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DOE/NASA CONTRACTOR
REPORT

DOE/NASA CR-161485

SOLAR SPACE HEATING FOR THE VISITORS CENTER, STEPHENS COLLEGE, COLUMBIA, MISSOURI - FINAL REPORT

Prepared from documents furnished by

Mr. Marion Henley, Director
Building and Grounds Department
Stephens College
Columbia, Missouri 65215

Under DOE Contract EG-77-A-01-4084

Monitored by

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

For the U. S. Department of Energy

U.S. Department of Energy

Solar Energy

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TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.
DOE/NASA CR-161485

2. GOVERNMENT ACCESSION NO.

3. RECIPIENT'S CATALOG NO.

4. TITLE AND SUBTITLE
Solar Space Heating for the Visitors Center
Stephens College, Columbia, Missouri -
Final Report

5. REPORT DATE
June 1980

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)

8. PERFORMING ORGANIZATION REPORT #

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Mr. Marion Henley, Director
Building and Grounds Department
Stephens College
Columbia, Missouri 65215

10. WORK UNIT NO.

11. CONTRACT OR GRANT NO.
EG-77-A-01-4084

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Department of Energy,
Conservation and Solar Energy
Washington, DC 20585

13. TYPE OF REPORT & PERIOD COVERED
Contractor Final
Report

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

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

16. ABSTRACT

This document is the final report of the solar energy system located at the Visitors' Center on the Stephens College Campus, Columbia, Missouri. The system is installed in a four-story, 15,000 square foot building designed to include the college's Admission Office, nine guest rooms for overnight lodging for official guests of the college, a two-story art gallery, and a Facility Lounge. The solar energy system is an integral design of the building and utilizes 176 Honeywell/Lennox hydronic flat-plate collectors which use a 50 percent water-ethylene glycol solution and water-to-water heat exchanger. Solar heated water is stored in a 5,000 gallon water storage tank located in the basement equipment room. A natural gas fired hot water boiler supplies hot water when the solar energy heat supply fails to meet the demand. The designed solar contribution is 71 percent of the heating load. The demonstration period for this project ends June 30, 1984.

The project is part of the U.S. Department of Energy's solar demonstration program and became operational May, 1979.

17. KEY WORDS

18. DISTRIBUTION STATEMENT UC59a
Unclassified-Unlimited

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WILLIAM A. BROOKSBANK, JR.
Mgr., Solar Energy Applications Projects

19. SECURITY CLASSIF. (of this report)
Unclassified

20. SECURITY CLASSIF. (of this page)
Unclassified

21. NO. OF PAGES
299

22. PRICE
NTIS

MSFC - Form 3292 (Rev. December 1972)

For sale by National Technical Information Service, Springfield, Virginia 22161

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SUMMARY

This PON Cycle 2 solar energy site located on the Stephens College Campus at a latitude of 39 degrees North has met virtually all of the requirements for a demonstration solar project in a colder climate. The south facing site is near downtown Columbia, Missouri and is adjacent to a well traveled intersection. Since the building will function as an admissions center, many parents, students and guests will be visiting the building daily.

This a beautiful installation and a very outstanding landmark in a town the size of Columbia. The site will be observed by students from all parts of the country that attend the University of Missouri as well as those attending Stephens College.

The four-floor Visitors' Center with an air conditioned area of 13,000 square feet will house the Admissions Office, the Faculty Lounge, and rooms for guests of the college. The 176 liquid flat-plate, Lennox LSC 18-1S collectors with an area of 3,168 square feet and a tilt angle of 50 degrees are integrated into the roof in a series / parallel arrangement with one in-line pump circulating a 50/50 glycol-water solution through a tube and shell heat exchanger. The heating system consists of fan-coil units and air handlers with hot/chilled pumps receiving energy from a 5,000 gallon lined steel water storage tank located in the mechanical room. If the system water temperature drops below design conditions, a gas fired boiler will supply the supplemental heat.

The total construction cost of this project is $129,585 with the Department of Energy sharing $88,118 of this cost. The designed solar contribution is 71 percent of the heating load. The design review was completed in September, 1977, building construction started November, 1977, and was completed January, 1979. The solar energy system installation and acceptance test was completed in May, 1979.

The solar energy system performance has been exceptional. Although the site is not instrumented, an operating panel with various instruments including an integration (British Thermal Unit) meter is provided for interested visitors and "quick look" determination of system operation.

Major difficulties with the control system marred an otherwise perfect installation. The major element of the problem was finally determined to be in the controls system. Further, this controls problem has been discussed throughout the industry by person to person contact in the solar energy contractor reviews.

MSFC provided knowledgeable personnel to support the design reviews. One suggested change reduced the roof design complexity and provided an easier maintained roof to collector interface at a lower cost. MSFC personnel also were able to confirm for the Project Manager that the automatic control system is not performing to design specifications. The demonstration period for this project ends June 30, 1984.

PART I DESIGN AND INSTALLATION

INTRODUCTION

This Final Report covers the construction of the solar heating demonstration system installed in the Visitors' Center on the Stephens College campus in Columbia, Missouri.

The Visitors' Center is a four-story, 15,000 square foot building that was designed to include the College's Admissions Office, nine guest rooms for overnight lodging for official guests of the College, a two-story art gallery and a faculty lounge. The Center is situated on Broadway Street, which is the major street in Columbia and is also centrally located on the Stephens College campus.

The solar system is an integral design of the building and utilizes 176 Honeywell/Lennox hydronic flat-plate collectors which are a part of the roof system and slopes 50° to the south. The collectors use a 50 percent water-ethylene glycol solution and a water-to-water heat exchanger. The collector circuit is drained during non heating periods. Solar heated water is stored in a 5,000 gallon water storage tank located in the basement equipment room. Hot water for building heat is circulated from the storage tank to fan-coil units and to low temperature air handling units by a small pump. A standby natural gas fired hot water heating boiler supplies hot water when the solar heat supply fails to meet the demand. The control system for effecting the solar heat - fossil fuel heat changeover is fully automatic.

The primary solar circuit transfers solar energy from the collectors to the storage tank, using ethylene glycol solution and a water-to-water heat exchanger. A temperature sensor in the collector array determines when the circulation should occur. When the temperature of the glycol solution exceeds a safe limit, the purge unit is activated. This circuit is designed to be drained during the non-heating periods. The secondary solar circuit transfers heat from the storage tank to fan-coil units and to low temperature air handling unit preheat coils. A temperature sensor in the storage tank determines when circulation should occur. A pair of interlocked three-way changeover valves transfers the fan-coil units from solar water to boiler water whenever the solar water is inadequate for the demand. If the water in tank exceeds a safe limit, an automatic valve drains the water from the tank, allowing cold make-up water to enter.

The boiler water circuit supplies fossil-fuel heat to direct radiation (fin-coil, convectors, and unit heaters), to high-temperature second-position air handling unit coils, and to the fan-coil units via the above mentioned three-way valves. Controls are adjusted so that these functions occur only when the solar heat supply fails to meet the demand.

The solar system was funded in part by a grant of $88,118 from the Department of Energy. Technical advise and management assistance was furnished by representatives from the Marshall Space Flight Center, Huntsville, Alabama.

Construction on the project started in November, 1977, and was essentially complete in February, 1979. Difficulties with adjustments of the control system delayed the acceptance tests until May, 1979. The installation was dedicated on April 20, 1979 and declared operational on June 30, 1979.

INSTALLATION PROBLEMS, SOLUTIONS AND IMPROVEMENT CONSIDERATIONS

The Architect, the Engineer and the owner's representative (the writer) had worked well together for a number of years in the design and execution of a number of buildings on this campus. With this background of a successful working relationship, we felt comfortable in tackling the solar system design, although there was not one minute of solar experience to our credit. Midway through the design, we could have filled a good sized notebook with problems. These were solved, one by one, by asking questions, reading and sometimes by plain horse sense. The proof of the design came to us when we attended the Solar Heating Contractors' Review in New Orleans last year. After listening to innumerable papers and talking to a lot of people, we realized that we had made the right basic decisions.

One problem that didn't get solved at the design state or at the Contractors' Review was how to attach the collectors to a roof and still maintain water tight integrity. A 50 degree roof presents some difficult working conditions at best, then add an array of 176 solar collectors with the necessary piping, then figure out, if you will, how an owner would ever repair a roof leak. The answer is that you build the roof system so you don't have leaks. We worked both sides of the street on this problem, with designs being considered and rejected, until the architect finally designed a special bracket to support the collector array several inches off the roof system. The brackets were manufactured, hot dip galvanized, then installed on the roof as the shingles were laid. Each bracket was carefully flashed in sheet lead as it was installed. The use of the backets materially reduced the number of roof penetrations and we think will work as expected. Time will tell!

A number of problems had to be solved during construction, after owner, architect, engineer and contractor had a first hand look at what the systems were being required to do. The problems that required our attention are as follows:

1. Collector piping and interconnections were changed as follows: Size of panel-to-panel and panel-to-header connectors = 3/8" instead of 1/2". Provided automatic air vents at high points of return headers, relief valves on each supply and return headers, shutoff valves at each header connection to rise, square-head balancing cock at each return header connection to main, and sight glass in each return header. Allowance made for expansion/contraction by addition of compensators, anchors, and guide rings.

2. Storage tank connections: Added automatic fill valve and backflow preventer. Added taps for future subsystems (domestic water heating).

3. Insulation: Called for insulating all pipe and fittings in the collector array. Added insulation to saddles supporting the storage tank.

4. Changes to control sequence.

Differential Temperature Controls

a. Installed a high temperature sensor within the collector enclosure. This required the removal of the window of one collector. It may have been easier to work on an end unit, but it would also be farther away from the control lines, so we used one of the collectors next to the center space. The sensor should be in the top unit of the vertical pair.

b. We installed a spare sensor in case we have trouble with the first, one. We may also need a third sensor to accomplish the purge controls -- this will depend on the versatility of Johnson's components.

c. The low-temperature sensor should be located near the bottom of the storage tank rather than at the top. One possible way to do this without violating the coating of the tank is to install a tee in the "dump" connection and insert the sensor through the straight part of the tee into the tank. The "dump" pipe can then be reconnected to the side outlet of the tee. A second choice would be to install the sensor in one of the pipes at the bottom of the tank, as close to the tank as possible.

d. The controls should be set to start the pump when the differential between the two sensors is 18°F., and to stop them when the differential is 5°F. The opinion seems to be that for normal operation, pumps "A" and "B" should start simultaneously; and that they should start on differential only, regardless of the collector temperature.

NOTE - System changes resulting from the correction of the control problems and other considerations dictated the revision to pump sequence operation described in the introduction to the Maintenance Section of this report.

Purging

a. the sensor which starts the purge unit should be located on the downstream side of the three-way valve. This is particularly important when the valve is modulating as opposed to two-position.

b. The purge fan should start before the three-way valve is fully open, otherwise, the valve will tend to open fully rather than to modulate.

c. A sensor in the collector plate (see item 4a above) should start the purge unit when the plate temperature reaches 220°F. regardless of whether the pipe sensor is calling for purge. Also, pump "A" should start whenever there is a call for purging, regardless of the differential temperature.

5. Due to an error in calculations, the size of piping in the solar loop was noted 1½" instead of 2½"; and that in the exchanger loop was noted 2" instead of 3". These sizes were changed before installation began.

6. Expansion tank capacities were generally too small. We increased capacities of the system tanks and of the solar loop tanks. A tank for the exchanger loop was not considered necessary, therefore, we omitted it.

7. Special attention should be given to selection of storage tank lining as many of the linings on the market will not maintain their integrity at temperatures above 180° or so, and these temperatures can be

attained in the tank under some conditions of operation. The lining in the storage tank used for this project will maintain its stability to 180°. This tank will be monitored to see that the lining stays intact.

8. Accessories: We are considering installing facilities for transferring glycol solution to storage tanks for summertime, and for re-charging the solar loop at the start of the heating season. We should also have glycol-testing equipment to monitor the anti-freeze capabilities and especially the condition of the inhibitors.

PROJECT DEVELOPMENT MILESTONES

MAY, 1977

The Energy Resources and Development Administration (ERDA) anounced that the Visitors Center had been one of 80 sites selected under the second cycle of a five year demonstration program.

JULY, 1977

Stephens College and ERDA signed cooperative agreement No. EG-77-A-01-4084 which stipulates that ERDA will pay $88,118 towards the cost of the solar system. This represents about 68% of the estimated cost.

SEPTEMBER, 1977

The Final Design Review of the project was held on the Stephens College campus. Those in attendance included representatives from the architect, the engineer, the owner, the government and a private consulting firm employed by the government, Planning Research Company.

OCTOBER, 1977

Construction bids for the Visitors Center were opened and the contract was awarded to the low bidder, the John Epple Construction Company of Columbia, Missouri. The low bid was $723,000.

NOVEMBER, 1977

Construction started. Footing and foundation poured, underground utilities started.

DECEMBER, 1977

The solar storage tank delivered to the job site and set in place. First floor deck poured.

JANUARY AND FEBRUARY, 1978

The job was shut down because of severe cold weather.

MARCH AND APRIL, 1978

Brick and concrete work progressing after a ten week shutdown.

MAY, 1978

Brick and concrete work completed and roof structure in place.

JUNE, 1978

The special brackets to hold the solar collectors being installed and flashed as the roofing goes in place.

JULY, 1978

The collectors installed and connected.

AUGUST AND SEPTEMBER, 1978

The interior finishing process in progress.

OCTOBER, 1979

The collectors filled with water-ethylene glycol mix. The system circulates and works, but no controls are installed.

NOVEMBER AND DECEMBER, 1978

Painting, carpet installation, testing of the solar system and miscellaneous mechanical work in progress. One floor of the building was occupied, starting on December 26.

JANUARY, 1979

The building is essentially complete, and we are experiencing our first problem with temperature controls. Representative from NASA, the architect, engineer, owner, control contractor and the mechanical contractor met on January 10 and 11, 1979 to work on this.

FEBRUARY, 1979

The building construction is complete and all of the contractors' men are off the job. The owner has occupied all parts of the building. Control problems continue.

MARCH AND APRIL, 1979

The solar system performs well, but parts of the controls are being operated by hand. The building was dedicated April 20, 1979.

MAY, 1979

Through the combined efforts of the engineer, the control contractor and NASA personnel, the control system is now working as designed. Some sensors had to be relocated, some errors in workmanship corrected and some piping added, in order to correct the deficiencies. The system was drained for the summer on May 30, 1979.

JUNE, 1979

The architect has certified the building as substantially complete and the solar system is declared operational as of June 30, 1979.

PROJECT SUMMARY

GENERAL INFORMATION

OWNER: Stephens College
Columbia, Missouri 65215

ARCHITECT: Sovik Mathre Sathrum Quanbeck
Northfield, Minnesota 55057

MECHANICAL ENGINEER: Lewis D. Freedland Company
Minneapolis, Minnesota 55416

GENERAL CONTRACTOR: John Epple Construction Company
Columbia, Missouri 65201

MECHANICAL CONTRACTOR: Drummond-Officer Mechanical Contractors
Columbia, Missouri 65201

ELECTRICAL CONTRACTOR: Richardson Electric, Inc.
Columbia, Missouri 65201

PROJECT MANAGERS:

Stephens College	Marion Henley	
NASA/MSFC	Daniel E. Henry	November '77 to May '79
NASA/MSFC	Charles L. Greer	May '79 to present

OPERATIONAL DATE: June 30, 1979

CLIMATALOGICAL DATA

LATITUDE:	38° 58' N
HEATING DEGREE DAYS:	
Yearly	5,046
January	1,515
AVERAGE TEMPERATURE:	
Summer	72° F
Winter	43° F

CLIMATALOGICAL DATA - Continued

YEARLY SUNSHINE: 60%

PEAK DAILY INSOLATION: 3,180 BTU/Ft^2 June 21

SOLAR COLLECTORS

COLLECTOR MANUFACTURER: Honeywell/Lennox

COLLECTOR MODEL NUMBER: LSC18-1S

GLAZING: Single

TILT ANGLE: 50 Degrees

AREA:

Gross 3,270 square feet

Net 2,710 square feet

ABSORBER COATING: Black chrome on bright nickel

SOLAR ACCESSORIES

CONTROLS: Johnson Controls

PUMPS & VALVES: Bell & Gossett

HEAT EXCHANGER: Bell & Gossett

FLEXIBLE CONNECTIONS: Aeroquip #FC252 silicone hoses with pre-formed spring wire clamps.

BACK UP SYSTEM

BOILER: Weil McLain, Type EGH, Series 2

FUEL: Natural Gas

COST SUMMARY

This building was placed on the market for competitive bids in October, 1977. Four bids were received and the low bid of $723,000 for the building, including the solar system, was accepted.

The solar system cost is computed as follows:

ITEM	COST
General construction	$ 12,020
Electrical work	570
Solar collectors	45,950
Mechanical construction	
a) Equipment, including purge unit, storage tank, thermometers, relief valve, etc.	17,160
b) Pipe, valves and fittings	7,961
c) Insulation	11,700
d) Temperature control	18,700
e) Labor	26,478
Mechanical change order number 1	4,950
TOTAL	$145,480

OPERATIONAL DATA

Although this project was not declared operational until June 30, 1979, the building was occupied about January 1, 1979 and the solar system was in use.

For comparison purposes, we have a building on our campus, Smith Hall, that is similar in size to the Visitors Center, and the uses are nearly alike. In fact, Smith Hall was built in the middle 1940's by the same contractor that constructed the Visitors Center. The major differences, other than the solar, is that Smith is not nearly so well insulated.

Here are the natural gas costs for the two buildings.

Natural Gas Costs

	Visitors Center	Smith Hall
February, 1979	$ 202.74	$ 718.85
March, 1979	122.61	595.61
April, 1979	72.71	354.63
May, 1979	39.82	119.40

ACCEPTANCE TEST PLAN

I. General Description

1. This is not a fully-instrumented installation, and thermodynamic performance tests will not be required. Tests shall be performed, however, to assure that there are no leaks in the system, that the systems and equipment perform as designed, and that design flow rates of the media are achieved.

2. The hydronic installation consists of the following systems:

   A. Outdoor Solar Loop, including Collector System, piping, and Purge System.

   B. Solar Tank Circulating Loop, including Storage Tank, Heat Exchanger, and Piping.

   C. Indoor Solar Loops, including the Fancoil System (Motel Rooms), and the Upstream AHU coils (Other Areas).

   D. Boiler Loops, including Director Radiation (Fincoil, Convectors, and Unit Heaters), the Fancoil System, and the Downstream AHU Coils.

   E. Chilled Water Loop

3. Adjustment and Calibration of control instruments and systems will be performed by Johnson Control Co., and is therefore mentioned briefly herein, where it pertains to adjustments by the Mechancial Contractor.

II. Leak Testing

1. All hydronic systems shall be tested with a hydrostatic pressure of 60 psi. for a period of 24 hours. If any drop in pressure occurs, the leaks shall be located and repaired; and the test

shall then be repeated until there are no leaks.

2. During the pressure tests, isolate the solar storage tank and any other equipment not designed to withstand this pressure. Lock all relief valves, vents, etc. which are designed to open at less than 60 psi. If the solar loop is tested during periods of solar radiation, caution must be observed to prevent rupture of the pipes. In this case, the relief valve shall be set at 60 psi., or the test performed for a shorter period at night.

3. After testing has been completed, the systems shall be cleaned and flushed as described on Page 206 of the Specifications.

III. Filling of Systems

1. The outdoor solar loop shall be filled with a 50/50 solution of water and Dowtherm DRI ethlyene glycol. The remaining systems, including the boiler, storage tank, piping, etc., shall be filled with soft water.

2. All air vents shall be opened during filling to remove the air from the systems. After filling, the media shall be circulated through the systems at maximum flow rates, and all manual air vents shall be opened periodically to eliminate any entrained air.

3. Adjust the water level in the compression tanks to approximately 2/3 full.

IV. Outdoor Solar Loop

1. These adjustments must be made during a period when the solar radiation is adequate to raise the temperature of the solution in the loop. Caution must be exercised when working around the collectors and piping, as very high temperatures may be present on the metal surfaces.

2. Adjust all relief valves to open at 20 psi. Open all gate valves and squarehead cocks. Start up Pump "A".

3. Using a surface pyranometer, measure the temperature of the fluid in the return mains at the point just before they connect to the bulk header (vertical main). Adjust the square-head cocks until the temperatures at these six points are equal.

4. With pump "B" shut down, allow the collector water to rise to 200°F., and adjust the Purge Unit to start at that point.

5. Place the controls for Pumps "A" and "B" in the automatic mode, and then adjust the controls to start the pumps when the temperature in the solar fluid reaches 100° F., and to stop them when the temperature falls below that point.

V. Solar Tank Circulating Loop

1. With Pumps "A" and "B" running, and during a period of high solar radiation, shut off the downstream systems beyond the tank, and allow the water temperature in the tank to rise. Adjust the emergency dump valve to open at 210°F. Set the relief valve to open at 5 psi.

2. Check the automatic fill valve, and adjust to maintain full water level in the tank.

VI. Indoor Solar Loops

1. Start up Pump "C". Adjust the pump controls so that this pump will run whenever the temperature of the water in the tank is 90° F. or higher, and will stop when that temperature drops below 90° F.

2. Open all Fancoil and AHU coil control valves to fully open position. See that all shutoff valves, square-head cocks, etc. are open. Position the three-way changeover valves in the fancoil loops to the "solar" position, as opposed to the "boiler" position.

3. Adjust the circuit-setters as follows:

Fancoil Units "A", each --------------- 1.05 gpm
Fancoil Units "B", each --------------- 1.22 gpm
Fancoil Units "C", each --------------- 1.79 gpm
AHU #1 Upstream Coil ------------------ 9.91 gpm
AHU #2 Upstream Coil ------------------16.60 gpm
AHU #3 Upstream Coil ------------------ 4.20 gpm

4. Shut off flow to all direct radiation, fancoil units, and AHU's. Adjust the Pressure Regulating Valve in the Fancoil Loop to open at this condition. Crack open a valve in any of the fancoil units, and adjust the P.R. Valve to close as soon as flow occurs in the system.

VII. Boiler Loops

1. Shut off Pump "C", and start Pump "D". Adjust pump controls for Pump "D" so that it will start and run whenever the outdoor temperature falls below 65° F.

2. Position the three-way changeover valves in the fancoil loop to the "boiler" position. Open all control and shutoff valves in the direct radiation, fancoil units, and AHU's to the fully open position. Adjust the circuit-setters in the AHU Downstream Coils as follows:

AHU #1 --------------------------- 6.85 gpm
AHU #2 ----------------------------11.48 gpm
AHU #3 --------------------------- 2.91 gpm

3. Observe the flow rates to the fancoil units at this condition, and record them, but do not change the position previously set for the solar water.

4. Using the pyranometer, adjust the square-head cocks at the direct radiation so that a temperature drop of about 20° F. occurs across each unit of radiation when the building is cold, and all thermostats are calling for heat. After the radiation has been adjusted, return to the AHU coils, and make a final adjustment to the flow rates listed in item 2 above.

VIII. Chilled Water Loops

1. Position the automatic valves at the Fancoil Units to full cooling, that is, open to the chilled water mains.

2. Start up the Chiller and Pump "E". Adjust the controls for this pump and Chiller so that they will start on a call for cooling from any of the nine Fancoil Units.

3. Adjust the circuit-setter in the chilled water main to a flow rate of 9.48 gpm.

4. Shut off all flow to the Fancoil Units, and adjust the Pressure Regulating Valve so that it will open at this condition. Crack the valve at any of the Fancoil Units, and adjust the P.R. Valve so that it will close as soon as flow is restored in the chilled water system.

drummond officer MECHANICAL CONTRACTORS, INC.
2306 N. OAKLAND GRAVEL P.O. 935, COLUMBIA, MISSOURI 65201 314-449-0571
314-449-0846

September 1, 1979

RESULTS OF ACCEPTANCE TEST PLAN

SOLAR HEATING SYSTEM DESIGNED

STEPHENS COLLEGE VISITORS CENTER

COLUMBIA, MISSOURI

LEAK TESTING

1. The solar loop was hydrostatically pressure tested at 60 psig which included the collector system and purge system for a period of 24 hours. All leaks were repaired.

2. The solar tank circulating loop including the heat exchanger, pump and piping but excluding the solar tank was hydrostatically tested at 100 psig. All leaks were repaired.

3. The indoor solar loops including the fan coil system (Motel Rooms) and the upstream AHU coils (other areas) was hydrostatically tested at 100 psig. All leaks were repaired.

4. The boiler loops which include all fin tube radiation, fan coil units, convectors, downstream AHU coils and unit heaters were hydrostatically tested at 100 psig. All leaks were repaired.

5. The chill water system piping including the chiller and fan coil units were hydrostatically tested at 100 psig. All leaks were repaired.

After testing of the above systems cleaning solution was circulated throughout the above systems and flushed out with clean water.

CONTROL SYSTEM

Temperature control system was installed by Johnson Service Company. Upon completion all controls were calibrated and tested. Also spot check were made during heating season to adjust to conditions to the satisfaction of the engineer, owner and accupants.

CHARGING SOLAR LOOP

Outdoor solar loop after being cleaned, flushed and tested was filled with 50-50 solution of soft water and ethlyene glycol by opening the air vents at all high points and allowing the system to fill slowly eliminating any air in the system.

The upper relief valves at the high points were set to relieve at 35 psig while the lower ones were set at 50 psig.

SETTINGS

The temperature in the solar loop where the individual return mains connect to the common return header was adjusted so the temperature was the same at all points.

The purge unit was set to come on at 200° F.

Controls for circulating the solar water through the heat exchanger and the solar tank is set to come on at 105° F and to shut off at 100° F.

The emergency dump valve on the storage tank is set to open at 210° F and the automatic water fill valve is adjusted to maintain full water level in the tank.

The relief valve on the tank is set to relieve at 5 psig.

Controls are set to circulate water in the indoor solar loop when the temperature is 90° F or above in the storage tank and circulation will stop when the temperature is below 90° F.

Boiler loop is set to circulate when the outdoor temperature falls below 65° F. Chill water system is automatic and will maintain water temperature of 45° whenever one or more of the nine (9) fan coil units call for cooling. The circuit setter in the chill water system is set to a flow of 9.48 GPM.

Water balance test have been completed and is shown on data sheet attached herein. The balance sequence was done in strict accordance with the engineers instructions and procedures for this job.

April 11, 1979

STEPHENS COLLEGE VISITORS CENTER

WATER BALANCE REPORT

	SOLAR COIL				BOILER COIL			
	CIRCUIT VALVE SETTING	HEAD LOSS #	REQUIRED GPM	ACTUAL GPM	CIRCUIT VALVE SETTING	HEAD LOSS#	REQUIRED GPM	ACTUAL GPM
AHU #1 Basement	20%	3.75	9.91	9.95	39%	10.75	6.85	6.90
AHU #2 1st Floor	6%	3.80	16.60	16.60	2%	1.25	11.48	11.50
AHU #3 2nd Floor	42%	5.70	4.20	4.20	52%	8.50	2.91	3.00
FCU East					19%	1.70	6.73	6.80
FCU West					36%	3.50	4.54	4.50

Balanced with all control valves in Open position and used B & G Circuit setter for water balance.

drummond officer MECHANICAL CONTRACTORS, INC.
2306 N. OAKLAND GRAVEL P.O. 935, COLUMBIA, MISSOURI 65201 314-449-0571
314-449-0846

STEPHENS COLLEGE VISITORS CENTER

COLUMBIA, MISSOURI

SOLAR HEATING SYSTEM FOR SPACE HEATING

This is to certify that this project was installed and the performance of the system balanced and adjusted in strict accordance with the design data available to us by the architect and engineer and also with recommendations received direct from NASA through the owner.

CERTIFIED BY ______________________

DATE September 1, 1979

Ventilation Test Report

JOB NAME Visitors Center ; Stephens College

TEST BY R.M.

ADDRESS Columbia, Mo.

PAGE 1 OF 1

VENTILATING CONTRACTOR Drummond - Officer

Columbia Mo.

SYSTEM AHU # 1 EQUIPMENT LOCATION Rm. 12

FAN: MAKE Trane

SIZE 6

TYPE

	RATED	ACTUAL
LINE VOLTS	208/60/3	210
MOTOR AMPS	4.1	4

MOTOR: HP 1

RPM 1740

	REQUIRED	ACTUAL
FAN RPM	1042	1010
SYSTEM CFM	2000	2270

REMARKS:

ROOM	NO.	SIZE	STYLE	DESIGNED		TEST 1	TEST 2	TEST 3	K FAC.	ACT CFM	REMARKS
				CFM	FPM	FPM	FPM	FPM			
18		8"	T Bar Lay In	205	890	870	885	895	x .23	= 206	
18		8"	"	205	890	890	895	890	x .23	= 204	
19		10"	"	318	835	850	850	845	x .38	= 321	
19		10"	"	318	835	860	850	850	x .38	= 323	
19		10"	"	318	835	880	860	850	x .38	= 323	
19		10"	"	318	835	890	865	855	x .38	= 325	
		10"	"	318	835	860	865	845	x .38	= 321	
									x	=	
									x	=	
									x	=	
									x	=	
									x	=	
									x	=	
									x	=	

VENTILATION TEST REPORT

JOB NAME Visitors Center - Stephens College **TEST BY** R.M

ADDRESS Columbia, Missouri **PAGE 1 OF** 2

VENTILATING CONTRACTOR Drummond - Officer

Columbia, Mo.

SYSTEM A.H.U. #2 **EQUIPMENT LOCATION** Room 117

FAN: **MAKE** Trane

SIZE 6

TYPE

	RATED	ACTUAL
LINE VOLTS	208/60/3	210
MOTOR AMPS	6.6	6.2

MOTOR: **HP** 2

RPM 1745

	REQUIRED	ACTUAL
FAN RPM	1221	1200
SYSTEM CFM	3000	3080

REMARKS:

[illegible]	NO.	SIZE	STYLE	DESIGNED		TEST 1	TEST 2	TEST 3	K FAC.	ACT CFM	RE
				CFM	FPM	FPM	FPM	FPM			
101		6"	T-BAR LAY-IN	100	835	750	1000	875	x .12	= 105	
[illegible]		8"	"	144	630	955	565	600	x .23	= 138	
[illegible]		6"	"	100	835	1080	960	835	x .12	= 100	
[illegible]		8"	"	144	630	955	565	605	x .23	= 139	
[illegible]		6"	"	100	835	665	750	875	x .12	= 105	
10[illegible]		8"	"	144	630	610	630	620	x .23	= 14[illegible]	
[illegible]A		10"	"	252	665	620	630	630	x .38	= 235	
[illegible]B		10"	"	252	665	580	630	685	x .38	= 2[illegible]	
108A		10"	"	252	665	565	605	660	x .38	= 2[illegible]	
108B		10"	"	252	665	660	670	685	x .38	= 260	
108B		10"	"	252	665	645	670	670	x .38	= 25[illegible]	
108B		10"	"	252	665	620	630	660	x .38	= 251	
112		8	"	15	650	850	760	650	x .23	= 150	
									x	=	

Sheet 2 of 2

VENTILATION TEST REPORT

PROJECT Visitors Center Stephens College DATE

ADDRESS Columbia, Mo. TEST BY

SYSTEM AHU #2 LOCATION Room 117 DWG. NO.

REMARKS MFG.

ROOM	NO.	SIZE	STYLE	DESIGNED		TEST 1	TEST 2	TEST 3	K FAC.	ACT CFM	REMARKS
				CFM	FPM	FPM	FPM	FPM			
113		6"	T-BAR LAY-IN	135	1125	915	1040	1080 x	.12	= 130	
113		6"	"	135	1125	1250	1210	1210 x	.12	= 145	
114		8"	"	168	730	980	870	720 x	.23	= 166	
114		8"	"	168	730	695	720	720 x	.23	= 166	
								x		=	
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Ventilation Test Report

JOB NAME Visitors Center - Stephens College **TEST BY** R. M.

ADDRESS Columbia, Mo. **PAGE 1 OF** 1

VENTILATING CONTRACTOR Drummond - Officer

SYSTEM A.H. U. #3 **EQUIPMENT LOCATION** Equipment Room 200

FAN: **MAKE** Trane

SIZE 6

TYPE -

	RATED	ACTUAL
LINE VOLTS	208/60/3	210
MOTOR AMPS	4.1	4.0

MOTOR: **HP** 1

RPM 1740

	REQUIRED	ACTUAL
FAN RPM	949	950
SYSTEM CFM	2000	2050

REMARKS:

ROOM	NO.	SIZE	STYLE	DESIGNED		TEST 1	TEST 2	TEST 3	K FAC.	ACT CFM	REMAR
				CFM	FPM	FPM	FPM	FPM			
225	1	24x12	Side Wall Register	500	365	300	325	360 x	1.38 =	497	
	2	24x12	"	500	365	305	330	365 x	1.38 =	503	
	3	24x12	"	500	365	360	365	370 x	1.38 =	510	
	4	24x12	"	500	365	400	380	370 x	1.38 =	510	
								x	=		
								x	=		
								x	=		
								x	=		
								x	=		
								x	=		
								x	=		
								x	=		
								x	=		
								x	=		

The Stephens College VISITORS CENTER

Visitors Center Facts In Brief

Architect: Sovik Mathre Sathrum Quanbeck of Northfield, Minn.

Mechanical Engineer: Lewis P. Freedland Company, Columbia, Mo.

Contractor: John Epple Construction Company, Columbia, Mo.

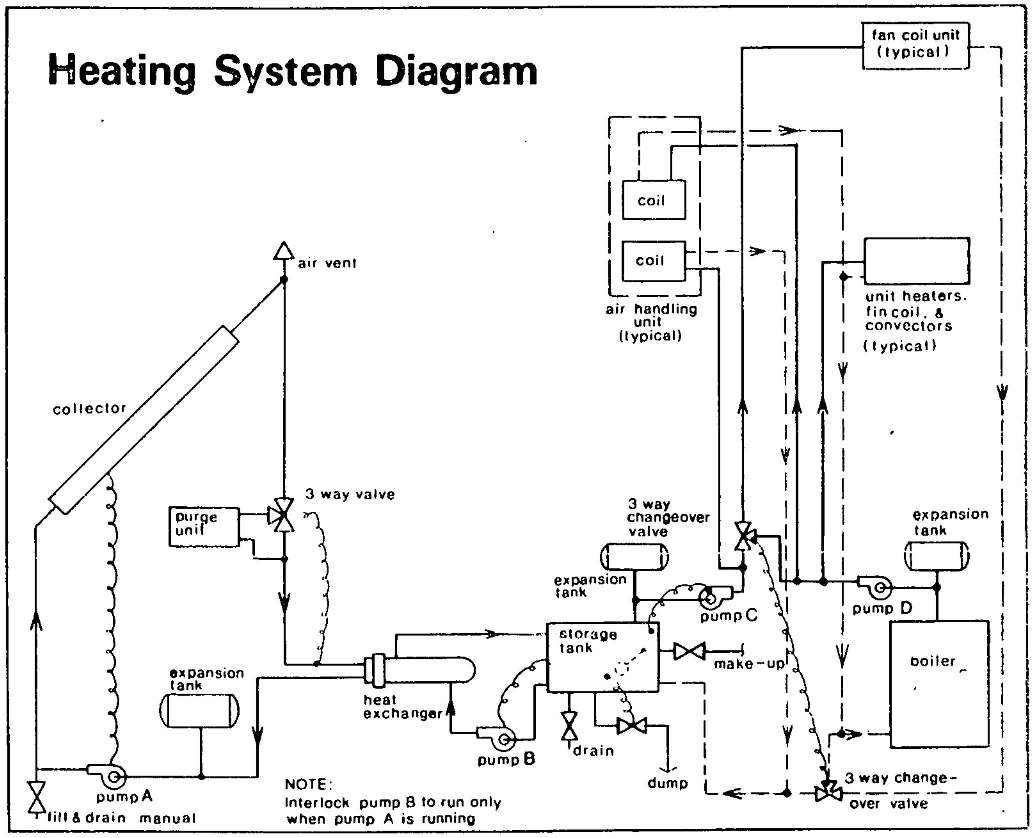
Operational Date: January 1979

Latitude: 30°58" N

Climatic Data:
- Heating Degree Days 5,046
- Average Temperature
  - Summer 72°F
  - Winter 43°F

Solar Energy System:
- Collector
  - Type: Hydronic Flat-Plate
  - Area (sq. ft.): 2,710 net 3,270 gross
  - Manufacturer: Honeywell/Lennox
- Storage
  - Type: Water
  - Capacity: 5,000 gallons

Description:

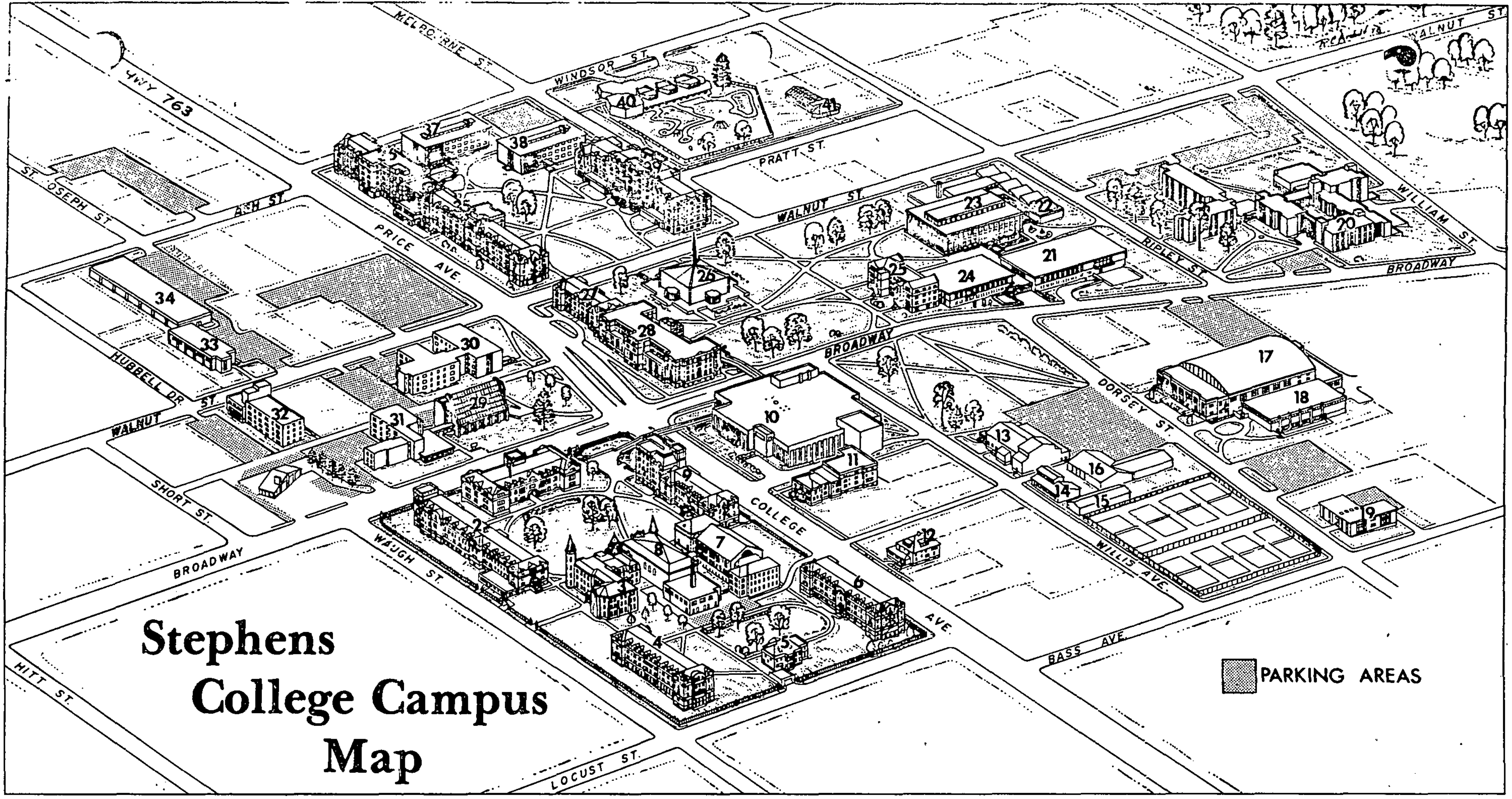


Heating System Diagram

NOTE:
Interlock pump B to run only when pump A is running

The solar collectors are single glazed, filled with a 50/50 solution of water and ethylene glycol, and are designed to handle about 50 percent of the heating load. The control system is completely automatic. When not enough solar energy is available to heat the building, a boiler water circuit is automatically employed. The collectors are integrated into the building design and are flashed to provide a first line of weather proofing. The roof is asphalt shingles, 30 pound felt and plywood deck under the collector supports. The building is designed for energy conservation with 'U' = 0.057 walls and 'U' = 0.0193 roof with triple glazed fixed glass and double glazed operators with integrated metal blinds ('U' = 0.58). This means that the building will use 55 percent of the energy required to heat a conventionally designed building in this area.

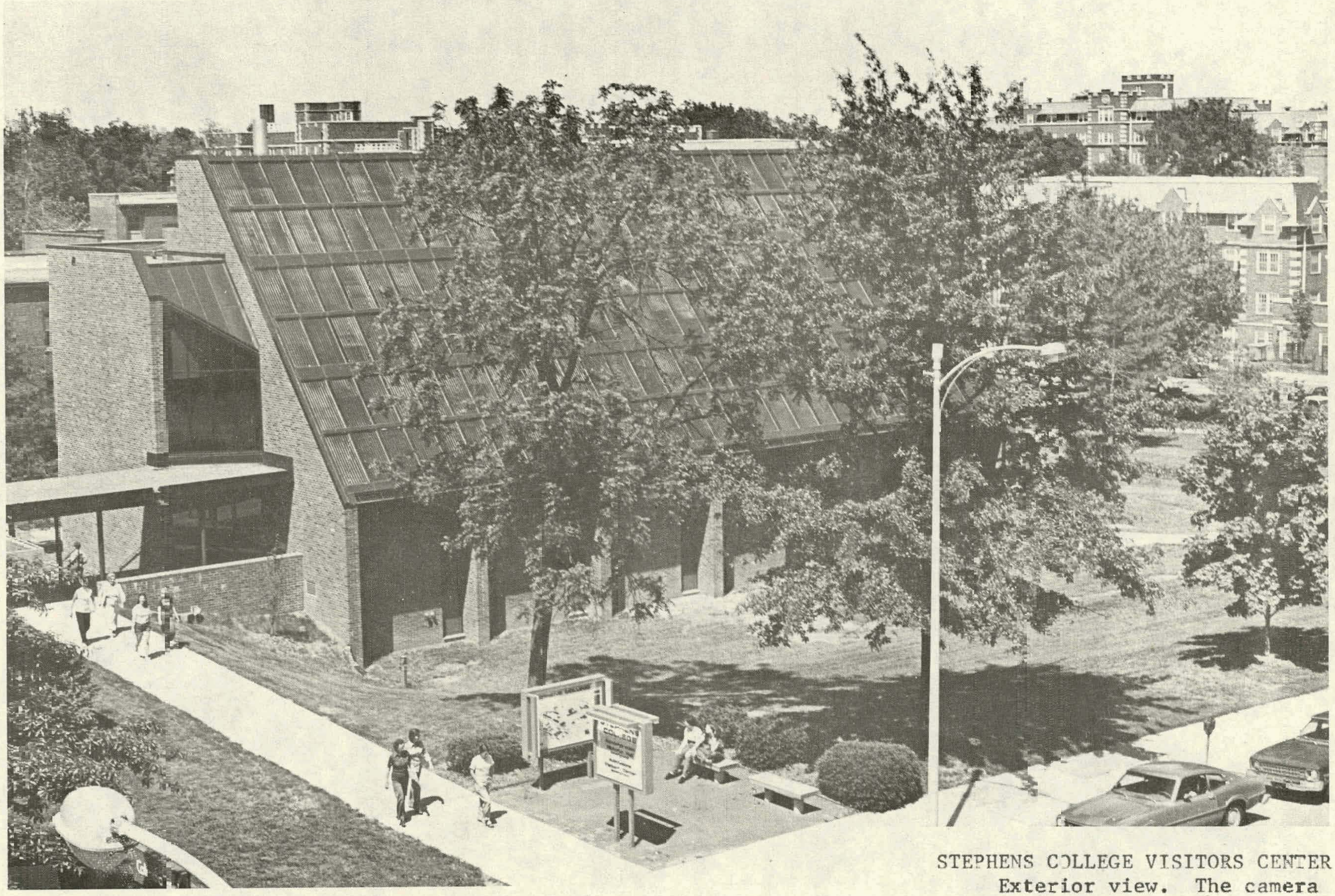
Stephens College Campus Map



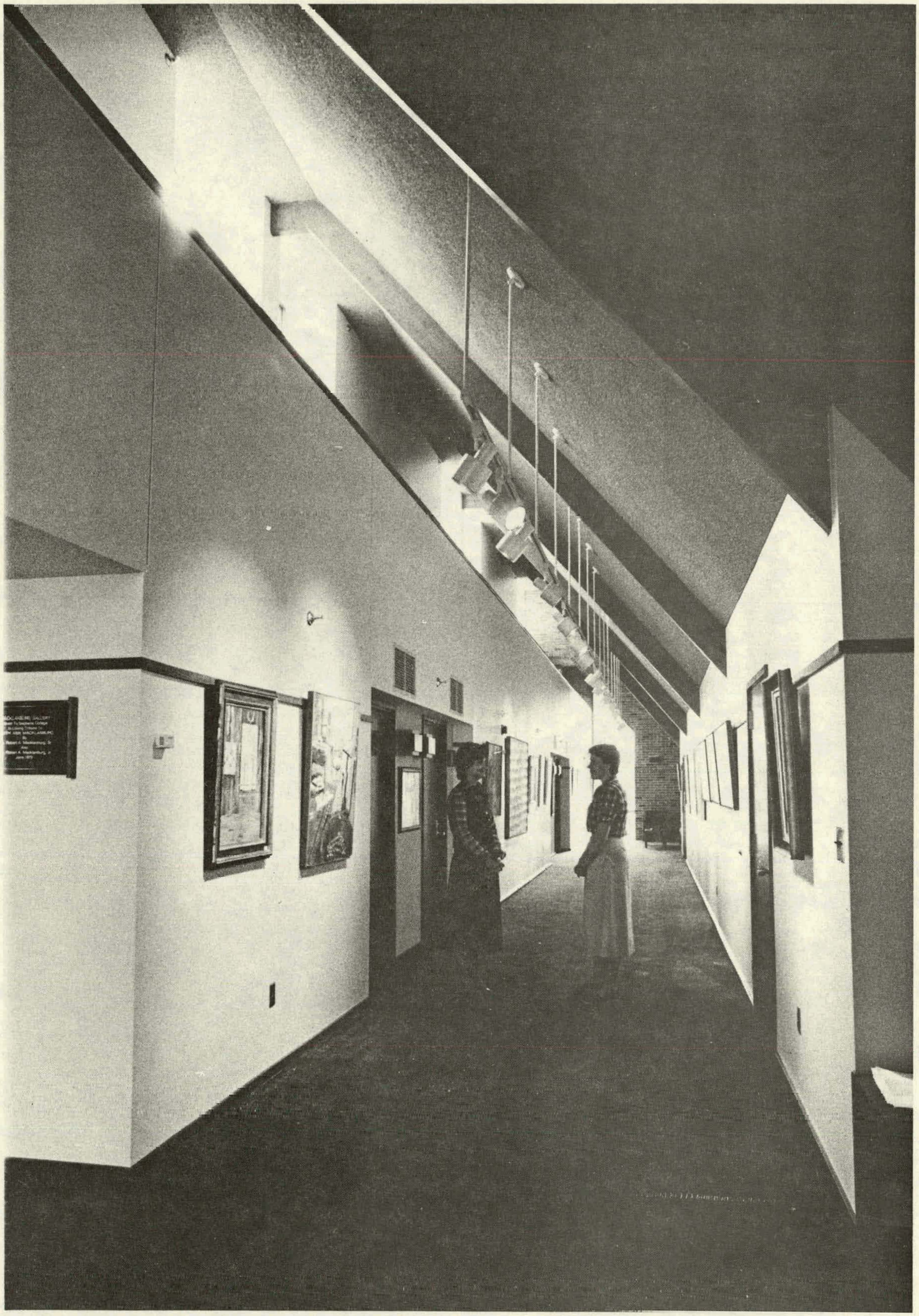
- **Hickman Hall/1**
  - Administrative Offices
  - Alumnae Office
  - Business Administration Department
  - Counseling Service
  - Office of Public Information
  - Placement Office
- • **Columbia Hall/2**
- **Senior Hall/3**
- • **South Hall/4**
- **President's Home/5**
- • **Wales Hall/6**
- **Gauntlett Hall/7**
  - Dance Department
  - Music Department
- **South Campus Auditorium/8**
- • **Wood Hall/9**
  - Registrar's Office
  - The Empty Frame
- **Stamper Commons/10**
  - Bookshelf
  - Faculty Club
  - Hole-in-the-Wall
  - Post Office
  - Stude[illegible] Rooms
  - Winds[illegible]e
- • **Fielding-Smith Hall/11**
  - Theatre Costume Department
- **Newton Hall [rental unit]/12**
- **Playhouse/13**
  - Theatre Arts Department
- **Scene Shop/14**
- **Design Shop/15**
- **Warehouse Theatre/16**
- **Assembly Hall/17**
  - Auditorium
  - Box Office
  - Physical Education Department
- **Swimming Pool/18**
  - (Entrance on north side of Assembly Hall)
- **Faculty Apartments/19**
- • **Hillcrest Hall/20**
- **Radio-TV-Science Building/21**
  - Communications Department
  - Science Department
  - Windsor Auditorium
- **Art Center/22**
  - Art Department
  - Davis Art Gallery
- **Library/23**
  - Penthouse

* indicates dormitories

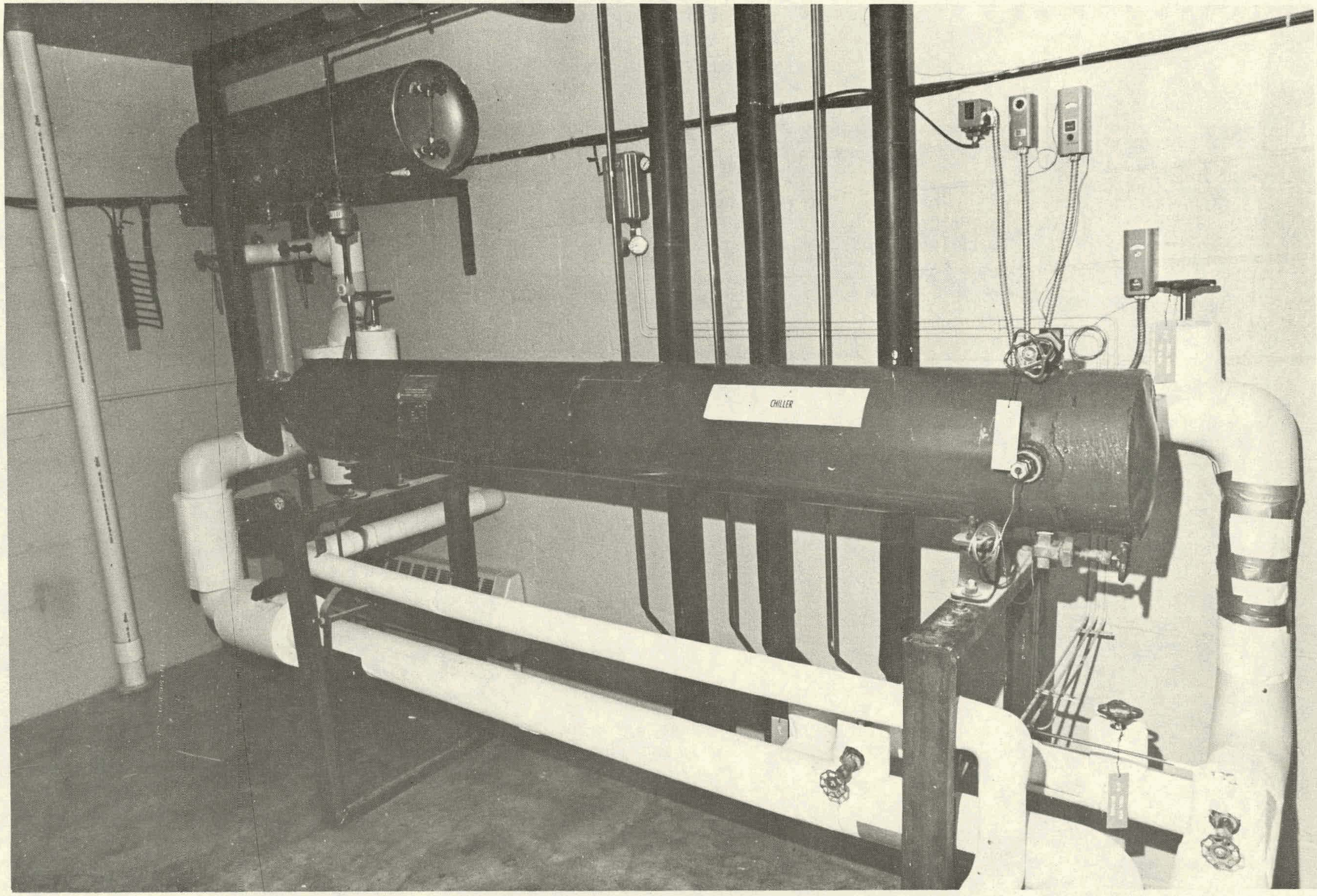
- **Dudley Hall/24**
  - Columbia Foyer
    - Arena Classroom
    - Charters Lecture Hall
    - Secondary Education Department
  - English Department
  - Humanities Department
- **Walter Hall/25**
  - Language Department
  - Mathematics Department
  - Off-Campus Studies
  - Religion and Philosophy Department
- **Firestone Baars Chapel/26**
- • **Laura Stephens Hall/27**
  - Language House
  - Stephens Life (campus newspaper)
- **Lela Raney Wood Student Center/28**
  - Ballroom
  - Black Culture Lounge
  - Collegian Room
  - Sorority Suites
  - Student Activities Office
  - Student Center Lounge
  - Student Government Association Office
  - Student Organization Offices
  - Study Rooms
  - Towne Hall Lounge
- → **Visitors Center/29**
  - Admissions Offices
- **Dearing Hall/30**
  - School of Liberal and Professional Studies
  - Women's Studies Center
- **Sampson Hall/31**
  - Fashion Department
  - Fashion Service Center
  - Travel Bureau
- **Smith Hall/32**
  - Student Health Center
- **Buildings and Grounds Offices/33**
- **Buildings and Grounds Shops/34**
- • **Roblee Hall/35**
  - History and Social Science Department
- • **Pillsbury Hall/36**
  - Psychology Department
- • **Searcy Hall/37**
  - House Plan
- • **Prunty Hall/38**
- • **Tower Hall/39**
- **Child Study Center/40**
  - Child Study Department
- **Greenhouse/41**



