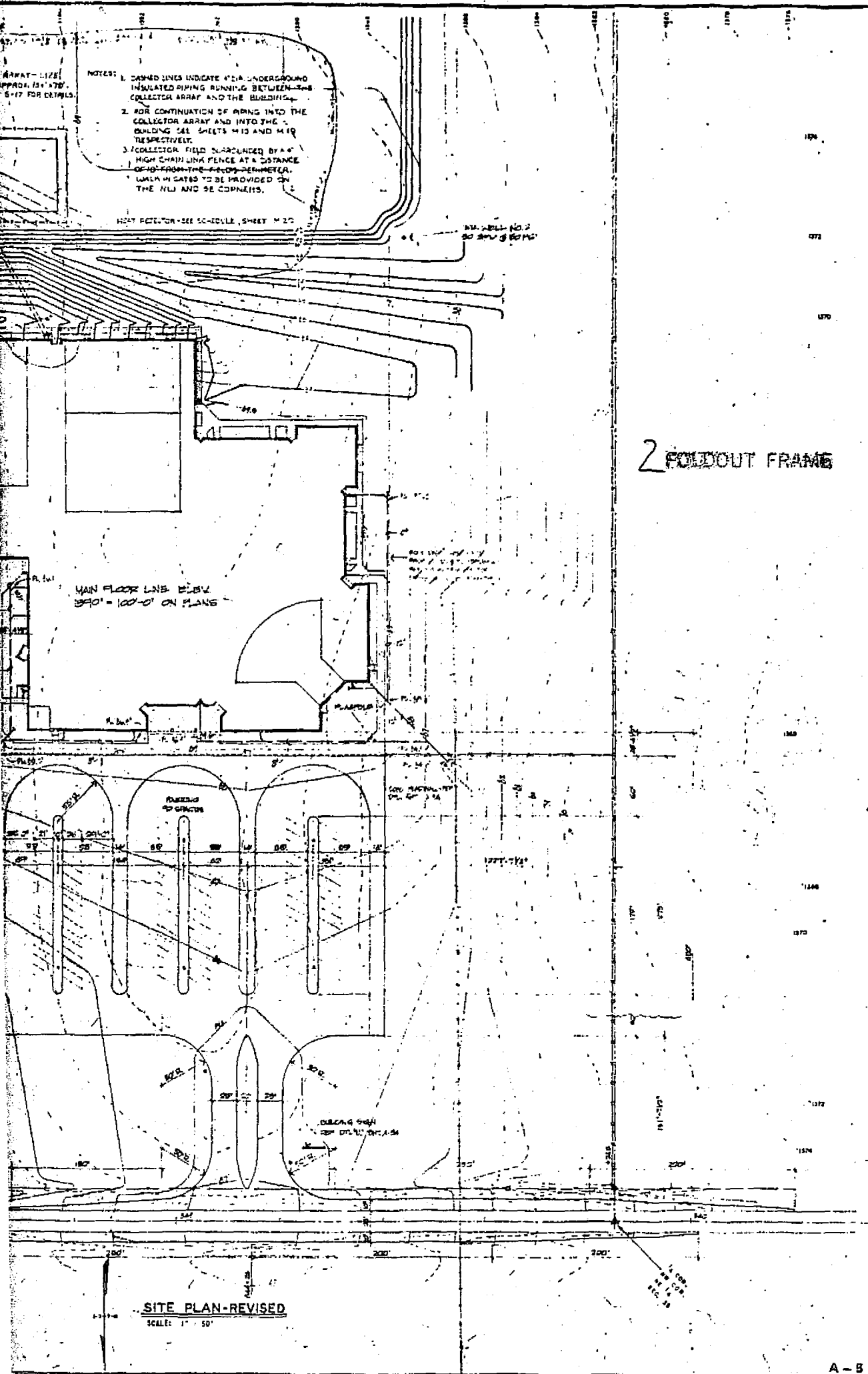


SECTION
INLET DETAIL
SCALE: 3/8\"/>

NOTE: ALL INTO PERIMETER OF MANHOLE
DITCHES SHALL BE COLLECTED
AS PART ITEM OF WORK.
ALL GRADING SHALL BE IN ACCORDANCE
WITH THE CON. SPEC. PAGE 205
& 206/207.

NOTE:
FOR APPROX. MANHOLE SIZE FOR BEST AT
FOR E.E. MANHOLE ROOMS, PLEASE LET
WORKER FOR BEST E.I.

FOLDOUT FRAME



- NOTES:
1. DASHED LINES INDICATE 4" DIA. UNDERGROUND INSULATED PIPING RUNNING BETWEEN THE COLLECTOR ARRAY AND THE BUILDING.
 2. FOR CONTINUATION OF PIPING INTO THE COLLECTOR ARRAY AND INTO THE BUILDING SEE SHEETS M13 AND M19 RESPECTIVELY.
 3. COLLECTION FIELD SURROUNDED BY A 4' HIGH CHAIN LINK FENCE AT A DISTANCE OF 10' FROM THE FENCE PERIMETER. WALKWAYS TO BE PROVIDED ON THE NW AND SE CORNERS.

HEAT PUMP - SEE SCHEDULE, SHEET M 20

2 FOLDOUT FRAME

MAIN FLOOR LINE PLUS 10'-0" ON PLANE

SITE PLAN - REVISED
SCALE: 1" = 50'

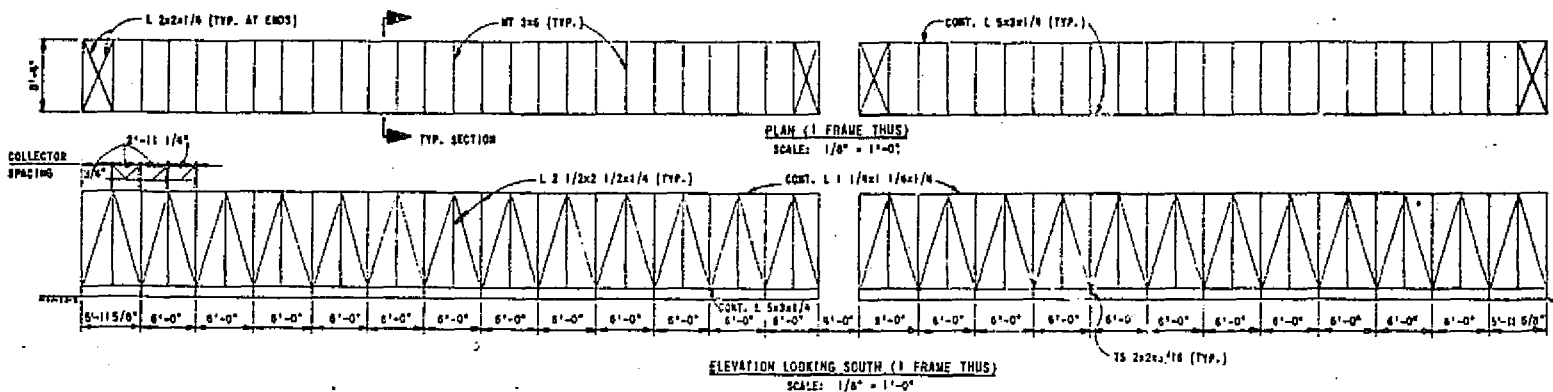
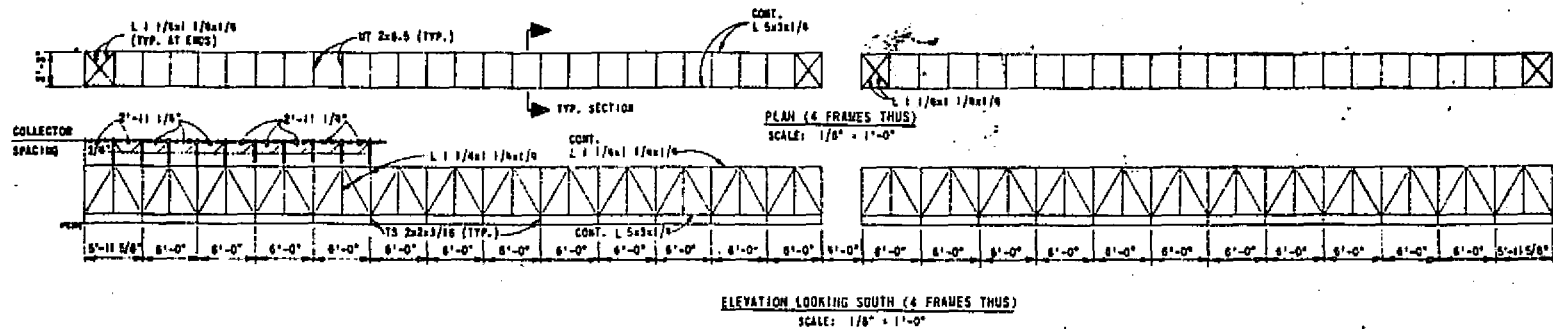
REVISION	DATE	BY
(1) SELECTION FOR SOLAR ARRAY	10-17-76	WJC
REVISIONS AND COMMENTS	10-17-76	WJC

WILSON & COMPANY
SALINA KANSAS

SOUTHWEST OF SALINE
K-12 SCHOOL BUILDING
UNIFIED SCHOOL DISTRICT 308
SALINE COUNTY, KANSAS

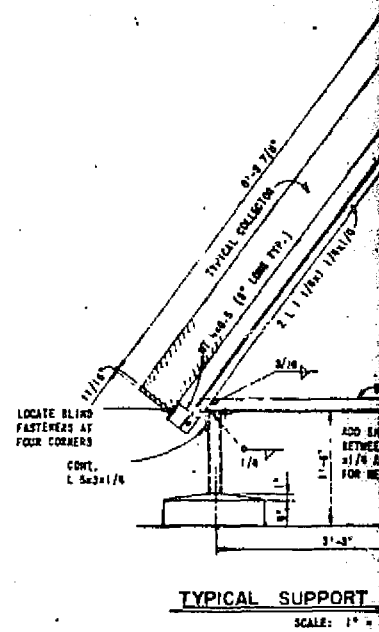
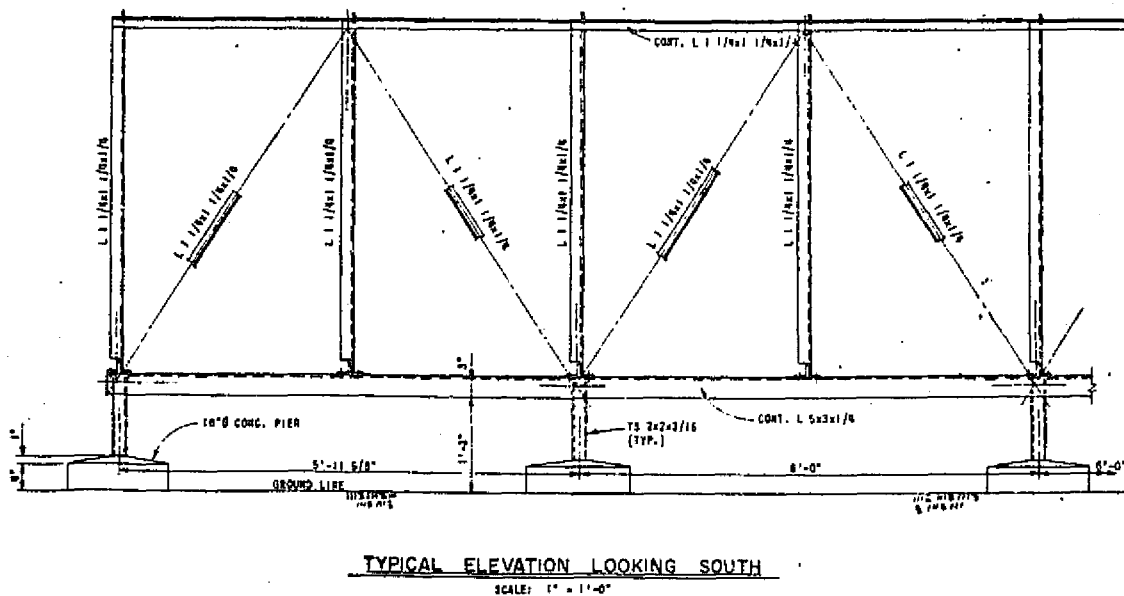
DESIGN	105
DRAWN	1.W.D. DEH
DATE	OCT. 1976
FILE NO.	73-59
SHEET NO.	1 OF 3

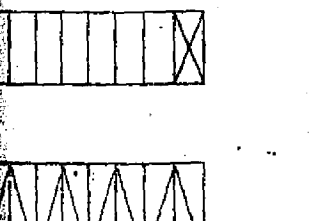
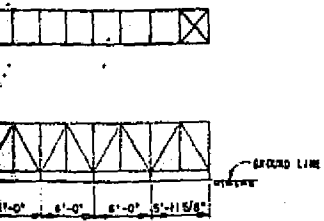
FOLDOUT FRAMES



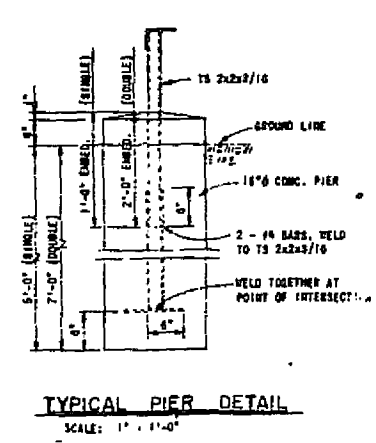
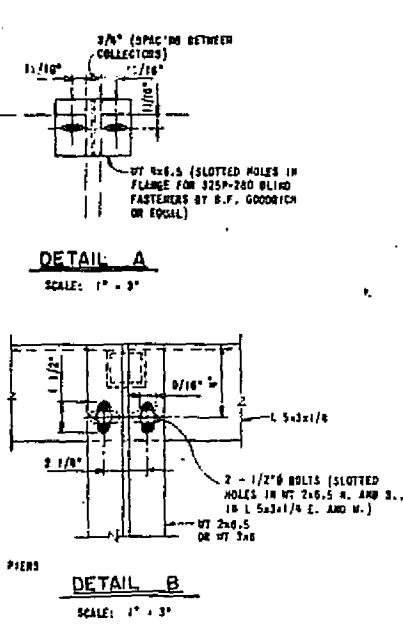
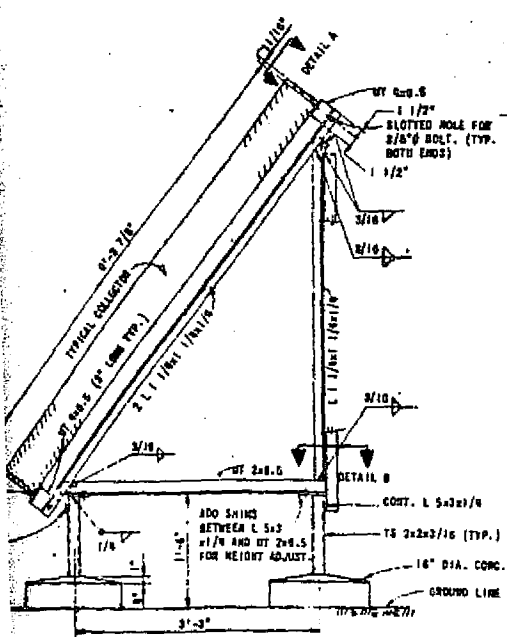
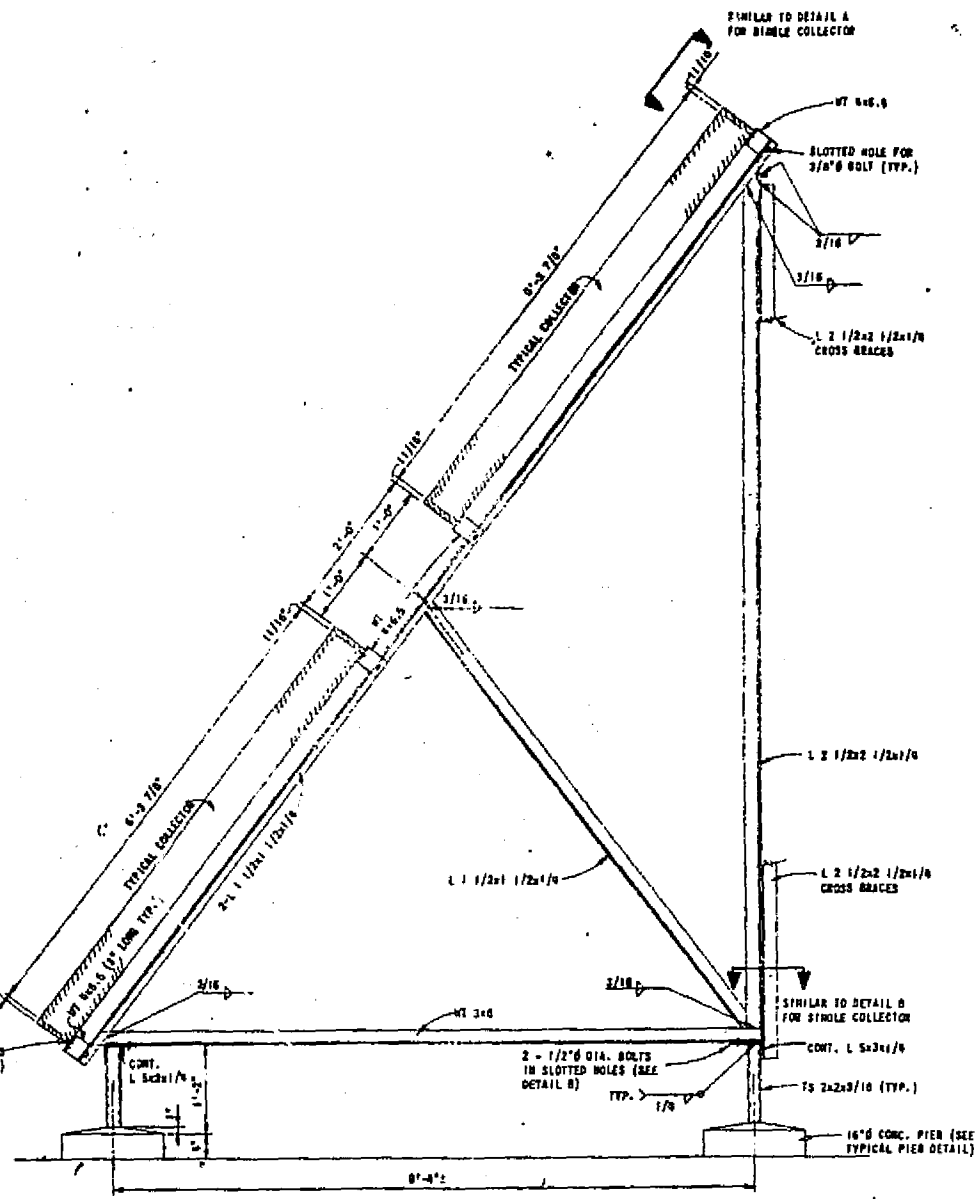
- NOTES:
1. USE ASTM A36 STEEL ON ALL STEEL SHAPES, PLATES AND TUBES.
 2. STANDARD BOLTS AND NUTS ARE ASTM A307.
 3. WELD ACCORDING TO STRUCTURAL WELDING CODE AWS D1.1-75.
 4. EXPOSED STRUCTURAL STEEL SURFACES SHALL RECEIVE A SHOP PAINT SYSTEM IN ACCORDANCE WITH SSPC-PA 1-01-641.

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OF POOR QUALITY





USE ALL STEEL SHAPES,
AND BOLTS ARE ASTM A307.
STRUCTURAL WELDING CODE
ALL STEEL SURFACES SHALL
BE PAINTED IN ACCORDANCE
WITH A.S.P.C. 12-1.



FOLDOUT FRAME

DATE	BY
REVISION	

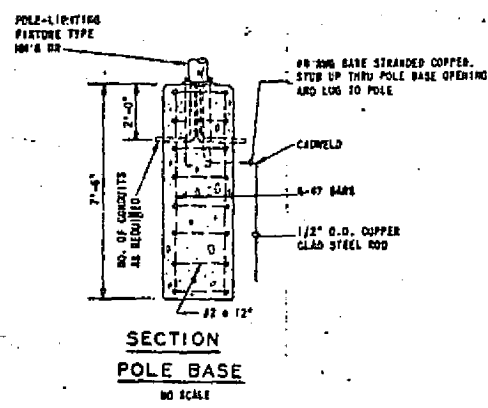
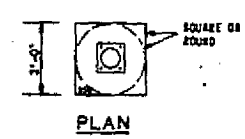
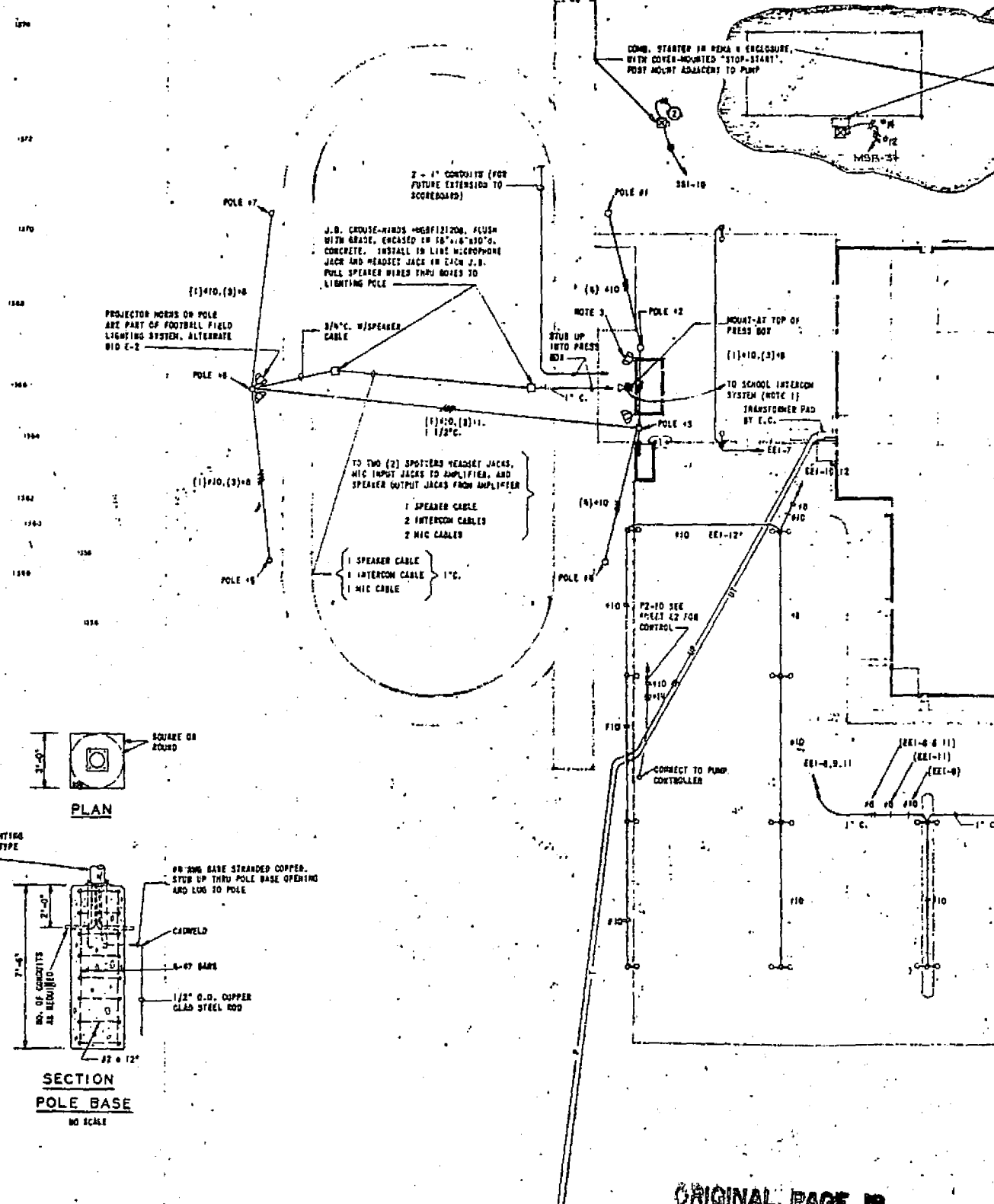
WILSON & COMPANY

KANSAS

SALINA

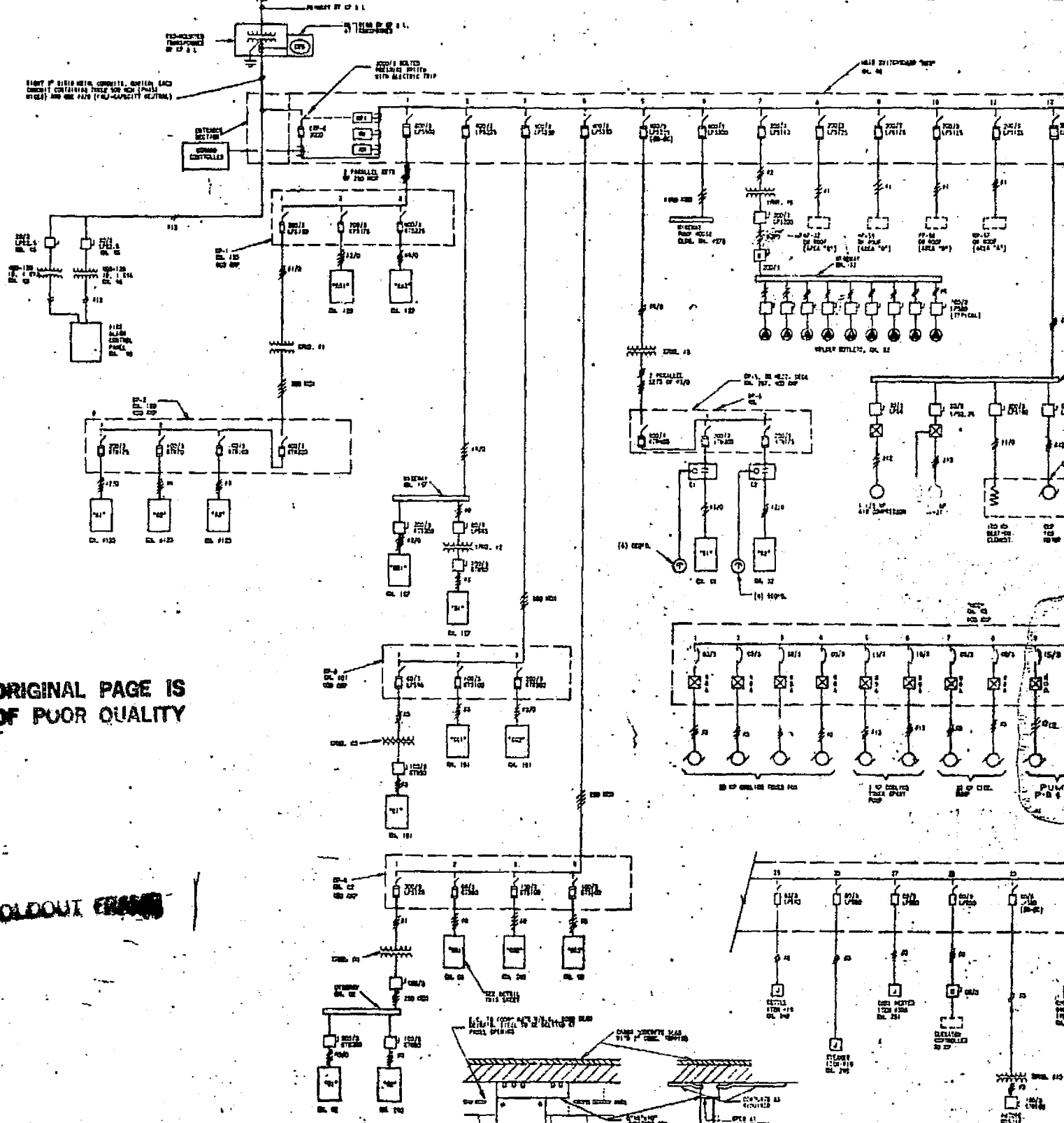
SOUTHWEST OF SALINE
R-12 SCHOOL BUILDING
UNIFIED SCHOOL DISTRICT 300
SALINE COUNTY, KANSAS

DESIGN	RBA
DRAWN	FBD
DATE	JAN. 1970
FILE NO.	73-50
SHOOT NO.	S17



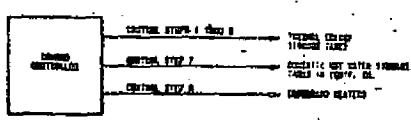
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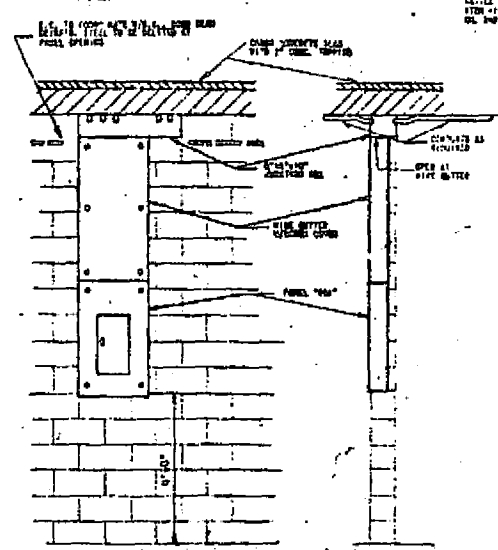


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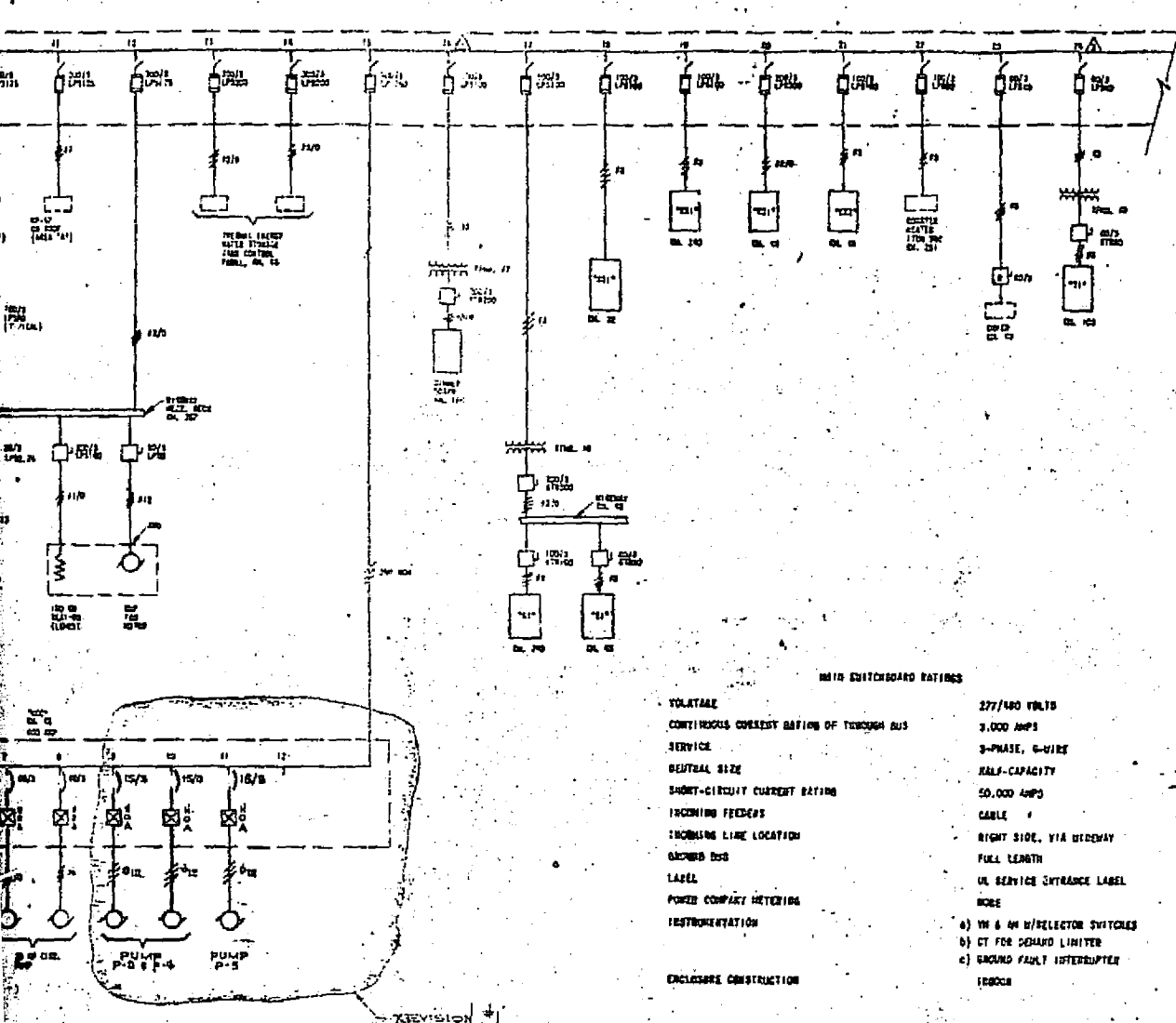
DEMAND CONTROL DIAGRAM



ELEVATION SECTION
DETAIL - PANEL "GGI"

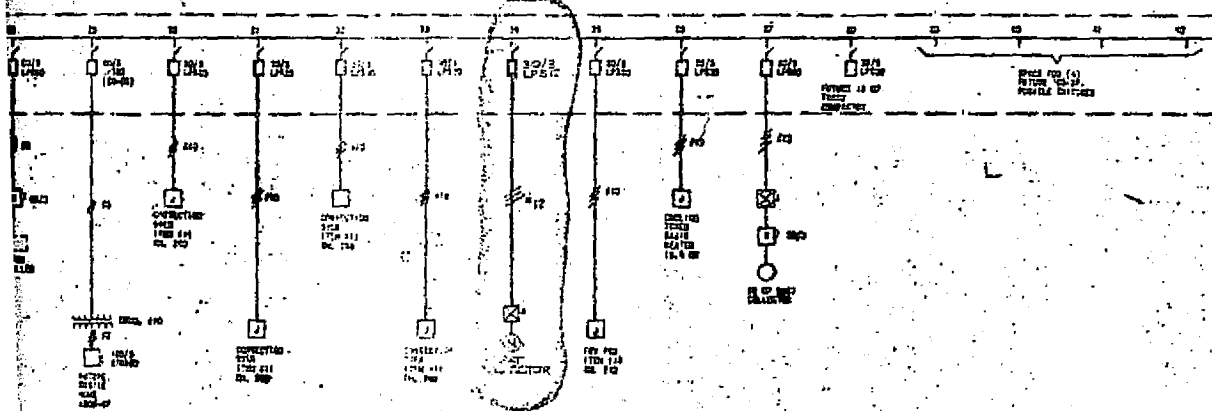
TRANSFORMER SCHEDULE		
TRF. NO.	KVA	VOLTS
1	120	117.5 E.V.A.
2	150	30 E.V.A. 25
3	180	30 E.V.A. 25
4	60	75 E.V.A. 25
5	240	75 E.V.A. 25
6	60	75 E.V.A. 25
7	180	75 E.V.A. 25
8	60	75 E.V.A. 25
9	180	30 E.V.A. 25
10	45	25 E.V.A. 15
11	270	25 E.V.A. 15

CONNECTED LOAD 8,235 KVA
 ESTIMATED MAXIMUM DEMAND, WITH DIVERSITY 2,900 KVA



MTR SWITCHBOARD RATINGS

VOLTAGE	277/480 VOLTS
CONTINUOUS CURRENT RATING OF THROUGH BUS	3,000 AMPS
SERVICE	3-PHASE, 4-WIRE
BUSBAR SIZE	3/4"-CAPACITY
SHORT-CIRCUIT CURRENT RATING	50,000 AMPS
INCOMING FEEDERS	CABLE
INCOMING LINE LOCATION	RIGHT SIDE, VIA UNDERWAY
GROUND BUS	FULL LENGTH
LABEL	UL SERVICE ENTRANCE LABEL
POWER COMPANY IDENTIFICATION	NONE
INSTRUMENTATION	A) 10 & 40 AMP/SELECTOR SWITCHES B) CT FOR DEMAND LIMITER C) GROUND FAULT INTERRUPTER
ENCLOSURE CONSTRUCTION	18000A



TRANSFORMER SCHEDULE

ROOM NO.	DESCRIPTION
120	112.6 KVA, 50, 480-120/208V.
159	30 KVA, 75, 480-120/208V.
101	30 KVA, 50, 480-120/208V.
42	75 KVA, 50, 480-120/208V.
207	75 KVA, 10, 480-120/208V.
86	75 KVA, 10, 480-120/208V.
100	75 KVA, 50, 480-120/208V.
80	75 KVA, 50, 480-120/208V.
103	30 KVA, 50, 480-120/208V.
41	25 KVA, 10, 480-120/208V.
270	25 KVA, 10, 480-120/208V.

NOTES

- △ ALTERNATE BID E-2. SAME BID INCLUDES 200A./SP. SPACE AND 1/2" EMPTY CONDUIT TO ROOM 100.
- △ ALTERNATE BID E-3 INCLUDES DELETION OF SWITCHES, FUSES, TRANSFORMER, PANELBOARDS, CONDUIT AND DUCT. PROVIDE SPACE ONLY TO "MTR" FOR 600A./SP. FEASIBLE SWITCH.

- GF1 - GROUND FAULT INTERRUPTER
- EM - ELEMATTHOUSE METERS
- MF - MAIN FEASIBLE
- C - CONTACTOR
- AM - AMMETER
- VM - VOLTMETER
- G-A - GROUND-OFF-AUTOMATIC

POLYCAST FRAME 2

10/17/77 MODS

REVISION	DATE	BY

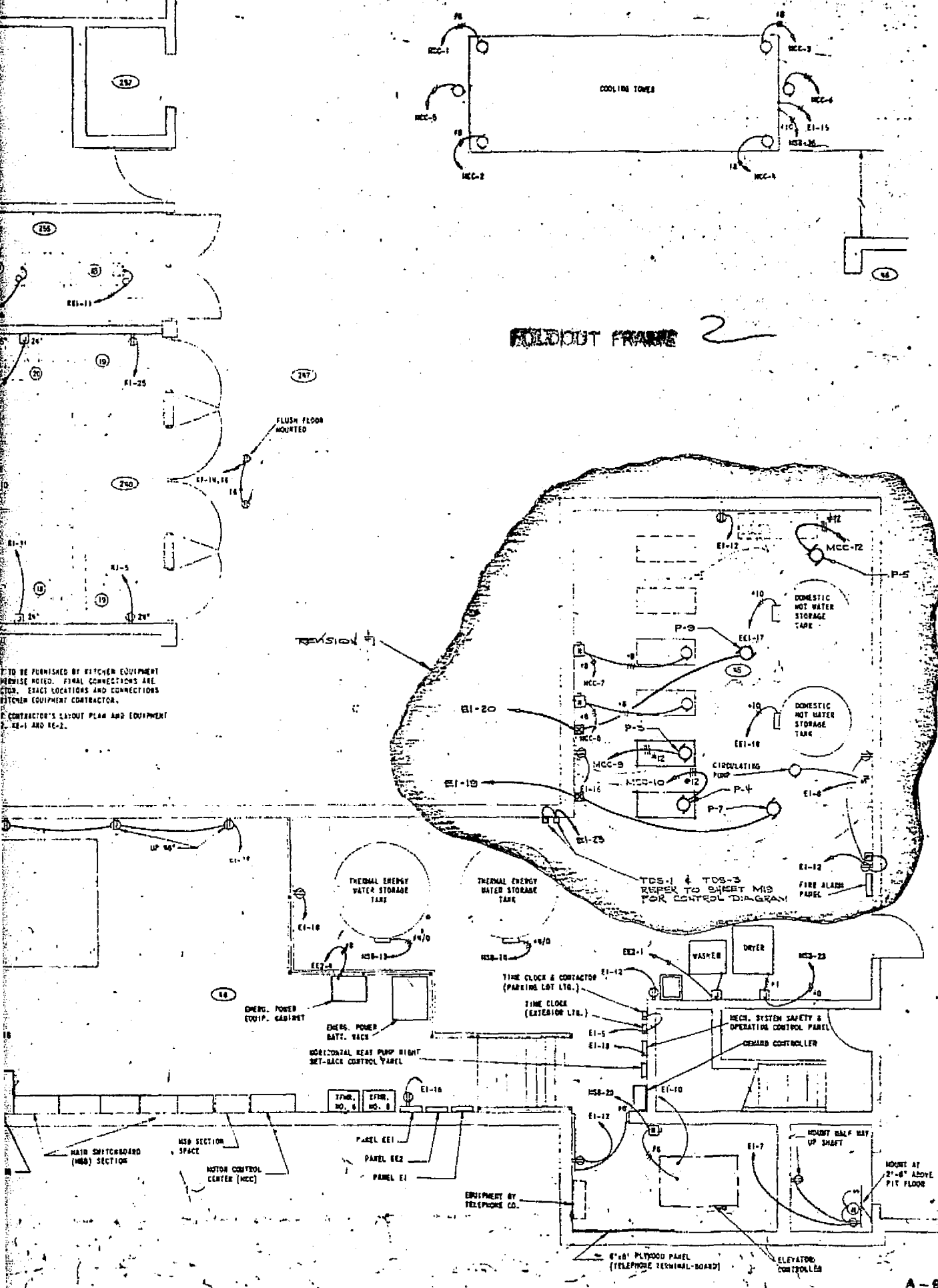
WILSON & COMPANY
 SALINA KANSAS

SOUTHEAST OF SALINE
 K-12 SCHOOL BUILDING
 UNIFIED SCHOOL DISTRICT #88
 SALINE COUNTY, KANSAS



DESIGN	WCB
DRAWN	DLJ
DATE	MAR. 1976
FILE NO.	73-55
WORK NO.	E 4

TO BE FURNISHED BY KITCHEN EQUIPMENT
UNLESS OTHERWISE NOTED. FINAL CONNECTIONS ARE
TO BE MADE BY THE CONTRACTOR. EXACT LOCATIONS AND CONNECTIONS
TO BE DETERMINED BY THE CONTRACTOR.
CONTRACTOR'S LAYOUT PLAN AND EQUIPMENT
LISTS ARE ATTACHED TO SHEETS EC-1 AND EC-2.