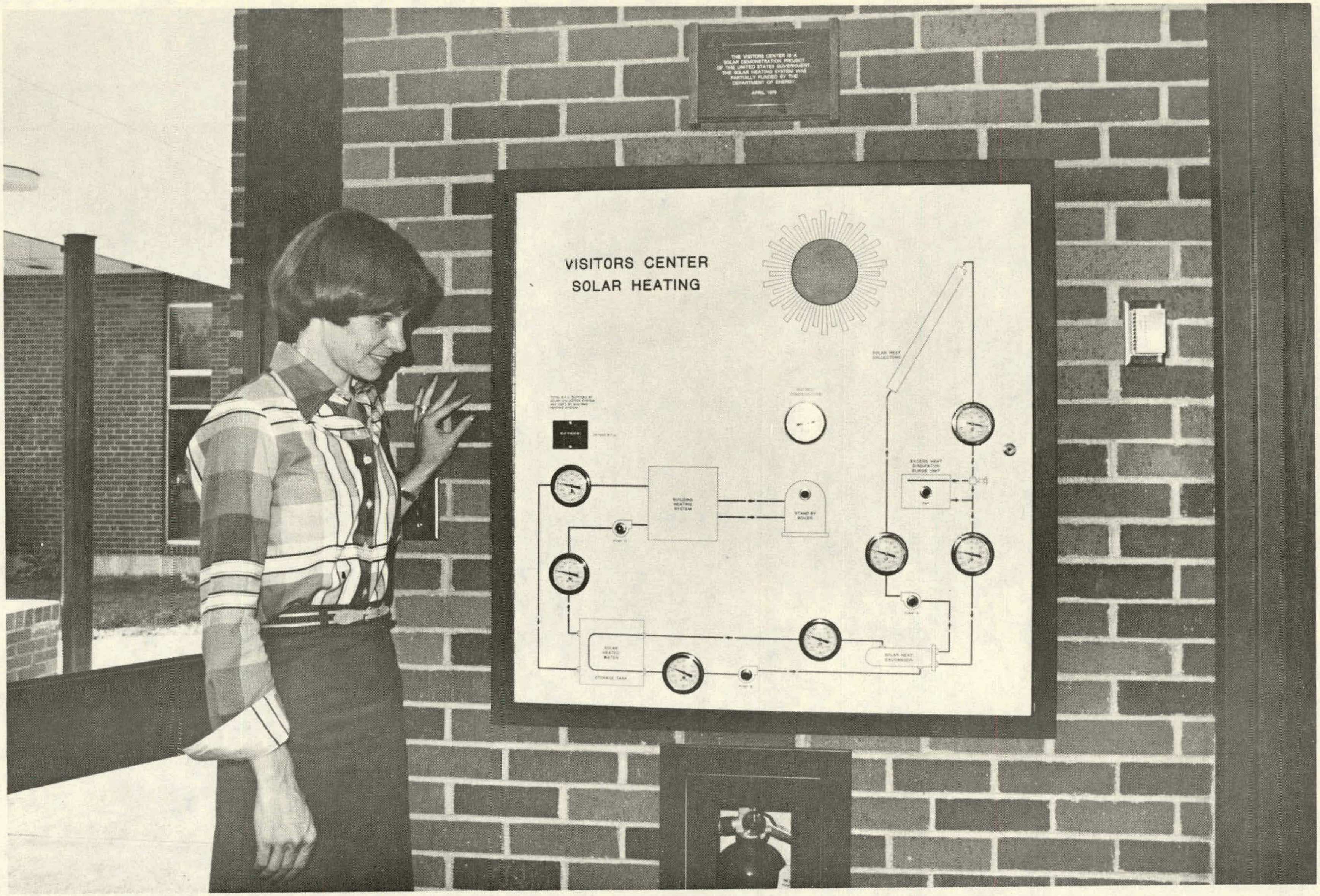
STEPHENS COLLEGE VISITORS CENTER
Exterior view. The camera
is facing north-east



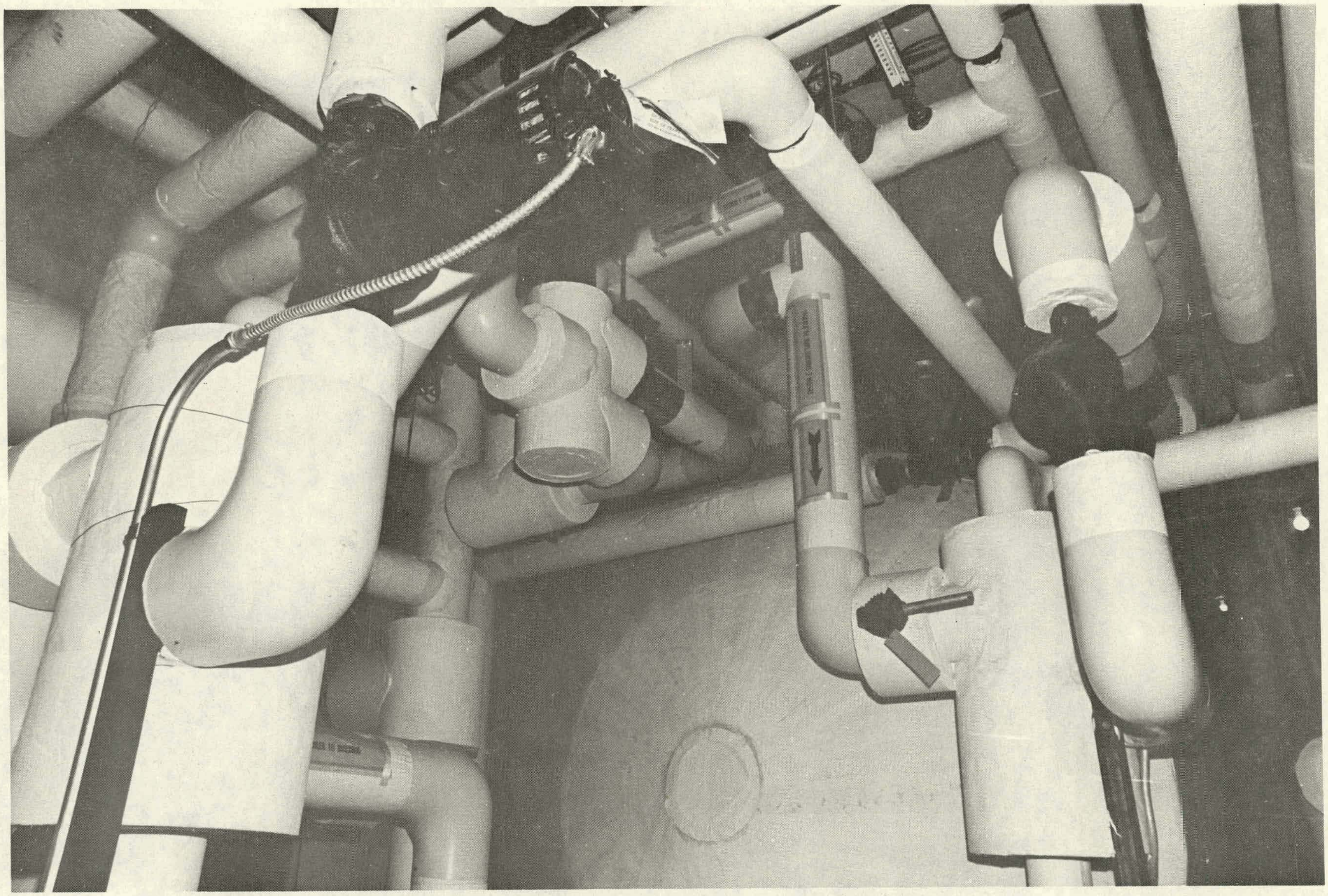
STEPHENS COLLEGE VISITORS CENTER
An interior view of
the guest room area



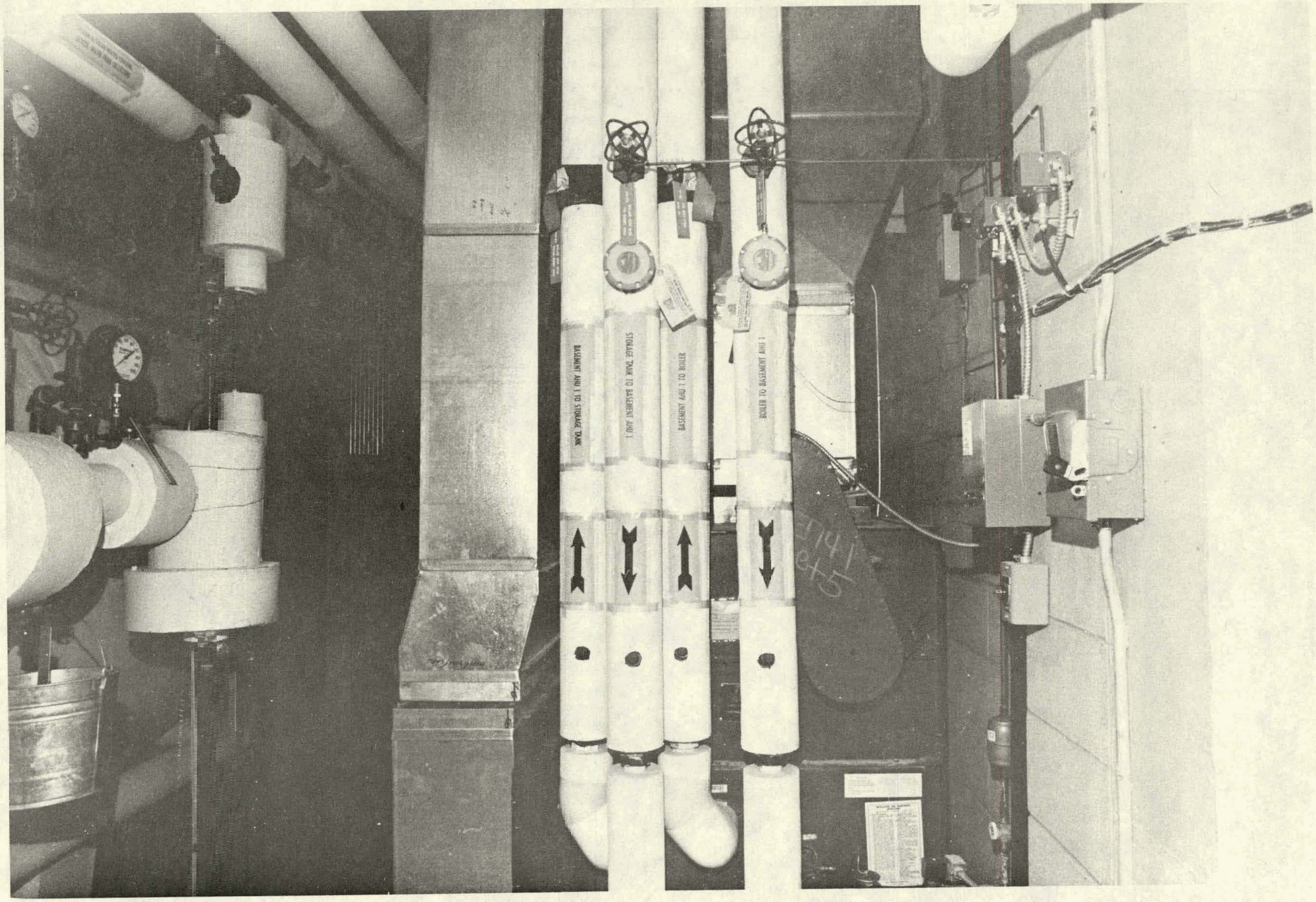
STEPHENS COLLEGE VISITORS CENTER
The chiller



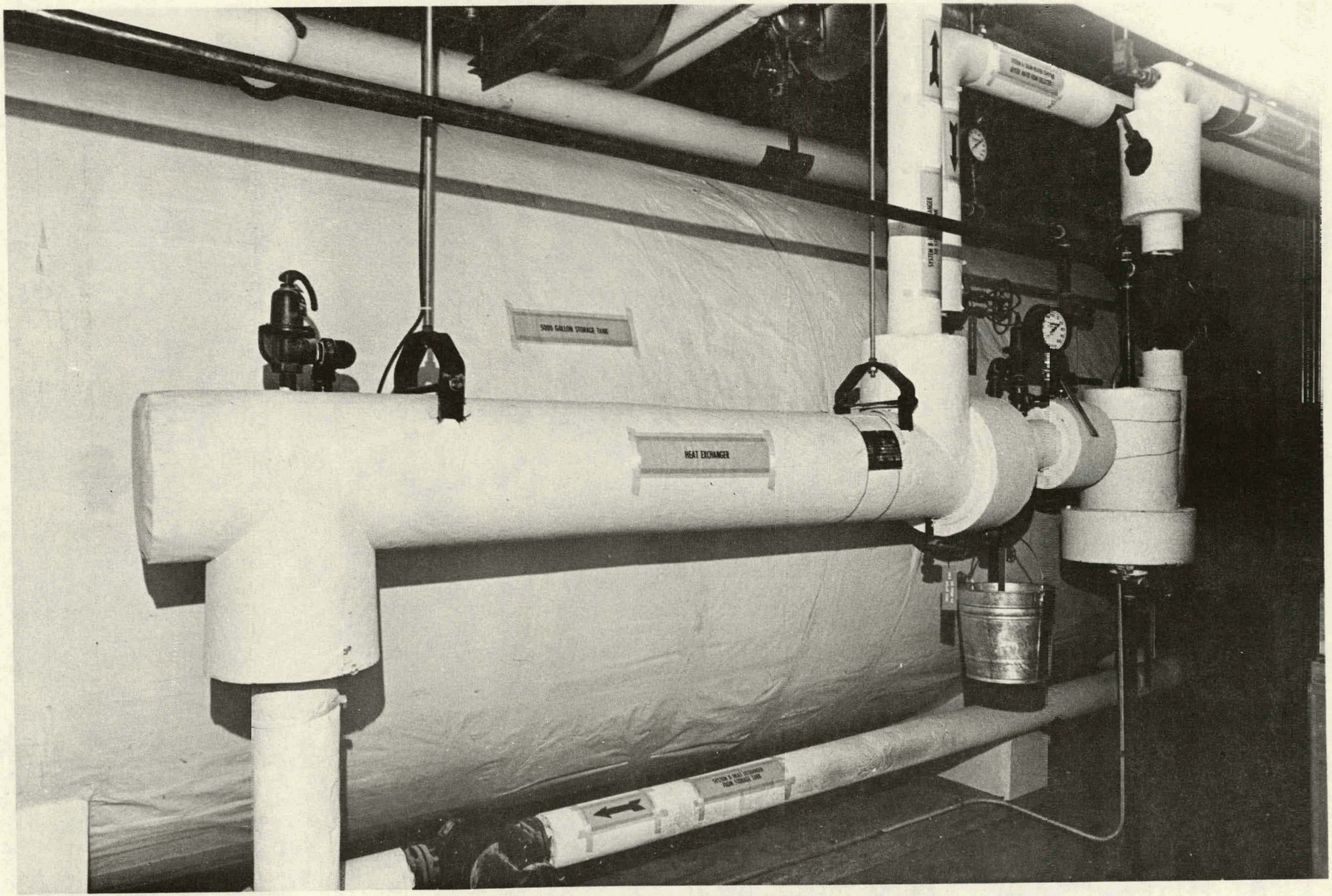
STEPHENS COLLEGE VISITORS CENTER
The solar heating
system display panel



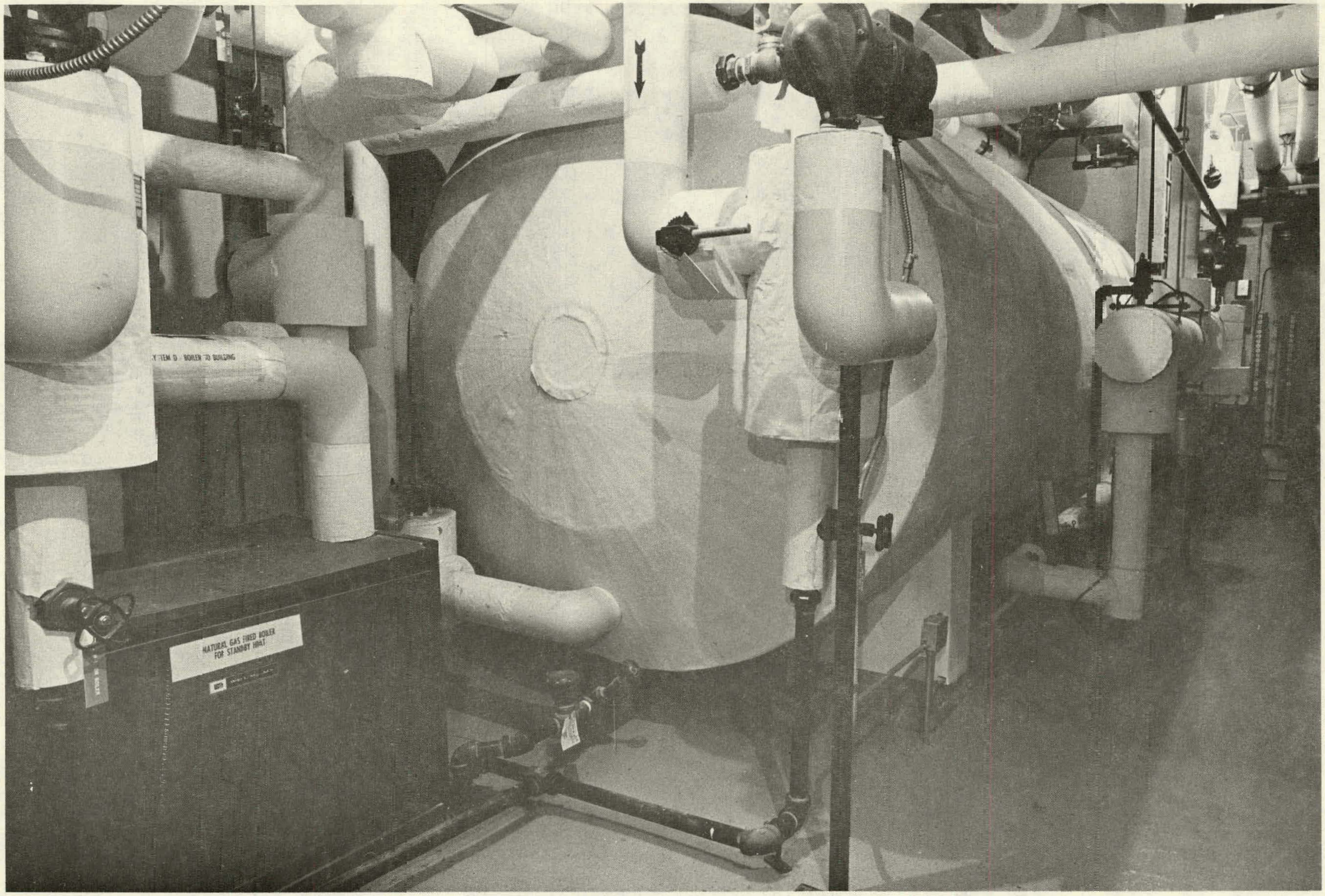
STEPHENS COLLEGE VISITORS CENTER
Typical hot water circulating pumps



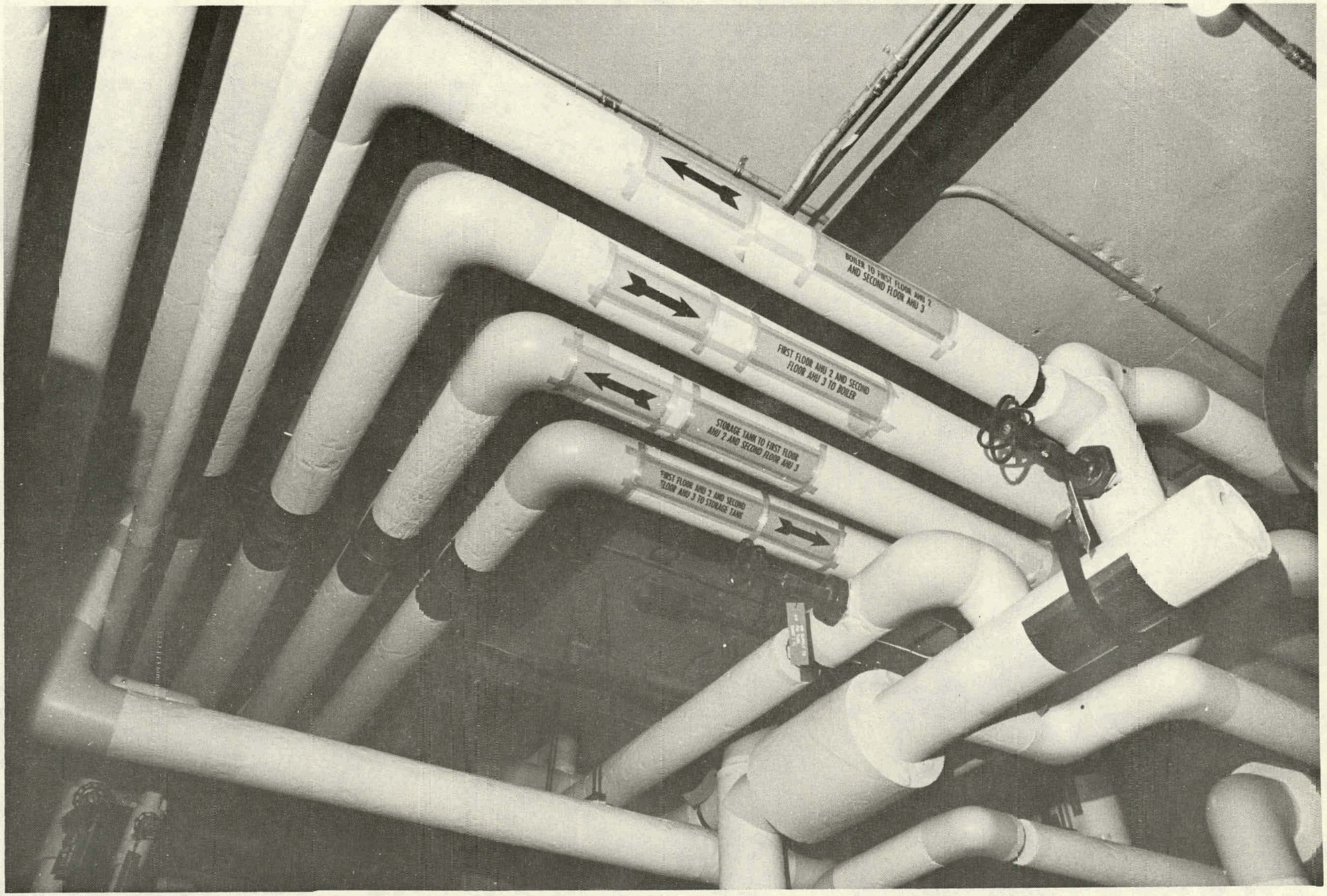
STEPHENS COLLEGE VISITORS CENTER
Air handling unit No. 1



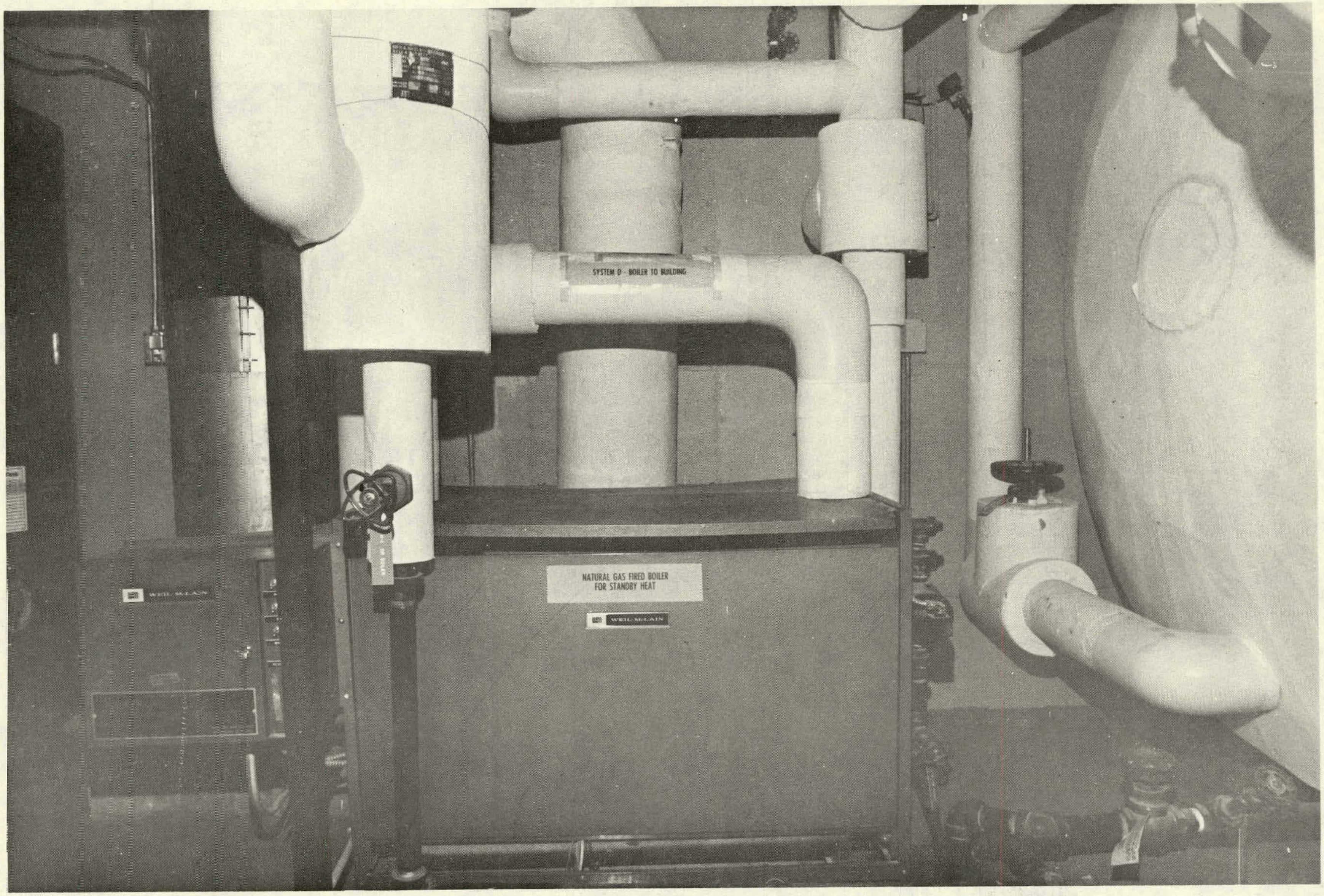
STEPHENS COLLEGE VISITORS CENTER
The heat exchanger, with the
storage tank in the background



STEPHENS COLLEGE VISITORS CENTER
View of the boiler room showing
the storage tank and standby boiler

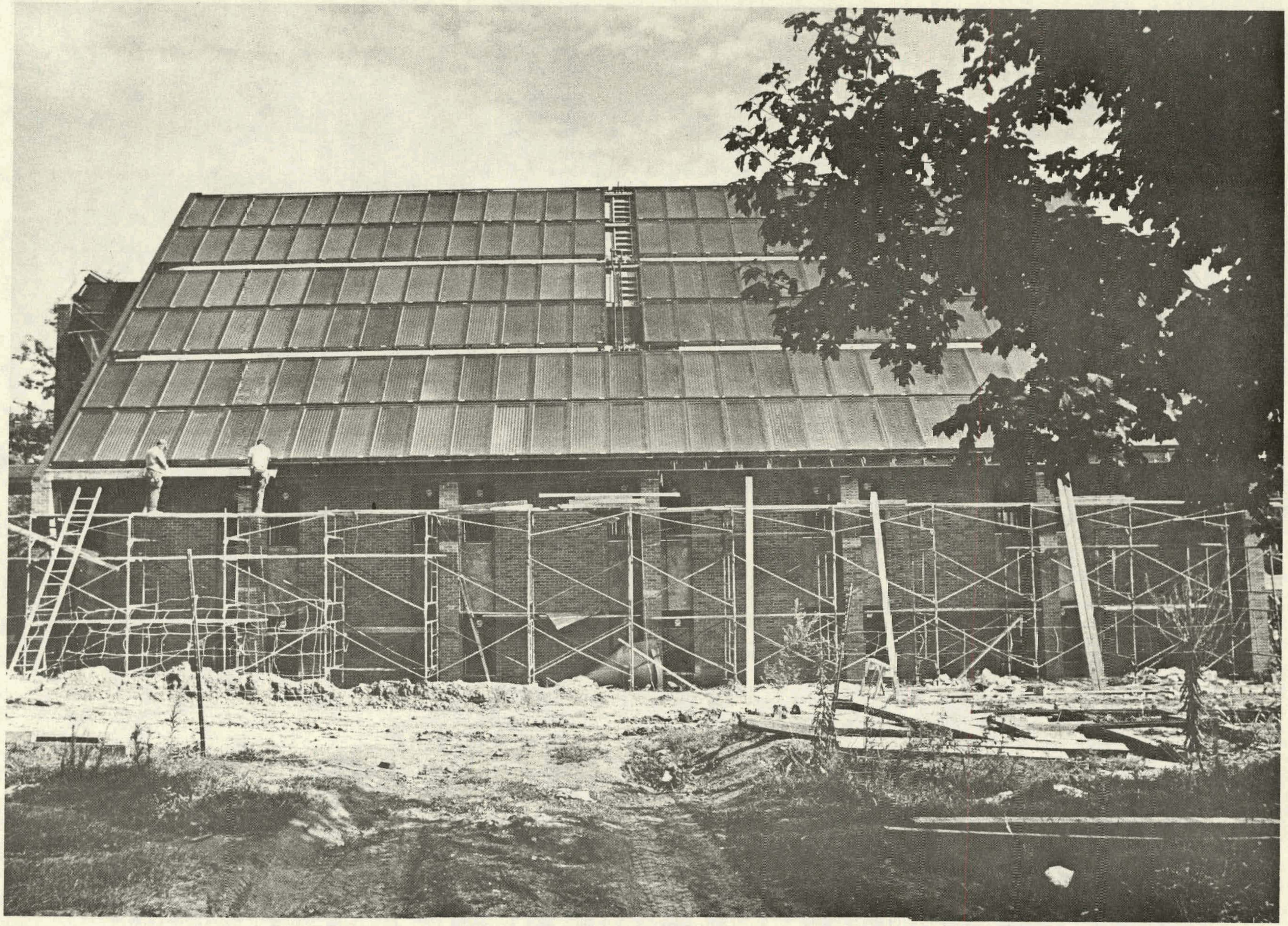


STEPHENS COLLEGE VISITORS CENTER
Typical piping insulation & marking

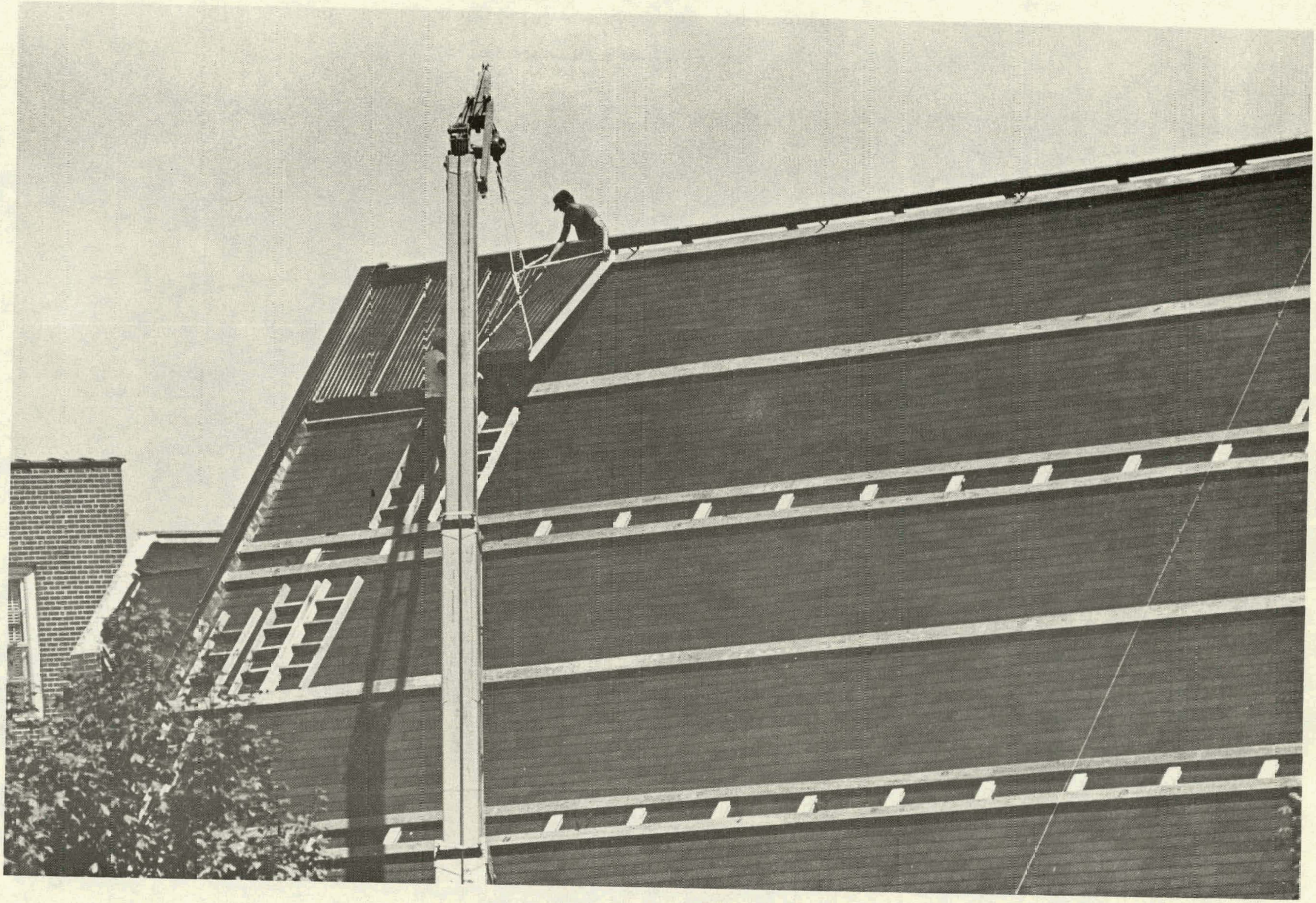


STEPHENS COLLEGE VISITORS CENTER
The natural gas fired standby boiler

STEPHENS COLLEGE VISITORS CENTER
June, 1978 - View of the special roof brackets for mounting the collectors



STEPHENS COLLEGE VISITORS CENTER
July, 1978 - Collector piping in progress



STEPHENS COLLEGE VISITORS CENTER
July, 1978 - Collector installation
over the completed roof

STEPHENS COLLEGE VISITORS CENTER

April, 1978 - Brickwork in progress

PART II MAINTENANCE

OPERATION AND MAINTENANCE INSTRUCTIONS

SOLAR HEATING SYSTEM

VISITORS CENTER - STEPHENS COLLEGE

COLUMBIA, MISSOURI

The building is primarily heated by a solar-heated hot water system with the hot water being supplied from solar collectors mounted on the roof. A gas fired boiler located in the basement is used as supplement and back up to the solar system. The hot water is located in the basement Equipment Room.

The heating cycle starts with transfer of heat from the sun to the solar collector on the roof. This is transfered to an ethylene glycol solution circulated through the collector, to the basement and through a heat exchanger. The circulation is done by a circulating pump located in the basement. The ethylene glycol system is a closed system with relief valves located on the roof set at 50 PSI in case of overheating. An expansion tank is located in the basement Equipment Room to allow for expansion and contraction of the ethylene glycol. The solar circulating pump "A" starts when the collector temperature reaches 105° F. The pump will shut off when collector temperature drops to 100° F.

The heat exchanger located in the basement Equipment Room is supplied heat from the solar system. This heat is taken from the heat exchanger by circulating the water from the 5,500 gallon storage tank through the heat exchanger by pump "B". Pump "B" will start circulating when the temperature in the heat exchanger is 10° above the temperature in the storage tank and will shut off when the temperature drops below the 10° difference. An auotmatic fill valve maintains a specified water level in the storage tank. Should the water in the storage tank rise above 200° F an automatic dump valve will release the water to the drain allowing the make up water to enter the tank and cool it down.

When the outside temperature drops below 65° circulating pump "C" will circulate water from the storage tank throughout the building. Solar heating is supplied in the building by fan coil units and air handling units. Also when the outside temperature drops below 65° the boiler is engaged and circulating pump "D" is ready to be used in case the temperature in the solar storage tank is below normal usage.

The area supplied by air handling units have a solar hot water coil, a boiler hot water coil and an air conditioning DX coil. The temperature controls are automatic and will adjust to which ever system it should use.

The area supplied by fan coil units are also controlled automatically and three way valves located in the piping in the Equipment Room will dictate which system, solar or gas boiler, will be used depending on the water temperature in the storage tank.

START UP IN FALL OF YEAR

NOTE: Refer to "Procedure for Filling Collectors" (page 55 of instructions) for additional information.

1. Close all drain lines on all heating units and main piping systems.

2. Close all by-pass valves on make up PRV's.

3. Open vent valves at all high points.

4. Open all valves between pumps and systems.

5. Clean all strainers in piping system. Remove strainer and blow out with air. Make sure all openings are clean.

6. Clean or replace all filters in air handling units and remote room units. Throw aways should be replaced; permanent filters to be washed and sprayed with oil. This should be done monthly during operation.

7. Oil pump motors; use SAE 30. Oil approximately once monthly using only few drops.

8. Tighten motor belts. "V" belts should be kept only tight enough to prevent serious slipage or squeaking under start up. Increased tension will only put undue burden on the bearings. Tension should be checked monthly and slack belt should be taken up.

   Proper tension is indicated when about one pound of pressure on the top of the belt, halfway between the pulleys will depress the belt approximately one inch.

9. All packing on valves should be inspected and replaced if valve appears to be easier to turn than normal.

10. If any leaks were observed in the system during previous use, these leaks should be repaired before start up.

11. Fill solar loop to collectors.

A. Use 50-50 solution of ethylene glycol and water.

B. Fill from low point to allow air to rise to top without trapping.

C. When solution reaches high point shut vent valves. All air should be gone from system.

12. Fill solar storage tank by using the by-pass valve around the auto fill. When the tank is almost filled close the by-pass valve and put the automatic fill in operation.

13. Place the disconnects on pumps A, B, C and D in ON position.

14. Place temperature control system in WINTER position.

15. As the pumps circulate throughout each system open the bleed valves at the high points to allow the air to escape.

16. Make sure the expansion tanks in each system is 60% full of water and 40% full of air. If tanks become water logged drain off enough water to allow the proper air cushion.

17. Place disconnects and starters in ON position on all air handling units and remote room units. Make sure the temperature control system for each system is in the WINTER position.

18. Start boiler by making sure system is filled with water. Close all drain lines before filling.

19. Open main gas valve to burner and light pilot.

20. All exhaust fans are started automatically by placing switches in ON position.

21. Refer to the automatic temperature control diagram located in basement Equipment Room should there be an area not within the comfort range.

SHUT DOWN SOLAR SYSTEM DURING SUMMER

NOTE: Refer to "Procedure for Draining Collectors" (page 56 of instructions) for additional information.

A. Place START-STOP and disconnect switches on all pumps in the OFF position.

B. Place temperature control system in SUMMER position.

C. Connect hose to drain valves for collector system and drain ethylene glycol solution into containers to be used next heating season.

D. Open vent valves to allow easier draining of system.

E. Draining of solar tank and hot water system can be done by opening all drain valves at the low point and running water into drain. It is proper to leave water in the inside heating system throughout the year. Draining would be at the option of the owner.

Start up of air conditioning system can be accomplished by placing all temperature control switches in the SUMMER position. The system is fully automatic and will function without full supervision.

MAINTENANCE

DAILY CHECK LIST

1. Inspect each fan for abnormal noise or temperature.
2. Inspect pumps for abnormal noise or temperature.
3. Check thermometers and gauges on all systems for abnormal conditions.
4. Inspect penumatic control panels for abnormal pressure indications.
5. Check pressure reducing valves for normal operation.

WEEKLY CHECK LIST

1. Check expansion tank for proper level.
2. Check storage tank for proper level.
3. Check all strainers ahead of pumps to be sure they are not clogged.
4. Check storage tank for proper level.

MONTHLY CHECK LIST

1. Check should be made on all packing of all pumps. The packing should be tightened as required. Any replacement of packing material should be done in the off season if possible.

2. Check the air compressor monthly for proper oil level and drain water from tank. Remove intake filter and clean by blowing out with compressed air.

3. Air handling equipment and remote room units should be checked for filters. Clean or replace depending on judgement.

4. Collector system on roof should be inspected for leaks. This can

be done by looking into the gutter at the lower part of the roof. The ethylene glycol will leave a discoloration which will indicate a leak somewhere in the system. To locate it from this point, start with the relief valves to see if they are leaking and then investigate the connecting hoses to each collector.

5. Check freeze protection temperature of glycol solution and add ethylene glycol as required. If refil requirements are excessive, check for leaks.

YEARLY CHECK LIST

1. Disassemble and clean tubes in the instantaneous and storage water heaters.

2. Pull and clean every strainer; those ahead of pumps, control valves. Tag each strainer with date cleaned.

3. Inspect and lubricate all control valves and motors.

4. Check all valve bonnets for leaks.

5. Check all gauges for calibration.

6. Check thermostats for calibration.

7. Check ph factor of glycol solution and neutralize as required to a ph of 6.7 to 7.4.

STEPHENS COLLEGE VISITORS CENTER

COLUMBIA, MISSOURI

PROCEDURE FOR FILLING COLLECTORS - ROOF & EQUIPMENT ROOM

SYSTEM "A" (PUMP "A")

1. Connect hose to submergible sump pump.

2. Lower pump into 50-50 ethylene glycol solution in 55 gallon drum located in Basement Equipment Room. Drum has top cut out of it.

3. Connect other end of hose to bottom connection of Airtrol fitting in System "A" located at south end of large storage tank. Make sure solution enters system on suction side of system pump "A".

4. Open valve between hose and Airtrol fitting.

5. Close all drain valves in System "A".

6. Make sure all valves in System "A" are open to allow circulation, especially the triple duty valve on disconnect line of pump "A".

7. Open both air cocks at peak of roof outside.

8. Open air cocks on purge unit located on flat roof.

9. Start submergible pump pumping into system.

10. Start pump "A".

11. As system fills to high points where air cocks are open a solution comes out. Close air cocks.

12. Fill expansion tank in Equiment Room to 75% with solution.

13. When you feel system is full circulate system and once per day for approximately one (1) week bleed out air and fill with anti freeze at high point on roof with a bucket.

14. Provided the system is leak free the solution should not have to be attended to for the season.

STEPHENS COLLEGE VISITORS CENTER

COLUMBIA, MISSOURI

PROCEDURE FOR DRAINING COLLECTORS ON ROOF

SYSTEM "A" (PUMP "A")

1. Furnish four (4) 55 gallon drums with tops cut out in Basement Equipment Room. (This is if complete system is to be drained.)

2. Install hose to drain on return side of piping system, suction side of pump "A" located in Basement. Run hose to one of the barrels.

3. Install hose on supply drain lines located above access panel underneath eve about middle of building outside south side. Run hose through lower window to barrels in Equipment Room.

4. Open drain valves and empty into barrels. Caution is necessary in case barrels run over since complete system holds under 200 gallons.

5. Open vents on roof. Do not open vents or drains on purge unit.

6. Cover barrels with plastic.

7. It is important to leave vents and drain valves open while system is drained down. If closed system will build up excessive pressure.

INSTRUCTION MANUAL

Bulletin No. BF-1A

LAWLER BACKFLOW PREVENTERS

- Reduced Pressure Principle Valves
- Double Check Valves

INSTRUCTION MANUAL
INSTALLATION • TESTING • SERVICING • PARTS

Lawler Reduced Zone Backflow Preventer

Catalog Number		Type	Size (NPT)
Without Strainer	With Strainer		
RZ-3	RZ-3-S	Reduced Zone	¾
RZ-4	RZ-4-S	Reduced Zone	1
RZ-5	RZ-5-S	Reduced Zone	1¼
RZ-6	RZ-6-S	Reduced Zone	1½
RZ-8	RZ-8-S	Reduced Zone	2

Lawler Double Check Backflow Preventer

Catalog Number		Type	Size (NPT)
Without Strainer	With Strainer		
DC-3	DC-3-S	Double Check	¾
DC-4	DC-4-S	Double Check	1
DC-5	DC-5-S	Double Check	1¼
DC-6	DC-6-S	Double Check	1½
DC-8	DC-8-S	Double Check	2

LAWLER ITT
FLUID HANDLING DIVISION

INSTALLATION DATA

The Lawler ITT line of Backflow Preventers are quality engineered to offer the best products of this type in the field of contamination prevention control. In order to receive the maximum benefits from these products, it is important that you:

1. follow all of the local codes which may apply.
2. follow the installation, testing and servicing instructions carefully.

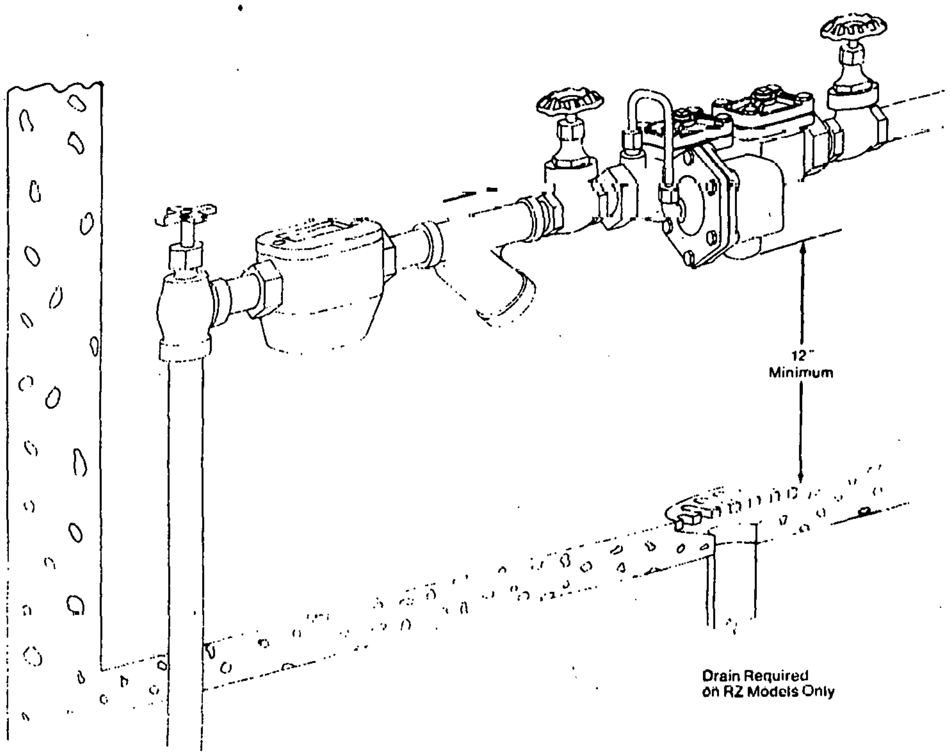


Figure 1

Installation Instructions

Double Check Models and Reduced Zone Models

1. The Lawler ITT Backflow Preventers may be installed either indoors or outdoors providing the temperatures *never* approach freezing.
2. Both the Double Check models and the Reduced Zone models should be protected on the incoming water supply by a strainer. All of the Lawler ITT models are available with such a strainer, if desired. (See Catalog listings.)
3. Select a location which is readily accessible for future testing, servicing, etc. A location such as a drain pit or ground depression is *not* recommended because of possible flooding. (See Dimensions on page 8.)
4. The Lawler ITT Backflow Preventers should be installed in a horizontal position wherever possible, but may be installed in any position where the flow direction would be downward. Check local code requirements for any special situations.
5. On RZ models (Reduced Zone Type) make sure that the discharge outlet from the Relief Device is located at least 12 inches above the floor, drain or ground. No piping should be connected to this unthreaded discharge opening. (It is recommended that a controlled drain be located under the vent port of the Relief Valve.) If the Relief Device is to be discharged into auxiliary piping to a remote drain, then there should be an air gap of at least 4 inches between the discharge opening and the auxiliary piping.

NOTE: During the *normal* operation of an RZ Model (Reduced Zone Type), there can be occasional operation or dripping of the relief valve assembly. This can be caused by sudden changes in pressures (from water hammer, solenoid valve closure, flush valves, etc.). A water hammer arrester installed just upstream from the source causing the pressure change will help to keep this problem to a minimum.

If leakage is continuous then the relief valve or one (or both) of the check valves may be fouled. (See Servicing Procedures.)

TYPICAL APPLICATIONS

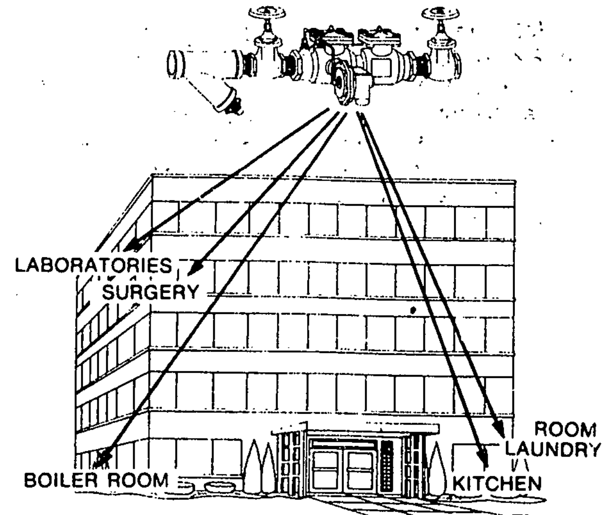


Figure 2

Hospitals, Institutions

Local codes will usually dictate whether the RZ (Reduced Zone) or the DC (Double Check) models should be used. In each case the Backflow Preventer is utilized to prevent contamination from flowing back to the potable water supply.

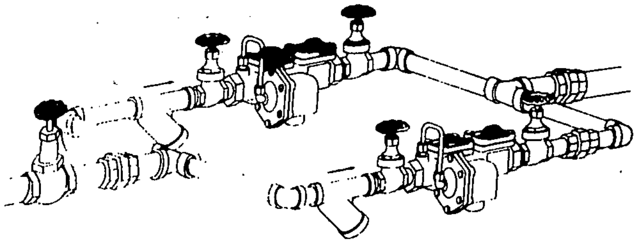


Figure 3

PARALLEL INSTALLATION

Where continuous flow may be required even during times of servicing or testing, or where greater capacity than a single unit may be necessary, then two units connected in parallel would be recommended.

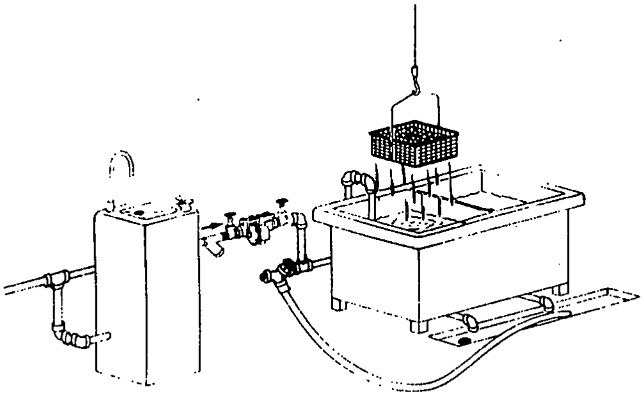


Figure 4

Industrial Plants—Plating, Pickling and Caustic Tanks

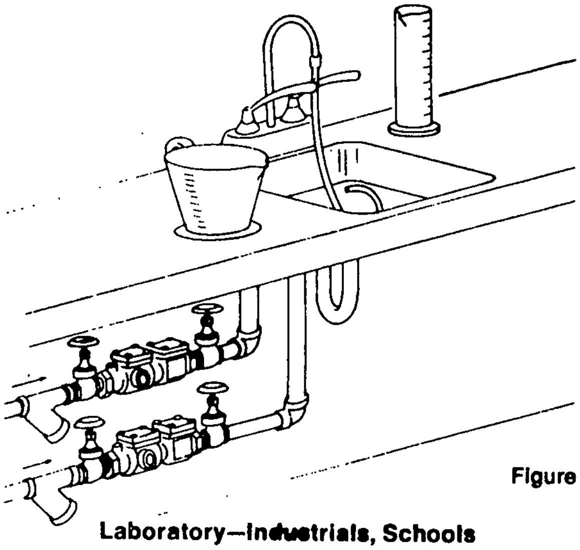


Figure 5

Laboratory—Industrials, Schools

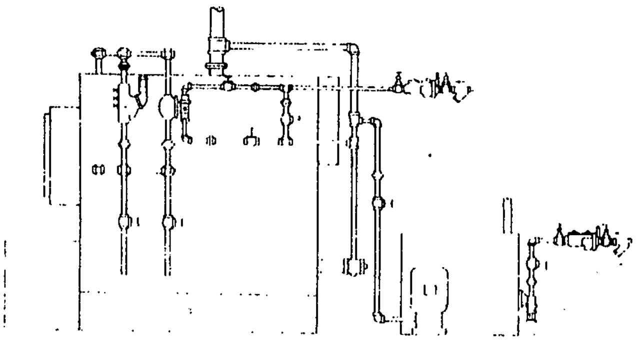


Figure 6

Boiler Room—Low and High Pressure Boilers

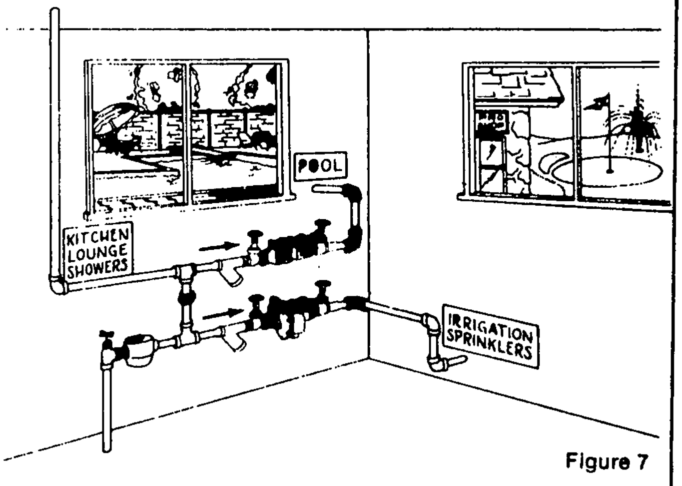


Figure 7

Sprinkling and Irrigation Systems

FIELD TEST PROCEDURES

The Lawler ITT Backflow Preventer devices offer a high degree of safety in the prevention of contamination of potable water. A backflow preventer can only perform its intended function when the unit is in proper operating condition.

To insure proper operation, both Double Check Valves and Reduced Zone Valves should be tested periodically. How often should this be done? Possibly once a week to once a month on systems passing large quantities of foreign materials; never less than once a year; and at least as often as required by local code.

The following procedures for testing both the DC Models and RZ Models utilize a commercially available test instrument, but other types of pressure differential meters or dual pressure gauges may also be utilized to accomplish the same purpose. Check local codes for any variation from these testing techniques. Make sure that the testing instrument being utilized is in proper working order and calibrated.

Test No. 1 and Test No. 2 apply to both DC and RZ Models. Test No. 3 applies only to RZ Models and may be performed after first two tests.

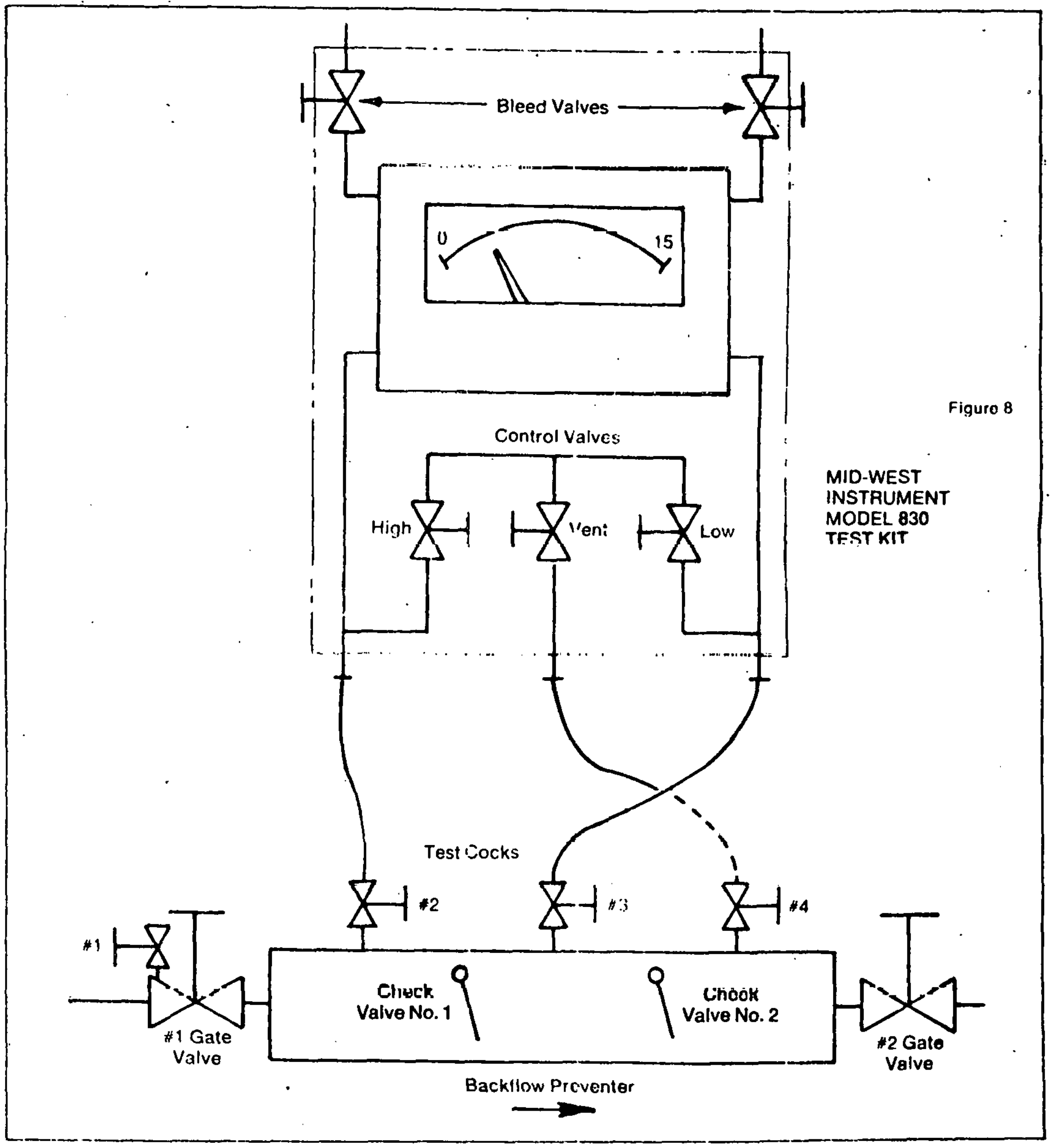


Figure 8

Warranty

Seller warrants for a period of one year from date of installation that the product is free from defects in materials and workmanship. SELLER MAKES NO OTHER REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE WARRANTY OF MERCHANTABILITY OR THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL SELLER BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. The limit of Seller's liability for failure of the product to meet this Warranty shall be, at Seller's option, to either repair or replace the defective product Seller shall have no responsibility whatsoever for losses resulting from faulty installation, improper application or misuse of the product, or from foreign material lodged beneath valve seats which prevent proper functioning of any working part.

TESTING PROCEDURES

TEST No. 1

Purpose: To test No. 1 Check Valve for tightness against reverse flow.

1. To start test, Gate Valve #1 should be open and Gate Valve #2 should be closed.
2. All Test Cocks should be closed.
3. Install test equipment as shown in diagram with all instrument Control Valves closed. Hose to Test Cock #4 should *not* be attached at this time.
4. Vent air from hoses and gauge. (To vent, open Test Cocks #2 and #3, open "Vent" Control Valve, open "High" Control Valve until air is expelled, and then close. Open "Low" Control Valve until air is expelled, and then close. Alternately open and close Bleed Valves expelling air in gauge.)
5. With both "High" Control Valve and "Low" Control Valve closed, note reading on meter.
6. If pressure differential shown on meter is maintained, then Check Valve No. 1 can be considered "Closed Tight."
7. If pressure differential shown on meter drops, then Check Valve No. 1 is "leaking." (See Service Instructions.)

TEST No. 3

Purpose: To test operation of Pressure Differential Relief Valve which must maintain the zone between the two check valves at least 2 psi less than the supply pressure.

1. To start test, Gate Valve #1 should be open and Gate Valve #2 should be closed.
2. All Test Cocks should be closed.
3. Install test equipment as shown in diagram with all instrument Control Valves closed. Hose to Test Cock #4 should *not* be attached at this time.
4. Vent air from hoses and gauge. (To vent, open Test Cocks #2 and #3, open "Vent" Control Valve, open "High" Control Valve until air is expelled, and then close. Alternately open and close Bleed Valves expelling air from Gauge.)
5. Open "High" Control Valve.
6. Open "Low" Control Valve *very slowly* until needle on gauge begins to drop. Hold valve in this position until Differential Relief Valve begins to drip. Note gauge reading at that moment.
7. Differential Relief Valve is operating properly if gauge reading is not less than 2 psi.
8. If gauge reading is less than 2 psi, then valve must be disassembled for inspection. (See Service Instructions.)

TEST No. 2

Purpose: To test No. 2 Check Valve for tightness against reverse flow.

1. To start test, Gate Valve #1 should be open and Gate Valve #2 should be closed. Test Cocks #2 and #3 should still be open and all instrument Control Valves closed.
2. At this point, connect hose to Test Cock #4 and open Test Cock.
3. Observe differential pressure reading on gauge.
4. Open "High" Control Valve and "Vent" Control Valve.
5. If gauge maintains pressure differential reading, then Check Valve No. 2 can be considered "Closed Tight."
6. If gauge reading drops, then Check Valve No. 2 is "leaking." (See Service Instructions.)

ALTERNATE TEST PROCEDURE FOR CHECK VALVES ONLY

NOTE: Can be utilized where no meter is available, but this test procedure may not be acceptable to local codes.

Purpose: To test No. 1 and No. 2 Check Valves for tightness against reversed flow.

1. Using a 3 ft. section of hose, connect it between Test Cocks #1 and #3.
2. Close Gate Valve #1 and Gate Valve #2.
3. Open Test Cocks #1 and #3.
4. Slowly open Test Cock #2. Other than initial leakage, if there is no further flow from Test Cock #2, then Check Valve No. 1 is tight.
5. If leakage continues from Test Cock #2, then Check Valve No. 1 is leaking. (See Service Instructions.)
6. Close all Test Cocks and place hose between Test Cocks #1 and #4.
7. Open Test Cocks #1 and #4.
8. Slowly open Test Cock #3. Other than initial leakage if there is no further flow from Test Cock #3, then Check Valve No. 2 is tight.
9. If leakage continues from Test Cock #3, then Check Valve No. 2 is leaking. (See Service Instructions.)

Figure 9

Figure 10

Figure 11

To Inspect Check Valves on DC and RZ Models

1. Close gate valves on each end of unit.
2. Remove square casting cover from top of Check Valve No. 1 chamber. (Figure 9.) Check Valve No. 1 is located on inlet side of unit.
3. Carefully slide back stainless plate beyond the latch and slowly raise plate and remove attached assembly along with the spring. (Figures 10 and 11.)
4. Place the end of a screwdriver under upper lip of check valve seat. and assembly should pop out into chamber. Be very careful not to scratch seating surface or nick soft seating disc. (Figure 12).
5. Examine seating disc and seating surface for foreign materials or damage. (Figure 13.) Replace seating disc assembly, if necessary. (See Parts, Page 8.) If bronze body seat is damaged, then complete replacement of Backflow Preventer is necessary.
6. Check Valve No. 2 may be examined in the same manner. The seating assembly can very easily be popped out of casting by pushing through with a finger from Check Valve No. 1 Chamber.
7. To reassemble, first re-insert valve seating assembly.

   NOTE: On RZ unit models, the Check Valve No. 1 spring is stainless steel, and Check Valve No. 2 spring is bronze. These springs must *not* be interchanged.
8. Place one end of spring in housing of stainless plate assembly, and by placing a finger under other end of spring, carefully guide spring into recessed opening on valve seat assembly. (Figure 14.) Compress spring sufficiently to drop stainless plate assembly into chamber. (On ¾" or 1" models, a screwdriver or long-nose pliers may be required to replace spring.)
9. With flat end of stainless plate pivoted on centerline of chamber opening, push round end of stainless plate down onto casting and slide latch into place.
10. Center the stainless plate assembly. (Check again to see that spring is still properly fitted into valve seat assembly.)
11. Replace gasket and casting cover, replace bolts and tighten. Open gate valves. Retest unit.

Figure 12

Figure 13

Figure 14

To Inspect Relief Valve on RZ Models

1. Close gate valves on each end of unit.
2. Loosen nuts on ends of ¼" tubing and remove tubing. (Figure 15.)
3. Remove the 6 bolts from end of Relief Valve.
4. Remove housing cover, being careful not to damage diaphragm. (Figure 16.)
5. Firmly grasping the round flat metal plate, slowly pull complete assembly straight out of base casting. (It is very important that the two *sets of guiding prongs do not scratch the seating surfaces.*) Remove spring. (Figure 17.)
6. Examine both the flat elastomer seat and the O-ring seat for signs of foreign material or damage. Replace assembly if damaged. Examine Diaphragm for signs of damage (See Parts, Page 8).
7. Also check stainless seat and O-ring bore for foreign material or damage. Relief valve must be replaced if either seat is damaged.
8. To reassemble, first apply a liberal amount of silicone grease into the O-ring bore and in the stainless seat bore. Also apply to O-ring. (Figure 18.)
9. Place spring in end of *seating* assembly and very carefully slide assembly into casting.
10. Pushing the seating assembly all the way in, insert a ½" open end wrench into the discharge opening of the Relief Valve so that the wrench locks the spring assembly in the compressed position. (Figure 19.)
11. While applying back pressure on the end wrench to hold spring assembly *in its most compressed valve closed position*, place diaphragm (concave side toward spring assembly) onto brass housing cover and replace bolts. (Figure 20.) *Continue to compress spring assembly until all 6 bolts have been tightened.* (Prevents slippage of diaphragm and possible leakage.)
12. Remove wrench. Replace ¼" tubing. Open gate valves. Retest unit.

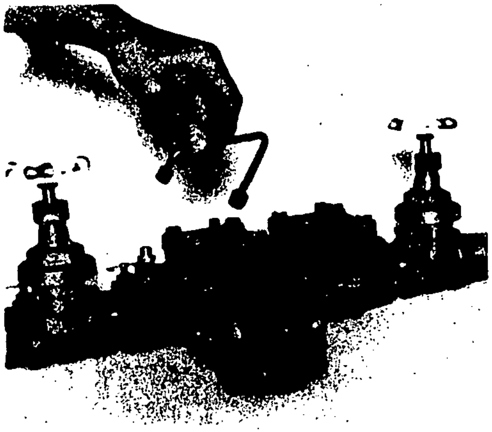


Figure 15

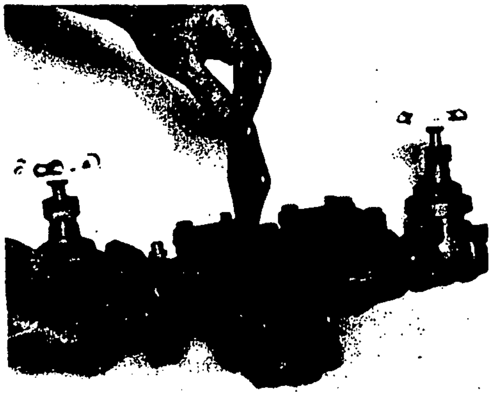


Figure 16

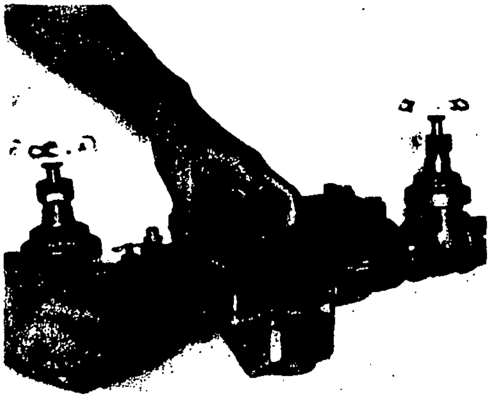


Figure 17

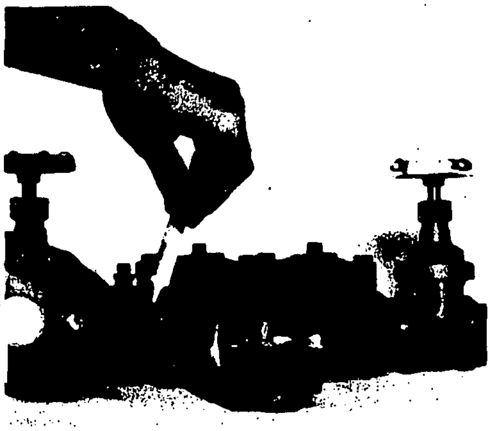


Figure 18

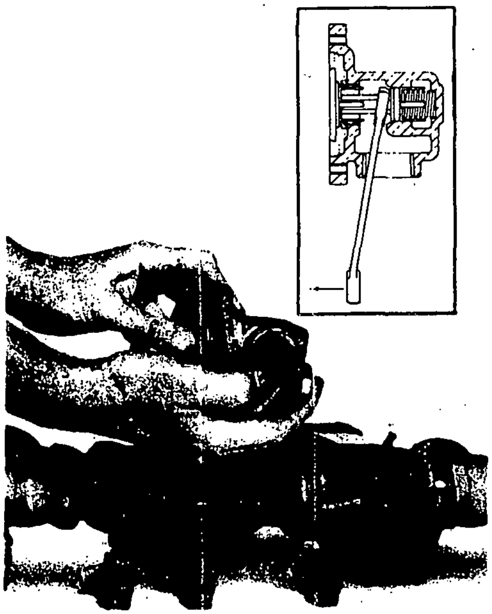


Figure 19 (From below)

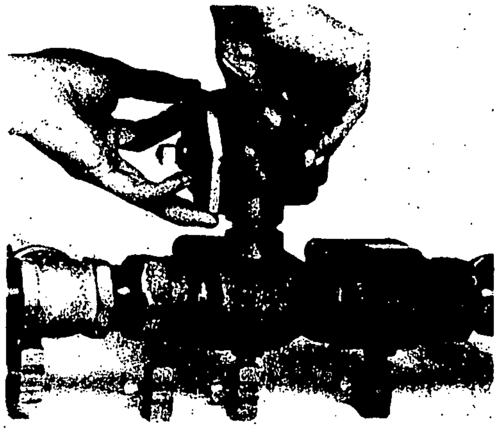


Figure 20 (From below)

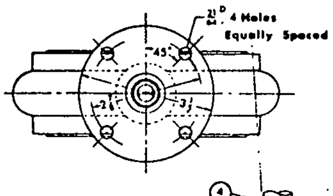
2.

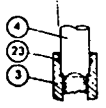
PUMPS, PRV, COMPRESSOR TANKS
AIRTROL FITTINGS, TANK CHARGER
TRIPLE DUTY VALVES

Because of copyright material, information on booster pumps bearing assembly, service instruction, series "60" in-line pumps, compression tanks, Airtrol fittings, heat exchangers, reducing and balancing valves have been deleted. For information on these items contact Bell and Gossett-ITT, 8200 N. Austin Avenue, Morton Grove, Illinois 60053.

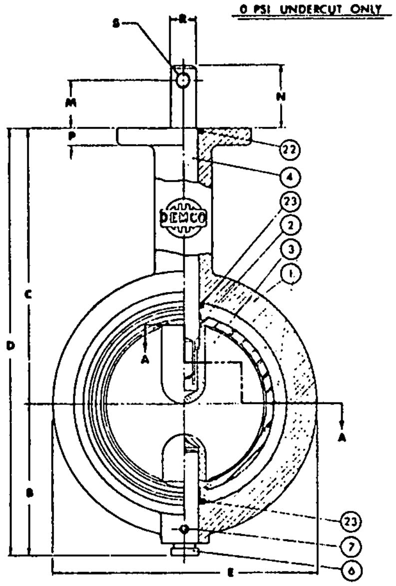
B-17
7-23-73
SHEET 1

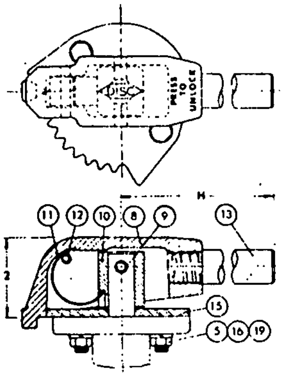
SERIES NE BUTTERFLY VALVE



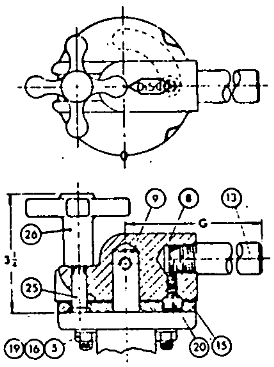


0 PSI UNDERCUT ONLY

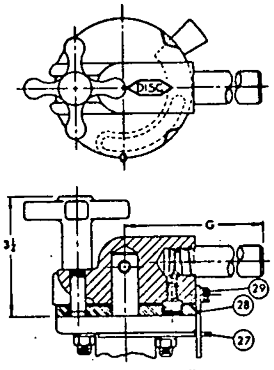




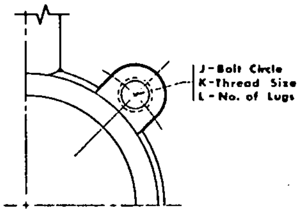
Optional 10 Position Lever Lock Handle



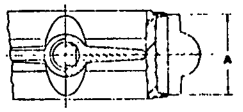
Optional Infinite Throttle Handle



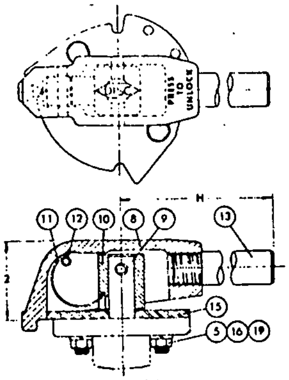
Infinite Throttle Handle With Optional Memory Stop



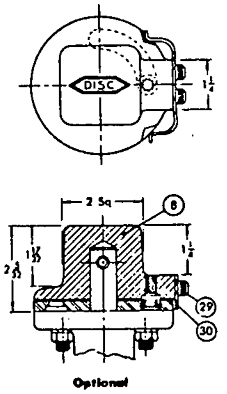
Optional Lug Body
LIMITED TO 150 PSI SHUT-OFF ON END-OF-LINE SERVICE.



SECTION "A-A"



Optional 2 Position Lever Lock Handle



Optional Square Nut Hub

DIMENSIONAL DATA

SIZE / DIMENSION	2"	2-1/2"	3"	4"	5"	6"	8"	10"	12"
A	1-3/4	1-7/8		2-1/8	2-1/4		2-9/16	2-3/4	3-1/4
B	2-27/32	3-1/16	3-5/16	3-15/16	4-7/16	4-15/16	6-1/8	7-15/32	9-17/32
C	5-5/8	6-1/8	6-3/8	7-1/8	7-3/4	8-1/4	9-7/16	11-1/4	12-3/16
D	8-15/32	9-3/16	9-11/16	11-1/16	12-3/16	13-3/16	15-9/16	18-23/32	21-23/32
E	4-1/8	4-7/8	5-3/8	6-7/8	7-3/4	8-3/4	11	13-3/8	16-1/8
G	7-1/2				10			13	
H	7-3/4				10-1/4			13-1/4	
J	4-3/4	5-1/2	6	7-1/2	8-1/2	9-1/2	11-3/4	14-1/4	17
K	5/8-11				3/4-10			7/8-9	
L	4			8				12	
M	1-1/4				1-3/16			1-3/32	
N	1-5/8							1-17/32	
P	7/16							9/16	
R	.652/.649				.775/.771			.900/.896	
S	5/16				3/8				
BASE NO.- 250 PSI	7952	7953	7954	7955	7956	7957	7958	7959	7960
- 150 PSI	2148	2149	2150	2151	2152	1615	2154	2155	2156
- 50 PSI	4909	4910	4911	4912	4913	4914	4915	4916	4917
- 0 PSI	4918	4919	4920	4921	4922	4923	4924	4925	4926

ASSEMBLY PART NUMBER

BASE PART NUMBER
BODY CONFIG. 1-Wafer 5-Lug
BODY MATL. 1-Ductile Iron (Lug) 2-Gray Iron (Wafer)
STEM MATL. 1-416 SS 2-316 SS 3-Monel
DISC MATL. 1-Duct. 2-316 SS 3-Monel 4-Brz 5-NY-Plate 6-Lead 7-Alloy 20 8-Hastelloy C 0-Duct./SS Edge
RING MATL. 3-Phenolic
SEAT MATL. 1-Buna N 2-Blk. Neop. 3-Hypalon 4-Viton 5-EPT 6-Nat. Rubber 7-White Neoprene
ACTUATION 1-10 Pos. Leverlock 2-Thtlg. 3-Mem. Stop 5-Sq. Nut 6-2 Pos. Leverlock 9-Less Handle

DEMCO SERIES NE BUTTERFLY VALVE
PARTS LIST

INDEX	REQD.	SIZE DESCRIPTION	2"	2-1/2"	3"	4"	5"	6"	8"	10"	12"	MATERIALS
		BASE NUMBER - 250 PSI - 150 PSI - 50 PSI - 0 PSI	#7952 #2148 #4909 #4918	#7953 #2149 #4910 #4919	#7954 #2150 #4911 #4920	#7955 #2151 #4912 #4921	#7956 #2152 #4913 #4922	#7957 #1615 #4914 #4923	#7958 #2154 #4915 #4924	#7959 #2155 #4916 #4925	#7960 #2156 #4917 #4926	
1	1	BODY - WAFER - LUG	#1819-012 #2167-051	#1825-012 #2168-051	#1826-012 #2169-051	#1828-012 #2170-051	#1830-012 #2171-051	#1022-012 #2172-051	#1831-012 #2173-051	#1832-012 #2174-051	#1833-012 #2175-051	-012 Gray Iron -051 Ductile Iron
2	1	SEAT	#1786-03X	#1788-03X	#1790-03X	#1792-03X	#1794-03X	#1002-03X	#1798-03X	#1815-03X	#1817-03X	-031 Buna-N -032 Neoprene -033 Hypalon -034 Viton -035 EPT -036 Nat. Rubber -037 Wht. Neop.
3	1	DISC - 250 PSI SHUT OFF - 150 PSI SHUT OFF - 50 PSI SHUT OFF - 0 PSI SHUT OFF	#7440-0XX #1313-00X #3150-00X #3397-00X	#7441-0XX #1759-00X #3219-00X #3398-00X	#7442-0XX #1330-00X #3863-00X #3399-00X	#7443-0XX #1375-00X #3347-00X #3400-00X	#7444-0XX #1411-00X #3343-00X #3401-00X	#7445-0XX #1618-00X #3349-00X #3402-00X	#7446-0XX #1685-00X #3350-00X #3403-00X	#7447-0XX #1691-00X #3395-00X #3404-00X	#7448-0XX #1663-00X #3396-00X #3405-00X	-001 Duct. Iron -002 316 SS -003 Monel -004 Mang. Brz. (except 250 psi) -005 NY-Plate -006 Lead * -007 Alloy 20 -008 Hastelloy C * -014 Alum. Brz. (250 psi only)
		DISC - 250 PSI SHUT OFF - 150 PSI SHUT OFF - 0 PSI SHUT OFF	---			#7889-002 #7294-002 #7365-002	#7890-002 #7295-002 #7366-002	#7891-002 #7296-002 #7367-002	#7892-002 #7297-002 #7368-002	#7893-002 #7298-002 #7369-002	#7894-002 #7299-002 #7370-002	Ductile Iron/SS Edge
4	1	UPPER STEM	#2009-00X	#2008-00X		#2007-00X	#2006-00X		#2005-00X	#2004-00X	#2003-00X	-001 416 SS -002 316 SS -003 Monel
6	1	LOWER STEM	#1183-00X	#1184-00X		#1185-00X	#1338-00X		#1680-00X	#1681-00X	#1682-00X	-001 416 SS -002 316 SS -003 Monel
7	1	SPRING PIN (LOWER STEM	#5445-18720				#5445-18724			#5445-37528	#5445-37536	Spring Steel
22	1	TOP O-RING	#5530-116				#5530-212			#5530-214	#5530-220	Buna-N
23	2**	STEM O-RINGS	#5530-113 #5531-113 #5535-113	#5530-115 #5531-115 #5535-115		#5530-116 #5531-116 #5535-116	#5530-212 #5531-212 #5535-212			#5530-214 #5531-214 #5535-214	#5530-220 #5531-220 #5535-220	Buna-N Viton (Special Order) EPT (Special Order)
35	1	HANDLE ASSEMBLY-LVRLK. 10-POS -THROTTLING -MEM. STOP -SQ. NUT -PADLOCK 2-POS	#7098-001 #2386-001 #2389-001 #3248-001 #8598-001				#7099-001 #2387-001 #2390-001 #3249-001 #8599-001			#7100-001 #2388-001 #2391-001 #3250-001 #8600-001		

** 4 Required 0 psi Undercut only.

* 2"-6" sizes only.

LEVERLOCK HANDLE ASSEMBLIES

INDEX	REQD.	SIZE DESCRIPTION	2"-4"	5"-8"	10"&12"	MATERIALS
5	2	SCREW	#2367-001		#2367-002	STAINLESS STEEL
8	1	HUB	#7086-001	#7086-002	#7086-003	CAST IRON
9	1	SPRING PIN	#5445-31232	#5445-37532		SPRING STEEL
10	1	SPRING ADAPTER	#6975-001	#6975-002	#6975-003	SINTERED IRON
11	1	SPRING	#6978			SPRING STEEL
12	1	SPRING PIN	#5445-25020			STEEL
13	1	HANDLE	#7096-001	#7096-002	#7096-003	STEEL
15	1	THROTTLE PLATE - 10 POSITION - 2 POSITION PADLOCK	#6977-001 #8587-001	#6977-002 #8587-002	#6977-003 #8587-003	STEEL
16	2	LOCKWASHER	#5900-005			SPRING STEEL
19	2	NUT	#5327-022			STEEL

THROTTLING HANDLE ASSEMBLIES

INDEX	REQD.	SIZE DESCRIPTION	2"-4"	5"-8"	10"&12"	MATERIALS
5	2	SCREW	#2367-001		#2367-002	STAINLESS STEEL
8	1	HUB	#7328	#7330	#7332	CAST IRON
9	1	SPRING PIN	#5445-31220	#5445-37520		SPRING STEEL
13	1	HANDLE	#7096-001	#7096-002	#7096-003	STEEL
15	1	THROTTLE PLATE	#1714	#1844	#1845	STEEL
16	2	LOCKWASHER	#5900-005			SPRING STEEL
19	2	NUT	#5327-022			STEEL
20	1	STOP	#5665-22006			STEEL
25	1	T-BOLT	#1715			410 STAINLESS STEEL
26	1	LOCK NUT	#1721			CAST IRON
27	1	PLATE - MEMORY STOP	#2001			CARBON STEEL
28	1	TAB - MEMORY STOP	#2002			CARBON STEEL
29	2	SCREW - MEMORY STOP	#5665-20008			STEEL

SQUARE NUT ASSEMBLIES

INDEX	REQD.	SIZE DESCRIPTION	2"-4"	5"-8"	10"&12"	MATERIALS
5	2	SCREW	#2367-001		#2367-002	STAINLESS STEEL
8	1	HUB	#3234	#3235	#3236	CAST IRON
9	1	SPRING PIN	#5445-31220	#5445-37520		SPRING STEEL
15	1	THROTTLE PLATE	#1714	#1844	#1845	STEEL
16	2	LOCKWASHER	#5900-005			SPRING STEEL
19	2	NUT	#5327-022			STEEL
20	1	STOP	#5665-22006			STEEL
29	2	SCREW	#5665-20008			STEEL
30	1	SPRING	#2970			STAINLESS STEEL

3. SOLAR PANELS

operation
maintenance
and
installation
instructions

18-1 and LSC18-1S Solar Collectors

SOLAR
501,249M
7/77

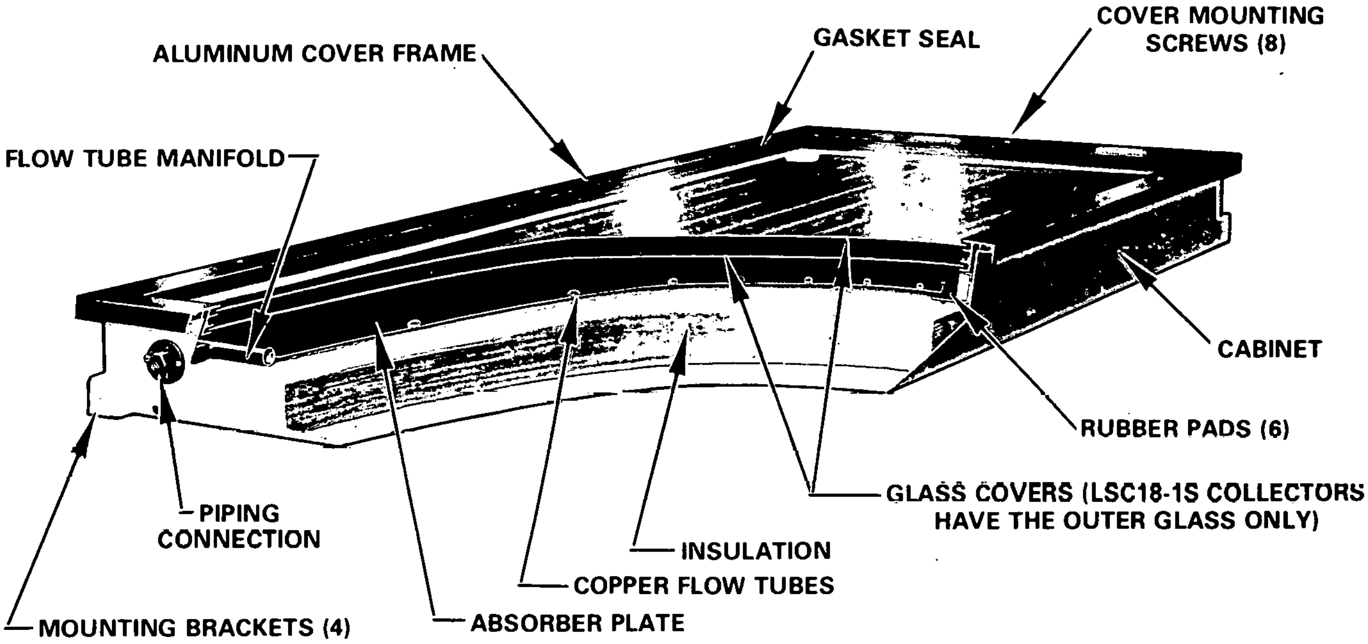
RETAIN THESE INSTRUCTIONS
FOR FUTURE REFERENCE

Supersedes 6/76

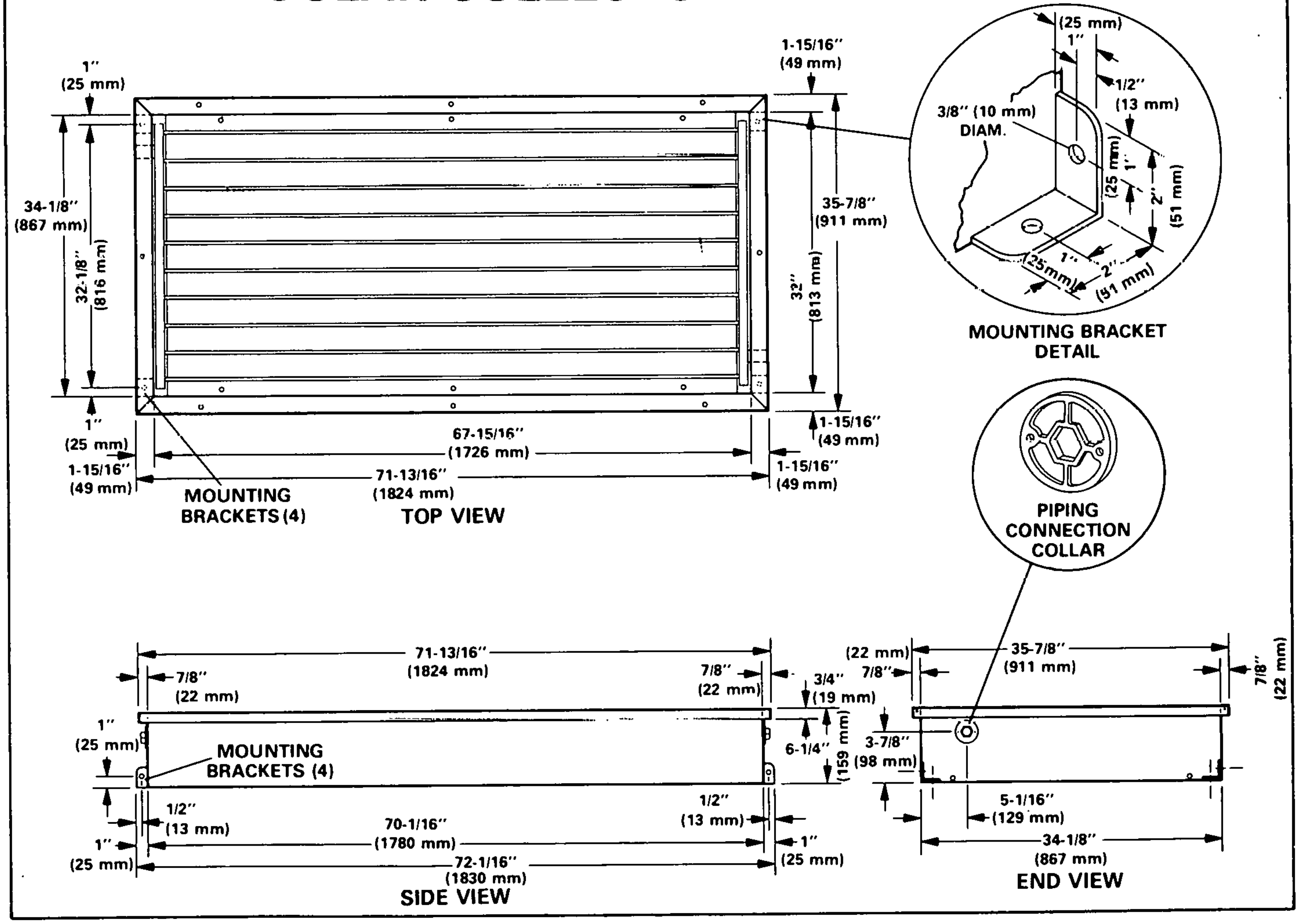
LENNOX *Industries Inc.*

Columbus, Ohio/Decatur, Georgia/Fort Worth, Texas/Sacramento, California/Marshalltown, Iowa/Lennox Industries (Canada) LTD - Calgary, Toronto

PARTS ARRANGEMENT



SOLAR COLLECTOR DIMENSIONS



FRAMING - FLASHING - COLLECTOR MOUNTING

I - SHIPPING AND PACKING LIST

Package 1 of 1 Contains

1 - Assembled solar collector

II - SHIPPING DAMAGE

Check unit for shipping damage. Contact the last carrier immediately if any damage is found.

III - GENERAL

These instructions are intended as a general guide and do not supersede local codes. Authorities having jurisdiction should be consulted before installation.

IV - APPLICATION

The consulting engineer, architect or dealer must determine the solar collector application including number required, placement, mounting angle and piping sequence. This instruction outlines one typical method of framing and installing the solar collectors. Other designs can be substituted if the basic guidelines within the instruction are followed. Figure 1 illustrates a typical residential application.

V - SOLAR COLLECTOR

The collectors must mount on a watertight roof. Roof construction must be adequate to support the collectors and mounting frame. Solar collectors must be installed with the flow tubes in the vertical

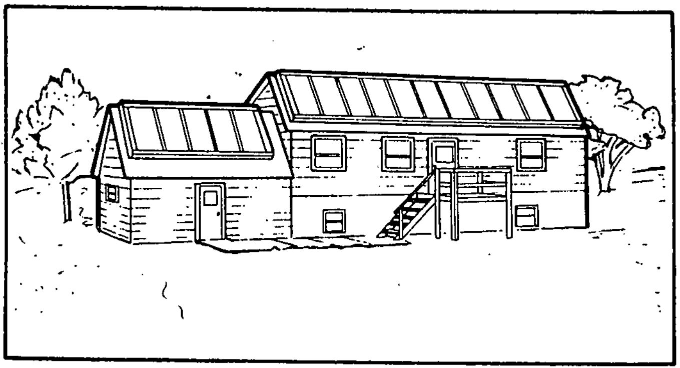


FIGURE 1

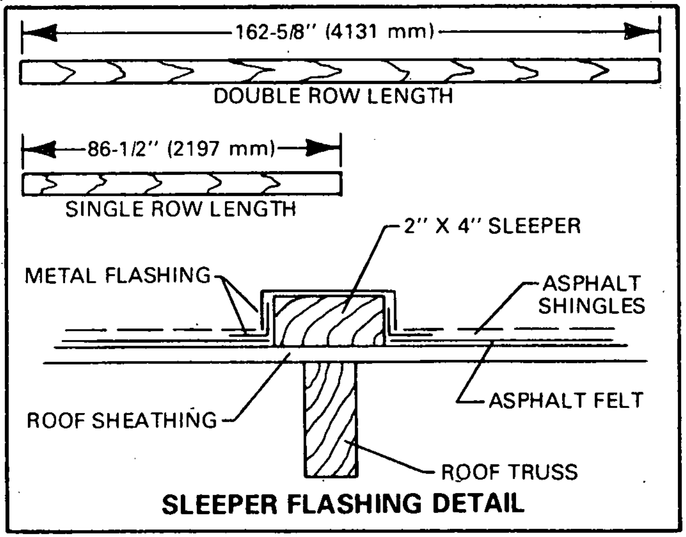


FIGURE 3

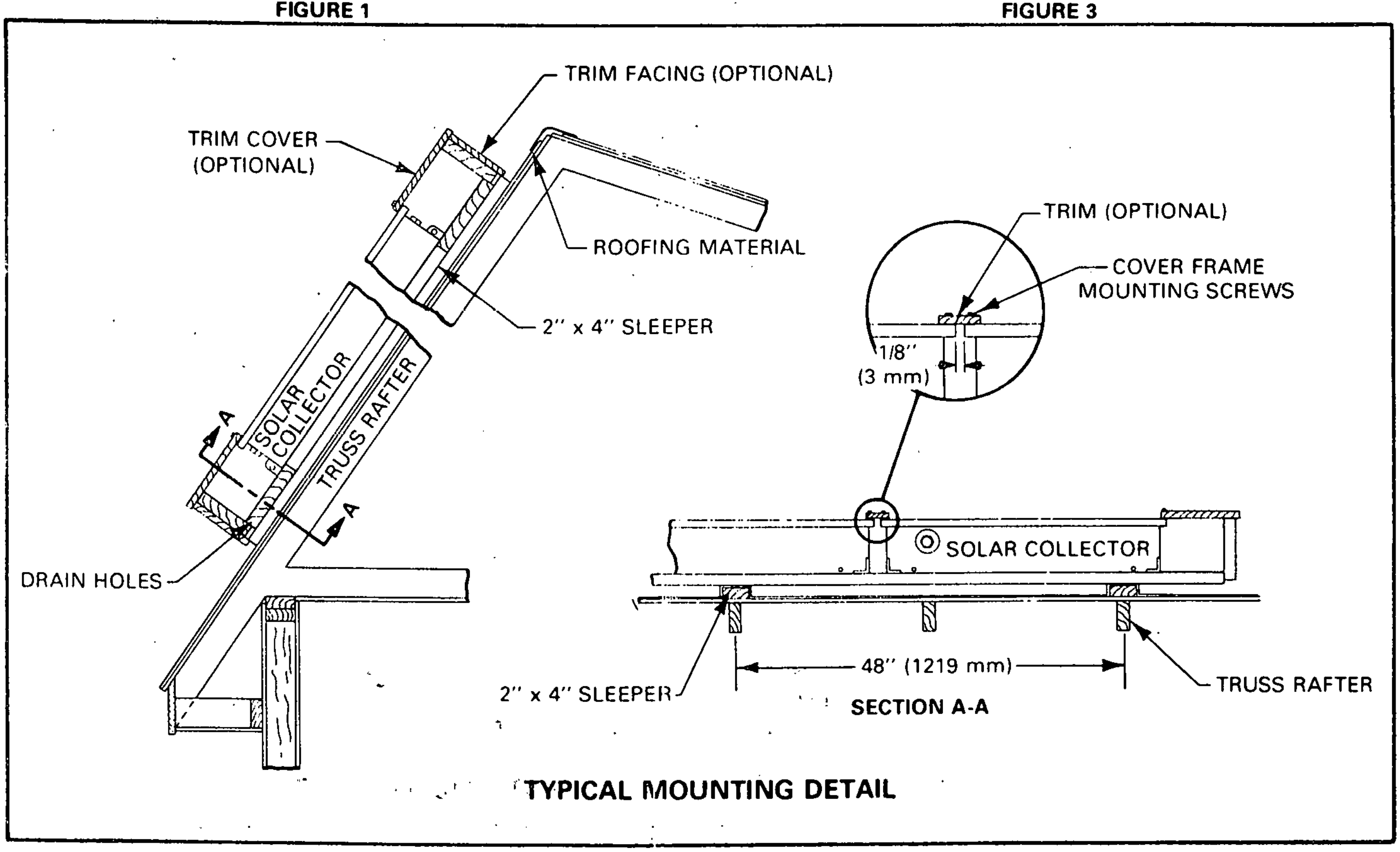
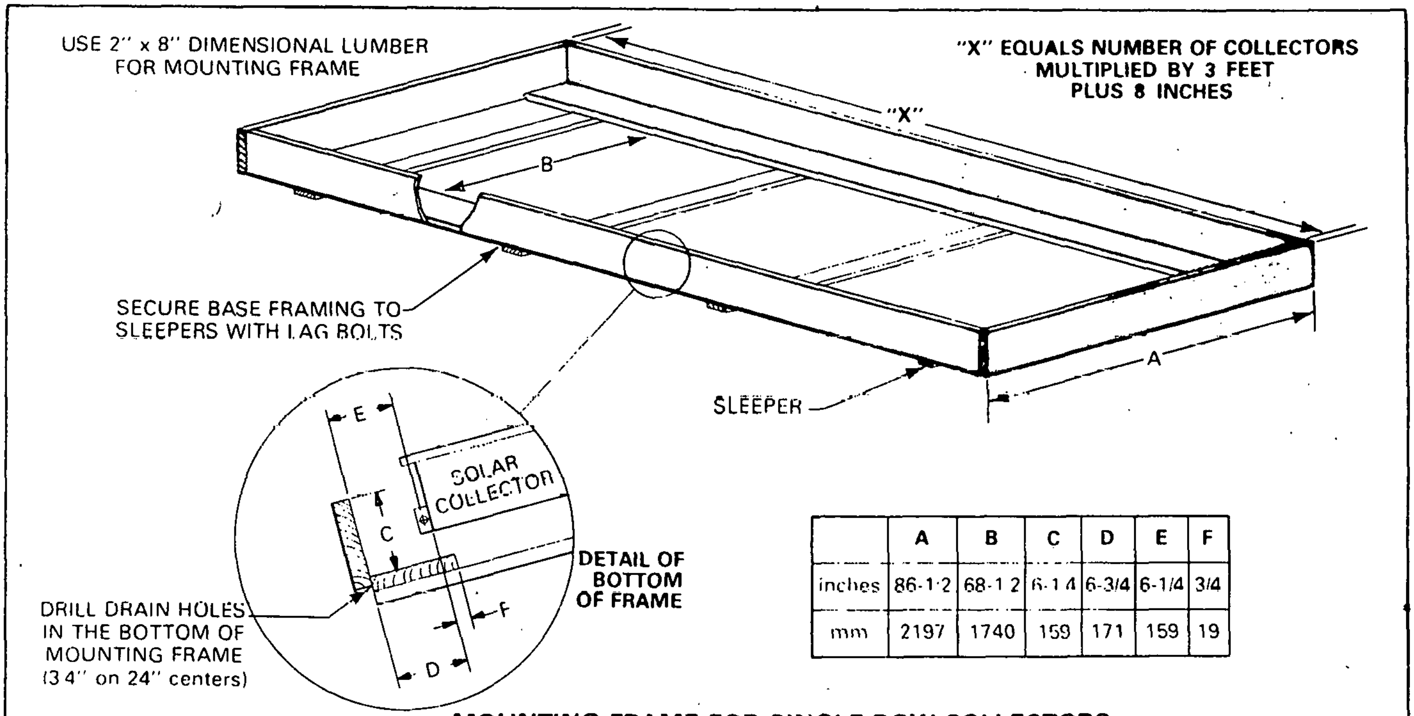


FIGURE 2

position. Figure 2 illustrates details for a typical mounting frame. Install the frame and solar collectors as follows:

1 - Center sleepers over trusses and secure to roof. Figure 3 shows the sleeper flashed into the roof.
   a - Length of sleepers required for a single row of collectors is 86-1/2 inches.
   b - Length of sleepers required for two rows of collectors is 162-5/8 inches.

2 - Figure 4 illustrates typical framing construction for one row of collectors. Figure 5 illustrates construction for two rows of collectors. 2" x 8" dimentional lumber is utilized.



USE 2" x 8" DIMENSIONAL LUMBER FOR MOUNTING FRAME

"X" EQUALS NUMBER OF COLLECTORS MULTIPLIED BY 3 FEET PLUS 8 INCHES

SECURE BASE FRAMING TO SLEEPERS WITH LAG BOLTS

DRILL DRAIN HOLES IN THE BOTTOM OF MOUNTING FRAME (3 4" on 24" centers)

DETAIL OF BOTTOM OF FRAME

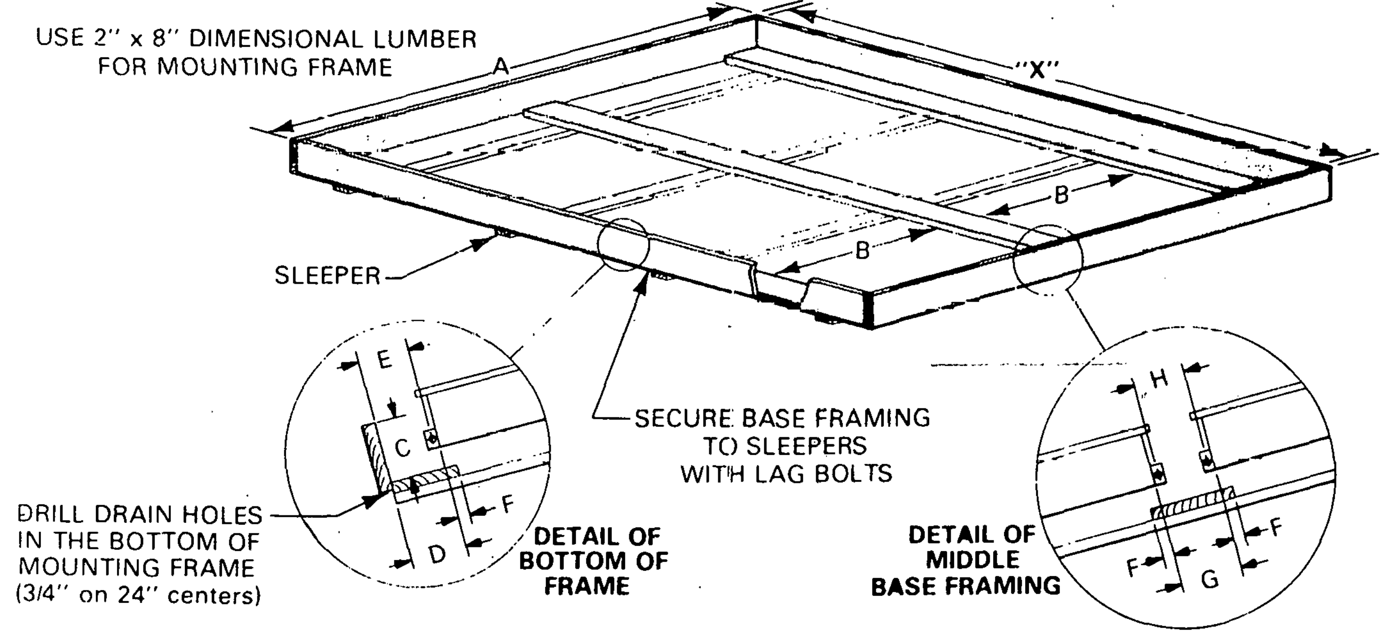
	A	B	C	D	E	F
inches	86-1/2	68-1/2	6-1/4	6-3/4	6-1/4	3/4
mm	2197	1740	159	171	159	19

MOUNTING FRAME FOR SINGLE ROW COLLECTORS

FIGURE 4

	A	B	C	D	E	F	G	H
inches	162-5/8	68-1/2	6-1/4	6-3/4	6-1/4	3/4	6	5
mm	4131	1740	159	171	159	19	152	127

"X" EQUALS NUMBER OF COLLECTORS MULTIPLIED BY 3 FEET PLUS 8 INCHES



USE 2" x 8" DIMENSIONAL LUMBER FOR MOUNTING FRAME

SECURE BASE FRAMING TO SLEEPERS WITH LAG BOLTS

DRILL DRAIN HOLES IN THE BOTTOM OF MOUNTING FRAME (3/4" on 24" centers)

DETAIL OF BOTTOM OF FRAME

DETAIL OF MIDDLE BASE FRAMING

MOUNTING FRAME FOR DOUBLE ROW COLLECTORS

FIGURE 5

3 - Position first collector 4-7/8 inches from end of frame and then maintain 1/8 inch between remainder of collectors. Refer to Figure 6. Secure collectors to frame with lag bolts (4 per collector). If desired the inside spacing could enclose the supply and return header runs where they penetrate through roof.

NOTE - Solar collectors can be piped individually as they are set or if working area permits, piped after all collectors are set.

4 - The temperature control system has a sensor which secures directly to one absorber plate. Remove the collector frame from desired collector and install the sensor in the center of absorber plate. Refer to manufacturer's installation instructions. Drill a hole through collector cabinet and route wiring to sensor.

5 - After the system has been leak tested and the insulation has been installed on outdoor piping, flash the frame and solar collectors as illustrated in Figure 7. This flashing prevents air flow around collectors minimizing convection losses. This trim can bolt directly to the collector frame.

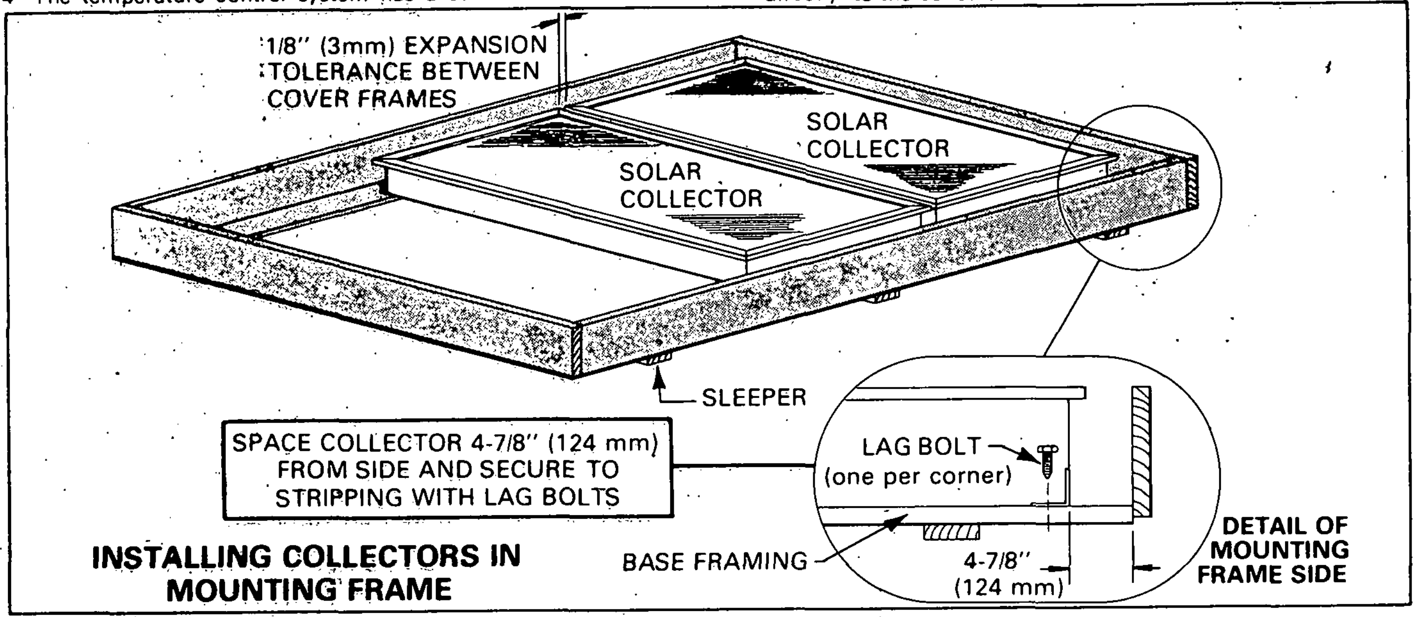


FIGURE 6

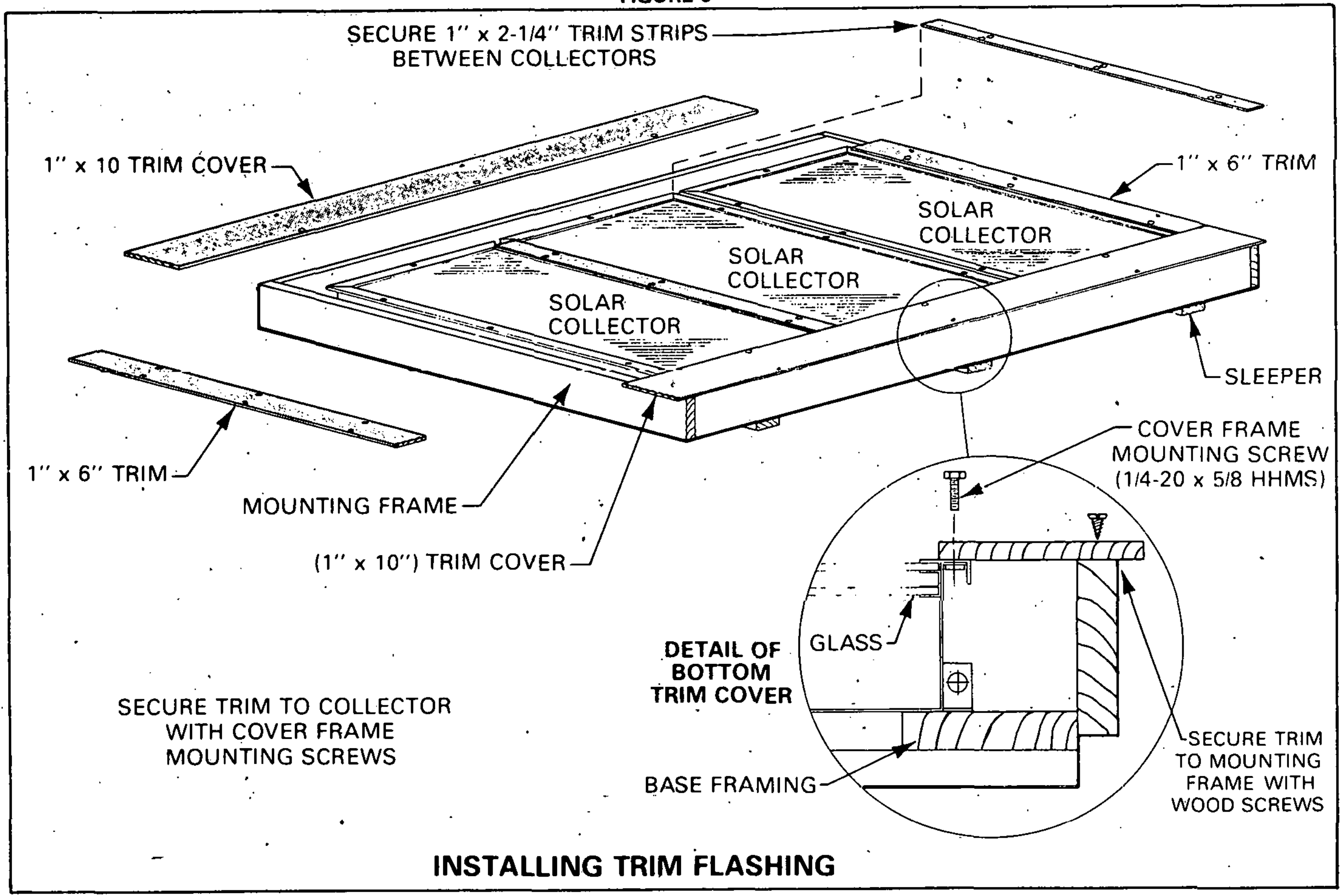


FIGURE 7

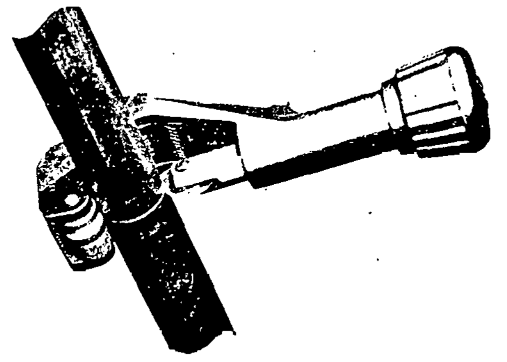
PIPING

VI - PIPING FOR SOLAR COLLECTORS

A - Basic Piping Fundamentals

1 - Flared Connections

a - Cut pipe to size with a roller type tubing cutter. See Figure 8.