DATE	
REVISION	

WILSON & COMPANY

SALINA KANSAS

SOUTHWEST OF SALINE
K-12 SCHOOL BUILDING
UNIFIED SCHOOL DISTRICT 300
SALINE COUNTY, KANSAS



DESIGN	908
DRAWN	DLJ
DATE	MAR 1976
FILE NO.	73-53
SHEET NO.	E19

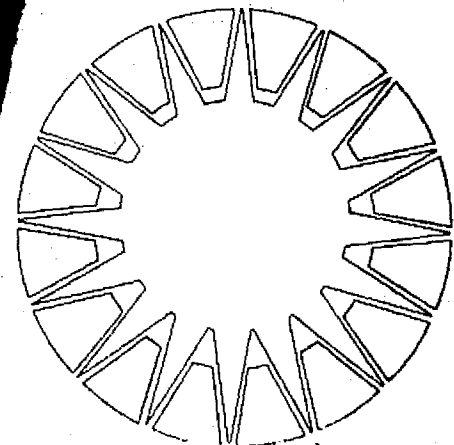
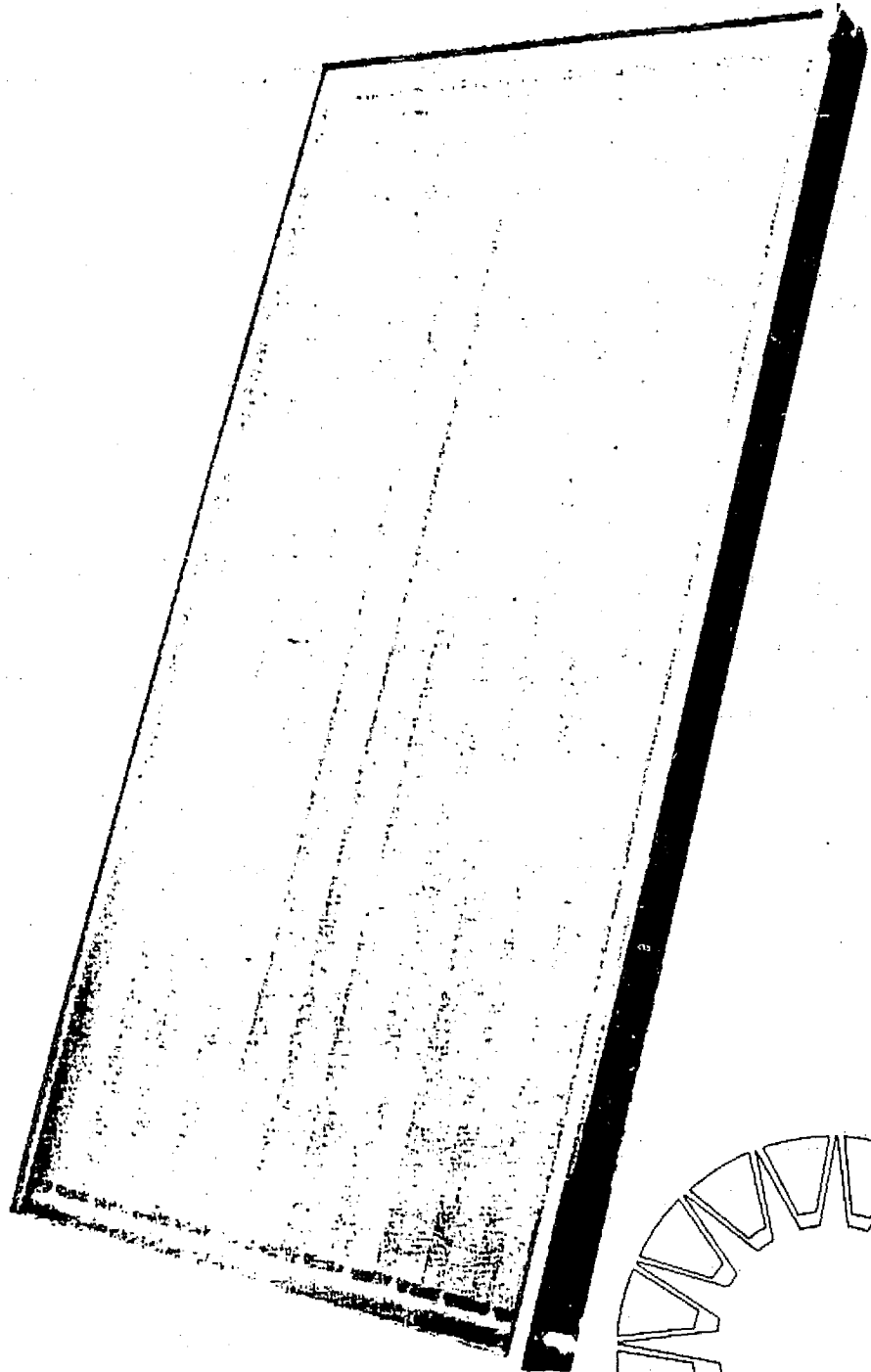
APPENDIX B

PARTS LISTING AND MANUFACTURERS LITERATURE

PARTS LISTING INCLUDES MANUFACTURERS DATA AND LOCATION ON PLANS.

- B1 - 1 SOLAR COLLECTORS
LOCATED SOUTH OF SCHOOL BUILDING, SEE DWG. 1 OF 3 AND M-19
- B2 - 1 HEAT REJECTOR
LOCATED SOUTH OF SCHOOL BUILDING, SEE DWG 1 OF 3 AND M-20
- B - 3 SOLAR HEAT EXCHANGER
LOCATED IN MECHANICAL EQUIPMENT ROOM, SEE DWG. M-15 AND M-20
- B - 4 DOMESTIC WATER HEAT EXCHANGER
LOCATED IN MECHANICAL EQUIPMENT ROOM, SEE DWG M-5 AND M-20
- B5 - 1 PUMPS AND ACCESSORIES
LOCATED IN MECH. EQUIP. ROOM, SEE DWG M-5, M-15, AND M-20
- B6 - 1 AIR SEPARATOR
LOCATED IN MECH. EQUIP. ROOM, SEE DWG M-15 AND M-20
- B - 7 EXPANSION TANKS
LOCATED IN MECH. EQUIP. ROOM DWG M-15 AND M-20
- B8 - 1 RELIEF AND REDUCING VALVES
- B9 - 1 THERMOSTATIC VALVE
LOCATED IN MECH. EQUIP. ROOM DWG M-15 AND M-20
- B10 - 1 TEMPERATURE CONTROLS
LOCATED IN MECH. EQUIP. ROOM AND ON EQUIP., SEE DWG M-20
- B11 - 1 PRE-INSULATED UNDERGROUND PIPING
LOCATED SOUTH OF SCHOOL BUILDING, SEE DWG 1 OF 3
- B12 - 1 PIPE INSULATION
SEE DWG M-5, M-15, M-19 AND M-20
- B13 - 1 THERMAL ENERGY STORAGE TANKS
LOCATED IN MECH. EQUIP. ROOM, SEE DWG M-15 AND M-20
- B14 - 1 BLIND FASTENERS
LOCATED ON COLLECTORS, SEE DWG S-17

COST EFFECT DESIGN **CEID** **SOLAR COLLECTORS**



Solar Corporation of America

19 WINCHESTER STREET, WARRENTON, VIRGINIA 22186
TELEPHONE (703) 347-0550

The Bottom Line

The CED Collector is Cost Effective Because:

It provides rapid roof top or ground mounting clips to reduce costly field labor. Installation costs can run over 25% of collector costs.

Large 1 5/8" OD Copper fully insulated manifolds are available inside the box to eliminate the need for unsightly exterior piping, which can add \$2.00 per foot plus rooftop brazing labor and insulation.

Quick connectors are available to rapidly join a row of boxes together up to 150 feet long without brazing or soldering. Can be taught easily to unskilled labor.

SCA boxes are 4' x 8' to fit building standard modules and to require fewer connections on the roof.

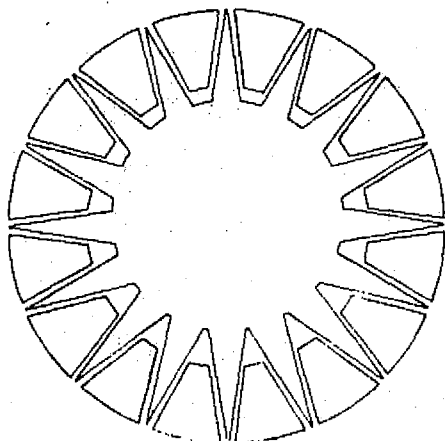
SCA boxes are structural, requiring support only at the ends to provide the correct tilt angle.

All SCA CED collector materials are designed to last 25 years or more. Other collectors which use black paint will have to be recoated in 5 years, according to the paint supplier.

SCA has designed for the highest available efficiency so that a small collector area will supply the heat requirement. This saves both collector initial cost and installation cost. In addition, the SCA thermal control design permits double glazing efficiency with a single glaze.

CED provides expansion joints in the manifolds and in the boxes.

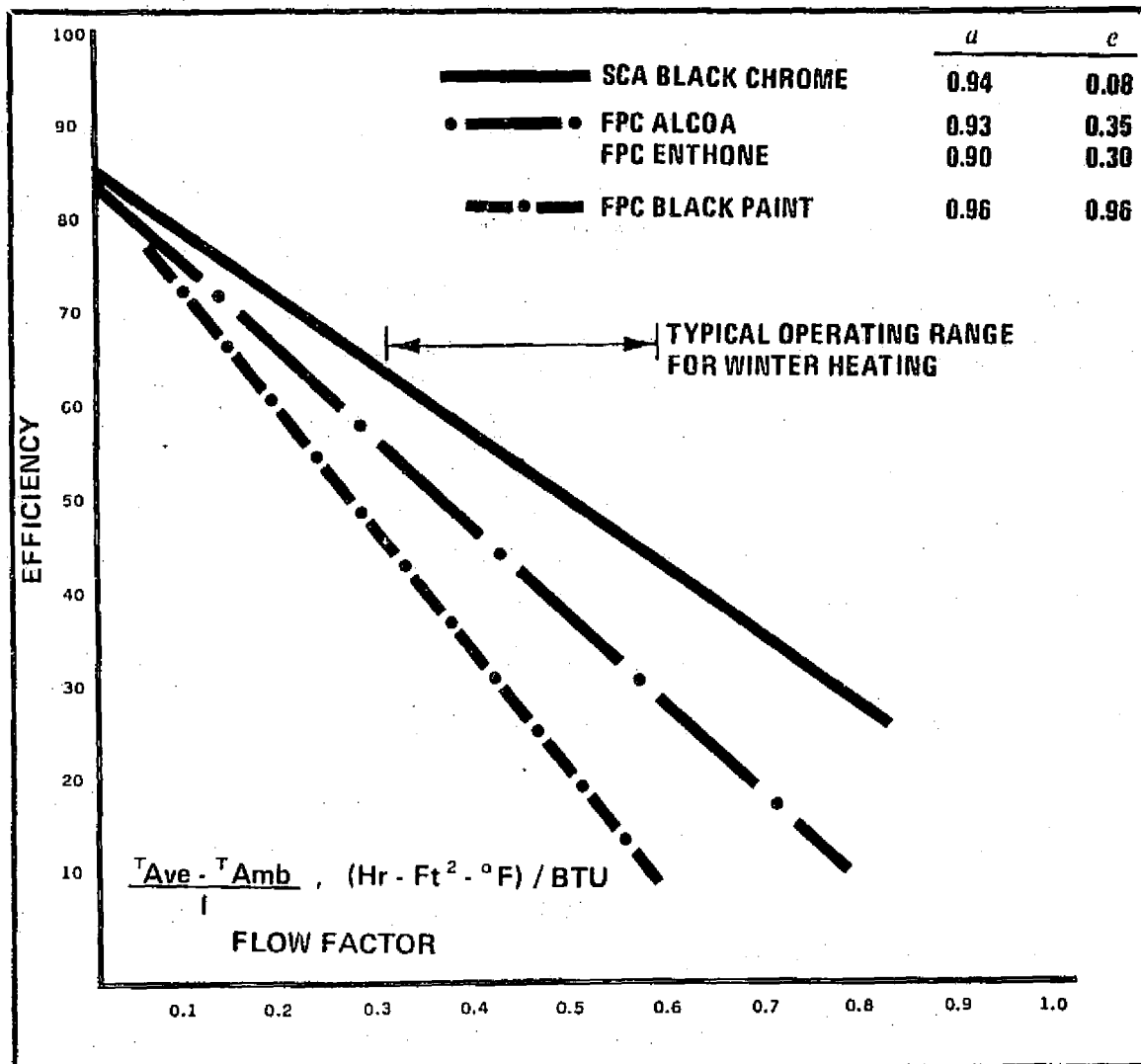
CED permits on-the-roof glass replacement should that ever be required.



Solar Corporation of America

19 WINCHESTER STREET, WARRENTON, VIRGINIA 22186
TELEPHONE (703) 347-0550

Efficiency of Single Glazed Collectors with Different Selective Coatings



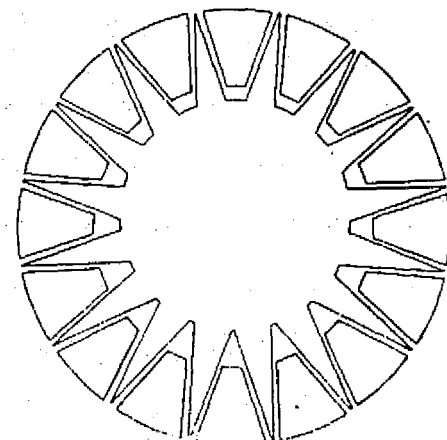
CED Mark IV Solar Collector

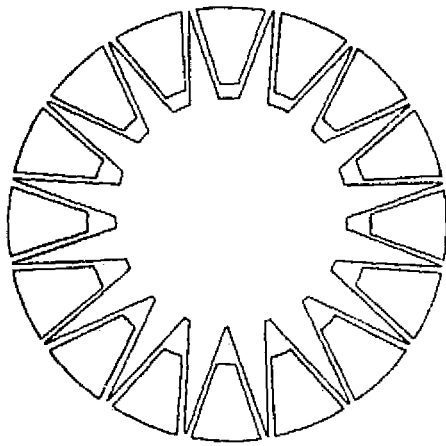
Solar Corporation of America offers a high technology solar collector; designed to last the term of your mortgage and to keep producing the most heat for the installed dollar available with current technology. We believe we are the only company who offers all these top features:

- Custom design service.
- Collector can use water or any conventional coolant.
- All copper liquid system for corrosion resistance.
- Tempered, high transmittance 3/16" glass in one or two-pane styles.
- High temperature seals for dry-plate temperature resistance.
- Black chrome on absorber for highest thermal performance.
- Fiberglass insulation in galvanized steel box modules.
- Uniroof™, Uniside™, concentrating, planar, and free-standing designs.
- For heating and cooling or heating and hot water only.
- System engineered for low-cost installation.
- Installation available; collector only or complete system.
- Two-year limited warranty.
- Extended warranty and maintenance available.

***Installation**

***Service**





Solar Corporation of America takes pleasure in announcing its increased line of products:

- Solar Collectors for Buildings and Homes.
- Solar Hot Water Heaters.
- Solar Swimming Pool Heaters.
- Solar Collector Modules for the Do-It-Yourselfer.
- Solar Heaters for Commerce (Restaurants, Motels, Laundries, Car Washes, . . .)
- Solar Heaters for Industry. (Process Heat)
- Solar Crop Dryers.
- Solar Air Conditioning Equipment.

The SCA line of CED (Cost-Effective Design) solar collectors are backed by America's leading solar engineering consultants, InterTechnology Corporation (ITC).

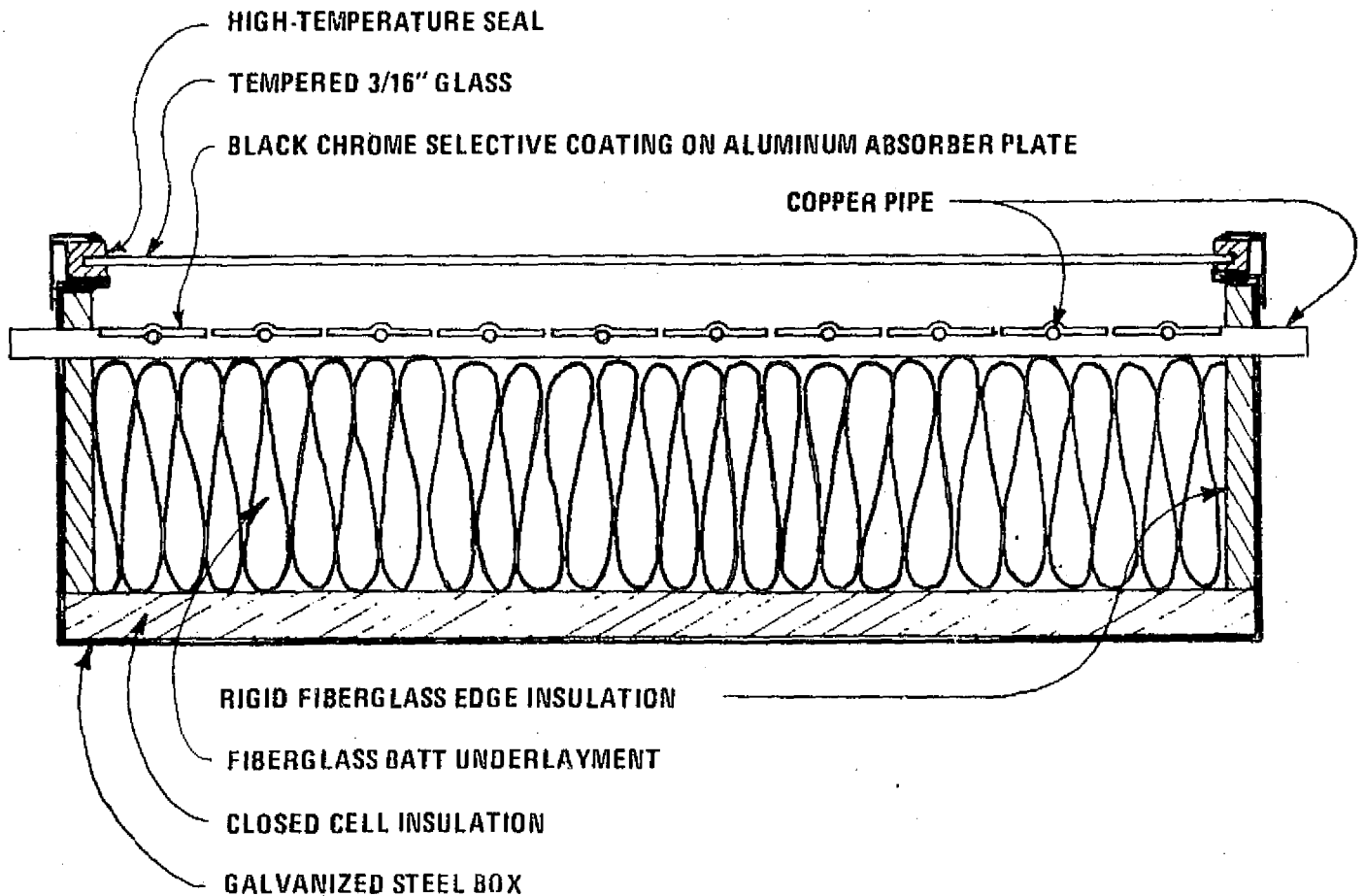
The CED collectors are winning wide acceptance for their life-cycle low cost.

SCA will be most responsive to the needs of both large and small solar requirements.

***Design**

***Manufacture**

***Marketing**



INTERTECHNOLOGICAL CORPORATION

10000 W. 10th Avenue
Denver, Colorado 80202
303-751-1000

10000 W. 10th Avenue
Denver, Colorado 80202
303-751-1000

FOR manifold explanation see plan
views & attached sheet. December 1, 1977

Specification 770401 Solar Collector - Medium Temperature Model Mark V

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NO - black Chromium Reg'd

1. Glazing: Glass. 1/8" thick, tempered low iron, single glazed; $\alpha = .89$.
2. Glazing Seal: Continuous molded EPDM rubber.
3. Pressure Plate: 18 Ga. stainless steel type 304.
4. Fasteners: 3/4" x #10 Truss Head stainless steel sheet metal screws at 12" ± O.C.
5. Frame: 20 Ga. galvanized steel, welded corner construction. *2 1/2" req'd*
6. Fin Tube Absorber Assembly.
 - A. Manifolds: Two, harddrawn, type M copper tubes, 1" ϕ Nominal.
 - B. Cross Tubes: Eight, harddrawn, type M copper tubes, 1/4" ϕ Nominal.
 - C. Absorber Fins: Eight Aluminum Extrusions; .060" x 4.22 x 69.5".
 - D. Absorber Coating = Black paint - $\alpha = 0.95$ $\epsilon = 0.8$.

water white glass

7. Manifold Connectors - High temperature formed rubber hose with hose clamps. *silicon*
8. Insulation - 1" fiberglass around edges; 3" fiberglass under absorber.
9. Working Pressure - 50 PSIG; maximum 100 PSIG.
10. Area - 19.0 square feet (35 3/8" W x 77 3/8" L x 5 1/4" D overall dimensions).
11. Effective Absorber Area - 17.3 square feet.
12. Mounting Provisions - Consult factory.
13. Dry Weight - 113 pounds.
14. Liquid Volume - .063 ft³ or 3.95 pounds of water.

plan view shows
3 1/2" fiberglass plus
1" urethane. which
do you intend
to furnish? the
plan is correct
& I.B.W. prev.
conversations & draw
Please clarify JMH III

Yass
Manifold
absorber coating
insulation



Retail Pricing and Options Available for
Model Mark V

Mark V Specification 770401.....Base Price \$208.00

Options

1. Water White Glass: High transmittance $\tau=0.91$ \$ 11.00
2. Black Chromium Absorber Coating with $\alpha=0.94$ $\epsilon=0.1$ \$ 45.00
3. Optional manifold 2" or 2 1/2" \emptyset Nominal - Consult
factory for pricing.

All option prices are in addition to Mark V base price. Options available
in any combination.

Prices effective 1 January 1978. All prices subject to change without notice.
All prices exclusive of packing and freight.
Collectors and accessories FOB Warrenton, Va.

Retail Discount Schedule

<u>Volume (Units)</u>	<u>Discount</u>
1-10	-0-
11-50	5.0%
51-100	10.0%
Greater than 100	Factory Pricing

Order Terms

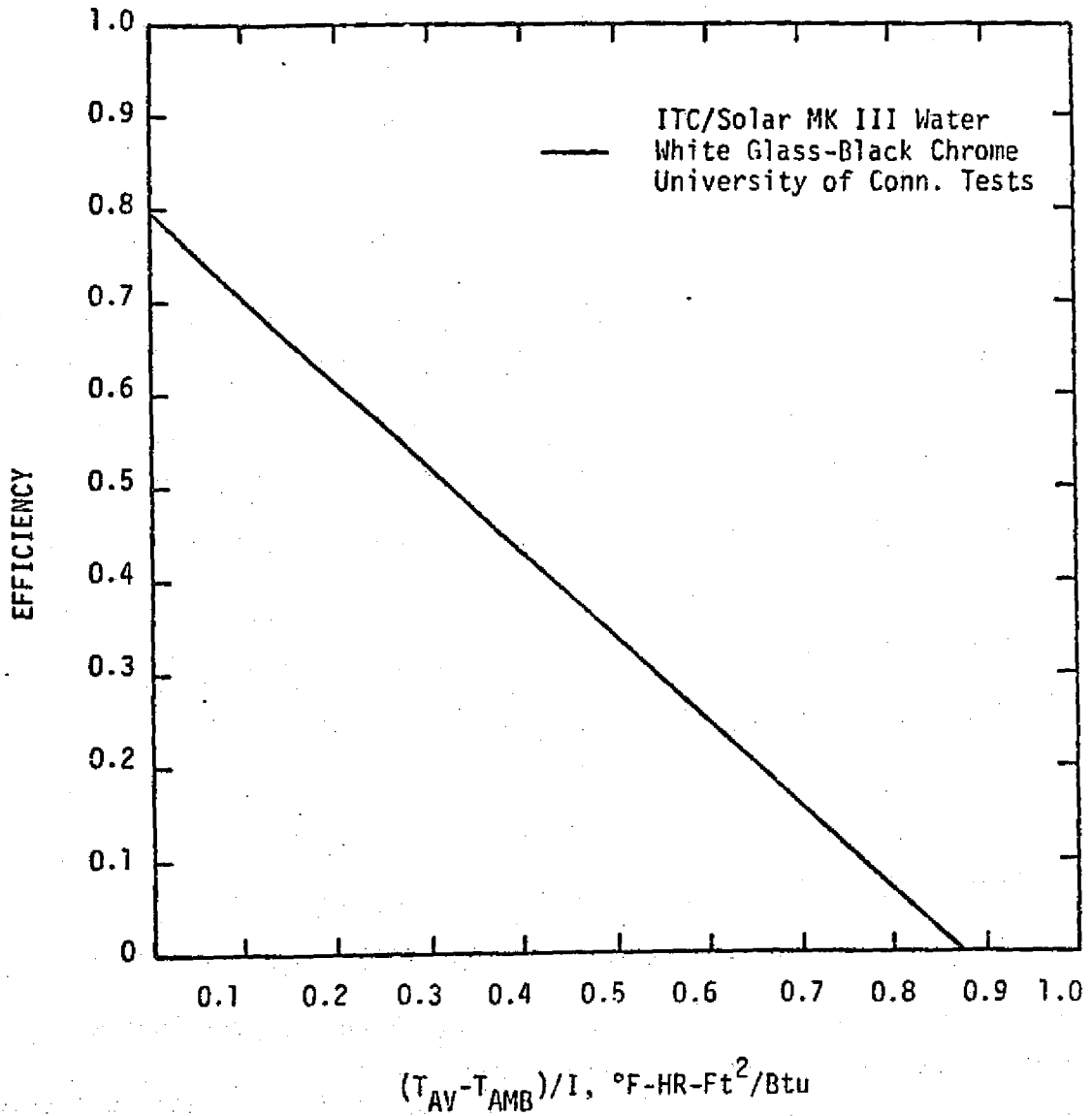
1/3 with order, COD. Net 30 days with approved
credit. Orders honored as placed.



INTERTECHNOLOGY/SOLAR CORPORATION

CORPORATE AND ENGINEERING
100 Main Street
Warrenton, Virginia 22186
Telephone 703-347-7900
TWX 710-839-5450

SOLAR MARKETING AND
MANUFACTURING
276 Henricview Avenue
Warrenton, Virginia 22186
Telephone 703-347-9500



LIMITED WARRANTY
(HUD Solar Hot Water Initiative)

InterTechnology/Solar Corporation
("ITC/Solar")
100 Main Street
Warrenton, Virginia 22186
703-347-9500

PRODUCT

Joule BoxTM (Solar Water Heating) System

EXTENT AND DURATION OF WARRANTY

I. System

A. Extent

Any system failure caused by a defect in either materials, manufacture or installation by ITC/Solar or its distributor or agent will be remedied. All necessary (as solely determined by ITC/Solar) replacement parts, labor, shipping or handling will be provided without charge to the owner. Where installation is performed by the owner, the warranty covers only defects in materials or manufacture and is limited to the provision, at the site and without charge to the owner of all parts necessary (as solely determined by ITC/Solar) to remedy the defect.

B. Duration

This warranty is effective for one (1) year from the date of completion of the initial installation. Any warranty replaced item will carry only the unexpired portion of the original warranty.

II. Solar Collectors

A. Extent

1. Defects in materials or manufacture

All necessary (as solely determined by ITC/Solar) replacement parts, labor, shipping or handling will be provided without charge to the owner.

2. Corrosion of the absorber plate and other coolant passages which adversely affects performance of the system

All necessary (as solely determined by ITC/Solar) replacement parts, labor, shipping or handling will be provided without charge to the owner. (NOTE limitation in B below.)

B. Duration and special limitation

Excluding corrosion defects described below, this warranty is effective for five (5) years from the date of completion of the initial installation. HOWEVER, the warranty for corrosion defects arising more than one (1) year from the date of completion of the initial installation covers only the cost of any parts or new collectors, delivered to

the site, necessary (as solely determined by ITC/Solar) to remedy the defect. Any warranty replaced item will carry only the unexpired portion of the original warranty.

III. Other Components

The other components (tanks, pumps and controller) used in the Joule Box™ System carry their own manufacturer's limited warranty. ITC/Solar and/or its distributors pass these warranties to the owner at the point of sale. In particular, ITC/Solar warrants against defects in materials and manufacture of heat exchangers and tanks for a period of five (5) years. This warranty shall include shipping and handling but not include removal and reinstallation.

OWNER RESPONSIBILITIES

If the Joule Box™ System is installed by parties other than ITC/Solar or its distributor or agent, the owner is responsible for insuring that the installation is made in accordance with ITC/Solar specifications.

Although ITC/Solar and/or its distributor will promptly inspect the system at the site to verify failure, establish probable cause, and determine corrective action, if the inspection reveals no warranty related defect, a reasonable charge may be made to the owner for the inspection. Any item to be replaced must be made available for inspection in exchange for a replacement.

HOW TO MAKE A CLAIM

A claim under this warranty should be made to the distributor from whom the system was purchased. If this cannot be done, ITC/Solar should be contacted directly.

ITEMS NOT COVERED BY THIS WARRANTY

ITC/Solar and/or its distributors are not responsible for any damage to the glass or other components of the system arising from causes not attributable to defects in materials, manufacture or installation. Damage attributable to natural disaster or other acts of God is specifically excluded from coverage under this warranty.

ITC/Solar and/or its distributors are not liable for any incidental or consequential damages or any payment other than for repair, replacement or refund of the purchase price paid for the system. NOTE: Some states do not allow the exclusion or limitation of incidental or consequential damages. Therefore, this limitation or exclusion may not apply to the owner.

GENERAL

All warranties shall continue, to the extent of the warranty period remaining to any subsequent owner of the system, provided that the new owner contacts ITC/Solar or the distributor within thirty (30) days of purchase to establish

the new ownership, have questions answered and obtain the system operating and maintenance manuals.

In the absence of other suitable proof of the date of completion of the installation, the effective date of this warranty shall be based upon the warranty registration records maintained by ITC/Solar or its distributor.

THIS WARRANTY GIVES THE OWNER SPECIFIC LEGAL RIGHTS. THE OWNER MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

Warranty Registration
Promptly Return to Seller

Name of Owner

Name of Dealer

Address of Owner

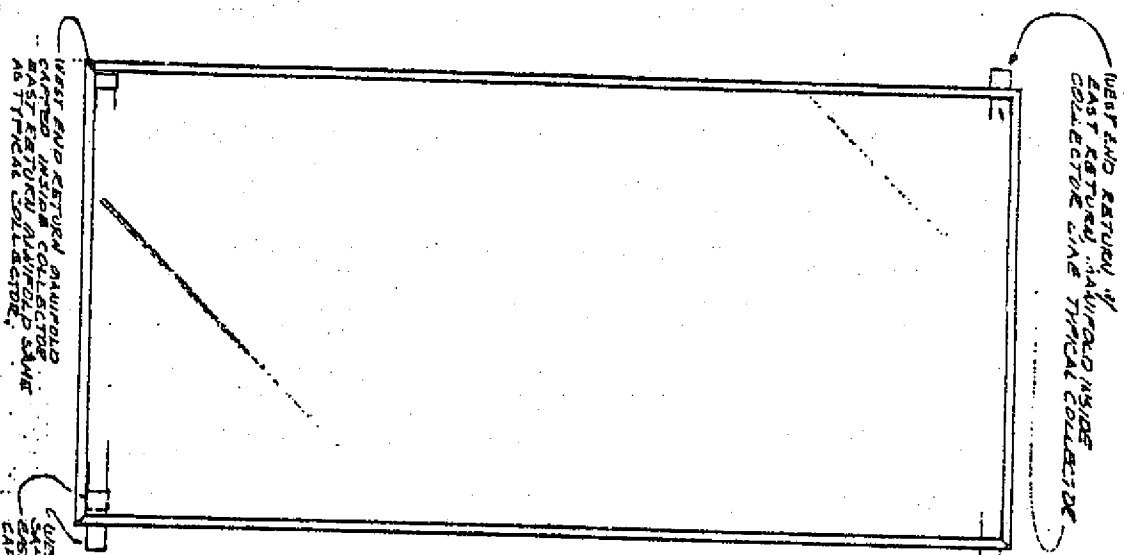
Address of Dealer

Model Number

Serial Number

Date Purchased

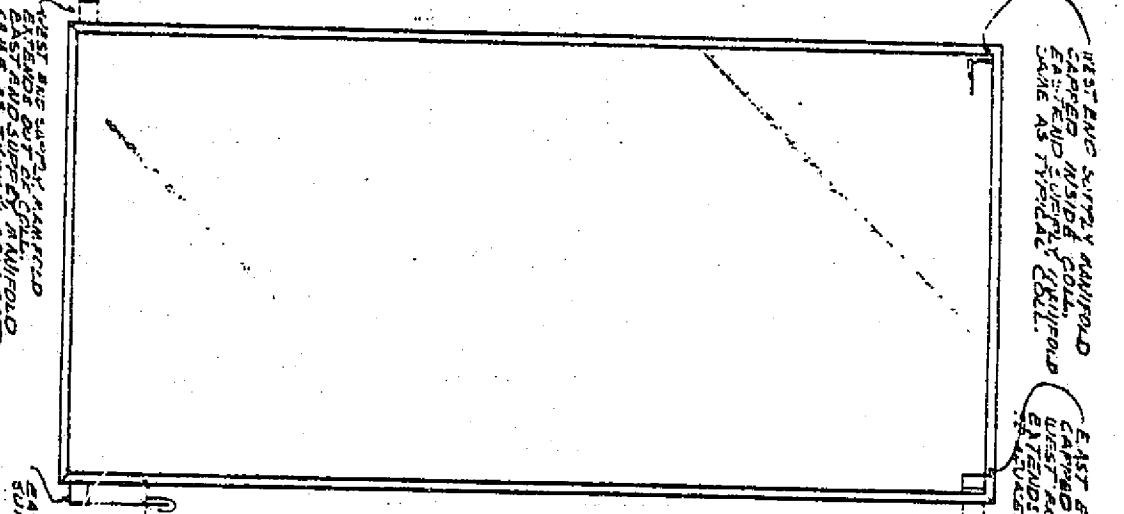
Date Installed



WEST END RETURN W/ WINDPROVIDES EAST RETURN W/ WINDPROVIDES COLLECTOR LINE TYPICAL COLLECTOR

WEST END/EAST END RETURN SAME

WEST END RETURN W/ WINDPROVIDES EAST RETURN W/ WINDPROVIDES CAPPED WIND COLLECTOR



WEST END SURVEY WINDPROVIDES EAST END SURVEY WINDPROVIDES CAPPED WIND COLLECTOR SAME AS TYPICAL COLLECTOR

EAST END SURVEY WINDPROVIDES EAST END SURVEY WINDPROVIDES CAPPED WIND COLLECTOR EAST END SURVEY WINDPROVIDES EAST END SURVEY WINDPROVIDES CAPPED WIND COLLECTOR

WEST END SURVEY WINDPROVIDES EAST END SURVEY WINDPROVIDES CAPPED WIND COLLECTOR SAME AS TYPICAL COLLECTOR

EAST END/EAST END SURVEY WINDPROVIDES EAST END SURVEY WINDPROVIDES CAPPED WIND COLLECTOR

TYPICAL

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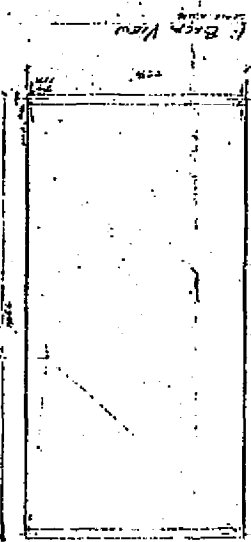
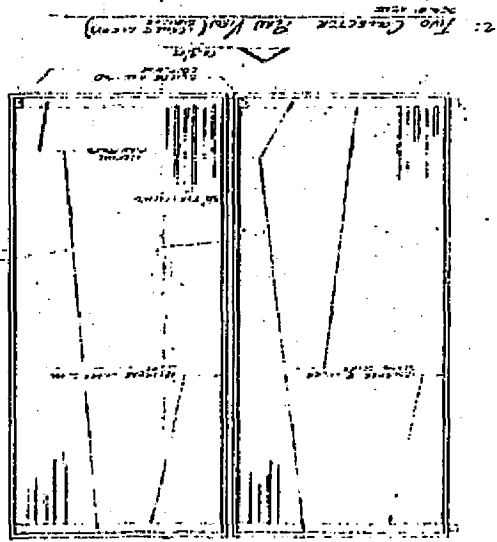
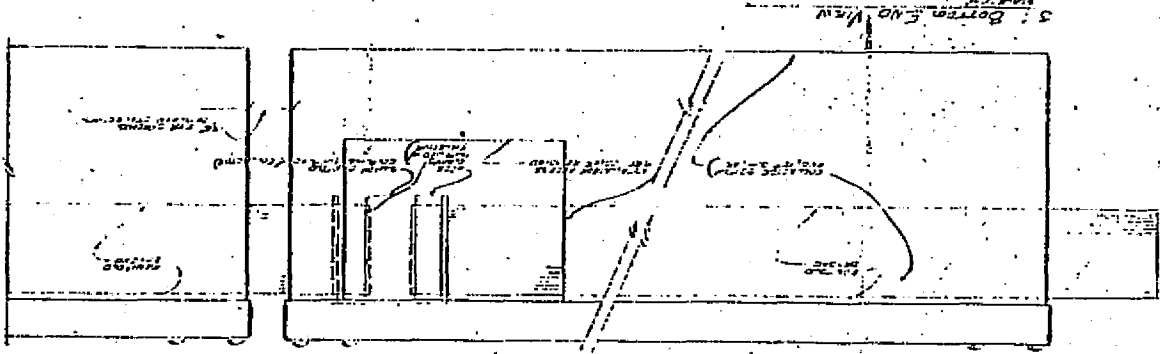
COLLECTOR FRONT VIEW
SCALE: NONE

DRAWING NO



INTERTECHNOLOGY/Solar CORPORATION
100 MAIN STREET, WARRENTON, VIRGINIA 22186, U.S.A. TELEPH. NO. 703-347-7900, TWX 710-030-0450

JOB TITLE: <i>End Collector</i>	DATE: <i>10/1/77</i>	DWG. BY: <i>M. APP.</i>
DWG. TITLE: <i>FRONT VIEW</i>		REV'D DATE:
JOB NO: <i>34001-20</i>		



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3 x 1 1/4 x 3/16 CHANNEL IRON

2 1/2 x 1 1/4
REDUCING
COUPLING

WELD TO STEEL SUPPORT STRUCTURE

SOLAR COLLECTOR
ITC/SOLAR CORP. - MARK 52

PROVIDE STEEL SHIM BETWEEN
CAPPED HEADER PIPE AND
COLLECTOR FRAME.

NOTE:
PROVIDE INSULATING MATERIAL BETWEEN COPPER AND
STEEL TO PREVENT GALVANIC CORROSION.

INSTALLATION OF SOLAR COLLECTOR INSTALLATION TO
"TYPE 1" OR "TYPE 2" APPLICABLE TO END COLLECTORS ONLY.
(TYPICAL 34 PLACES)

SOLAR ENERGY APPLICATION
K-12 SCHOOL MENTOR, KS.
BUCKLEY INC.



INSTALLATION & MAINTENANCE INSTRUCTIONS
FOR FACTORY ASSEMBLED
MWC AND HC AIR COOLED HEAT EXCHANGERS

RECEIVING

Inspection

- Inspect unit for shipping damage (especially core) before uncrating.
- Rotate fan which should move freely. Note that one blade is wired to guard on some models for shipping. Remove wire before rotating fan.

Handling

- Exercise care to avoid damage to core.
- All units are shipped with wood skid facilitating fork lift handling. Lifting holes are provided in MWC and some HC side members. HC units have integral or removable lifting lugs (shipped loose on some models).

Storage

- Units normally have one coat of medium gray, semi-gloss (chlorinated rubber base) enamel paint. A finish coat of paint should be applied to all exterior ferrous surfaces unless storage is indoors and no significant corrosion started during shipment.
- Do not paint core as this may impair air flow and heat transfer.
- All openings are sealed with appropriate pipe plugs, pipe caps, thread protectors, flange covers and/or pressure caps at the factory. Be sure these are in place.

INSTALLATION

Location

- Insure that no obstructions impede either discharge or inlet air flow. If unit is mounted in wall, provide ample room ventilation.
- MWC units should be oriented to take advantage of prevailing winds to avoid recirculation and the resultant loss of cooling effect. Expected wind direction on hot, summer days should especially be anticipated.
- Duct work on housing of unit adds air flow static resistance which must be overcome with extra fan capacity. Ducting should be larger in area than heat exchanger core face and contain only straight runs and long radius turns.

Foundation and Mounting

- Flexible connections or non-rigid plumbing (elbows and right-angle bends) should be used to allow thermal expansion of core, insulation from vibration and freedom from static loading.
- Consult "cooled equipment" manufacturer for recommendations on specific plumbing system. Inlet to heat exchanger is normally at the highest connection, but this is not essential.
- In the case of round tube cores with counter-flow passes, plumb inlet fluid to connection farthest from blower fan to avoid co-flow of tube fluid and cooling air.

Fan Drive System

- If fan is motor driven, check that voltage, frequency and number of phases on motor nameplate are compatible with electrical supply.
- Connect motor leads so that rotation of forced draft blower fan is counter-clockwise when viewed from fan side of unit unless fan is supplied with special, left-hand blades.
- If drive includes vee belts, sheave alignment and correct belt tension must be maintained to transmit sufficient power to fan and prevent excessive belt and bearing wear.
- If fan is engine driven, the preferred location for the idler sheave is on the slack side of the belt drive. Belt guards are normally provided by engine packager as required by OSHA.

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Startup

- Per RED TAG on unit, bolts securing MWC top tank or HC floating end tank to side members must be loosened to permit differential thermal expansion of steel sides and nonferrous core.
- If tube fluid is water, fill unit from a clean and chemical free source. Use a 50% aqueous ethylene glycol solution if freezing is possible. For ambient conditions below -25F(-32C) use a 60% solution, below -50F (-45C) consult factory.
- Check unit for undue vibration resulting from fan imbalance or loose drive components.

MAINTENANCE

Motor

- Ball bearings should be lubricated once per year or each nine months for severe duty motors, 10 hp or larger. Consult local motor manufacturer representative for grease type specification.
- Clean ventilation openings as needed.

Fan Bearings (Vee Belt & External Drive Systems)

- Fan and idler bearings are provided with combination Alemite grease and relief fittings and should be lubricated once per year or more often for severe duty applications.
- Bearing temperature should never exceed 150-160F.

Fan Drive

- Check and maintain alignment of sheaves by adjusting location on shaft and adjusting pillow block base.
- Check and maintain correct tension of fan belts by adjusting idler.
- Check for frame vibration due to fan imbalance, bearing wear or loose drive components.

Core and Frame

- Periodically check for core or plumbing leakage.
- Inspect MWC top tank or HC system high point for correct liquid level.
- Test anti-freeze coolant for correct specific gravity before cold weather.
- Examine interior of MWC top tank through filler neck for signs of scale formation and rust. Radiator should be cleaned and flushed if necessary using Young 585 cleaner A271169 (Directions A277919). When replacing water in system add Young 3-1-2 Cooling System Treatment A271163 (Directions A277913) as a corrosion inhibitor.
- If steel frame develops rust, clean and repaint as necessary.
- Dirt accumulation on core can be removed by brushing and blowing with compressed air. A steam jet may also be effectively used if grease deposits are on core. Note: be careful that fins or tubes are not damaged from rough brushing or excessive jet pressure of either steam or air.

WARRANTY PROGRAM (See published guarantee)

Please note the following:

- If a warranty matter occurs, contact the factory Service Department immediately through your local Young representative.
- In all communications with Service Department, include complete nameplate data.
- Units will not be accepted for return unless prior authorization from Factory has been obtained.