CUT TUBING WITH A ROLLER-TYPE TUBING CUTTER

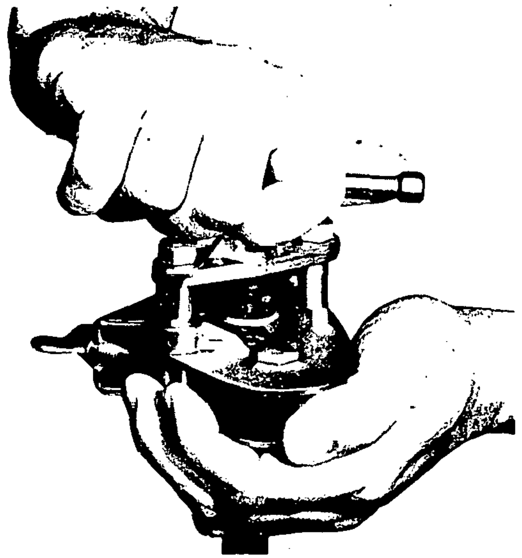
FIGURE 8

b - Remove any burrs with knife or reaming tool as shown in Figure 9.

REMOVE BURR WITH KNIFE OR REAMING TOOL

FIGURE 9

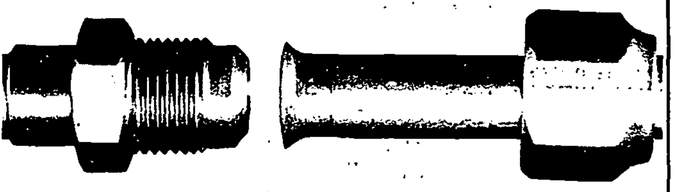
c - Flare tubing with a flaring tool as illustrated in Figure 10.



INSERT TUBING TO DEPTH GAUGE AND TIGHTEN THE FLARING CONE

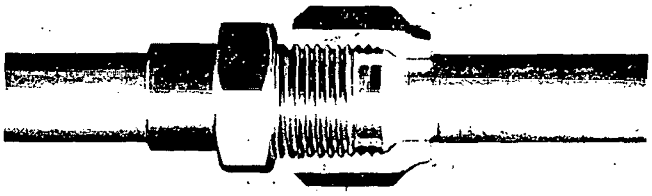
FIGURE 10

d - Align parts as shown in Figure 11 and tighten using two wrenches to prevent twising lines. Figure 12 shows cutaway of flared connections.



ALIGN PARTS AND THEN PUSH FLARE ONTO FITTING

FIGURE 11



TIGHTEN NUT USING TWO WRENCHES

FIGURE 12

2 - Soldered Connections

a - Cut the pipe to size.

b - Remove burr.

c - Fit tubing into coupling maintaing a tight and proper clearance. See Figure 13.

d - Use *minimum* 95-5 rated solder.

e - Make joint using proper amount of heat to draw solder in joint.

f - Cool and clean the joint with wet cloth.

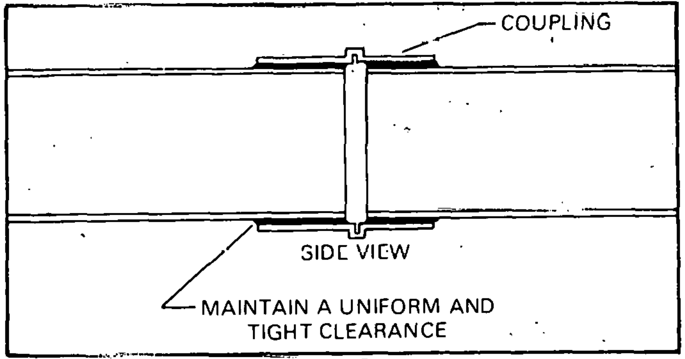


FIGURE 13

B - General Guidelines

1 - The solar collectors can be assembled in parallel, series or series-parallel combinations. Figure 14 illustrates various sequencing arrangements. **The supply header is always positioned at the bottom side of collectors while the return header is on the top.**

NOTE - For residential applications, no more than two collectors should be connected in series.

TABLE 1

APPLICATION	SIZE
Single family heating and heating/cooling	1-1/4" (38 mm)
Multi-family heating and heating/cooling	3" (76 mm)
Commercial heating and heating/cooling	4" (102 mm)

2 - Table 1 lists information for sizing headers.

3 - Avoid dissimilar metals. Where copper piping connects to different piping materials, dielectric insulating couplers should be used to prevent corrosion.

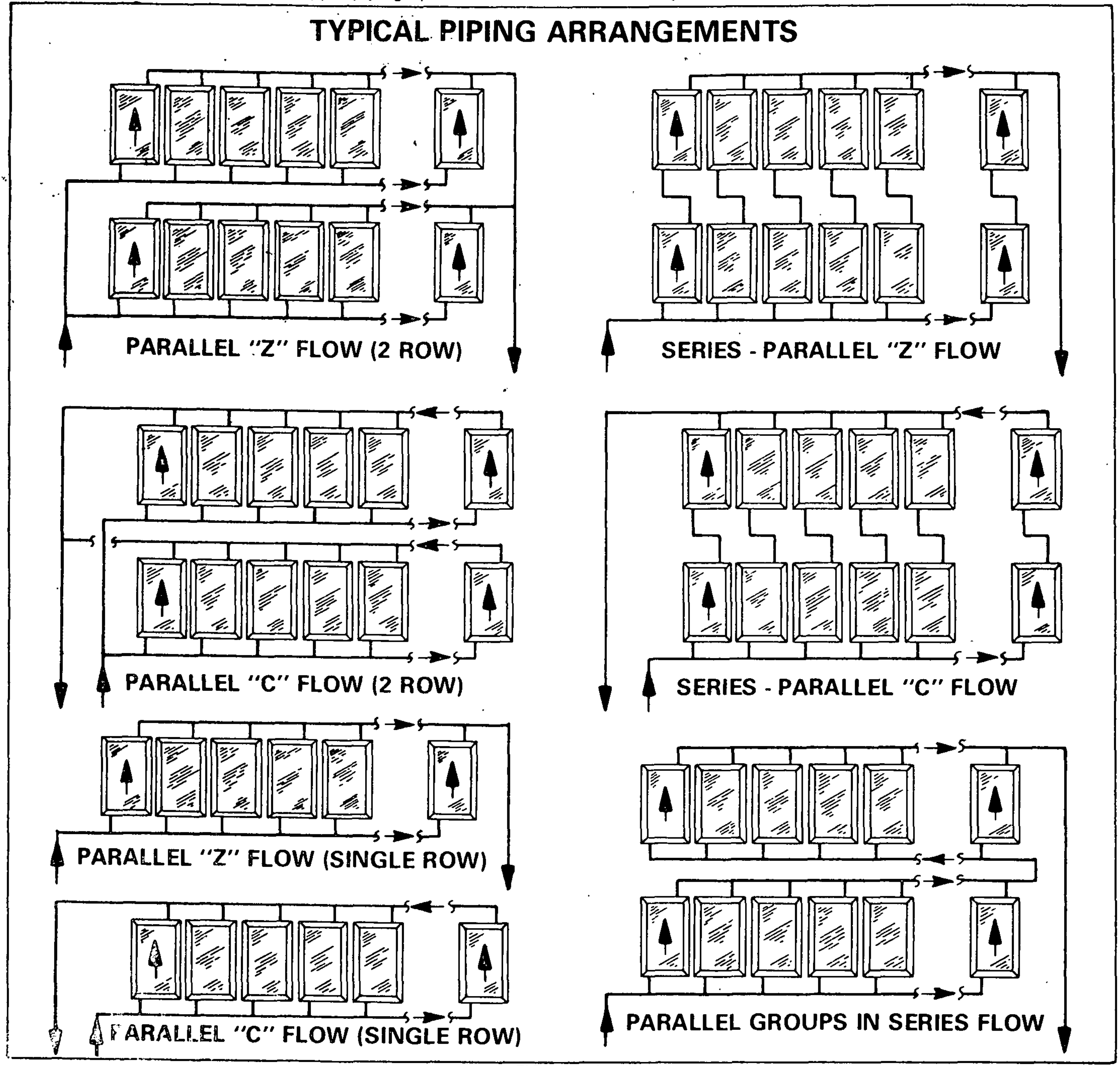


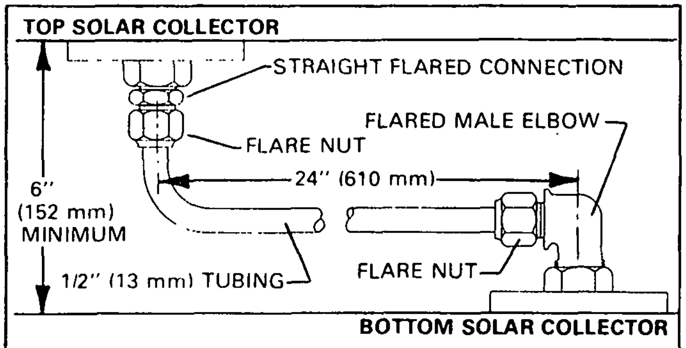
FIGURE 14

C - Installation of Piping

1 - Remove the plug from each end of solar collector.

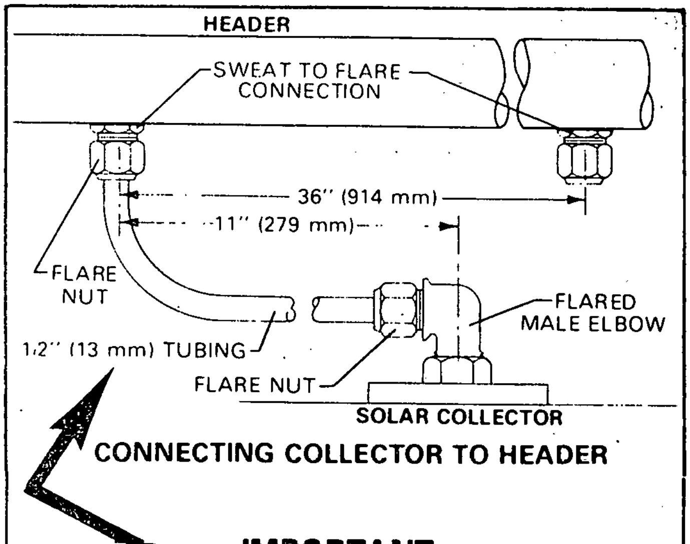
2 - The collector either pipes to another collector or into a header. The 1/2 inch copper tubing must be field provided.
  a - Figure 15 illustrates two solar collectors piped in series. Install a flare male elbow at the bottom collector and a flare male straight connection at the top collector.
  b - A 3/8 inch sweat to 1/2 flare fitting must be soldered into each header at 36 inch intervals. Install a flare male elbow at the collector and connect piping as shown in Figure 16. In a two row parallel application, the return and supply headers can be piped according to Figure 17 to minimize collector spacing.

3 - Route the supply and return headers into the interior of building and then flash completely to waterproof the opening.



CONNECTING TWO COLLECTORS IN SERIES

FIGURE 15

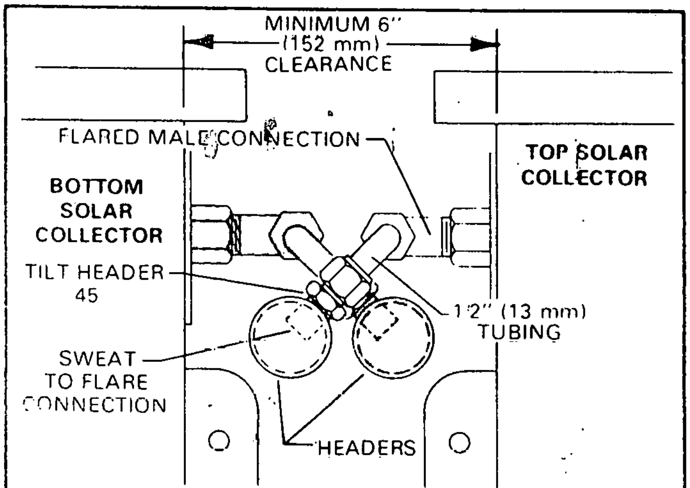


CONNECTING COLLECTOR TO HEADER

IMPORTANT
STRAIN RELIEF LOOP
FOR EXPANSION AND CONTRACTION

FAILURE TO PROVIDE THIS LOOP BETWEEN INLET AND OUTLET COLLECTOR CONNECTIONS AND HEADERS WILL RESULT IN FRACTURED FITTINGS AT COLLECTORS AND HEADERS.

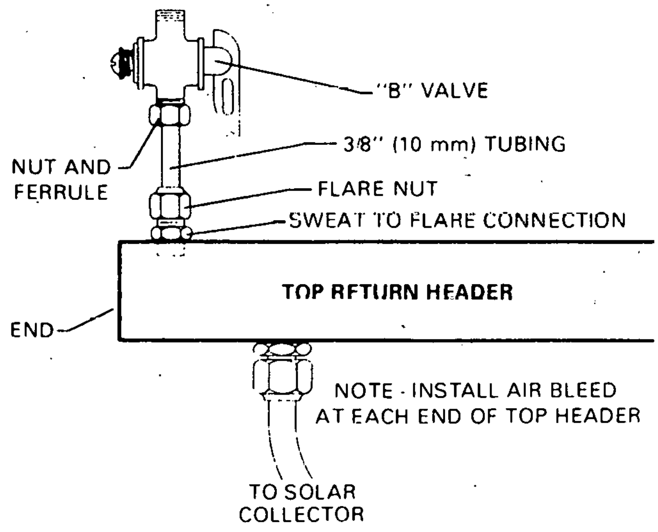
FIGURE 16



PIPING FOR MINIMUM SPACING BETWEEN 2 ROWS OF COLLECTORS IN PARALLEL

FIGURE 17

4 - An air bleed valve must be installed at each end of the return header for the top row of collector cells. Solder a sweat to flare fitting into the ends of return header. Connect a short length of 3/8 inch tubing to flared connection and then secure to a "B" valve with a nut and ferrule. Refer to Figure 18.



INSTALLING AIR BLEED VALVE

FIGURE 18

5 - Leak test the installation thoroughly and make any needed repairs. Insulate all outdoor piping with 3/4 inch thick foamed plastic insulation. Waterpoof outdoor pipe insulation with two coats of plastic finish reinforced with glass mesh. Install per manufacturer's recommendations.

MAINTENANCE

VII - MAINTENANCE

1 - If the glass cover becomes dirty, clean the glass using a soft clean cloth, mild soap or detergent and clean rinse water. Alkalies can stain the glass if allowed to remain in contact too long.

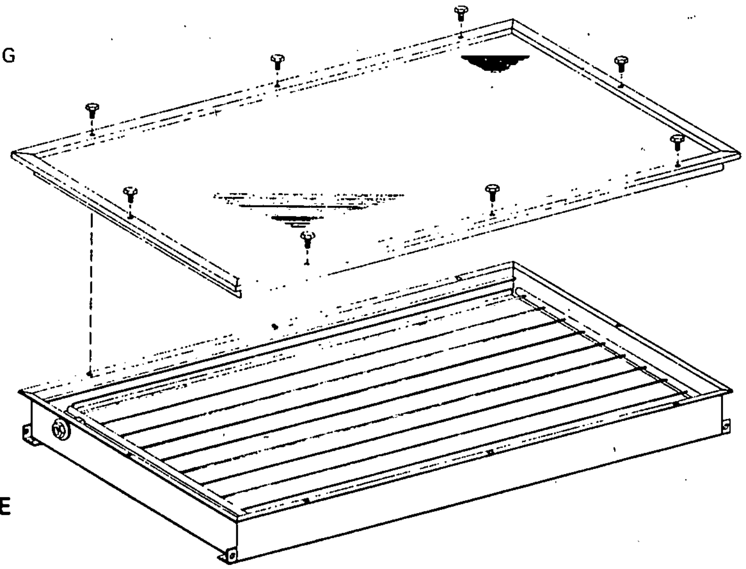
NOTE - The collector surface temperature can burn. Handle solar collector with caution.

2 - Use rubber gloves when handling solar collector to avoid finger prints on glass.

3 - To replace the glass, remove the collector as shown in Figure 19 and dismantle according to Figure 20. To re-assemble frame, insert the glass sheets and new gaskets into side pieces making sure the glass is centered and the ends are even. Next insert the glass into the end pieces and secure with existing screws. Use sealer compound on corner joints.

4 - To replace an absorber plate refer to following sequence and Figure 21.
   - a - Drain collector.
   - b - Remove collector frame.
   - c - Remove plate seal and gasket on each end of collector.
   - d.- Disconnect flare fitting on each end of collector.
   - e - Remove 6 screws securing absorber and left plate from cabinet. Avoid touching coating on plate.
   - f - When re-assemblying absorber plate, tighten screws between 10 lbs and 15 lbs torque.

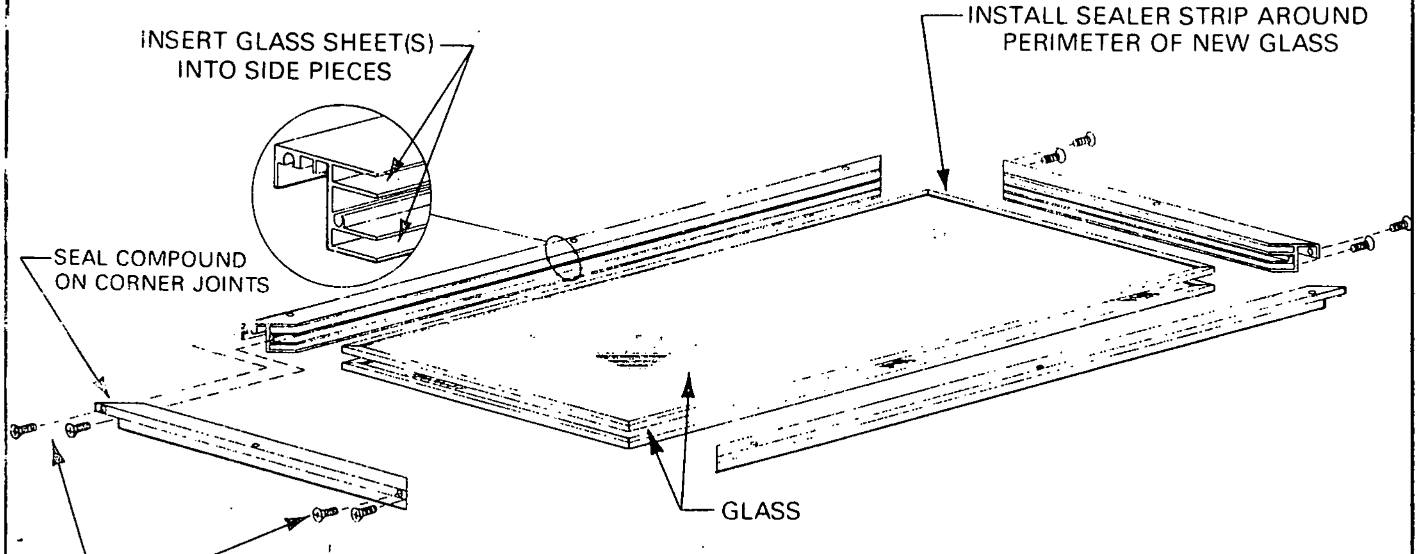
5 - The ethylene glycol/water mixture should be checked once a year by your Lennox service organization for proper freeze protection and inhibitor level.



REMOVE (8) SCREWS SECURING FRAME TO COLLECTOR

REMOVING COVER FRAME

FIGURE 19



INSERT GLASS SHEET(S) INTO SIDE PIECES

INSTALL SEALER STRIP AROUND PERIMETER OF NEW GLASS

SEAL COMPOUND ON CORNER JOINTS

GLASS

REMOVE (4) SCREWS PER END TO DISASSEMBLE COVER FRAME

NOTE - LSC18-1S SOLAR COLLECTORS HAVE ONLY THE OUTER GLASS SHEET

DISASSEMBLING COVER FRAME

FIGURE 20

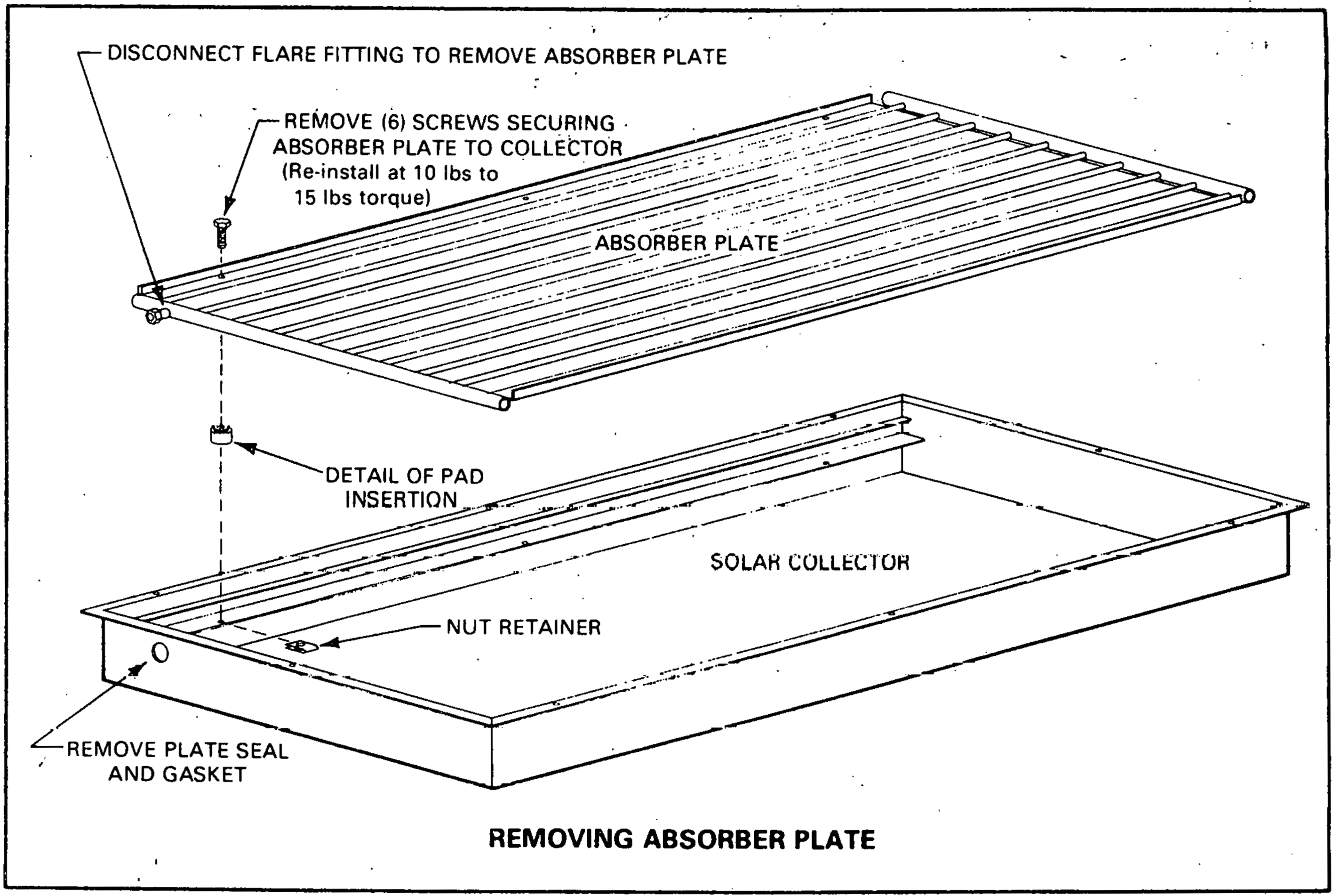

DISCONNECT FLARE FITTING TO REMOVE ABSORBER PLATE
REMOVE (6) SCREWS SECURING ABSORBER PLATE TO COLLECTOR (Re-install at 10 lbs to 15 lbs torque)
ABSORBER PLATE
DETAIL OF PAD INSERTION
SOLAR COLLECTOR
NUT RETAINER
REMOVE PLATE SEAL AND GASKET
REMOVING ABSORBER PLATE

FIGURE 21

OWENS-CORNING
FIBERGLAS

MECHANICAL CONTRACTING SERVICES
1207 MACON STREET, NORTH KANSAS CITY, MISSOURI 64116
PHONE: (816) 842-0181

4. INSULATION

APPROVED AS NOTED
[illegible]
DATE 4/17/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

March 29, 1978

DRUMMOND/OFFICER
Mech. Contractors, Inc.
Date: 4-6-78
Checked:
Section 1510 Col 8 & 9
" 1520 Col 8
" 1530 Col 9

SUBMITTED TO: Drummond/Officer Mechanical
2606 N. Oakland Gravel
Columbia, Missouri 65201

SUBJECT: Visitors Center
Stephens College
Columbia, Missouri
OCF Job # L24-1137

SUBMITTED BY: Owens/Corning Fiberglas
Mechanical Contracting Services
1207 Macon
North Kansas City, Missouri

The following interior aboveground systems shall be insulated with Fiberglas 25 ASJ/SSL pipe insulation or equivalent material as manufactured by Johns-Manville or Certain-Teed. <u>Lit.P1</u>

Fittings on these systems shall be insulated with Zeston Premolded PVC fitting covers. <u>Lit.Zeston</u>

1½" 1/2" thickness on domestic hot, domestic hot circulating, domestic cold, and condensate drain pipe.

1 1/2" thickness on hot water heating supply and return, chilled water supply and return, and solar water.

The following interior aboveground systems shall be insulated with Armstrong Armaflex 22 foamed plastic pipe insulation or equivalent material as manufactured by Johns-Manville. <u>Lit. JM Aerotube</u>

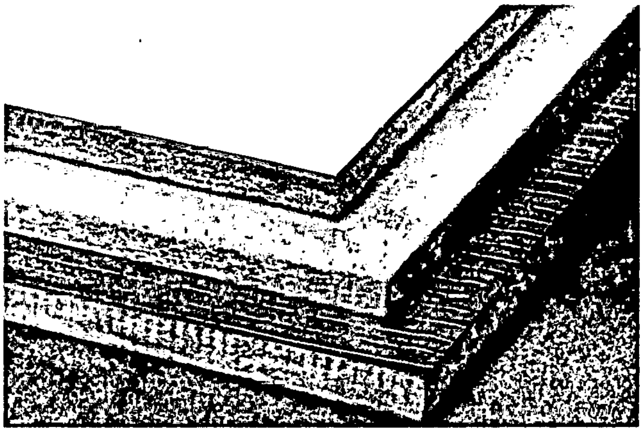
1½" 3/4" thickness on refrigerant suction lines.

Solar storage tank and hot water converter shall be insulated with 2" thick Owens/Corning Fiberglas, either pipe insulation or pipe wrap for cylindrical surfaces with ASJ jacket and 703 Fiberglas board finished with rewettable glasscloth for irregular surfaces. <u>Lit.P1 or P3 & E2</u>

The boiler breeching shall be insulated with 2" thk. Kaylo block wired on, then 1" hex mesh, coat of cement and finished with 6 oz. canvas adhered with lagging adhesive. <u>Lit.E6</u>

Industrial Insulation, 700 series, Plain and Faced

A highly versatile group of Fiberglas insulating boards designed to insulate ductwork, equipment, vessels, and tanks, both thermally and acoustically. For operating temperatures to +450F



uses

The 700 series Boards have been designed primarily to insulate heating and air conditioning ducts, ovens, tanks, boilers, hot water generators and other hot equipment.

Type 701—A lightweight resilient insulation, in board form, used on vessels having irregular surfaces where the exterior finish is supported by welded studs, pins, or other mechanical attachments.

Type 703—A semi-rigid board recommended for use on equipment, vessels, and air conditioning ductwork.

Type 705—A rigid board with very high strength characteristics for use on chillers, hot and cold equipment, heating and air conditioning ductwork where greater abuse resistance and good appearance is required.

description

Fiberglas* 700 Series Industrial Insulations are made of inorganic glass fibers pre-formed into semi-rigid to rigid rectangular boards of varying densities. The series consists of Types 701, 703, and 705. Each type has specific thermal and physical characteristics which make it suitable for the uses described. Types 703 and 705 are available with factory-applied FRK-25. Type 705 is available with ASJ-25. Both facings are vapor barriers and provide a neat, finished appearance.

benefits

Lower operating costs—the exceptional thermal efficiency of Fiberglas 700 Series Insulations lowers operating costs.

End-use tailored—three densities offer a selection of products to meet specific performance and economic requirements.

Lower maintenance costs—700 Series Insulations resist damage, maintain structural integrity and efficiency. Thickness stays uniform.

Wide temperature-use range—applications range from -60F to +450F.

Neat finished appearance—the boardlike characteristics of the heavier density Type 703 and 705 products provide neat square corners. The factory-applied facing provides an attractive finished appearance.

Immediate building code approval—Fiberglas 700 Series Insulation (faced and unfaced) has a UL flame spread rating of less than 25.

Noise control—a versatile group of Fiberglas products that efficiently reduce sound transmission.

---

*Trademark registered Owens-Corning Fiberglas Corporation.

sound absorption coefficients

Mounting

No. 7 (Modified): Insulation placed against 24-gauge sheet metal over a 16-inch air space. This mounting configuration is typical of a sheet metal enclosure with insulation on one side.

Sound Absorption Coefficients

Unfaced	Insulation Type					
	701		703		705	
Frequency (Hz)	One-Inch Thickness	Two-Inch Thickness	One-Inch Thickness	Two-Inch Thickness	One-Inch Thickness	Two-Inch Thickness
125	.38	.44	.33	.38	.32	.39
250	.34	.66	.28	.63	.30	.59
500	.68	.99	.62	.99	.66	.99
1000	.82	.99	.88	.99	.90	.99
2000	.87	.99	.96	.99	.95	.99
4000	.96	.99	.99	.99	.99	.99
NRC	.68	.90	.69	.90	.70	.89

Faced	Insulation Type					
	701		703 FRK		705 FRK or ASJ	
Frequency (Hz)	One-Inch Thickness	Two-Inch Thickness	One-Inch Thickness	Two-Inch Thickness	One-Inch Thickness	Two-Inch Thickness
125	Not Available Faced		.31	.38	.25	.38
250			.45	.51	.48	.36
500			.62	.83	.28	.39
1000			.65	.73	.57	.37
2000			.51	.53	.39	.56
4000			.28	.37	.30	.38
NRC			.56	.65	.43	.42

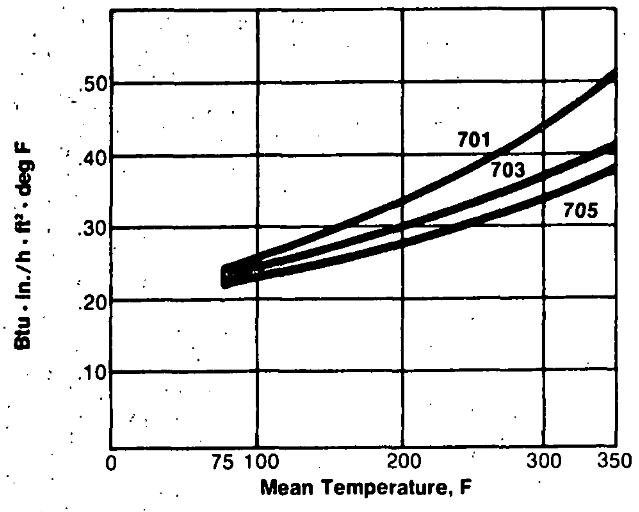
For further Noise Control information, contact your local Owens-Corning Fiberglas representative.

Size and Density

	701	703	705
Density (pcf)	1.58	3.00	6.00
Thickness (½" (increments)	1½"-4"	1"-2"	1"-2"
Compressive strength (psf at 10% deform.)	4.5*	100	350
Standard size (inches)	24"x48"		
Thermal conductivity at 75F mean temp.	0.242	0.230	0.220

°After compression packaged

Thermal Conductivity



Moisture absorption—less than 2% by volume

Bacteria and fungus resistance—*does not breed or promote*

Humidity and temperature effect—cycling conditions will not cause spalling or crumbling

Corrosion—does not accelerate corrosion of copper, steel, or aluminum

Fire safety—Fiberglas 700 Series, both faced and unfaced, can be specified and used without danger of contributing to the spread of fire or liberation of excessive smoke.

facings

Types 703 and 705 are available with the following factory-applied vapor barrier facings, with UL labels available if specified:

FRK—Foil reinforced kraft: 703, 705

ASJ—Embossed white kraft foil laminate: 705 only

Vapor transmission rates: ASJ-25-.02 perms
FRK-25-.02 perms

Beach puncture resistance: ASJ-25-50 units
FRK-25-25 units

surface burning characteristics

(unfaced or faced:)

flame spread	25
fuel contributed	50
smoke developed	50

(compared to untreated Red Oak as 100)

application recommendations

Type 701—lightweight unfaced flexible insulation in board form for use on vessels having irregular surfaces, where the compressive strength is not a performance criterion.

Types 703 and 705—board insulations normally impaled on welded pins on flat surfaces. They are cut in segments and banded in place on irregular surfaces. Unfaced boards are normally finished with reinforced insulating cement or weatherproof mastic. For outdoor application: Types 703 and 705, faced.

ASJ-25 or FRK-25 faced insulation boards shall be applied using mechanical fasteners such as weld pins or stick clips. Fasteners shall be located not less than 3" from each edge or corner of the board. Pin spacing along the duct should be no greater than 12" on centers. Additional pins or clips may be required to hold the insulation tightly against the surface where cross breaking is used for stiffening. Weld pin lengths must be selected to insure tight fit but avoid "oil canning" effect.

Apply only OCF vapor seal ASJ or FRK pressure-sensitive patches. Rub hard with the nylon sealing tool to insure a tight bond and a vapor seal.

All insulation edges and butt joints are to be sealed only with OCF pressure-sensitive joint sealing tape to match the jacket. Rub hard with nylon sealing tool. Use 3" wide tapes on flat surfaces, or where edges are shiplapped and stapled. 5" wide tape can be used in lieu of shiplapping.

Precautions:

- Keep all contact adhesive surfaces clean.
- Use nylon sealing tool to prevent wrinkles and fishmouths.
- Duct-work or radius may require pre-scoring to allow the board to conform to the surface.
- When painting the facings for indoor applications, use only water base/latex products.

Limitations:

- Pressure-sensitive sealing tapes or patches should only be applied when the ambient temperature is between +35F and +110F.
- Maximum insulation surface temperatures in use are limited to -10F to +150F.
- Outdoor applications require additional weather protection.

economic thickness

Caution: The recommended Economic Thicknesses shown are chosen with respect to cost, thermal performance, and energy conservation. It is possible that heat may be generated from the resinous binder of insulations if ignited by external sources such as welding slag, cutting torches, etc. Care should be taken to avoid direct contact with the insulation by fire or ignition sources.

Selection of an insulation for any specific application should take into consideration the following important criteria: **1.** Cost of insulation applied. **2.** Cost of heat energy at midlife. **3.** Cost of capital. **4.** Capital investment in heat production equipment. **5.** Temperature differential. **6.** Size of the pipe surface. **7.** Conductivity of insulation. **8.** Depreciation period—insulation and facility. The thicknesses shown in the tables below are based on the following typical conditions:

Commercial (full time):

Annual fuel price increase: 4%
Initial heat cost: $2.75/1000 lb. steam
Heat cost at midlife: $4.07/1000 lb. steam
Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Flat insulation cost (1"): $3.40/sq ft
Depreciation time: 20 years
Hours of operation: 8760/year

Economic thickness for heated equipment to 450F
(80F ambient, still air, commercial full time)

Surface Temp., F	Type 701			Type 703			Type 705		
	ET	HL	ST	ET	HL	ST	ET	HL	ST
150	2½	5	84	2½	5	84	2½	5	84
200	3½	6	86	3½	6	86		*	
300	5½	8	87		*			*	
400	7	9	88		*			*	
450	7½	10	89		*			*	

ET = economic thickness, inches
HL = heat loss, Btu/hr/sq ft
ST = surface temperature, deg. F

* For requirements in this area, contact your local OCF representative.

Commercial (part time):

Annual fuel price increase: 4%
Initial heat cost: $3.00/1000 lb. steam
Heat cost at midlife: $4.44/1000 lb. steam
Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Flat insulation cost (1"): $3.40/sq ft
Depreciation time: 20 years
Hours of operation: 5400/year

Economic thickness for heated equipment to 450F
(80F ambient, still air, commercial part time)

Surface Temp.	Type 701			Type 703			Type 705		
	ET	HL	ST	ET	HL	ST	ET	HL	ST
150	2	6	86	2	6	85	2	6	85
200	3	7	87	3	7	86	3	7	86
300	4½	9	88	4	10	89		*	
400	5½	11	90		*			*	
450	6	12	91		*			*	

ET = economic thickness, inches
HL = heat loss, Btu/hr/sq ft
ST = surface temperature, deg F

* For requirements in this area, contact your local OCF representative.

Thickness to prevent condensation on cold ducts and equipment—faced board

The following chart indicates the recommended thickness for installation on cold air ducts at various temperature differences (duct to air). Also shown are values for heat gain and approximate maximum relative humidity allowable.

Temperature Differences deg. F	Recommended Thickness (Inches)	Heat Gain Btu/sq ft/hr	Permissible Relative Humidity
20	1	4.3	90%
25	1	5.2	87%
30	1	6.1	89%
35	1	7.1	88%
40	1½	5.7	90%
45	1½	6.3	89%
50	2	5.4	90%

specification compliance

These products conform to the property requirements of Government Specifications:

	701	703*	705
HH-I-558B (Amendment 3), Form A, Class 1	●	●	●
HH-I-558B (Amendment 3), Form A, Class 2		●	●
HH-I-558B (Amendment 3), Form B, Type 1, Class 7	●		
NAVFAC (Naval Facilities Engineering Command) TS-15180		●	●
Corps of Engineers C.E.-301.06,.08		●	●

* Type 703G is specially produced for contracts where certification of compliance, to the above Government Specifications are required. Available plain or faced for use on hot or cold equipment and for air conditioning duct work.

Products 703 and 705 also comply with the requirements of NFPA 90A.

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OWENS-CORNING FIBERGLAS CORPORATION
Mechanical Division
Fiberglas Tower, Toledo, Ohio 43659

Pub. No. 1-IN-6360-E Litho in U.S.A., Sept., 1976

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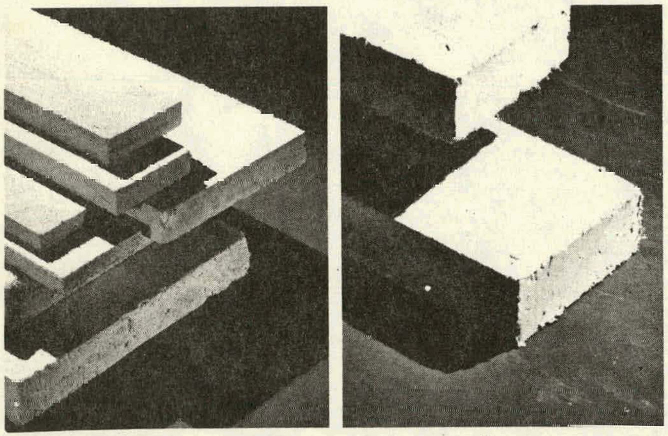
TRADEMARK ®

Kaylo 10
Asbestos Free
Block Insulation

Rigid calcium silicate insulations for all types of heated equipment operating at temperatures up to 1200F.



uses

Kaylo 10* Asbestos Free Block is for use on indoor or outdoor equipment operating at temperatures up to 1200F. Kaylo block is ideally suited for use on stainless steel vessels and equipment as it does not contribute to stress corrosion cracking. Typical applications are for boilers, breeching, tanks, vessels. Kaylo 10 Asbestos Free Block is white in color.

description

Kaylo 10 Asbestos Free Block Insulation is a rigid hydrous calcium silicate heat insulation. It is strong, efficient and highly resistant to abrasion and moisture damage.

benefits

High thermal efficiency—Kaylo 10 Asbestos Free offers excellent thermal efficiency coupled with high strength. A low k of .40 for Kaylo 10 at 200F mean temperature proves that Kaylo will provide significant savings in operating costs over the life of the equipment.

Resistant to abuse—resists mechanical damage because of hard, tough, reinforced structure.

Will not cause stress corrosion cracking—Kaylo 10 Asbestos Free will not cause stress corrosion cracking of stainless steel because it has a very low chloride content.

No asbestos—Kaylo 10 Asbestos Free can be safely used and applied in conformance with OSHA regulations.

Resistant to moisture damage—unlike many other insulations, Kaylo 10 Asbestos Free is not affected appreciably from moisture damage. It regains thermal efficiency and strength after drying out. Outdoor installations must be weather-proofed, however, for long continuous service.

Dimensionally stable—Kaylo 10 Asbestos Free does not shrink appreciably in service, even at elevated temperatures. This means less heat leakage at the joints.

Fabricates easily—ordinary insulator's tools are all that is required to fabricate Kaylo 10 Asbestos Free. It cuts with a clean true edge for tighter fit at the joints. Fittings are neater and faster.

*Kaylo 10 is a trademark of the Owens-Corning Fiberglas Corporation

performance characteristics

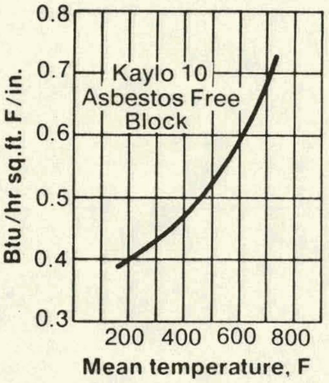
Density:	12.5 pcf
Flexural strength (ASTM C-203):	50 psi average
Compressive strength (ASTM C-165), at 5% deformation:	100 psi
Hardness (ASTM C-569):	.55mm

Resistance to abrasion (ASTM C-421), conventional tumbling test—

loss in weight	after 10 minutes, 20% max.
before heating:	after 20 minutes, 45% max.

Dimensional stability (ASTM C-356), linear shrinkage after heating for 24 hours in muffle at 1200F:	1.5%

Thermal conductivity



specification compliance

HH-I-523c Insulation Block, Pipe Covering, Thermal, (Calcium Silicate for temperatures up to 1200F). Type 1.

MIL-I-2819E Insulation Block, Thermal. Class 1 and 2. ASTM C533-67.

MIL-I-24244 (Amend. 3) (Ships) Insulating Materials, Thermal, with Special Corrosion and Chloride Requirements (Kaylo 10 only), Type 3A, 3B.

sizes

thickness—1½", 2", 2½", 3", 3½" and 4"
width—6", 12" and 18"
length—36"

For pipe sizes greater than those for which Kaylo 10 Asbestos Free Pipe Insulation sizes are available, Kaylo beveled lags may be used to insulate piping. Lags beveled to fit pipes from 18" to 72" in diameter are available in thicknesses of 1½", 2", 2½", 3". Lags are 36" long and 3" wide.

application recommendations

Kaylo 10 Asbestos Free Block Insulations are held in place by mechanically fastening with bands wired or welded to rods or studs. The insulation may be finished with a trowel coat of insulating cement, canvassed and painted. Outdoor installations require weatherproofing with mastic or metal jacketing.

economic thickness

Selection of an insulation for any specific application should take into consideration the following important criteria: 1. Cost of insulation applied. 2. Cost of heat energy at midlife. 3. Cost of capital. 4. Capital investment in heat production equipment. 5. Temperature differential. 6. Size of the pipe surface. 7. Conductivity of insulation. 8. Depreciation period—insulation **and** facility. The thicknesses shown in the tables below are based on the following typical conditions:

Utility (calcium silicate):
Annual fuel price increase: 4%
Initial heat cost: $1.75/1000 lb. steam
Heat cost at mid-life: $3.15/1000 lb. steam
Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Flat insulation cost (1"): $4.90/sf
Depreciation cost: 30 years
Hours of operation: 8760/year

Process (calcium silicate):
Annual fuel price increase: 4%
Initial heat cost: $2.19/1000 lb. steam
Heat cost at mid-life: $2.93/1000 lb. steam
Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Flat insulation cost (1"): $4.90/sf
Depreciation time: 15 years
Hours of operation: 8760/year

Economic thickness for heated equipment to 1200F
(80F ambient, still air)

Operating Temperature	Utility			Process		
	ET	HL	ST	ET	HL	ST
200	3½	13	89	3	15	91
300	4½	21	94	4	23	96
400	6	24	96	5	29	99
500	7	29	99	6	33	103
600	8	33	102	7	37	105
700	9	36	105	7½	43	110
800	10	40	107	8½	47	112
900	11	43	110	9½	50	114
1000	12	47	112	10	56	118
1100	exceeds 12"			11	59	120
1200	exceeds 12"			11½	65	124

ET=economic thickness, inches

HL=heat loss, Btu/ft² hr

ST = surface temperature, F

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Mechanical Division
Fiberglas Tower, Toledo, Ohio 43659

Pub. No. 1-IN-5953-B Litho U.S.A. June 1974

Ow[redacted] CORNING
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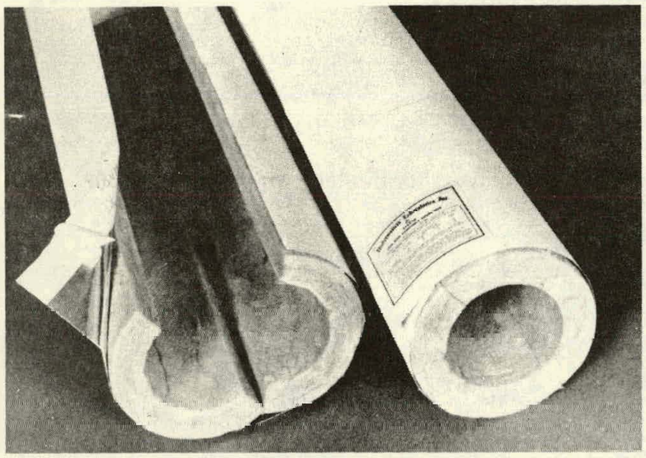
TRADEMARK®

2-Piece heavy density
pipe insulation

Fiberglas 25 ASJ/SSL

(ALL SERVICE JACKET)

A UL-rated noncombustible pipe insulation for hot or cold concealed and exposed piping operating at temperatures from −60F to +450F



uses

Recommended for use on all hot, cold, concealed and exposed commercial piping operating from −60F to 450F such as commercial and institutional buildings, schools, hospitals, and places of public assembly. Also recommended for processing lines where fire safety is a paramount criterion.

description

Fiberglas 25* ASJ/SSL pipe insulation is composed of Fiberglas heavy density sectional pipe insulation jacketed with an embossed vapor barrier laminate. The jacket has a pressure sealing lap adhesive to eliminate the use of staples, adhesives, or bands.

benefits

Fire safety—a complete insulation product with a UL Fire Hazard Classification.

Damage resistant—the extra heavy density pipe insulation provides additional protection during construction.

Lower operating cost—the exceptional thermal efficiency of Fiberglas Heavy Density pipe insulation contributes to lower operating cost of heating and cooling equipment.

No condensation drippage—the foil vapor barrier and pressure sensitive lap, when applied in accordance with instructions, assure a positive vapor seal.

Insurance savings—Fiberglas 25 ASJ/SSL pipe Insulation meets all existing standards for fire safety and its use may result in lower insurance costs.

Meets federal specifications—Fiberglas ASJ/SSL pipe insulation complies with federal specifications HH-I-558B (Form D, Type III, Class 12), MIL-I-22344B, and MIL-I-24244A (Ships).

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*Fiberglas (Reg. U.S. Pat. Off.) and 25 are trademarks of O-CF Corp.

performance characteristics

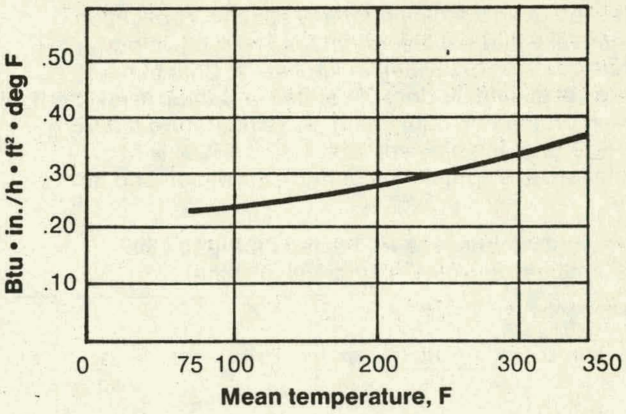
Insulation

Moisture absorption: 0.2% by volume 96 hours at 120F and 95% RH
Specific heat: 0.20 Btu/lb.F
Shrinkage: none
Alkalinity: ph9
Capillarity: negligible after 24 hours
Dimensional stability: will not warp, shrink, rot, or decompose.
Vermin and rodent resistant—provides no sustenance.
Temperature limitation—recommended for chilled or hot water piping from -60F to +450F.

Jacket

Water vapor permeance—.02 perms.
Beach puncture—minimum 50 units.

Thermal conductivity



fire hazard classification

Fiberglas 25 ASJ/SSL is classified by Underwriters' Laboratories for Pipe Covering:

Flame Spread	25
Fuel Contributed	50
Smoke Developed	50

The classification covers Fiberglas 25 ASJ including self-sealing lap and factory furnished butt strips. This is your assurance that you can specify and use Fiberglas 25 ASJ/SSL without the danger of contributing to the spread of fire or that combustion will liberate excessive smoke. The system has been designed to meet the stringent fire safety requirements of the GSA and Corps of Engineers.

application recommendation

The self-sealing lap feature of Fiberglas 25 ASJ pipe insulation sections makes installation on straight runs of pipe a simple procedure. The only precaution needed is to keep all contact adhesive surfaces clean and to rub hard all longitudinal and circumferential seams with a nylon sealing tool. The end joints are similarly sealed with a factory furnished (butt) strip with pressure sealing adhesive.

Self sealing lap or butt strips should only be applied when the ambient temperature is between 35F and 110F. There can be no condensation or other contaminants on the surface. Maximum insulation temperature is limited to minus 10F and plus 150F. **Outdoor applications** must be protected from the weather.

If painting is required for indoor applications, use only water base/latex paint.

caution

The recommended Economic Thicknesses shown are chosen with respect to cost, thermal performance, and energy conservation. It is possible that heat may be generated from the resinous binder of insulations if ignited by external sources such as welding slag, cutting torches, etc. Care should be taken to avoid direct contact with the insulation by fire or ignition sources.

Dual-temperature lines

If dual temperature line, compare with economic thickness for hot side service and choose greatest to minimize operating costs. Never choose thickness less than that required to prevent condensation in cold operation.

Cold and dual-temperature lines (90F at 80% RH)

pipe surface temperature, F	50 & up		49 to 35		34 to 0		0 to -30	
pipe size	RT	HG	RT	HG	RT	HG	RT	HG
½	1	4	1	5	1	8	1½	8
¾	1	5	1	6	1	9	1½	10
1	1	6	1	7	1½	8	1½	11
1¼	1	7	1	8	1½	9	1½	12
1½	1	8	1	9	1½	10	1½	13
2	1	10	1	11	1½	12	1½	15
2½	1	12	1	13	1½	15	2	15
3	1	11	1	15	1½	16	2	17
3½	1	12	1	12	1½	18	2	19
4	1	13	1	14	1½	18	2	20
4¼	1	14	1	15	1½	22	2	23
5	1	15	1	19	1½	23	2	23
6	1	17	1	22	1½	25	2	26
7	1	18	1	25	1½	28	2	29
8	1	20	1	27	1½	31	2	32
9	1	22	1	29	1½	34	2	35
10	1	25	1	32	1½	36	2	38
11	1	25	1	34	1½	39	2	41
12	1	26	1	35	1½	43	2	44

RT = recommended thickness, inches HG = heat gain, Btu/hr/lineal foot

economic thickness

Selection of an insulation for any specific application should take into consideration the following important criteria: **1.** Cost of insulation applied. **2.** Cost of heat energy at midlife. **3.** Cost of capital. **4.** Capital investment in heat production equipment. **5.** Temperature differential. **6.** Size of the pipe surface. **7.** Conductivity of insulation. **8.** Depreciation period—insulation and facility.

The thicknesses shown in the tables below are based on the following typical conditions:

Commercial (full time):
Annual fuel price increase: 4%
Initial heat cost: $2.75/1000 lb. steam
Heat cost at midlife: $4.07/1000 lb. steam
Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Pipe insulation cost (1½" x 1"): $2.40/lf
Depreciation time: 20 years
Hours of operation: 8760/year

Economic thicknesses for heated piping to 450F
(80F ambient, still air, commercial full time)

pipe temp., F	150			200			300			400			450		
temp. diff., F	70			120			220			320			370		
IPS	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**
½	½	8	100	1	12	90	1½	20	91	2½	25	88	2½	30	90
¾	1	8	86	1	15	92	2	20	89	2½	28	89	3	31	89
1	1	8	85	1½	12	86	2	22	89	3	29	88	3	35	90
1¼	1	11	87	1½	14	86	2½	23	88	3	34	90	3½	38	90
1½	1	11	86	1½	16	87	2½	23	87	3½	32	87	3½	38	89
2	1½	10	84	2	15	85	2½	27	88	3½	37	88	4	41	88
2½	1½	10	83	2	16	84	3	27	86	4	37	87	4½	42	87
3	1½	13	84	2	20	86	3	32	87	4	43	88	4½	48	88
3½	1½	13	84	2½	18	84	3½	30	85	4½	41	86	5	47	87
4	1½	16	84	2½	21	85	3½	34	86	4½	46	87	5	52	88
4½	2	13	83	2½	21	84	3½	34	86	4½	48	87	5	50	86
5	2	16	83	2½	24	85	4	35	85	5	49	87	5½	56	87
6	2	18	83	2½	28	85	4	40	86	5	55	87	5½	63	88
7	2	20	83	3	26	84	4	44	86	5½	57	87	6	59	86
8	2	22	84	3	29	84	4	48	86	5½	62	87	6	71	87
10	2	26	84	3	35	84	4½	52	86	5½	73	87	6½	79	87
12	2	30	84	3	40	84	4½	59	86	5½	83	87	6½	89	87
14	2	35	84	3	45	85	4½	65	86	5½	90	88	6½	97	88
16	2	39	84	3	50	85	4½	73	86	5½	100	88	6½	106	88
18	2	43	84	3	55	85	4½	80	86	5½	110	88	6½	117	88
20	2	48	84	3	61	85	4½	87	86	5½	120	88	6	134	89
24	2	57	84	3	72	85	4	112	88	5½	139	89	6	155	89
30	2	69	85	2½	90	87	4	140	88	5	165	90	5½	185	91

ET = economic thickness inches HL = heat loss, Btu/hr/lineal foot ST = surface temperature, F

Commercial (part time):
Annual fuel price increase: 4%
Initial heat cost: $3.00/1000 lb. steam
Heat cost at midlife: $4.44/1000 lb. steam
Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Pipe insulation cost (1½" x 1"): $2.40/lf
Depreciation time: 20 years
Hours of operation: 5400/year

Economic thicknesses for heated piping to 450F (80F ambient, still air, commercial part time)

pipe temp., F	150			200			300			400			450		
temp. diff., F	70			120			220			320			370		
IPS	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**	**ET**	**HL**	**ST**
½	½	8	100	1	12	90	1½	20	91	2	28	93	2	34	95
¾	½	10	97	1	15	92	1½	23	93	2	32	95	2	39	98
1	½	12	98	1	15	90	1½	25	93	2	35	94	2½	38	93
1¼	1	11	87	1	20	93	2	26	90	2½	37	92	2½	45	95
1½	1	11	86	1½	10	87	2	25	88	2½	37	91	3	41	91
2	1	13	86	1½	18	87	2	31	90	3	40	90	3	48	92
2½	1	15	87	1½	19	86	2½	29	87	3	42	90	3½	47	90
3	1	18	87	1½	24	88	2½	35	89	3½	46	89	3½	55	91
3½	1½	13	84	2	20	85	2½	36	88	3½	48	89	4	54	89
4	1½	16	84	2	24	86	3	37	87	3½	54	90	4	60	90
4½	1½	16	84	2	24	85	3	38	87	4	50	88	4	61	90
5	1½	19	85	2	29	86	3	43	88	4	56	89	4½	63	89
6	1½	23	85	2	32	86	3	49	88	4	63	89	4½	71	90
7	1½	25	85	2½	31	85	3½	48	87	4½	64	88	4½	78	90
8	1½	28	85	2½	33	85	3½	52	87	4½	70	88	5	79	89
10	2	26	84	2½	40	85	3½	63	88	4½	83	89	5	94	90
12	2	30	84	2½	46	85	3½	72	88	4½	95	89	5	106	90
14	2	35	84	2½	52	86	3½	79	88	4½	104	90	5	116	91
16	2	39	84	2½	58	86	3½	89	88	4½	116	90	5	129	91
18	2	43	84	2½	65	86	3½	98	89	4½	127	90	5	142	91
20	2	48	84	2½	71	86	3½	107	89	4½	139	90	5	154	91
24	1½	73	86	2½	84	86	3½	126	89	4½	162	91	5	180	92
30	1½	85	88	2	115	88	3	176	92	4	212	93	4½	236	94

ET = economic thickness, inches HL = heat loss, Btu/hr/lineal foot ST = surface temperature, F

The thicknesses shown in the tables below are based on the following typical conditions:
Process (metal jacket):
Annual fuel price increase: 4%
Initial heat cost: $2.19/1000 lb. steam
Heat cost at mid-life: $2.93/1000 lb. steam

Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Pipe insulation cost (2½x1½): $2.40/lf
Depreciation time: 15 years
Hours of operation: 8760/year

Economic thicknesses for heated piping to 450F (80F ambient, still air, process, metal jacket)

pipe temp., F	150			200			300			400			450		
temp. diff., F	70			120			220			320			370		
IPS	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST
½	½	8	98	1	11	98	1½	19	102	1½	31	112	2	33	110
¾	½	8	96	1	13	101	1½	28	117	2	31	108	2	38	113
1	½	11	100	1	14	99	1½	24	105	2	34	108	2½	37	107
1¼	1	10	94	1	18	103	2	25	102	2½	35	106	2½	43	111
1½	1	10	93	1	18	101	2	24	99	2½	35	104	2½	43	108
2	1	11	93	1½	17	96	2	29	103	2½	42	108	3	47	108
2½	1	13	94	1½	17	95	2	31	102	3	41	103	3	50	107
3	1	15	95	1½	22	98	2½	34	101	3	49	107	3½	54	107
3½	1½	12	90	1½	22	96	2½	35	100	3½	46	103	3½	56	107
4	1½	14	92	2	22	95	2½	40	103	3½	52	105	4	58	106
4½	1½	14	91	2	22	94	3	36	98	3½	53	104	4	59	105
5	1½	17	92	2	26	96	3	41	100	3½	59	107	4	65	107
6	1½	20	93	2	30	97	3	46	102	4	61	104	4½	69	106
7	1½	22	93	2	33	97	3	50	102	4	67	105	4½	75	107
8	1½	24	93	2	36	98	3½	50	100	4	73	106	4½	82	108
10	1½	28	94	2½	37	95	3½	59	101	4½	80	105	5	90	107
12	2	27	91	2½	42	96	3½	67	102	4½	91	106	5	102	108
14	1½	38	95	2½	47	97	3½	75	103	4½	99	108	5	112	110
16	1½	42	95	2½	53	97	3½	83	104	4½	110	109	5	124	111
18	1½	47	96	2½	58	98	3½	92	105	4½	121	109	5	136	112
20	1½	51	96	2½	64	98	3½	100	105	4½	132	110	4½	160	115
24	1½	61	97	2	89	102	3	132	110	4	168	115	4½	186	117
30	1½	74	97	2	109	103	3	161	111	4	204	116	4	248	123

ET = ecoromic thickness, inches HL = heat loss, Btu/hr/lineal foot ST = surface temperature, F

The thicknesses shown in the tables below are based on the following typical conditions:
Utility (ASJ jacket):
Annual fuel price increase: 4%
Initial heat cost: $1.75/1000 lb. steam
Heat cost at mid-life: $3.15/1000 lb. steam

Cost of money: 7½%/year
Capital investment: $20/lb. steam/hour
Pipe insulation cost (2½x1½): $2.40/lf
Depreciation time: 30 years
Hours of operation: 8760/year

Economic thicknesses for heated piping to 450F (80F ambient, still air, utility, ASJ jacket)

pipe temp., F	150			200			300			400			450		
temp. diff., F	70			120			220			320			370		
IPS	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST
½	½	9	91	1	12	89	1½	20	91	2	28	93	2½	30	91
¾	1	8	86	1	15	91	1½	23	93	2½	28	90	2½	39	97
1	1	8	86	1½	12	87	2	22	89	2½	31	91	3	35	91
1¼	1	11	87	1½	14	87	2	26	91	3	33	91	3	41	93
1½	1	11	86	1½	16	88	2	25	89	3	34	90	3½	38	90
2	1	13	87	1½	18	88	2½	27	89	3	40	91	3½	44	91
2½	1½	10	84	2	16	85	2½	29	88	3½	39	89	4	44	89
3	1½	13	85	2	20	86	3	32	88	3½	46	90	4	51	91
3½	1½	13	84	2	20	86	3	32	88	4	44	89	4½	50	89
4	1½	16	85	2	24	87	3	37	88	4	49	90	4½	55	90
4½	1½	16	85	2	24	86	3½	34	87	4	50	89	4½	58	92
5	1½	19	86	2½	24	86	3½	39	88	4½	52	89	5	59	89
6	2	18	84	2½	27	86	3½	43	88	4½	58	89	5	66	90
7	2	20	84	2½	31	86	3½	47	88	5	60	89	5½	69	89
8	2	22	84	2½	32	86	4	47	87	5	65	89	5½	74	90
10	2	26	84	3	35	85	4	57	88	5	77	90	5½	87	90
12	2	30	85	3	40	85	4	64	88	5	87	90	6	93	90
14	2	34	85	3	44	86	4	71	88	5	96	90	5½	108	91
16	2	38	85	3	50	86	4	79	89	5	106	91	5½	119	92
18	2	43	85	3	55	86	4	87	89	5	117	91	5½	131	92
20	2	47	85	3	60	86	4	95	89	5	127	91	5½	143	92
24	2	56	85	2½	83	88	4	112	89	5	148	92	5½	166	93
30	2	69	85	2½	102	88	3½	152	91	4½	196	93	5	216	94

ET = economic thickness, inches HL = heat loss, Btu/hr/lineal foot ST = surface temperature, F

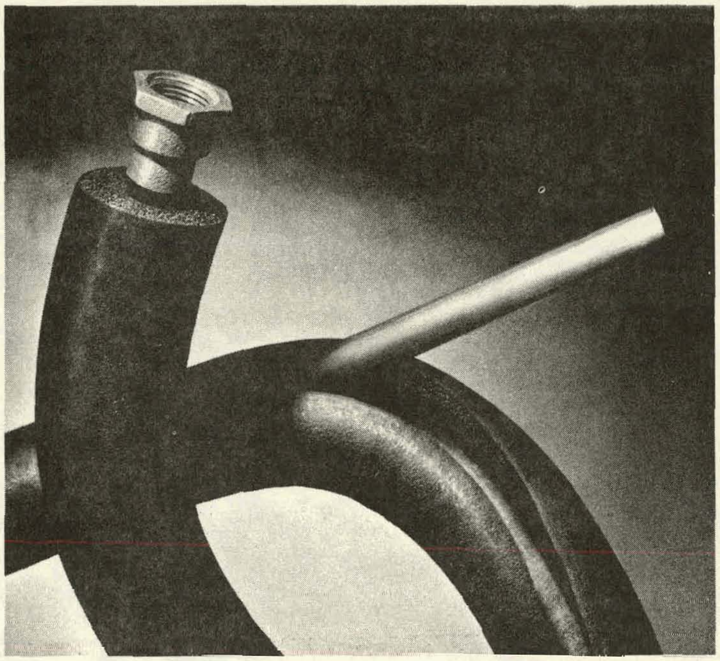
OWENS/CORNING FIBERGLAS

OWENS-CORNING FIBERGLAS CORPORATION
Mechanical Division
Fiberglas Tower, Toledo, Ohio 43659

Pub. No. 1-IN-5537-F Litho in U.S.A., July, 1975

JM Johns-Manville

INSULATION SYSTEMS



TYPE: PIPE INSULATION
TEMP. LIMIT: 220F

J-M Aerotube®

Foamed Plastic Pipe Insulation

DESCRIPTION: Johns-Manville Aerotube is a closed cell, foamed plastic, tubular pipe insulation for use at temperatures up to 220F. Its extreme flexibility permits quick, easy application, especially on bent tubing and fittings. Aerotube is clean, odorless, durable and does not carry flame.

AVAILABLE FORMS: Furnished in 6′ lengths from ⅜″ ID through 5″ IPS without longitudinal joints for both iron pipe and copper tubing in nominal wall thicknesses of ⅜″, ½″, and ¾″. Also available in flat sheets for 6″, 8″ and 10″ IPS sizes in nominal wall thicknesses of ½″ and ¾″. Fifty-foot continuous coils also available in selected wall thicknesses and pipe sizes.

USES: Recommended for use on virtually all types of lines in heating, plumbing and air-conditioning service, particularly where sweating or condensation is a problem. The thicknesses have been calculated to prevent condensation on insulation surface. Since Aerotube is supplied in tubular form, it may be slipped over pipe or tubing before pipe connections are made. This results in substantial labor savings. Where connections have already been made, Aerotube is easily slit longitudinally with a sharp knife and snapped onto the pipe. Does not require a separate vapor barrier.

USDA compliance available upon request.

ADVANTAGES:

Built-in Vapor Barrier Aerotube's closed cell structure retards the flow of water vapor. It has a water vapor transmission rating of 0.1 perm-in. (average value).

Easy to Install and Seal Tubular form without longitudinal joint speeds application. Where piping is in place, just slit Aerotube section longitudinally, snap over piping and seal with J-M adhesive.

Aerotube

Specification Data[†]

AVERAGE PHYSICAL PROPERTIES

Density, lbs/cu ft	ASTM D-1622	5.4
Thermal conductivity, Btu/hr sq ft (F /in)	ASTM C-177 or C-518	
75F mean temperature		0.253
90F mean temperature		0.258
Temperature limits, F		
Upper[††]		220
Lower[†††]		—40
Thermal stability, % shrinkage	ASTM C-548	
7 days, 200F		5.8
7 days, 220F		6.6
Water absorption, % by weight	ASTM D-1056	3.0
Water vapor permeability, wet cup, perm-in.	ASTM C-355	**0.1**
Ozone resistance		good
Odor		negligible

Flammability

Standard Aerotube pipe insulation has been evaluated for flame spread rate and smoke density factor by test method ASTM E84 "Surface Burning Characteristics of Building Materials." This test method is commonly referred to as the 25-ft. tunnel.*

*This numerical flame spread rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.

STANDARD AEROTUBE PIPE INSULATION

Wall Thickness	Flame Spread Rate	Smoke Density Factor
0.300″	45	115
0.375″	45	140
0.500″	45	210
0.625″	50	290
0.750″	55	300
1.000″	75	490

NOTE: The pipe insulation wall thicknesses reported are typical for N ⅜″, N ½″, and N ¾″ engineered wall series.

MILITARY SPECIFICATION COMPLIANCE

J-M Aerotube can be furnished upon request to meet:
ASTM C-534, Type I-Tubular
ASTM D-1056, SBE 41-42
MIL-C-3133B (MIL STD 670B),
Grade SBE 3
HH-I-573B, Class T-Tubular

RECOMMENDED THICKNESS*

NORMAL DESIGN CONDITIONS**

Pipe Size, in.	Thickness (inches) at Pipe Temperature 50F	35F	0F
⅜ ID through 3 IPS	Nom. ⅜″	Nom. ½″	Nom. ¾″
Over 3 IPS thriugh 10 IPS	Nom. ½″	Nom. ½″	Nom. ¾″
Over 10 IPS	⅜″ sheet	⅝″ sheet	1″ sheet

MILD DESIGN CONDITIONS***

⅜ ID through 3 IPS	Nom. ⅜″	Nom. ⅜″	Nom. ½″
Over 3 IPS thorugh 10 IPS	Nom. ½″	Nom. ½″	Nom. ½″
Over 10 IPS	⅜″ sheet	⅜″ sheet	½″ sheet

SEVERE DESIGN CONDITIONS****

⅜ ID through 10 IPS	Nom. ¾″	Nom. ¾″	See Note
Over 10 IPS	¾″ sheet	1⅛″ sheet	See Note

*Based on available manufactured thicknesses.
**Normal Design Conditions: max. temp. 85F, rel. hum. 70%
***Mild Design Conditions: max. temp. 80F, rel. hum. 50%
****Severe Design Conditions: max. temp. 90F, rel. hum. 80%
NOTE: Available for zero F on special request.

[†] The physical properties of Johns-Manville Aerotube pipe insulation represent typical average values obtained in accordance with accepted test methods and are not to be used for writing material specifications. They are subject to normal manufacturing variations and are supplied as a technical service. They are subject to change without notice. Check the Johns-Manville district office to assure current information.

[††] Aerotube pipe insulation will withstand pipe temperature up to 220F. When the pipe size is greater than 5″ IPS and Aerotube pre-cut pipe insulation and Aerotube sheet are secured by cementing together only the edges, the temperature limit is 220F. J-M 57 Adhesive may be used with pipe insulation applications up to 220F. Aerotube sheet adhered with full adhesive coverage on curved or flat metal surfaces may be applied to surfaces operating up to 180F using J-M 57 Adhesive.

[†††] Below −20F flexible Aerotube will be hard and start to become brittle. This characteristic does not impair the low conductivity nor the resistance to water vapor.

For Information on other J-M Thermal Insulations and Systems, Write the Johns-Manville Insulation Center, Drawer 17L, Denver, Colorado 80217 or Call (303) 979-1000.

JM

Johns-Manville

P.O. Box 5108 • Denver, Colorado 80217

Sales Offices in Principal Cities

IND-3039 10-76

Litho in USA

Johns-Manville

Insulation Systems

Zeston®

Insulated Fitting Covers

Type: Premolded PVC Insulated Fitting Covers
Temp. Limits: 0 - 500°F

Description

PVC covers come premolded in one piece (in several shapes and sizes) with a Hi-Lo Temp® fiber glass insulation insert, all of which fit snugly over a variety of fittings. The insulation and the cover provide insulation, plus vapor barrier, in a simple, quickly applied system. Temperature range is 0°F - 500°F.

Available Shapes and Sizes

Shapes available for 45° and 90° short and long radius elbows, tees and valves plus a wide variety of other fittings; flanges, reducers, end caps, soil flanges, traps and mechanical line fittings. IPS sizes from ¼" through 24"; CT sizes from ½" through 6⅛".

Applications

For insulating chilled water, hot water, steam and other piping systems in commercial, institutional, industrial construction on indoor and outdoor piping systems. Meets most requirements of Federal, State and local codes, and federal and military specifications. For use with Micro-Lok® 650 pipe insulation and a variety of other pipe insulations.

Advantages

Strong and Durable. Pliable, tough PVC cover accepts blows and crushing. Withstands water, most acids, alkalies, and chemical washdowns. Resists alcohols, aliphatic hydrocarbons, and oils. Insulation will not settle or separate in vibration.

Neat Appearance, Paintable. Attractive, off-white Zeston insulated cover provides excellent appearance. The smooth finish may be painted if desired. Painting is recommended for certain exterior applications. Contact a sales representative or factory for recommendations.

Simple, Fast Installation. Requires no special tools. Just wrap the fiber glass insert around the fitting and tuck it in as necessary; pop on the fitting cover and smooth it into position; secure with tacks, or tape as required.

General Properties of Hi-Lo Temp fiber glass insert

Thermal Conductivity	at 75°F mean temp., "k" = .27
Temperature Limits	0°F to 500°F
Vapor and Moisture Resistant	Fibers cannot absorb moisture. Resistance to moisture facilitates rapid drying out.
Sanitary	Odorless. Will not asborb odors. Provides no food for insects, rodents, or mildew.
Corrosion Resistant	Will not promote corrosion when in contact with aluminum or steel.
Vibration Proof	Will not settle or separate.
Fire Safety	Meets most requirements of federal, state, and local codes. Accepted for commercial institutional, industrial, residential projects in all parts of U.S. The fiber glass inserts have U/L 25/50 Rating.

Specification Data

Zeston® Fitting Covers

General
Where the factory molded one piece PVC insulated fitting covers are to be used, the proper factory precut Hi-Lo Temp insulation insert shall be applied to the fitting. The ends of the Hi-Low Temp insulation insert shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked in, fully insulating the pipe fitting. The one piece PVC fitting cover is then secured by tack fastening, banding or taping the ends to the adjacent pipe covering.

Chilled
Chilled water systems shall be insulated as above with the addition of all seam edges between the fitting cover and the pipe insulation as well as the overlap in the throat of the fitting cover to be sealed with Zeston vapor mastic adhesive or equal. The circumferential edges of cover shall be wrapped with Zeston vapor-barrier pressure sensitive color matching Z Tape. The tape shall extend over the adjacent pipe insulation, and have an overlap on itself at least 2 inches on the downward side.

Compliance with Government Specs
The PVC cover conforms to Federal Specification L-P-535D, Composition A, Type II, Grade GU.

Hot
On fittings where temperature exceeds 250°F, 2 layers of the factory precut Hi-Lo Temp insulation inserts shall be applied with a few wrappings of twine on first layer, to be sure there are no voids or hot spots. The fitting cover shall then be applied over the Hi-Lo Temp insulation as described in "General".

Refrigerant
The same procedure for 2 layer insulation described above is to be followed on insulating fittings for pipe temperature 35°F and lower. In addition, the seam edges of the PVC fitting cover shall be sealed with Zeston vapor barrier mastic adhesive or equal. The circumferential edges shall be wrapped with Zeston vapor-barrier pressure sensitive color matching Z Tape. The tape shall extend over the adjacent pipe insulation, and have an overlap on itself at least 2 inches on the downward side.

Qualifications for Use
Insulation
When insulation thickness is greater than 2" or pipe temperature exceeds 250°F, additional inserts must be used. (A "Rule of Thumb" for temperatures over 250°F, or insulation thicker than 2", is to use one Hi-Lo Temp insert for each 1" of pipe insulation.)

Fitting Cover
The temperature of the PVC fitting cover shall be kept below 150°F (65.5°C) by the use of proper thickness of insulation and by keeping the PVC cover away from, contact with, or exposure from sources of direct or radiant heat.

Note: The contractor may insulate all untested piping leaving all fittings uninsulated until after tests are completed.

JM
Johns-Manville
Ken-Caryl Ranch
Denver, Colorado 80217

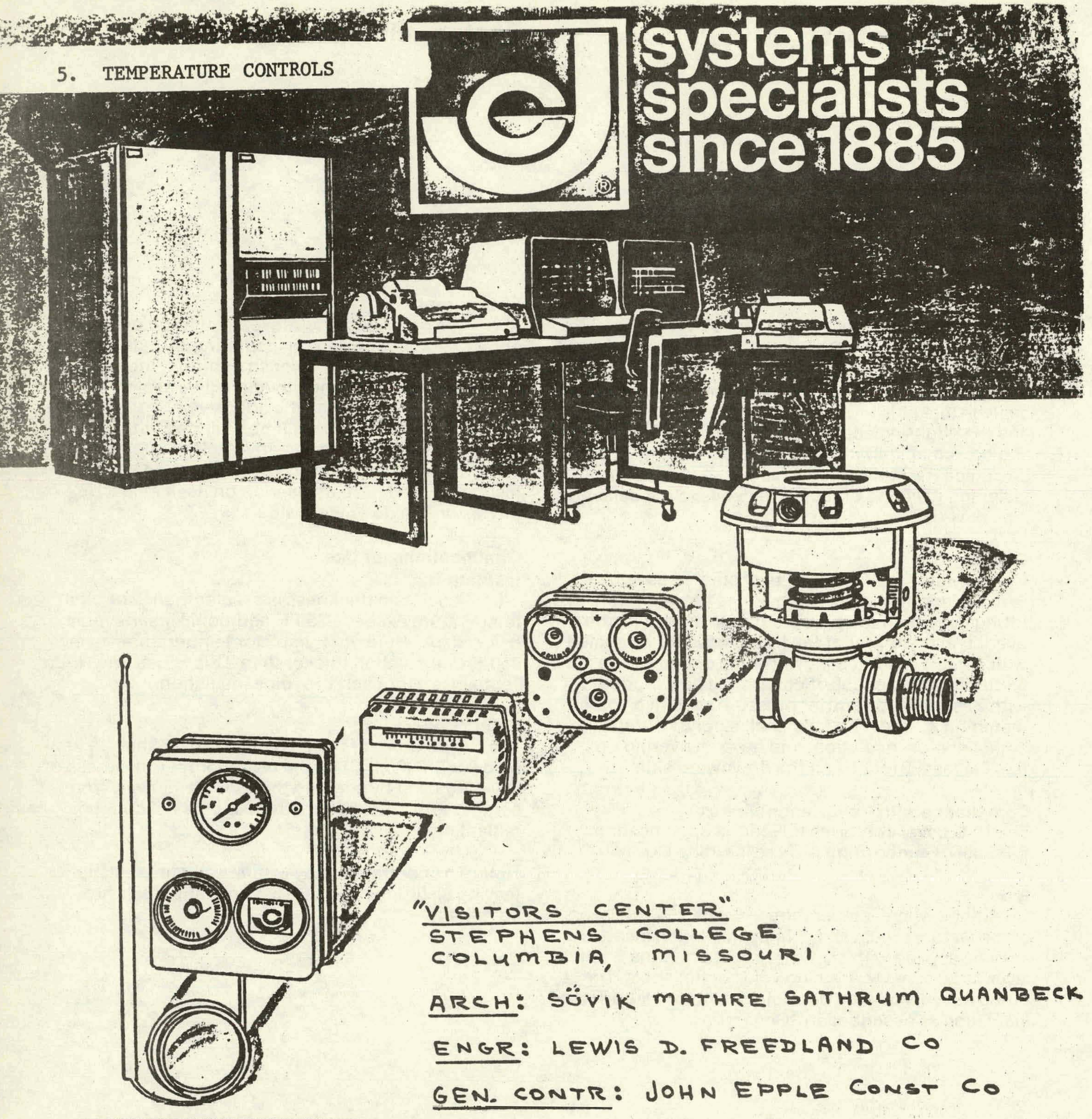
For Information on other J-M Thermal Insulations and Systems, Write the Johns-Manville Insulation Center, Drawer 17L, Denver, Colorado 80217 or Call (303) 979-1000.

The physical and chemical properties of Johns-Manville PVC Insulated Fitting Covers represent typical average values obtained in accordance with accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice. Numerical flame spread rating is not intended to reflect hazards presented by this or any other materials under actual fire conditions. Check the Johns-Manville district office to assure current information.

IND-4009 11-77

Litho in USA

5. TEMPERATURE CONTROLS



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MECH. CONTR: DRUMMOND-OFFICER

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FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR CORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 4/18/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

PROJ #7034-25

JOHNSON SERVICE COMPANY
Corporate Offices
Milwaukee, Wisconsin 53201

2128 S. HANLEY RD
ST. LOUIS MO 63144
(314) 645-0637

Product Data —— Catalog Section **Penn**
Issue Date **17J3** Series **A19ABC**

JOHNSON CONTROLS

Johnson Controls, Inc.
Penn Division

2221 Camden Court
Oak Brook, IL 60521

A19ABC
Electric Thermostat Direct Mounting or Bulb Element

The Penn A19ABC electric thermostats are for applications where a closed circuit is required for either a rise or fall in temperature. Models with 100 to 240F (37 to 110C) range are for applications where rapid water temperature changes occur; such changes occur, for example, in small fast-acting boilers in hot water heating systems. The liquid-filled temperature elements measure the slightest temperature change to assure rapid response to changes in the controlled variable.

These line voltage controls have single-pole, double-throw, snap-acting switches. The SPDT contact unit has color coded terminals, see Fig. 3. They have an adjustable differential and a range adjustment knob.

Mounting

The separable wells screw directly into a top or side tapping of a boiler or domestic hot water storage tank.

Installation

1. Drain the system to a level below tapping.
2. Remove separable well from the control by loosening set screws in the hex nut.
3. Place a small amount of pipe dope on the well threads to prevent leakage.
4. Turn well securely into the boiler tapping. CAUTION: Be sure that unobstructed depth is sufficient so well will not make metal-to-metal contact. The well must be completely submerged; avoid mounting where it might be partially above the operating liquid level or surrounded by an air pocket.
5. Insert the bulb into well applying a firm pressure to be sure the bulb is at bottom of well. Tighten the set screws.
    a. On remote bulb models, remove bushing from the separable well. Insert bulb into well. Slide bushing over capillary and push into well. Tighten set screws.

The remote bulb controls are mounted directly to a flat surface with screws through holes in back of case.

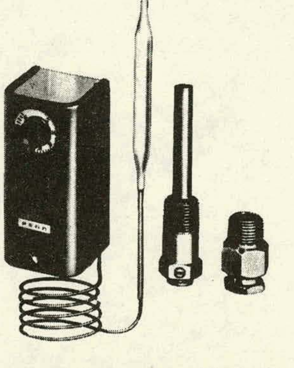


Fig. 2: Control with Remote Bulb Showing Well Assembly and 1/2" MPT Packing Nut.

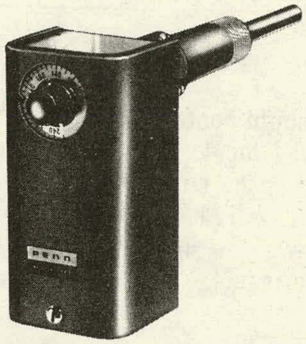


Fig. 1: Well Immersion Control for Direct Mounting

Specifications

CODE NUMBER	A19ABC-11	A19ABC-12	A19ABC-40
RANGE	100 TO 240F (37 TO 110C)	100 TO 240F (37 TO 110C)	30 TO 110F (-1 TO 43C)
DIFFERENTIAL (ADJ.)	6 TO 24F (3 TO 13C)	6 TO 24F (3 TO 13C)	3-1/2 TO 14F (1.6 TO 6.6C)
MAXIMUM ALLOWABLE BULB TEMPERATURE	290F (143C)	290F (143C)	140F (60C)
MOUNTING	DIRECT WELL IMMERSION	REMOTE WELL IMMERSION	REMOTE BULB MOUNTING
BULB AND ELEMENT	NO CAP. .290" X 2-1/2" BULB	6 FT. CAP. .290" X 2-1/2" BULB	6 FT. CAP. 3/8" X 5" BULB
KIND OF ACTION	RED TO YELLOW CLOSES ON TEMPERATURE INCREASE AND RED TO BLUE CLOSES ON TEMPERATURE DECREASE		
CONTACT UNIT	SPDT, SNAP-ACTING		
CONDUIT OPENING	COMBINATION KNOCKOUT FOR 1/2" OR 3/4" CONDUIT IN BOTTOM OF CASE		
CASE	.063 COLD ROLLED STEEL WITH GRAY BAKED ENAMEL FINISH		
COVER	.025 COLD ROLLED STEEL WITH GRAY BAKED ENAMEL FINISH		

PRINTED IN U.S.A.

Penn-Baso Product

Electrical Ratings

MOTOR RATINGS	120 Volts	240 Volts
A.C. Full Load Amps	10.0	6.0
A.C. Locked Rotor Amps	60.0	36.0
A.C. Non-Inductive Amps	10.0	6.0
Pilot Duty – 125VA – 24 to 600V A.C.		

Wiring

All wiring should conform to the National Electrical Code and local regulations. Wire as shown in Fig. 3. Red is the common terminal. CAUTION: Use No. 8-32 x 1/4" terminal screws. Longer terminal screws can interfere with switch mechanism and damage the switch.

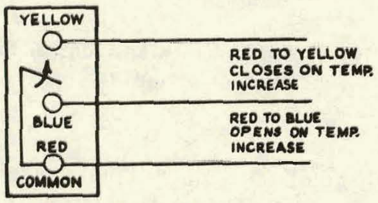


Fig. 3: Diagram Showing Terminal Identification.

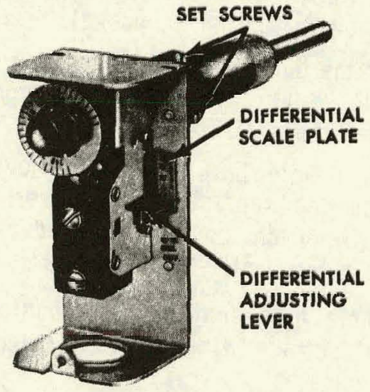


Fig. 4: Interior View Showing Differential Adjusting Lever and Well Assembly Set Screws

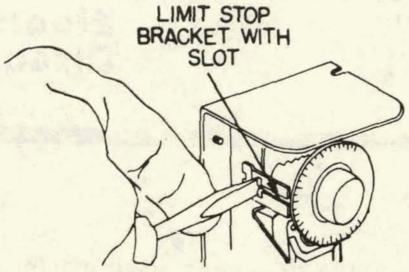


Fig. 5: Sliding Stop to Front of Control to Set High Limit Stop

Adjustments

Dial settings normally indicate the cutout setting. The controls are calibrated so the dial pointer indicates the temperature at which the red to blue contacts open on a rise in temperature.

Rotate the adjusting knob to raise or lower both the cutout and cut-in settings. The controls have a differential scale plate with multipliers as shown, see Fig. 4. For example, when "Min." differential is 6F°, then x 2 is 12F°, x 3 is 18F°, and x 4 is 24F°, the maximum differential possible. The adjusting lever is set at the minimum differential stamped on the control. To adjust, move the lever to the differential required.

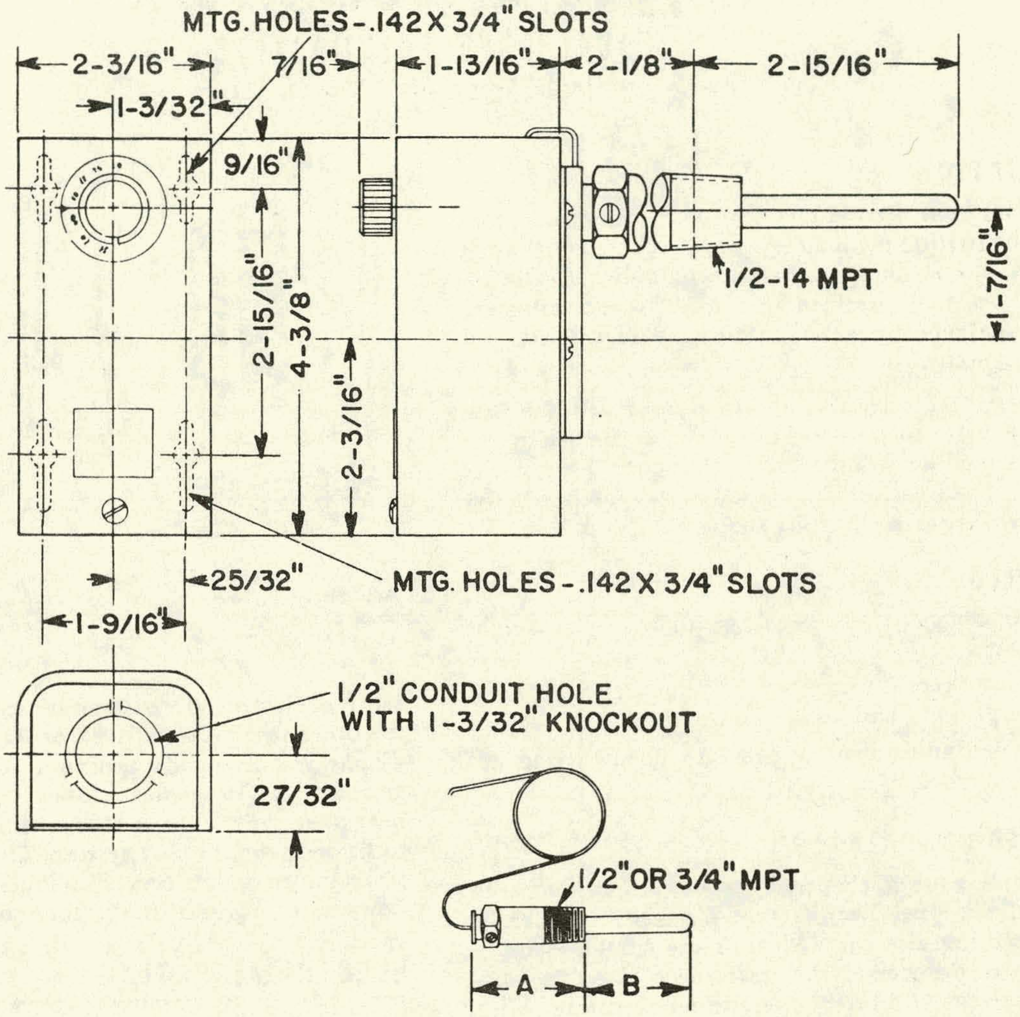
High Limit Stop

The high limit stop is an integral part of these controls and can be field adjusted. To set high limit stop, proceed as follows:

1. Set dial to temperature at which stop is desired.
2. Remove control cover.
3. Slide dial stop to front of control (toward dial) against step behind dial, see Fig. 5.

NOTE: *Sometimes an exact setting is not possible and the stop must be set to the closest step corresponding to the dial setting.*

Dimensions


MTG. HOLES - .142 X 3/4" SLOTS
2-3/16"
7/16"
1-13/16"
2-1/8"
2-15/16"
1-3/32"
9/16"
2-15/16"
4-3/8"
2-3/16"
1/2-14 MPT
1-7/16"
25/32"
1-9/16"
MTG. HOLES - .142 X 3/4" SLOTS
1/2" CONDUIT HOLE
WITH 1-3/32" KNOCKOUT
27/32"
1/2" OR 3/4" MPT
A
B

PENN

BASO

PENN CONTROLS

DIVISION OF JOHNSON SERVICE COMPANY

types A19FBC, A28FA

DUAL BULB THERMOSTATS

(Single Stage and Two Stage)

APPLICATION

These dual bulb thermostats are for outdoor reset control of the heating medium. As the outdoor temperature decreases, the medium temperature is automatically increased by a predetermined amount. This maintains the selected balance between heating requirements and heating capacity.

Thermostats are offered with different ratios (the relationship between outdoor temperature change to the resulting medium temperature change). This meets operating requirements for various types of hot water and forced warm air heating systems.

FEATURES

- Dependability . . . snap-acting contacts in dust-tight enclosure.
- Precision "repeat" accuracy . . . unaffected by barometric pressure and cross ambient problems.
- Concealed adjustment discourages unauthorized adjustment changes.

GENERAL DESCRIPTION

Temperature sensing elements are of the solid charge (liquid filled) type. Temperature increase, at either of the two sensing elements, expands the liquid to move a diaphragm member at the instrument case. The diaphragm movement directly operates an electrical switch through a constant load pivot mechanism.

The two sensing elements are integral parts of a common thermal system. A temperature decrease at one sensing element necessitates a temperature increase at the other sensing element in order to maintain the same diaphragm or switch position. So, as the temperature at the outdoor sensing element decreases, an increase in temperature at the indoor sensing element must occur to balance the thermal system. The increase in medium temperature which occurs as outdoor temperature goes down is a function of the thermostat.

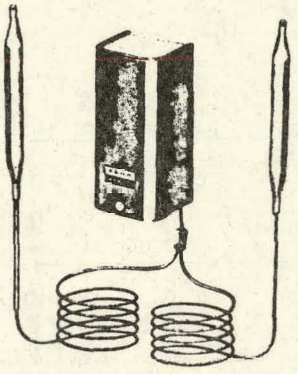


Fig. 1 — Exterior view of dual bulb thermostat with direct immersion indoor bulb.

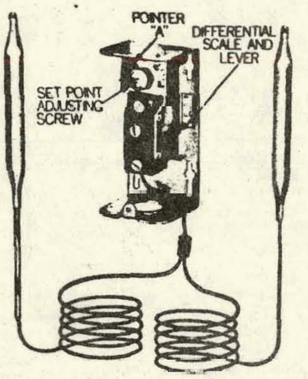


Fig. 2 — Interior of Type A19FBC. Note set point adjusting screw and differential adjusting lever.

ELECTRICAL RATINGS

Motor Rating (A.C. Only)	120 V.	240 V.
Full Load Amps.	10.0	6.0
Locked Rotor Amps.	60.0	36.0
Pilot Duty — 125 VA. at 120/240 V. A.C.		

SELECTION TABLE

Product Number		Reset Ratio †	Type of Indoor Bulb	Bulb Size		Capillary Length	
1 Stage	2 Stage			Indoor	Outdoor	Indoor	Outdoor
A19FBC-2	A28FA-2	1:1	Averaging	3/32" x 14½ ft.	3/8" x 3¼"	10'	20'
A19FBC-4	A28FA-4		Liquid Immersion * or Air	3/8" x 3¼"	3/8" x 3¼" **	10'	30'
A19FBC-1	A28FA-1	1:1½	Averaging	3/32" x 14½ ft.	3/8" x 4 3/16"	10'	20'
A19FBC-6	A28FA-6		Liquid Immersion * or Air	3/8" x 3¼"	3/8" x 4 3/14" **	10'	30'
A19FBC-3	A28FA-3	1½:1	Averaging	3/32" x 14½ ft.	3/8" x 2⅝"	10'	20'
A19FBC-5	A28FA-5		Liquid Immersion * or Air	3/8" x 3¼"	3/8" x 2⅝" **	10'	30'

† Outdoor change to medium change.

* For Liquid Immersion, specify Part No. FTG13A-600 Closed Tank Connector or WEL14A-602 Bulb Well.

** Includes Part No. SHL10A-600 Weather Shield.

SPECIFICATION TABLE

Range	Differential		Maximum Temperature	
	1 Stage	2 Stage	Shipping & Storage	Overrun
60 to 140° F.	7 to 28° F. (Adjustable)	7° F. each stage (Fixed) 2 to 7° F. Interstage (Adj.)	140° F.	Total of indoor and outdoor bulb temperatures must not exceed 300° F.

APPARATUS BULLETIN **A-2000**

07JCI

JOHNSON CONTROL

DESIGN • MANUFACTURE • INSTALLATION

JOHNSON SERVICE COMPANY

MILWAUKEE, WISCONSIN AND PRINCIPAL CITIES

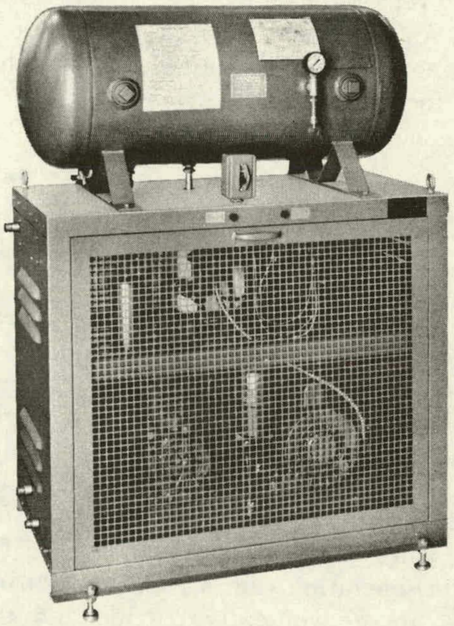
Johnson A-2000 Instrument Air System

¼ thru 1½ h p

The Johnson A-2000 is a factory assembled, complete instrument air supply unit. It consists of an air compressor, aftercooler, air filter, drain trap, single air pressure reducing station, pressure switch, and optional safety devices all mounted within a vented metal housing. Sizes from 1/4 through 1-1/2 hp are available. A 30 gallon ASME approved air tank and the starter switch are mounted on top of the housing. The entire unit is completely factory wired and piped with all air outlet and drain connections accessible at the outside of the cabinet. Four leveling legs and two rigging hooks are provided.

An aftercooler bypass, recommended for all aftercooler installations, is provided with this unit. The bypass is manually operated, and is used in case the aftercooler is to be removed for service. An interlock is provided between the compressor and the aftercooler to prevent the compressor from starting without running the aftercooler; it will also keep the aftercooler running after the air compressor has been stopped.

An unloading feature on 1/2 thru 1-1/2 hp compressors assures loadless starting. Oil entrainment is minimized with the use of side sealer piston rings, low compressor speeds which keep head temperature at a reduced level and the high flash point of the special lubricating oil. An oil dip stick, conveniently located on all models, makes it easy to check for proper oil level. If oil is to be added or changed, drains and filler ports are also conveniently located.



Snap acting DPST pressure switches, factory calibrated to close at 70 psi and open at 90 psi, are provided on all models; models 1/2 thru 1-1/2 hp are furnished with an unloader feature. A pop safety valve on each model is factory set at 110 psi.

The mounting base on all models has a V-belt tension adjustment to aid in maintaining proper compressor and motor alignment while adjusting the tension.

Clean air is assured by minimizing oil entrainment and by using a 10 micron intake filter with a replaceable cartridge. Long life of the check valve is assured by using a coiled discharge line from the compressor to reduce the operating temperature.

MODEL	HP	COMP. RPM	CFM @80 psi	NUMBER OF CONTROL UNITS *	NET WEIGHT (LBS.)
A-2025	¼	625	0.82	47	390
A-2050	½	470	1.50	86	425
A-2075	¾	620	2.68	154	425
A-2100	1	520	3.40	196	440
A-2150	1½	720	4.70	270	445

* Based on 50% running time.

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All components of the A-2000 are completely accessible by removing the front or back panel. Four thumb screws are used to hold the panels in place. The components are placed within the enclosure so that any necessary repairs or replacements can easily be made. An additional air pressure reducing station can be field installed, within the housing, for dual pressure systems.

All motors are 40C ° rise, NEMA, B, L or N design, continuous duty, and are available for 115 and 230 volt 60 Hz single phase or 208/220/440 volt 60 Hz three phase operation. The 1/4 and 1/2 hp motors are factory wired for 115 volts, but may be field rewired for 230 volts. The 3/4, 1, and 1-1/2 hp single phase motors are factory wired for 230 volts and may be field rewired for 120 volts. All three phase motors are factory wired for 208/220 volts, and may be field rewired for 440 volts operation. In all cases, wiring diagrams are conveniently provided on the tank. Follow the instructions on each motor when changing motor voltages. Single phase motors have built-in overload protection and a DPST disconnect switch. Three phase motors have a manual starter and require overload heaters that must be furnished locally.

Two alarm lights are available, both with the press-to-test feature, to immediately indicate a malfunction, if one should occur. One alarm will be actuated if the automatic drain fails to function. The other alarm will be actuated by a high temperature thermostat mounted on the drain leg of the heat exchanger. The alarm light will be energized whenever the aftercooler is not running, or when the temperature of the drain leg rises to approximately 65F.

Mounting

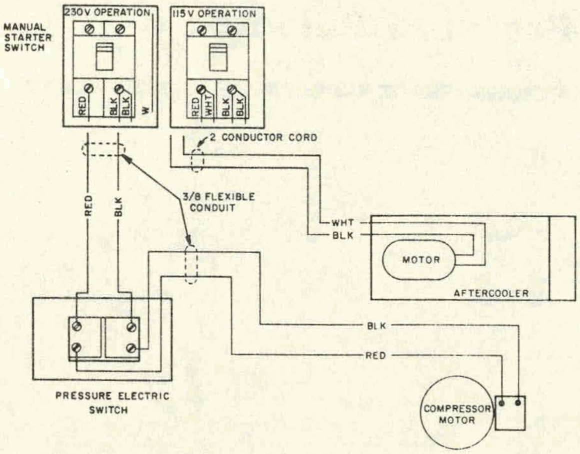
The A-2000 is designed as a free-standing unit. Two rigging hooks are provided at the top of the unit to facilitate movement; hand holes are provided in both side panels and should be used when moving the unit, after removing it from the case. Leveling legs are provided on all four corners to level the unit in each direction; when the A-2000 is properly leveled, it does not require floor anchors. Adequate space should be left on all sides of the unit for service and maintenance and to assure free air circulation over the components. Space must be allowed for piping the unit to the instrument piping.

ELECTRICAL RATINGS

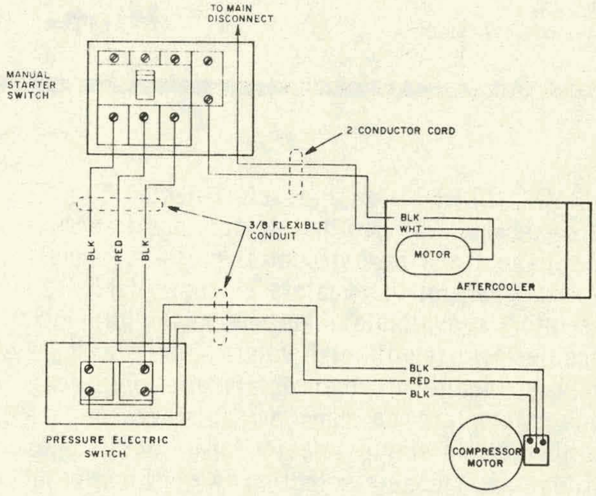
Maximum NEC Full Load & Locked Rotor Current for A.C. Motors (Amperes)*

AIR COMP. HP RATING	SINGLE PHASE				THREE PHASE					
	115V		230V		208V		220V		440V	
	FULL LOAD	LOCKED ROTOR	FULL LOAD	LOCKED ROTOR	FULL LOAD	LOCKED ROTOR	FULL LOAD	LOCKED ROTOR	FULL LOAD	LOCKED ROTOR
¼	5.8	29	2.9	15	1.2	7.5	1.1	6.0	.55	3.0
½	9.8	58.8	4.9	29.4	2.1	12.7	2	12	1	6
¾	13.8	82.8	6.9	41.4	3	17.8	2.8	16.8	1.4	8.4
1	16	96	8.0	48	3.7	22	3.5	21	1.8	10.8
1½	20	120	11	60	5.3	31	5	30	2.5	15

* Maximum Possible Motor Amperage recognized by National Electrical Code.

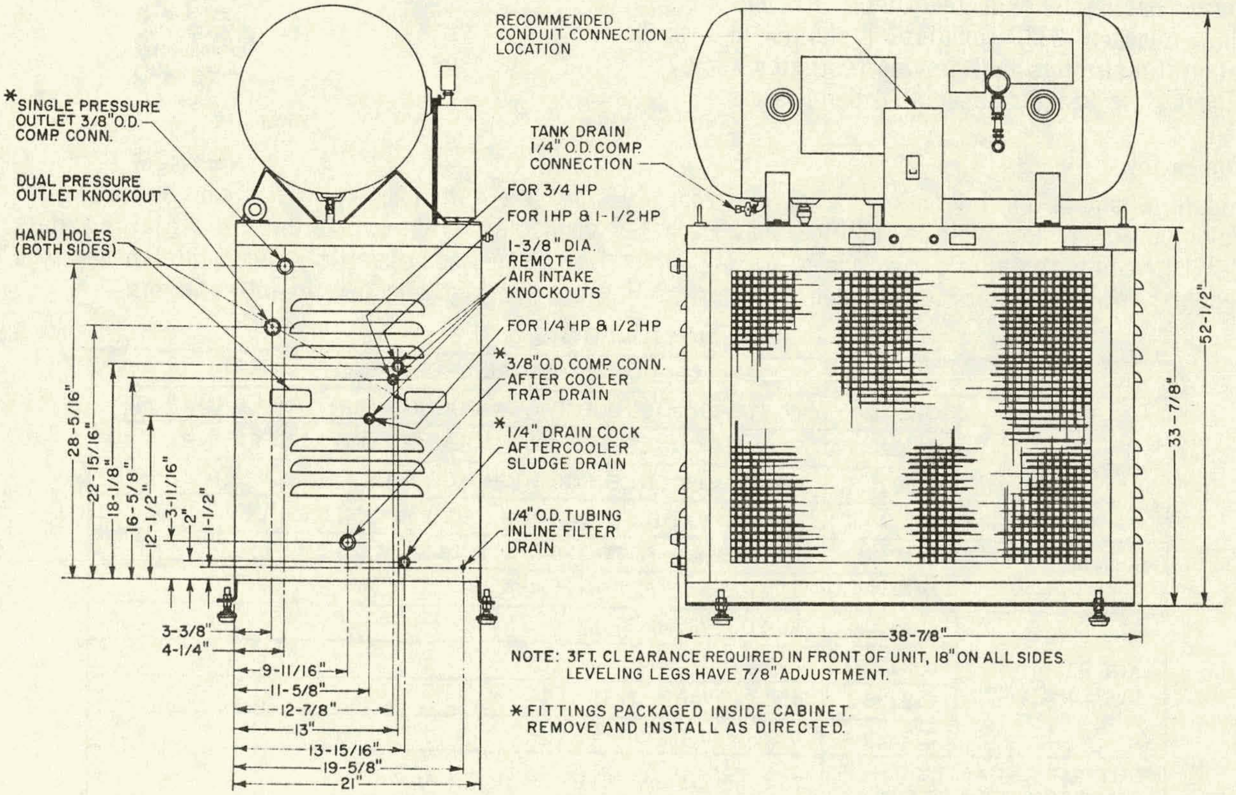


Wiring Diagram for Single-Phase Connections Less Safety Devices



Wiring Diagram for Three-Phase Connections Less Safety Devices

Dimensions



NOTE: 3FT. CLEARANCE REQUIRED IN FRONT OF UNIT, 18" ON ALL SIDES.
LEVELING LEGS HAVE 7/8" ADJUSTMENT.

* FITTINGS PACKAGED INSIDE CABINET.
REMOVE AND INSTALL AS DIRECTED.

Product Data — Catalog Section C
Issue Date 57J4 Series 2220

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

C-2220
High-Low Pressure Selector

The C-2220 High-Low Pressure Selector, Fig. 1, is a pneumatic device that selects and transmits the highest and lowest control pressure signals from a group of thermostats or controllers. The selector is available in either master or slave modules for use with high volume (relay) and low volume (non-relay) thermostats or controllers. One master and as many as 19 slaves can be combined in a single selector for up to 20 zones of high-low pressure selection. A combination of high and low volume modules can also be used in the same selector for applications involving both high and low volume thermostats. In all cases however, the appropriate C-2220 module must be chosen for proper operation with the corresponding type of thermostat or controller. Low volume C-2220 modules are furnished with integral restrictors that provide restricted supply air pressure to their associated thermostats.

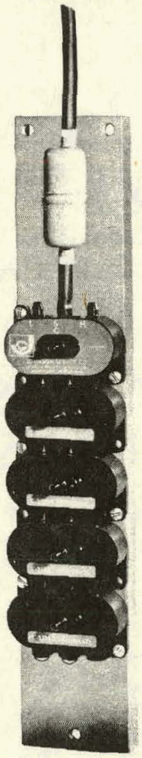


Fig. 1: C-2220 Selector on C-2220-5 Mounting Base

Operation

Figure 2 shows an internal view of a 3-zone selector for a low volume application. Each C-2220 module contains a high and a low signal repeater. When modules are coupled together to form the selector, the high signal repeaters are connected in series and the low signal repeaters are connected in parallel. These interconnections form the high and low signal selectors.

Specifications

PRODUCT		C-2220 HIGH-LOW PRESSURE SELECTOR
MODELS	C-2220-1	MASTER MODULE FOR LOW VOLUME CONTROLLER INPUT
	C-2220-2	SLAVE MODULE FOR LOW VOLUME CONTROLLER INPUT
	C-2220-3	MASTER MODULE FOR HIGH VOLUME CONTROLLER INPUT
	C-2220-4	SLAVE MODULE FOR HIGH VOLUME CONTROLLER INPUT
SIGNAL LIMITS	OUTPUT	1 TO 19 psig (7 TO 135 kPa) @ 25 SCIM (25 dm ^{3}/h)
	INPUT	0 TO 25 psig (0 TO 175 kPa)
AIR CONSUMPTION	C-2220-1	60 SCIM (60 dm ^{3}/h)
	C-2220-2	20 SCIM (20 dm ^{3}/h)
	C-2220-3	40 SCIM (40 dm ^{3}/h)
	C-2220-4	0 SCIM (0 dm ^{3}/h)
OUTPUT CAPACITY (MASTER MODULES ONLY)		25 SCIM (25 dm ^{3}/h) EACH (HIGH AND LOW)
SUPPLY PRESSURE		20 psig (140 kPa); 25 psig (175 kPa) MAXIMUM
MATERIAL		POLYSULFONE PLASTIC
AIR CONNECTIONS		BARBED FITTINGS FOR 1/4 IN. O.D. POLYTUBING
AMBIENT TEMP. LIMITS		0 TO 125F (-18 TO 52C)
ACCESSORY (ORDER SEPARATELY)		C-2220-5 MOUNTING BASE KIT FOR 1 MASTER AND UP TO 5 SLAVES

Through the use of the C-2220 high-low pressure selector, heating and cooling are delivered to the zones with the greatest demand. Heating cool air or cooling heated air, which may occur in double-duct and multizone systems, is minimized.

Mounting

C-2220 modules are assembled by pressing the three parallel barbed fittings of the first slave module into the parallel receptacles of the master module. Slave modules likewise have receptacles to accept the barbed fittings of succeeding slave modules. Up to 19 slaves can be interconnected in this manner, providing a maximum capacity selector of 20 zones.

Master C-2220 modules are furnished with an externally connected air filter, two vinyl plugs and two small round head screws. The filter is connected into the supply air line and the vinyl plugs are used with the small screws to block off the "supply" and "low signal" receptacles of the last slave module. These plugs can be easily removed and replaced if the number of modules is expanded at a later time.

Two 5/32" holes are provided in each C-2220 module for base mounting with #6 sheet metal screws. To anchor a selector to a rigid flat surface, it is generally necessary to secure only the master, every second slave and the final slave module. Refer to Fig. 3 for dimensions and tubing connection identifications.

Accessory

A mounting base kit is available which contains a channel to support one master and up to five slaves. This kit can be used to provide a rigid flat surface for an installation where such a surface is not readily accessible or where prefabricated mounting is desirable.

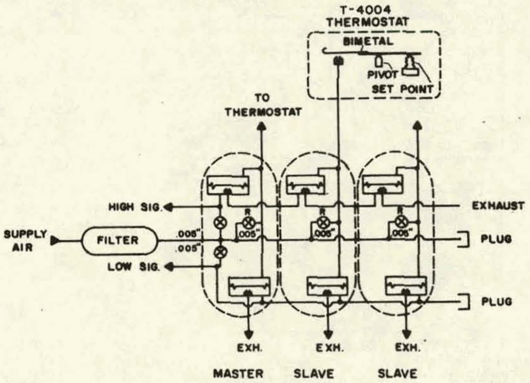


Fig. 2

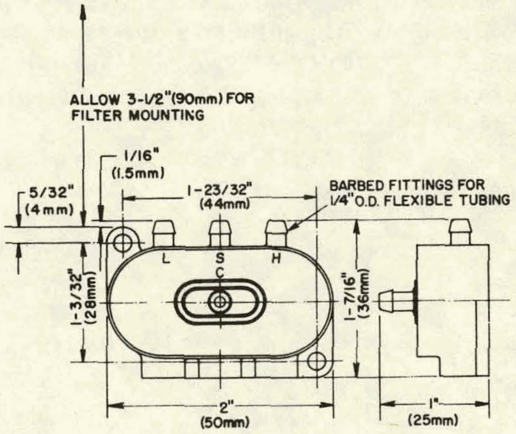


Fig. 3

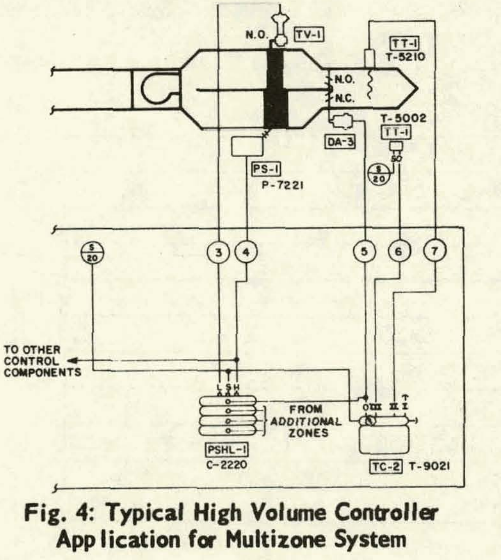


Fig. 4: Typical High Volume Controller Application for Multizone System

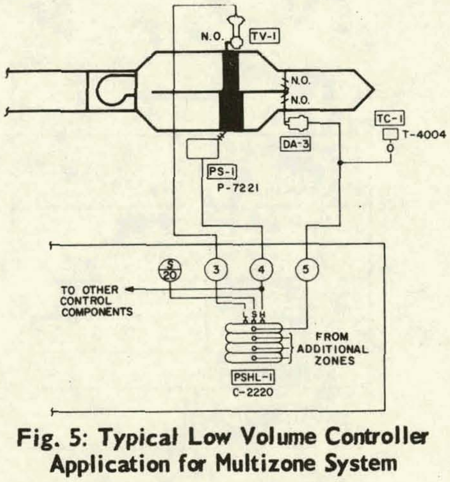


Fig. 5: Typical Low Volume Controller Application for Multizone System

Johnson Controls, Inc.
507 E Michigan Street
P O Box 423
Milwaukee WI 53201

C-5226
Pneumatic Signal Transmitter

The Johnson C-5226 Signal Transmitter (Fig. 1) is a multipurpose pressure operated repeater/selector. In application, the C-5226 is used to repeat pneumatic transmission signals (Fig. 3) or to select the higher (Fig. 4) or lower (Fig. 5) of two pneumatic signal levels directly from the output of a controller.