Y **YOUNG RADIATOR COMPANY**
2825 Four Mile Road • Racine, Wisconsin 53404

Plants at Racine, WI, Mattoon, IL and Centerville, IA



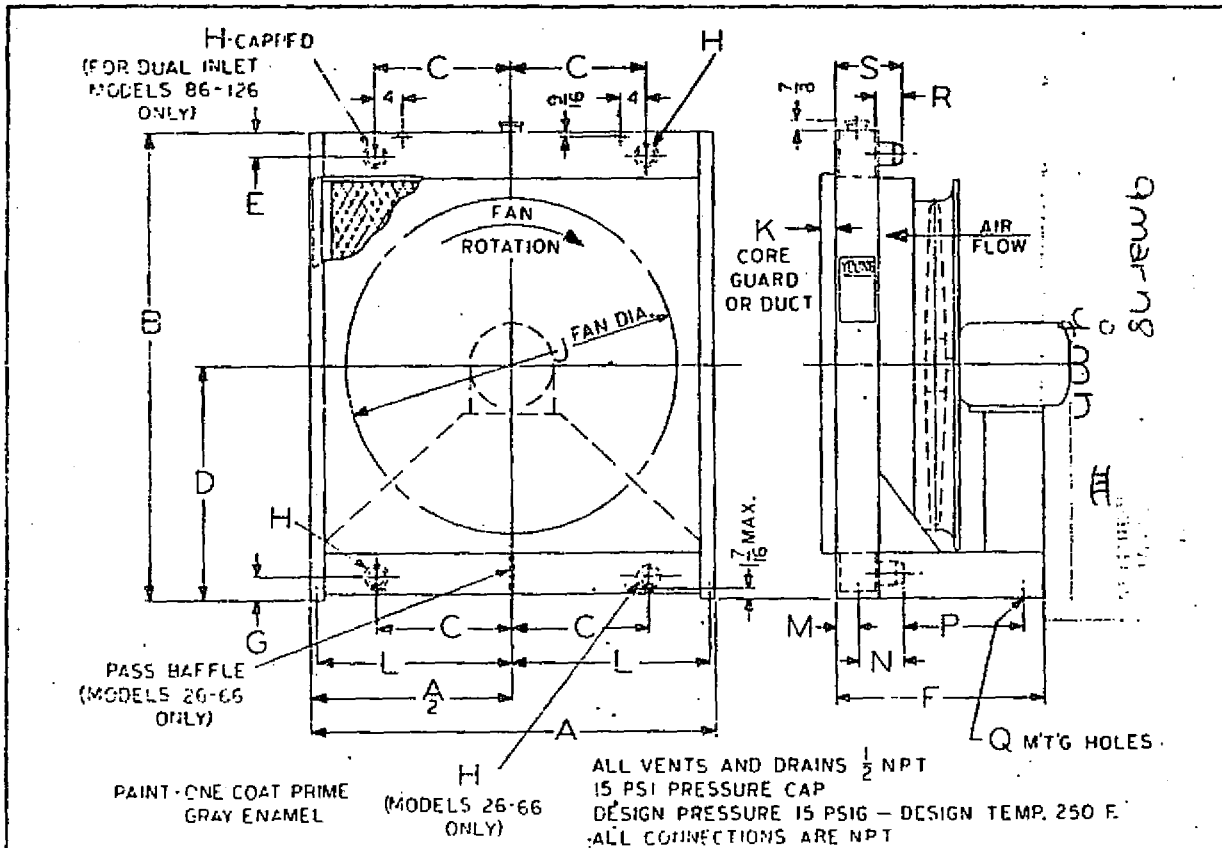
Form 1776
3-5-77

A277387

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REVISED

B2-3



CUSTOMER REQUIREMENTS	DIMENSION DRAWING
	Customer Buckley, Inc.
	Address Wichita, Kansas
	Cust. Order No. W-457-146-02
	Y. R. Co. Order No. B-157529
	Y. R. Co. Part No. 24416
	Y. R. Co. Model No. 8605
	Per Dorothy Lutz
	Date February 2, 1976
SPECIAL NOTE FOR MODELS 26D - 66D	MOTOR DATA
2 PASS - USE BOTTOM TANK FOR INLET AND OUTLET	5 HP 1750 RPM 1 SPEED
1 PASS - USE TOP TANK FOR INLET, MANIFOLD BOTTOM TANK FOR OUTLET	3 PH 60 Hz 230/460V
	230 TYPE 184T FRAME

MODEL	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S
26D	31	35 1/4	10	17 3/8	2 3/8	19	2 3/8	2 1/2	24	2	14 3/4	3 1/4	6 1/2	6	3/8	2 3/8	8 13/16
46D	37	40 3/4	12	20 3/8	2	19	2 1/2	3	27	2	17 3/4	3 1/4	6 1/2	6	3/8	3 3/8	9 5/8
66D	44 3/8	48 1/4	15	24 1/4	2 1/2	20 1/4	2 1/2	3	32	2	21 1/8	3 1/4	6 1/2	7 1/4	3/8	3 1/8	9 5/8
86D	50 13/16	57 1/8	18	29	2 3/8	27 3/4	3 1/2	4	36	2	24 1/2	3 1/4	6 1/2	14 3/4	3/8	3 1/8	9 5/8
106D	57 1/8	63 3/8	20	32	2 3/8	32 3/4	3 1/2	4	42	2	27 3/8	3 1/4	6 1/2	18 3/4	3/8	3 3/8	9 5/8
126D	59 1/8	69 3/8	20	34 3/8	3 3/8	35 1/4	3 1/2	4	48	2	29 1/2	3 1/4	6 1/2	22 1/4	3/8	3 3/8	9 5/8

YOUNG RADIATOR COMPANY, RACINE, WISCONSIN 53404 STANDARD MWC - DIRECT DRIVE AM-8691

This page has been removed because of copy restriction. For information on the solar heating 150 gpm heat exchanger, unit number 4CT-14-90, contact Richmond Engineering Company, Richmond, Virginia.

This page has been removed because of copy restriction. For information on the domestic hot water heat exchanger, unit number 2CT-05-36, contact Richmond Engineering Company, Richmond, Virginia.

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Buckley, Inc.

W-457-M8-05

2-9-78

J-9432

see attached sheet for explanations

(A) 1	VAS-3	Air Sep.	150 GPM
(A) 2	100 Gas. each	ASME Exp. Tank	
(A) 2	14-75	Ga. Glass Sets	
(AC) 2	TMA-24	Tank Fitting	
(A) 1	740-3/4-30#	Relief Valve	
(A) 1	RD-50	Make-Up 12# Valve	
(A) 2	P-3, P-4 4030-2½E	Armstrong - Base Mounted	1150 RPM 150 GPM @ 23 ft. TDH 1½ HP 460/3 22 125 PSIG 184T
(AC) 2	P-5, P-6 4380-3D 4380-2D	same Armstrong Inline	1750 RPM 150 GPM @ 34 ft. 2 HP 460/3 125 PSIG
(AC) 2	P-7, P-8 H-41 H-51	Inline Circ.	18.3 1750 RPM 10 GPM @ 18 ft. 120/1 114 hp
(A) 2	P-9, P-10 S-25-3/4 AB		1750 RPM 10 GPM @ 2.0 ft. 120/1 125 PSIG
(A) 24	1½-TEC	Arm. Pump Connectors	
(A) 2	152TR-1215 3 x 2½	Keflex Pump Conn	
(A) 2	152TR-1215 4 x 3	Keflex Pump Conn	
(A) 2	FTA-34	Flo-Trex Valve Armstrong	
(A) 2	SG-33	Suction Guide Armstrong	

WILSON
ENGINEERS & ARCHITECTS
BOX 1640
SALINA
KANSAS

FROM:

gwc

TO:

DATE: USD #306 FILE 73-59

SUBJECT: Shop drawings

p-5,6

due to the pumps having to handle wide variations in total dynamic head i believe the 4320-2D would be the best choice

p-7,8

your submittal data, other than the cover sheet, shows the H-51 as the selection while the cover sheet shows the H-4L. due to the submittal heat exchangers having a higher pressure drop than expected i think the H-51 to be the pump needed.

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ARMSTRONG CENTRIFUGAL PUMPS BASE MOUNTED

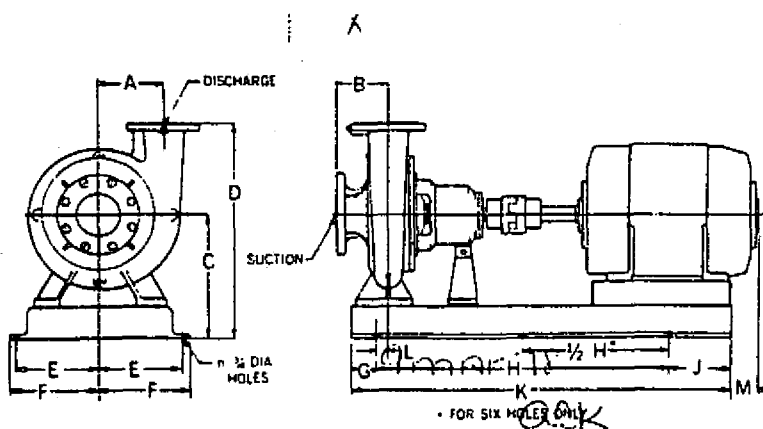
LIT. NO. 5040.922
 DATE: Sept. 1, 1975
 SUPPL. SHEETS: 5040.922
 DATE: Mar. 30, 1969

DIMENSIONAL DATA

SERIES 4023 AND 4030

WITH T-FRAME MOTOR

PUMP SIZES 2" AND LARGER HAVE 125 LB. STANDARD FLANGES. SMALLER PUMP SIZES HAVE SCREWED CONNECTIONS. ALL PUMPS ARE RATED FOR 175 PSIG MAXIMUM WORKING PRESSURE.



ALL DIMENSIONS IN INCHES*

PUMP SIZE	BRANCH SIZES		MOTOR FRAME SIZE		BASE NO.	A	B	C	D	E	F	G	H	J	K	L	n	DIMENSION 'M'			
	DISCH.	SUCT.	(i)	(ii)														DRIP-PROOF (i)	TEFC (ii)	(i)	(ii)
1 1/4 D	1 1/2 NPT	1 1/2 NPT	56	—	S-1	4 1/2	2 1/2	8 1/2	13 1/2	7	8	3	20	6	29	1 1/2	4	—	—	—	—
			143T	145T	S-1	4 1/2	2 1/2	8 1/2	13 1/2	7	8	3	20	6	29	1 1/2	4	—	—	3/8	1 1/2
			182T	184T	S-3	4 1/2	2 1/2	8 1/2	13 1/2	7	8	3	23	7	33	1 1/2	4	—	—	—	—
			213T	215T	S-3	4 1/2	2 1/2	9 1/4	14 1/4	7	8	3	23	7	33	1 1/2	4	3/8	2 1/2	3 3/8	4 3/8
1 1/2 D	1 1/2 NPT	2 NPT	56	—	S-1	4 1/2	3 3/8	8 1/2	14 1/2	7	8	3	20	6	29	1 1/2	4	—	—	—	—
			143T	145T	S-1	4 1/2	3 3/8	8 1/2	14 1/2	7	8	3	20	6	29	1 1/2	4	—	—	3/8	1 1/2
			182T	184T	S-3	4 1/2	3 3/8	8 1/2	14 1/2	7	8	3	23	7	33	1 1/2	4	—	—	—	—
			213T	215T	S-3	4 1/2	3 3/8	9 1/4	15 1/4	7	8	3	23	7	33	1 1/2	4	3/8	2 1/2	3 3/8	4 3/8
2 D	2 ASA	2 1/2 ASA	56	—	S-1	4 3/4	3	8 1/2	15	7	8	3	20	6	29	1 1/2	4	—	—	—	—
			143T	145T	S-1	4 3/4	3	8 1/2	15	7	8	3	20	6	29	1 1/2	4	—	—	3/8	1 1/2
			182T	184T	S-3	4 3/4	3	8 1/2	15	7	8	3	23	7	33	1 1/2	4	—	—	—	—
			213T	215T	S-3	4 3/4	3	9 1/4	15 1/4	7	8	3	23	7	33	1 1/2	4	3/8	2 1/2	3 3/8	4 3/8
			254T	256T	M-1	4 3/4	3	11	17 1/2	9	10	3	36	7 1/2	46 1/2	2 1/2	6	—	—	—	1 1/2
2 1/2 D	2 1/2 ASA	3 ASA	56	—	S-1	4 1 1/16	3 3/8	8 1/2	14 1/2	7	8	3	20	6	29	1	4	—	—	—	—
			143T	145T	S-1	4 1 1/16	3 3/8	8 1/2	14 1/2	7	8	3	20	6	29	1	4	—	—	3/8	1 1/2
			182T	184T	S-3	4 1 1/16	3 3/8	8 1/2	14 1/2	7	8	3	23	7	33	1	4	—	—	—	—
			213T	215T	S-3	4 1 1/16	3 3/8	9 1/4	15 1/4	7	8	3	23	7	33	1	4	3/8	2 1/2	3 3/8	4 3/8
			254T	256T	M-1	4 1 1/16	3 3/8	11	17	9	10	3	36	7 1/2	46 1/2	2	6	—	—	—	1 1/2
3 D	3 ASA	4 ASA	143T	145T	S-1	5	4 1/2	8 1/2	14 1/2	7	8	3	20	6	29	1 1/2	4	—	—	3/8	1 1/2
			182T	184T	S-3	5	4 1/2	8 1/2	14 1/2	7	8	3	23	7	33	1 1/2	4	—	—	—	—
			213T	215T	S-3	5	4 1/2	9 1/4	15 1/4	7	8	3	23	7	33	1 1/2	4	3/8	2 1/2	3 3/8	4 3/8
			254T	256T	M-1	5	4 1/2	11	17	9	10	3	36	7 1/2	46 1/2	1 1/2	6	—	—	—	1 1/2
			284TS	286TS	M-1	5	4 1/2	11	17	9	10	3	36	7 1/2	46 1/2	1 1/2	6	—	3/8	1 1/2	3 3/8
4 D	4 ASA	5 ASA	143T	145T	S-1	5	4 3/4	9 1/2	15 1/4	7	8	3	20	6	29	3/4	4	—	—	3/8	1 1/2
			182T	184T	S-3	5	4 3/4	9 1/2	15 1/4	7	8	3	23	7	33	3/4	4	—	—	—	—
			213T	215T	S-3	5	4 3/4	9 1/2	15 1/4	7	8	3	23	7	33	3/4	4	3/8	2 1/2	3 3/8	4 3/8
			254T	256T	M-1	5	4 3/4	12	18 1/2	9	10	3	36	7 1/2	46 1/2	1 1/2	6	—	—	—	1 1/2
			284TS	286TS	M-1	5	4 3/4	12	18 1/2	9	10	3	36	7 1/2	46 1/2	1 1/2	6	—	3/8	1 1/2	3 3/8
			324TS	—	M-1	5	4 3/4	12	18 1/2	9	10	3	36	7 1/2	46 1/2	1 1/2	6	1 1/4	—	4 3/8	—
1 1/2 E	1 1/2 NPT	1 1/2 NPT	143T	145T	S-1	5 1/2	2 1 3/16	9 1/2	17 1/2	7	8	3	20	6	29	1 1/2	4	—	—	3/8	1 1/2
			182T	184T	S-3	5 1/2	2 1 3/16	9 1/2	17 1/2	7	8	3	23	7	33	1 1/2	4	—	—	—	—
			213T	215T	S-3	5 1/2	2 1 3/16	9 1/2	17 1/2	7	8	3	23	7	33	1 1/2	4	3/8	2 1/2	3 3/8	4 3/8
			254T	256T	M-1	5 1/2	2 1 3/16	12	20	9	10	3	36	7 1/2	46 1/2	2 1/2	6	—	—	—	1 1/2
			284TS	286TS	M-1	5 1/2	2 1 3/16	12	20	9	10	3	36	7 1/2	46 1/2	2 1/2	6	—	3/8	1 1/2	3 3/8

ARMSTRONG CENTRIFUGAL PUMPS

SERIES 4023 and 4030
with T-Frame Motor
(continued)

ALL DIMENSIONS IN INCHES*

PUMP SIZE	BRANCH SIZES		MOTOR FRAME SIZE		BASE NO.	A	B	C	D	E	F	G	H	J	K	L	n	DIMENSION "M"			
	DISCH.	SUCT.	(i)	(ii)														DRIP-PROOF		TEFC	
																		(i)	(ii)	(i)	(ii)
1½E	1½ NPT	2 NPT	143T	145T	S-1	5¾	3¾	9½	16	7	8	3	20	6	29	1½	4	—	—	¾	1¾
			182T	184T	S-3	5¾	3¾	9½	16	7	8	3	23	7	33	1½	4	—	—	—	—
			213T	215T	S-3	5¾	3¾	9½	16	7	8	3	23	7	33	1½	4	¾	2¼	3¾	4¾
			254T	256T	M-1	5¾	3¾	12	18½	9	10	3	36	7½	46½	2½	6	—	—	—	1½
			284TS	286TS	M-1	5¾	3¾	12	18½	9	10	3	36	7½	46½	2½	6	—	¾	1¾	3¾
2E	2 ASA	2½ ASA	143T	145T	S-1	5¾	3¾	9½	16½	7	8	3	20	6	29	1½	4	—	—	¾	1¾
			182T	184T	S-3	5¾	3¾	9½	16½	7	8	3	23	7	33	1½	4	—	—	—	—
			213T	215T	S-3	5¾	3¾	9½	16½	7	8	3	23	7	33	1½	4	—	2¼	3¾	4¾
			254T	256T	M-1	5¾	3¾	12	19	9	10	3	36	7½	46½	1½	6	—	—	—	1½
			284TS	286TS	M-1	5¾	3¾	12	19	9	10	3	36	7½	46½	1½	6	—	¾	1¾	3¾
			324TS	—	M-1	5¾	3¾	12	19	9	10	3	36	7½	46½	1½	6	1¼	—	4¾	—
2½E	2½ ASA	3 ASA	182T	184T	S-3	6	3½	9½	16¼	7	8	3	23	7	33	1½	4	—	—	—	—
			213T	215T	S-3	6	3½	9½	16¼	7	8	3	23	7	33	1½	4	¾	2¼	3¾	4¾
3E	3 ASA	4 ASA	182T	184T	S-3	6¾	4¾	9½	17	7	8	3	23	7	33	¾	4	—	—	—	—
			213T	215T	S-3	6¾	4¾	9½	17	7	8	3	23	7	33	¾	4	¾	2¼	3¾	4¾
			254T	—	S-7	6¾	4¾	10½	18	7¾	8¾	3	28	7	38	¾	4	—	—	—	—
4E	4 ASA	5 ASA	—	184T	S-5	6¾	4¾	10½	18	7	8	3	23	7	33	¾	4	—	—	—	—
			213T	215T	S-5	6¾	4¾	10½	18	7	8	3	23	7	33	¾	4	¾	2¼	3¾	4¾
			254T	256T	S-7	6¾	4¾	11½	19	7¾	8¾	3	28	7	38	¾	4	—	1½	—	3¾
5E	5 ASA	6 ASA	213T	215T	S-5	6½	5½	11½	19¾	7	8	3	23	7	33	¾	4	¾	2¼	3¾	4¾
			254T	256T	S-9	6½	5½	14	22¼	9	10	3	30	7	40	¾	4	—	—	—	1¾
			284T	—	M-5	6½	5½	14	22¼	10	11	3	36	7½	46½	1¾	6	¾	—	2½	—
6E	6 ASA	8 ASA	254T	256T	M-3	7½	7	15	26	10	11	3	36	3¼	42¼	1½	6	1¼	3¾	3½	5¾
			284T	286T	M-5	7½	7	15	26	10	11	3	36	7½	46½	1½	6	¾	1¾	2½	4¾
2G	2 ASA	3 ASA	213T	215T	M-3	7½	5½	14	23½	10	11	3	36	3¼	42¼	1¾	6	—	—	—	—
			254T	256T	M-3	7½	5½	14	23½	10	11	3	36	3¼	42¼	1¾	6	—	1¾	1¾	3¾
3G	3 ASA	4 ASA	213T	215T	M-3	7½	5½	14	23½	10	11	3	36	3¼	42¼	1¾	6	—	—	—	—
			254T	256T	M-3	7½	5½	14	23½	10	11	3	36	3¼	42¼	1¾	6	—	1¾	1¾	3¾
4G	4 ASA	5 ASA	213T	215T	M-3	8	6	15	26	10	11	3	36	3¼	42¼	1½	6	—	—	—	—
			254T	256T	M-3	8	6	15	26	10	11	3	36	3¼	42¼	1½	6	—	1¾	1¾	3¾
			284T	286T	M-5	8	6	15	26	10	11	3	36	7½	46½	1½	6	—	¾	1¾	2½
6G	6 ASA	8 ASA	254T	256T	M-7	9¼	8	16	29	13½	14½	6	36	6	48	¾	6	—	—	—	¾
			284T	286T	M-7	9¼	8	16	29	13½	14½	6	36	6	48	¾	6	—	1	2	3½
			324T	326T	M-7	9¼	8	16	29	13½	14½	6	36	6	48	¾	6	2½	4	5¾	6¾
			364T	365T	M-9	9¼	8	16	29	13½	14½	6	44	6	56	¾	6	—	—	1¼	2¼

*For exact installation data, please write factory for certified dimensions.

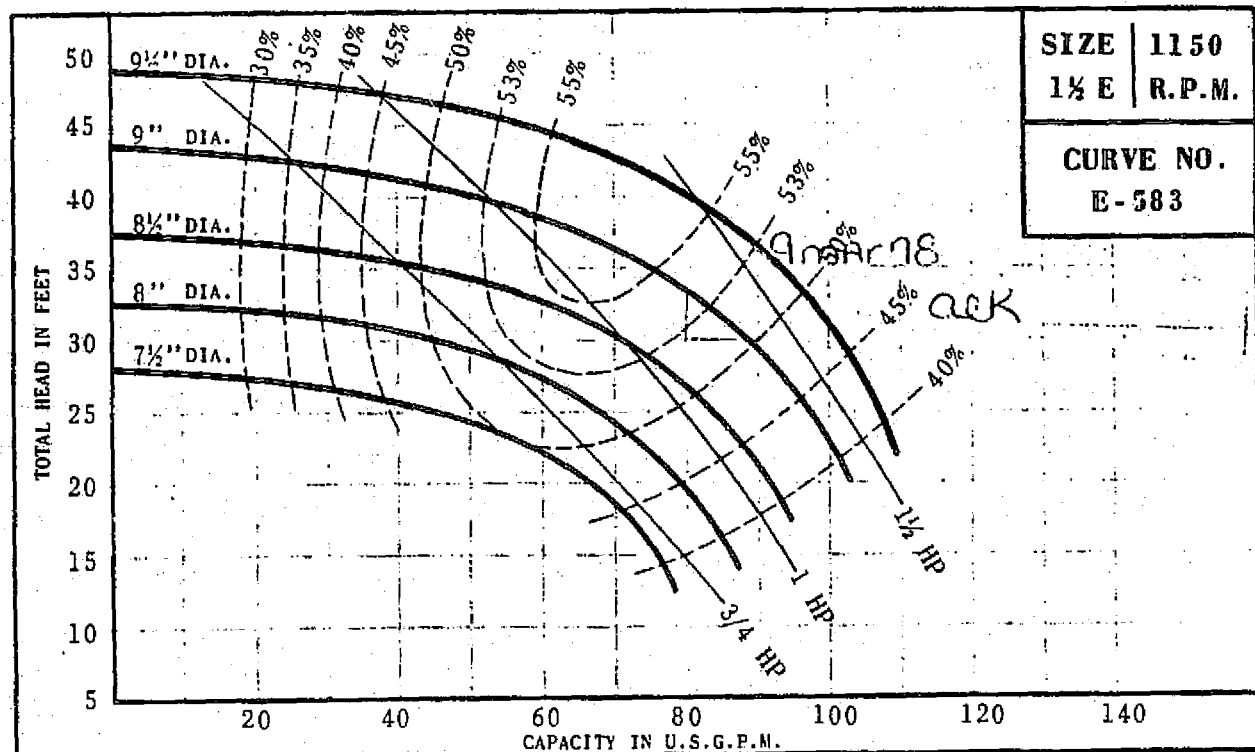
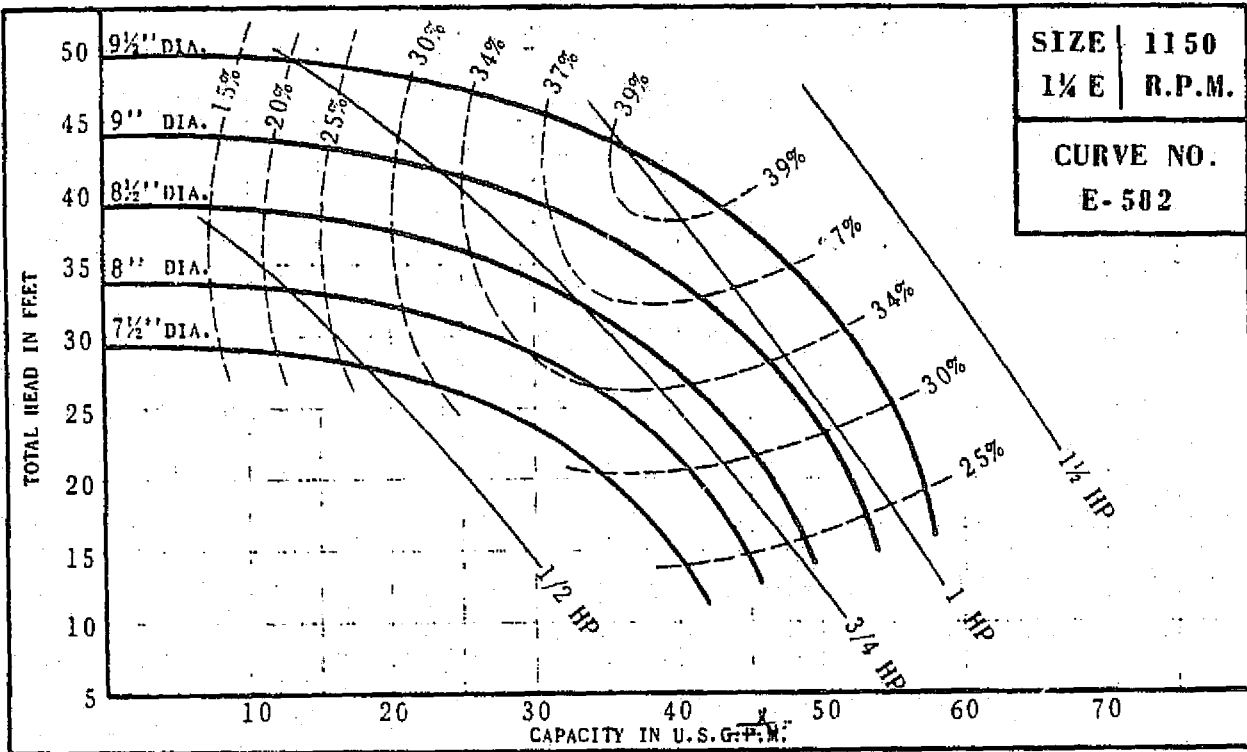


ARMSTRONG CENTRIFUGAL PUMPS PERFORMANCE CURVES

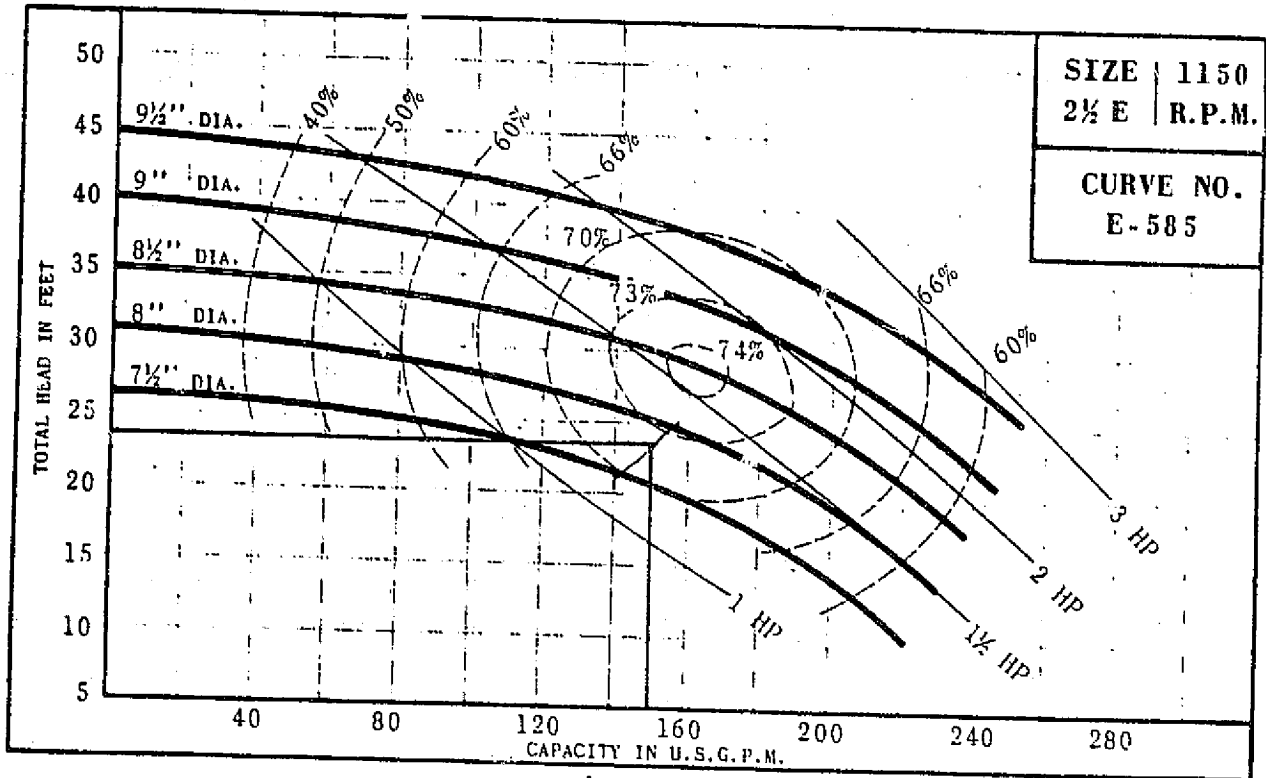
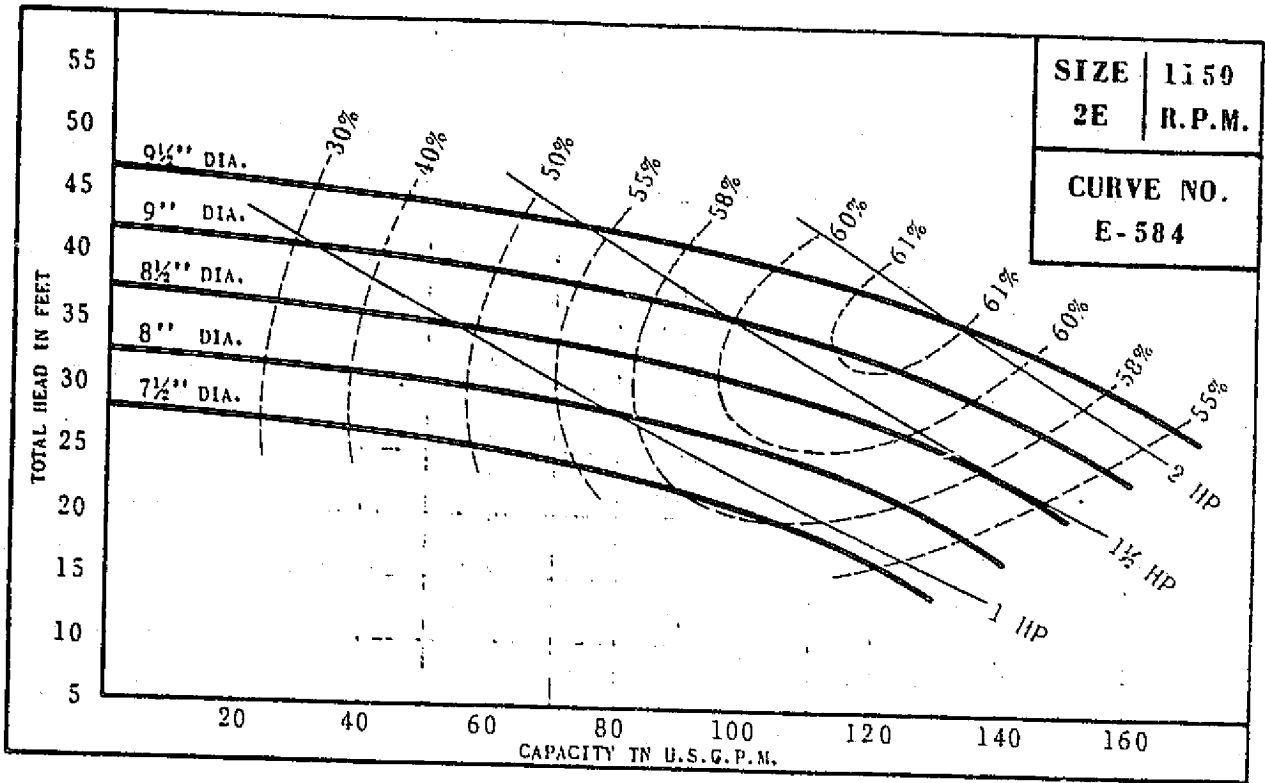
FILE NO.: 5048.37
 DATE: June 30, 1971
 SUPERSEDES: NEW
 DATE:

SERIES 4030-4035-4040

A



SERIES 4030-4035-4040 PERFORMANCE CURVES



ARMSTRONG CENTRIFUGAL PUMPS SUBMITTAL DATA

FILE NO.: 5043.96
DATE: Apr. 16, 1973
SUPERSEDES: 5043.9b
DATE: May 31, 1972

SERIES 4380

CUSTOMER

CUSTOMER'S ORDER NO.

ARMSTRONG REFERENCE

ENGINEER

JOB REFERENCE

SPECIFICATION REFERENCE

NO. OF PUMPS
2

QUOTATION REFERENCE

PUMP DESIGN DATA	
PUMP SIZE <i>3-D 2-D</i>	LIQUID
CAPACITY U.S.G.P.M. 150	TEMP. F.
FEET HEAD 34	SPECIFIC GRAVITY

MOTOR DESIGN DATA		
H.P. RATING 2	FRAME SIZE 145 JM	ENCLOSURE
SPEED R.P.M. 1750		
VOLTS 460	CYCLES 60	PHASE 3

PART NAME	CONSTRUCTION		
	ALL-IRON	BRONZE-FITTED <input checked="" type="checkbox"/>	ALL-BRONZE <input type="checkbox"/>
VOLUTE IMPELLER	CAST IRON	CAST IRON BRONZE	BRONZE BRONZE
BRACKET	CAST IRON	CAST IRON BRONZE	BRONZE BRONZE
SHAFT SLEEVE	PLATED STEEL		
MECH. SEAL	STEEL FITTED	BRASS FITTED	BRASS FITTED
SEAL RING	CARBON	CARBON	CARBON
SEAT INSERT	CERAMIC	CERAMIC	CERAMIC
INSERT GASKET	RUBBER	RUBBER	RUBBER
SPECIAL FEATURES	X		

SPECIFICATIONS	
<p>PUMP:- VERTICAL SHAFT, SINGLE STAGE, SINGLE SUCTION, RADIALY SPLIT CASING, IN-LINE MOUNTING CENTRIFUGAL TYPE WITH SINGLE MECHANICAL SEAL. IMPELLER MOUNTED DIRECTLY ON MOTOR SHAFT EXTENSION.</p> <p>MOTOR:- VERTICAL, SOLID SHAFT, CONTINUOUSLY RATED, BALL BEARING, SQUIRREL CAGE INDUCTION TYPE WITH NEMA "C" FLANGE AND EXTENDED SHAFT.</p>	

MAXIMUM WORKING PRESSURE - PUMP VOLUTE			
CAST IRON	175 PSIG	<input type="checkbox"/>	
CAST IRON	250 PSIG	<input type="checkbox"/>	
CAST STEEL	300 PSIG	<input type="checkbox"/>	
SPECIAL			<input type="checkbox"/>

REMARKS AND OR ACCESSORIES	
DIMENSIONS: SEE REVERSE SIDE	
PERFORMANCE: SEE FILE NO.	<i>AF 18</i>
	<i>OK</i>

PREPARED BY:

DATE:

FORM NO. 6448-B

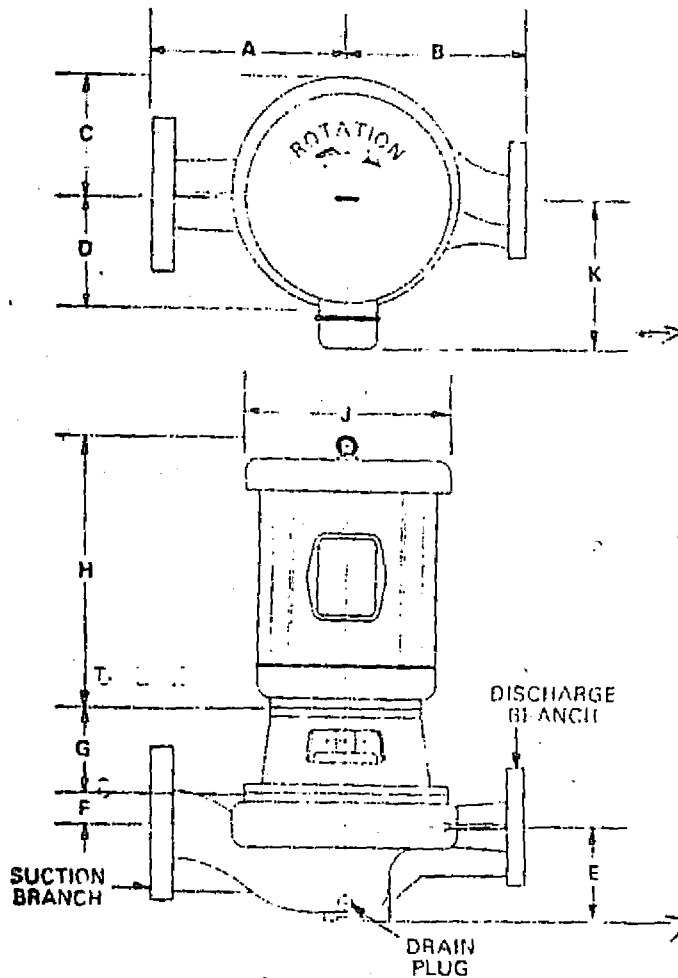


ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y. 14120

SERIES 4380

DIMENSIONAL DATA

All dimensions are in inches. For exact installation data, please write factory for certified dimensions.



PUMP DIMENSIONS								
PUMP SIZE	BRANCH SIZES		DIMENSIONS					
	Disch.	Suct.	A	B	C	D	E	F
1½D	1½	2	7	6½	4½	4¾	3¾	1½
2D	2	2½	8	7	5	4¾	4¼	1¾
3D	3	4	10	9	6½	5	5¼	1¾
4D	4	6	12	10	6½	5	6¼	2
1½E	1½	2	9½	9	6½	5¾	4¼	1¾
2E	2	3	11	10	7½	6¼	5¼	1¾
3E	3	4	12	11	7	6¼	6¼	1¾
4E	4	6	14	12	8½	6¾	8¼	2

FLANGE DETAILS								
BRANCH SIZE	125 LB. ASA CAST IRON 150 LB. ASA CAST STEEL				250 LB. ASA CAST IRON 300 LB. ASA CAST STEEL			
	Flange O.D.	No.	Boils Size	B.C.D.	Flange O.D.	No.	Boils Size	P.C.D.
1½	5	4	½	3¾	6½	4	½	4¼
2	6	4	¾	4¼	6½	6	¾	5
2½	7	4	¾	5½	7½	6	¾	5¾
3	7½	4	¾	6	8½	6	¾	6¼
4	9	8	¾	7½	10	8	¾	7¼
6	11	8	¾	9½	12½	12	¾	10¼

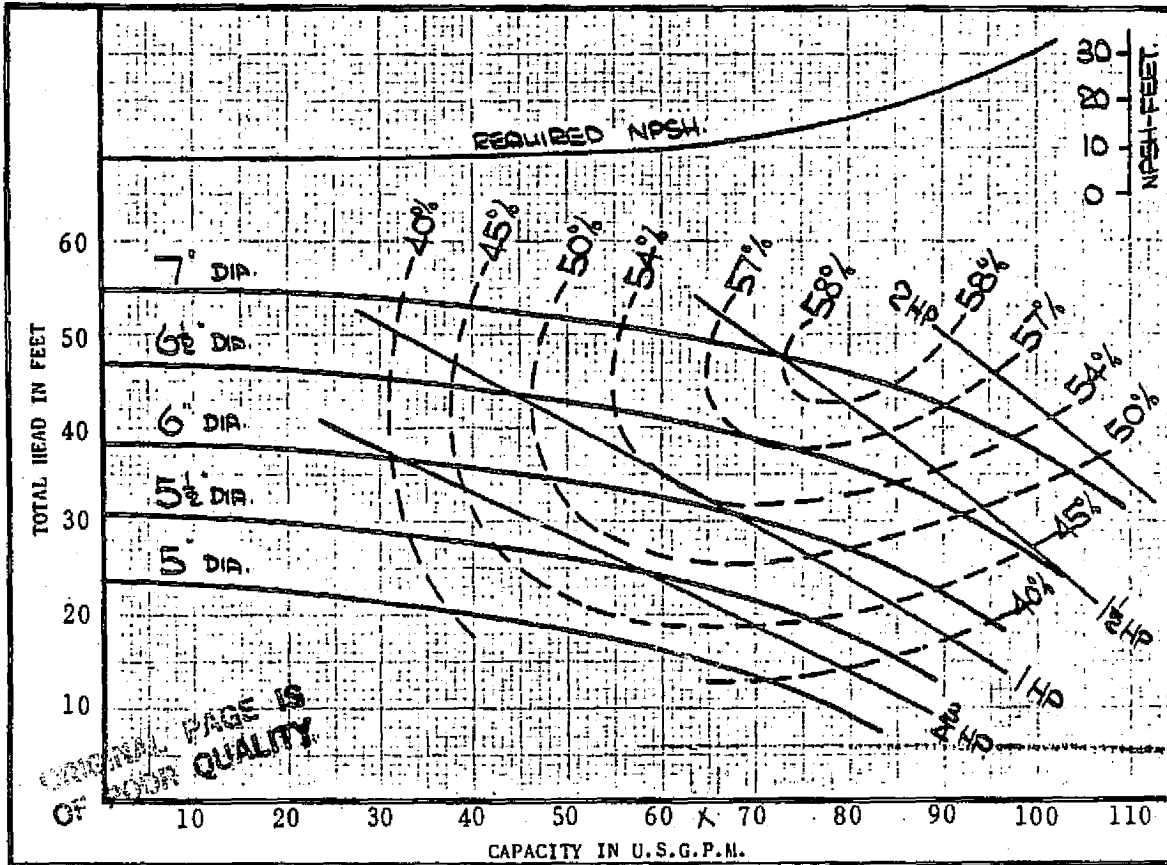
MOTOR DIMENSIONS (DRIP-PROOF AND T.E.F.C.)										
MOTOR FRAME SIZE SERIES 4380	HP @ 1700 RPM	HP @ 3600 RPM	DRIP-PROOF				T.E.F.C.			
			G	H	J	K	G	H	J	K
143JM	1	1½	3¼	9½	7	5¾	3¼	10¼	7¼	5¾
145JM	1½	2	3¼	10¼	7	5¾	3¼	11½	7¼	5¾
145JM	2	3	3¼	10¾	7	5¾	3¼	11½	7¼	5¾
182JM	3	5	3¼	10¾	9	8¼	3¼	12¾	9¼	8¼
184JM	5	7½	3¼	11¾	9	8¼	3¼	13¾	9¼	8¼
213JM	7½	10	3¼	13½	10¾	8¼	3¼	15½	11¼	9¼
215JA	10	15	3¼	13¾	10¾	8¼	3¼	15¾	11¼	9¼
254TCZ	15	20	7¼	18¼	12½	9¾	7¼	20¾	13¼	10¼
256TCZ	20	25	7¼	20¼	12½	9¾	7¼	22¾	13¼	10¼
284TCZ	25	30	7¼	21	14	11¼	7¼	23	15	12¾
286TCZ	30	40	7¼	22¼	14	11¼	7¼	24¼	15	12¾
324TCZ	40	50	7¼	23	16	14	7¼	25¼	17	15¼
326TCZ	50	60	7¼	24¼	16	14	7¼	26¼	17	15¼



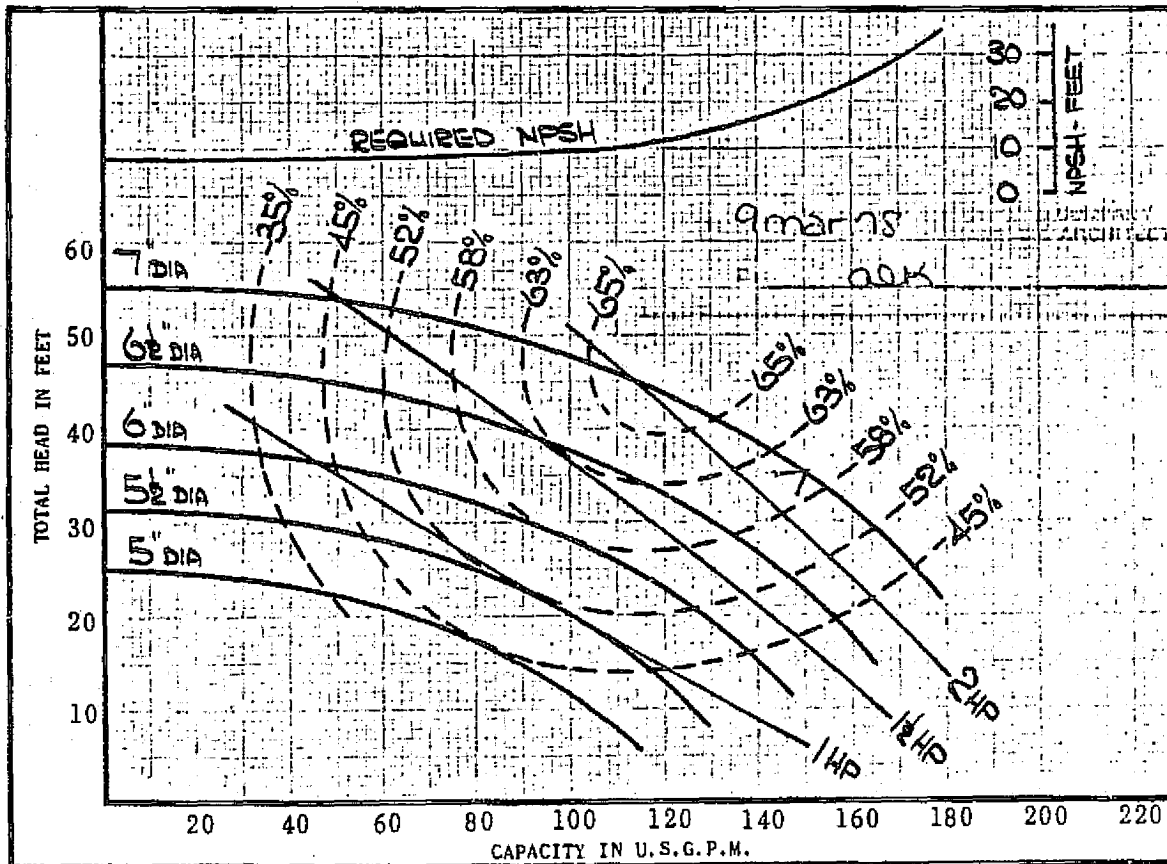
ARMSTRONG PERFORMANCE CURVES

SERIES 4300/80/85 1750 RPM

FILE NO: 5043.540
 DATE: Feb. 28, 1973
 SUPERSEDES: NEW
 DATE:



CURVE NO.	E-999
PUMP SERIES	4300/80/85
PUMP SIZE	1-1/2 D
SPEED, RPM	1750
VOLUTE PATT.	25521/2
IMP. PATT.	11860
AVAILABILITY	4300
	1 HP MINIMUM
	4380
	1 HP MINIMUM
4385	
1 HP MINIMUM	

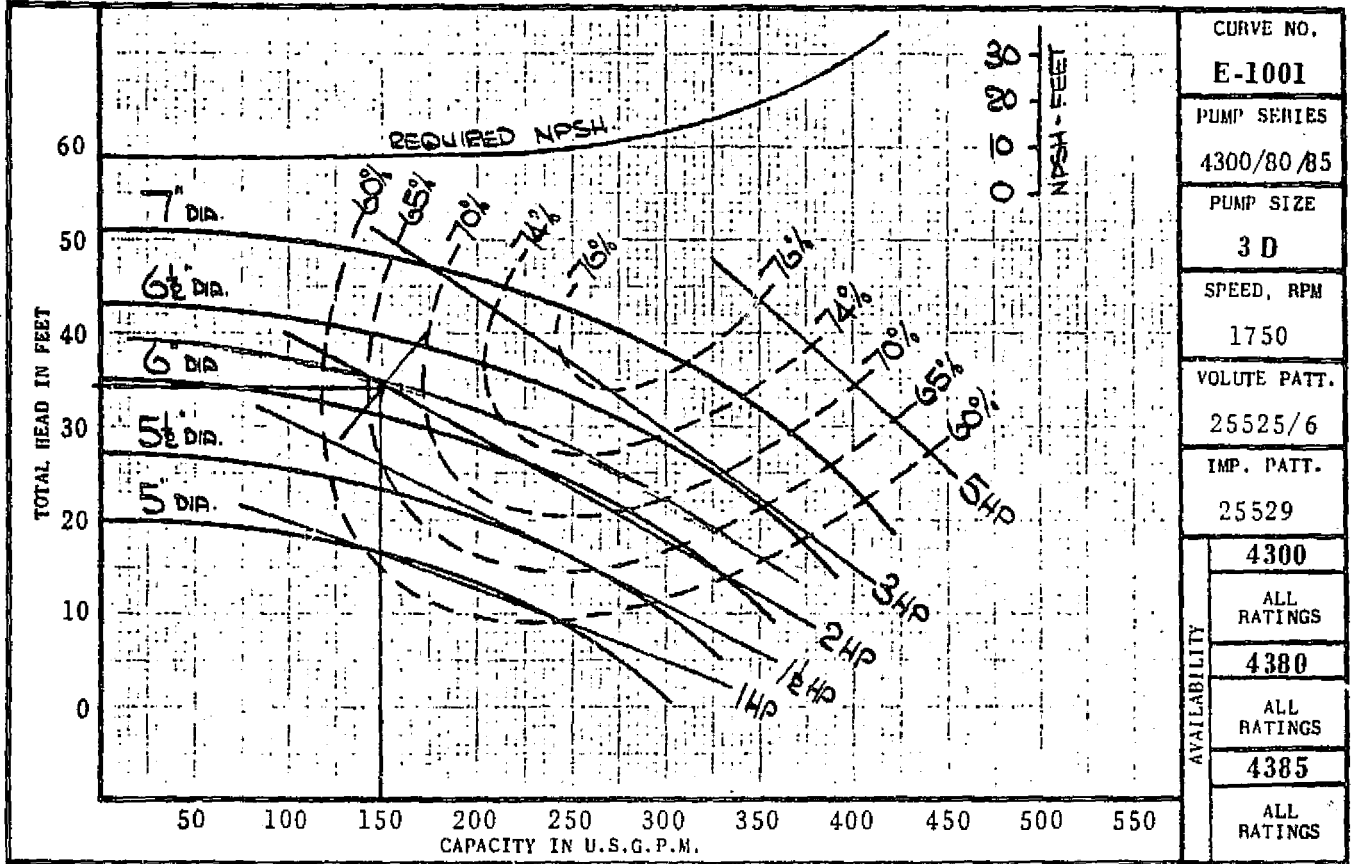


CURVE NO.	E-1000
PUMP SERIES	4300/80/85
PUMP SIZE	2 D
SPEED, RPM	1750
VOLUTE PATT.	25523/4
IMP. PATT.	11860
AVAILABILITY	4300
	ALL RATINGS
	4380
	ALL RATINGS
4385	
ALL RATINGS	

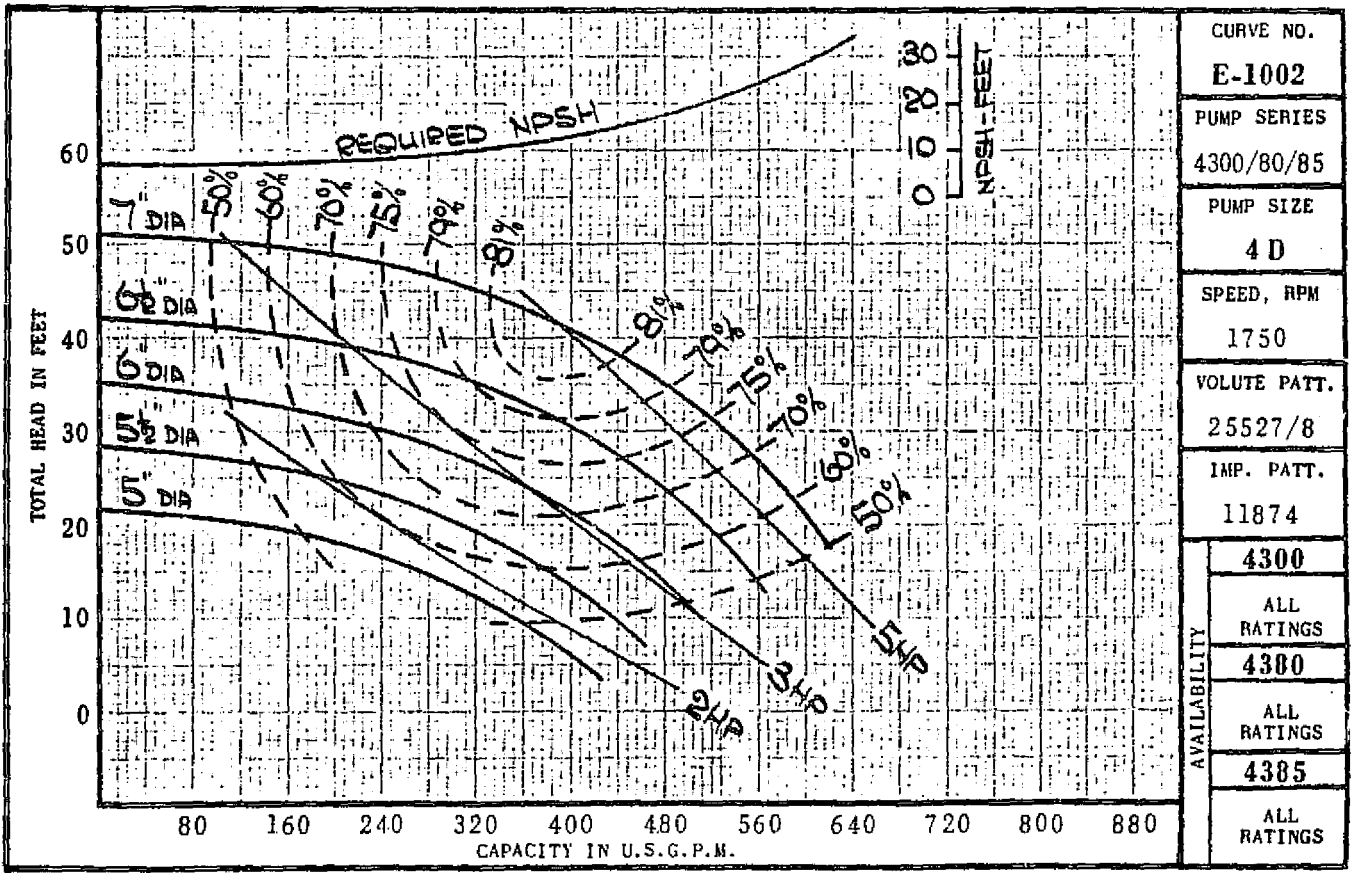


ARMSTRONG PERFORMANCE CURVES

SERIES 4300/00/85 - 1750 RPM (Cont'd)



CURVE NO.	E-1001
PUMP SERIES	4300/80/85
PUMP SIZE	3 D
SPEED, RPM	1750
VOLUTE PATT.	25525/6
IMP. PATT.	25529
4300	
ALL RATINGS	
4380	
ALL RATINGS	
4385	
ALL RATINGS	



CURVE NO.	E-1002
PUMP SERIES	4300/80/85
PUMP SIZE	4 D
SPEED, RPM	1750
VOLUTE PATT.	25527/8
IMP. PATT.	11874
4300	
ALL RATINGS	
4380	
ALL RATINGS	
4385	
ALL RATINGS	



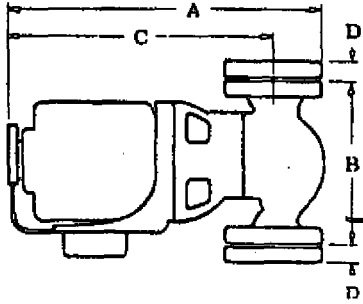
ARMSTRONG HIGH DUTY CIRCULATORS SUBMITTAL DATA

FILE NO.: 5010.92
DATE: July 30, 1970
SUPERSEDES: 5010.92
DATE: May 30, 1969

60 CYCLE - 1750 RPM

AC

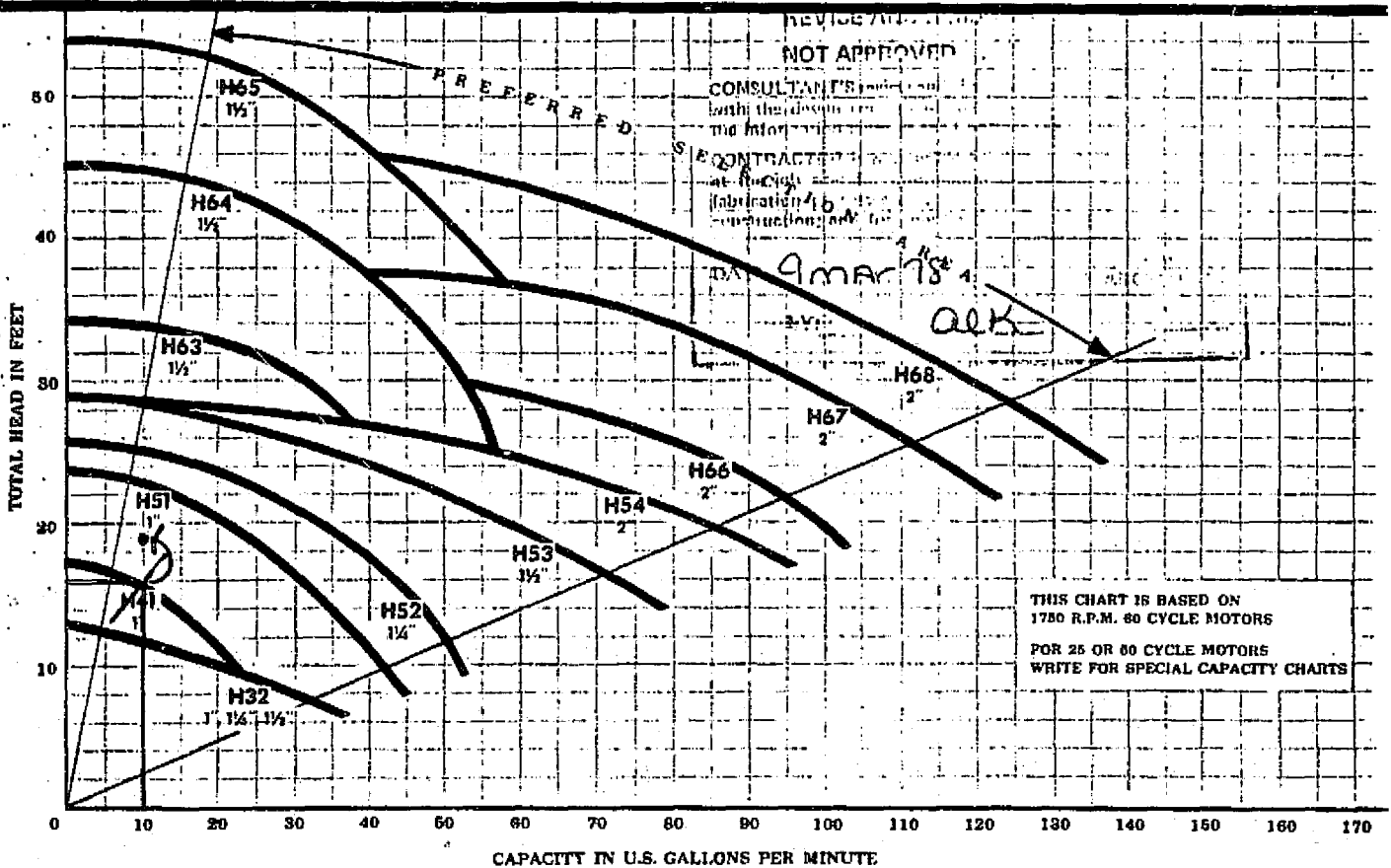
DIMENSIONS AND ELECTRICAL DATA



MODEL NO.	FLANGE PIPE SIZE IN INCHES	DIMENSIONS IN INCHES				MOTOR H.P. & CURRENT CHARACTERISTICS OF STANDARD 60 CYCLE EQUIPMENT		APPROX. SHIPPING WEIGHT IN LBS.
		A	B	C	D	H.P.	PHASE & VOLTS	
H32	1	15	8-1/2	12-1/2	7/8	1/6	1 Phase 115 Volt	38
	1-1/4	15	8-1/2	12-1/2	7/8	1/6		38
	1-1/2	15	8-1/2	12-1/2	7/8	1/6		38
H41	1"	15-1/4	8-1/2	12-1/2	3/4	1/6		39
H51	1"	17-1/4	11-1/2	13-1/2	3/4	1/4		57
H52	1-1/4	17-1/4	11-1/2	13-1/2	7/8	1/3	59	
H53	1-1/2	19-3/4	11-1/2	16	7/8	1/2	69	
H54	2	20	11-1/2	16-1/2	7/8	3/4	80	
H63	1-1/2	22	13-1/2	18-3/4	7/8	1/2	1 Phase 115/230 Volt or	102
H64	1-1/2	23	13-1/2	19-3/4	7/8	3/4		105
H65	1-1/2	23-1/2	13-1/2	20-1/4	7/8	1	3 Phase 208 or 230/460 Volt	110
H66	2	23-1/4	14	19-3/4	7/8	3/4		116
H67	2	23-3/4	14	20-1/4	7/8	1	3 Phase 208 or 230/460 Volt	120
H68	2	22-3/4	14	19-1/4	7/8	1-1/2		122

* Motors with special current characteristics available at extra charge as listed in price sheets.
All single phase motors are equipped with built-in thermal overload protection. 3 phase motors require external overload protection.

APPROVED
 APPROVED AS SHOWN



* Dimensions shown are for reference only. For exact installation data, write Marketing Division for certified dimensions.

ARMSTRONG HIGH DUTY CIRCULATORS SUBMITTAL DATA

MODELS: H32-H41-H51-H52-H53-H54-H63-H64-H65-H66-H67-H68 60 CYCLE 1750 RPM

CUSTOMER

CUSTOMER'S ORDER NO

ARMSTRONG REFERENCE

ENGINEER

JOB REFERENCE

SPECIFICATION REFERENCE

NO. OF PUMPS

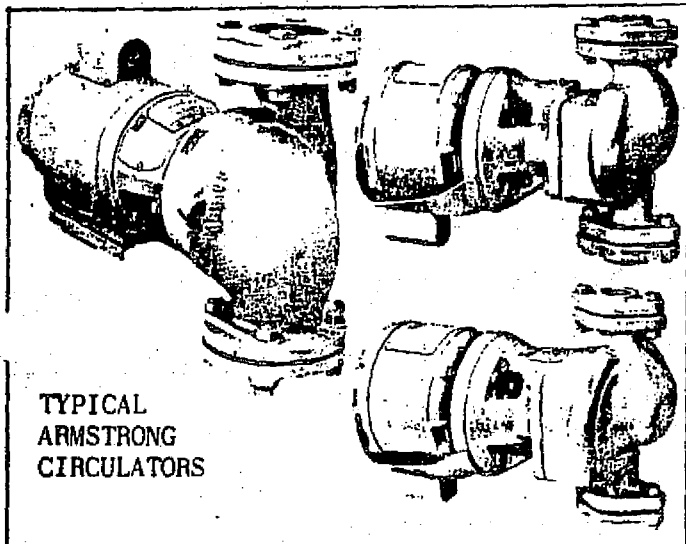
QUOTATION REFERENCE

PUMP DESIGN DATA	
PUMP MODEL AND SIZE: NOTE: Models H-32 and H-41 are down-discharge. Models H-51 thru H-68 are up-discharge.	
CAPACITY	TEMP. °F.
FEET HEAD	LIQUID
COMPANION FLANGES ARE FURNISHED FOR SUCTION AND DISCHARGE OF PUMP	

MOTOR DESIGN DATA		
H.P. RATING	ENCLOSURE	
SPEED R.P.M.		
VOLTS	CYCLES	PHASE
MAXIMUM WORKING PRESSURE: For Models H-32 and H-41 - 125 psi. For Models H-51 thru H-68 - 175 psi MAXIMUM STANDARD OPERATING TEMPERATURE: 225°F.		

PART NAME	STANDARD PUMP CONSTRUCTION	
	MODELS H-32 & H-41	MODELS H-51 THRU H-68
VOLUTE CASING	STANDARD Cast Iron	BRONZE FITTED Cast Iron
IMPELLER	Steel - Plated	H-51 to H-54: Brass - Stamped H-63 to H-68: Bronze - Cast
BEARINGS	Sleeve, Oil Lubricated	Sleeve, Oil Lubricated
SHAFT	Alloy Steel - Copper Sleeve	Alloy Steel - Copper Sleeve
SEAL	Mechanical	Mechanical
STATIONARY SEAT	Cast Iron	ARMSEAL Ceramic
COUPLER	Flexible, 4-Spring Type	Flexible Type
MOTOR (1750 rpm)	Sleeve, Resilient Mounted	Sleeve, Resilient Mounted

OPTIONAL FEATURES	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	HIGH TEMP. CONSTRUCTION STAINLESS STEEL SHAFT SPECIAL ELECTRICS ALL IRON CONSTRUCTION ALL BRONZE CONSTRUCTION BRONZE FITTED CONSTRUCTION SPECIAL MOTOR ENCL. _____



PREPARED BY:

DATE:

FORM NO. 6049C

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ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y. 14120



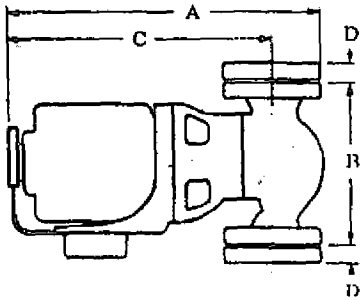
ARMSTRONG STANDARD CIRCULATORS

FILE NO.: 5010.90
 DATE: Aug. 15, 1973
 SUPERSEDES: 5010.90
 DATE: July 30, 1970

SUBMITTAL DATA

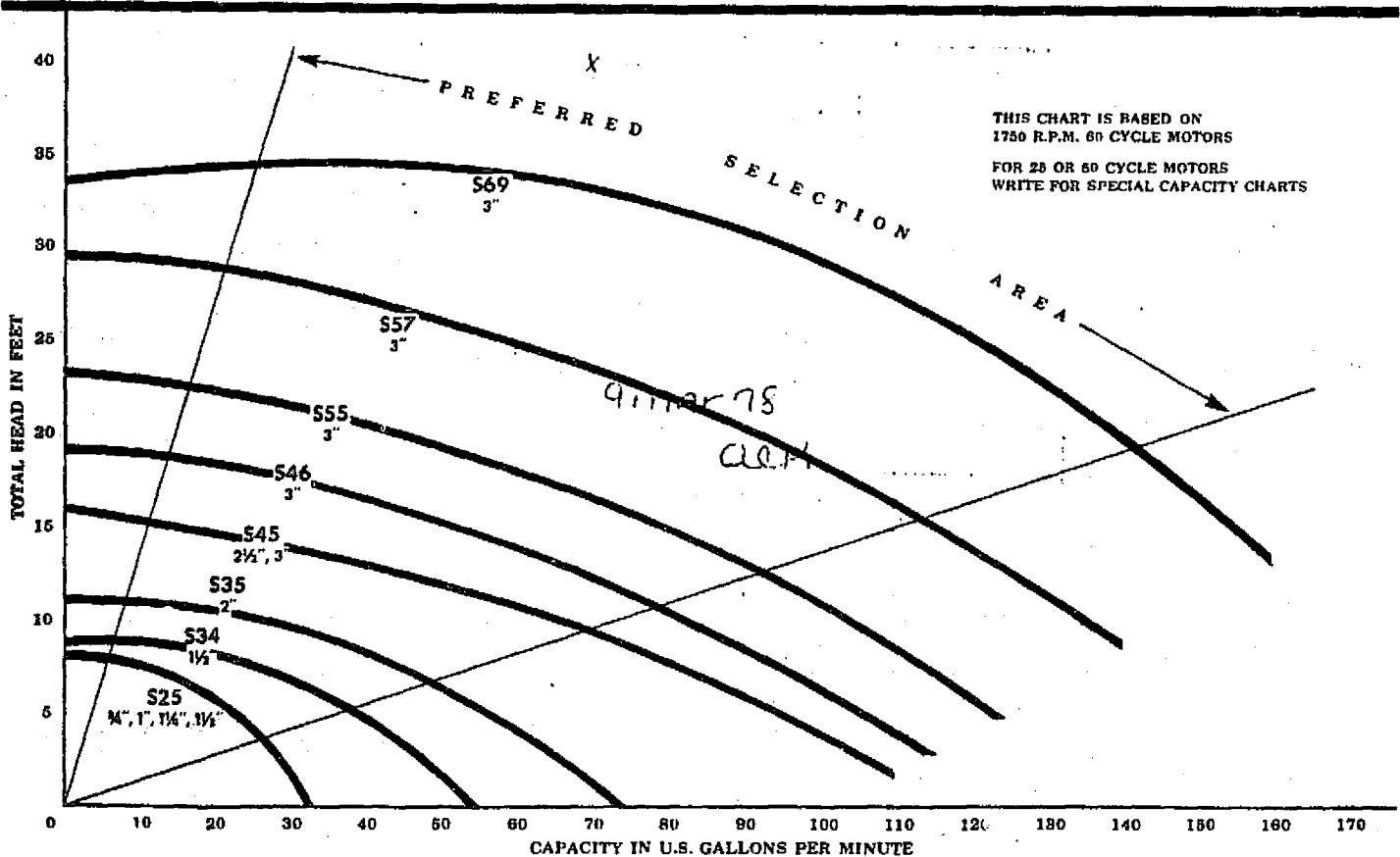
60 CYCLE - 1750 RPM

DIMENSIONS AND ELECTRICAL DATA



* Motors with special current characteristics available at extra charge as listed in price sheets.
 All single phase motors are equipped with built-in thermal overload protection. 3 phase motors require external overload protection.

MODEL NO.	FLANGE PIPE SIZE IN INCHES	DIMENSIONS IN INCHES				* MOTOR H.P. & CURRENT CHARACTERISTICS OF STANDARD 60 CYCLE EQUIPMENT			APPROX. SHIPPING WEIGHT IN LBS.
		A	B	C	D	H.P.	PHASE	VOLTS	
S25	3/4	13-3/4	6-1/2	11-1/2	3/4	1/12	1	115	24
	1	13-3/4	6-1/2	11-1/2	3/4	1/12	1		24
	1-1/4	13-3/4	6-1/2	11-1/2	7/8	1/12	1		24
	1-1/2	13-3/4	6-1/2	11-1/2	7/8	1/12	1		24
S34	1-1/2	15	6-1/2	12-1/2	7/8	1/6	1	36	
S35	2	15	8-1/2	12-1/2	7/8	1/6	1	41	
S45	2-1/2	15-3/4	10	12-1/2	1	1/4	1	56	
	3	15-3/4	10	12-1/2	1	1/4	1	56	
S46	3	15-3/4	10	12-1/2	1	1/3	1	65	
S55	3	19-1/2	12	16	1	1/2	1	115/230	82
	3	19-1/2	12	16	1	1/2	3	208 or 230/460	82
S57	3	20	12	16-1/2	1	3/4	1	115/230	85
	3	20	12	16-1/2	1	3/4	3	208 or 230/460	85
S69	3	25	14-1/4	20-1/4	1	1	1	115/230	135
	3	25	14-1/4	20-1/4	1	1	3	208 or 230/460	135



* Dimensions shown are for reference only. For exact installation data, write Marketing Division for certified dimensions.

ARMSTRONG STANDARD CIRCULATORS SUBMITTAL DATA

MODELS: S25-S34-S35-S45-S46-S55-S57-S69

60 CYCLE - 1750 RPM

CUSTOMER

CUSTOMER'S ORDER NO.

ARMSTRONG REFERENCE

ENGINEER

JOB REFERENCE

SPECIFICATION REFERENCE

NO. OF PUMPS

QUOTATION REFERENCE

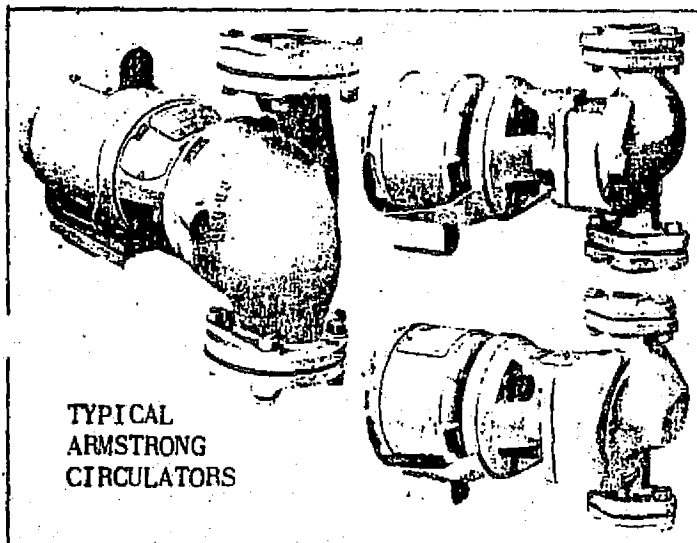
PUMP DESIGN DATA	
PUMP MODEL AND SIZE: NOTE: Models S25 to S46 are down-discharge. Models S55 to S69 are up-discharge.	
CAPACITY	TEMP. °F.
FEET HEAD	LIQUID
COMPANION FLANGES ARE FURNISHED FOR SUCTION AND DISCHARGE OF PUMP	

MOTOR DESIGN DATA		
H.P. RATING	ENCLOSURE	
SPEED R.P.M.		
VOLTS	CYCLES	PHASE

MAXIMUM WORKING PRESSURE: 125 psi
 MAXIMUM STANDARD OPERATING TEMP: 225°F.

PART NAME	CONSTRUCTION	
	STANDARD	ALL BRONZE
PUMP BODY	Cast Iron	Bronze
IMPELLER	Steel-Plated	Brass - Stamped
BEARINGS	Sleeve Oil Lubricated	Sleeve Oil Lubricated
SHAFT	Alloy Steel-Copper Sleeve	Alloy Steel-Copper Sleeve
SEAL	ARMSEAL Mechanical	ARMSEAL Mechanical
STATIONARY SEAL FACE ...	S25 to S46 - Cast Iron S55 to S69 - ARMSEAL Ceramic	ARMSEAL Ceramic
COUPLER	Flexible 4-Spring Type	Flexible 4-Spring Type
MOTOR: 1750 rpm	Sleeve Bearing Resilient-mounted	Sleeve Bearing Resilient-mounted

- | OPTIONAL FEATURES | |
|--------------------------|-------------------------|
| <input type="checkbox"/> | SPECIAL ELECTRICS |
| <input type="checkbox"/> | HIGH TEMP. CONSTRUCTION |
| <input type="checkbox"/> | SPECIAL MOTOR ENCLOSURE |
| <input type="checkbox"/> | ALL IRON CONSTRUCTION |
| <input type="checkbox"/> | BRONZE FITTED CONSTR. |
| <input type="checkbox"/> | STAINLESS STEEL SHAFT |
| <input type="checkbox"/> | SPECIAL COUPLER |



PREPARED BY:

DATE:



ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y.

ARMSTRONG FLEXIBLE PUMP CONNECTORS SUBMITTAL DATA

FILE NO. 5035.977
DATE: Nov. 1, 1973
SUPERSEDES: NEW
DATE:

MODELS TEC-1/2 TO TEC-2

FEC-2-1/2 TO FEC-12

CUSTOMER

CUSTOMER'S ORDER NO.

ARMSTRONG REFERENCE

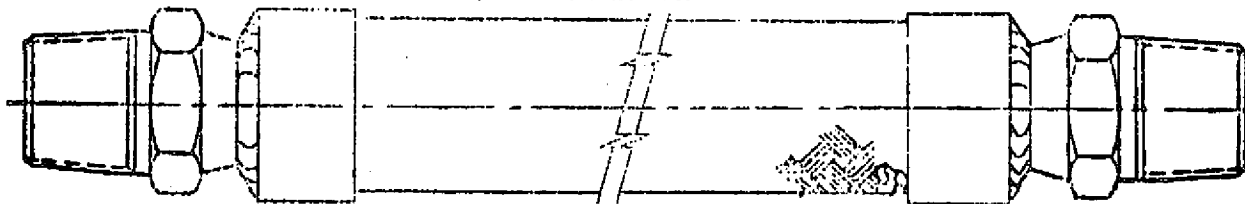
ENGINEER

JOB REFERENCE

SPECIFICATION REFERENCE
9 mar 78 ack

QUOTATION REFERENCE

MODEL TEC



CONSTRUCTION
SIZES 1/2" TO 1"

CONSTRUCTION
SIZES 1 1/2" TO 2"



QUANTITY REQUIRED	IDENTIFICATION	MODEL NO.	NOMINAL PIPE SIZE NPT	OVERALL LENGTH	MAXIMUM WORKING PRESSURE PSIG		APPROX. SHIPPING WT. LBS.
					AT 76°F	AT 250°F	
		TEC 1/2	1/2	6-1/2	1040	950	3/8
		TEC 3/4	3/4	7	600	550	1/2
		TEC 1	1	8	580	530	3/4
24		TEC 1-1/4	1-1/4	8-1/2	450	410	1
		TEC 1-1/2	1-1/2	9	410	375	1-1/4
		TEC 2	2	10-1/2	180	440	2-1/8

UNITS DESIGNED FOR PIPE VIBRATION PLUS 1/8" MISALIGNMENT. FOR PULSATING PRESSURE, REDUCE
MAXIMUM WORKING PRESSURE BY 50%.

FEATURES:

- CUSHES VIBRATION
- MINIMIZES STRESS ON PIPE AND EQUIPMENT
- REDUCES NOISE
- SAVES SPACE
- LONGER SERVICE LIFE

MATERIALS:

- FLANGES: STEEL CORRUGATED
- ENDING AND FLANGE
- BREADED ENDS: CARBON STEEL

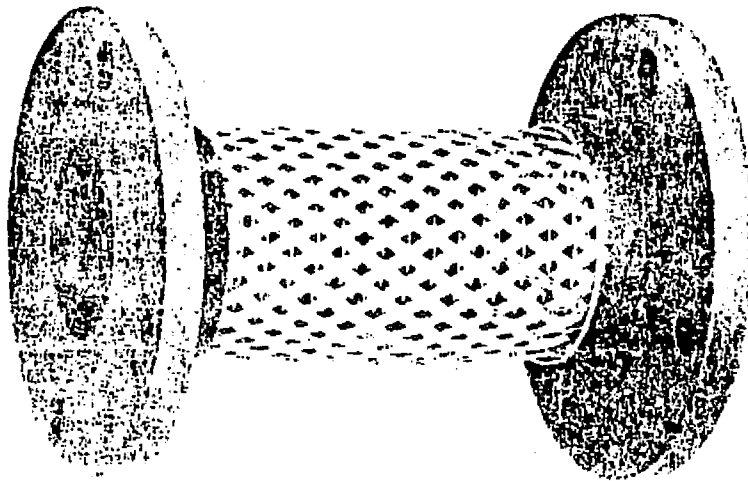
PREPARED BY

DATE



**ORIGINAL PAGE
OF POOR QUALITY**

ARMSTRONG FLEXIBLE PUMP CONNECTORS



MODEL FFC

QUANTITY REQUIRED	IDENTIFICATION	MODEL NO.	NOMINAL PIPE SIZE	*OVERALL LENGTH	MAXIMUM WORKING PRESSURE PSIG		APPROX. SHIPPING WT. LBS.
					AT 70°F	AT 250°F	
		FFC 2-1/2	2-1/2	9	500	460	13-1/4
		FFC 3	3	9	330	304	14-3/4
		FFC 4	4	9	230	212	19-3/4
		FFC 5	5	11	265	244	27-3/4
		FFC 6	6	11	240	221	32-1/2
		FFC 8	8	12	185	170	58-1/2
		FFC 10	10	13	165	152	76
		FFC 12	12	14	155	143	108

UNITS DESIGNED FOR PUMP VIBRATION PLUS 1/8" MISALIGNMENT, FOR PULSATING PRESSURE, REDUCE MAXIMUM WORKING PRESSURE BY 50%.

* FACE TO FACE

FEATURES:

- EQUALLY ABLE TO HANDLE CHILLED OR HOT WATER
- RESISTS VIBRATION
- MINIMIZES STRESS IN PIPE AND EQUIPMENT
- REDUCES NOISE
- SAVES SPACE
- LONGER SERVICE LIFE

MATERIALS:

- STAINLESS STEEL CORRUGATED TUBING AND BRAID
- STEEL FIXED FLANGES - ASA 150 LB STANDARD
- COMPANION FLANGES NOT INCLUDED

GENERAL

PIPING SHOULD BE ANCHORED SO THE PIPING WEIGHT DOES NOT REST ON THE PUMP CONNECTORS.

SPECIFICATION

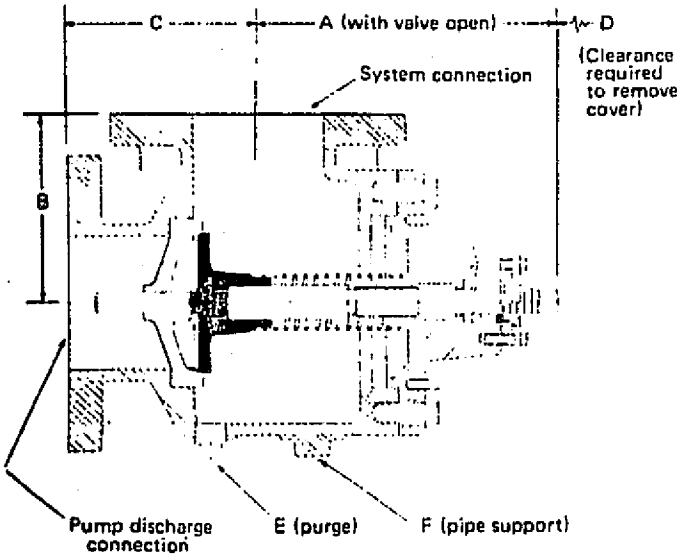
FURNISH AND INSTALL, WHEN SHOWN ON PLANS, ARMSTRONG FLEXIBLE PUMP CONNECTORS WITH STAINLESS STEEL BRAIDED REINFORCING AND FIXED ENDS.

MODELS _____ SIZES _____

ARMSTRONG

ANGLE TYPE FLO-TREX CONTROL VALVES

MODELS FTA-225 to FTA-68



PERFORMANCE

Model	Pressure Drop in Feet of Water					
	Line Velocity in Feet per Second					
	3 ft/sec.	4 ft/sec.	5 ft/sec.	6 ft/sec.	8 ft/sec.	10 ft/sec.
FTA-225						
FTA-23	2.4 ft	2.6 ft	2.9 ft	3.2 ft	4.3 ft	6.5 ft
FTA-2525	45 gpm	60 gpm	75 gpm	90 gpm	120 gpm	150 gpm
FTA-253						
FTA-33	2.3 ft	2.5 ft	2.7 ft	2.8 ft	3.8 ft	5.7 ft
FTA-34	70 gpm	92 gpm	115 gpm	138 gpm	185 gpm	230 gpm
FTA-44						
FTA-45	2.2 ft	2.3 ft	2.5 ft	2.7 ft	3.7 ft	5.5 ft
FTA-46	118 gpm	155 gpm	198 gpm	238 gpm	315 gpm	396 gpm
FTA-55						
FTA-56	2.1 ft	2.2 ft	2.3 ft	2.6 ft	3.5 ft	5.3 ft
	187 gpm	250 gpm	315 gpm	375 gpm	500 gpm	625 gpm
FTA-66						
FTA-68	2.0 ft	2.1 ft	2.2 ft	2.3 ft	3.4 ft	5.1 ft
	270 gpm	360 gpm	450 gpm	540 gpm	720 gpm	900 gpm

TYPICAL SPECIFICATION

Furnish and install on the discharge line of each pumping unit an Armstrong Model FTA Angle Type Combination Shut-off, Balancing and Check Valve, with positive spring-loaded seating, flanged cast iron body, bronze disc and seat, and stainless steel stem and spring.

Valve is to be installed to allow for valve stem clearance.

MATERIALS OF CONSTRUCTION

BODY	cast iron
DISC and SEAT	bronze
STEM	stainless steel
SPRING	stainless steel
PACKING	graphited asbestos

DIMENSIONS*

Model	Connection Sizes Flanged 125 lb A.S.A.		DIMENSIONS (inches)							Max. Body Dia.	Wt
	Inlet	Outlet	A	B	C	D	E	F			
FTA-225	2	2-1/2	8-1/4	4-1/4	4-1/4	4-1/2	1/2	1	7	38	
FTA-23	2	3	8-1/4	4-11/16	4-1/4	4-1/2	1/2	1	7-1/2	42	
FTA-2525	2-1/2	2-1/2	8-1/4	4-1/4	4-1/4	4-1/2	1/2	1	7	43	
FTA-253	2-1/2	3	8-1/4	4-11/16	4-1/4	4-1/2	1/2	1	7-1/2	50	
FTA-33	3	3	8-5/8	4-3/4	4-3/4	5-1/4	3/4	1	7-1/2	56	
FTA-34	3	4	8-5/8	5-5/8	4-3/4	5-1/4	3/4	1	9	65	
FTA-44	4	4	10-1/8	5-3/4	5-3/4	6	3/4	1-1/4	9-1/4	98	
FTA-45	4	5	10-1/8	6-5/8	5-3/4	6	3/4	1-1/4	10	102	
FTA-46	4	6	10-1/8	7-1/2	5-3/4	6	3/4	1-1/4	11	107	
FTA-55	5	5	11-5/8	6-1/2	6-1/2	7	1	1-1/4	10-3/4	138	
FTA-56	5	6	11-5/8	7-3/8	6-1/2	7	1	1-1/4	11	142	
FTA-66	6	6	13	7	7	8	1	2	12-3/4	148	
FTA-68	6	8	13	8-3/4	7	8	1	2	13-1/2	153	

* Consult factory for certified dimensions

DESIGN INFORMATION

Maximum working pressure 175 psig

Maximum working temperature 300°F

9 MAR 78

ALM

ARMSTRONG SUCTION GUIDE SUBMITTAL DATA

FILE NO.: 5035.94
DATE: Feb. 15, 1974
SUPERSEDES: 5035.94
DATE: March 31, 1971

MODELS: SG-252 TO SG-1010

CUSTOMER

CUSTOMER'S ORDER NO.

ARMSTRONG REFERENCE

ENGINEER

JOB REFERENCE

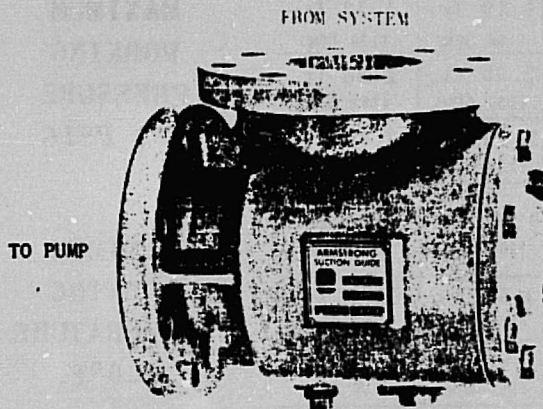
SPECIFICATION REFERENCE

QUOTATION REFERENCE

QUANTITIES REQUIRED

MAXIMUM WORKING PRESSURE 175 PSIG - MAXIMUM WORKING TEMPERATURE 300°F.

MODEL NUMBER	CONNECTION SIZES 125 LB A.S.A. FLANGED		QUANTITY REQUIRED	IDENTIFICATION
	INLET FROM SYSTEM	OUTLET TO PUMP		



TYPE SG SUCTION GUIDE

PREPARED BY

DATE:

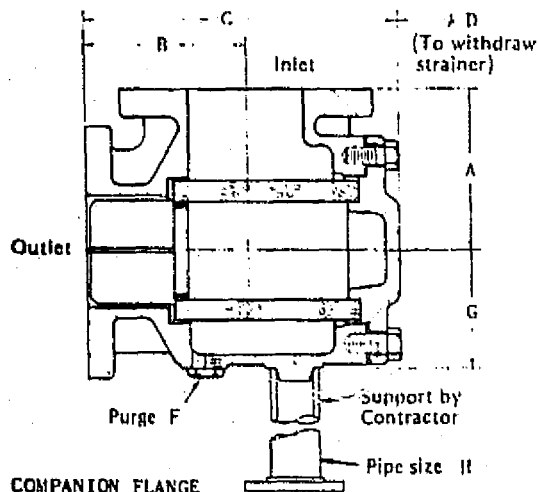
Form No. 6430-A
Litho in Canada



ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y. 14120

ARMSTRONG SUCTION GUIDE

FOR USE ON SUCTION CONNECTION OF CENTRIFUGAL PUMP
 ... TO SAVE SPACE, SIMPLIFY PIPING AND PROVIDE
 STEADY FLOW CONDITION AT PUMP INLET.