The C-5226 Signal Transmitter operates at a 1:1 ratio to compensate for pressure drops and time lags inherent in long pneumatic transmission lines. Due to the minimum hysterisis characteristic, it will accurately reproduce the output of a pneumatic transmitter. It will provide additional capacity for a pneumatic transmitter with input to several T-9000 controllers.

As shown in Figs. 4 and 5 respectively, several C-5226 Signal Transmitters can be connected in series to transmit the highest of several pilot pressures or in parallel to transmit the lowest of several pilot pressures.

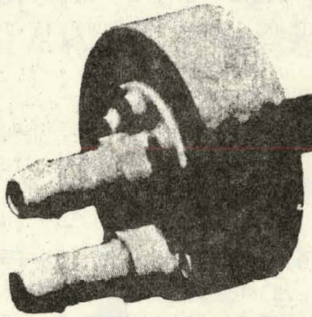


Fig. 1: C-5226 Signal Transmitter

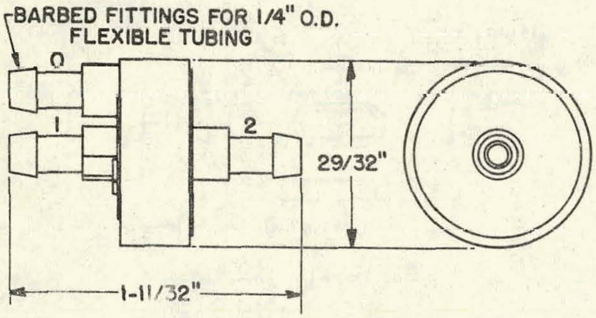
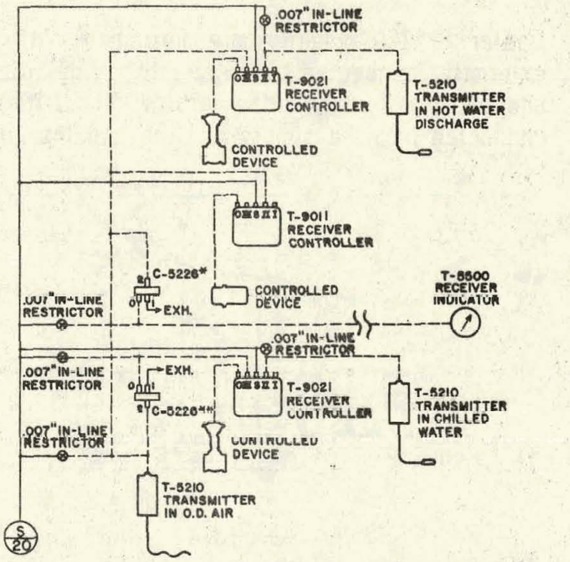


Fig. 2: C-5226 Dimensions



*C-5226 compensates for time lag and pressure drop from long transmission line.

**C-5226 provides additional capacity for pneumatic transmitter.

Fig. 3: C-5226 Used as a Repeater

Specifications

PRODUCT		C-5226 SIGNAL TRANSMITTER
ACTION		PROPORTIONAL – DIRECT
RATIO		1:1
MOUNTING		IN-LINE
MAXIMUM PRESSURE		25 psig
AMBIENT TEMPERATURE		40 TO 120F (5 TO 50C)
MATERIAL	BODY	POLYSULFONE PLASTIC
	DIAPHRAGM	SILICONE RUBBER
CONNECTIONS		BARBED FITTINGS FOR 1/4" FLEXIBLE TUBING
ACCESSORIES		EXTERNAL RESTRICTOR .007" (T-5210-100) OR .005" (T-4004-9)

Performance specifications are nominal and are subject to accepted manufacturing tolerances and application variables.

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Installation

The C-5226 Signal Transmitter is an in-line device; it is mounted directly in and supported by the flexible tubing connections. All connections are made to 1/4" barbed fittings. Refer to Fig. 2 for dimensions and tubing connection identifications.

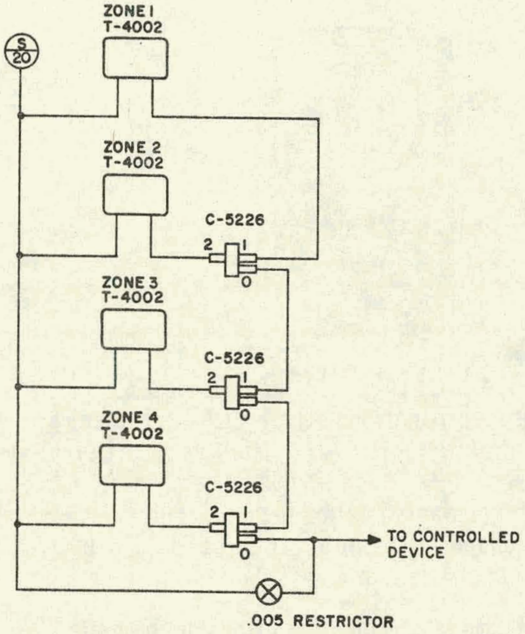


Fig. 4: High Pressure Selector with C-5226 Transmitters Connected in Series

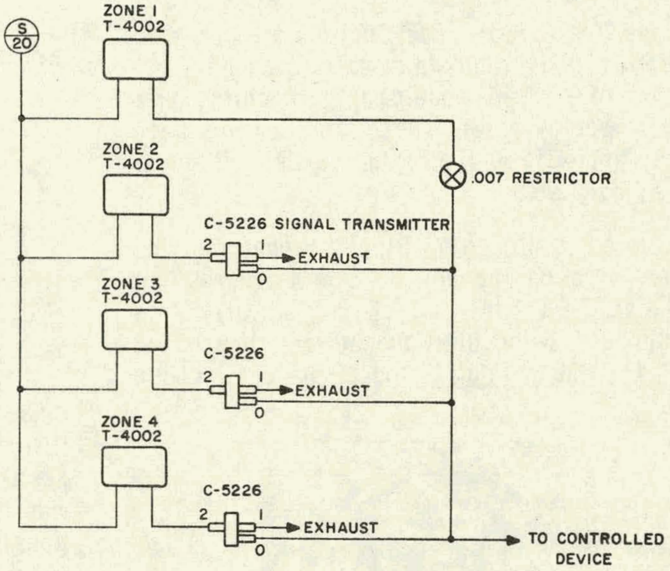
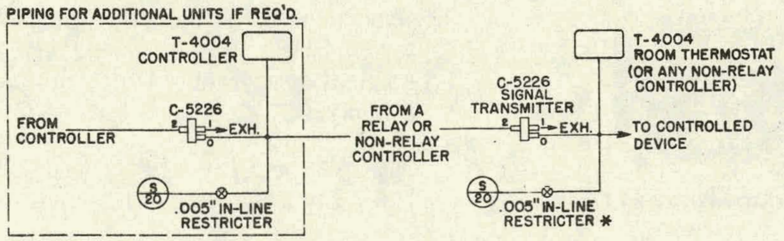
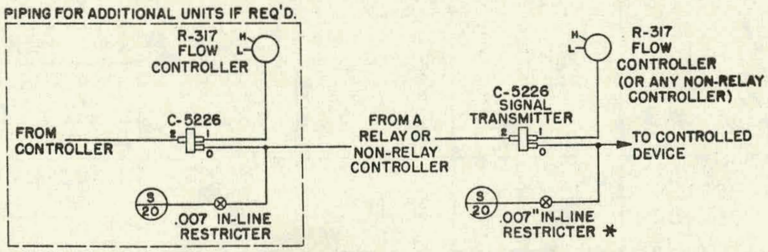


Fig. 5: Low Pressure Selector with C-5226 Transmitters Connected in Parallel



*Restrictor size depends on controller used.

Fig. 6: C-5226 Used as a Low Pressure Selector when one of the Controllers is Non-relay



*Restrictor size depends on controller used.

Fig. 7: C-5226 Used as a High Pressure Selector when one of the Controllers is Non-relay

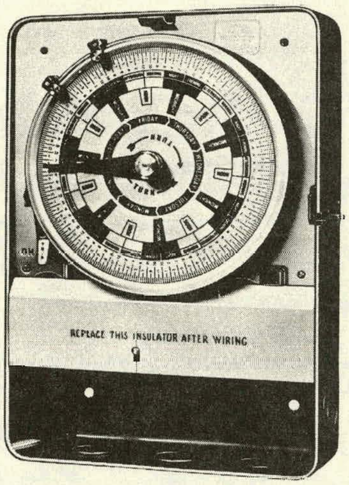
JOHNSON CONTROLS

Johnson Controls, Inc.
507 E Michigan Street
P O Box 423
Milwaukee WI 53201

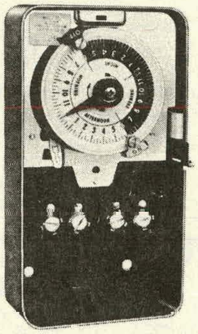
C-7351 Time Controls

The Johnson C-7351 Time Controls are designed for applications where automatic switching operations of electrical equipment is required on a daily or weekly basis. These time controls have C.S.A. approval and are Underwriters' Laboratories, Inc. listed.

Circuits are switched by trippers mounted at the desired time on the edge of the large rotating time dial. To set the correct time, simply rotate the dial clockwise until the correct time is indicated at the pointer. Trippers are color coded for positive identification; silver "On" and black "Off". The dial is marked with "Morning", "Afternoon", "Evening", and "Night" segments. A manual trip mechanism allows the circuit to be transferred ahead of the automatic schedule without disturbing the rest of the schedule.



7 Day Model in Surface Mounted Case



24 Hr. S.P.D.T. Model

Contacts are made of cadmium alloy for long life and are rated for 40 amps, non-inductive per pole at 120, 208-240 or 277 volts; 690 VA pilot duty or 1 hp for 1 pole only. Connections are made at convenient terminals. The clock mechanism is powered by a 120 volt 60 Hz synchronous motor. Ambient temperature limits are -40F (-40C) to 248F (120C).

One 7-day and two 24-hour models are available. The 7-day model is available with an electrically

CODE NO. C-7351	MODEL	CONTACTS*	TRIPPERS FURNISHED	MINIMUM INTERVAL	CLOCK MOTOR	CASE	FEATURES
–1	7 DAY	4 POLE (2 N.O. - 2 N.C.)	7 ON 7 OFF	3 HR.	120V 60 Hz	MOVEMENT ONLY	—
–2						SURFACE	
–3						MOVEMENT ONLY	SPRING RESERVE
–4						SURFACE	
–5	24 HR.	4 POLE (2 N.O. - 2 N.C.)	1 ON 1 OFF	90 MIN.	120V 60 Hz	MOVEMENT ONLY	SKIP-A-DAY DEVICE
–6						SURFACE	
–9	24 HR.	S.P.D.T.	1 ON 1 OFF	90 MIN.	120 V, 60 Hz	SURFACE	—

*Contacts rated 40 amps at 120V, non-inductive.

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wound 10-hour spring reserve feature that will maintain switching schedules in case of a power failure. The spring is automatically rewound when power is restored, at the rate of 2 hours for each one hour of power failure.

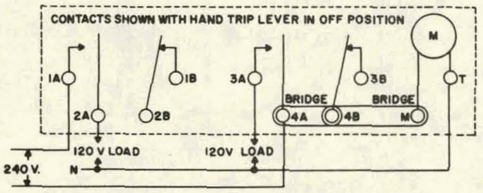
The 24-hour, 4-pole model is furnished with a skip-a-day feature that allows up to 6 days to be skipped from the daily switching schedule. Days are skipped by inserting pins in the skip-a-day device for the desired day(s).

Three bridges are supplied with the 7-day and 24-hour, 4-pole models, and are used to provide the various switching arrangements shown.

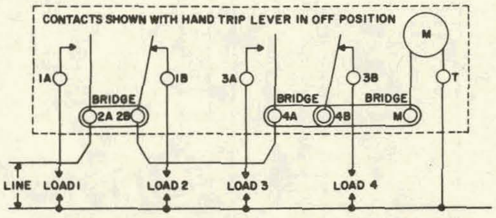
Mounting

All time controls are available in surface mounted, grey crinkle finish, compact cases with latches, or movement only for mounting in M-8000 control cabinets. Flush mounted cases are available for 7-day and 24-hour, 4-pole models. A mounting bracket is available for mounting the movement only. All movements snap into the cases and mounting brackets, no tools are required. Cases have 1/2 in. and 3/4 in. conduit knockouts.

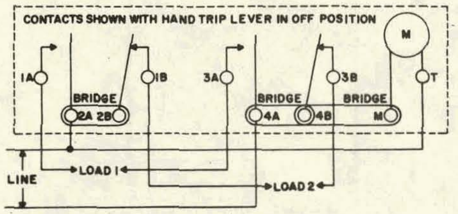
Typical Wiring Diagrams



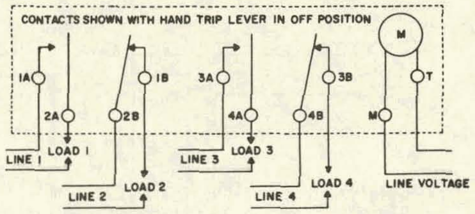
4 Pole Model: D.P.S.T. 3 Wire with 120 Volt Motor



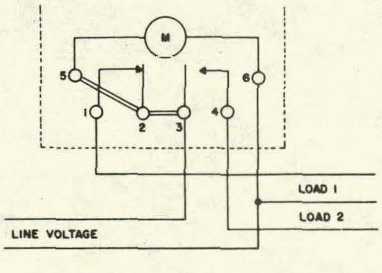
4 Pole Model: D.P.D.T. One Side of Line Common to Switches and Motor



4 Pole Model: Double Break Two Loads – One Load "OFF" When Other Load "ON." Common Motor Voltage

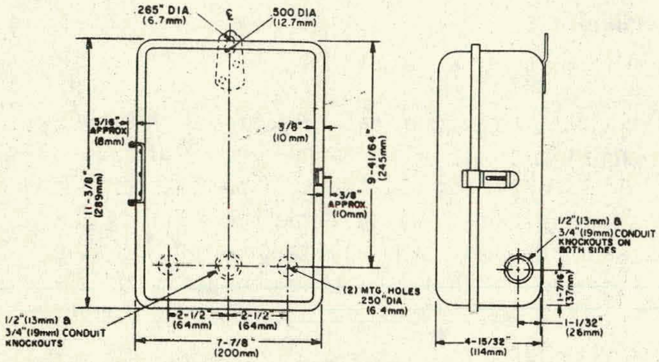


4 Pole Model: Four Loads Controlled – Two Switched "ON" as Two Switched "OFF." All Loads Have Separate Voltages

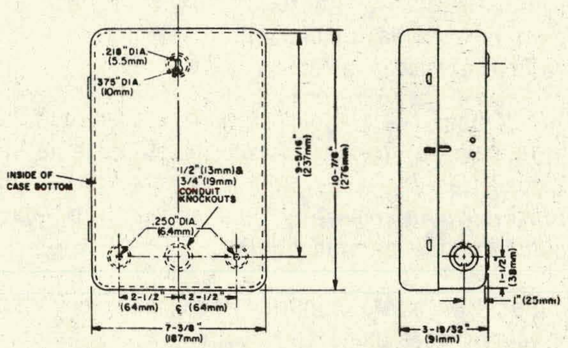


S.P.D.T. Model: Controlling Two Loads. Common Motor Voltage

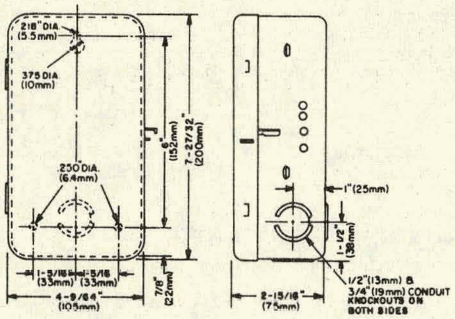
Dimensions



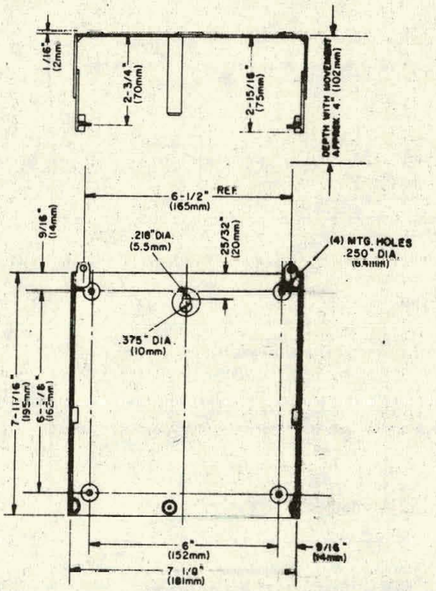
Indoor-Outdoor Case for 4 Pole Models With Spring Reserve



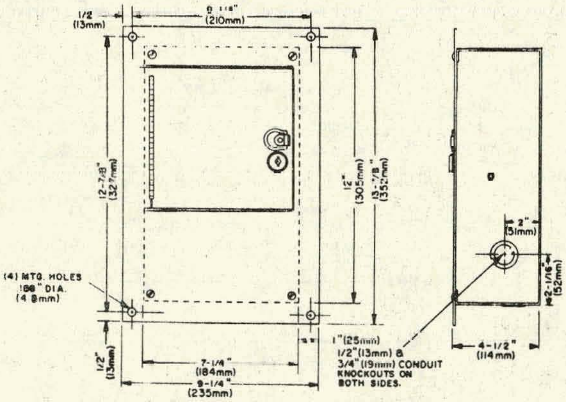
Case for 4 Pole Models Without Spring Reserve



Case for S.P.D.T. Model



Mounting Bracket for all 4 Pole Models



Flush Mounted Case for all 4 Pole Models

Product Data —— Catalog Section C
Issue Date 57J3 Series 7510

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

C-7510 Optimal Start Controller for Pneumatic Night Setback Temperature Control System

The C-7510 Optimal Start Controller is a pneumatic-electric device designed to be used with a pneumatic night setback and morning warm-up system of controlling building temperatures. It automatically delays the morning start-up of heating and ventilating systems until they are actually needed for proper conditioning of a space prior to occupancy. Significant energy savings can result from optimal heating start-up. Energy savings include both heating fuel and electrical energy used to operate the ventilating equipment.

The C-7510 is designed for use with a 7-day programmable clock* (C-7351) and 100F° span, -20 to 80F range pneumatic temperature transmitter (T-5210).

***If an existing system 7-day clock is used:**

1. **Clock must have full 7-day programming capability.**
2. **Clock must have available at least one pair of dry contacts.**
3. **Clock must already be in use for the HVAC day-night control and be compatible with the C-7510 program time schedule.**
4. **If all conditions (1, 2 and 3 above) do not exist, a separate 7-day clock must be provided.**

Operation

The C-7510 has a toggle switch provision for selection of either manual or automatic mode. When set on automatic, the C-7510 controls the morning start-up of heating and ventilating systems through the operation of its heating start switch and damper switch respectively. Two, independently adjustable, cams that rotate on the same 24 hr clock shaft, provide a daily sequence for activation of the two 120 volt switches. The external 7-day clock sequences the night cycle operation of the system and a single dry pair of contacts in the clock programs the C-7510 for morning warm-up control and day cycle operation.

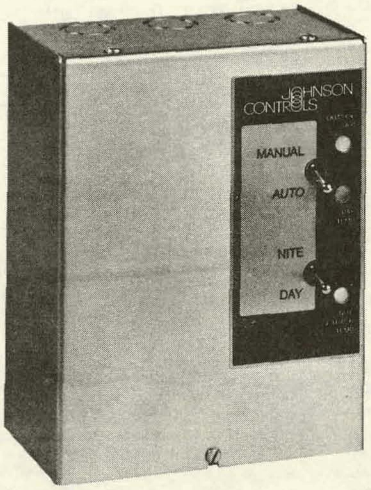


Fig. 1: C-7510 Optimal Start Controller

The damper switch has a direct mechanical linkage to the damper cam so that its contacts will transfer at the same time each day to open the outside air dampers to admit fresh air into the building in accordance with the system schedule. The heating start switch is mechanically linked to the "U" factor cam which affects

Specifications

PRODUCT		C-7510 OPTIMAL START CONTROLLER
OPERATING VOLTAGE (SYNCHRONOUS CLOCK)	C-7510-1	120 VOLTS ± 10%, 60 Hz
	C-7510-2	120 VOLTS ± 10%, 50 Hz
"U" FACTOR SET POINT RANGE		0.10 TO 0.30 BTU/HR FT² F° (0.60 TO 2.0 W/m² C°)
MAXIMUM OUTPUT LOAD (RESISTIVE)		5 AMPERES, 120 VOLTS A.C.
AMBIENT TEMPERATURE LIMITS		0 TO 130F (-18 TO 54C)
ACCESSORIES (ORDER SEPARATELY)		EXTERNAL PROGRAMMABLE 7-DAY CLOCK
		OUTSIDE AIR TEMPERATURE TRANSMITTER WITH 100F° SPAN

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the system start-up time. This start-up time is controlled by the optimal start mechanism which is under the influence of two independent factors, the outside air temperature and the building "U" factor (heat transfer coefficient). This mechanism essentially compares a variable outside temperature factor to a fixed building "U" factor and causes a delay in the morning start-up of the heating equipment. The curve of Fig. 2 illustrates a typical delay schedule provided by the optimal start-time mechanism. As shown in the curve, as the temperature approaches 60F, a shorter lead time is required for morning start-up of the heating equipment. The maximum lead time for any morning warm-up schedule will not exceed 4 hours. This lead time is set on the external 7-day program clock by placing the "ON" tripper 4 hours ahead of the occupancy time.

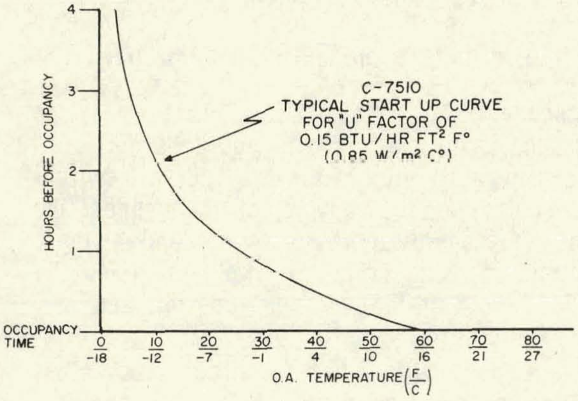


Fig. 2

"U" Factor

The building "U" factor is determined by the exterior wall construction and is defined as the amount of heat energy (Btu/ft^2 hr F°) transferred thru the wall. In most recently constructed buildings, the wall "U" factor is part of the building specification and may be used in determining the C-7510 "U" factor set point. If the "U" factor is not available, Chart I may be used as a starting point in making the "U" factor determination. The "U" factors listed in the chart for all masonry walls can be used directly as the C-7510 set point. "U" factors for metal curtain walls must be adjusted before the actual set point setting is selected. Metal walls have little heat capacity and therefore require less warm-up time. On metal walls, the warm-up lead time can safely be reduced to as low as 2 hours before occupancy, while still maintaining proper warm-up conditioning, since a wall with a low heat capacity will warm-up to a steady-state heat transfer condition sooner than a wall with a high heat capacity. For all metal walls, the "U" factor values listed in the chart should be decreased by 0.03 when the set point value is selected.

Example 1

A particular building has an exterior wall made of 4 in. face brick, 4 in. light weight concrete block and 1 in. of insulation. From the chart, this building would have a "U" factor of 0.15. Because these walls are masonry, the value

CHART I

External Wall	Typical Building Materials			"U" FACTOR*	
				$\frac{\text{Btu}}{\text{hr ft}^2\ \text{F}^\circ}$	$\frac{\text{W}}{\text{m}^2\ \text{C}^\circ}$
Masonry	4 in. face brick	2 in. insulation	4 in. common block	0.11	0.62
	4 in. face brick	3/4 in. insulation	6 in. l.w. †conc. block	0.13	0.74
	4 in. face brick	1 in. insulation	4 in. l.w. †conc. block	0.15	0.87
	8 in. h.w. †conc. block	1 in. insulation		0.18	1.02
	4 in. h.w. †conc. block	1 in. insulation	3/4 in. gypsum board	0.20	1.14
	4 in. face brick	3/4 in. air space	4 in. l.w. †conc. block	0.25	1.42
Metal	Metal curtain walls with 3 in. insulation			0.09	0.51
	Metal curtain walls with 2 in. insulation			0.13	0.74
	Metal curtain walls with 1 in. insulation			0.23	1.30

* These values taken from Chapter 22 of 1972 ASHRAE Fundamentals Handbook pp. 426–429. They are to be considered as starting point figures only. Several readjustments may be necessary to exactly match the C-7510 to the building. "U" factor is also discussed in Chapter 20 of this handbook.

†h.w. = heavy weight and l.w. = light weight

listed in the chart can be used directly in making the C-7510 set point setting. Since the C-7510 is provided with the "U" factor factory positioned at 0.15, no additional change in set point would be required. The curve of Fig. 2 describes the C-7510 morning warm-up schedule for the building in this example.

Example 2.

A particular building has an exterior wall made of metal with 2 in. of insulation. From the chart this building would have a "U" factor of 0.13. To make the C-7510 set point adjustment, the 0.13 value must be decreased by 0.03 to 0.10 since the walls are metal curtain with little heat capacity. In addition, the 7-day program clock should be set for a maximum warm-up lead time of 2 hours. After the "U" factor set point is set, the heating start switch pressure must be checked (and adjusted if required) by following the procedures outlined in Installation Data C-7510-A.

Installation (See Fig. 4)

The C-7510 controller is enclosed in a 16 gauge steel box with wrap-around cover and can be wall or panel mounted with the four #8 screws and anchors **supplied**. Knockouts for 1/2 or 3/4 in. conduit are provided in the top and bottom of the enclosure for wiring and tubing access. The outside temperature transmitter air line connection is made to a barbed fitting for 5/32 or 1/4 in. O.D. polytubing. All wiring connections are made to an 8-position screw-type terminal strip. **Caution**: When routing the wiring thru the top of the unit, be sure to keep away from the moving parts of the timing mechanism. All wiring must be in accordance with applicable electrical code requirements.

Factory Set-Up (See Fig. 3)

The C-7510 controller is furnished with the "U" factor set point selector factory positioned at 0.15 (right edge of the slider). The heating start switch is factory adjusted for a cutoff (warm-up lockout) pressure at 12.6 ± 0.3 psig. This 12.6 psig pressure is produced by the -20 to 80F, temperature transmitter when the outside temperature reaches 60F, the temperature point at which no warm-up is required. The damper cam is factory set to energize the outside air damper solenoid air valve for full day cycle at the occupancy time. The 24 hr dial on the C-7510 is factory positioned with an occupancy index at 8:00 AM.

If the C-7510 is used on an application which has the same "U" factor and occupancy conditions as described above, the only set-up requirements would be to make the electrical and

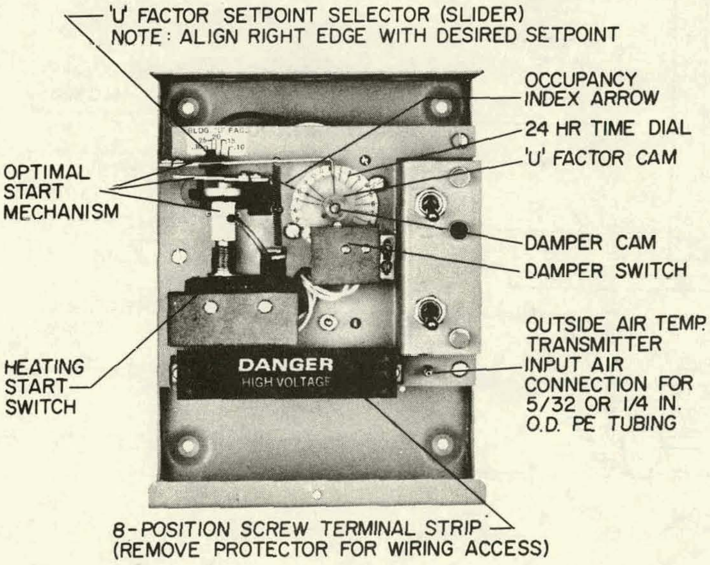


Fig. 3

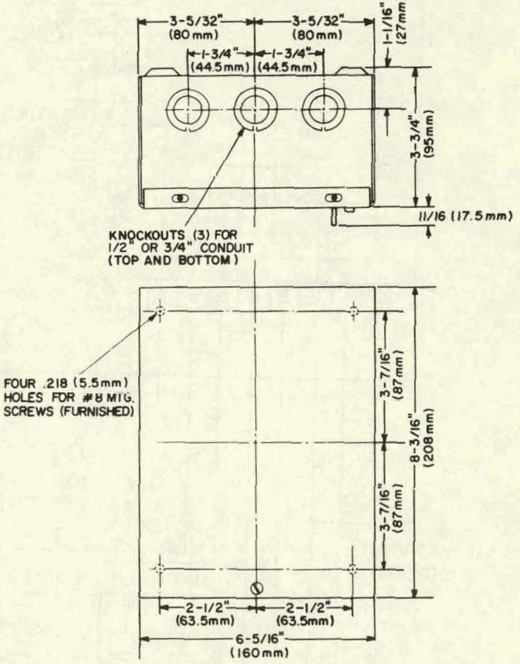


Fig. 4

pressure connections, to set the external 7-day program clock "ON" tripper to 4:00 AM (the maximum warm-up lead time) and to set the real time on the C-7510 24 hr clock. To set the real time, simply rotate the "U" factor cam clockwise to the corresponding time of day, i.e. if the C-7510 is set into operation at 9:00 in the morning, the arrow on the cam should be aligned with the 9 before N (noon) on the 24 hr time dial.

Field Calibrations and Adjustments

Numerous adjustments can be made on the C-7510 unit to match the various field conditions as applicable. Adjustment procedures are detailed in the Installation Data bulletin C-7510-A. Information on the use of a different 100F° span outside air temperature transmitter with the C-7510 is also detailed in the installation data bulletin. Additional information on building "U" factor determination can be found in the 1972 ASHRAE Fundamentals Handbook.

C-7510 Settings
(Readjust as Required)

Adjustment	Factory Set
"U" Factor Setting	0.15
Occupancy Index	8:00 AM
Heating Start Switch Cutoff Pressure	12.6 psig for −20 to 80F Range
Damper Cam Setting	8:00 AM

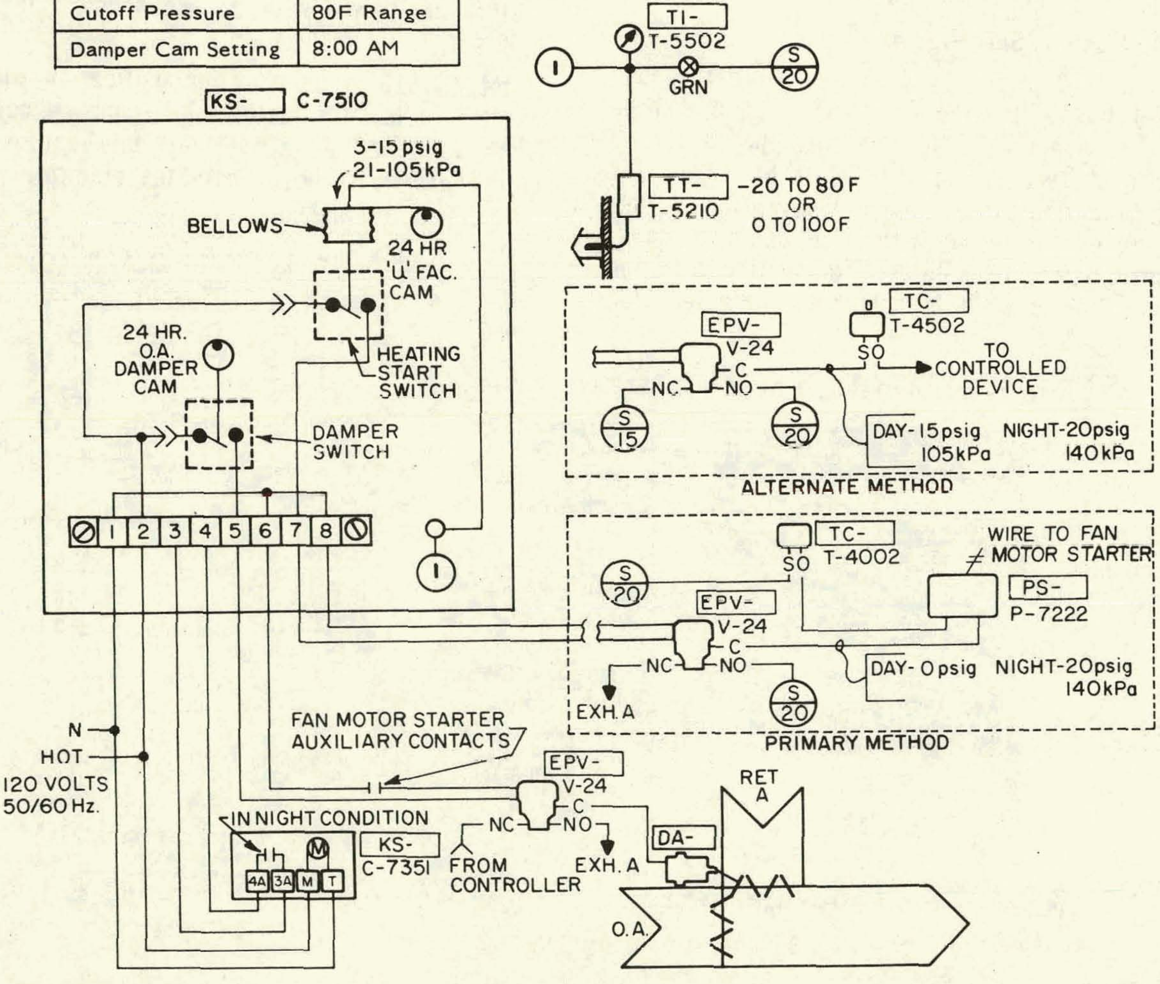


Fig. 5: Typical C-7510 Application

Catalog Section D
Series 251
Product Data ——
Issue Date 1076

JOHNSON CONTROLS

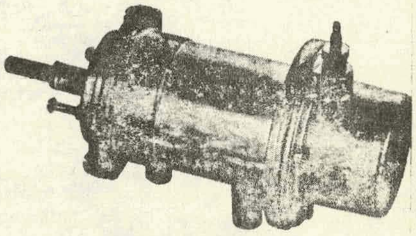
Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

D-251
Pneumatic Piston Damper Actuator No. 2 & No. 3

D-251 Pneumatic Piston Damper Actuators are used to accurately position dampers in response to the output signals of pneumatic controllers. Two models are available in this series that vary in stroke and positioning power. Both models are completely enclosed in sturdy housings to protect them against dirt and damage. Adjustable external stops are provided to limit the stroke of the actuator in either direction. Note: These stops must be properly adjusted to prevent over-extension of the shaft so as not to exceed the physical rotation limits of the damper. The D-251 No. 3 actuator is available with or without a factory mounted D-9502 Positioner.

Operation

Air pressure from the pneumatic controller is applied to the synthetic elastomer diaphragm which moves the piston against the opposing spring force. The stroke of the actuator is proportional to the air pressure from the controller, within the spring range. When the air pressure is decreased, the spring returns the actuator shaft to a position where the spring force and air pressure on the diaphragm are balanced.



Typical D-251 Actuator

Mounting

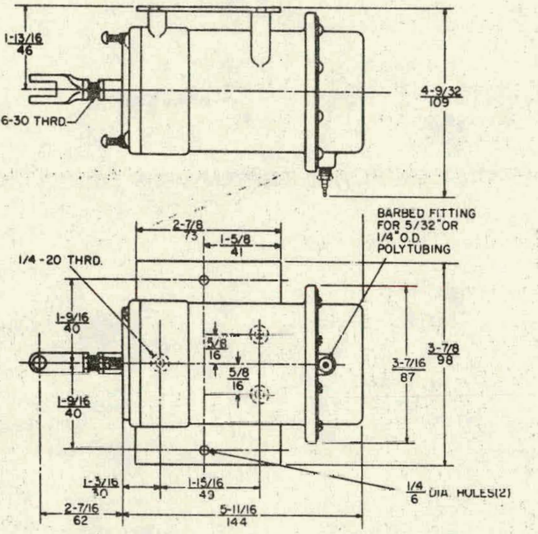
D-251 actuators can be mounted in any position to operate normally open or normally closed dampers. Various mounting arrangements, brackets and linkages are available. Type "F" mounting is used for attaching the actuator to the damper frame. Type "W" is for attaching the actuator to a wall or duct; type "W Short" is used where the mounting area is limited.

Table 1: D-251 Actuator Force Values 20 PSIG (140 kPa) Supply

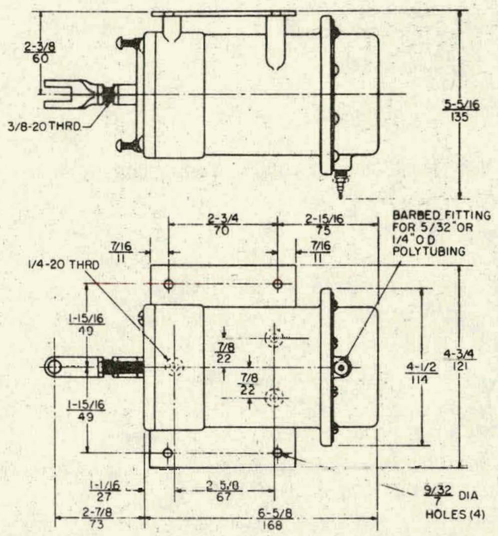
Actuator No.	Stroke	Nominal Spring Ranges in $\frac{\text{PSIG}}{\text{kPa}}$		
		$\frac{3 \text{ to } 7}{21 \text{ to } 49}$	$\frac{5 \text{ to } 10}{35 \text{ to } 70}$	$\frac{8 \text{ to } 13}{55 \text{ to } 90}$
		Force in $\frac{\text{LBS}}{\text{Newtons}}$		
2	Power	$\frac{36.4}{162}$	$\frac{28}{125}$	$\frac{19.6}{87}$
	Return	$\frac{8.4}{37}$	$\frac{14}{62}$	$\frac{22.4}{100}$
3	Power	$\frac{81.1}{361}$	$\frac{6.4}{278}$	$\frac{43.7}{194}$
	Return	$\frac{18.7}{83}$	$\frac{31.2}{139}$	$\frac{49.9}{222}$

Specifications

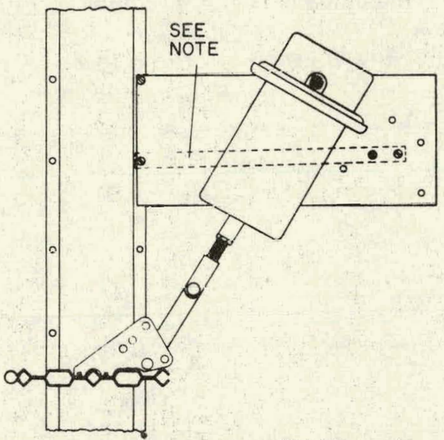
Product		D-251 Pneumatic Piston Damper Actuators	
Models		D-251 No. 2	D-251 No. 3
Strokes		2-1/8 in. (54 mm)	2-3/4 in. (70 mm)
Effective Diaphragm Areas		2.8 Sq. in. (18 cm²)	6.24 Sq. in. (40 cm²)
Spring Ranges (Nominal)		5 to 10 PSIG (35 to 70 kPa) 8 to 13 PSIG (55 to 90 kPa)	3 to 7 PSIG (21 to 49 kPa) 5 to 10 PSIG (35 to 70 kPa) 8 to 13 PSIG (55 to 90 kPa)
Control Air Pressure		25 PSIG (175 kPa) Maximum	
Positioner (D-9502 Factory Installed)		Available Only on D-251 No. 3	
Materials	**Body**	Die Cast Aluminum	
	Diaphragm	Synthetic Elastomer	
Air Connection		Barbed Fitting for 5/32 or 1/4 in. O. D. Polytubing	
Ambient Temp. Limits		-20 to 150F (-29 to 66C)	
Accessories (Order Separately)		Mounting Brackets and Linkages	



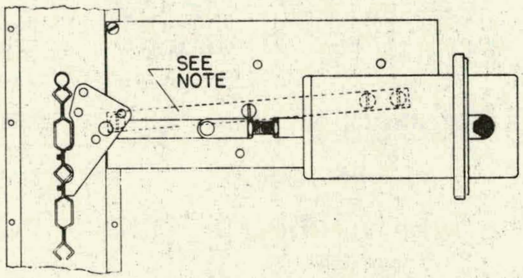
Dimensions $\frac{\text{in.}}{\text{mm}}$ for D-251 No. 2 Actuator with Type "W Short" Bracket

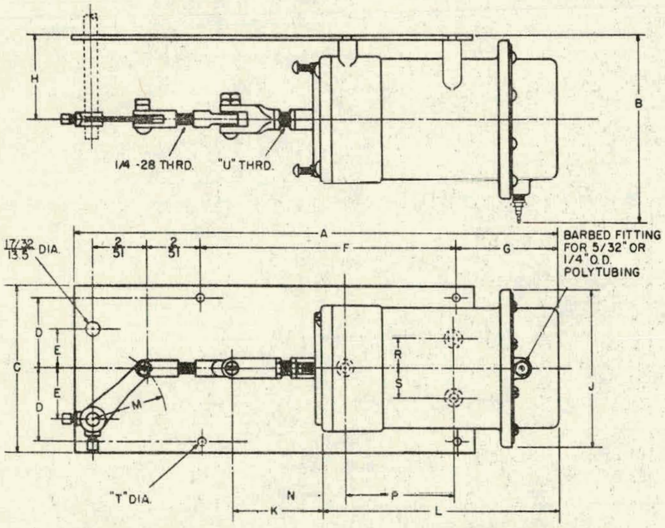


Dimensions $\frac{\text{in.}}{\text{mm}}$ for D-251 No. 3 Actuator with Type "W Short" Bracket



D-251 No. 3 Actuator Type "F" Mounting Detail Normally Open (above) & Normally Closed (below) Note: Brackets and linkages furnished with actuators (order D-1300-111 separately).





Dimensions $\frac{\text{in.}}{\text{mm}}$ for D-251 No. 2 & 3 Actuators with Type "W" Brackets

Actuator	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R & S	T	U
No. 2	13 330	4-9/32 109	3-7/8 98	1-9/16 40	1-9/64 29	4-1/2 114	3-3/4 86	1-13/16 46	3-7/16 87	2-7/16 62	5-11/16 144	1-5/8 41	1-3/16 30	1-15/16 49	5/8 16	1/4 6	5/16-30
No. 3	15 381	5-5/16 135	4-3/4 121	1-15/16 49	1-3/8 35	5-5/8 143	4-3/8 111	2-3/8 60	4-1/2 114	2-7/8 73	6-5/8 168	1-15/16 49	1-1/16 27	2-5/8 67	7/8 22	9/32 7	3/8-20

Product Data —— Catalog Section **P**
Issue Date **07P3** Series **7221**

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E Michigan Street
P O Box 423
Milwaukee WI 53201

P-7221
Pressure Electric Switch

The Johnson P-7221 Pressure Electric Switch is designed for applications where a pneumatic controller is used to actuate an electric device. The instrument is Underwriters' Laboratories, Inc. listed and has a SPDT switch that is snap acting, assuring quick make and break contact.

Operation

The P-7221 switch contact unit has color coded terminals; the common terminal is red; the red to yellow terminals close on a rise in pressure; and the red to blue terminals open on a rise in pressure. A visible calibration scale indicates the pressure at which the switch will operate on a rise in pressure.

Adjustments

The range setting can be adjusted without removing the cover. The range adjusting screw, located at the bottom of the switch, can be turned with either a screwdriver or a ¼″ wrench. When the range is adjusted the differential will change.

The differential is adjustable between 2 and 6 psi by an adjusting screw located inside the case. Adjustment is made with an Allen wrench and should be made by trained personnel only. At the high end of the operating range the differential will be approximately 25% greater than mid-range and approximately 25% less at the low end of the operating range.

NOTE: The differential should be checked if the switch is adjusted to the extreme end of the operating range.

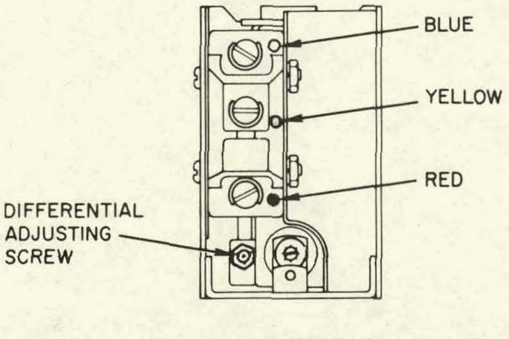


Fig. 2: Interior View of P-7221 Pressure Electric Switch. Note Differential Adjusting Screw

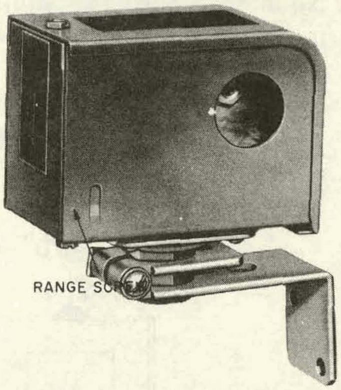


Fig. 1: P-7221 Pressure Electric Switch. Note Range Screw

Maximum Differential: To obtain maximum differential, turn the differential screw counterclockwise until the operating lever will remain in the raised position when no pressure is applied to the unit. NOTE: Trip lever must be raised manually. Turn the adjusting screw 1½ turns more.

Minimum Differential: To obtain minimum differential, turn the adjusting screw clockwise until it becomes snug, then turn it counterclockwise one turn. This will give a minimum differential of approximately 2 psi.

The P-7221 should never be operated with the differential adjusting screw turned in so far that it will clamp down the operating lever. This will damage the unit.

Specifications

Model	P-7221 Pressure Electric Switch
Action	Single Pole Double Throw
Range	3 to 20 psi
Differential	Adjustable between 2 and 6 psi
Pressure Connector	1/8″ F.P.T.
Conduit Connection	One 1/2″ conduit opening
Mounting	Bracket furnished. Attaches to surface in any position
Ambient Temp. Limits	32 to 140F (0 to 60C).

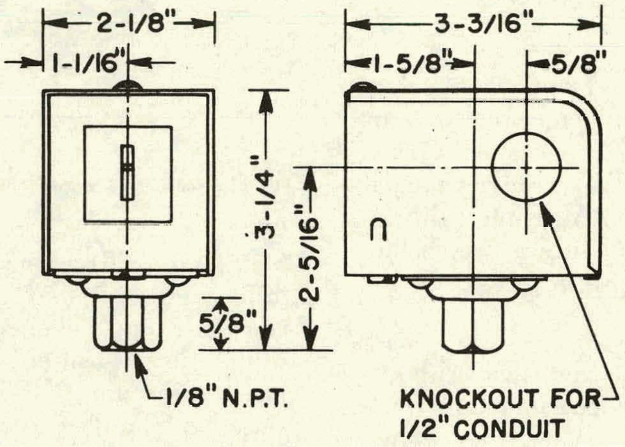
Electrical Ratings

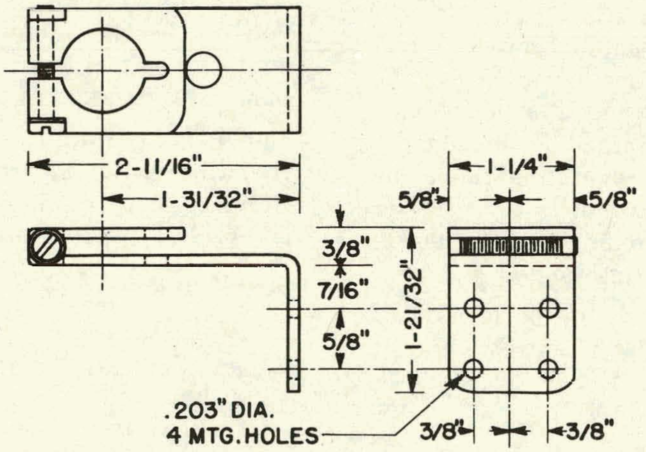
Motor Rating	120 V.	208 V.	240 V.	277 V.
A.C. Full Load Amps.	16.0	9.2	8.0	—
A.C. Locked Rotor Amps.	96.0	55.2	48.0	—
Non Inductive Amps.	16.0	9.2	8.0	7.2
Pilot Duty—125 V.A. at 24—277 V.A.C.				

Mounting—Wiring

The P-7221 can be mounted in any position using the mounting bracket furnished with the instrument. No internal wiring is required. All external wiring must conform to the National Electrical Codes and local regulations. Be sure the instrument is not installed on equipment to handle loads in excess of the electrical ratings.

DIMENSION DRAWINGS





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JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

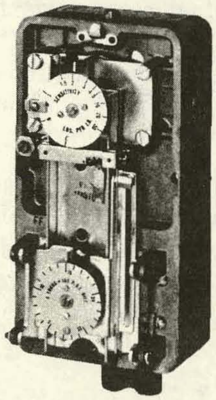
PRODUCT
DATA
P-8575

JOHNSON P-8575
DIFFERENTIAL PRESSURE CONTROLLER

The Johnson P-8575 Differential Pressure Controller is adaptable to a wide range of pressure differential control applications. Pneumatic feedback, an integral part of the controller stabilizes the control point of the instrument by utilizing a portion of the output pressure. This prevents hunting at high sensitivities and provides higher accuracy at low sensitivities. Models are available as either direct or reverse acting. A simple field change of pivot location can change the action of the instrument.

Operation

The differential element is composed of two metal bellows with opposing movements. As the two pressures are applied, one to each bellows, the actuating movement is transmitted to the control port lid through a system of levers. Output pressure changes in proportion to the control port movement. With pivots at "A" and "D", the instrument is direct acting and output pressure increases as the pressure differential increases.



With the pivots at "B" and "C", the instrument is reverse acting and output pressure decreases as the pressure differential increases. The P-8575 is supplied as a direct or reverse acting instrument. However, the pivots may be changed in the field if the opposite action is desired.

Full movement of the bellows is obtained with a 90 psi differential. The differential should not

Specifications

MODEL		P-8575 DIFFERENTIAL PRESSURE CONTROLLER
ACTION		PROPORTIONAL – DIRECT OR REVERSE ACTING *
OPERATING DIFFERENTIALS		0 TO 90 psi, 0 TO 5.25 kp/cm^2
DIAL RANGE		0 TO 25 psi
DIAL MARKINGS		0 TO 25 psi IN 1 psi INCREMENTS
DIAL GRADUATIONS		4 TURNS EQUALS 100 psi DIFFERENTIAL
SENSITIVITY		ADJUSTABLE FROM 1/2 TO 20 psi/psi
DIFFERENTIAL SET POINT ADJUSTMENT		DIAL CONCEALED BENEATH COVER
MATERIAL	BODY	DIE CAST ALUMINUM
	COVER	DIE CAST ZINC
FINISH	BODY	IRIDITE
	COVER	SPRAYED SILVER
MOUNTING		SURFACE OR SEMI-FLUSH
AMBIENT TEMPERATURE LIMITS		-35 TO 150F (-37 TO 65C)
AIR CONNECTIONS		1/8" F.P.T.
MAXIMUM SUPPLY PRESSURE		25 psig
ACCESSORIES **		GAGES, FITTINGS AND SEMI-FLUSH MOUNTING KIT

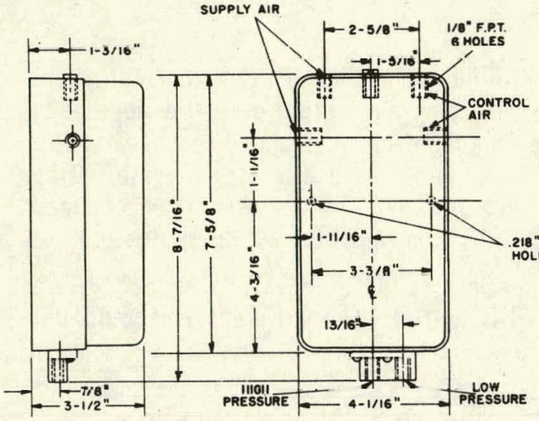
* The pivots may be changed in the field if the opposite action is desired.

** The D.A., 0 to 90 psi model is available with or without gages and fittings as standard equipment. On all other models, gages and fittings are accessory items.

exceed 90 psi and the instrument should not be used for pressure applications in excess of 250 psig.

A portion of the output pressure is fed back to the pneumatic feedback bellows within the instrument to stabilize the control point and produce accurate control. This action also reduces "hunting".

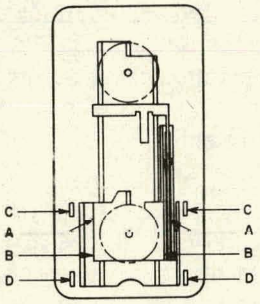
The mechanical sensitivity of the instrument is set as high as possible. The sensitivity dial on the feedback bellows is so adjusted that feedback is just sufficient to produce stable control over the entire range of the instrument.



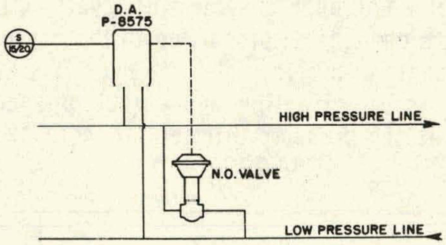
Dimensions

Mounting

The P-8575 should be mounted on a wall, column or panel at an accessible level. The higher of the two pressure inputs should be piped to the left side of the instrument and the lower pressure input should be piped to the right side. Either the high or low input may be applied as the reference input, providing that the reference is respectively higher or lower than the low or high controlled medium.



Pivot Location



Typical Application

JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

PRODUCT
DATA
R-130

JOHNSON R-130
AIR PRESSURE REDUCING VALVE

The Johnson R-130 Air Pressure Reducing Valve is designed for use on a compressed air system to reduce the primary air to a desired pressure. A relieving feature will reduce the output pressure when the pressure setting is lowered. Excessive pressure build-up in the regulated pressure system is also prevented.

All sizes have two connections in the valve body which can be used for an output pressure gage or the optional mounting bracket. The output pressure setting is changed by turning the adjusting screw on the top of the larger valves and the black top knob portion of the 1/8" valve; locknuts are provided on the larger valves; the 1/8" model utilizes a lockring.


MOUNTING NUT
(ORDER SEPARATELY)

1/8" Model


3/8", 1/2" and 3/4" Models

Specifications

PRODUCT		R-130			
SIZES (F.P.T.)		1/8"	3/8"	1/2"	3/4"
CAPACITY (scfm)		1	25	35	60
INPUT PRESSURE		UP TO 400 psi			
OUTPUT PRESSURE		0 TO 50 psi ± 0.5 psi			
AMBIENT TEMPERATURE LIMITS		3/8", 1/2" AND 3/4"	-40 TO 150F		
		1/8"	0 TO 150F		
MATERIAL	BODY	3/8", 1/2" AND 3/4"	ZINC DIE CASTING		
		1/8"	BRASS		
	TOP	3/8" AND 1/2"	ZINC DIE CASTING		
		3/4"	ALUMINUM DIE CASTING		
		1/8"	DELRIN		
FINISH		3/8", 1/2" AND 3/4"	MOSS GREEN ENAMEL		
		1/8"	NATURAL MATERIAL		
MOUNTING		IN-LINE, WITH MOUNTING BRACKET; OR PANEL MOUNTING FOR 1/8" MODEL			

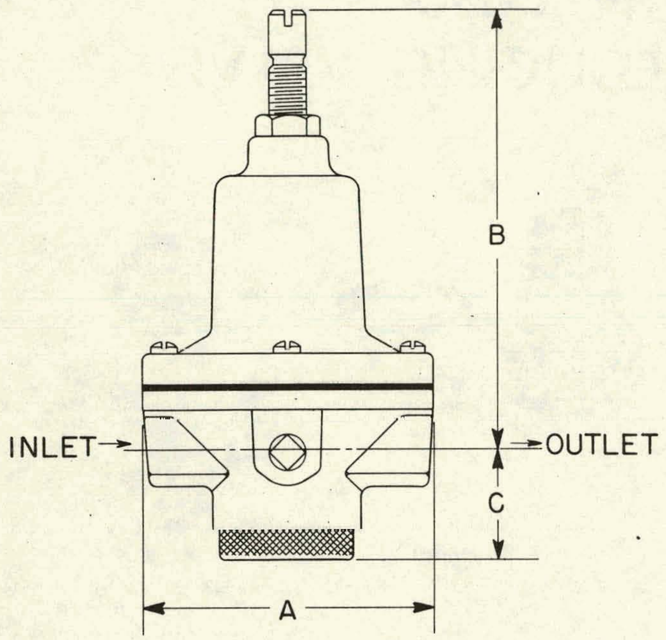
PRINTED IN U.S.A.