MATERIAL

BODY CAST IRON
 STRAINER STAINLESS STEEL
 START-UP STRAINER FINE MESH BRASS
 (Remove and dispose of start-up strainer after 1 month operation)
 GUIDE VANES STEEL

DIMENSIONS

MODEL NO.	125# A. S. A.		STRAINER OPENINGS DIA.	STRAINER FREE AREA (SQ. IN)	DIMENSIONS (INCHES)								APPROX. SHIPPING WT. LBS.
	INLET	OUTLET			A	B	C	D	WIDTH E	F	G	H	
SG-252	2 1/2"	2"	1 8"	37	4-1 4	4-1 4	8-1 2	4-3 4	7	1 2	3-1 8	1	36
SG-32	3	2	1 8	37	4-11 16	4-1 4	8-1 2	4-3 4	7-1 2	1 2	3-1 8	1	37
SG-252S	2 1/2	2 1/2	1 8	37	4-1 4	4-1 4	8-1 2	4-3 4	7	1 2	3-1 8	1	40
SG-325	3	2 1/2	1 8	37	4-11 16	4-1 4	8-1 2	4-3 4	7-1 2	1 2	3-1 8	1	41
SG-33	3	3	1 8	50	4-3 4	4-3 4	9-1 2	5-1 2	7-1 2	3 4	3-5 8	1	53
SG-43	4	3	1 8	50	5-5 8	4-3 4	9-1 2	5-1 2	9	3 4	3-5 8	1	55
SG-44	4	4	1 8	82	5-3 4	5-3 4	11-1 2	7	9	3 4	4-1 4	1 4	75
SG-54	5	4	1 8	82	6-5 8	5-3 4	11-1 2	7	10	3 4	4-1 4	1 4	81
SG-64	6	4	1 8	82	7-1 2	5-3 4	11-1 2	7	11	3 4	4-1 4	1 4	86
SG-55	5	5	1 8	104	6-1 2	6-1 2	12-3 4	8	10	1	4-7 8	1 4	95
SG-65	6	5	1 8	104	7-3 8	6-1 2	12-3 4	8	11	1	4-7 8	1 4	106
SG-66	6	6	1 8	153	7	7	14-1 4	9-1 4	11-1 4	1	5-3 4	2	146
SG-86	8	6	1 8	153	8-3 4	7	14-1 4	9-1 4	13-1 2	1	5-3 4	2	151
SG-88	8	8	1 8	275	9-1 4	9-1 4	18	12-1 4	13-3 4	1	7	2	240
SG-108	10	8	1 8	275	11	9-1 4	18	12-1 4	16	1	7	2	265
SG-1010	10	10	1 8	420	11-1 4	11-1 4	22-1 2	15	16	1	8-1 8	2	360

PERFORMANCE

MODEL NO.	PRESSURE DROP IN FEET OF WATER							
	VELOCITY IN FT./SEC.							
	3 FT. SEC.	4 FT. SEC.	5 FT. SEC.	6 FT. SEC.	8 FT. SEC.	10 FT. SEC.	12 FT. SEC.	
SG-252	.11 ft.	.20 ft.	.32 ft.	.43 ft.	.80 ft.	1.28 ft.	1.72 ft.	
SG-32	(32 GPM)	(43 GPM)	(54 GPM)	(67 GPM)	(105 GPM)	(108 GPM)	(128 GPM)	
SG-252S	.18 ft.	.32 ft.	.50 ft.	.72 ft.	1.28 ft.	2.00 ft.	2.88 ft.	
SG-325	(45 GPM)	(60 GPM)	(75 GPM)	(90 GPM)	(120 GPM)	(150 GPM)	(180 GPM)	
SG-33	.20 ft.	.35 ft.	.55 ft.	.80 ft.	1.42 ft.	2.20 ft.	3.15 ft.	
SG-43	(70 GPM)	(92 GPM)	(115 GPM)	(138 GPM)	(185 GPM)	(230 GPM)	(276 GPM)	
SG-44	.17 ft.	.29 ft.	.47 ft.	.68 ft.	1.20 ft.	1.90 ft.	2.75 ft.	
SG-54	(118 GPM)	(155 GPM)	(198 GPM)	(238 GPM)	(315 GPM)	(396 GPM)	(475 GPM)	
SG-64	.17 ft.	.29 ft.	.47 ft.	.68 ft.	1.20 ft.	1.90 ft.	2.75 ft.	
SG-55	.23 ft.	.41 ft.	.67 ft.	.95 ft.	1.70 ft.	2.65 ft.	3.80 ft.	
SG-65	(187 GPM)	(250 GPM)	(315 GPM)	(375 GPM)	(500 GPM)	(625 GPM)	(750 GPM)	
SG-66	.22 ft.	.38 ft.	.60 ft.	.86 ft.	1.54 ft.	2.40 ft.	3.45 ft.	
SG-86	(270 GPM)	(360 GPM)	(450 GPM)	(540 GPM)	(720 GPM)	(900 GPM)	(1080 GPM)	
SG-88	.21 ft.	.37 ft.	.58 ft.	.85 ft.	1.50 ft.	2.30 ft.	3.35 ft.	
SG-108	(470 GPM)	(625 GPM)	(780 GPM)	(940 GPM)	(1250 GPM)	(1550 GPM)	(1870 GPM)	
SG-1010	.26 ft.	.46 ft.	.73 ft.	1.03 ft.	1.85 ft.	2.92 ft.	4.20 ft.	
	(740 GPM)	(980 GPM)	(1230 GPM)	(1480 GPM)	(1960 GPM)	(2450 GPM)	(2940 GPM)	

**MAXIMUM
 WORKING
 PRESSURE
 175 PSIG**

**MAXIMUM
 WORKING
 TEMPERATURE
 300°F.**

DIFFERENTIAL PUMP CONNECTORS

NEW PRODUCT PRE-CATALOG RELEASE

MODEL 152-TR-1215

FOR PUMP SUCTION AND DISCHARGE LINES

The new Keflex Bellows Type Differential Pump Connectors, Model 152-TR-1215, are designed to compensate for multi-plane axial, lateral and angular movement in non-torsional applications. At the same time, they *eliminate* the need for a *separate expander* on the pump discharge or a *separate reducer* on the pump suction side. By eliminating this steel taper, the differential pump connector saves the cost of the taper, plus the cost of installing it and the valuable space it would normally occupy.

The new differential pump connector has retained the same superior design characteristics as the Keflex standard bellows pump connector. It is capable of a maximum operating pressure of 150 PSIG and a maximum operating temperature of 800° F. The unit can also achieve a total axial traverse of 5/8" (1/2" compression, 1/8" extension), a total lateral

movement of 1/2" (1/16" each side of center line), and an angular offset of 3-1/2 degrees maximum. Heavy duty restraining rods and spacers assure protection against bellows distortion in the event anchors are not properly secured. Chatterproof spacers absorb mechanical vibration without hampering axial, lateral and angular movement of the connector.

The new Keflex differential pump connector is currently available in eight sizes as listed on the opposite page. Contact the factory for other size combinations you may have or need.

TO ORDER: Specify the differential pipe sizes desired (i.e. 4" x 3") followed by the model number 152-TR-1215.

Refer to Keflex Bulletin KPC-3 for installation and other operational data, also for other pump connector models.

This page has been removed because of copyright material. For information on the Keflex Differential Pump Connectors, contact Keflex, Inc., 225 S. Main Street, Bartlett, Illinois 60103.

ARMSTRONG VORTEX AIR SEPARATOR SUBMITTAL DATA

FILE NO. 5035.955
DATE: Sept. 30, 1974
SUPERSEDES: 5035.955
DATE: May 10, 1974

MODELS: VA-2 TO VA-12 LESS STRAINER
VAS-2 TO VAS-12 WITH STRAINER

CUSTOMER

CUSTOMER'S ORDER NO.

ARMSTRONG REFERENCE

ENGINEER

JOB REFERENCE

SPECIFICATION REFERENCE

QUOTATION REFERENCE

MODEL NUMBER	MAXIMUM FLOW
	USGPM

WORKING CONDITIONS
MAXIMUM WORKING PRESSURE 125 psi
MAXIMUM WORKING TEMPERATURE 350°F
HYDROSTATIC TEST PRESSURE 200 psi

CONSTRUCTION OF VORTEX AIR SEPARATOR
<p>Fabricated steel shell constructed according to ASME Code for Unfired Pressure Vessels.</p> <p>Form U-1A Manufacturer's Data Sheet signed by N.B. Inspector provided in accordance with ASME Code for the following units ONLY: VA5 - VAS5 to VA12 - VAS12 inclusive.</p> <p>Certificates are not required, and are not available, for smaller Units VA2 - VAS2 to VA4 - VAS4 inclusive.</p> <p>Connections provided for:</p> <ul style="list-style-type: none"> (a) Main inlet and outlet flow (b) Air connections for line to compression tank (c) Drain flushing connection at bottom to eliminate dirt and sediment (d) With strainer () without strainer () <p style="text-align: center;">J.S. PATENT NO. 3771290</p>

SPECIFICATIONS
<p>VERTICALLY MOUNTED AIR SEPARATOR HAVING STEEL TANK WITH TANGENTIAL INLET AND OUTLET FOR SEPARATION OF AIR IN HYDRONIC SYSTEM AND TO ACT AS A SEDIMENT TRAP. REMOVABLE STEEL AIR COLLECTOR TUBE.</p> <p>SUITABLE FOR PIPE-LINE MOUNTING.</p>

PREPARED BY:

DATE:

Form No. 6429-D
Litho in Canada

REMARKS AND/OR ACCESSORIES
<p>DIMENSIONS: SEE REVERSE SIDE</p>

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ARMSTRONG PUMPS INC.
North Tonawanda, N. Y. 14120

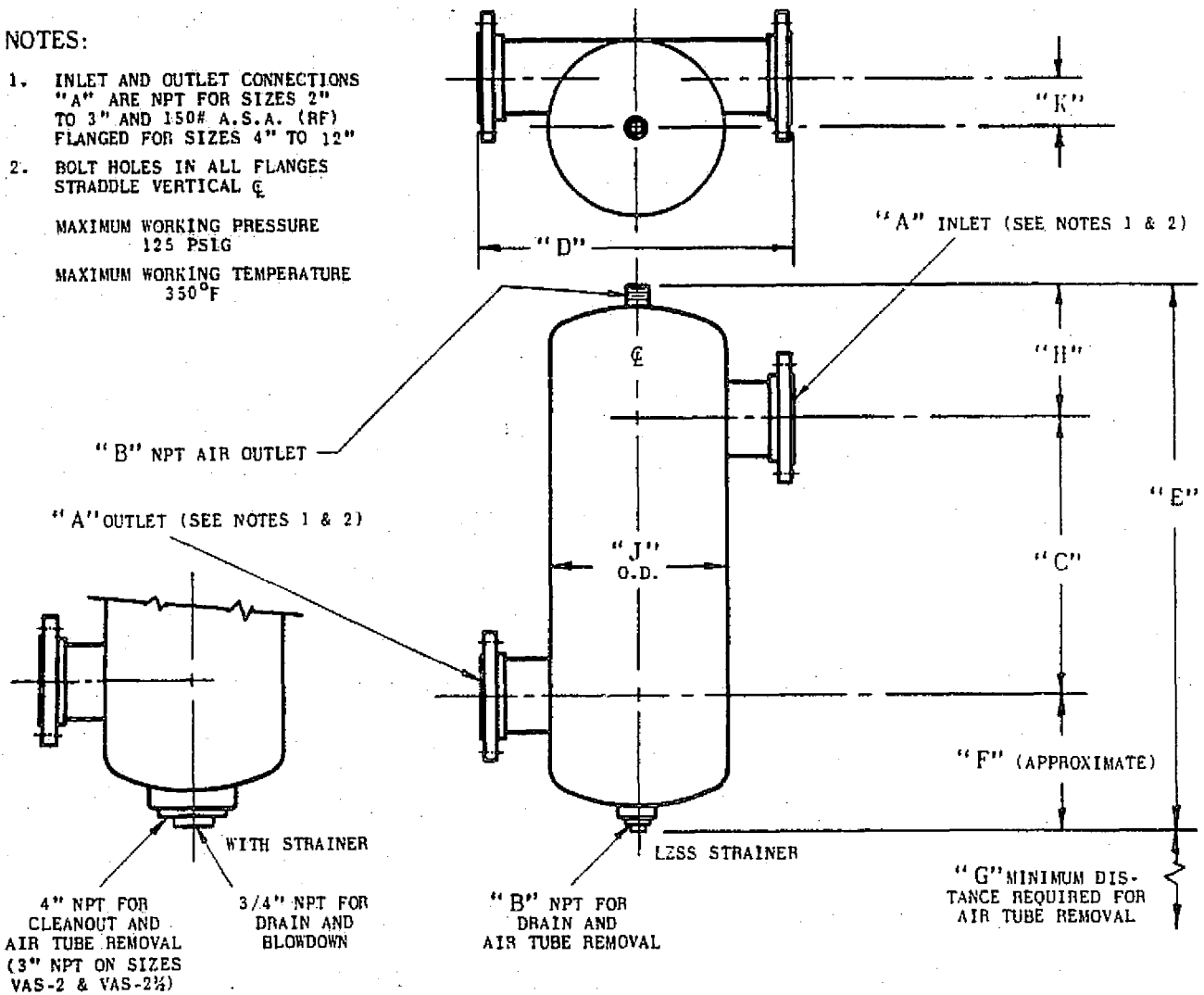
DIMENSIONAL DATA - ARMSTRONG VORTEX AIR SEPARATOR

NOTES:

1. INLET AND OUTLET CONNECTIONS "A" ARE NPT FOR SIZES 2" TO 3" AND 150# A.S.A. (RF) FLANGED FOR SIZES 4" TO 12"
2. BOLT HOLES IN ALL FLANGES STRADDLE VERTICAL C

MAXIMUM WORKING PRESSURE
125 PSIG

MAXIMUM WORKING TEMPERATURE
350°F



MODEL NUMBER		DIMENSIONS (IN INCHES)												MAX. FLOW USGPM	APPROX. WEIGHT LBS.	
LESS STR.	WITH STR.	A	B	C	D	E		F		G	H	J	K		LESS STR.	WITH STR.
						LESS STRAINER	WITH STRAINER	LESS STRAINER	WITH STRAINER							
VA-2	VAS-2	2	1	6	10	18-1/2	6-1/2	19-3/8	7-1/4	14	6-1/8	5-15/16	1-3/4	60	22	34
VA-2½	VAS-2½	2½	1	7	12	18-5/8	5-7/8	19-3/8	6-3/4	15	5-5/8	6-5/8	1-7/8	90	28	40
VA-3	VAS-3	3	1	7-1/2	14	20-3/8	6-5/8	21-1/2	7-3/4	16	6-1/4	8-5/8	2-9/16	180	36	48
VA-4	VAS-4	4	1-1/2	9-1/2	18	24-1/2	7-3/4	25-1/2	8-3/4	20	7-1/4	10-3/4	3-1/8	310	92	103
VA-5	VAS-5	5	1-1/2	11	20	27-3/4	8-5/8	28-3/4	9-5/8	23	8-1/8	12-3/4	3-5/8	500	122	133
VA-6	VAS-6	6	1-1/2	12-1/2	24	31-1/4	9-5/8	32-3/8	10-3/4	26	9-1/8	16	4-11/16	725	196	208
VA-8	VAS-8	8	2	16	28	39-3/8	12	40-3/8	13	33	11-3/8	20	5-11/16	1250	372	384
VA-10	VAS-10	10	2	20	32	46-7/8	13-3/4	47-7/8	14-3/4	40	13-1/8	24	6-5/8	2000	526	540
VA-12	VAS-12	12	2	26	38	57-3/8	16	58-3/8	17	49	15-3/8	30	8-5/8	2800	805	820



ARMSTRONG

AIR CONTROL DEVICES FOR HYDRONIC SYSTEMS

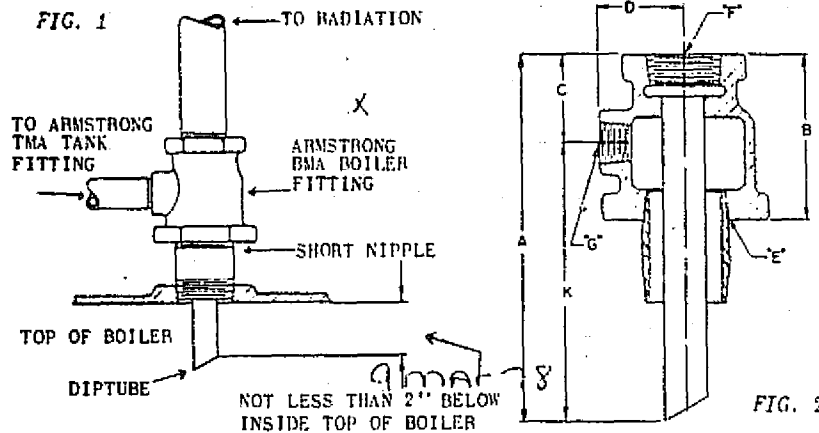
FILE NO.: 5011.90
DATE: Feb. 28/69
SUPERSEDES: 5011.90
DATE: Oct. 24/66

AC

should be TMA-10

ARMSTRONG BMA BOILER FITTING

Armstrong BMA Boiler Fittings are made in sizes 1" through 4". The size selected should be the same as the supply main at the boiler. The Armstrong Boiler Fitting is designed to remove the air at the point of release - the boiler.



All dimensions in inches

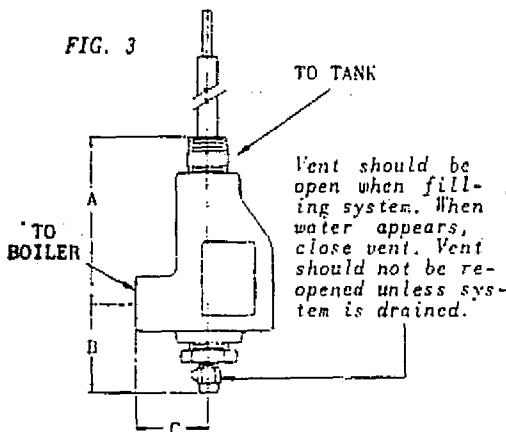
UNIT NO.	A	B	C	D	PIPE THREAD			K
					E	F	G	
BMA 1	10½	4	2½	1½	2	1	¾	7
BMA 1½	10½	4	2½	1½	2	1½	¾	7
BMA 1½	10½	4	2½	1½	2	1½	¾	7
BMA 2	12½	4½	2½	2½	3	2	¾	8½
BMA 2½	12½	4½	2½	2½	3	2½	¾	8½
BMA 3	14½	4¾	2¾	3	4	3	¾	10½
BMA 4	15½	4¾	2¾	4½	6	4	1½	11½

INSTALLATION NOTE

When installing Armstrong BMA Boiler Fittings, care should be taken to ensure that diptube does not strike any obstruction in boiler. If standard diptube is too long for insertion in boiler, diptube may be cut to suit. Diptube must always be installed below inside top of boiler. See Fig. 1.

ARMSTRONG TMA TANK FITTING

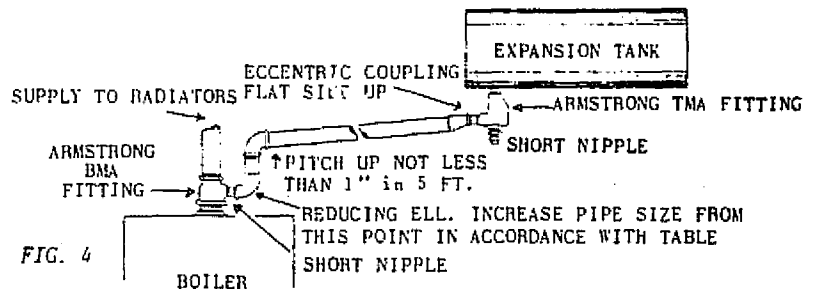
The Armstrong Tank Fitting is designed to maintain the correct amount of air in the expansion tank. When selecting the Armstrong Tank Fitting it is important that the diameter of the expansion tank be known and a Tank Fitting be selected to suit as follows: -



SIZE	TANK DIAMETER	CONNECTIONS - NPT		A	B	C
		TO TANK	TO BOILER			
TMA-9	9"					
TMA-12	12, 13 or 14"					
TMA-16	16"					
TMA-18	18"	1/2"	3/4"	3-1/2"	2"	1-5/8"
TMA-20	20"					
TMA-24	24"					
TMA-L	48"	1"	1-1/4"	4-1/2"	2-3/4"	2"

* TMA-L may be used for smaller diameter tanks. Cut tubing on installation to length equal to 2/3 diameter of tank.

PIPE SIZING FROM BOILER TO TMA TANK FITTING		
DISTANCE OF HORIZONTAL PIPE FROM BOILER TO FURTHEST TANK		
UNDER 7 FT.	OVER 7 FT. UNDER 20 FT.	OVER 20 FT. UNDER 40 FT.
¾"	1"	1½"



CAUTION: - When using several Armstrong Boiler Fittings on one boiler, only one Boiler Fitting should be connected to a Tank Fitting. Expansion tank connections on remaining Boiler Fittings must be plugged.

ARMSTRONG

SUBMITTAL DATA

AIR CONTROL DEVICES FOR HYDRONIC SYSTEMS

125 psig WORKING PRESSURE - 250°F MAXIMUM OPERATING TEMPERATURE

CUSTOMER

CUSTOMER'S ORDER NO.

ARMSTRONG REFERENCE

ENGINEER

JOB REFERENCE

SPECIFICATION REFERENCE

QUOTATION REFERENCE

BMA BOILER AIR FITTING

SIZE	1	1¼	1½	2	2½	3	4
No. Req.							

TMA TANK AIR FITTING

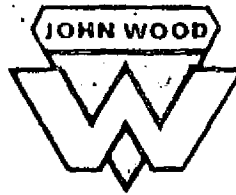
SIZE	9	12	16	18	20	24	L
No. Req.							

PREPARED BY:

DATE:



ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y. 14120

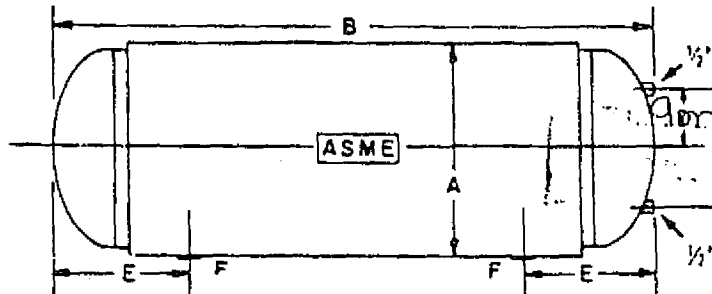


Conshohocken, Pa. 19428

TELEPHONE NUMBER 215-825-9110
215-828-0800

APPROVED
 APPROVED AS SHOWN
DATE: _____
BY: _____
gwc

SPECIFICATIONS FOR
ASME EXPANSION-COMPRESSION TANKS
125 Lbs. Working Pressure - 188 Lbs. Test Pressure
Painted Red Oxide or Galvanized



GAL.	A	B	C	D	E	F	WEIGHTS	
							PAINTED	GALV.
15	12"	33"	8"	4"	7 1/2	1"	45#	50#
18	12	39	8	4	7 1/2	1	50	60
24	12	52	8	4	7 1/2	1	63	70
30	14	48	10	5	8 3/8	1	65	73
40	14	63	10	5	8 3/8	1	83	93
60	16	72	12	6	9 1/2	1	113	127
80	20	62 1/2	16	8	10	1	130	145
100	20	78	16	8	10	1	162	181
120	24	65	20	10	11 1/2	1	195	215
135	24	72	20	10	11 1/2	1	215	235
180	30	62 1/2	22	11	13 1/2	1 1/2	295	318
220	30	77	22	11	13 1/2	1 1/2	355	383
235	30	81 1/2	22	11	13 1/2	1 1/2	385	415
310	30	105 1/2	22	11	13 1/2	1 1/2	480	517
300	36	71 1/2	28	14	14 3/4	1 1/2	485	515
400	36	93 1/2	28	14	14 3/4	1 1/2	634	675
515	36	120 1/2	28	14	14 3/4	1 1/2	789	840
525	42	97	2 Sets	15" Ctr.	14 7/16	2	834	882
750	42	136	2 Sets	15" Ctr.	14 7/16	2	1133	1200
1000	48	129	2 Sets	18" Ctr.	15 3/4	2	1729	1814
1500	48	198	2 Sets	18" Ctr.	15 3/4	2	2319	2421
2000	48	267	2 Sets	18" Ctr.	15 3/4	2	2914	3025

* Sizes normally in stock for prompt shipment.

Tanks are fabricated to ASME Code, subject to approval of a resident, licensed Inspector.

Telltale holes are furnished in lieu of inspection opening on all sizes thru 15 to 144 gallon. Two 2" plugged inspection openings are provided on sizes 180 thru 515 gallon. 525 gallon and larger are equipped with an 11 x 15" manhole.

Taps for 2 overlapping gauge glass assemblies are included on 525 gallon size & larger.

Guarantees are against defects in material or workmanship, and are good up to the time of installation and test only. The guarantee is to the extent of the tank only, and does not include any allowance for replacement or consequential damage. Material must not be returned without first receiving our permission.



ARMSTRONG

SUBMITTAL DATA

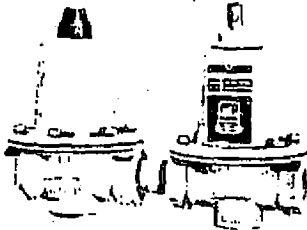
RELIEF AND REDUCING VALVES

FILE NO.	5011.95
DATE:	Feb. 15, 1974
SUPERSEDES:	5011.95
DATE:	Sept. 1, 1966

A

COMBINATION UNITS

Note: Reducing Valve factory set at 12 psi, adjustable 7 to 25 psi. Reducing Valve equipped with strainer, anti-syphon check, composition disc and brass valve seat.



MODEL NO.	SIZE	RELIEF SETTING	BODY	APPROX. SHIPPING WT.
C-11	1/2"	30 PSI	BRASS	2 1/2 LBS.
C-20	1/2"	30 PSI	IRON	6 LBS.

RELIEF VALVES

MODEL NO.	SIZE	RELIEF SETTING	BODY	APPROX. SHIPPING WT.
RL-11	1/2"	30 PSI	BRASS	1 1/4 LBS.
RL-20	1/2"	30 PSI	IRON	3 LBS.

REDUCING VALVES

Note: RD-11 and RD-20 Reducing Valve same as used in C-11 and C-20 Combination Units. All Units complete with strainer and anti-syphon check.

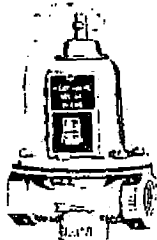
MODEL NO.	SIZE	STD. DEL. SETTING	BODY	APPROX. SHIPPING WT.
RD-11	1/2"	12 PSI *	BRASS	1 1/4 LBS.
RD-20	1/2"	12 PSI *	IRON	3 1/4 LBS.
RD-50	3/4"	12 PSI *	IRON	3 1/4 LBS.
HRD-60	1/2"	45 PSI +	BRASS	3 1/4 LBS.
HRD-70	3/4"	45 PSI +	BRASS	3 1/4 LBS.

* Adjustable 7 PSI to 25 PSI.

+ Adjustable 25 PSI to 125 PSI. Maximum Initial Pressure 150 PSI.

- APPROVED
- APPROVED
- APPROVED
- APPROVED

CONSIDER
with the
the
CONTROL
at the
fabrication
construction



DATE: 9 March 78

BY: QOK



ARMSTRONG

RELIEF AND REDUCING VALVES



JOB: - _____
ENGINEER: - _____
CONTRACTOR: - _____
ORDER NO. _____ DATE _____
QUOTATION REFERENCE: - _____
REPRESENTATIVE: - _____

COMBINATION UNITS

MODEL NO.	STD. SETTINGS		NO. REQ'D.
	RED. *	RELIEF	
C-11	12 PSI	30 PSI	
C-20	12 PSI	30 PSI	

* Adjustable 7 PSI to 25 PSI.

RELIEF VALVES

MODEL NO.	RELIEF SETTING	NO. REQ'D.
RL-11	30 PSI	
RL-20	30 PSI	

REDUCING VALVES

MODEL NO.	STD. DEL. + SETTING	NO. REQ'D.
RD-11	12 PSI	
RD-20	12 PSI	
RD-50	12 PSI	
HRD-60	45 PSI	
HRD-70	45 PSI	

+ RD-11, RD-20 and RD-50 Adjustable 7 PSI to 25 PSI.

HRD-60 and HRD-70 Adjustable 25 PSI to 125 PSI. Maximum Initial Pressure 150 PSI.

ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y. 14120

WATTS

174A-740 SERIES

ASME WATER PRESSURE RELIEF VALVES

for Pressure Protection of Hot Water Heating Boilers

Sizes: 3/4" thru 2"

The 174A-740 Series was developed to offer a complete line of boiler safety relief valve sizes from 3/4" through 2" inclusive and with corresponding high BTU discharge capacity ratings. Watts was the first to offer this full selection of sizes, which afford complete pressure protection for the great majority of all hot water heating and supply boilers with a single valve.

Sizes 1" to 2" inclusive are proportionately larger valves to the 3/4" size. They are designed for larger institutional and industrial installations to protect high BTU rated boilers that need greater relief capacities.

Whenever plans call for the latest and finest in A.S.M.E. relief valves, you'll find them in the Watts line.

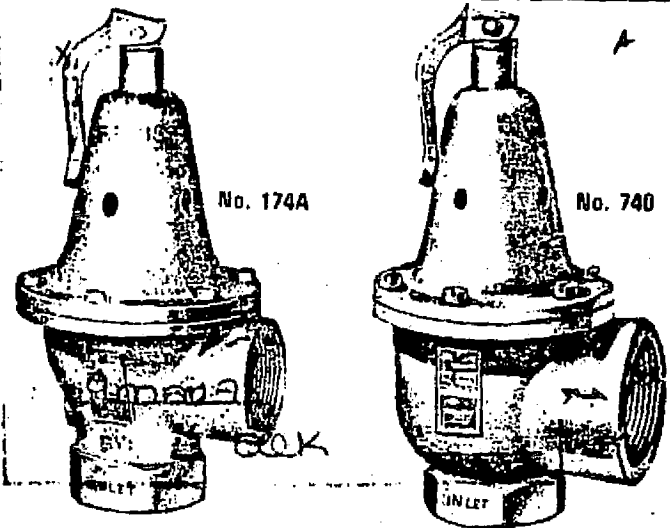
FEATURES

- Seat located above drain: water can't be trapped and sediment can't foul seat
- Non-mechanical seat-to-disc alignment will not stick or freeze
- Water seal of high temperature resisting material isolates spring working parts from water during relief
- No. 740 has the same design features as No. 174A except for difference in body construction and material

SPECIFICATIONS

BOILER RELIEF VALVES

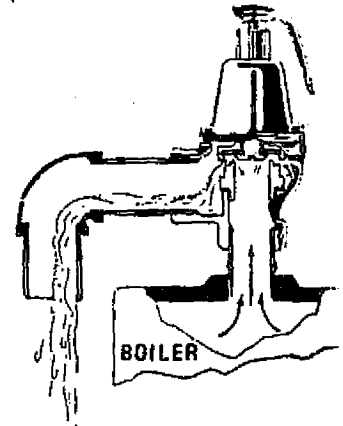
Each hot water space heating boiler shall be equipped with a pressure relief valve set to relieve below the maximum boiler working pressure. The device shall be certified in accordance with A.S.M.E. low pressure heating boiler code Section 4. The BTU rating of the valve must be in excess of the BTU output heating of the boiler. Watts Regulator Company Series 174A, 740 or equal.



OPERATION: A hot water heating boiler operates normally full of water and steams only when there is trouble with the firing controls. When this occurs, it is good "safety" procedure to reduce the energy stored in the boiler by lowering the heat content of the boiler as rapidly as practicable.

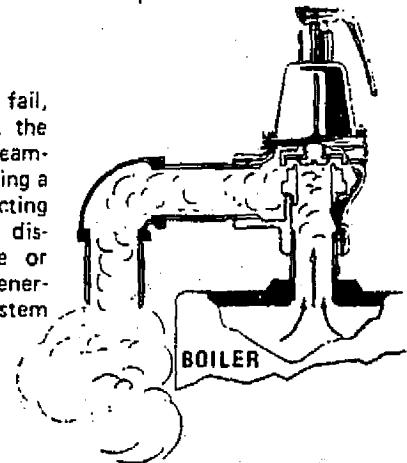
WATER DISCHARGE

As thermal expansion conditions develop, pressures may be built up to the setting of the relief valve. In this phase of operation, it acts as a water relief valve, discharging the small quantity of water which is expanded in the system.



STEAM DISCHARGE

Should operating controls fail, permitting run-away firing, the boiler water may reach steam-forming temperatures, creating a steam pressure condition. Acting as a steam safety valve, it discharges steam at the rate or faster than the boiler can generate it, thus restoring system pressure to a safer level.



DESIGNED AND MANUFACTURED BY:

WATTS

The name that protects your name

WATTS REGULATOR CO. • LAWRENCE, MASS., U.S.A.

With Representatives in Over 40 Cities from Coast to Coast

IN CANADA

WATTS REGULATOR OF CANADA, LTD.

WESTON, ONTARIO

MATERIALS

174A Series

- Bronze body construction
- Non-metallic disc-to-metal seating

740 Series

- Iron body construction
- Non-metallic disc-to-metal seating

PRESSURE - TEMPERATURE

174A Series

Pressure range 30 lbs. to 160 lbs. with corresponding high BTU/HR ratings from 650,000 to 14,370,000 BTU/HR.

740 Series

Pressure range 30 lbs. to 75 lbs. with corresponding high ratings from 925,000 to 10,700,000 BTU/HR.

STANDARDS



ASME



Tested and rated by A.S.M.E. National Board of Boiler and Pressure Vessel Inspectors.

DIMENSIONS - WEIGHT

No. 174A Series

No.	Size	Model	Height	Length	Weight
174A	3/4" x 3/4"	M3	5 1/8"	2 1/2"	1 1/2 lbs.
174A	1" x 1"	M1	5 3/4"	3"	3 1/8 lbs.
174A	1 1/4" x 1 1/4"	M	8 3/8"	4 3/4"	6 1/4 lbs.
174A	1 1/2" x 1 1/2"	M	9"	4 7/8"	7 1/4 lbs.
174A	2" x 2"	M	11 5/8"	6 1/4"	13 3/4 lbs.

No. 740 Series

No.	Size	Model	Height	Length	Weight
740	3/4" x 1"	M1	5 5/8"	3"	1 7/8 lbs.
740	1" x 1 1/4"	M	7 1/4"	3 1/2"	3 1/8 lbs.
740	1 1/4" x 1 1/2"	M	8 3/4"	4 5/8"	6 1/8 lbs.
740	1 1/2" x 2"	M	9 1/4"	5 1/4"	7 1/2 lbs.
740	2" x 2 1/2"	M	11 5/8"	6 3/4"	16 1/2 lbs.

WATTS

The name that protects your name

CAPACITY

No. 174A Series

SETTINGS and RELIEVING CAPACITIES

(National Board Certified Ratings)
BTU Steam Discharge Capacities

Size	30 lbs.	100 lbs.	125 lbs.	150 lbs.
3/4"	650,000	1,695,000	2,070,000	2,445,000
1"	1,005,000	2,635,000	3,215,000	3,795,000
1 1/4"	1,865,000	4,870,000	5,945,000	7,020,000
1 1/2"	2,020,000	5,290,000	6,460,000	7,630,000
2"	3,815,000	9,970,000	12,170,000	14,370,000

NOTE: We recommend No. 740 Series as best buy for hot water space heating boiler requirements between 30 through 75 lbs.

No. 740 Series

SETTINGS and RELIEVING CAPACITIES

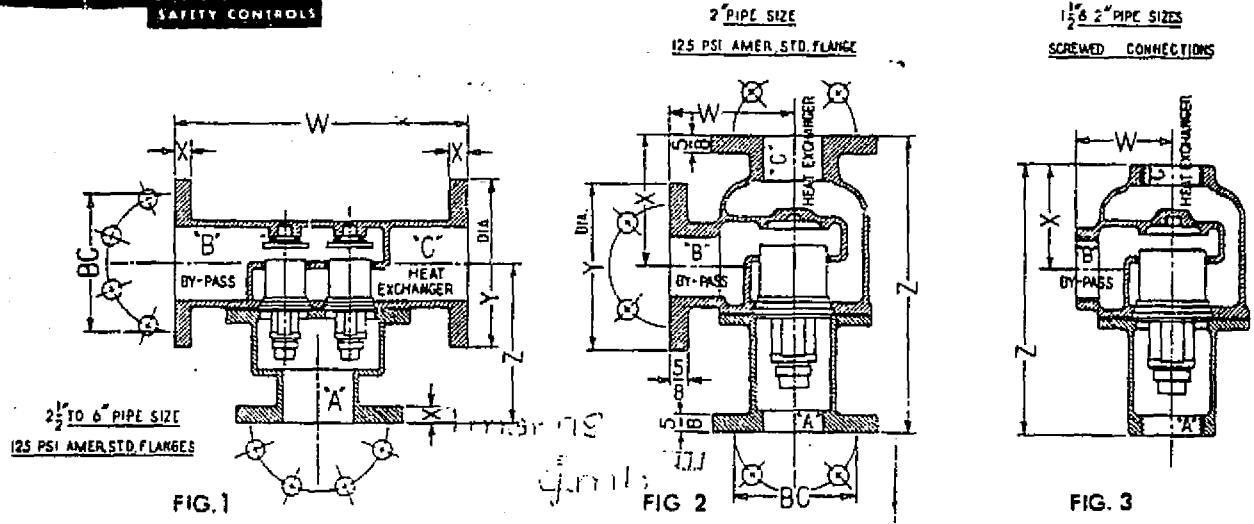
(National Board Certified Ratings)
BTU Steam Discharge Capacities

Size	30 lbs.	45 lbs.	50 lbs.	75 lbs.
3/4" x 1"	925,000	1,245,000	1,352,000	1,886,000
1" x 1 1/4"	1,300,000	1,749,000	1,899,000	2,649,000
1 1/4" x 1 1/2"	2,105,000	2,830,000	3,075,000	4,285,000
1 1/2" x 2"	2,900,000	3,903,000	4,238,000	5,910,000
2" x 2 1/2"	5,250,000	7,050,000	7,650,000	10,700,000

NOTE: Valve settings, other than shown above, are available in 5 lb. increments between the pressure range of 30 through 75 lbs.

① valve stem connections should have oil bodies
 ② the other stem connections should have oil bodies

W457 MB D



MODEL NO.	PIPE SIZE	FIG. NO.	PRINCIPAL DIMENSIONS				MAX. WIDTH OTHER PLANE	FLANGE DRILLING			NO. OF ELEMENTS	SHIPPING WT.		EXPORT CU. FT.
			W	X	Y	Z		NO. OF HOLES	DIA. OF HOLES	BC		IRON	BRONZE	
1 1/2 A	1 1/2"	3	3 1/8	2 13/16	-	8 5/8	4 7/8	-	-	-	1	18	20	.4
2 B	2"	3	3 9/16	3 13/16	-	9 3/4	5 1/2	-	-	-	1	22	25	.4
2 B F	2"	2	4 7/8	4 3/4	6	10 5/8	6	4	3/4	4 3/4	1	35	40	.4
2 1/2 B	2 1/2"	1	10	11 1/8	7	6 1/2	8 1/4	4	3/4	5 1/2	2	65	75	1.1
3 B	3"	1	10 1/2	3 3/4	7 1/2	6 3/4	8 1/2	4	3/4	6	2	70	80	1.1
4 B	4"	1	15 7/8	15 1/8	9	8 9/16	12 1/4	8	3/4	7 1/2	4	150	165	2.4
5 B	5"	1	19 1/4	15 1/8	10	9 1/2	14	8	7/8	8 1/2	6	200	240	3.5
6 B	6"	1	19 1/4	1	11	10	19	8	7/8	9 1/2	9	265	300	5.3

140°F
 145°F
 190°F
 75°F

BASIC MODELS 1-1/2A, 2B AND 2BF ARE AVAILABLE IN CAST IRON OR ALL BRONZE. BASIC MODELS 2-1/2B THROUGH 6B ARE AVAILABLE IN CAST IRON, DUCTILE IRON OR ALL BRONZE. CAST IRON AND DUCTILE IRON VALVES ARE BRONZE FITTED.

VALVES MAY BE ORDERED BY SPECIFYING THE BASIC MODEL NO., THE HOUSING MATERIAL DESIRED, THE NOMINAL TEMPERATURE DESIRED, AND ANY SPECIAL CONDITIONS THE VALVE MUST WITHSTAND. AMOT IS ADOPTING THE POLICY OF ADDING TO THE COMPLETE MODEL NUMBER, A LETTER DESIGNATING ANY SPECIAL HOUSING FEATURES, ANOTHER LETTER TO DESIGNATE HOUSING MATERIAL (C, B, D OR A, ETC.) AND A CODE NUMBER AFTER THE NOMINAL TEMPERATURE TO INDICATE TYPE OF ELEMENT. THUS A VALVE ORDERED AS A 2-1/2B-160 CAST IRON BRONZE FITTED, WILL BE STAMPED ON THE NAMEPLATE AS A 2-1/2B0C-160-01. THE O MEANS STANDARD CONSTRUCTION, C MEANS CAST IRON, THE 01 MEANS STANDARD 1096X- TYPE ELEMENT SRT TO MAINTAIN A NOMINAL 160°F. FLUID TEMPERATURE.

AMOT THERMOSTATIC VALVES ARE TEMPERATURE RATED FOR THE EXPECTED NOMINAL OPERATING TEMPERATURE IN JACKET WATER SERVICE. ON LUBRICATING OIL APPLICATIONS, THE OPERATING TEMPERATURE MAY BE SLIGHTLY ABOVE THE NOMINAL RATING DEPENDING ON THE TYPE OF OIL, FLOW RATE, AND OTHER CONDITIONS OF THE SYSTEM.

STANDARD STOCK TEMPERATURE SETTINGS AVAILABLE FOR A&B SERIES VALVES ARE 75, 90, 105, 120, 130, 140, 150, 155, 160, 165, 170, 180 AND 195°F. SOME OTHER TEMPERATURE SETTINGS AVAILABLE ON SPECIAL ORDER ON LIMITED STOCK BASIS. BASIC MODEL 1-1/2A REQUIRES ONE 1126X-(TEMP.) TYPE THERMOSTATIC ELEMENT. BASIC MODEL B REQUIRES THE 1096X-(TEMP.) TYPE ELEMENTS WHICH ARE INTERCHANGEABLE ON 2" THROUGH 6" SIZE.

2" TO 6" TYPE B VALVES ARE AVAILABLE WITH NAVY PLANCE DRILLING.

CERTIFIED PRINT

CUSTOMER _____ BY _____

PURCHASE ORDER NO. _____ DATE _____

AMOT CONTROLS CORPORATION

RICHMOND, CALIF., U.S.A.

OUTLINE DIMENSIONS
 MODELS A & B
 THERMOSTATIC VALVES

FORM 121

REV. 8
 DATE 7-70

PRINTED IN U.S.A.

Amot

MODELS A & B

THERMOSTATIC VALVES

Your Amot Thermostatic Valve has been manufactured with extreme care and tested to insure that it had no detectable defects at the time it left the factory. If the valve is correctly applied and installed it will give years of service under reasonable operating conditions. This instruction manual will give you service information for nearly all normal operating conditions, but for unusual situations it may be necessary to contact your Amot representative or the Amot factory.

All Amot A & B series valves use the "expanding wax" type of temperature sensing element. These elements are set to their nominal temperature rating under closely controlled conditions, and cannot be altered once they have been set. If it is ever necessary to change the nominal rating of a valve, a different set of elements must be used. Amot has an element exchange program for new or only slightly used elements-see Form 138 for terms and conditions of the exchange.

INSPECTING THE VALVE ON ITS RECEIPT

Immediately on receiving your valve, check it over carefully for damage received in shipping, and to be sure you have received the proper unit. In checking the model number of the valve against your order, you may find that here are a few more digits on the nameplate than show on the order. These extra letters and numbers merely help us to be able to identify the valve and its type of construction more fully than in the past. For example you may have ordered a 2BF Cast Iron Valve at 160°F nominal, but you received a 2BFC-160-01. The larger number means the valve is a 2BF type, with cast iron housing, 160°F nominal rating; and the -01 indicates standard 1096X type elements were used. Similarly, a 14A-170 (available in bronze only) becomes 14AOB-170-01. The first O means standard 1½" NPT connection threads, B means bronze and the 01 indicates standard 1126X elements.

INSTALLATION

A&B Valve Dimensions are given on Form 121, a certified copy of which is supplied with each valve order, and which should be checked against the actual valve on receipt of the order. If special engineered drawings have been prepared, these drawings should be followed. Any conflict arising between such drawings and Amot standard instructions should be resolved before the valve is put into service.

On Page 3 of this bulletin are several recommended methods of applying Amot valves. In general, a "diverting" system will provide slightly more even temperature control than a "mixing" arrangement. This is because the former introduces a homogeneous fluid to the sensing elements whereas a mixing system requires the fluid at two different temperatures to mix in the small volume of the valve.

If severe electrolysis is expected or encountered in the system, a zinc or magnesium waste plug should be installed in the valve at the A port - or as close as possible to it. For direct sea water cooled installations, bronze valves with plated elements must be used. Cast iron housings are not generally satisfactory on sea water.

If the valve is mounted at the high point of any system, be sure that the system is properly vented to prevent trapping air at the elements. A good rule to follow on systems is to place air vents at all high points and drains at all low points. Vents can all be connected to a single collection point if feasible, as shown in Fig. 1, Page 3.

OPERATION

After initially placing the valve in operation, system temperatures should be closely watched to be sure that all portions of the circuit are performing properly. A system in which the valves have been properly selected for the anticipated flows and heat rejection rates should operate very close to the valve nominal temperature rating. Water cooling systems will usually operate at or slightly below the nominal temperature. Lubricating oil or other viscous fluids with lower specific heats than water will indicate at or slightly above the nominal temperature.

In any system where the indicated temperatures are more than 5°F from the nominal valve rating, an effort should be made to find the cause. Any system operating at an indicated 10°F or more from the anticipated temperatures could be in trouble and the cause must be located immediately. Standard Amot elements should not be operated continuously at temperatures in excess of 25°F above their nominal rating. On most Amot elements, 10°F above the nominal is the maximum stroke point of the element sliding valve, and beyond that point the valve is directing all of the flowing fluid to the C Port.

The assembled-unit type of construction of the Amot elements make them easy to check if they are suspected of causing erroneous system operation. The following procedure will give you an indication as to whether the element is close to its proper calibration. (For an accurate test, we suggest the elements be shipped prepaid to Amot for checking in our calibrated test tanks. Note! Whenever shipping elements, be sure to wrap them individually for protection against nicks and bumps.)

On most elements in the A & B valve series, the sliding valve starts to lift off the spider seat at 5°F below the nominal temperature rating stamped on the side strap. (This is the only number referencing temperature on the element. All others are production control numbers.) At 10°F above the nominal, the element is at or near its full stroke.

TROUBLE SHOOTING

Place the element in a bucket of water 10°F below the nominal rating and stir the water vigorously with the element for 5 minutes (the sliding valve should not be off its seat). Next, place the element in water at 15°F above the nominal rating and stir vigorously for 5 minutes. The element should now be fully stroked. This is determined by immediately placing the element back in the valve housing, and pushing the element spider fully into its counterbore. If the resistance of the sliding valve overtravel spring can be felt, the element is fully stroked. Perform the last step quickly before the element has cooled, and **DO NOT USE OIL AS THE TEST BATH.** On very high temperature elements, water and glycol may be used.

MAINTENANCE

Amot thermostatic valves probably require less maintenance than any other type for similar use. Elements in normal service should be good for 6 to 10 years. Excessive temperatures, chemical, electrolytic or cavitation attack will of course shorten the life of the elements and seats (which are replaceable). Water additives may cause swelling of the O-ring seal around the sliding valve, to the point where they may affect element action and require replacement. Synthetic base lubricants will definitely attack the O-ring seals which may be removed, or replaced by rings of alternate material.

Carbonates, scale and other solids must not be permitted to build up on sliding valve or sensing cup surfaces. The valve and elements may be cleaned with mild acid or Oakite solutions. Hard scale may require wire brush buffing. Unless definite trouble is encountered in operation, a valve need not be inspected more than every 2 to 3 years. When replacing elements, a light coating of grease on the O-ring is helpful in re-assembly. Be sure the O-ring is centered in the sleeve before replacing element. When ordering replacement parts for Amot valves, always give the item number, name of the part, the complete valve model number and the correct serial number.

Amot does not recommend that a large stock of spare parts be maintained at the valve installation. Most commonly used elements and seals are immediately available from Amot's stocking area representatives, or from the factory direct. Rubber seals and composition gaskets are rated for a shelf life of one year from date of shipment. If adequately sealed from air, they may be good for longer periods. Shelf life of the Amot elements is from one to two years, depending on storage conditions.

COMMONLY USED REPLACEMENT PARTS

BASIC MODEL NO.	NO. OF ELEMENTS & O RINGS PER VALVE	BASIC ELEMENT PART NO.	O RING ELEMENT SEAL NO.	HOUSING GASKET PART NO.
1 1/2 A (Older)	1	1126X-(Temp.)	1919	1067
1 1/2 A (Current)	1	1126X-(Temp.)	1919	761
1 1/2 B 2B 2BF (Older)	1	1096X-(Temp.)	1183	1100
1 1/2 B 2B 2BF (Current)	1	1096X-(Temp.)	1183	761
2 1/2 B	2	1096X-(Temp.)	1183	1094
3 B	2	1096X-(Temp.)	1183	1094
4 B	4	1096X-(Temp.)	1183	1123
5 B	6	1096X-(Temp.)	1183	1117
6 B	9	1096X-(Temp.)	1183	1149

In the event that your cooling system does not operate close to the desired temperature, the following check list may point to one or more causes for the problem.

1. SYSTEM TEMPERATURE TOO COLD.
 - A. Insufficient heat rejected to coolant to maintain temperature.
 - B. Wrong nominal temperature selected.
 - C. Bi-metallic type thermometers will indicate low when calibrated in oil, then used in water.
 - D. Thermostatic valve greatly oversized or cooling capacity of system much greater than required.
 - E. Thermostatic valve installed backwards, forces water to cooler at low temperatures.
 - F. Worn O-ring seal or broken old style lip-type seal (see Form 542).
 - G. Too great a pressure difference (in excess of 25 psi) between valve ports.
 - H. Foreign material stuck between sliding valve and seat.
2. SYSTEM TEMPERATURE TOO HOT.
 - A. Cooling capacity of system not adequate.
 - B. Thermostatic valve too small for flow rate (also causes high pressure drop and possibly cavitation).
 - C. Valve installed backwards--as temp. increases, B port closes, reducing flow to cooler.
 - D. Bypass will not close due to worn or pitted seats, sliding valve, O-ring seal, etc.
 - E. Element may have been over-temperated sufficiently to affect calibration or rupture wax seal. Requires complete new element.
 - F. Solids buildup on element sliding valve prevents proper action of element.
 - G. Foreign material stuck between sliding valve and seat.
 - H. Excessive pressure differential between ports (very low pressure through bypass leg-very high pressure in cooler).

ADDITIONAL ITEMS THAT MAY BE CHECKED ARE--

- A. Thermometers--A thermometer that reads the same whether system is cold or hot needs replacing.
- B. Location of thermometers--On horizontal pipe runs, these should be in the side of the pipe when possible. (Particularly on oil systems.)
- C. They should be as far as possible downstream from the confluence of two streams of different temperature.
- D. Look for bypasses or "sneak circuits" which prevent thermostatic valve control of the complete system.
- E. Check to see that valve is marked properly. Look in the B port, one should always see the top of the element sliding valve (see section on Page 4).
- F. Cracked or broken valves may be due to trying to make up piping runs that are too short; using small ring-type gaskets on flat face cast iron flanges and pulling bolts too tight; lack of expansion isolation between valve and piping; excessive weight or mis-alignment of piping; allowing untreated water to freeze in the system.

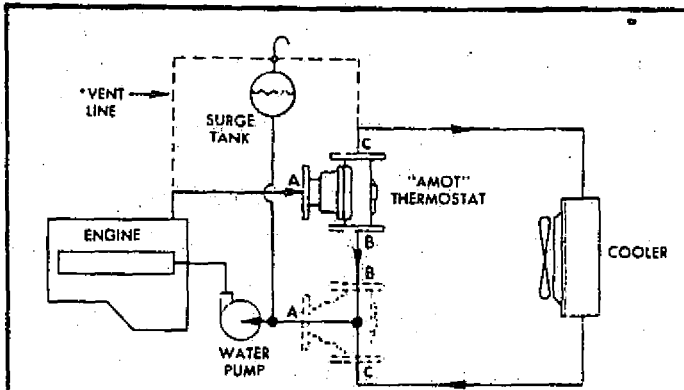


Fig. 1

COOLING WATER CONTROL—RADIATOR

Valve shown in "diverting" position to control outlet temperature. In dotted position, valve will "mix" to control inlet water to engine.

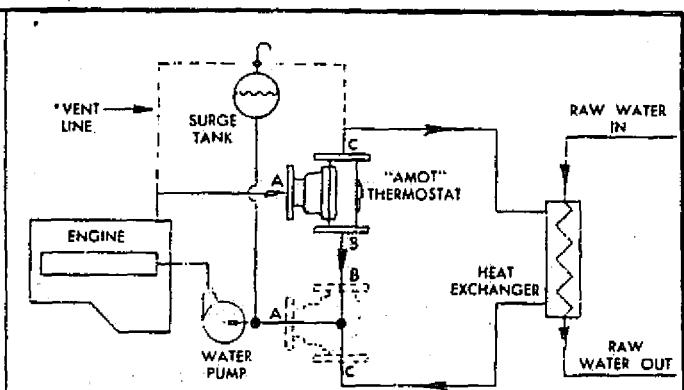


Fig. 2

COOLING WATER CONTROL—HEAT EXCHANGER

Valve shown in "diverting" installation. Mount valve as shown in dotted position for "mixing" applications.

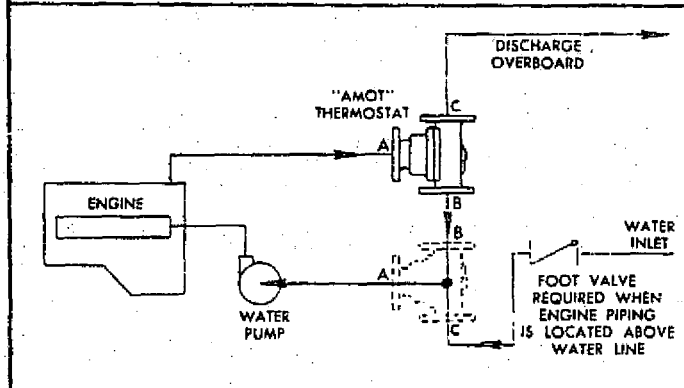


Fig. 3

DIRECT COOLING WITH RAW WATER (140°F OR LESS)

Valve shown in "diverting" installation. Mount valve as shown in dotted position for "mixing" applications.

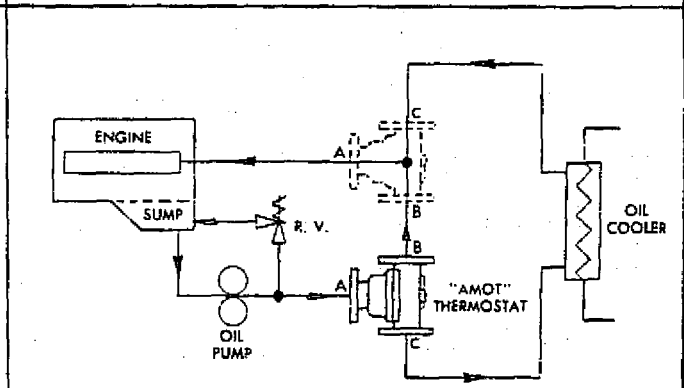


Fig. 4

LUBE OIL CONTROL

Valve shown in "diverting" position to control oil sump temperature. In dotted position valve will "mix" to control oil temperature to bearings or manifold.

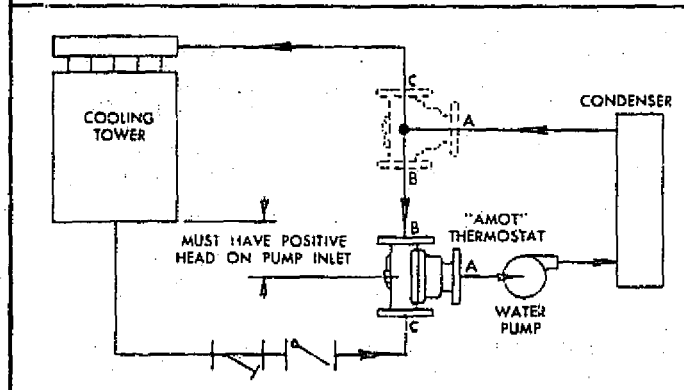


Fig. 5

AIR CONDITIONING

Valve shown in "mixing" position to control temperature of inlet water to refrigeration system condenser. Valve in dotted position controls outlet temperature.

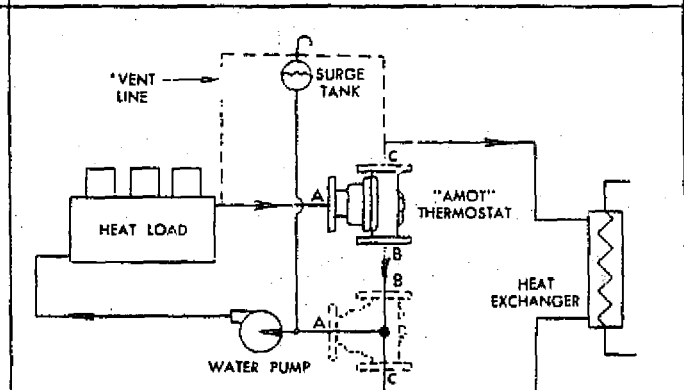


Fig. 6

ELECTRIC SYSTEM COOLING

Valve shown in "diverting" position to control max. temperatures from tubes, batteries or other heat loads. Valve in dotted position controls inlet temperature.

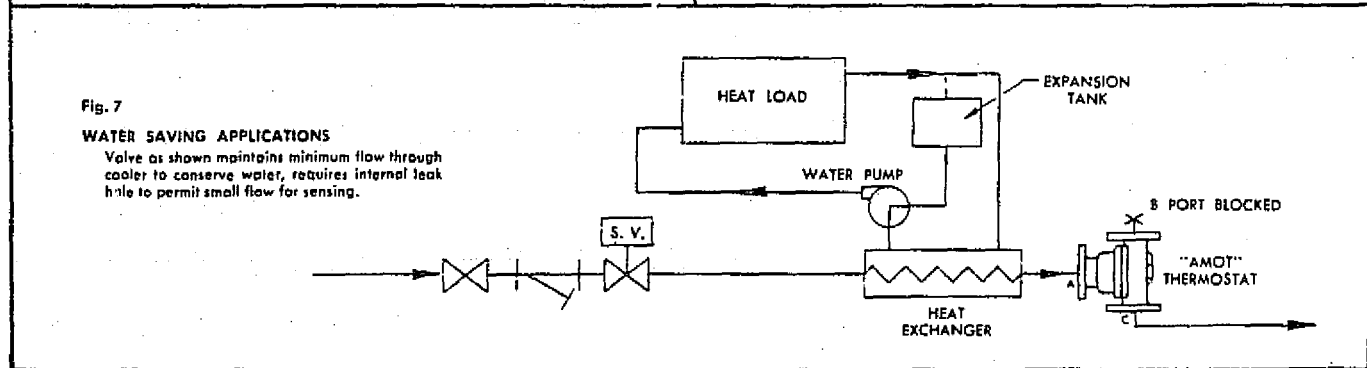


Fig. 7

WATER SAVING APPLICATIONS

Valve as shown maintains minimum flow through cooler to conserve water, requires internal leak hole to permit small flow for sensing.

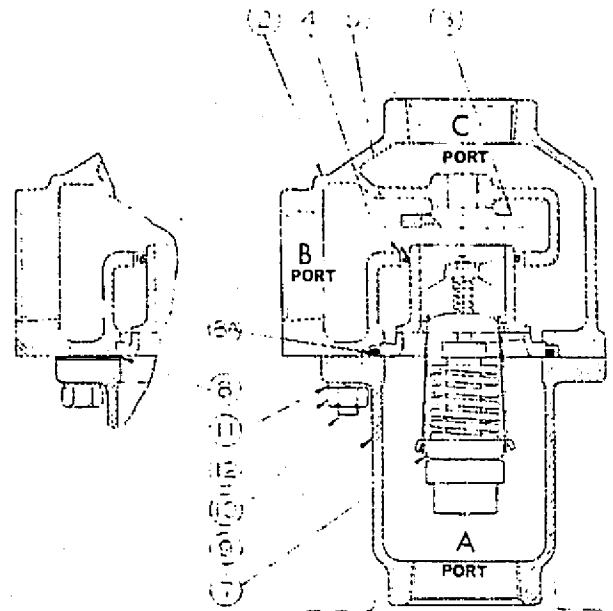
WHEN COMMUNICATING WITH AMOT REGARDING OPERATION OF A CONTROL ALWAYS GIVE THE MODEL NO. AND SERIAL NO. IF ORDERING PARTS, ALSO INCLUDE THE DESCRIPTION, PART NO., AND QUANTITY DESIRED.

PARTS LIST

MODELS 1 1/2 A 2B 2BF

REF. NO.	DESCRIPTION	QTY. PER UNIT	1-1/2A PART NOS.	2B&2BF PART NOS.
1	HOUSING ASSY.	1	NOTE 4	NOTE 4
2	UPPER HSG.	1	NOTE 4	NOTE 4
(1) 3	SEAT	1	NOT REQ'D.	1092
4	SLEEVE	1	3904	5634
5	O RING SEAL	1	1919	1183
7	ELEMENT ASSY.	1	1126X--*	1096X--*
(2) 8	FLAT GASKET	1	1067	**
(3) 8A	O RING GASKET	1	761	761
9	LOWER HSG.	1	NOTE 4	NOTE 4
10	CAPSCREW	4	**	**
11	LOCKWASHER	4	**	**
12	NUT	4	**	**

- (1) ON MODEL 1-1/2A, THE SEAT IS NOT REPLACEABLE.
- (2) FLAT GASKET USED ON ALL OLDER SINGLE ELEMENT VALVES HAVING SHORT MODEL NO. (SUCH AS 1-1/2A-170, 2BF-160, ETC).
- (3) O RING GASKET USED ON ALL CURRENT SINGLE ELEMENT VALVES HAVING LONGER MODEL NO. (SUCH AS 1-1/2ADB-170-01, 2BFC-160-01, ETC.).
- (4) ORDER HOUSINGS BY STATING THE MODEL NO. AND MATERIAL REQUIRED.



** ORDER BY REFERENCE NO., DESCRIPTION AND VALVE MODEL NO. E.G. #10, CAPSCREW FOR 4B VALVE, #8, FLAT GASKET FOR 2R VALVE.

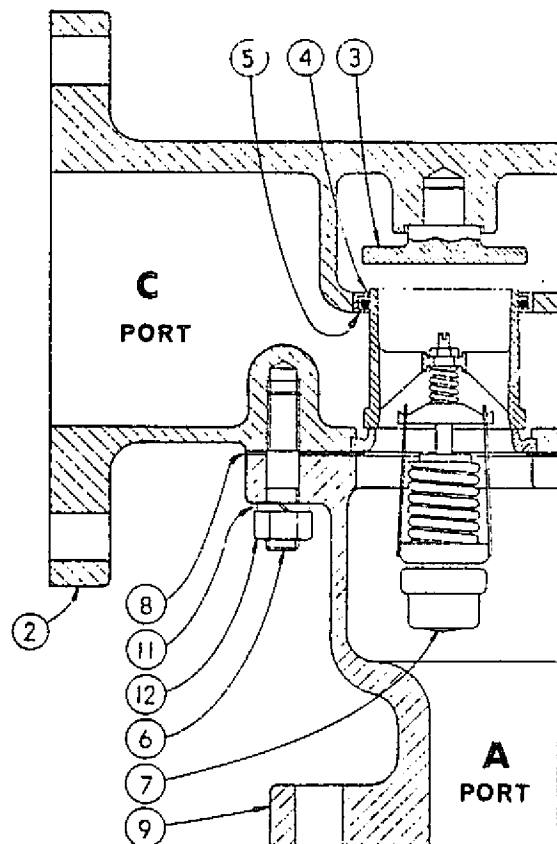
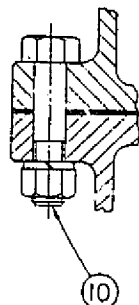
PARTS LIST

MODELS 2 1/2 B 3B 4B 5B 6B

REF. NO.	DESCRIPTION	QUANTITY REQ'D. PER UNIT					PART NUMBERS
		2-1/2B	3B	4B	5B	6B	
1	HOUSING ASSY.	1	1	1	1	1	NOTE 4
2	UPPER HSG.	1	1	1	1	1	NOTE 4
3	SEAT	2	2	4	6	9	1092
4	SLEEVE	2	2	4	6	9	1182
5	O RING SEAL	2	2	4	6	9	1183
6	STUD	0	0	2	2	4	**
7	ELEMENT ASSY.	2	2	4	6	9	1096X--*
8	FLAT GASKET	1	1	1	1	1	**
9	LOWER HSG.	1	1	1	1	1	NOTE 4
10	CAPSCREW	4	4	6	6	8	**
11	LOCKWASHER	4	4	8	8	12	**
12	NUT	4	4	8	8	12	**

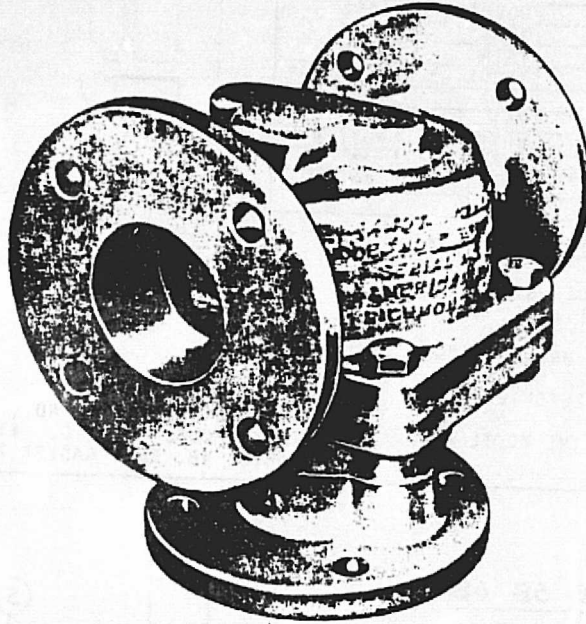
- * ORDER ELEMENTS BY BASIC MODEL NO. AND TEMPERATURE. E.G. 1126X-150°, 1096X-180°.
- ** ORDER BY REFERENCE NO., DESCRIPTION AND VALVE MODEL NO. E.G. #10, CAPSCREW FOR 4R VALVE. #8, FLAT GASKET FOR 3R VALVE.

- (4) ORDER HOUSINGS BY STATING THE MODEL NO. AND MATERIAL REQUIRED.



AMOT

MODELS A & B THERMOSTATIC VALVES



AMOT Thermostats offer the following advantages for automatic engine jacket water and lubricating oil temperature control:

- Large capacity combined with light weight.
- Excellent reliability even under extreme shocks and vibration.
- No external bulbs or tubing to break and cause trouble.
- Operating forces are very large and with no packing glands, there is no chance of valve ever sticking or becoming inoperative.
- Holds close regulation and is not sensitive to pressure.
- Temperature is fixed and cannot be tampered with.
- Because of its simple and rugged construction, practically no maintenance is ever required.
- Compact in size, and will operate in any position, which facilitates piping.
- Has positive 3-way action.
- Prices are competitive.

AMOT CONTROLS CORPORATION

HOME OFFICE: RICHMOND, CALIF., U.S.A.

GENERAL INFORMATION ON AMOT THERMOSTATS

All AMOT thermostats are equipped with positive 3-way valve action in which the water or lubricating oil is positively made to flow in the direction required. On jacket water applications when the engine is started up and is cold, the AMOT thermostat causes all of the water to be positively by-passed back into the engine, thus providing the quickest warm-up period possible. After warm up, the correct amount of water is by-passed and automatically mixed with the cold water returning from the heat exchanger or other cooling device to produce the desired jacket water outlet temperature. If ever required, the AMOT thermostat will shut off positively on the by-pass line. The 3-way action of the AMOT thermostat allows constant volume of water through the pump and engine at all times with no pump restriction when the engine is cold.

No adjustments or service are ever required on AMOT thermostats. Once installed an AMOT thermostat can be forgotten about. It is entirely self-contained, and there are no external bulbs or lines to become damaged or broken. There are no packing glands to tighten and no parts to oil. The temperature is permanently set at the factory and requires no further adjustment. The operating temperature can be changed only by changing elements. Elements are easily replaced by unbolting the housing. Elements are all interchangeable between the 2" to 6" sizes and sizes larger than 2" contain multiple elements in one housing. This means that the same size AMOT element will fit any size AMOT thermostat housing from the 2" pipe size to the 6" pipe size model.

Because AMOT thermostats are set to a predetermined temperature at the factory, costly errors due to mistakes of operating personnel are eliminated. After an AMOT thermostat has been installed, it is impossible for the operator to change the operating temperature and run the engine too cold unless the elements themselves are changed.

The temperature range of any AMOT thermostat ordered should follow the engine builder's recommendation. This information is usually available from AMOT engineers who work closely with the engine manufacturers. A few general recommendations can be made, however. For direct salt water cooled marine engines the 120°F. model should be used as this temperature is well below the point at which salt will deposit in the water passages of large diesel engines. Although it is safe to go somewhat higher than this temperature it is general practice to use the 120°F. model for diesels and the 140°F. model for smaller gasoline marine engines with direct salt water cooling. Special salt water thermostats are available at extra cost in the 120°F. and 140°F. models. For marine and stationary engines using heat exchangers, radiators, or some other type of fresh water system a jacket water outlet temperature of 160°F. is fairly universal. In regard to size, the size thermostat corresponding to the water outlet pipe size on the engine is usually satisfactory. However, if water flow information is available, the graph on figure 2 can be used to select the proper size. Pressure drop is usually limited to approximately 7 pounds per square inch.

Thermostat housings in the 2" flanged size and larger are furnished in either cast iron, ductile iron, or all bronze. The cast iron models are recommended for most applications because of their equal performance at a lower price. All bronze models are sometimes used on Navy installations when all bronze construction is specified. The 2" size with screwed connections and smaller sizes are furnished in all bronze only. 1/2" to 1 1/4", and models larger than 6" AMOT thermostats are also available

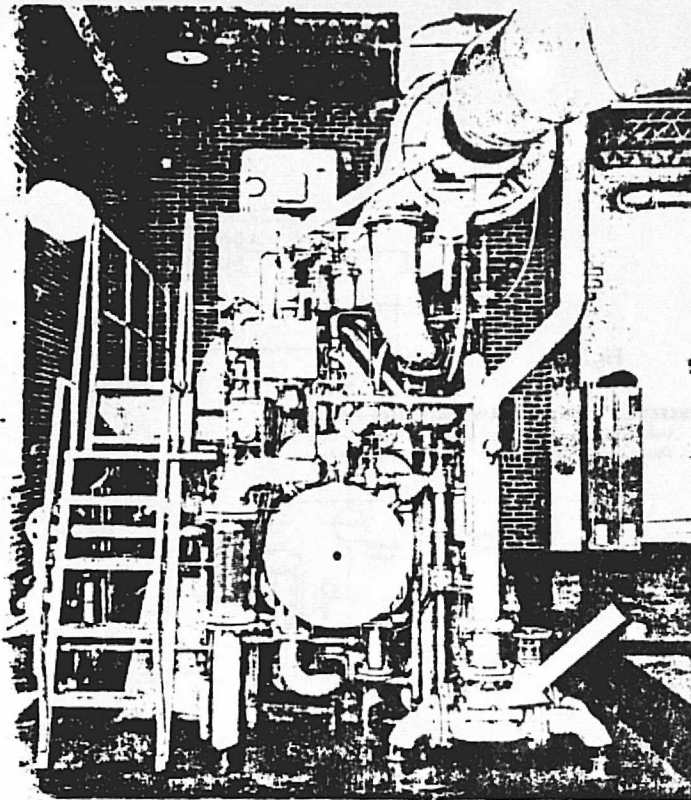
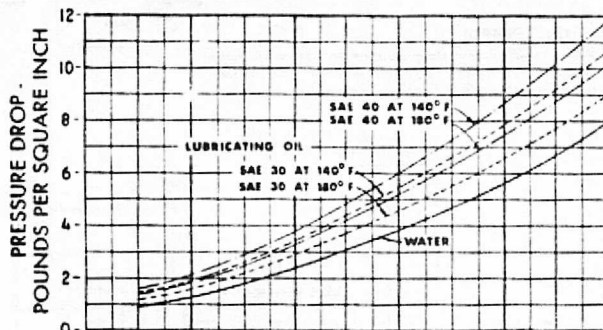


Fig. 1. Typical Amot thermostat installation on a 1200 hp dual fuel engine at Phillips Pipe Line Sharpe, Kansas station. Arrow shows position of a 4" Amot thermostat in the engine water outlet line.



1 1/2 A	40	55	70	85	100	115
2 B	40	60	80	100	120	140
2 1/2 B	75	110	145	180	215	250
3 B	80	120	160	200	240	280
4 B	160	240	320	400	480	560
5 B	240	360	480	600	720	840
6 B	360	540	720	900	1080	1260

FLOW IN U.S. GALLONS PER MINUTE
Recommended pressure drop is 2 to 7 psi.

Fig. 2. Pressure drop through Amot thermostats.

ELIMINATE THE CHANCE FOR COSTLY HUMAN

and are described in other bulletins. Dimensions and weights of AMOT thermostats are shown on the last page of this bulletin.

PIPING DIAGRAMS FOR AMOT THERMOSTATS

The two most commonly used piping diagrams for jacket water control are shown in figures 4 and 5. The AMOT thermostat will operate in any position and mounting should be made in accordance with convenience.

For lubricating oil temperature control, the AMOT thermostat is used directly in the lubricating oil line as shown in figure 6. The oil will by-pass the heat exchanger when cold and will reach the desired operating temperature rapidly. When warm, the correct amount of oil will be circulated through the heat exchanger to maintain the desired temperature automatically. The system shown in fig. 6 A is similar to the standard jacket water temperature control system. In fig. 6 B the AMOT thermostat is used as a mixing valve. Hot oil enters "B" and cold oil enters "C" and the oil is mixed and proportioned so as to emerge from "A" at the desired temperature. This system is sometimes used in connection with jacket water temperature control when it is desired to maintain a certain temperature of the water entering the engine.

FEATURES OF AMOT THERMOSTAT ELEMENTS

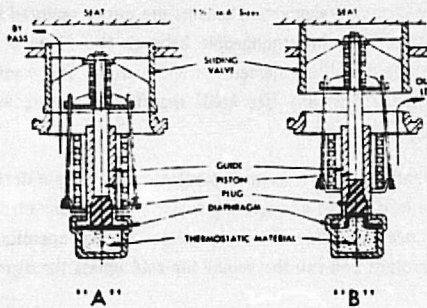


Fig. 3.

The power creating medium utilizes the expansion of a special thermostatic material which remains in a semi-solid form and which is highly sensitive to temperature changes.

The operating range is determined by the chemical composition of the material. Expansion of the material created by a rise in temperature develops a pressure that is transmitted directly to the piston producing a very large force which easily overcomes the return spring force of over 100 pounds. Construction is simple and rugged, yet the unit is very sensitive to changes in temperature. The element can stand extreme temperatures without damage or change in calibration. Changes in pressure do not affect the element and due to the valve construction surges in pressure do not tend to upset the stability of the thermostat.

"A" in figure 3 shows the element with the operating piston in the cold position. The water travels out the by-pass as shown by the arrow.

"B" in figure 3 shows the piston moved up to the extended or warm position. The by-pass closes off as the sliding valve seats and the water travels out the outlet as shown by the arrow. In actual operation, the sliding valve is normally in about the mid-position. When the unit operates, the expansion of the thermostatic material forces a moulded synthetic rubber plug into a reduced diameter in the piston guide, which multiplies the movement of the piston by an extruding action. The plug and diaphragm are of a synthetic composition.

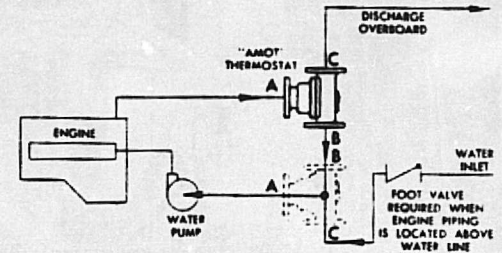


Fig. 4.

DIRECT COOLING WITH RAW WATER (1140 F OR LESS)

Valve shown in "diverting" installation. Mount valve as shown in dotted position for "mixing" applications.

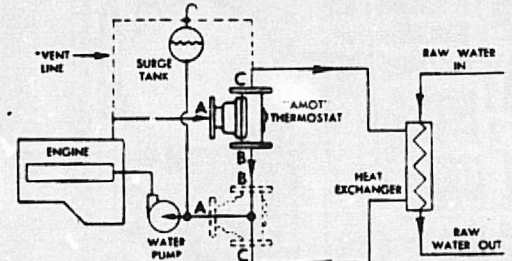


Fig. 5.

COOLING WATER CONTROL - HEAT EXCHANGER

Valve shown in "diverting" installation. Mount valve as shown in dotted position for "mixing" applications.

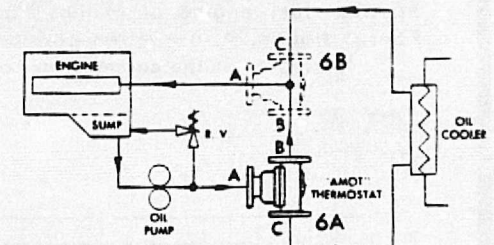


Fig. 6.

LUBE OIL CONTROL

Valve shown in diverting position to control oil sump temperature. In dotted position valve will "mix" to control oil temperature to bearings or manifold.

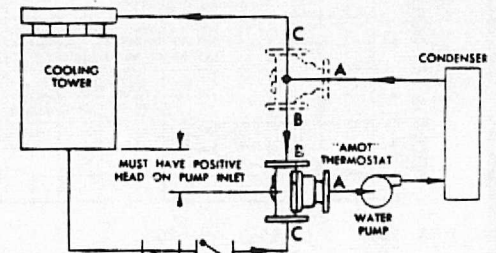


Fig. 7.

AIR CONDITIONING

Valve shown in "mixing" position to control temperature of inlet water to refrigeration system condenser. Valve in dotted position controls outlet temperature.

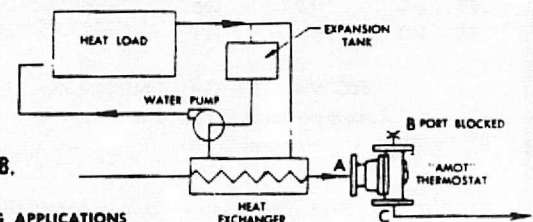


Fig. 8.

WATER SAVING APPLICATIONS

Valve as shown maintains minimum flow through cooler to conserve water, requires internal leak hole to permit small flow for sensing.

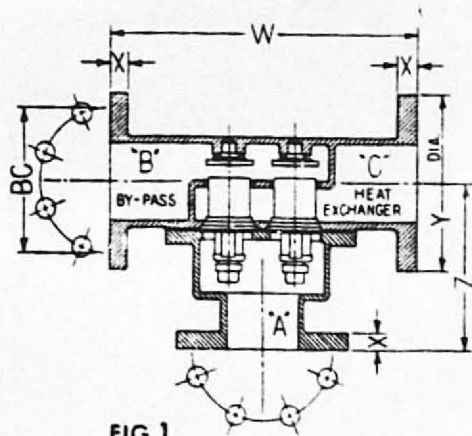


FIG. 1

2 1/2 TO 6" PIPE SIZE
125 PSI AMER. STD. FLANGES

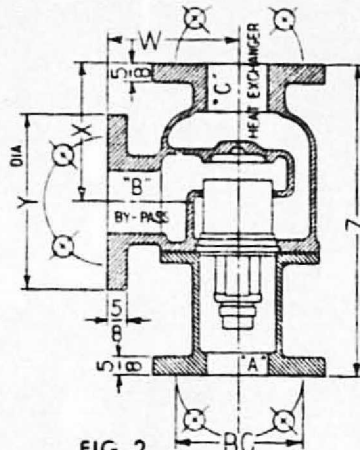


FIG. 2

2" PIPE SIZE
125 PSI AMER. STD. FLANGE

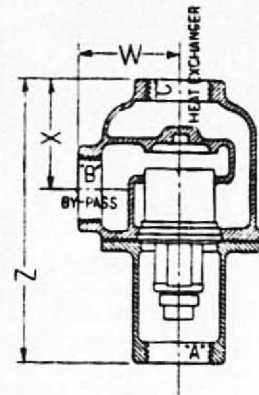


FIG. 3

1 1/2 TO 2" PIPE SIZES
SCREWED CONNECTIONS

MODEL NO.	PIPE SIZE	FIG. NO.	PRINCIPAL DIMENSIONS				MAX WIDTH OTHER PLANE	FLANGE DRILLING			NO OF ELEMENTS	SHIPPING WT.		EXPORT CUBIC FEET
			W	X	Y	Z		NO OF HOLES	DIA. OF HOLES	B.C.		IRON	BRONZE	
1 1/2 A	1 1/2"	3	3 1/8	2 13/16	--	8 5/8	4 7/8	--	--	--	1	18	20	.4
2B	2"	3	3 5/8	3 13/16	--	9 3/4	5 1/2	--	--	--	1	22	25	.4
2BF	2"	2	4 7/16	4 3/4	6	10 5/8	6	4	3/4	4 3/4	1	35	40	.4
2 1/2 B	2 1/2"	1	10	11/16	7	6 1/2	8 1/4	4	3/4	5 1/2	2	55	75	1.1
3B	3"	1	10 1/2	3/4	7 1/2	6 3/4	8 1/4	4	3/4	6	2	60	80	1.1
4B	4"	1	15 7/8	15/16	9	8 9/16	12 1/4	8	3/4	7 1/2	4	135	150	2.4
5B	5"	1	19 1/4	15/16	10	9 1/2	14	8	7/8	8 1/2	6	200	240	3.5
6B	6"	1	19 1/4	1	11	10	19	8	7/8	9 1/2	9	270	300	5.3

BASIC MODELS 1 1/2 A, 2B AND 2BF ARE AVAILABLE IN CAST IRON OR ALL BRONZE. BASIC MODELS 2 1/2 B THROUGH 6B ARE AVAILABLE IN CAST IRON, DUCTILE IRON OR ALL BRONZE. CAST IRON AND DUCTILE IRON VALVES ARE BRONZE FITTED. SPECIFY HOUSING MATERIAL.

VALVES MAY BE ORDERED BY SPECIFYING THE BASIC MODEL NO., THE HOUSING MATERIAL DESIRED, THE NOMINAL TEMPERATURE DESIRED, AND ANY SPECIAL CONDITIONS THE VALVE MUST WITHSTAND. AMOT HAS ADOPTED THE POLICY OF ADDING TO THE COMPLETE MODEL NUMBER A LETTER DESIGNATING ANY SPECIAL HOUSING FEATURES, ANOTHER LETTER TO DESIGNATE HOUSING MATERIAL (C, B, D, OR A, ETC.) AND A CODE NUMBER AFTER THE NOMINAL TEMPERATURE TO INDICATE TYPE OF ELEMENT. THUS A VALVE ORDERED AS A 2 1/2 B-160 CAST IRON BRONZE FITTED, WILL BE STAMPED ON THE NAMEPLATE AS A 2 1/2 BOC-160-01. THE 0 MEANS STANDARD CONSTRUCTION, C IS CAST IRON, THE 01 MEANS STANDARD 1096X-TYPE ELEMENT, THE 160 MEANS SET TO MAINTAIN A NOMINAL 160°F FLUID TEMPERATURE.

AMOT THERMOSTATIC VALVES ARE TEMPERATURE RATED FOR THE EXPECTED NOMINAL OPERATING TEMPERATURE IN JACKET WATER SERVICE. ON LUBRICATING OIL APPLICATIONS THE OPERATING TEMPERATURE MAY BE SLIGHTLY ABOVE THE NOMINAL RATING, DEPENDING ON THE TYPE OF OIL, FLOW RATE, AND OTHER CONDITIONS OF THE SYSTEM.

STANDARD STOCK TEMPERATURE SETTINGS AVAILABLE FOR A AND B SERIES VALVES ARE 75, 90, 105, 120, 130, 140, 150, 155, 160, 165, 170, 180, AND 195°F. SOME OTHER TEMPERATURE SETTINGS AVAILABLE ON SPECIAL ORDER ON LIMITED STOCK BASIS. BASIC MODEL 1 1/2 A REQUIRES ONE 1126X-(TEMP.) TYPE THERMOSTATIC ELEMENT. BASIC MODEL B REQUIRES THE 1096X-(TEMP.) TYPE ELEMENT WHICH IS INTERCHANGEABLE ON 2" THROUGH 6" SIZES.

2" TO 6" TYPE B VALVES ARE AVAILABLE WITH NAVY FLANGE DRILLING, AND MANUAL OVERRIDE IF DESIRED.



W457 1118 D

Honeywell

THE R7412 DIFFERENTIAL TEMPERATURE CONTROLLER PROVIDES AUTOMATIC CONTROL OF CIRCULATING PUMPS, VALVES, DAMPERS, MOTORS, AND OTHER ACCESSORIES USED IN SOLAR ENERGY SYSTEMS.

All models contain a solid state differential temperature controller.

R7412B includes freeze protection.

R7412C includes freeze protection and an auxiliary relay driver.

R7412D includes overtemperature protection.

R7412E includes overtemperature protection and an auxiliary relay driver.

R7412F includes freeze and overtemperature protection (field adjustable), and an auxiliary relay driver.

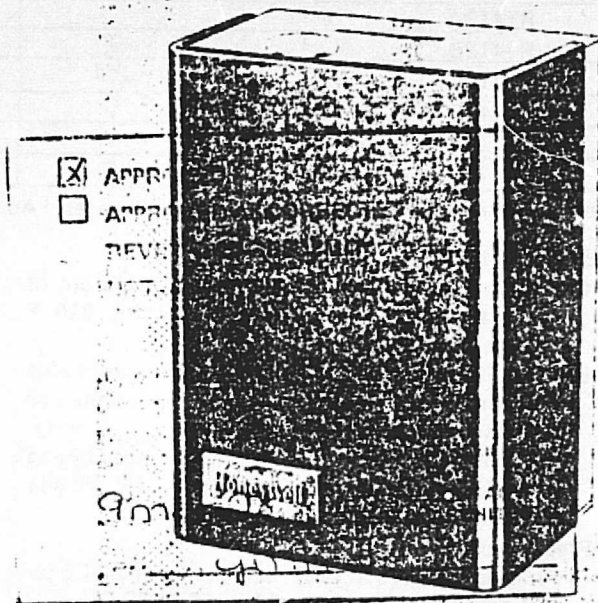
Plug-in resistors permit changing on and off temperature differential and adapting R7412 for single function temperature control.

R7412B-E overtemperature and freeze protection set points are selectable for factory setting, but are not field adjustable.

Uses one or two C773 Temperature Sensors.

R.L.
REV. 10-77 (.07)

DIFFERENTIAL TEMPERATURE CONTROLLER



R7412A-F

Form Number

60-2305-1

SPECIFICATIONS

IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

TRADELINE MODELS

TRADELINE MODELS are selected and packaged for ease of stocking, ease of handling, and maximum replacement value. TRADELINE specifications are the same as those of standard models except as noted below.

TRADELINE MODEL AVAILABLE:

R7412F Differential Temperature Controller.

TRADELINE FEATURES:

- Includes freeze and overtemperature protection and an auxiliary relay driver.
- TRADELINE Pack with cross reference label.

STANDARD MODELS

MODEL	DIFF. TEMP. CONTROL	FREEZE PROTECTION	OVERTEMPERATURE PROTECTION	AUXILIARY RELAY DRIVER
R7412A	Yes ^a			
R7412B	Yes ^a	Yes ^{ad}		
R7412C	Yes ^a	Yes ^{cd}		Yes ^c
R7412D	Yes ^a		Yes ^{bd}	
R7412E	Yes ^a		Yes ^{cd}	Yes ^c
R7412F	Yes ^a	Yes ^{ac}	Yes ^{bc}	Yes ^c

^aInternal relay energizes. ^bInternal relay de-energizes. ^cAuxiliary relay energizes. ^dProtection setpoint is factory fixed.