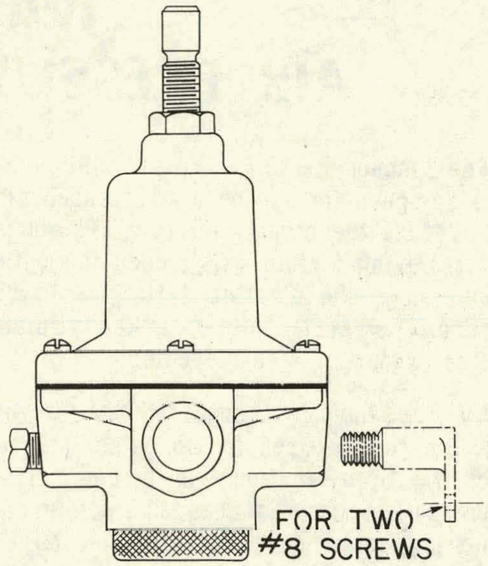
27J2

PRODUCT
DATA
R-130

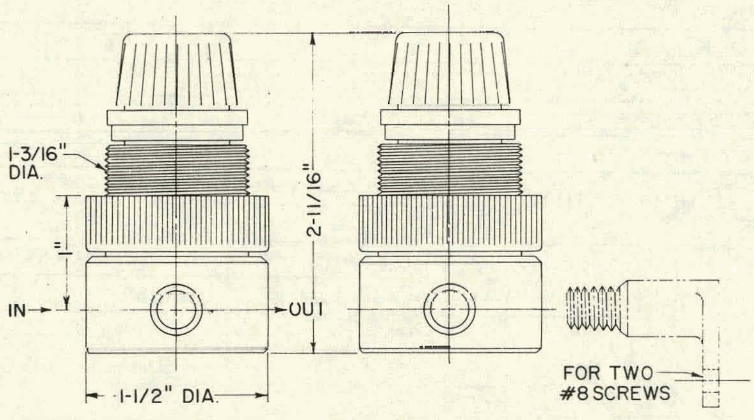
JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

Dimensions

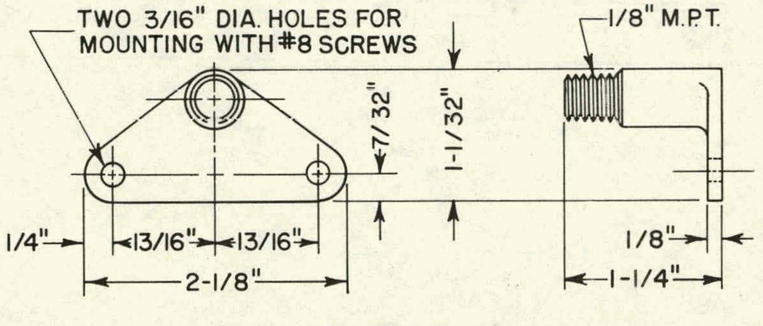




SIZE	A	B	C
3/8"	3 1/8"	4 15/16"	1 1/4"
1/2"	3 3/8"	5	1 3/8"
3/4"	4 5/8"	7 3/16"	1 5/8"



1/8" Model



Optional Mounting Bracket

PENN
BASO
PENN CONTROLS
DIVISION OF JOHNSON SERVICE COMPANY

CATALOG SECTION T
SERIES T26
BULLETIN NO. 4054
SUPERSEDES NEW

series T26

LINE VOLTAGE THERMOSTAT

Heating, Cooling, Combination Heating and Cooling
Standard Duty and Heavy Duty

APPLICATION

These line voltage thermostats control heating, cooling, or year 'round air conditioning units in commercial, industrial or residential installations. Typical uses are for unit heaters, fan coils, blast coils, refrigerated storage rooms, electric heat, duct furnaces, greenhouses, etc. Models are available with SPST or SPDT contact action and for standard duty (nominal 1/4 hp; 10 amps. non-inductive) or heavy duty (nominal 1 hp; 22 amps. non-inductive) applications. These thermostats are also suitable for low voltage applications.

Where critical or high value products are to be maintained at a specific temperature, a single thermostat should not be applied to perform as both an operating and a limit control. In these applications a separate limit control with alarm contacts should be wired to indicate when the limit control operates.

For line voltage thermostats with integral selector switches refer to Series T22, Bulletin 3233.

For low voltage thermostats refer to Series T51 and Y51 Bulletin 3144.

FEATURES

- Field adaptable to vertical/horizontal mounting and for knob, key or concealed adjustment.
- Knob, key or concealed set point adjuster.
- Low and high limit dial stops — concealed, adjustable throughout set point range. Can be set for locked dial. See Fig. 2.
- Locking cover with Phillips—head screws is standard.
- Close differential without need for anticipator.
- Internal dual celsius and fahrenheit scale is standard.

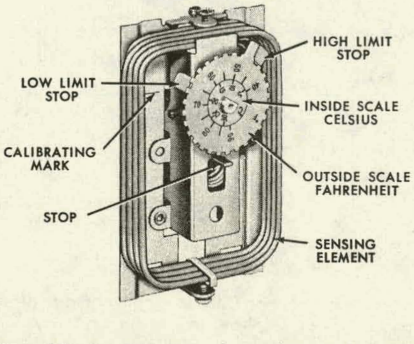


Fig. 2 — Interior of Series T26. Note how element is wrapped around inside of thermostat for maximum sensitivity. Integral adjustable high and low limit stops.

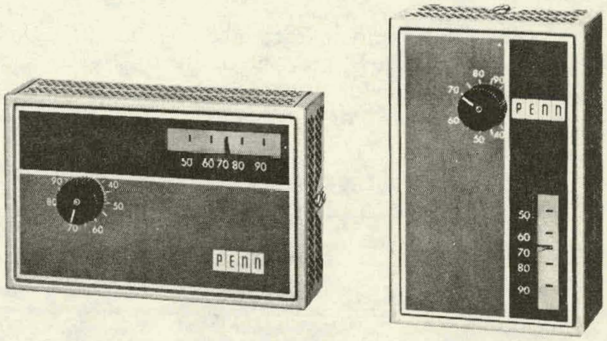


Fig. 1 — Series T26 thermostat with horizontal faceplate (left) or vertical faceplate (right).

- Enclosed Pennswitch contact unit — dependable, dust proof and field proven.
- Separable mounting plate allows easy mounting and wiring without removing thermostat cover.
- Switch mechanism and wiring terminals (#8 screws) go into switch box for safety and isolation of load from sensing element.
- Matching humidistat (Series W43A) is available, see Bulletin 3391.

GENERAL DESCRIPTION

These thermostats are extremely versatile. Using different field-installable faceplates, combinations of (1) vertical/horizontal mounting, (2) knob, key or concealed adjustment and (3) with or without thermometer indication are possible. These thermostats have metal locking covers with Phillips-head screws to discourage unauthorized tampering. The standard models are supplied with a faceplate installed for vertical mounting with knob adjustment and thermometer. A field installable faceplate for horizontal mounting is also included on wholesaler models. See Figs. 1 and 6. Standard models are SPDT for heating, cooling or heating and cooling applications.

Standard models can be changed in the field as follows:

1. To convert to key adjustment, remove the screw from center of knob and the knob becomes the key.
2. To convert to other configurations, for example concealed adjustment, select the faceplate kit that meets the desired requirements from the "Faceplate Selection Table" on Page 3.

The cover and faceplate design makes the thermostats adaptable to any decor. The thermostats have a sturdy steel cover with "tawny silver" finish. The faceplate is dark brown and light brown with aluminum numbers and graduation marks. The internal dial on these thermostats has a dual Fahrenheit-Celsius scale, see Fig. 2. When a faceplate with Celsius thermometer and set point scale is used the thermostat is totally Celsius.

The liquid charged sensing element is formed to achieve maximum sensitivity to surrounding air temperature changes (see Fig. 2). Coupled with a highly efficient diaphragm and leverage mechanism, the element operates a totally enclosed Pennswitch contact unit for close differential and dependable switching action without the use of "heat or cool" anticipators.

Elimination of anticipators increases versatility of these thermostats, which may be used on heating and/or cooling over a wide range of current loads, either on 24 V., 120 V. or 240 V. systems.

TYPE NUMBER SELECTION

Type Number	Function	Typical Application
HEATING		
T26A	SPST heating	Fig. 7
T26B	SPST heavy duty heating	Fig. 7
COOLING		
T26J	SPST cooling	Fig. 8
HEATING, COOLING OR HEATING AND COOLING		
T26S	SPDT heating and cooling	Figs. 9 thru 13
T26T	SPDT heavy duty heating and cooling	Figs. 9 thru 13

SPECIFICATIONS

Thermostat Range °F. (°C.)	Thermometer Range °F. (°C.)
40 to 90 (5 to 30)	50 to 90 (10 to 30)

Mechanical Differential: Approximately 0.7° F. (.4° C.).

Operating Differential: The operating temperature differential of any self-contained thermostat depends on tht current flowing through the thermostat (amperage load), the velocity of air over the thermostat, the rate of temperature change to which the thermostat is subjected and whether the thermostat is operating heating or cooling equipment.

Graphs (Figs. 3 and 4) show the operating temperature differentials of these thermostats under various load conditions. These curves are based on tests made in a NEMA standard test box according to NEMA standard DC3-1959. The air velocity was 25 feet per minute (.127 m/sec.) and the rate of temperature change was 6° F. (3.3° C.) per hour. For air velocities greater than 25 feet per minute and/or for rates of temperature change less than 6° F. per hour, the operating differentials will be less than shown in Figures 3 and 4.

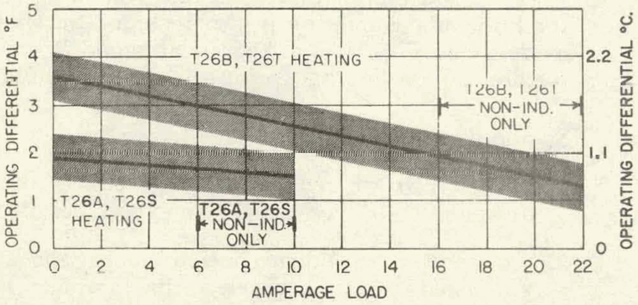


Fig. 3 — Operating differential for Series T26A and heating side of Series T26S (lower graph line). Upper graph line illustrates differential for T26B and heating side of T26T.

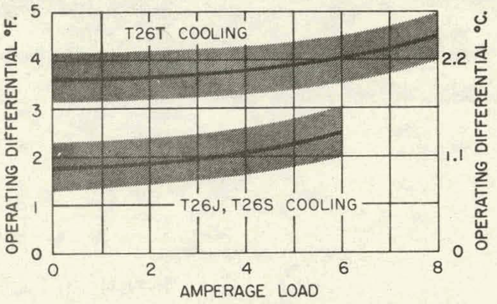


Fig. 4 — Operating differential for Series T26J and cooling side of Series T26S (lower graph line). Upper graph line illustrates differential for cooling side of Series T26T.

The heavy line in each of the above figures is the nominal operating temperature differential. Production thermostats may vary from the norm as indicated by the shaded areas.

Base: .050″ (1.27 mm) cold rolled steel. Baked on "tawny silver" finish.

Cover: .025″ (.64 mm) cold rolled steel. Baked on "tawny silver" finish. Faceplate is dark brown and light brown with aluminum letters and markings.

Mounting: Separable mounting plate, see Figs. 5 and 6.

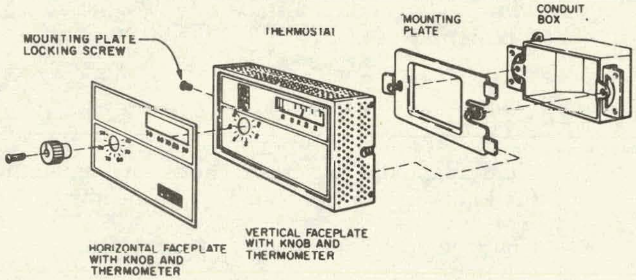


Fig. 5 — Line drawing illustrating method of mounting a vertical thermostat to a horizontal outlet box and installing a horizontal faceplate.

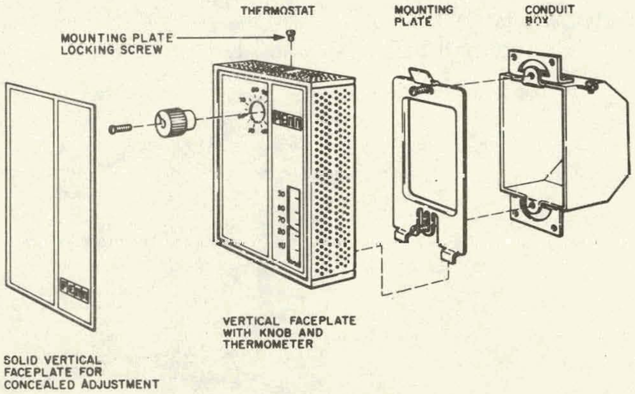


Fig. 6 — Line drawing illustrating method of mounting a vertical thermostat to outlet box. Also shown is a solid vertical faceplate for concealed adjustment when desired.

Sensing Element: Liquid charged for positive trouble free operation.

Thermometer: Bimetal type for accuracy and clarity. Thermometer may be quickly calibrated, if ever required, by turning hex-head screw inside cover.

Wiring: All wiring is connected to large, easily accessible wiring terminals located on the contact unit at the back of thermostat. Terminal identification markings are stamped on the back of the case.

ELECTRICAL RATINGS

Type T26A, T26S

Motor Ratings	120 V.	208 V.	240 V.	277 V.
A. C. Full Load Amps.	6.0	3.5	3.0	—
A. C. Locked Rotor Amps.	36.0	21.0	18.0	—
A. C. Non-Inductive Amps.	10.0	10.0	10.0	10.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.				

Type T26J

Motor Ratings	120 V.	208 V.	240 V.
A. C. Full Load Amps	6.0	3.5	3.0
A. C. Locked Rotor Amps.	36.0	21.0	18.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.			

Type T26B and Heating Side of T26T

Motor Ratings	120 V.	208 V.	240 V.	277 V.
A. C. Full Load Amps	16.0	9.2	8.0	—
A. C. Locked Rotor Amps.	96.0	55.2	48.0	—
A.C. Non-Ind. Amps.	22.0	22.0	22.0	22.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.				

Cooling Side of T26T

Motor Ratings	120 V.	208 V.	240 V.
A. C. Full Load Amps	8.0	8.0	8.0
A. C. Locked Rotor Amps.	48.0	48.0	48.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.			

TYPICAL APPLICATION DIAGRAMS

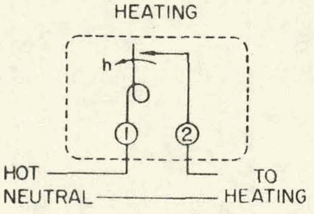


Fig. 7 — Internal diagram of Type T26A and T26B.

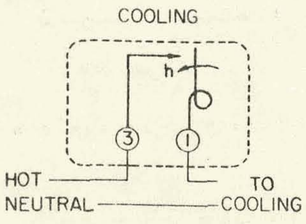


Fig. 8 — Internal diagram of Type T26J.

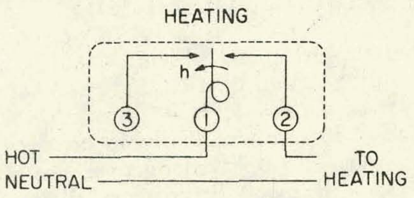


Fig. 9 — Types T26S, T26T wired for heating application.

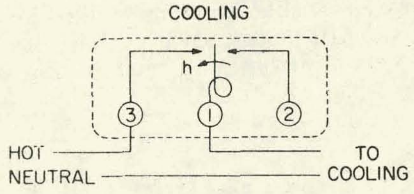


Fig. 10 — Types T26S, T26T wired for cooling application.

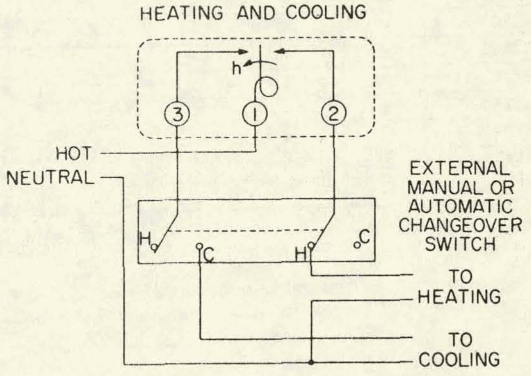


Fig. 11 — Types T26S, T26T wired for heating and cooling with manual or automatic changeover switch.

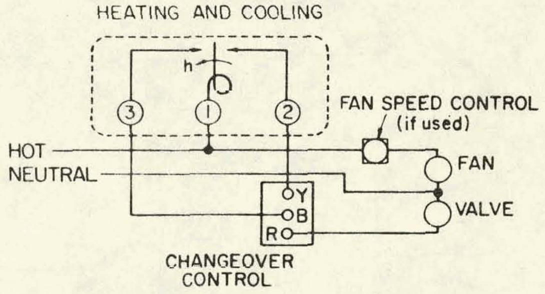


Fig. 12 — Types T26S, T26T on fan-coil unit with cycling valve continuous fan. Terminal markings shown for Type A19CAC changeover control.

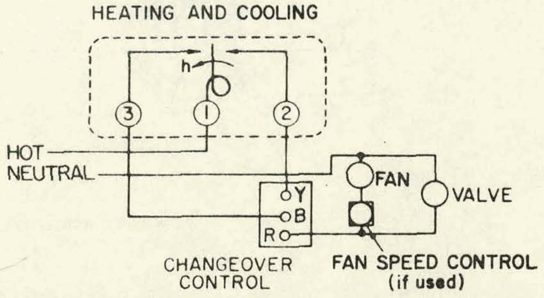


Fig. 13 — Types T26S, T26T on fan-coil unit with cycling fan and valve. Terminal markings shown for Type A19CAC changeover control.

OPTIONAL CONSTRUCTIONS

Brand Nameplates: Available on quantity orders. Check with the nearest Penn district office or Customer Service.

Concealed Adjustment: Available on factory order at no extra cost. For field changeover use the concealed faceplate kit and install directly over the faceplate on the cover. Locking cover screws are supplied in the faceplate kit.

Faceplates: Available in separate kits for on-the job installation. All plates have peel-off backing strips. Faceplates are available in all combinations shown in the following table.

FACEPLATE SELECTION TABLE

Kit Number	Mounting Position		Type of Adjustment		Thermometer	
	Vertical	Horizontal	Knob	Concealed	Yes	No
PLT213-5	—	X	—	X	—	X
PLT213-6	X	—	—	X	—	X
PLT213-9*	X	—	X	—	X	—
PLT213-11*	—	X	X	—	X	—
PLT213-15	X	—	—	X	X	—
PLT213-16	—	X	—	X	X	—
PLT213-17	X	—	X	—	—	X
PLT213-18	—	X	X	—	—	X

* Supplied with standard wholesaler models (vertical is factory installed).

Faceplates must be ordered in multiples of ten. Consult Penn salesman or Customer Service for Celsius set point dials or thermometer plates.

Key Adjustment: Remove the knob and keep for key adjustment when set point change is desired.

Locking Cover: Standard construction has Phillips-head cover screws. Allen-head cover screws and wrench are available in a kit for field installation, specify Kit No. SCR15A-600.

Thermostat Guards: Plastic, wire or cast aluminum guards are available at extra cost. See condensed catalog or "GRD" Bulletin No. 3860.

SHIPPING WEIGHTS

Individual Pack — lbs. (kg)	Overpack of 20 Units — lbs. (kg)
1.0 (.45)	22.0 (9.9)

REPAIRS AND REPLACEMENT

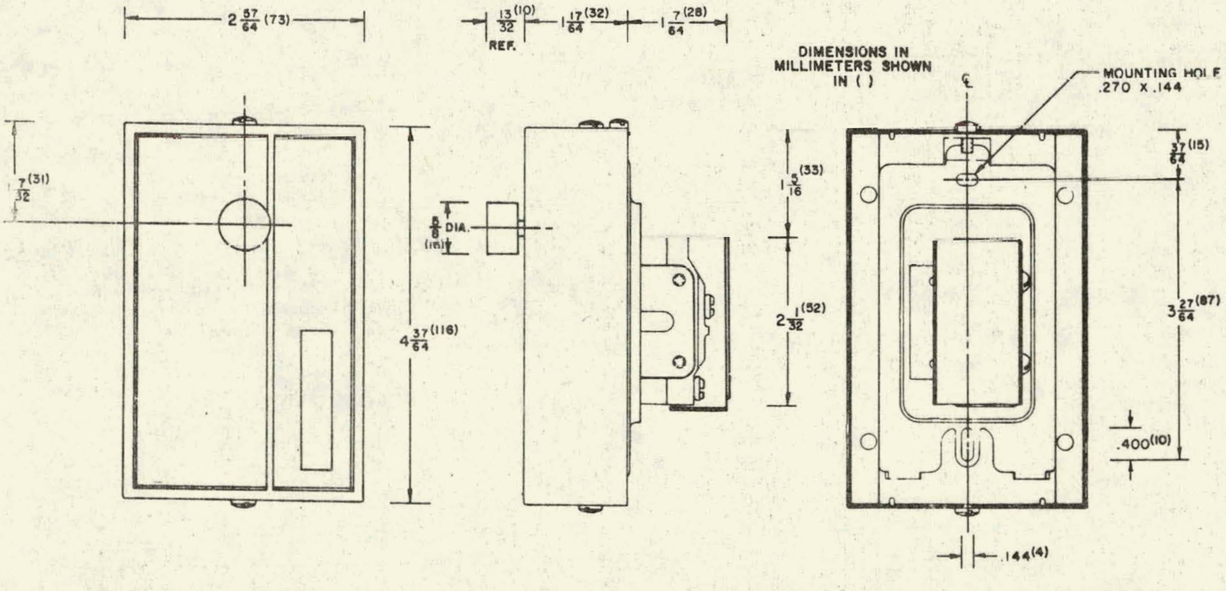
Field repairs must not be made. Replacement thermostats may be obtained from the nearest Penn-Baso Counterline Wholesaler. When ordering a replacement thermostat, specify Product Number and Serial Number as shown on cover label of the thermostat.

ORDERING INFORMATION

To order, specify:

1. Product Number, consult condensed catalog.
2. Faceplate kit, if other than standard is required. Order in multiples of ten.
3. Other optional construction features, if required (quantity orders only).
    a. Faceplate required if other than standard vertical.
    b. SPST contact action.
    c. Brand nameplate.

DIMENSIONS



Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

PENN CONTROLS
DIVISION OF JOHNSON SERVICE COMPANY
2221 CAMDEN COURT, OAK BROOK, ILL. 60521

Litho in U.S.A.

4-5-75

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

T-4000 Series Pneumatic Room Thermostats

T-4000 Series Pneumatic Room Thermostats provide individual space temperature control in all types of heating and cooling systems. They produce a proportional output signal which is used to modulate controlled devices in response to load changes.

Several T-4000 thermostat models are available to match the functional variations and requirements of different control systems. All models have bimetal temperature sensing elements. They all feature a shock and vibration resistant mechanism which regulates the supply input pressure to produce output pressure changes corresponding to the sensed temperature conditions. Most models have volume amplifiers to provide fast time response and over 400 scim air capacity with pneumatic feedback to insure more accurate proportional response. They all have standard set point dial ranges of 55 to 85F and recommended ambient temperature limits of –20 to 130F (–29 to 54C).

Model Descriptions

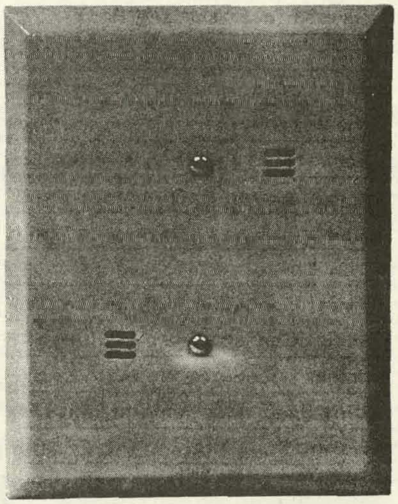
The **T-4002** is a single temperature thermostat.

The **T-4003** is a single temperature thermostat featuring a local and/or remote set point readjustment.

The **T-4004** is a single temperature low capacity thermostat. Through the use of a remote restrictor-tee arrangement, it requires only one air line connection at the thermostat.

The **T-4502** is a dual temperature thermostat for individual day control and programmed night or weekend setback. The day-night change is accomplished with a change in supply pressure levels. A 15 psig supply pressure is normally used for day or occupied settings. A 20 psig supply pressure is then used to switch temperature measurement to the second bimetal element which is calibrated to a lower setting. An optional manual switchover pushbutton is also available to restore the day temperature of the individual thermostat without affecting the total system program. The pushbutton can be unlatched either automatically with the program cycle or manually.

T-4000 Series Surface Mounted Thermostat



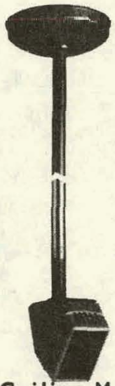
T-4000 Series Concealed Mounted Thermostat

The **T-4512** is a dual temperature thermostat for individual day control and programmed night or weekend setback. Functionally, it is similar to the T-4502, however it features an additional output air terminal which can be used as an on-off switchline to actuate auxiliary devices through the system program. The manual switchover pushbutton is standard on this thermostat. Use of the pushbutton restores day operation of the individual thermostat and exhausts the switchline pressure without affecting the total system program. The pushbutton can be unlatched either automatically with the program cycle or manually.

The **T-4752** is a heating-cooling thermostat. The heating-cooling change is accomplished with a change in supply pressure levels.

Mounting and Air Connection Chart

THERMOSTAT, MOUNTING OR AIR CONNECTION ACCESSORY DESCRIPTION		CODE NUMBER	FUNCTION
Room Instrument Mounting Bracket		T-4002-124	For surface mounting all thermostats and covers
Plastic Screw Anchors		F-1000-321	
Plaster Groundplate		T-4002-6038	For rough-in of surface mounted thermostats in masonry
Metal Wallbox		T-4002-6029	
Cover for Groundplate or Metal Wallbox		T-4002-5010	
Wire Guard	For Exposed Tubing	T-4002-3000	For surface mounted thermostat protection
	For Concealed Tubing	T-4002-3001	
Optional Wire Guard Mounting Plate		T-4002-6045	
Cast Aluminum Guard and Mounting Bracket		T-4002-3004	
Plastic Surface Mounting Back		T-4002-125	For surface mounted thermostats with exposed tubing
Terminal Connector with 2 Angle Fittings		T-4002-123	
Aspirator, Bracket, Wallbox and Beige Painted Wallplate		T-4000-105	For concealed mounted thermostats (less pushbuttons)
Aspirator, Bracket, Wallbox and Brushed Silver Wallplate		T-4000-106	
Optional Metal Rough-in Box for Masonry Walls		T-4000-104	
2-Tube Sheathed Polyethylene Strain Relief Bushing		T-4000-101	For rough-in box or metal wallbox to instrument air system tubing adaptation (1/2 in. knockout)
3-Tube Sheathed Polyethylene Strain Relief Bushing		T-4000-102	
1/2 in. Conduit (EMT) Connector		T-4000-103	
Terminal Connector with 2 Straight Fittings		T-4002-122	For optional plug-in connection to 5/32 in. O.D. polyethylene tubing
Terminal Connector with 3 Straight Fittings		T-4512-100	
Terminal Connector Protector Cap (For Rough-in Only)		T-4000-100	
Ceiling Suspended Mounting Kit (See T-4000-A Bulletin)		T-4002-100	Special
Adjusting Knob Kit		T-4002-5012	Optional set point dial provisions and parts
Set Point Dial Restricted Adjustment Kit		T-4002-5003	
0 to 180F Dial Strip (Select 30°F Span for Special Range)	Horizontal	T-4002-7000	
	Vertical	T-4002-7001	
−20 to 80C Dial Strip (Select 15°C Span for Special Range)	Horizontal	T-4002-7002	
	Vertical	T-4002-7003	

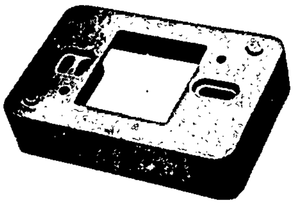


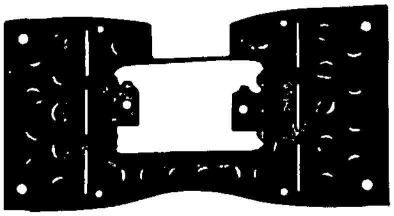
T-4000 Series Ceiling Mounted Thermostat
(Hanger Pipe and Ceiling Plate Purchased Locally)

Mounting and Air Connection Accessories


T-4002-124


F-1000-321

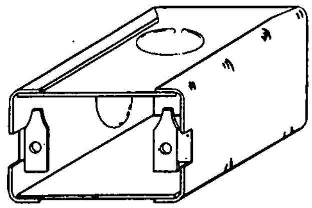

T-4002-125


T-4002-6038

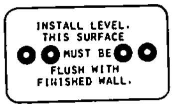

T-4002-123

(NOT SHOWN)
Refer to
T-4000-A.6 & A.7
Bulletins

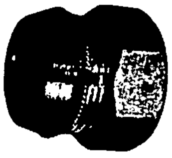
T-4000-105
T-4000-106
and
T-4000-104

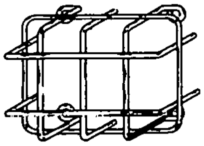

T-4002-6029


T-4000-101 & -102

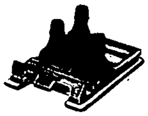


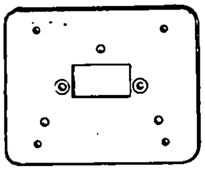
T-4002-5010


T-4000-103


T-4002-3000
or
T-4002-3001


T-4002-122


T-4512-100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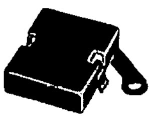
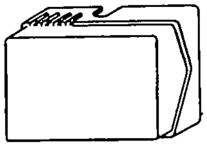
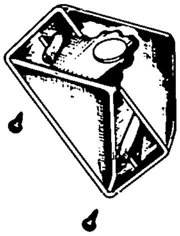
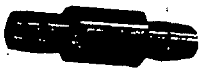

T-4000-100


T-4002-3004


T-4002-100

Additional Air Connection Accessories

FITTINGS


5/32 x 5/32 in.
F-300-31

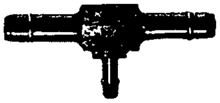

5/32 x 1/4 in.
F-300-30

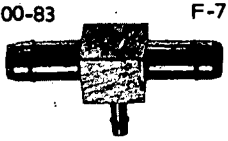

5/32 x 3/16 in. I.D.
F-100-20


5/32 or 1/4 in. Plug
F-1000-323

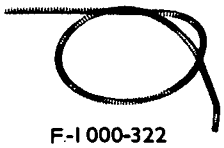
SUPPLY LINE TEES

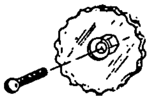

5/32 x 5/32 x 5/32 in.
F-700-83

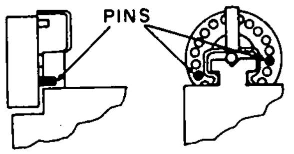

1/4 x 1/4 x 5/32 in.
F-700-84


3/8 x 3/8 x 5/32 in.
F-700-85

ANTI-KINK SPRING


F-1000-322


T-4002-5012



T-4002-5003

T-4002-7000, -7001, -7002 & -7003

Set Point Adjustment

The actual method of set point adjustment depends on the type of mounting and cover provision. For all concealed mounted thermostats, the wallplate must be removed to make set point adjustments. On surface mounted thermostat installations, concealed or exposed set point adjustments are available. The thermostat dials have a hex head drive which is designed to accept a T-4002-5012 adjusting knob. A T-4002-5003 restricted adjustment kit is available to physically limit the range of adjustment.

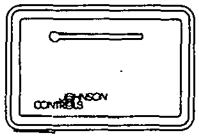
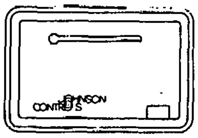
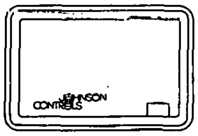
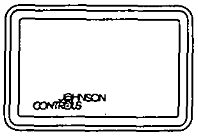
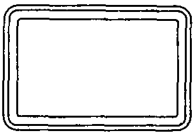
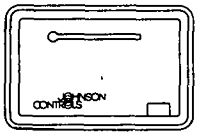
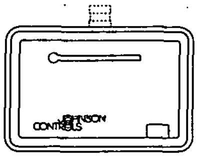
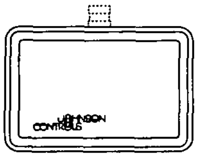
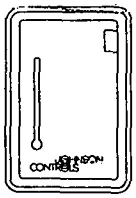
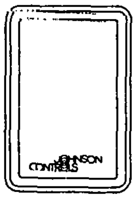
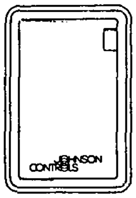
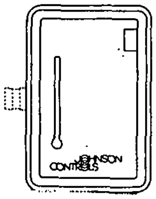
Installation

Thermostat installation procedures are detailed in appropriate T-4000-A series literature. Various accessories are available to facilitate mounting room thermostats to virtually any wall surface. Guards are available to provide extra protection to the installation in areas where such protection is desired or required. All thermostats can be conveniently surface mounted, with exposed or concealed tubing.

Concealed mounting, using an aspirator wallbox and flush wallplate, is available for all models, except those with manual switchover pushbuttons. An optional metal rough-in box is also available for installation of the aspirator wallbox in masonry walls. Thermostat installation kits are also available for ceiling suspended thermostat mountings, for modernizing Johnson T-400 installations and for converting non-Johnson thermostat installations.

Barbed terminal fittings are provided on all T-4000 series thermostats for direct air line connections with 5/32 in. O.D. polytubing. A plug-in terminal connector is furnished with all modernizing (conversion) kits and can be ordered separately as desired for any surface mounted thermostat installation (except T-4004).

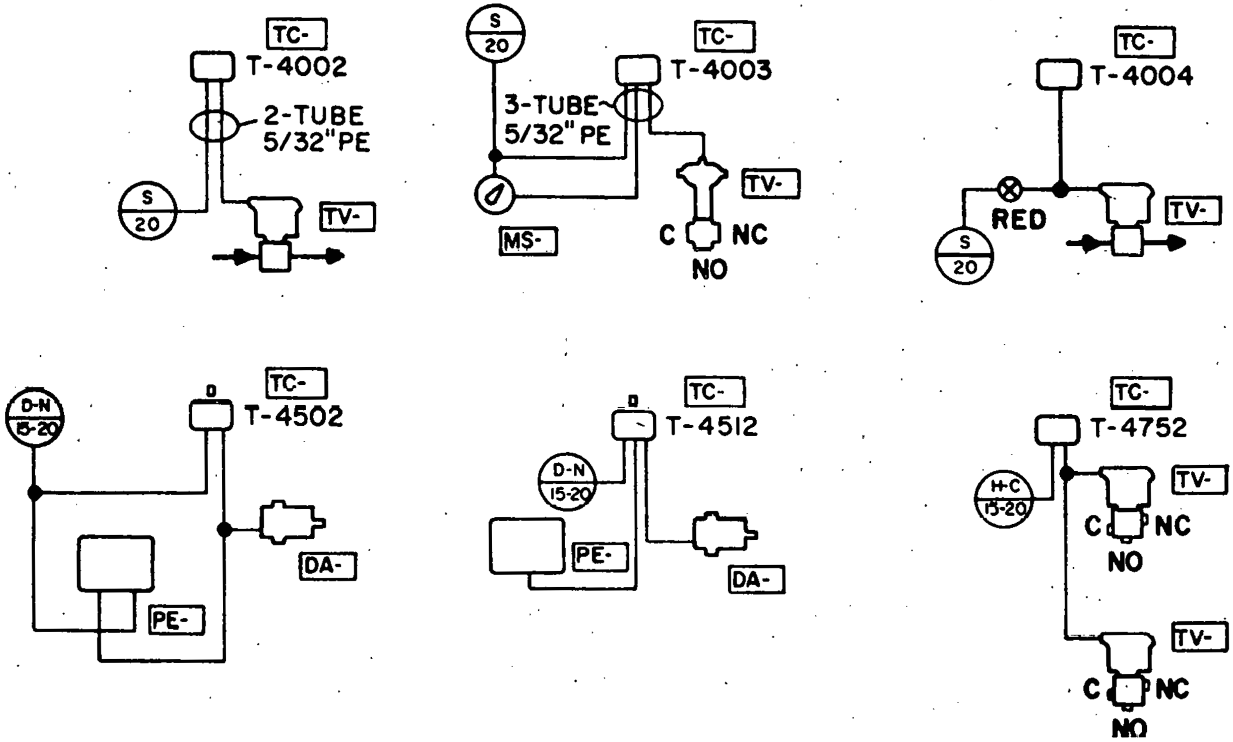
Beige Plastic Cover Selection Guide

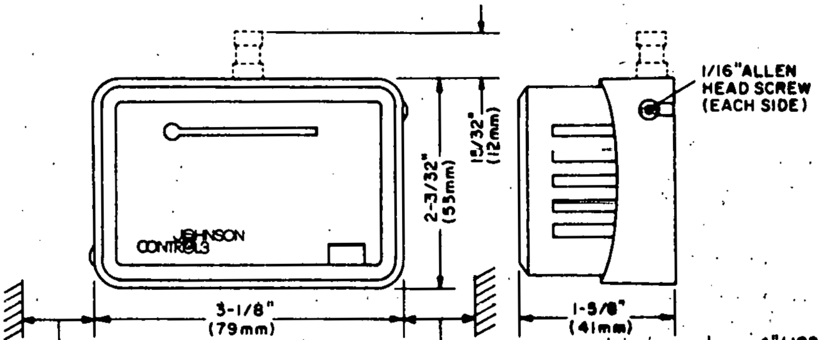
 35 to 95F T-4002-2140	 35 to 95F T-4002-2142	 T-4002-2141	 T-4002-2139
 Without Nameplate T-4002-2138	 0 to 35C T-4002-2143	 35 to 95F T-4502-1738	 T-4502-1737
 35 to 95F T-4002-2146	 T-4002-2144	 T-4002-2145	 35 to 95F T-4502-1739

Thermostat Selection Guide

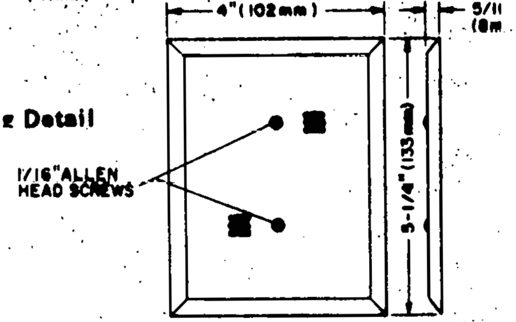
<table>
<tr><th>Models</th><th>Type</th><th colspan="2">Operation—Proportional</th><th>Gain</th><th>Air Connections</th><th>Standard Features</th><th>Optional Features</th></tr>
<tr><td>T-4002</td><td>Single Temperature
Single Bimetal</td><td colspan="2">400 scim (107 cm^3/sec) Air Capacity
Direct or Reverse Acting
Max. Supply of 25 psig (170 kPa)</td><td>Adjustable
1 to 6 psi/°F
(12 to 75 kPa/°C)</td><td>Two
Supply & Output</td><td>• Horizontal Dial
• Volume Amplifier
• Pneumatic Feedback</td><td>Vertical Dial</td></tr>
<tr><td>T-4003</td><td>Single Temperature
Single Bimetal
Submaster</td><td colspan="2">400 scim (107 cm^3/sec) Air Capacity
Direct Acting-Direct Readjustment
Reverse Acting-Reverse Readjustment
Readjustable Set Point of 0.004 to 1.0°F/psi (0.003 to 0.08°C/kPa)
Max. Supply of 25 psig (170 kPa)</td><td>Fixed
2.5 psi/°F
(31 kPa/°C)</td><td>Three
Supply, Output & Remote Reset Input</td><td>• Horizontal Dial
• Volume Amplifier</td><td>None</td></tr>
<tr><td>T-4004</td><td>Single Temperature
Single Bimetal</td><td colspan="2">25 scim (7 cm^3/sec) Air Capacity
Direct or Reverse Acting
Max. Supply of 25 psig (170 kPa)</td><td>Fixed
2.5 psi/°F
(31 kPa/°C)</td><td>One
Restricted Supply Thru 0.005 in. Orifice</td><td>• Horizontal Dial</td><td>Terminal Unit
Dial Lever</td></tr>
<tr><td>T-4502</td><td>Dual Temperature
Dual Bimetal
(Day-Night)</td><td colspan="2">400 scim (107 cm^3/sec) Air Capacity
Dual Direct Acting or Dual Reverse Acting with Automatic Changeover</td><td>Adjustable
1 to 6 psi/°F
(12 to 75 kPa/°C)</td><td>Two
Supply & Output</td><td>• Horizontal Dial Adjusts Both Set Points Equally
• Volume Amplifier
• Pneumatic Feedback
• 17 psig (117 kPa) Switchpoint</td><td>Vertical Dial
Manual Pushbutton</td></tr>
<tr><td rowspan="4">T-4512</td><td rowspan="4">Dual Temperature
Dual Bimetal
(Day-Night)
Switchline</td><td colspan="2">400 scim (107 cm^3/sec) Air Capacity
Dual Direct Acting</td><td rowspan="4">Adjustable
1 to 6 psi/°F
(12 to 75 kPa/°C)</td><td rowspan="4">Three
Supply, Output & Switchline</td><td rowspan="4">• Horizontal Dial Adjusts Both Set Points Equally
• Volume Amplifier
• Pneumatic Feedback
• 17 psig (117 kPa) Switchpoint
• Manual Pushbutton</td><td rowspan="4">Vertical Dial</td></tr>
<tr><td>Supply Pressure</td><td>Switchline Pressure</td></tr>
<tr><td>15 psig (100 kPa)</td><td>0</td></tr>
<tr><td>20 psig (140 kPa)</td><td>20 psig (140 kPa) or 0 (Button Depressed)</td></tr>
<tr><td rowspan="6">T-4752</td><td rowspan="6">Dual Temperature
Dual Bimetal
(Heating-Cooling)</td><td colspan="2">400 scim (107 cm^3/sec) Air Capacity
Automatic Changeover</td><td rowspan="6">Adjustable
1 to 6 psi /°F
(12 to 75 kPa/°C)</td><td rowspan="6">Two
Supply & Output</td><td rowspan="6">• Horizontal Dial Adjusts Both Set Points Equally
• Volume Amplifier
• Pneumatic Feedback
• 17 psig (117 kPa) Switchpoint</td><td rowspan="6">Vertical Dial</td></tr>
<tr><td>Action</td><td>Supply</td></tr>
<tr><td>Direct</td><td>15 psig (100 kPa)</td></tr>
<tr><td>Reverse</td><td>20 psig (140 kPa)</td></tr>
<tr><td>Direct</td><td>20 psig (140 kPa)</td></tr>
<tr><td>Reverse</td><td>15 psig (100 kPa)</td></tr>
</table>

Typical Thermostat Application Diagrams





Surface Mounted Cover Mounting Detail



Concealed Mounted Cover
Mounting Detail

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

T-5210
Pneumatic Temperature Transmitter

The T-5210 Pneumatic Temperature Transmitter is designed to measure a temperature and convert the measurement to an air pressure signal that is transmitted to a pneumatic receiver, controller or receiver-indicator. Pneumatic feedback is incorporated into the transmitter design to assure an exact proportional relationship between the measured temperature and the transmitted signal.

The T-5210 is a low volume instrument used with an external .007 in. (0.18 mm) restrictor. Various models are furnished with appropriate brackets for mounting to duct work, walls or directly to the hub of a duct flange or separable well. Models are available with bulb elements with 5-1/2 in. (140 mm) or 4 ft (1220 mm) capillaries or 8 ft (2440 mm) and 17 ft (5200 mm) averaging elements with 1 ft (305 mm) capillaries. All transmitters are furnished with a hypodermic plug-in test gage fitting on the air connection to facilitate checking the transmitter output pressure.

Table 1: Operating Ranges

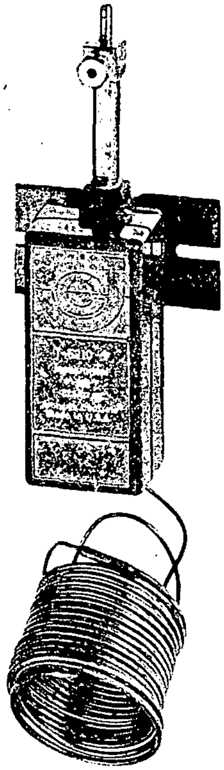
T-5210-Code Numbers	Operating Temperature Ranges F/C	Element Style
1	50 to 100 10 to 37.8	Bulb with 5-1/2 in. (140 mm) Capillary
2	0 to 100 -17.8 to 37.8	
4	40 to 240 4.4 to 115.6	
123	60 to 85 15.6 to 29.5	
8	50 to 150 10 to 65.6	
125	40 to 65 4.4 to 18.3	
113	-40 to 160 -40 to 71	Bulb With 4 ft (1220 mm) Capillary
144	-20 to 80 -28.9 to 26.7	
114	0 to 100 -17.8 to 37.8	
135	200 to 400 93.3 to 204.5	
7	50 to 150 10 to 65.6	8 ft (2440 mm) Averaging With 1 ft (305 mm) Capillary
6	40 to 24 4.4 to 115.6	
5	50 to 100 10 to 37.8	
9	0 to 100 -17.8 to 37.8	
124	40 to 65 4.4 to 18.3	
116	50 to 150 10 to 65.6	17 ft (5200 mm) Averaging With 1 ft (305 mm) Capillary
118	0 to 100 -17.8 to 37.8	

Operation

The T-5210 provides an accurate and linear output pressure change which is directly proportional to a sensed temperature change. The output signal, which varies from 3 to 15 PSIG (21 to 105 kPa) within each of the operating ranges available, is transmitted to a receiver which may be an indicator, a recorder, a controller or any combination of these.

Installation

The T-5210 transmitter operates in any position and should be mounted on a rigid flat surface.



Typical T-5210 with Averaging Element

Transmitters with averaging elements or bulb elements with 4 ft (1220 mm) capillaries are furnished with an appropriate

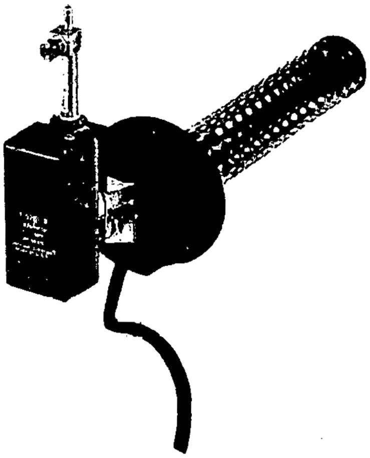
Specifications

Product	T-5210 Pneumatic Temperature Transmitter
Action	Direct—Proportional
Models & Operating Ranges	See Table 1
Element Styles (Liquid Filled)	Bulb Type and Averaging (See Table 1)
Transmitter Pressure Range	3 to 15 PSIG (21 to 105 kPa)
Supply Pressure	20 PSIG (140 kPa)
Mounting	With Appropriate Bracket Furnished
Air Connection	Gage Tee Fitting with Barbed Connection for 1/4 in. O.D. Polytubing
Ambient Temperature Limits	-20 to 150F (-29 to 65C)
Accessories (Order Separately)	Duct Flanges, Separable Wells, Compression Nut, Sheet Metal Bracket for Duct Mounting, Element Holder, 0.007 in. (0.18 mm) Aqua Restrictor, Dewcel® Adapter Kit and Sunshield

bracket for mounting with #8 sheet metal screws. Transmitters with bulb elements and 5-1/2 in. (140 mm) capillaries are furnished with an appropriate bracket for direct mounting to the hub of a duct flange or separable well. The transmitter is secured to the flange or well by tightening the spring locknut furnished.

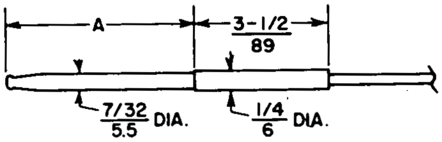
Readjustment

All T-5210 transmitters are factory calibrated. Instrument spans are set and sealed at the factory. The operating range of the instrument is adjustable for shifting spans for special applications; refer to the T-5210-A Installation Data for details.



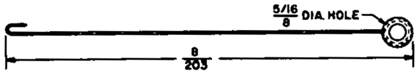
T-5210 Dew Point Transmitter Mounting

Bulb Element Dimensions

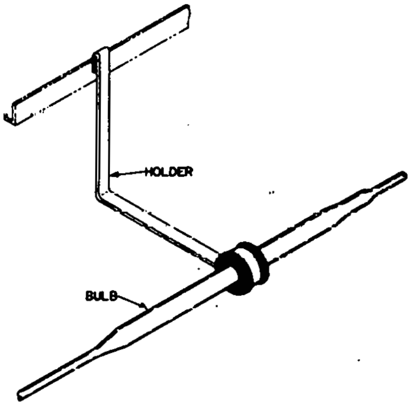


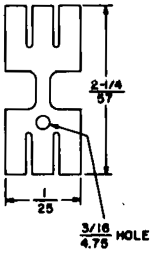
Transmitter T-5210-Suffix	Dim."A" (Nominal) in./mm	Usable Wells T-800-Suffix
1, 123 & 125	5-1/2 140	1618 1620
2, 4, 8, 113, 114 & 144	3-15/16 100	1606 1605 1624
135	4-1/8 105	

T-800-1608 Single Element Sunshield Mounting Detail

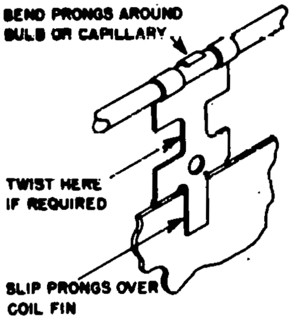


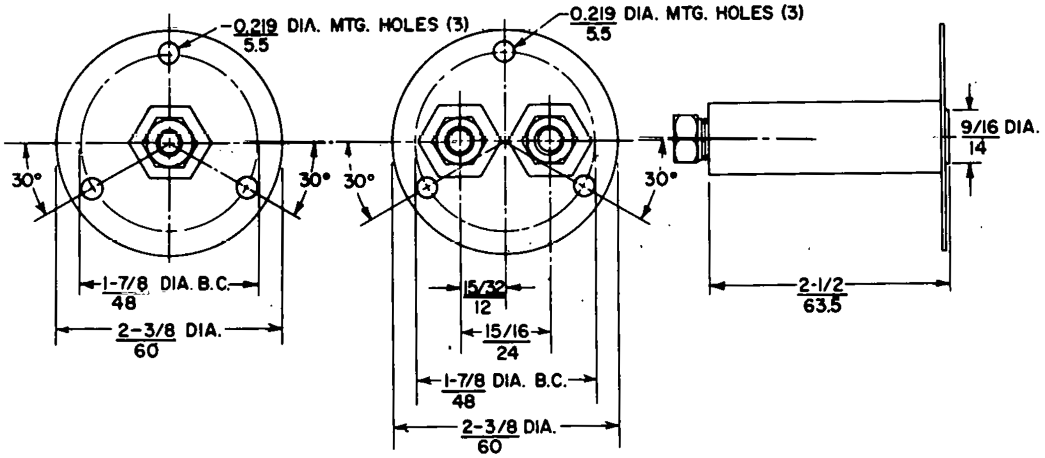
T-275-100 Bulb Holder Dimensions $\frac{\text{in.}}{\text{mm}}$ (above) & Mounting Detail (below)



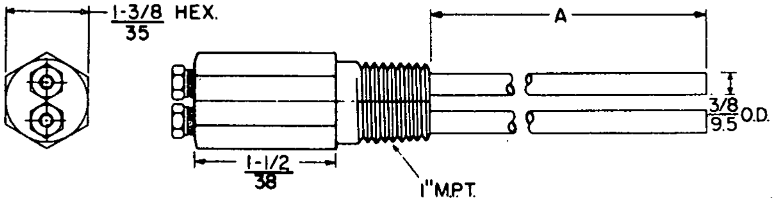


T-275-101 Averaging Element Holder Dimensions $\frac{\text{in.}}{\text{mm}}$ (left) and Mounting Detail (below)

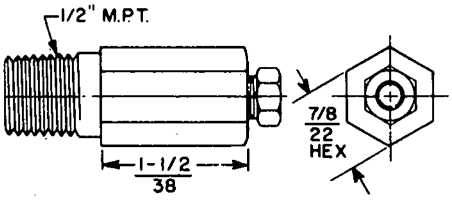




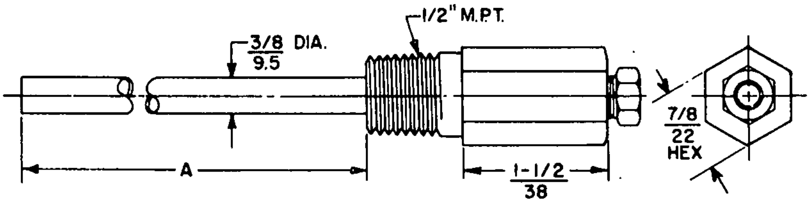
T-800-1603 (Single Hub) & T-800-1604 (Double Hub) Duct Flange Dimensions $\frac{\text{in.}}{\text{mm}}$



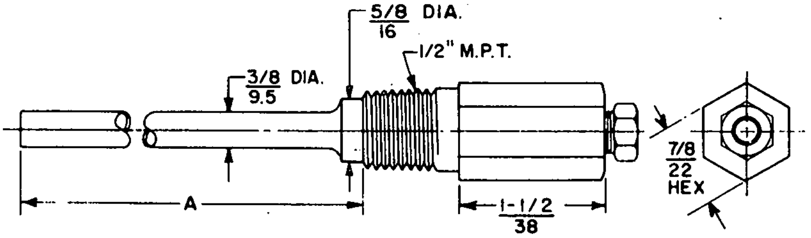
Dual Brass Well Dimensions $\frac{\text{in.}}{\text{mm}}$



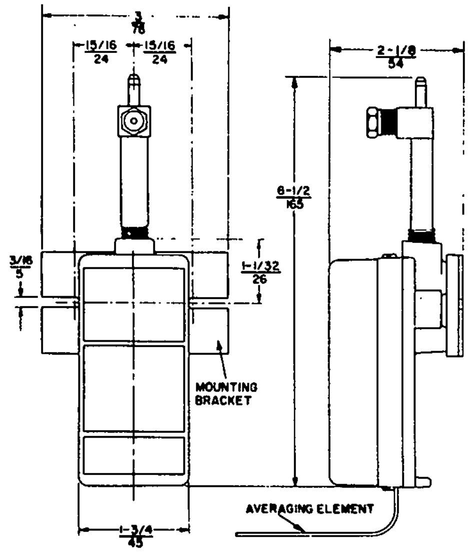
T-800-1610 Adapter Nut Dimensions $\frac{\text{in.}}{\text{mm}}$



Single Brass Well Dimensions $\frac{\text{in.}}{\text{mm}}$

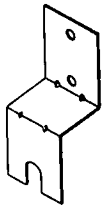


Stainless Steel Well Dimensions $\frac{\text{in.}}{\text{mm}}$

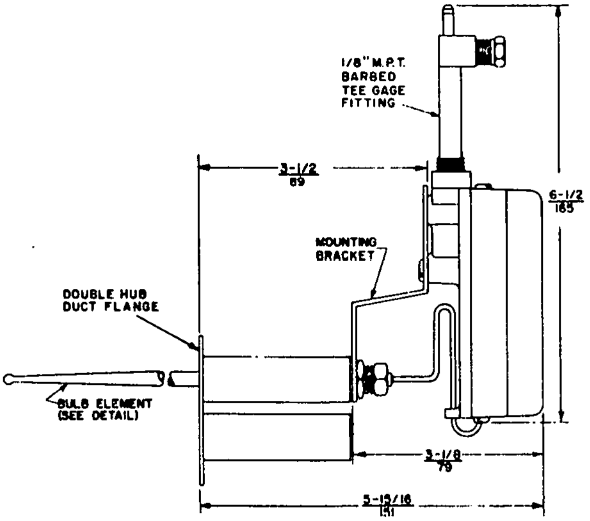


T-5210 with Averaging Element Dimensions $\frac{\text{in.}}{\text{mm}}$

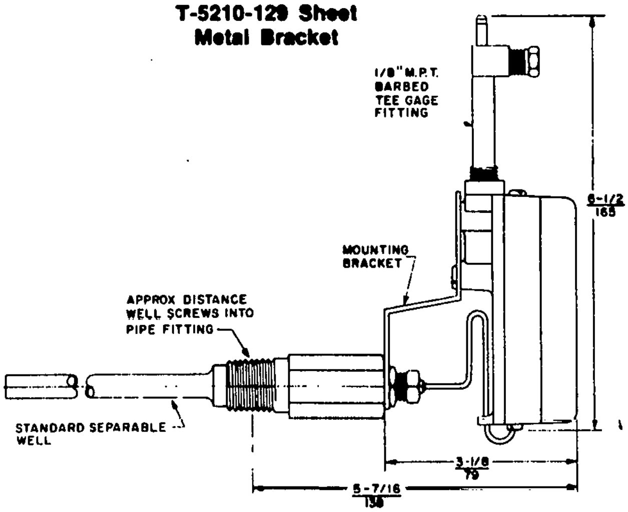
Dual Brass	Single Brass	Stainless Steel	Dim. In./mm "A"	Temperature Span
—	T-800-1618	T-800-1620	9-1/2 241	25F & 50F or 13.9C & 27.8C
T-800-1624	T-800-1605	T-800-1606	6-1/2 165	100F & 200F or 55.6C & 111.2C



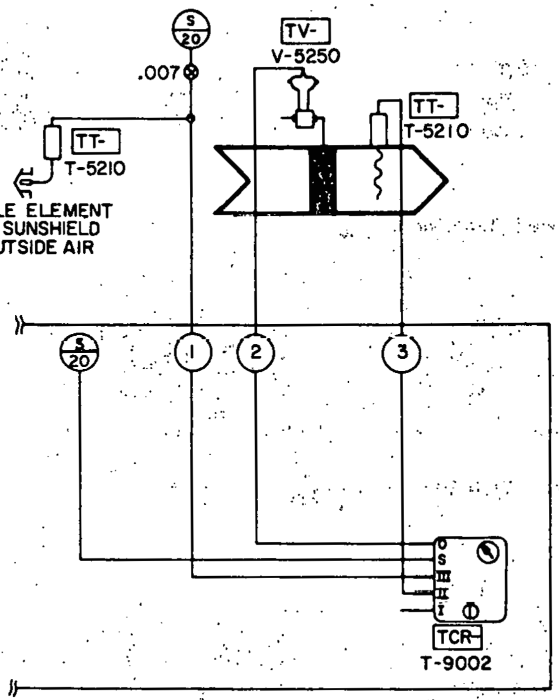
T-5210-129 Sheet Metal Bracket



T-5210 with Double Hub Duct Flange Dimensions $\frac{\text{in.}}{\text{mm}}$



T-5210 with Bulb Element Dimensions $\frac{\text{in.}}{\text{mm}}$



Typical T-5210 Application

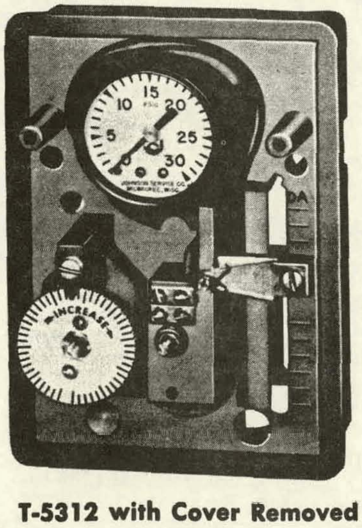
JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

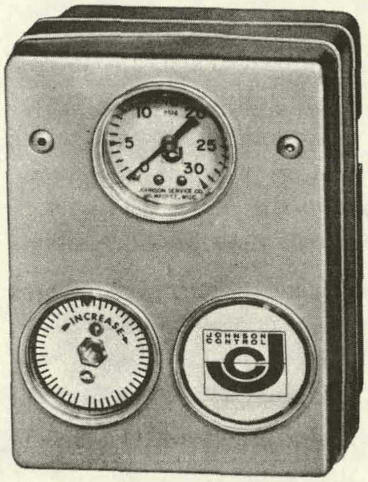
T-5312 Receiver-Controller for Pneumatic Transmission Systems

The Johnson T-5312 Receiver-Controller is designed for use in Pneumatic Transmission Systems to directly control dampers, valves and other devices. This instrument produces an output signal that is proportional to a 3 to 15 psi pressure signal from a remotely located transmitter measuring the value of any variable, such as temperature, humidity or pressure. A two-position instrument is also available. The T-5312 is ideally suited for installations that require the controller to be mounted on a local control panel.