TEMPERATURE SETTING RANGES:

Operating Range (as defined by the temperature of the low temperature sensor)—0 to plus 210 F [minus 18 to plus 99 C].

Differential Temperature Controller—Adjustable ON and OFF differentials from minus 10 to plus 40 F [minus 5.6 to plus 22.2 C]. Factory-set at 18 F [10 C] temperature difference ON and 3 F [1.7 C] temperature difference OFF. Plug-in resistors vary settings (see Table 1, page 7).

Freeze Protection—

Field adjustable (R7412F only) in 5 F [3.2 C] increments from 140 to 190 F [57 to 89 C].

R7412B-E set points may be specified in 5 F [3.2 C] increments from 140 to 190 F [57 to 89 C], but they are factory fixed.

Overtemperature differential—10 F [5.5 C].

Freeze differential—3 F [1.7 C].

Overtemperature—

Field adjustable settings (R7412F only) at 37, 42 or 47 F [3, 6, or 8 C].

R7412B-E set points may be specified at 37, 42, or 47 F [3, 6, or 8 C], but they are factory fixed.

Factory-set at 140 F [66 C].

(continued on page 3)

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Differential Temperature Controller order number. 2. Temperature Sensor order number (two required). | <ol style="list-style-type: none"> 3. Immersion Well order number. 4. Accessories, if desired. 5. Optional specifications, if desired. |
|--|---|

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

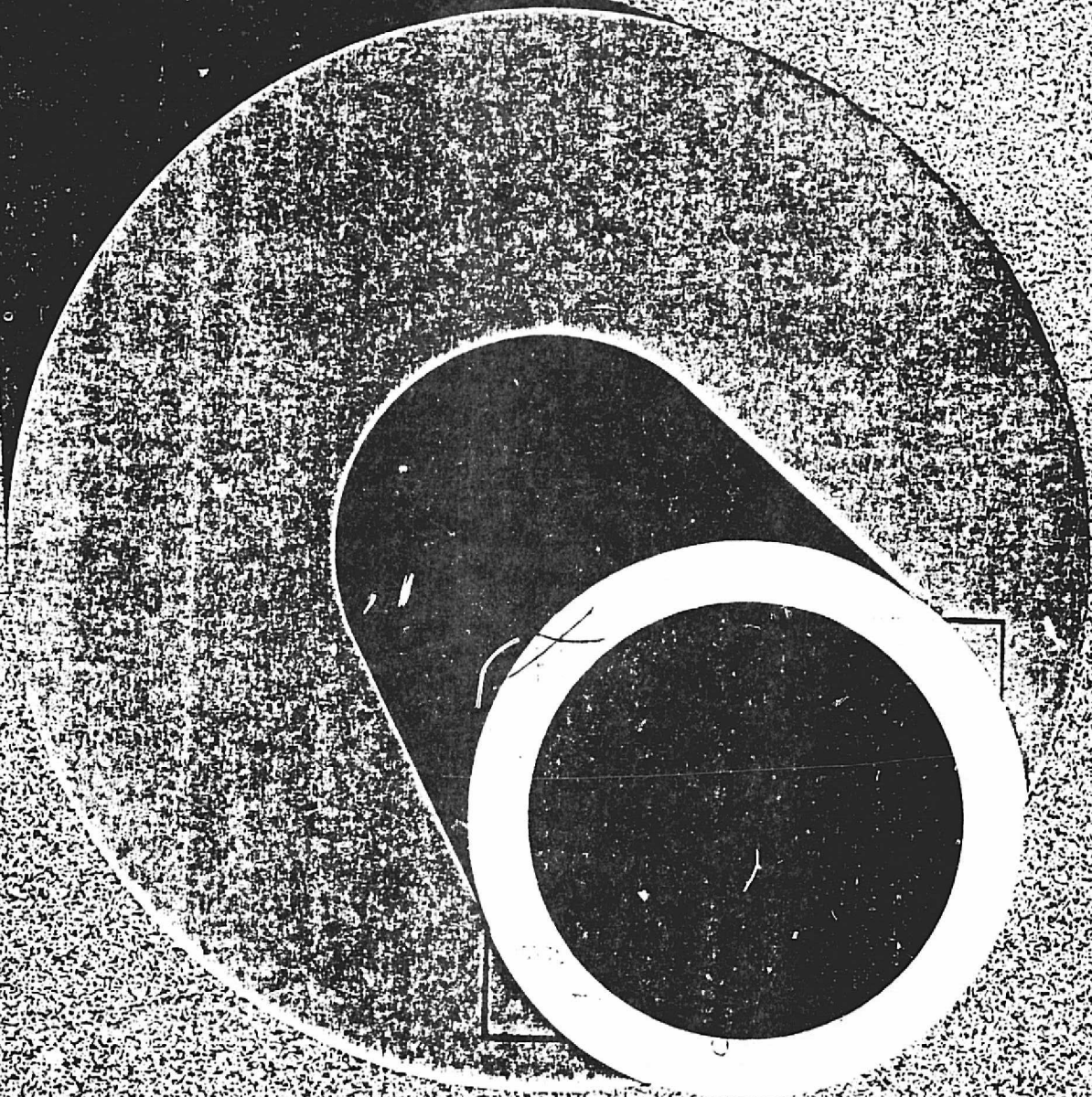
1. YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).

2. RESIDENTIAL DIVISION CUSTOMER SERVICE
 HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
 MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

(IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
 INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

Thermacor[®] C

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OF POOR QUALITY

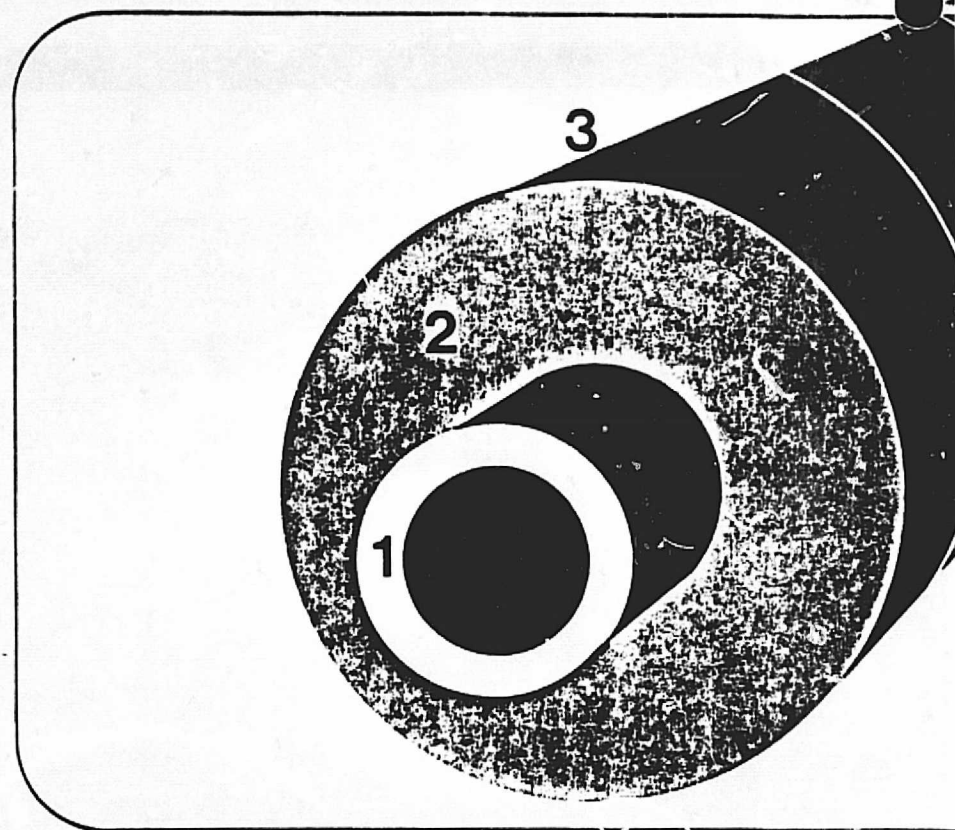


What is Thermacor c

An exclusive coating which insulates and controls corrosion on nearly any type or size of pipe. It is 95% installed before it leaves the plant. And it is unequalled in creating dramatic savings and quality improvements in a host of applications.

Thermacor Process Inc. of Fort Worth, Texas, has created Thermacor Type C — a revolutionary and exclusive patented pipe coating for thermal insulation and corrosion control using a urethane foam which is molded to the pipe in thicknesses of one or more inches. The coated pipe is then primed and wrapped with a polyvinyl chloride-butyl rubber laminate tape.

1 The Thermacor "C" coating bonds exceptionally and equally well to all types of pipe including steel, iron, copper, plastic, galvanized, aluminum, and asbestos cement. It can be used on pipe with diameters extending from ½ to 48 inches. The processing length of the pipe can be either 20/21-foot standard lengths or 40-foot random lengths. Pipe to be coated may be furnished through Thermacor Process Inc. or by the individual company before coating application. Thermacor "C" is produced by a patented process whereby the pipe actually leaves the factory with 95% of the insulation already installed. Six inches at both ends of the coated sections are left bare for final on-site field joining and insulating. Special easy-to-use kits and molds are available for uniform insulation of joints, tees and elbows.



2 The inner layer of bonded-to-pipe urethane cells forms an anti-corrosive and moisture proof seal. Even with a break in the outer layer, moisture will not penetrate. This layer also prevents any condensation that might result from temperature differential between the pipe and the environment. The outer layer — or skin — of high density urethane provides a protective barrier for the thick middle layer of closed-cell urethane . . . scientifically proven and well documented to be the best insulating material available.

3 The outer wrapping of polyvinyl chloride-butyl rubber laminate tape (which is available in black or white) applied over the urethane skin creates an extremely tough extra barrier to rocks, blows, earth shifts, etc. The tape's effectiveness as a vapor transmission and a di-electric barrier is a scientific fact. This combination of materials forming the Thermacor "C" coating, having a resistance of 30 to 48 PSI, provides a

quality product that is creating major economic breakthroughs in numerous applications.

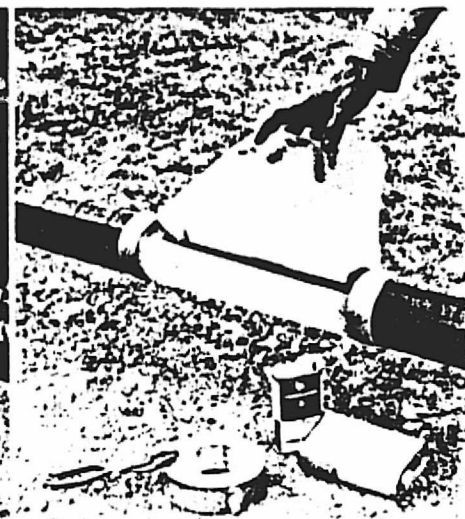
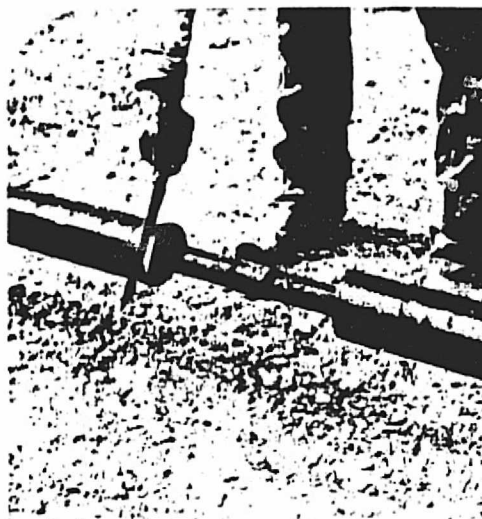
Thermacor "C" processed pipe is as near temperature proof as is possible to achieve with present technology against temperatures of between -325° and +275° Fahrenheit.

Special field installation kits containing the proper proportions of urethane components are available for connecting joints and fittings uniformly with the factory-applied coating . . . leaving absolutely no cracks or voids. Also available are portable and reusable molds of various sizes. Installation of an on-site, thoroughly bonded connection is simple and accomplished in minutes.

Thermacor Process Inc., with the introduction of Thermacor "C", has accomplished a major advance in the insulation of above and below ground pipe systems . . . in both initial cost and long-term results. Thermacor has

1 Thermacor Type C coating is simple to install in the field. A sharp knife will smoothly cut through the urethane foam and the tape, if needed.

2 On a straight coupling, merely tape the reusable mold securely onto the coated sections, as illustrated.



Installation is uniform,

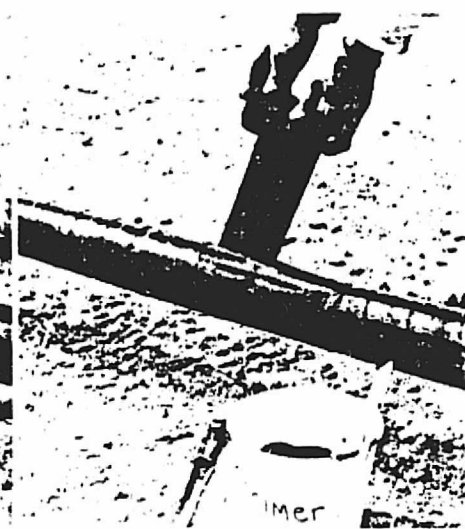
developed the maximum physical properties inherent in a specific formula of raw urethane foam and has adapted the process to more efficient, automated production techniques. It provides lower purchase cost, lower on-site field installation cost, ease of handling, and superior physical properties.

And, it has produced quality improvements in a host of industries and applications. By eliminating thermal conduits and expensive thick insulation, Thermacor "C" is ideal for underground low pressure steam, hot and chilled water, and domestic hot water distribution piping systems. It also is applicable to multi-building complexes, total energy systems and other large project piping . . . natural gas piping . . . refinery piping . . . cryogenic piping . . . low gravity or high paraffinic and crude transporting.

Thermacor "C" makes new things possible through an economical premium product.



6 Apply a primer to the entire bare surface. An ordinary paint brush is sufficient to do the job.

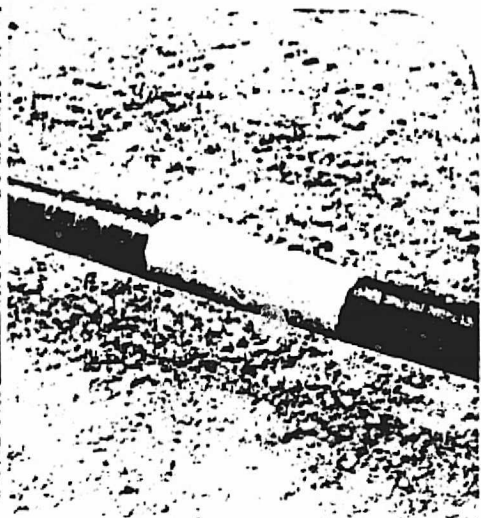
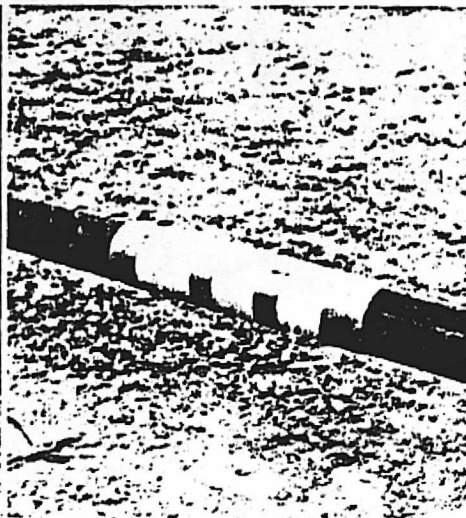
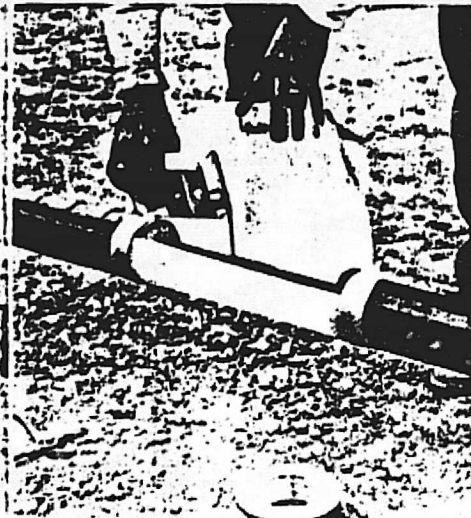


7 Wrap the primed area with the polyvinyl chloride-butyl rubber laminate tape to the primed surface. The field coating now is complete.

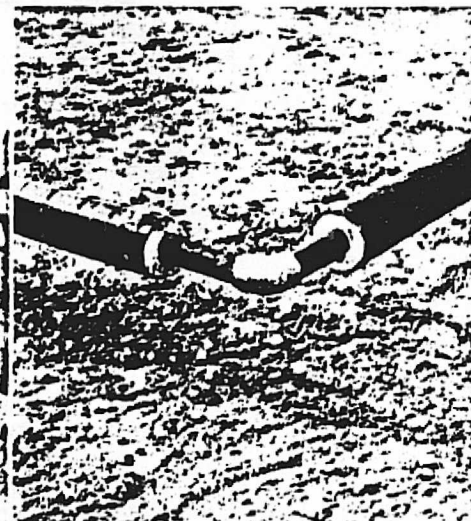
After the mold is in place, using the recommended kit of urethane components, pour the contents of Component B into the container of Component A. Shake vigorously for at least 10 seconds. Hold the flap of the mold open then pour the contents evenly into the mold.

4 Tape the flap securely in place. The material will then begin to foam. Allow approximately 20 minutes for the curing process. After curing, the urethane releases itself from the mold.

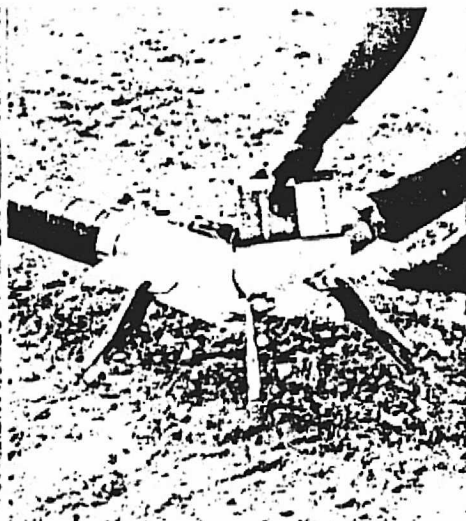
5 Remove the mold. You now have an insulation bonded uniformly — without cracks or voids — to the pipe and to the factory-applied coating.



quick, easy and continuously bonded



8 Elbow joints or tee connections are just as easy to complete using the Thermacor method.



9 For an elbow connection, the reusable mold comes in two pieces. Secure the top and bottom mold portions firmly with tape, metal strips or clamps. Prepare the urethane components as described previously. Pour the mixture into the pre-cut hole in the top of the mold. Tape shut to prevent any loss of the foam.



10 Allow approximately 20 minutes for the urethane to foam and cure. Remove the mold, apply primer and polyvinyl chloride-butyl rubber laminate tape securely. Installation is complete. (Tee joints are connected in the same manner.)

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Technical data

Physical Properties of Thermacor C

Thermal Conductivity (k-factor)	0.13
Moisture Absorption (%)	0.3%
Resistance to heat	250
Internal	275 F
Jacket	180 Deg F (max)
Tensile Strength	56 psi
Compressive strength	30-60 psi depending on density
Electrical Properties	
Dielectric Strength	
Internal	103 CP S. 1.06
Jacket volts/mil	650-850
Density	2.2 Lbs.

Polyvinyl Chloride-Butyl Rubber Laminate Tape

Shock Impact	Excellent
Abrasion	Excellent
Weathering	Excellent
Acids, non-oxidizing	Excellent
Alkalis	Good
Alcohol	Fair to Excellent
Hydrocarbons	Fair to Excellent

Schedule 40 Black Steel Pipe
1" Insulation Thickness

Urethane Foam-Thermacor Insulating Material

Moisture vapor Transmission — (grains/hr/sq ft/in) (cut Surface)	2-3 perm-in
Water Absorption —	.05 lbs/sq ft cut surface
Moisture pickup of material having barrier film, submerged under 8 ft head for 4 years	Negligible
Bond to pipe	Excellent
Solvent Resistance	
Conc. Alkali	Excellent
Dil. Alkali	Excellent
Hydrocarbons	Good to Excellent
Dil. Acids	Good
Conc. Acids	Poor
Degradation by Fungus	Good
Degradation by Molds	Good

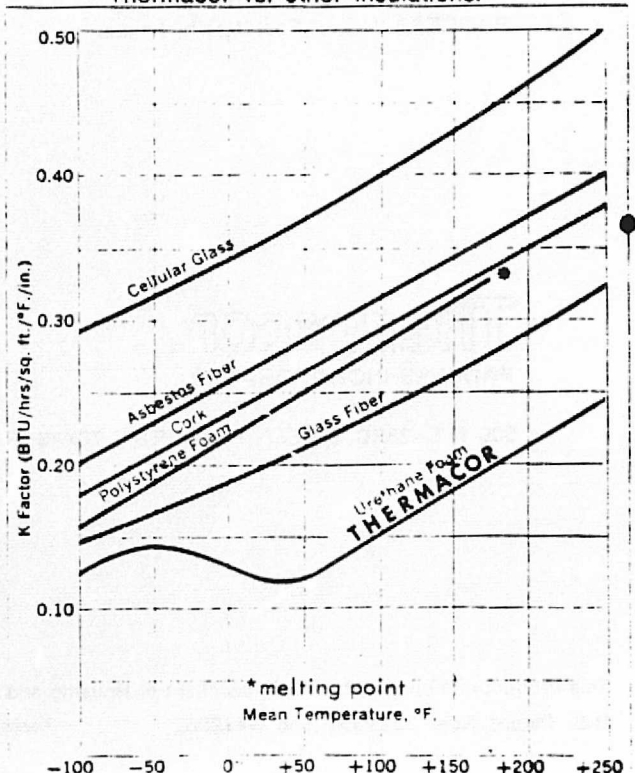
Bacteria	Excellent
Fungi	Excellent
Vapor Transmission	.002-.05 grams/100 sq. inches/24 hrs.
Tensile Strength	2800-3500 psi
Tear Strength	350-475 Lbs./in.

Thermacor "C" suggested thicknesses for proper insulation

Nom. Pipe Size	PIPE TEMPERATURE °F.										
	-300	-250	-200	-150	-100	-60	-40	-20	0	20	40
1/2	2	2	2	1 1/2	1 1/2	1 1/2	1 1/2	1			
3/4	2 1/2	2	2	2	1 1/2	1 1/2	1 1/2	1			
1	2 1/2	2 1/2	2	2	1 1/2	1 1/2	1 1/2	1	1		
1 1/4	3	2 1/2	2	2	1 1/2	1 1/2	1 1/2	1 1/2	1		
1 1/2	3	2 1/2	2	2	1 1/2	1 1/2	1 1/2	1 1/2	1		
2	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1 1/2	1		
2 1/2	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1 1/2	1		
3	3	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	1	
3 1/2	3	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	1	
4	3 1/2	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	1	1
4 1/2	3 1/2	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	1	1
5	3 1/2	3	3	2 1/2	2	2	1 1/2	1 1/2	1 1/2	1	1
6	3 1/2	3 1/2	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	1
8	4	3 1/2	3	2 1/2	2 1/2	2	1 1/2	1 1/2	1 1/2	1	1

Cold pipe insulation thicknesses based on 90°F. ambient air, 80% relative humidity, zero M.P.H. velocity, and a minimum surface temperature of 84°F.

Graph showing Thermal Conductivity of Thermacor "C" Thermacor vs. other insulations.



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C-2

Specifications

All underground lines shall be factory coated with a 1" or 2" \pm 1/8" thick closed cell urethane foam with an integral vapor barrier film of high density urethane, and an outer wrapping of primer and 20 mil laminated butyl rubber/polyvinyl tape, as an outer vapor barrier, producing the following physical properties:

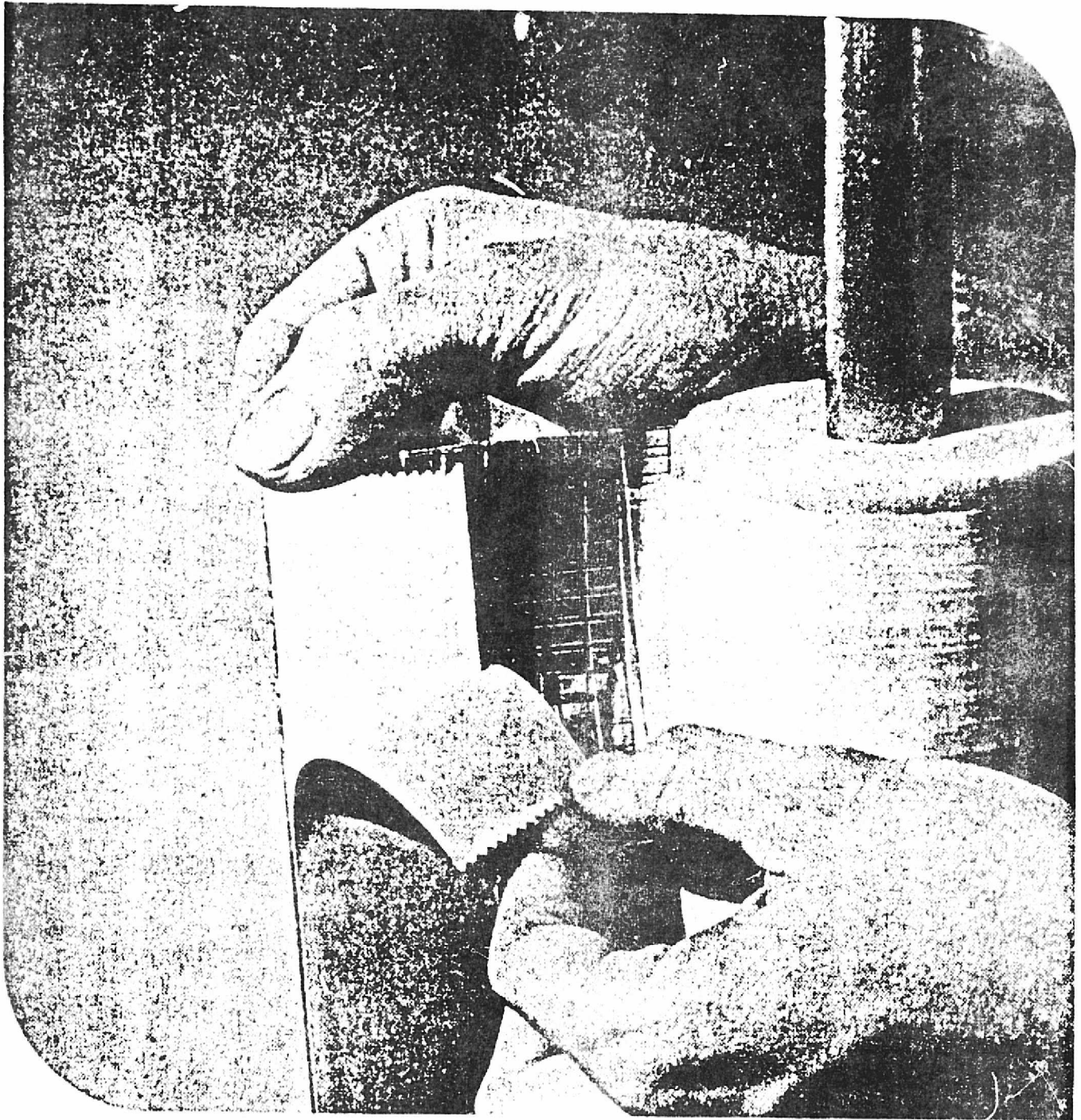
- 1 Minimum density of core 2 lbs/cubic ft.
- 2 Minimum compressive strength of core 30 psi.
- 3 Minimum average compressive strength of coating 48 psi.
- 4 K factor 0.13 at 50° F mean temperature.
- 5 Water vapor transmission of barrier film at 0.01 perm-in.
- 6 Water vapor transmission of core 2 to 3 perm-in.
- 7 Dielectric strength 103CP S 1.06.
- 8 Fully bonded and continuous throughout the length of the pipe with 6" cut back each end of each joint.

Joints and fittings shall be coated in the field with the same material and to the same thickness as the pipe, using methods and procedures as recommended by THERMACOR PROCESS INC. of Fort Worth, Texas.

Thermacor[®]
PROCESS INCORPORATED

500 N.E. 23RD STREET, FT. WORTH, TEXAS 76106, TELEPHONE A.C. 817 624-1181

CERTAINTEED 500° SNAP*ON FIBER GLASS PIPE INSULATION



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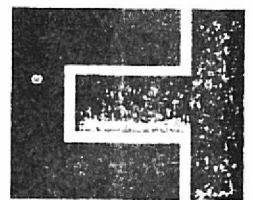
ASJ JACKET SHOWN WITH FACTORY APPLIED SSL TAPE. ALSO AVAILABLE WITHOUT SSL TAPE

PRODUCT DATA

CertainTeed 500° snap*on fiber glass pipe insulation

WITH FACTORY APPLIED ALL SERVICE JACKET (ASJ)

HEAVY
DENSITY



CERTAINTEED

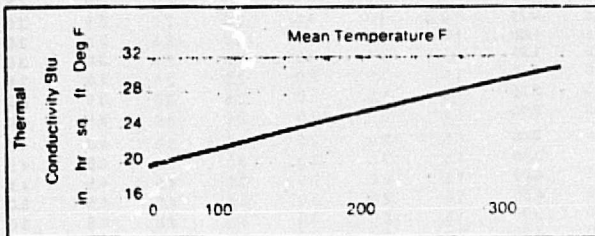
Description

CertainTeed 500° Snap*On Pipe Insulation is composed of extremely fine diameter glass fibers bonded together with a phenolic resin and molded in one piece sections. Made with a single seam. CertainTeed Snap*On spreads open to receive the pipe and snaps quickly in place. It has all the desirable features of glass. The glass fiber will not burn, is not affected by moisture, will not corrode metals, will not rot or mildew and is permanent. The insulation will permit expansion and contraction of the pipe without cracking and it will not shrink. CertainTeed 500° Snap*On Pipe Insulation with factory applied ALL SERVICE JACKET is specifically designed for dual temperature piping. The product may be used on lines operating from -20F to 500F.

Uses

Domestic Hot Water	Steam and Condensate
Heating Hot Water	Fuel Oil Piping
High Temperature	Tempered Water
Hot Water	Booster Heater Water
Chilled Water	Refrigerated Lines
Dual Temperature	Concealed and Exposed

Thermal Efficiency



Benefits

- Quick and clean application
- Flame resistant
- High thermal efficiency
- Vapor barrier not broken as need for staples is eliminated
- Meets the fire and safety requirements of building codes and government guide specifications

Specification Compliances

CertainTeed 500° Snap*On Pipe Insulation with factory applied ALL SERVICE JACKET meets the following specifications:
HH-B-100B, Types I and II, (Jacket)
HH-I-558B, Form D, Type III, Class 12 (to 450F)
Class 13 (to 500F)

MIL-I-22344B
ASTM C547-67

U.L. Listing

CertainTeed 500° Snap*On with factory applied ALL SERVICE JACKET is listed by Underwriters Laboratories as having a composite (pipe covering and jacket) flame hazard classification not to exceed the following:
Flame Spread 25 Fuel Contributed 50
Smoke Developed 50

Jacket Properties

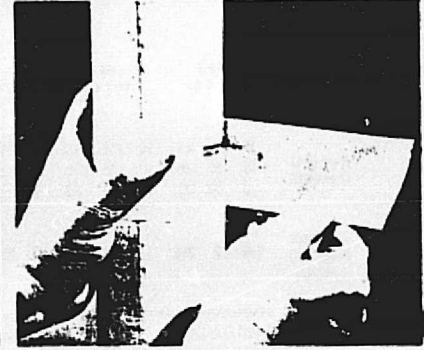
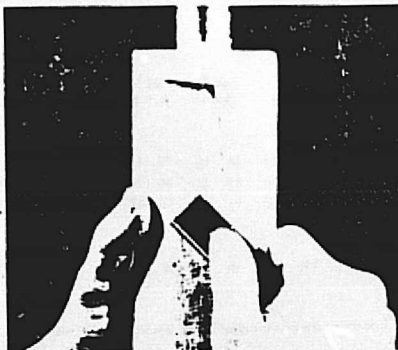
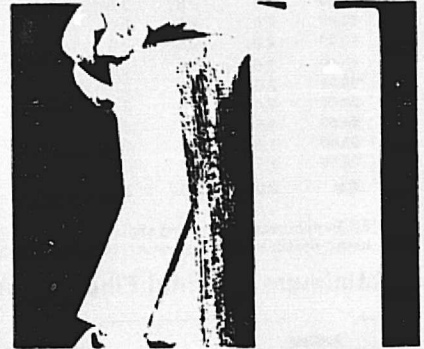
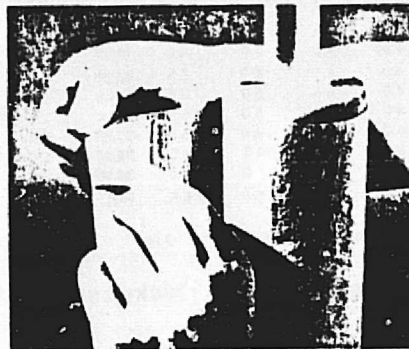
- Laminated aluminum foil, glass reinforcing and white kraft paper
- Perm rating of 0.01 perms (HH-B-100B, Type I)
- Puncture resistance: minimum 50 (Beach puncture)
- Tensile strength: 35 lbs./in.

850° Snap*On

CertainTeed also manufactures a Snap*On Pipe Insulation for service temperatures up to 850°F. Description of this extremely efficient fiber glass insulation for these temperatures is covered in data sheet #30-31-49U.

Recommendations For Installing CertainTeed 500° Snap*On With Self Sealing ASJ Jacket

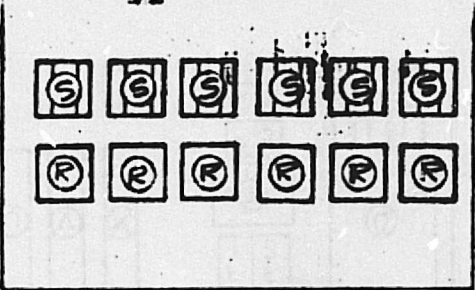
1. Make certain ASJ Jacket is clean.
2. Make all cuts and fabrications before removing release paper.
3. Make sure to rub hard to assure a positive seal.
4. Do not install when air temperature is lower than 35 F or over 120 F.
5. Do not leave adhesive strip exposed to the air. Adhere self sealing lap immediately after removing paper backing.



74" (F)

225" APPROX TOTAL HEIGHT
74" (E)

- (J) MAN. HI-LIMIT HONEYWELL L-4008E
- (W) 10 STEP TEMP CONTROLLER HONEYWELL
5988E - 10 STEPS IN USE
- (X) T991A T' STAT
- (Y) (3) KA BUS BARS



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TANK SPECIFICATIONS

1. DESIGN PRESSURE: 125 PSI.
2. TEST PRESSURE: 183 PSI.
3. DESIGN TEMPERATURE: 250°F
4. STORAGE CAPACITY: 5919 GALS.
5. TANK MATERIAL: CARBON STEEL
6. TANK LINING: PHENOLIC
7. UNIT BUILT IN ACCORDANCE WITH ASME CODE SECTION IV, INSPECTED & STAMPED
(3) COPIES OF INSURANCE CERTIFICATES FURNISHED.
8. TANK IS PAINTED HAMMERTONE BLUE.

NO. OF UNITS REQUIRED: ONE (1)
 PROJECT: STADIUM, SALINE CO. KANSAS
 CUSTOMER: BUCKLEY, INC. WICHITA, KANSAS
 ENGINEER: _____
 ARCHITECT: _____
 AGENT: C.C. McMICHAEL CO.

DURALEC

ADAMSON COMPANY, INC.

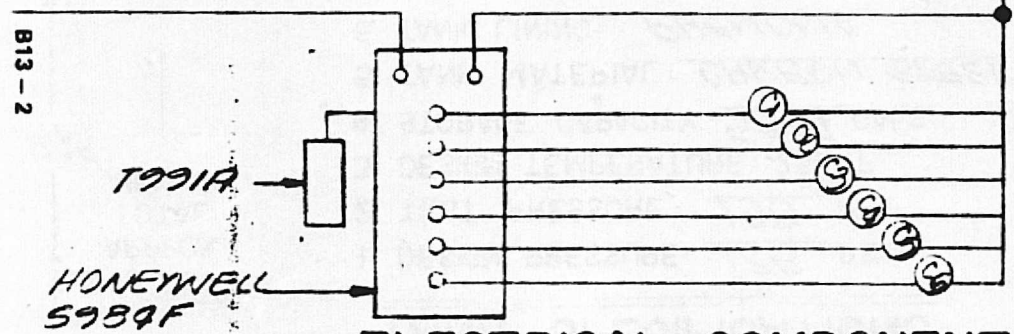
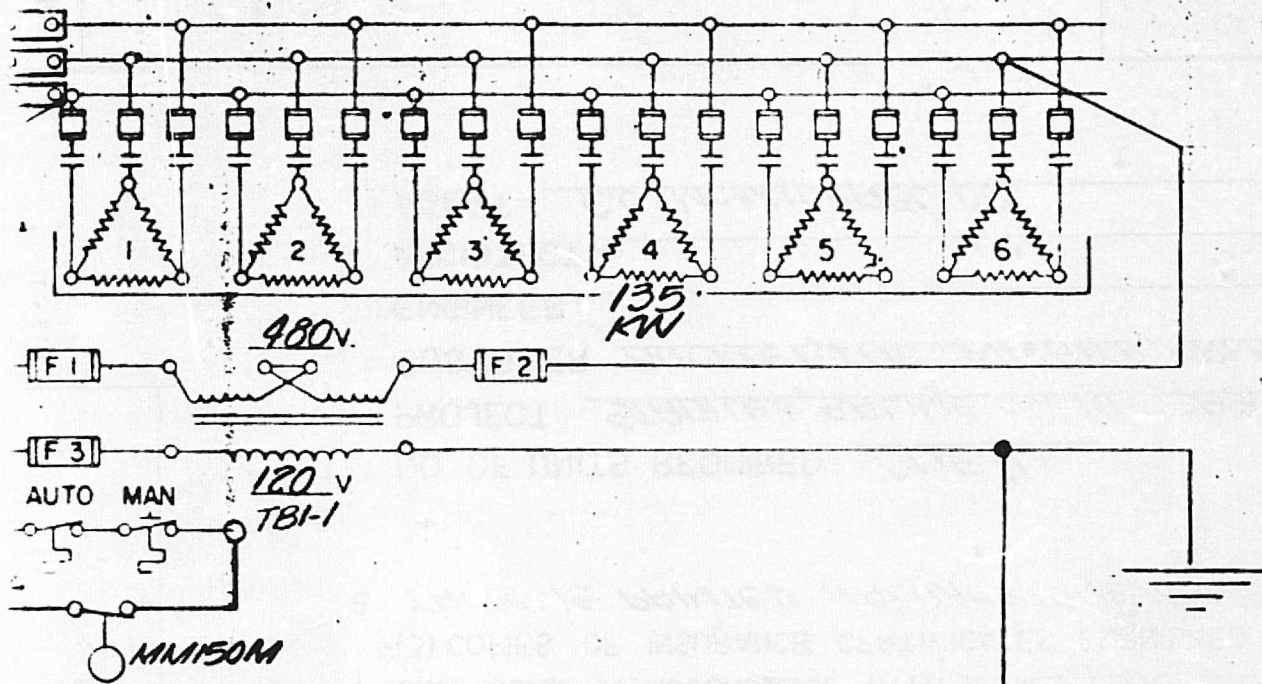
MODEL NO. BE135/5208V

N.T.S.

DRAWING NO. PE-1630-N

B13-1

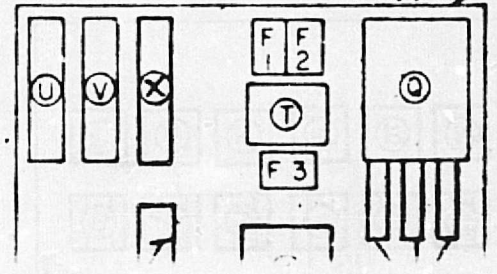
STEP ELECTRICAL SCHEMATIC



ELECTRICAL COMPONENTS

- (P) NEMA I PANEL BOX 42"Hx54"Wx10"D
- (Q) JB3225 CIRCUIT BRKR.
- (R) (Q) 30 AMP DEFINITE PURPOSE CONTACTORS
- (S) (18) 40 AMP ONE TIME FUSES
- (T) 150 VA TRANSFORMER 480V TO 120V

POWER CONDUCTORS MUST ENTER DIRECTLY ABOVE CIRC. BRKR. 7



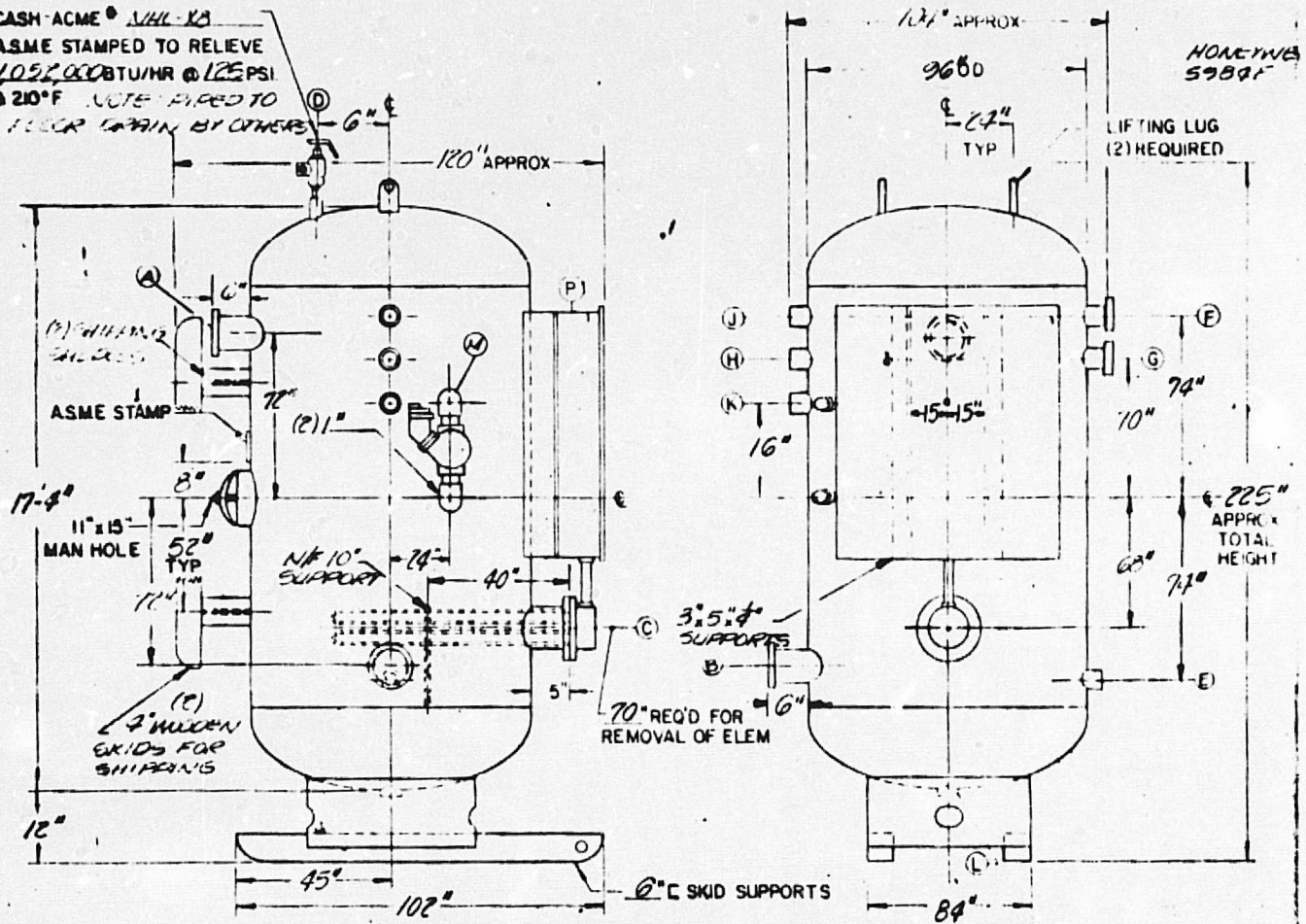
LUG WIRED

TANK OPENINGS

SIZE	TYPE	PURPOSE
A 6"	FLG	HOT WATER OUTLET 150° RGA
B 6"	FLG	COLD WATER INLET 150° RGA
C 10" 50°	FLG	HEATING ELEMENT
D 3/4"	THRD	P & T RELIEF VALVE
E 2"	THRD	RECIRCULATING LINE
F 3/4"	THRD	3 1/2" DIAL THERMOMETER BACK MOUNTED RANGE 30°F TO 240°F
G 3/4"	THRD	3 1/2" DIAL PRESSURE GAUGE BACK MOUNTED RANGE 0° TO 200°
H 3/4"	THRD	AUTOMATIC HI-LIMIT
J 3/4"	THRD	MANUAL HI-LIMIT
K 3/4"	THRD	THERMOSTAT
L 3"	THRD	DRAIN
M 1"	THRD	McDONNELL-MKLAR LOW WATER CUTOFF

ALL THREADED OPENINGS ARE C.U.S.T.
 ALL FLANGED NOZZLES ARE C.U.LINED (10) C.U.S.T. (6)

CASH-ACME® NHL-13
 ASME STAMPED TO RELIEVE
1052.000 BTU/HR @ 125 PSI
 @ 210°F. NOTE: FILLED TO
 110°C MAX. BY OTHERS



UNIT IS UL LABELED UNDER GUIDE 4010
 & WIRED IN ACCORDANCE WITH NEC

ELEMENT SPECIFICATIONS

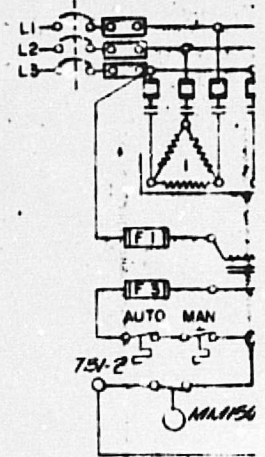
ELECTRIC ELEMENT TO HEAT 553
 GPH OF WATER FROM 20°F TO 120°F
 ELEMENT IS RATED @ 195 K.W., 480 V.,
3 PH., 60 HZ. W/ 19 NO. 5 COPPER
 SHEATHED BLADES INDIVIDUALLY RE-
 PLACEABLE & MECHANICALLY FIXED
 TO A STD. 10" 150° FLANGE W/ COPPER
 FACE R. 6 DELTA WIRED CIRCUITS,
 50 WATT MAX DENSITY.

FIELD WIRING FOR SUPPLY CONNECTIONS
 USE 4/0 RING WIRE SUITABLE FOR
 (167°F) 75°C PER 1975 NEC

FOR GROUND CONNECTIONS USE NO. 3
 AWG WIRE

INTERNAL POWER WIRING TO BE BLACK.

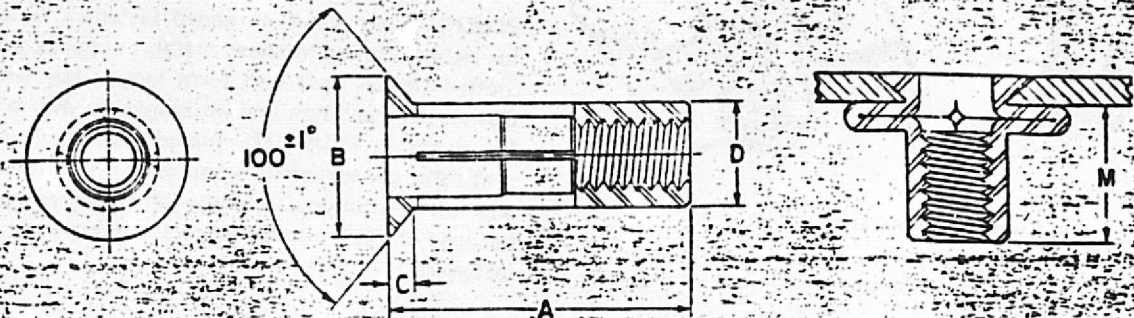
STEP EL



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NO.	DATE	CK BY	BY	REVISIONS	DRAWN BY	DATE
1					V.S.M.	6-29-76
2					CHECKED BY	DATE
3					J.W.H.	7-1-76
4					APPROVED BY	DATE

PLUSNUT SPECIFICATIONS COUNTERSUNK HEAD



Thread Size*	Type Number	Ident. Mark	Grip Range		A ±.015	B Ref.	C Max.	D Max.	M Nom.	Inst. Drill Size	Inst. Hole Size		Wt. (Lbs./100)	
			Min.	Max.							Min.	Max.	Brass	Steel and St. St.
No. 4-40	4P106	Blank	.051	.106	.500	.307	.051	.169	.250	11/64	.170	.175	2.20	2.0
	4P151	1 Rad.	.106	.151	.562	.307	.051	.169	.250	11/64	.170	.175	2.40	2.31
No. 6-32	6P166	Blank	.065	.166	.672	.345	.063	.208	.340	#4	.208	.213	4.18	3.8
	6P271	1 Rad.	.166	.271	.781	.345	.063	.208	.340	#4	.208	.213	4.68	4.2
No. 8-32	8P176	Blank	.065	.176	.672	.377	.063	.241	.335	C	.241	.246	5.17	4.7
	8P271	1 Rad.	.176	.271	.781	.377	.063	.241	.335	C	.241	.246	5.76	5.2
No. 10-32	10P196	Blank	.065	.196	.781	.412	.065	.272	.415	I	.272	.277	7.48	6.8
	10P321	1 Rad.	.196	.321	.922	.412	.065	.272	.415	I	.272	.277	8.49	7.7
3/4-20	25P296	Blank	.089	.296	1.015	.545	.089	.346	.505	S	.346	.352	15.42	14.07
	25P501	1 Rad.	.296	.501	1.234	.545	.089	.346	.505	S	.346	.352	17.83	16.21
3/16-18	31P301	Blank	.102	.301	1.156	.667	.102	.437	.565	3/16	.437	.453	27.68	25.16
	31P501	1 Rad.	.301	.501	1.375	.667	.102	.437	.565	3/16	.437	.453	31.57	28.70
3/8-16	37P316	Blank	.125	.316	1.250	.795	.124	.514	.610	23/64	.514	.522	40.17	36.52
	37P501	1 Rad.	.316	.501	1.453	.795	.124	.514	.610	23/64	.514	.522	44.55	40.50
1/2-13	50P426	Blank	.154	.426	1.609	.993	.154	.640	.780	41/64	.640	.650	68.67	62.43
	50P691	1 Rad.	.426	.691	1.875	.993	.154	.640	.780	41/64	.640	.650	75.13	68.30

*Both UNC and UNF threads are available in No. 10 and larger sizes.

CODE: Diameter and grip range as tabulated. First letter of type number indicates material: "S" for steel, "SS" for stainless steel, and "BR" for brass.

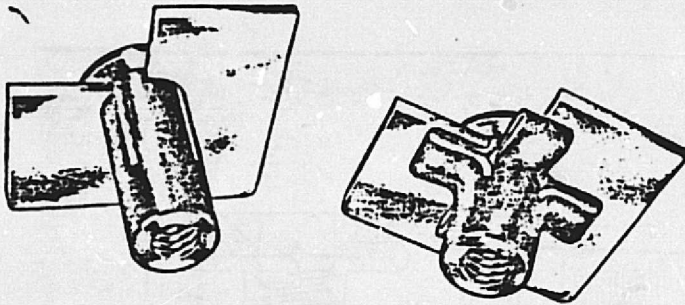
EXAMPLE: S25P296 — Steel 3/4-20 internal thread .089 - .296 grip range.

STANDARD PLUSNUT MATERIALS AND FINISHES

Material	Type No.	Standard Finish
STEEL	C-1108* C-1110*	Cadmium Plate — .0002" Minimum Thickness will meet Federal Specification: QQ-P-416b, Class 3, Type I
STAINLESS STEEL	430	Pickled and Passivated per Federal Specification QQ-P-35, Type II
BRASS	Alloy No. 260	Bright as machined.

*C-1108 and C-1110 steel may be used interchangeably;

PLUSNUT.®

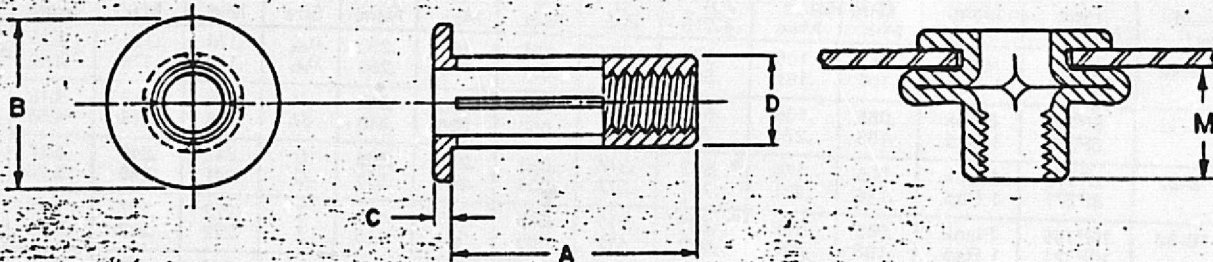


- Superb pull-out strength
- Wide grip range
- Exceptional torque and thread strength.

Developed specifically for automotive, electronic and appliance assembly. Also, suitable for wide applications throughout industry.

PLUSNUTS are blind, threaded fasteners recommended for rigid fastening in sheet metal, fiberglass and plastics. Slotted shanks split and form large flaps which evenly distribute installation and working loads over a large area. For example, PLUSNUTS provide excellent anchors for seat belts, car top carriers and mirror mounts. PLUSNUTS also offer solutions to many other fastening problems because of these outstanding advantages over other blind fasteners.

PLUSNUT SPECIFICATIONS FLAT HEAD



Thread Size*	Type Number	Ident. Mark	Grip Range		A ±.015	B Nom.	C Nom.	D Max.	M Nom.	Inst. Drill Size	Inst. Hole Size		Wt. (Lbs./1000)	
			Min.	Max.							Min.	Max.	Brass	Steel and St. Steel
No. 4-40	4P90	Blank	.020	.090	.484	3/16	.025	.169	.250	11/64	.170	.175	2.21	2.01
	4P150	1 Rad.	.090	.150	.562	3/16	.025	.169	.250	11/64	.170	.175	2.50	2.27
No. 6-32	6P150	Blank	.020	.150	.656	7/16	.032	.208	.335	#4	.208	.213	4.84	4.40
	6P270	1 Rad.	.150	.270	.765	7/16	.032	.208	.325	#4	.208	.213	5.30	4.82
No. 8-32	8P150	Blank	.020	.150	.656	7/16	.038	.241	.340	C	.241	.246	5.86	5.33
	8P270	1 Rad.	.150	.270	.781	7/16	.038	.241	.340	C	.241	.246	6.51	5.92
No. 10-32	10P175	Blank	.020	.175	.781	1/2	.038	.272	.425	I	.272	.277	8.72	7.93
	10P320	1 Rad.	.175	.320	.921	1/2	.038	.272	.425	I	.272	.277	9.67	8.79
3/8-20	25P280	Blank	.020	.280	1.000	3/8	.058	.346	.505	S	.346	.352	17.83	16.21
	25P500	1 Rad.	.280	.500	1.234	3/8	.058	.346	.505	S	.346	.352	20.41	18.55
3/16-18	31P280	Blank	.020	.280	1.141	3/4	.062	.437	.570	3/16	.437	.453	31.15	28.32
	31P500	1 Rad.	.280	.500	1.375	3/4	.062	.437	.570	3/16	.437	.453	35.26	32.05
3/8-16	37P280	Blank	.020	.280	1.218	3/4	.088	.514	.605	33/64	.514	.522	47.07	42.79
	37P500	1 Rad.	.280	.500	1.437	3/4	.088	.514	.605	33/64	.514	.522	51.50	46.52
1/2-13	50P360	Blank	.030	.360	1.562	1 1/8	.125	.640	.790	41/64	.640	.650	86.83	78.94
	50P690	1 Rad.	.360	.690	1.875	1 1/8	.125	.640	.780	41/64	.640	.650	94.03	85.48

*Both UNC and UNF threads are available in No. 10 and larger sizes.

CODE: Diameter and grip range as tabulated. First letter of type number indicates material: "S" for steel, "SS" for stainless steel, "BR" for Brass.

EXAMPLE: S10P175 — Steel No. 10-32 internal thread .020 - .175 grip range.

APPENDIX C
SUPPLEMENTAL COST DATA

- C - 1 ELECTRICAL EQUIPMENT**
- C - 2 MECHANICAL EQUIPMENT**
- C - 3 CONSTRUCTION**

1976 Our 25th Year

ELECTRICAL EQUIPMENT COMPANY, Inc.

Electrical Contractors

Residential and Commercial Wiring

PHONE 313 827-5249

P. O. BOX 591

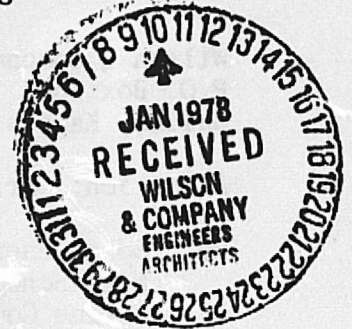
Salina, Kansas 67401

January 9, 1978

Wilson & Company
P. O. Box 1648
Salina, Kansas 67401

Att: Jim Hall

Re: USD 306
Southeast of Saline
K-12 School Building



Dear Sir:

We propose to furnish labor and material to complete the electrical work for the Solar Energy installation according to revised drawings showing pump #6-8-&10 as spare pumps only. The starters for pumps 3-4-&5 to be installed in existing motor control center. The starters for pump 7 and 9 to be separate starters. All control items furnished by others.

All the above for Eleven Thousand Four Hundred Seventy Five Dollars (\$11,475.65).

Sales Tax not included.

Sincerely,

Electrical Equipment Company, Inc.

Lyle O. Scott

Lyle Scott

cc: file



BUCKLEY
INCORPORATED MECHANICAL CONTRACTORS

1600 EAST MURDOCK • P. O. BOX 515 • WICHITA, KANSAS 67201 • PHONE (316) 263-5223

January 9, 1978

Wilson & Company, Engineers and Architects
P.O. Box 1648
Salina, Kansas 67401

Attention: Mr. James M. Hall, III

Re: Solar Energy System
K-12 School, U.S.D. #306
Saline County, Kansas



Dear Jim:

A review of cost parameters of the above referenced project indicates that, based on recent system design modifications as itemized herein, we will be able to hold firm to previously proposed contract dollar amounts; specifically dollar amounts as stated in a written proposal dated March 9, 1977, and a verbal proposal (to modify domestic hot water circulation system) of July 8, 1977. We propose, therefore, to provide a complete mechanical installation as defined in the previously referenced proposals, and modified herein, for the amount of: _____

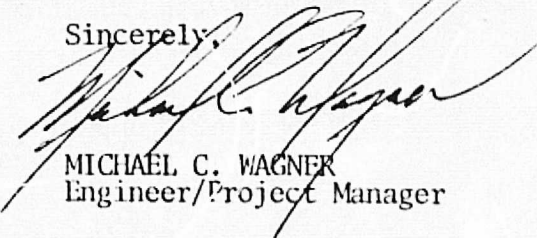
ONE HUNDRED SIXTY-THREE THOUSAND SEVEN HUNDRED and no/100 DOLLARS -- \$163,700.00.

System design modifications include:

1. Location of the solar array approximately one hundred fifty (150) feet southeast of the building location.
2. Installation of solar collectors in twelve (12) banks of twenty-five (25) collectors each.
3. Installation of 1½" thick fiberglass insulation on above ground piping; equivalent thickness of urethane foam on below ground piping; aluminum jacket over insulation exposed to the weather.
4. Installation of Pumps #P-3 and P-4 in parallel arrangement; installation of Pumps #P-5, P-7 and P-9 with Pumps #P-6, P-8 and P-10 provided to the owner as respective stand-by units.

If you **have** any questions in regard to the above, please advise.

Sincerely,


MICHAEL C. WAGNER
Engineer/Project Manager

MCW/jm

J. S. Frank Construction Co., Inc.

General Contractors



225 SOUTH FIFTH • SALINA, KANSAS 67401

P. O. BOX 20 PHONE: AC 913 827-2760
1726

January 19, 1978

Mr. James Hall
Wilson & Company, Architects
631 E. Crawford
Salina, Kansas 67401

Dear Mr. Hall:

Re Board of Education, Southeast of Saline, Kansas
Unified School District No. 306 (USD 306)
Solar Energy DSE 76-2


We propose to provide the necessary supports for the solar heating units as per drawings to include the concrete bases, angle iron frames, and pipe supports for the mechanical pipe, including painting, for the total sum of \$87,807.00 (Eighty-Seven Thousand Eight Hundred Seven Dollars).

This proposal subject to review if not accepted within thirty days.

Our breakdown is as follows:

	<u>Labor</u>	<u>Material</u>	<u>Subcontract</u>	<u>Total</u>
1. Excavation	\$10,923.	-	-	\$10,923.
2. Concrete	3,040.	\$ 5,900		8,940.
3. Structural Steel	15,760	42,320.		59,080.
4. Painting - Labor and Material			\$ 6,864	6,864.
5. Fence	1,000.	1,000.		2,000.
Totals	\$31,723.	\$49,220.	\$ 6,864.	\$87,807.

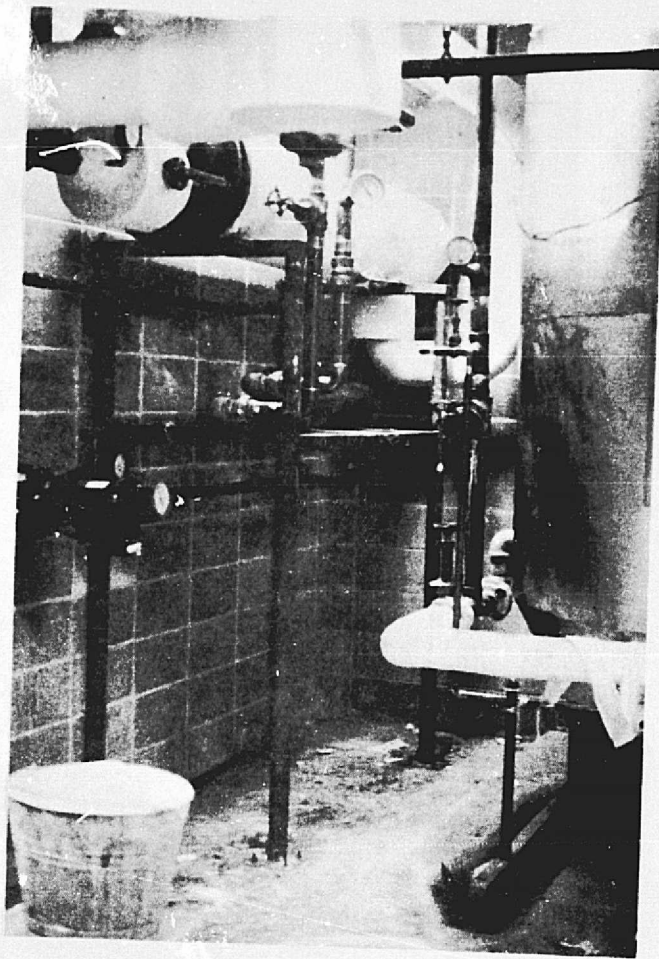
Sincerely


J. S. FRANK CONSTRUCTION CO., INC.
F. E. Frank, President

APPENDIX D

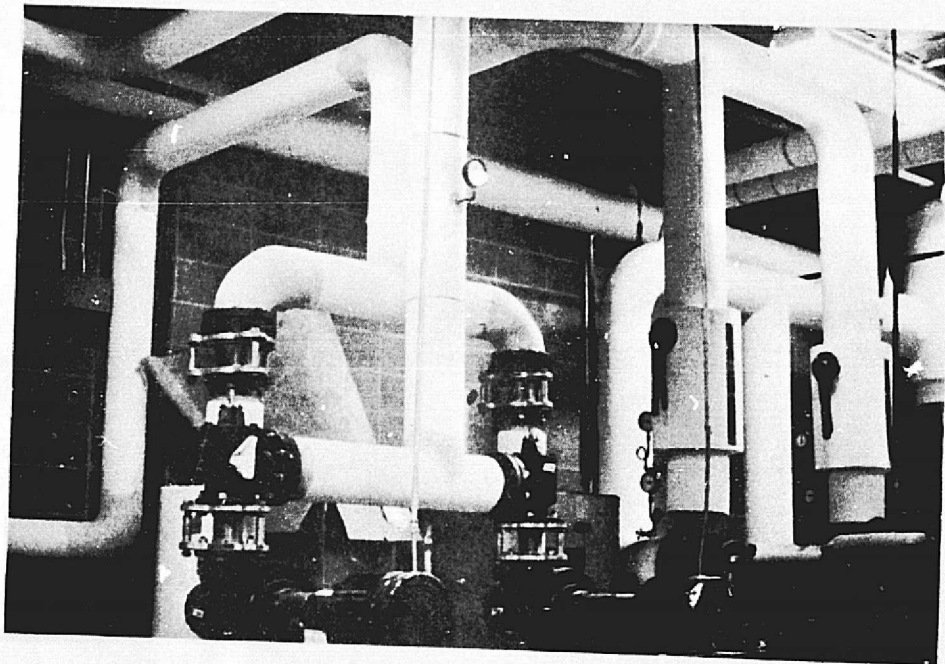
PICTURES

- D - 1 PRIMARY & SECONDARY HEAT EXCHANGER
TANK TO HEAT EXCHANGER PUMP
- D - 2 COLLECTOR PANEL
COLLECTOR FIELD
- D - 3 PIPING SUPPLY
PIPING RETURN
- D - 4 STRUCTURAL FRAMING OF ROWS
STRUCTURAL FRAMING REAR VIEW
- D - 5 DOUBLE TIERED COLLECTOR ROW
COLLECTOR FIELD

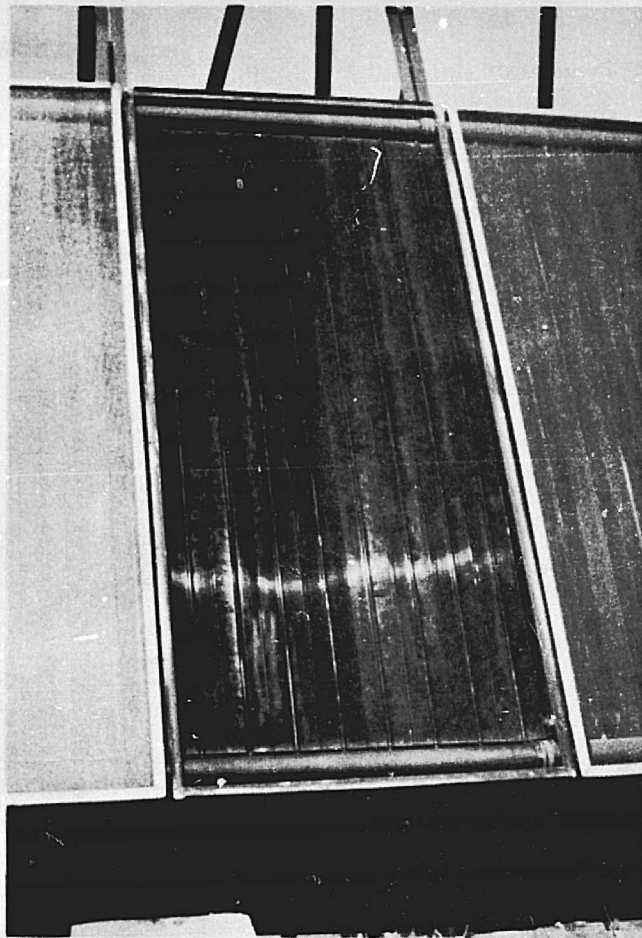


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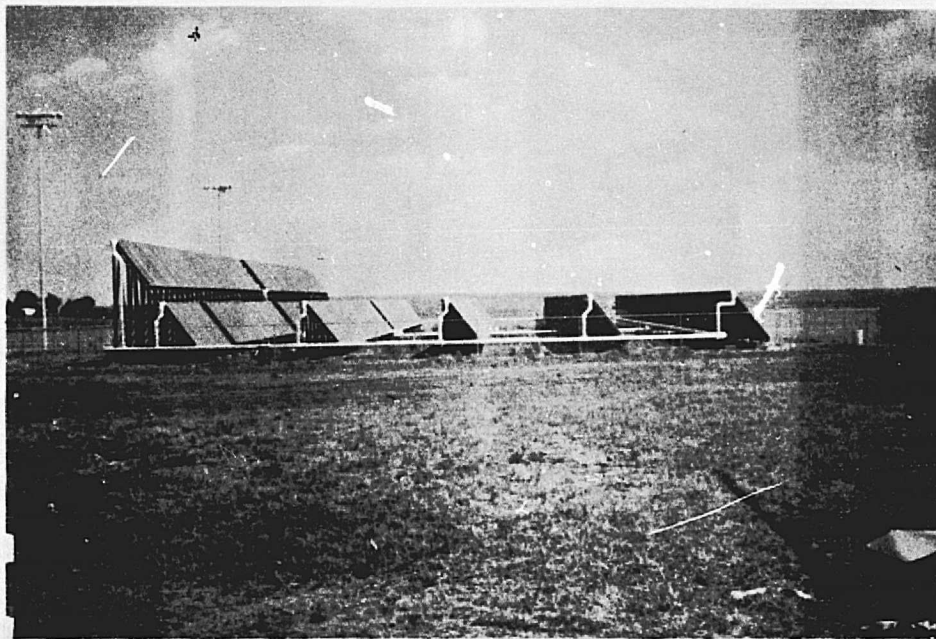
VIEW OF PRIMARY AND DHW HEAT EXCHANGER



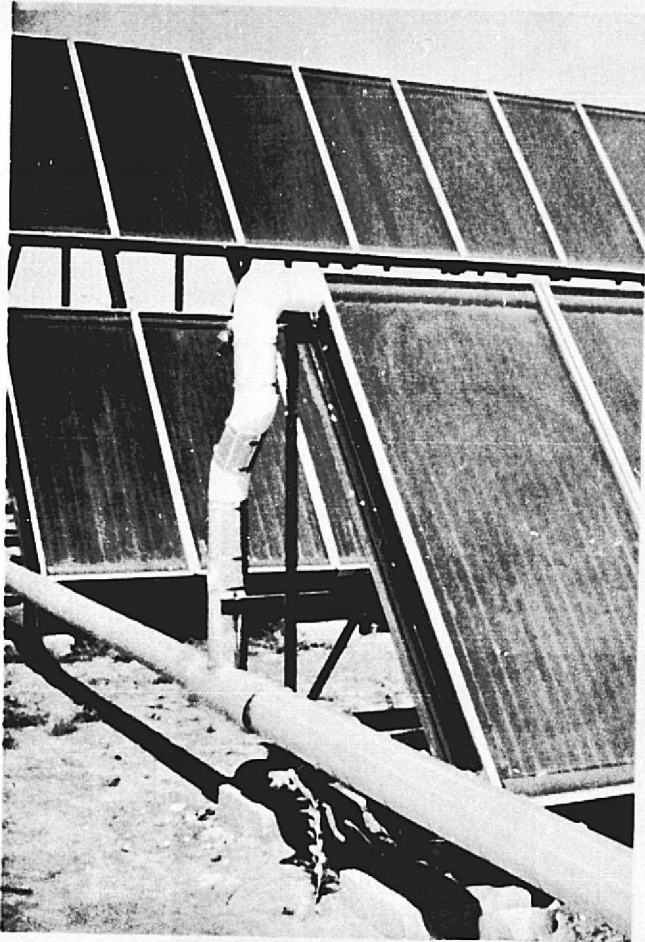
VIEW OF STORAGE TANK TO HEAT EXCHANGER PUMP



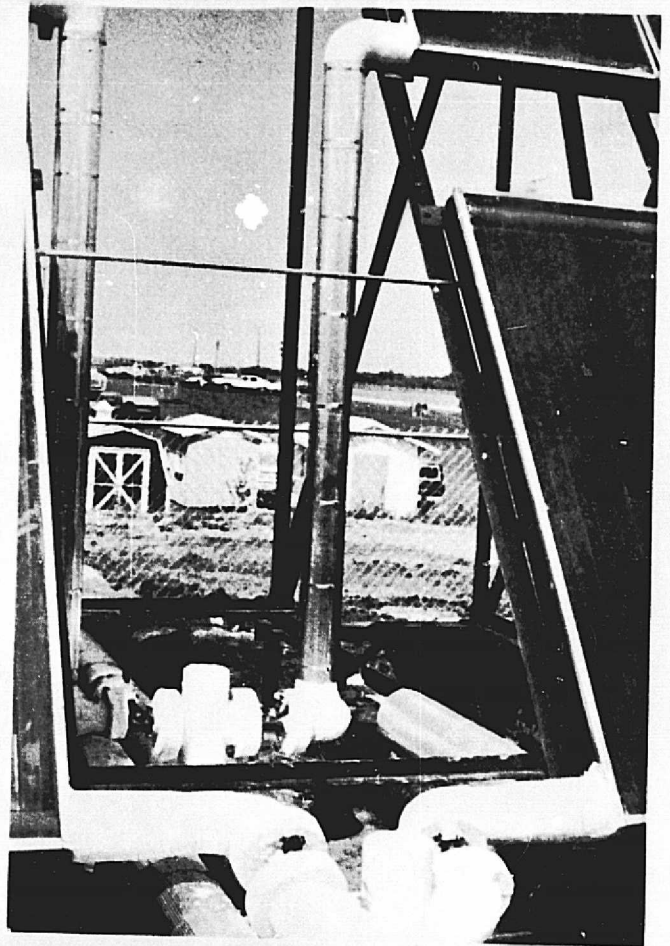
COLLECTOR PANEL WITHOUT GLAZING



VIEW OF COLLECTOR FIELD



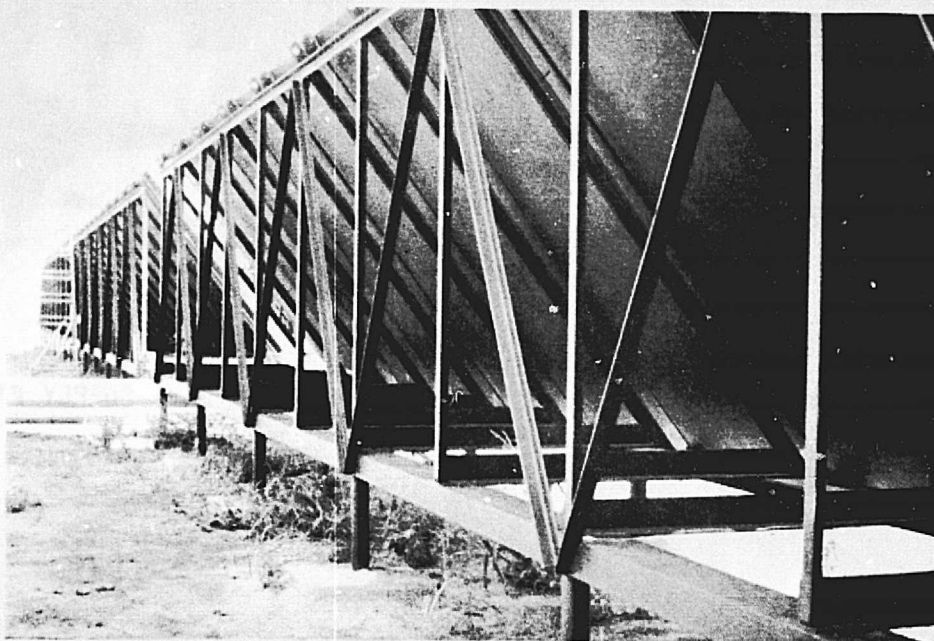
RETURN PIPING



SUPPLY PIPING

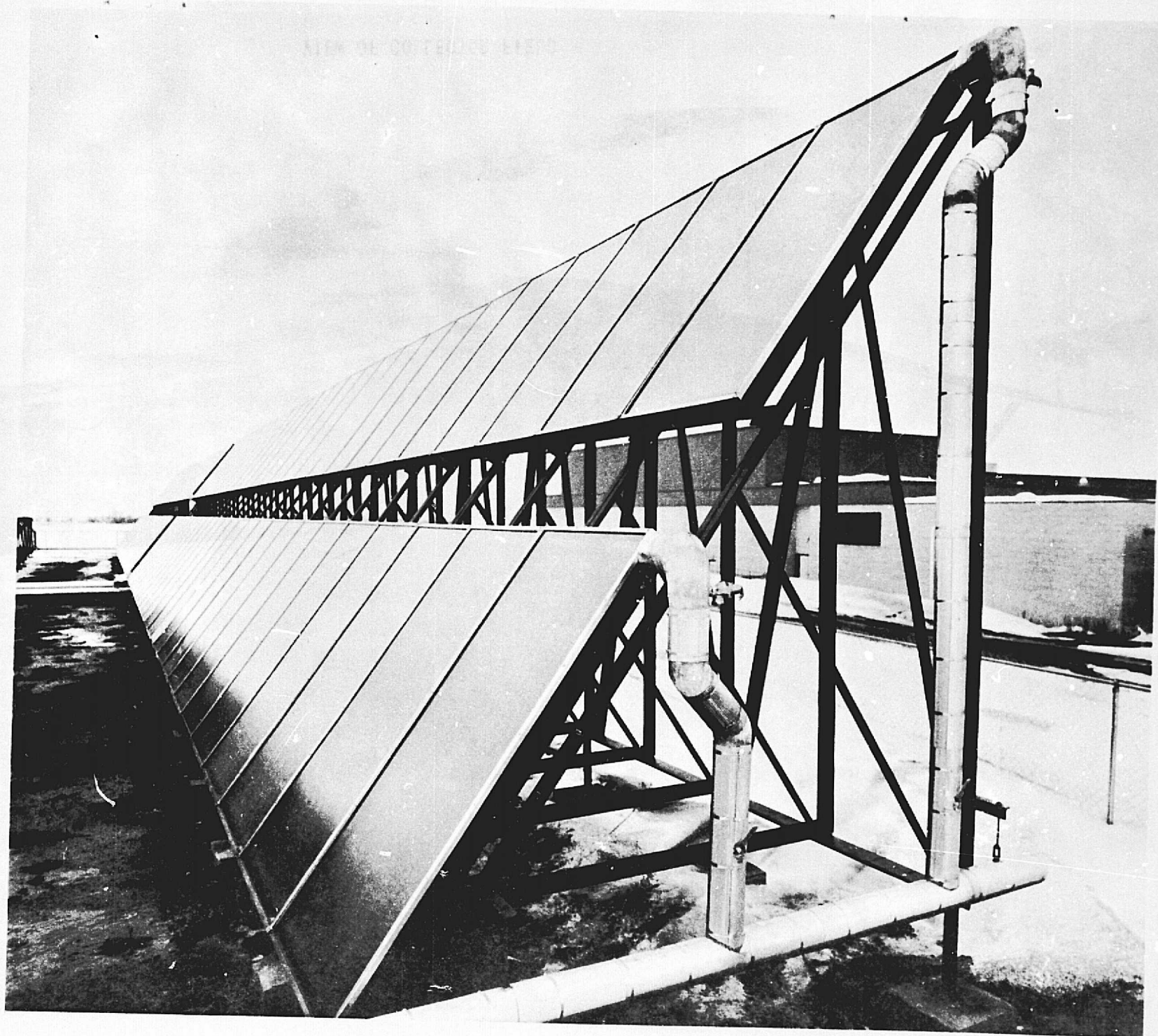


STRUCTURAL FRAMING OF ROWS



REAR VIEW OF STRUCTURAL FRAMING

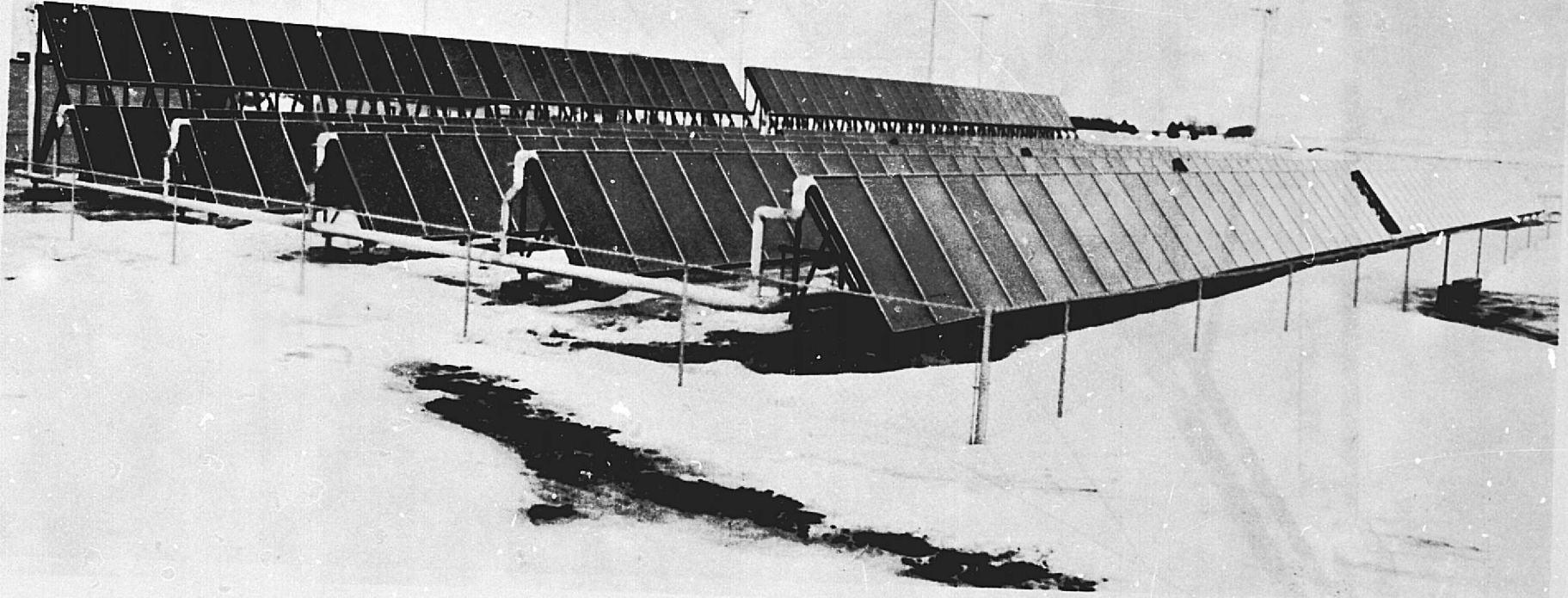
D-5



VIEW OF DOUBLE-TIERED COLLECTOR ROW SHOWING PIPING

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D-6



VIEW OF COLLECTOR FIELD

APPENDIX E

OPERATIONS AND MAINTENANCE

- 1. SYSTEM OPERATION SEQUENCE**
SYSTEM MAINTENANCE INSTALLATION
- 2. PUMP – FLUID LOSS**
 - POWER LOSS**
 - PROPYLENE GLYCOLL**
- 3. HYDROSTATIC TESTING**

BUCKLEY INCORPORATED MECHANICAL CONTRACTORS

1600 EAST MURDOCK • P. O. BOX 515 • WICHITA, KANSAS 67201 • PHONE (316) 263-5223

OPERATING AND MAINTENANCE INSTRUCTIONS

FOR

MECHANICAL EQUIPMENT INSTALLED IN
SOUTHEAST OF SALINE-K-12 SCHOOL BUILDING
SOLAR ENERGY APPLICATION
MENTOR, KANSAS

A. System Operation Sequence

(See Control Diagram for Equipment Designations)

1. If inlet water temperature at control "T₁" rises above set point, heat rejection unit fan will run.
2. When temperature difference between sensor "S₁" in storage tank and sensor "S₃" on collector plate rises above set point on controller "D₁", pumps #3 or 4 and 5 will run. When temperature difference falls below set point, pumps will stop. When collector plate sensor "S₅" temperature rises above set point on controller "D₃", pump #5 will start.
3. When temperature difference between sensor "S₂" in domestic hot water tank and sensor "S₄" in the storage tank rises above set point on controller "D₃", pumps #7 and #9 will run. When temperature difference falls below set point, pumps will stop. When domestic hot water temperature rises above set point on control "T₃", pumps will stop.

B. System Maintenance Installation

1. Service and maintain all mechanical equipment as recommended by Manufacturer.
2. Survey solar collector array daily.
 - a. Check glass for damage, breakage or excessive dust film; repair, replace or clean as required.
 - b. Check hose and clamp joints for leaks; should leak exist, tighten clamp as required.
3. Test solar transfer medium (liquid) periodically for proper strength; solution should be approximately 40% propylene glycol and 60% water, providing freeze protection to about -10°F. Add propylene glycol if necessary; an extra drum of propylene glycol (Dow Chemical "Dowfrost") has been provided for this purpose.

WILSON
E COMPANY
ENGINEERS
ARCHITECTS

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ENGINEERS
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Office Location... 631 EAST CHAWFORD AVE. • SALINA, KANSAS 67401

Mailing Address... PO BOX 1048 • SALINA, KANSAS 67401

6 October 1978

Southeast of Saline, USD 306
RR 1
Gypsum, KS 67448

Attn: Mr. Jim Buxton

Re: USD 306 K-12 School Building
WCEA File: 73-59

Dear Mr. Buxton:

In reply to your letter of 4 October 1978, requesting information regarding the operation of the supplemental solar heating system, we wish to advise you as follows:

1. In case the circulating pump which circulates the antifreeze solution does not function and the relief valves discharge antifreeze solution, we would recommend that you refill the system to replace that fluid which was lost after the circulating pump operation has been restored.
2. In case a leak develops in one of the rubber hose connections between panels we would recommend that you close the valves on the inlet and outlet to the panel array which contains the leak and continue to operate the rest of the system in the normal fashion. The fluid contained within that panel array should then be drained and a repair effected. It will be necessary then to refill the panel array which has been drained.
3. In case of a failure of the heat rejector during hot weather or any time in the event of a power failure if the system becomes hot, the relief valves will function to discharge fluid to prevent pressure build-up. After the power has been restored, refill the system.
4. After the antifreeze solution has been added, there will not be a freezing problem in either of the panels or in the outdoor piping during the winter. It is important to realize that the antifreeze solution which is used to protect the system from freezing is a mixture of 50 percent propylene glycol and water which is an antifreeze fluid used widely in the food processing industry. It is non-toxic. This fluid should not be confused with ethylene glycol which is commonly used in automobile radiators and is toxic. Under no circumstances should ethylene glycol ever be used in this system due to its toxicity.

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R.P.D.
Sheet Protector V-145

BUCKLEY INCORPORATED MECHANICAL CONTRACTORS

1600 EAST MURDOCK • P. O. BOX 515 • WICHITA, KANSAS 67201 • PHONE (316) 263-5223

June 11, 1979

Wilson & Company
Box 1648
Salina, KS 67401

Attn: George Chitwood

Re: Solar Energy Application
K-12 School Bldg., USD #306



Dear George,

Per your request, the following is a brief description of the system testing procedure that our personnel used on the above referenced project.

In general - with the exception of solar collector arrays - system piping and components were hydrostatically tested at a pressure equal to that in the water main serving the building (approximately fifty-five (55) psig). This pressure was maintained for a period of twenty-four (24) hours to verify system integrity.

Solar collector arrays were hydrostatically tested at a pressure of approximately thirty (30) psig. It was found that a static test caused the absorbers in the end two or three collectors of each array to "slide" in a direction away from the center of the array; this invariable caused the header tube of at least one collector to slip out of its coupling hose resulting in a leak at that point. To correct this situation, we provided - with the collector Manufacturer's authorization - an internal shim and an external constraint to eliminate the aforementioned movement of the absorber. With the absorber slippage problem corrected, we were able to conduct successful hydrostatic tests at thirty (30) psig for an appropriate period of time.

Should you have any question in regard to the above or require additional information, please advise.

Sincerely,

BUCKLEY INC.

A handwritten signature in black ink, appearing to read 'Michael C. Wagner'.

Michael C. Wagner
Project Manager

MCW/nc