Shock and vibration tests have proven the durability of the T-5312. The use of flexure levers reduces hysteresis and friction. This instrument can be made to function as a direct or reverse acting controller by changing the position of the patented sliding control port. Repositioning the sliding control port will also change the gain on proportional models and the differential on two-position models. Gain is the output pressure change in psi per input change in psi. Differential is the amount of change in input needed to change the output from maximum to minimum or vice versa.



T-5312 with Cover Removed



T-5312 Receiver-Controller

The output pressure is indicated on an integral gage that is visible through the cover. The graduated set point dial is also visible through the cover. An external dial adjustment assembly is available as a separate item.

Function identification label kits are available for placement in the window containing the Johnson emblem insert. One kit consists of blank phenolic plates for engraving the function identification. The other kit consists of blank paper labels for embossed tape, typewritten or other printed processes. Also available is a function label frame which may be used with the paper labels.

Pneumatic Transmission

Johnson Pneumatic Transmission Systems are especially designed for applications that require centralization of control and indication functions. The system consists of a remotely located transmitter, a receiver-controller and an indicator all connected by air pressure piping. Variables such as humidity, temperature, electrical current and voltage fluctuations which may affect electric and electronic

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transmission signals have no effect on pneumatic transmission.

Operation

As the pressure signal from the remote transmitter increases or decreases, it is measured by the element diaphragm of the T-5312. The pressure change at the diaphragm is transmitted to a system of levers that open and close the control port. This causes the output pressure of the T-5312 to change according to the transmitted pressure signal change.

The sliding control port rail is marked DA (direct acting) at the top and RA (reverse acting) at the bottom. Moving the sliding control port upward (DA) or downward (RA) from the mid-point on the slider rail increases the gain for proportional action applications and decreases the differential for two-position applications.

Mounting

The T-5312 can be surface mounted, in which case the air connections at the sides and the input signal connection at the bottom are used. Since the T-5312 is designed with a flange around the base, it can also be mounted on a panel up to 1″ thick, using the panel mounting kit available as a separate item. When panel mounted, the air connections and the input signal connection at the back of the base are used. Plugs are furnished for the connections that are not used.

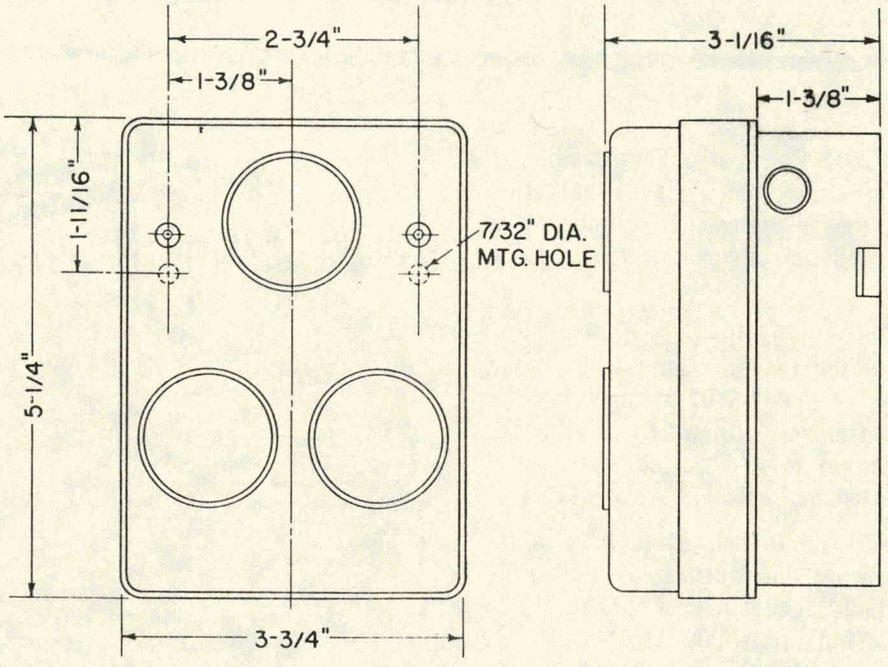
Set Point Dial Graduations

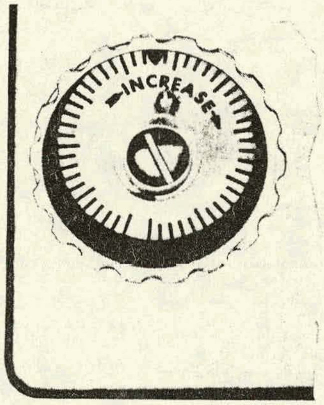
TRANSMITTER SPAN	GRADUATIONS REPRESENT
25 C DEGREES	½ C DEGREE
50 F OR C DEGREES	1 F OR C DEGREE
100 F OR C DEGREES	2 F OR C DEGREES
200 F DEGREES	4 F DEGREES

Specifications

MODEL		T-5312 RECEIVER CONTROLLER
ACTION		PROPORTIONAL OR TWO-POSITION, DIRECT OR REVERSE ACTING (FURNISHED DIRECT ACTING, FIELD REVERSIBLE)
ELEMENT		FLEXIBLE METAL DIAPHRAGM
GAIN (PROPORTIONAL)		ADJUSTABLE FROM 1:1 TO 40:1 FACTORY SET AT 8:1
DIFFERENTIAL (TWO-POSITION)		ADJUSTABLE FROM .2 TO 4 psi FACTORY SET AT .25 psi
MATERIAL	BODY	DIE CAST ALUMINUM
	COVER	DIE CAST ZINC
FINISH	BODY	IRIDITE
	COVER	SPRAYED SILVER
INSTRUMENT AMBIENT TEMP. LIMITS		—20 TO 150F (—29 TO 65C)
SET POINT ADJUSTMENT		VISIBLE GRADUATED DIAL, CONCEALED ADJUSTMENT
OUTPUT PRESSURE INDICATION		0 TO 30 psi INTEGRAL GAGE
MAXIMUM SUPPLY PRESSURE		25 psi
INPUT SIGNAL PRESSURE CONNECTION		⅛″ F.P.T.
AIR CONNECTIONS		⅛″ F.P.T.
MOUNTING		SURFACE OR PANEL
ACCESSORIES		EXTERNAL DIAL ADJUSTMENT ASSEMBLY; PANEL MOUNTING KIT; BLANK PHENOLIC OR PAPER FUNCTION LABEL KIT; FUNCTION LABEL FRAME

Dimensions





External Dial Adjustment

Product Data —— Catalog Section T
Issue Date 17J3 Series 5502

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

T-5502 Pneumatic Thermometer for Pneumatic Transmission Systems

The Johnson T-5502 Pneumatic Thermometer is designed to provide continuous visual indication of the temperature measurement of one transmitter in a 3 to 15 psi pneumatic transmission system.

This instrument is an easily read dial-type indicator available in standard sizes of 2½" and 3½". The range of the T-5502 must match the range of the transmitter with which it is used. The available ranges for the standard size thermometers are listed in Table I.

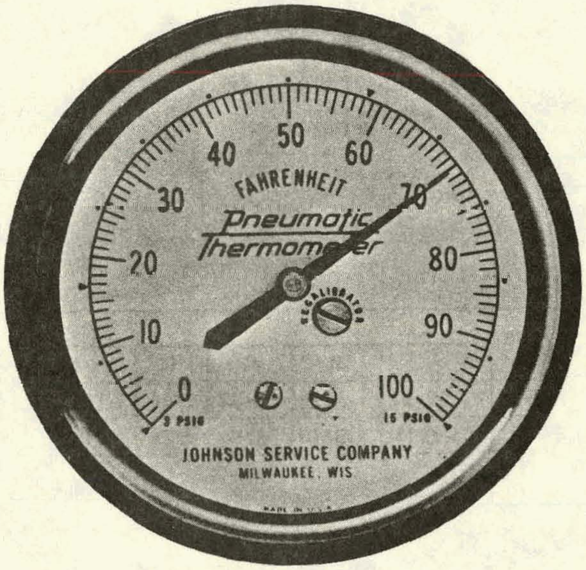
All T-5502 pneumatic thermometers have a recalibration screw on the face of the dial. The finish is dull black lacquer with a chrome plated ring. A set point indicator, consisting of a ring, crystal and red pointer assembly, is available on order.

Pneumatic Transmission System

A basic pneumatic transmission system consists of a pneumatic transmitter sending an air pressure signal to a receiver through air pressure piping.

TABLE I

TRANSMITTER SPANS	TEMPERATURE RANGE	CODE NUMBER T-5502-	
		2-1/2"	3-1/2"
25F°	40 to 65F	133	135
	60 to 85F	134	136
50F°	30 to 80F	160	157
	75 to 125F	151	152
	50 to 100F	1	20
100F°	0 to 100F	2	21
	50 to 150F	3	22
200F°	−40 to 160F	4	23
	40 to 240F	5	24
	200 to 400F	153	154
25C°	10 to 35C	102	120
50C°	−15 to 35C	101	121
	10 to 60C	103	122
100C°	0 to 100C	104	123
	−40 to 60C	105	124
	100 to 200C	155	156



The receiver can be an indicator, a recorder, a controller or any combination of the three. Pneumatic transmission has been especially engineered for installations, where centralization of all functions is desired; thus, temperatures can be controlled, indicated or recorded at a central panel.

Variables, such as humidity, temperature, electrical current and voltage fluctuation, have no effect on the pneumatic signal being transimtted to the receiver.

Operation

A signal pressure, which is proportional to the temperature being measured by the transmitter, is received by the T-5502 pneumatic thermometer. The T-5502 continuously converts the signal into a visual indication of the temperature being measured.

Mounting

The T-5502 thermometer is equipped to be flush or surface mounted. The "U" clamps, used for flush mounting, are notched to break off to accommodate various panel thicknesses.

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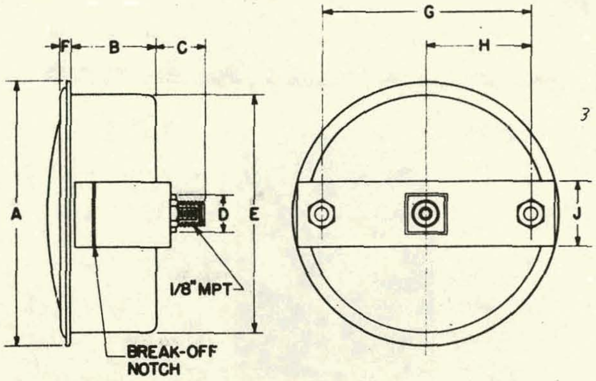
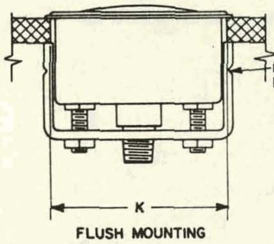
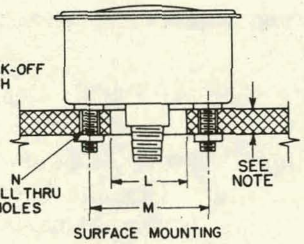
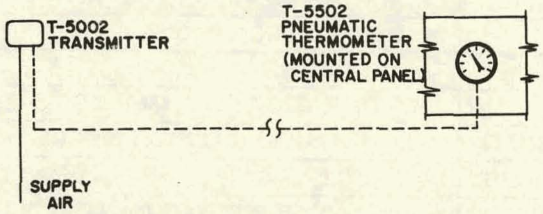




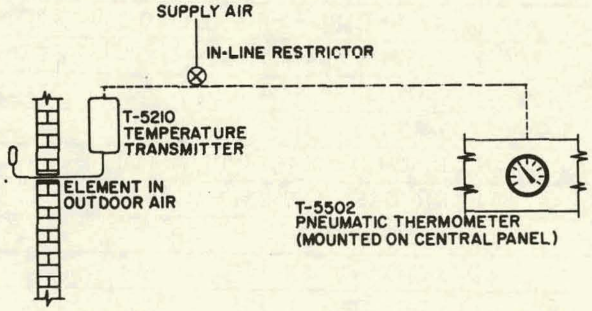


NOTE: Panel thickness not to exceed 1/16" minimum or 1/2" maximum.

Size (in.)	Dimensions (in.)												
	A	B	C	D	E	F	G	H	J	K	L	M	N
2½	2-29/32	1-3/16	25/32	9/16	2-19/32	3/32	2-3/32	1-1/16	1	2-5/8	7/8	2-3/32	7/32
3½	4-1/16	1-5/16	3/4	9/16	3-11/16	5/32	3-3/16	1-19/32	1	3-3/4	7/8	3-3/16	7/32



T-5502 Indicating Room Air Temperature



T-5502 Indicating Outdoor Air Temperature

Product Data —— Catalog Section **T**
Issue Date **17J2** Series **8501**

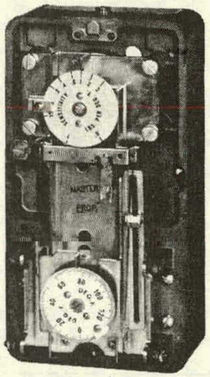
JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

T-8501 Submaster Thermostat Bulb Element

The Johnson T-8501 Remote Bulb Submaster Thermostat is provided with automatic readjustment of set point by a remote master controller. The set point varies as master pressure from the master controller varies. An adjusting dial permits manual readjustment of set point at the instrument.

The T-8501 is recommended for applications where highly accurate control is required with the measuring element installed where vibration exists. It is used also where the



Specifications

MODEL		T-8501 REMOTE BULB SUBMASTER THERMOSTAT	
ACTION		PROPORTIONAL – DIRECT OR REVERSE ACTING*	
DIRECTION OF READJUSTMENT		DIRECT OR REVERSE READJUSTMENT*	
ELEMENT		LIQUID FILLED	
CAPILLARY LENGTH		SEE TABLE I	
OPERATING RANGE		-30 TO 300F (-34 TO 148C)	
DIAL RANGES	FAHRENHEIT	-10 TO 125F AND 115 TO 250F (ON REVERSE SIDE OF DIAL)	
	CENTIGRADE	0 TO 140C	
DIAL GRADUATIONS		EQUALLY SPACED OVER ENTIRE RANGE; EQUALS 1F° OR 1C°	
DIAL MARKINGS	FAHRENHEIT	0 TO 120F AND 120 TO 240F IN 20° INCREMENTS	
	CENTIGRADE	10 TO 130C IN 20° INCREMENTS	
SENSITIVITY		ADJUSTABLE FROM 1/8 TO 5 psi/F°	
RANGE OF READJUSTMENT		MASTER AIR (psig)	SET POINT CHANGE
		0 TO 15	3 TO 165F°
		0 TO 20	4 TO 220F°
TEMPERATURE ADJUSTMENT		DIAL CONCEALED BENEATH COVER	
MATERIAL	BODY	DIE CAST ALUMINUM	
	COVER	DIE CAST ZINC	
	BULB	STAINLESS STEEL	
	CAPILLARY	STAINLESS STEEL	
FINISH	BODY	IRIDATE	
	COVER	SPRAYED SILVER	
MOUNTING		SURFACE OR SEMI-FLUSH	
AMBIENT TEMPERATURE LIMITS		-35 TO 150F (-37 TO 65C)	
AIR CONNECTIONS		1/8" F.P.T.	
MAXIMUM SUPPLY PRESSURE		30 psig	
ACCESSORIES		GAGES, FITTINGS, SEPARABLE WELLS, DUCT FLANGES, SEMI-FLUSH MOUNTING KIT, AND HIGH AND LOW LIMIT STOPS	

*** The pivots may be changed in the field if the opposite action or readjustment is desired.**

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measuring element location makes it inconvenient to make instrument adjustments and for control panel mounting.

The T-8501 is available as a proportional, direct or reverse acting instrument. A direct acting thermostat increases control pressure when temperature increases. A reverse acting thermostat decreases control pressure when temperature increases. A simple field change of pivot location converts the instrument from one action to the other.

The T-8501 is so designed that increasing master pressure raises or lowers the set point depending on the pivots used. When increasing master pressure raises the set point, the T-8501 has direct readjustment. When increasing master pressure lowers the set point, the T-8501 has reverse readjustment. The T-8501 is available with direct or reverse readjustment. The pivots may be changed in the field if the opposite readjustment is desired.

TABLE I: LIQUID FILLED ELEMENTS FOR T-8500 SERIES THERMOSTATS

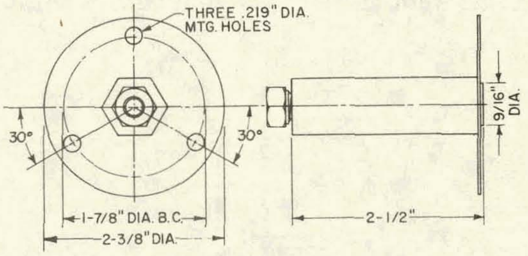
CAPILLARY TYPE	CAPILLARY LENGTH	ELEMENT
—	—	Insertion *
—	—	Immersion
—	—	8 Ft. Ave.
Non-Compensated	4'	"B" Bulb
		8 Ft. Ave.
	8'	"B" Bulb
		8 Ft. Ave.
	15'	"B" Bulb *
		8 Ft. Ave.
	25'	"B" Bulb
		8 Ft. Ave.
Compensated	8'	"B" Bulb
		8 Ft. Ave.
		16 Ft. Ave.
	15'	"B" Bulb
		8 Ft. Ave. *
		16 Ft. Ave. *
	25'	"B" Bulb
		8 Ft. Ave.
		16 Ft. Ave.
Compensated For Radiation	8'	Dual "B" Bulb

* Available with Marine Finish

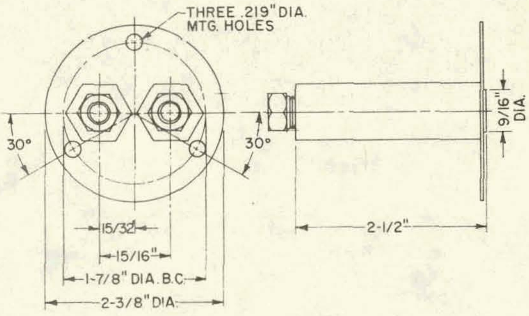
The linear expansion and contraction of the liquid in the measuring element result in uniform graduations and sensitivities over the entire range of operation. The T-8501 is available with a style "B" bulb or averaging element with various compensated and non-compensated capillaries. TABLE I lists the elements available. All elements are supplied separately and are field mounted to the thermostat.

A 5" non-compensated portion of bulb makes it possible to vary the depth of element insertion. A stainless steel or brass separable socket is available to make it possible to remove the bulb from a pipe or tank without draining the system.

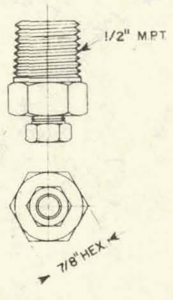
Sensitivity of a thermostat is defined as the change in control air pressure per unit change in the controlled variable. It is expressed as psi per degree. Sensitivity is adjustable from 1/8 through 5 psi per degree by moving a slider located on the control mechanism.



Single Well Duct Flange



Dual Well Duct Flange



Adapter Nut

Operation

1. Control mechanism

The liquid in the measuring element expands or contracts with temperature changes. This movement is transmitted to the control port lid through a system of levers. Output pressure to the controlled device varies with control port lid movement. The amount of movement depends on location of the sensitivity slider which applies movement to the control port lid. Pivots "A" and "B" determine whether the instrument is, respectively, direct or reverse acting. Pivots "D" and and "C" determine whether the instrument has respectively, direct readjustment or reverse readjustment.

2. Readjustment mechansim

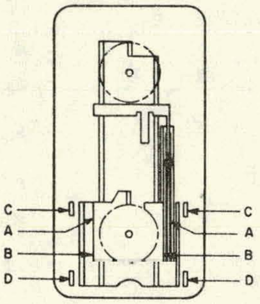
Set point depends on the position of the control mechanism assembly with respect to the control port. The assembly is so pivoted that turning the set point dial positions the assembly to establish set point. The readjustment bellows, connected to the free end of the control mechanism assembly changes set point as master pressure increases and expands the bellows.

Stops

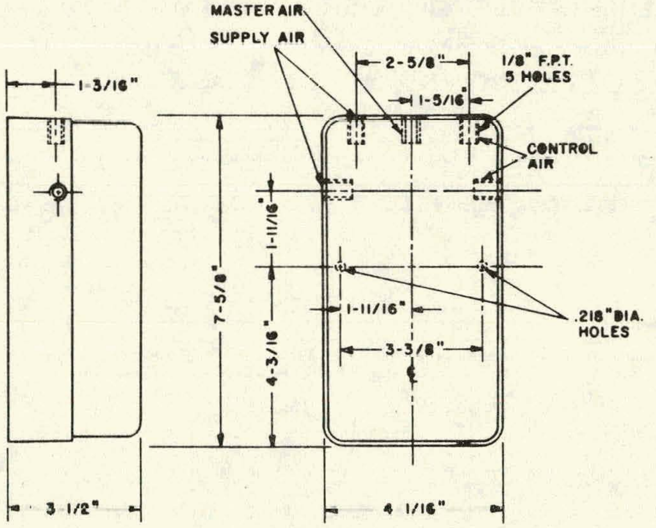
On some applications, it may be necessary to readjust the submaster thermostat over only a portion of the master pressure range. The T-8501 is available with special stops for this purpose. Stops may be arranged to limit readjustment in one direction only or in both directions, as may be required by the application.

Mounting

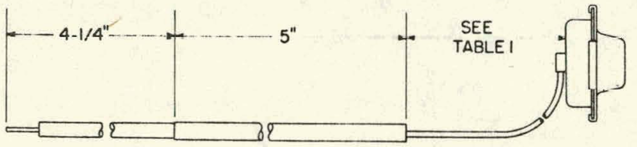
The T-8501 should be located on a wall, column or panel at an accessible level. The position and location of the measuring element do not affect operation. All elements for the T-8501 instruments are field installed. Avoid kinking the capillary when mounting.

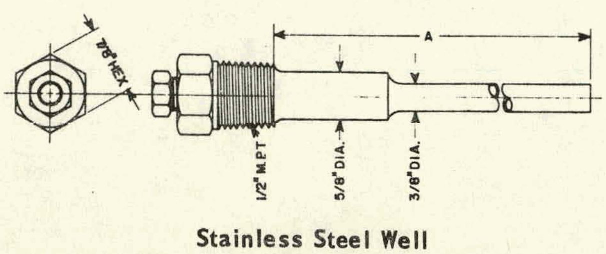


Pivot Location



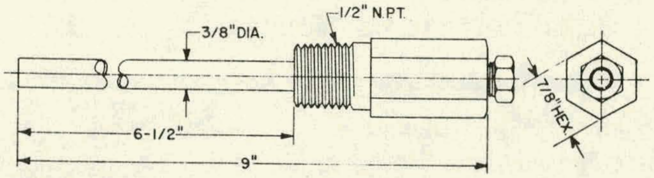
Dimensions



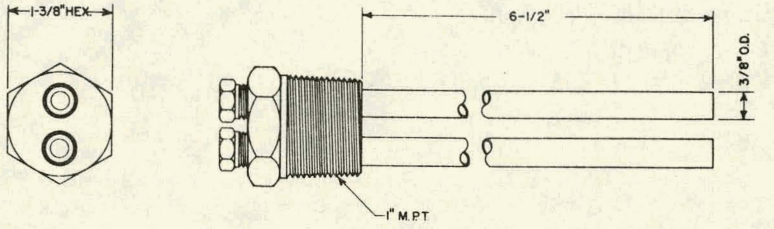


Stainless Steel Well

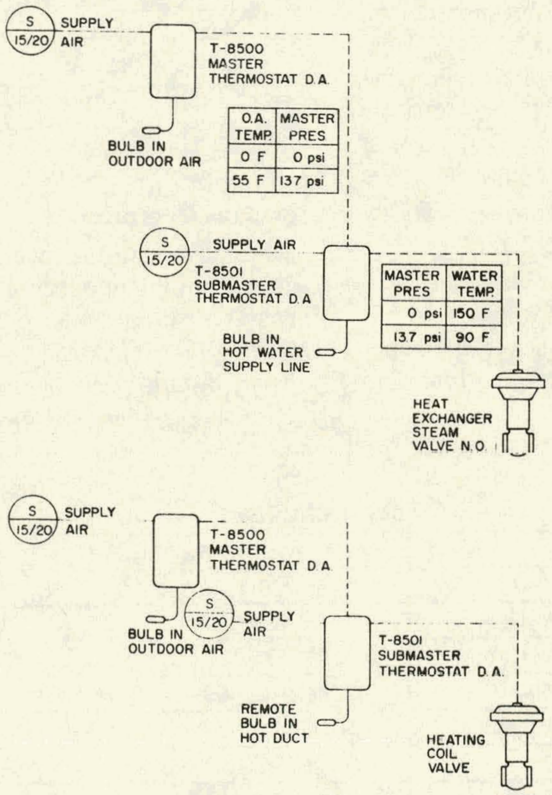
Dimension "A" (in.)	Temperature Span
9½	100F°
	50C°
6½	200F°
	100C°



Single Brass Immersion Well



Dual Brass Immersion Well



O.A. TEMP.	MASTER PRES
0 F	0 psi
55 F	13.7 psi

MASTER PRES	WATER TEMP.
0 psi	150 F
13.7 psi	90 F

Typical Applications

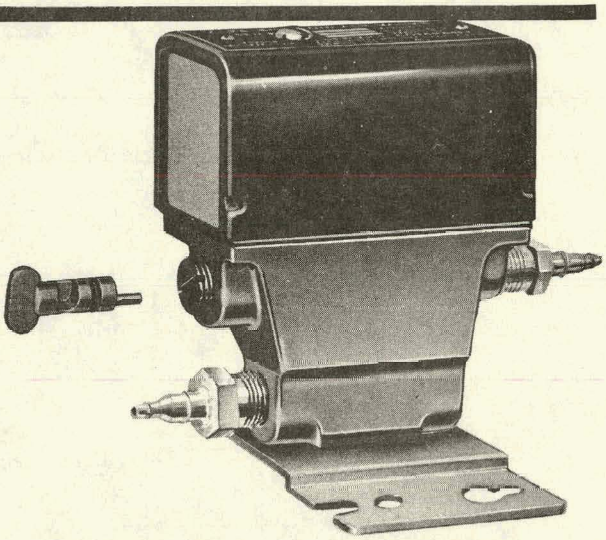
JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

V-24
Solenoid Three-Way Air Valve

The Johnson V-24 solenoid three-way air valve is used in applications where the operation of a pneumatically operated control device is dependent upon an electrical circuit.

Furnished for two-position action, the solenoid air valve has three piping connections marked: N.O. (normally open), N.C. (normally closed) and COM (common). The V-24 is U.L. listed.



Johnson V-24 Solenoid Three-Way Air Valve

Operation

Current flow through the solenoid generates an electromagnetic field. A permeable plunger, linked to the valving mechanism, is drawn into the field, opening the common outlet to the normally closed outlet. With no current flow, the plunger returns to its normal position, closing the valve to the normally closed outlet and opening the valve to the normally open outlet.

Mounting

The V-24 is supplied with a bracket attached. The unit is operable in whatever position it is mounted.

Manual Operation

The V-24 may be operated manually independently of the electrical circuit. This makes it possible to actuate the pneumatic circuit for testing or checkout without closing the electrical circuit. Manual operation is accomplished by removing the plug and inserting a key.

Specifications

PRODUCT		V-24 A.C. OPERATED
ACTION		TWO-POSITION
VOLTAGE (50/60 HZ A.C.)	24V	CODE NO. V-24-1
	110/120V	CODE NO. V-24-2
	208V	CODE NO. V-24-3
	220/240V	CODE NO. V-24-4
	277V	CODE NO. V-24-5
	440/480V	CODE NO. V-24-6
POWER CONSUMPTION		6 WATTS
AIR CONNECTIONS		BARBED FITTINGS (F-100-21) FOR 1/4 IN. OR 5/32 IN. O.D. FLEXIBLE TUBING
ELECTRICAL CONNECTIONS		1/2" CONDUIT OPENING (SEE DIMENSIONS, PAGE 2)
MAXIMUM AMBIENT TEMPERATURE		140F (60C)
MAXIMUM OPERATING PRESSURE-ALL AIR CONNECTIONS		30 psig (205 kPa)

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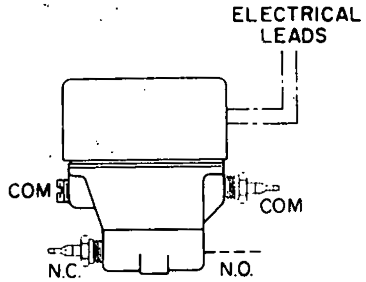
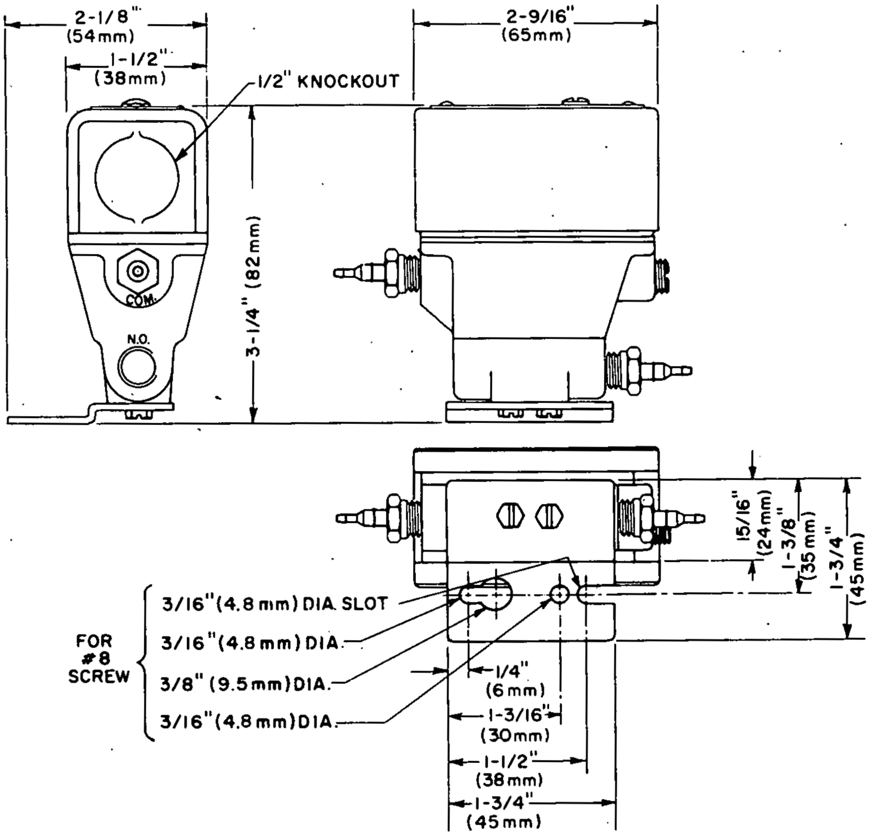
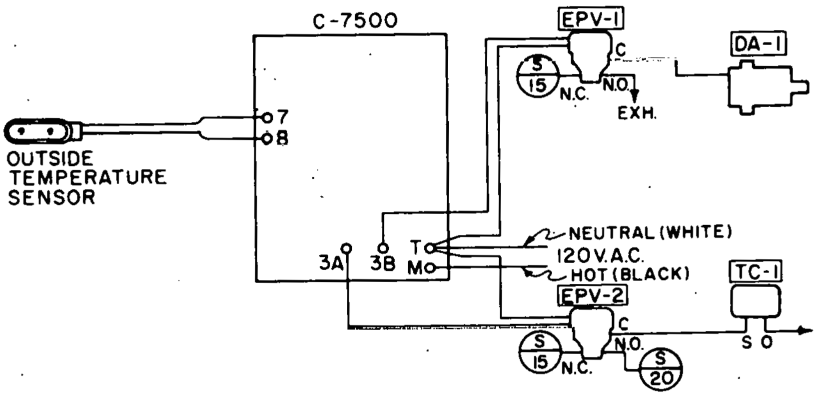


Dimensions



Typical Application



EPV-1 V-24 Two Pipe Application
EPV-2 V-24 Three Pipe Application

JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

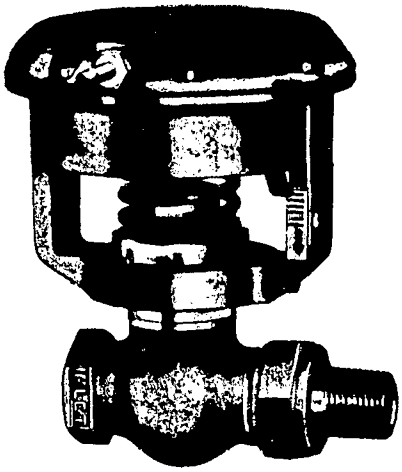
PRODUCT
DATA
V-3752

JOHNSON V-3752

Normally Open Steam or Water Valve
1/2″ Thru 2″ Cast Brass Body with Screwed Connections

The Johnson V-3752 Normally Open Valve is designed to precisely control the flow of steam or hot and cold water through coils or heat exchangers of all types.

This valve is accurately controlled by an exposed type V-3000 pneumatic actuator which has a synthetic rubber diaphragm in a die cast aluminum housing. The molded diaphragm design provides a constant diaphragm effective area throughout the stroke. The complete actuator assembly can be removed, by loosening a single set screw, without disturbing the remainder of the valve assembly. A completely enclosed



V-3752 Valve With Optional Position Indicator

Specifications

PRODUCT		V-3752 N.O. VALVE, STEAM OR HOT AND COLD WATER	
BODY PATTERN AND SIZES		UNION ANGLE – 1/2" THRU 1-1/2"	
		UNION GLOBE – 1/2" THRU 1-1/4"	
		GLOBE – 1-1/2" AND 2"	
SERVICE CONNECTIONS		UNION ANGLE	MALE UNION OUTLET; FEMALE INLET
		UNION GLOBE	
		GLOBE	SCREWED ENDS
CONTROL AIR CONNECTION		BARB FOR 1/4" O.D. FLEXIBLE TUBING	
NORMAL POSITION		OPEN – CONTROL SIGNAL CLOSES	
BODY RATING		150 psig (10.5 kp/cm²)	
MAX. PRESSURE & TEMPERATURE	STEAM	35 psig (2.5 kp/cm²); 281F (140C)	
	WATER	150 psig (10.5 kp/cm²); 281F (140C)	
MAXIMUM CONTROL PRESSURE		30 psig (2.1 kp/cm²)	
SPRING RANGES		4 TO 8 psig OR 9 TO 13 psig	
VALVE PLUG		EQUAL PERCENTAGE CHARACTERISTIC	
AMBIENT TEMPERATURE LIMITS		-10 TO 150F (-23 TO 65C)	
MATERIAL	BODY	CAST BRASS	
	ACTUATOR	DIE CAST ALUMINUM	
	TRIM	BRASS	
	STEM	STAINLESS STEEL	
	STEM PACKING	SYNTHETIC ELASTOMER U-CUP	
	DIAPHRAGM	SYNTHETIC RUBBER	
	DISC	REPLACEABLE COMPOSITION	
FINISH	BODY	NATURAL BRASS	
	ACTUATOR	GREEN ENAMEL	
ACCESSORIES (ORDER SEPARATELY)		VALVE POSITION INDICATOR	
		POSITIONER	

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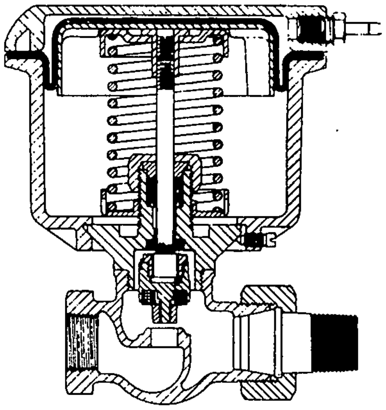
37J4

actuator is available on order. Valve bodies, less actuators, are also available for use with the T-3000 Series of valve top thermostats.

Installation

It is recommended that these valves be mounted in an upright position, piped so that the valve seats against the flow and arranged so that the actuator can be easily removed and replaced.



Sectional View V-3752
Union Globe Valve

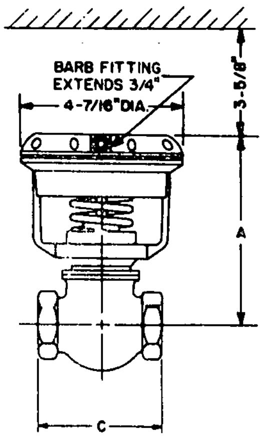
C_V Factor Table Union Angle Body

Valve Size (in.)	1/2		3/4	1	1-1/4	1-1/2
C_V Factor	1.5	2.5	3.7	7.7	12	20

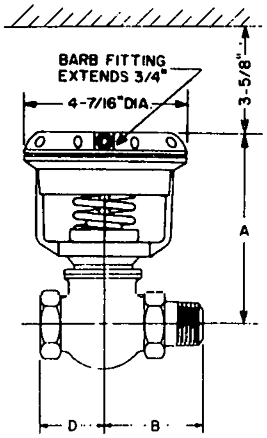
C_V Factor Table Globe Bodies

Valve Size (in.)	1/2			3/4	1	1-1/4	1-1/2	2
C_V Factor	0.9	1.5	1.8	3.8	7	12	20	26

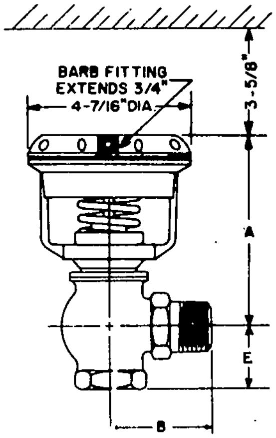
DIMENSIONS



Globe Body



Union Globe Body



Union Angle Body

Globe Bodies

Valve Size (in.)	Dimensions (in.)			
	A	B	C	D
1/2	4-5/8	2-11/16	–	1-3/8
3/4	5	3-1/16	–	1-5/8
1	5-5/16	3-5/8	–	1-7/8
1-1/4	5-7/16	4-1/16	–	2-1/8
1-1/2	5-15/16	–	4-7/8	–
2	6-7/16	–	5-1/8	–

Union Angle Body

Valve Size (in.)	Dimensions (in.)		
	A	B	E
1/2	4-3/8	2-11/16	1-3/8
3/4	4-13/16	3-1/16	1-5/8
1	5	3-5/8	1-7/8
1-1/4	5-1/4	4-1/16	2-3/16
1-1/2	5-11/16	4-1/4	2-1/4

Catalog Section V
Series 3754
Product Data —
Issue Date 0777

JOHNSON CONTROLS

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

V-3754 N.O. Cast Brass Valve Steam or Water Cage Trim ½, ¾ & 1" Screwed Ends

The V-3754 normally open valve is designed to accurately regulate the flow of steam or hot and cold water through coils or heat exchangers of all types. It is available with or without a factory installed V-3000 exposed type pneumatic actuator; enclosed actuators are also available, order separately. The V-3000 actuator has a die cast aluminum housing and a molded, synthetic rubber diaphragm that provides a constant effective area through the valve travel. By loosening a single set screw, the complete actuator assembly can be removed, without disturbing the remainder of the valve assembly. A V-3754 valve, less actuator, can also be used with a T-3110 or T-3310 Valve Top Thermostat. Actuator and valve provide a Push Down to Close (PDC) combination for normally open applications.

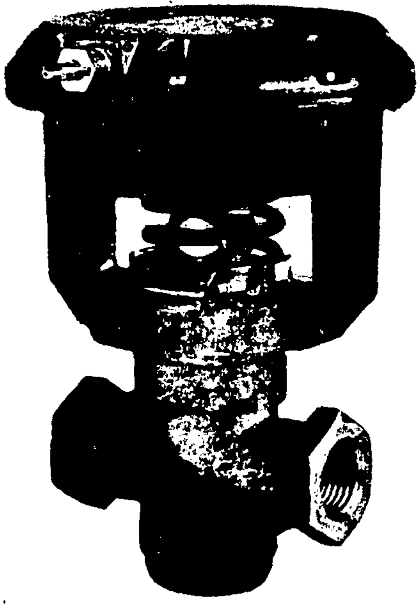
Features

All V-3754 valves feature a removeable cage trim design which provides valve plug guiding throughout the travel range and permits high rangeability. The cage also has an integral seat to facilitate convenient replacement. A modulating valve plug provides an equal percentage relationship between valve travel and flow at a constant pressure drop. A molded composition disc that assures tight shutoff is bonded to the valve plug. The bonnet, cage, and the stem and plug assembly can be removed for servicing. An arrow is stamped on one side of the valve body indicating normally open (black color) valve style and the direction of flow for proper piping.

Operation

Air pressure from a pneumatic controller is applied to the diaphragm of the actuator which moves the piston against the forces of the internal spring and the fluid. The piston will move the valve plug to a position where the diaphragm pressure and the spring force balance fluid forces. These fluid forces will cause the operating range to shift from the nominal spring range.

Where sequential operation is desired or positioning power is necessary, a V-9502 Positioner Kit must be ordered separately.



V-3754 with V-3000 Actuator

Specifications

Product			V-3754 N.O. Steam or Water Valve
Models & Sizes			See Table 1
Body Rating			Exceeds Requirements of ANSI B16.15, Class 250
Max. Temperature			281F (140C)
Max. Pressure	Steam		35 PSIG (Saturated)
	Water		400 PSIG (2800 kPa) Between -20 & 150F (-29 to 66C), Decreasing to 345 PSIG (2415 kPa) at 281F (140C)
Body Style & Sizes			Globe — 1/2, 3/4 and 1 in. Connections (I.P.T.)
Control Air Connection			Barbed Fitting for 5/32 or 1/4 in. O.D. Polytubing
Max. Control Pressure			30 PSIG (210 kPa)
Spring Ranges (Nominal)			4 to 8 or 9 to 13 PSIG (28 to 56 or 63 to 91 kPa)
Flow Characteristic			Equal Percentage
Material	Trim	Cage	Cast Brass Including Integral Seat
		Stem	Stainless Steel
		Plug	Brass with Molded & Bonded Composition Disc
	Body		Cast Brass with Natural Finish
	Actuator		Die Cast Aluminum with Enamel Finish
Ambient Temp. Limits			-10 to 150F (-23 to 65C)
Accessories (Order Separately)			Valve Position Indicator V-9502 Positioner Kit

Installation

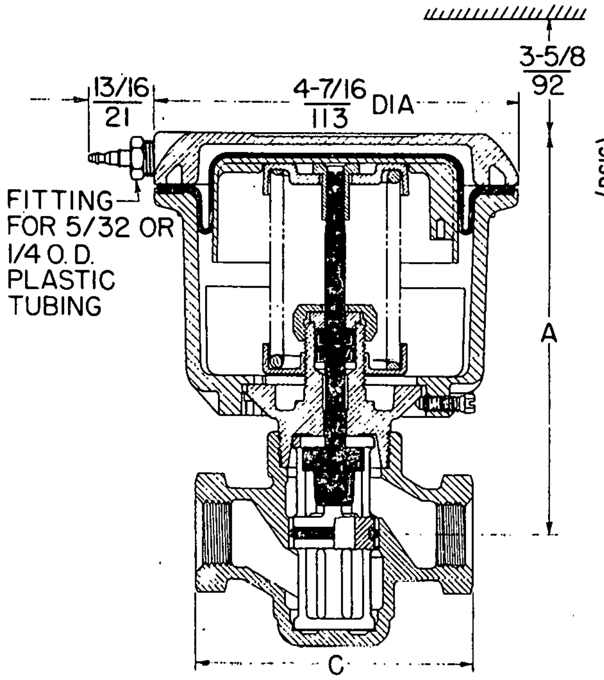
It is recommended that the V-3754 be mounted in an upright position in a conveniently accessible location. Sufficient clearance must be allowed for actuator and trim removal. The V-3754 must be piped with the flow in the direction indicated by the arrow so that the plug seats against the flow.

Dimensions $\frac{\text{in.}}{\text{mm}}$

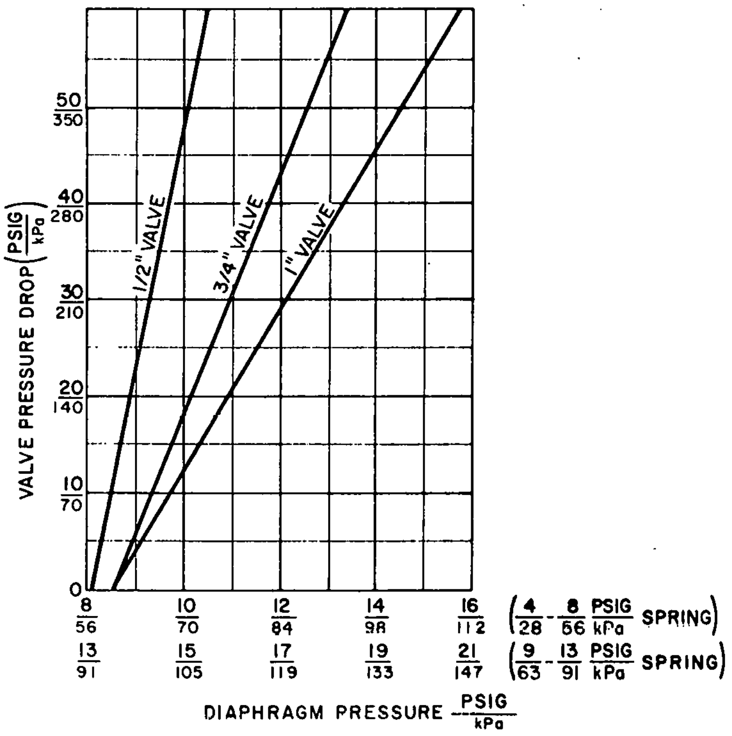
Size in.	Dimensions $\frac{\text{in.}}{\text{mm}}$ A	C
1/2	4-7/8 123	3-3/8 86
3/4	5 127	3-5/8 92
1	5-1/4 133	4-7/8 124

Table 1
Nominal Valve Properties

Size In.	C_v/k_v Factor	Range-ability	Spring Range PSIG / kPa	V-3754 Code Number with V-3000 Actuator	V-3754 Code Number Less Actuator
1/2	1.2/1	14:1	4-8 28-56	-1001	-1
	2.2/1.9	20:1		-1002	-2
	4.4/3.8	34:1		-1003	-3
	1.2/1	14:1	9-13 63-91	-1004	-4
	2.2/1.9	20:1		-1005	-5
	4.4/3.8	34:1		-1006	-6
3/4	8.6/7.3	40:1	4-8 28-56	-1007	-7
	8.6/7.3	40:1	9-13 63-91	-1008	-8
1	13.9/11.9	44:1	4-8 28-56	-1009	-9
	13.9/11.9	44:1	9-13 63-91	-1010	-10



Nominal Shut Off Pressures



JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

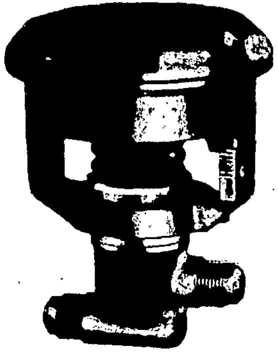
PRODUCT
DATA
V-3762

JOHNSON V-3762
NORMALLY OPEN WATER VALVE

Cast Brass Body for ½" and ⅝" O.D. Tubing
S.A.E. 45° Flared Connections—250 psi Body Rating

The Johnson V-3762 Normally Open Water Valve is designed to regulate the flow of hot or cold water in small room air conditioning units.

This valve is accurately controlled by an exposed type V-3000 pneumatic actuator which has a synthetic rubber diaphragm in a die cast aluminum housing. The molded diaphragm design provides a constant diaphragm effective area throughout the stroke. The complete actuator assembly can be removed, by loosening a single set screw, without disturbing the remainder of the valve assembly. A completely enclosed actuator is available on order. Valve bodies, less actuators, can also be used with the T-3000 Series of valve top thermostats.



V-3762 Valve with Optional Position Indicator

The V-3762 Valve body is constructed of cast red brass with 1/2" and 5/8" O.D. tubing connections. A modulating valve plug, with a replaceable composition disc especially compounded for hot and cold water service, provides an equal percentage relationship between valve lift and flow at a constant pressure drop.

Installation

It is recommended that these valves be mounted in an upright position, piped so that the valve seats against the flow and arranged so the actuator can be easily removed and replaced.

Specifications

MODEL		V-3762 NORMALLY OPEN WATER VALVE
BODY PATTERN AND SIZE		ANGLE AND OFFSET GLOBE WITH 1/2" AND 5/8" CONNECTIONS
SERVICE CONNECTIONS		FOR 1/2" (3/4"-16) AND 5/8" (7/8"-14) O.D. S.A.E. STANDARD FLARE
SPRING RANGE		3 TO 6 psi AND 4 TO 8 psi
VALVE PLUG		EQUAL PERCENTAGE CHARACTERISTIC
TRIM		BRASS
STEM		PHOSPHOR BRONZE
DISC		REPLACEABLE COMPOSITION
STEM PACKING		SYNTHETIC ELASTOMER U-CUP
BODY RATING		250 psi (17.6 kp/cm²)
MAXIMUM PRESSURE/TEMPERATURE		250 psi (17.6 kp/cm²); 281F (138C)
MATERIAL	BODY	CAST RED BRASS
	ACTUATOR	DIE CAST ALUMINUM
FINISH	BODY	NATURAL BRASS
	ACTUATOR	GREEN ENAMEL
MAXIMUM CONTROL PRESSURE		30 psi
CONTROL AIR CONNECTION		1/8" F.P.T.
ACCESSORIES		VALVE POSITION INDICATOR
MAXIMUM AMBIENT TEMPERATURE		150F (65C)

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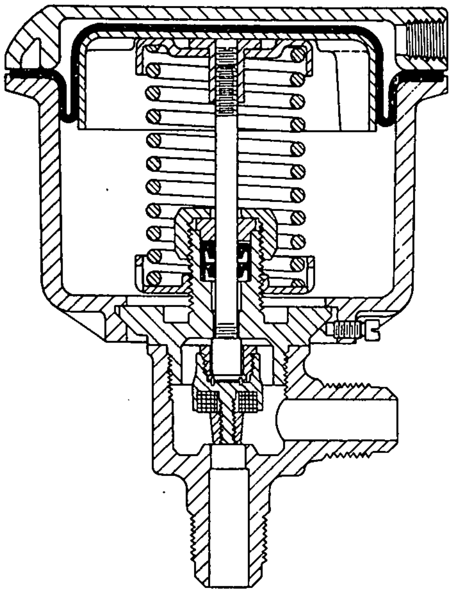
Angle C_V Factor Table

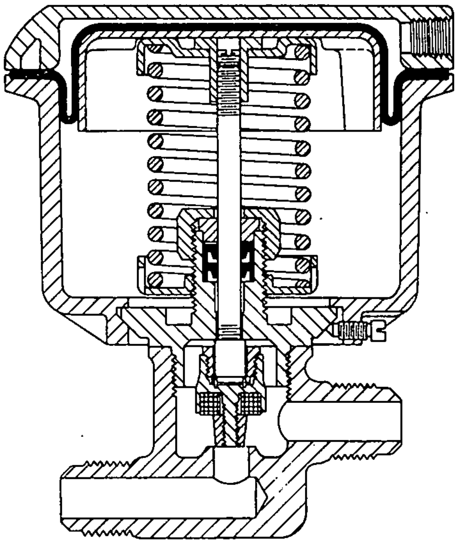
Valve Size (in.)	1/2			5/8
C_V Factor	0.9	1.5	2.2	3.3

Offset Globe C_V Factor Table

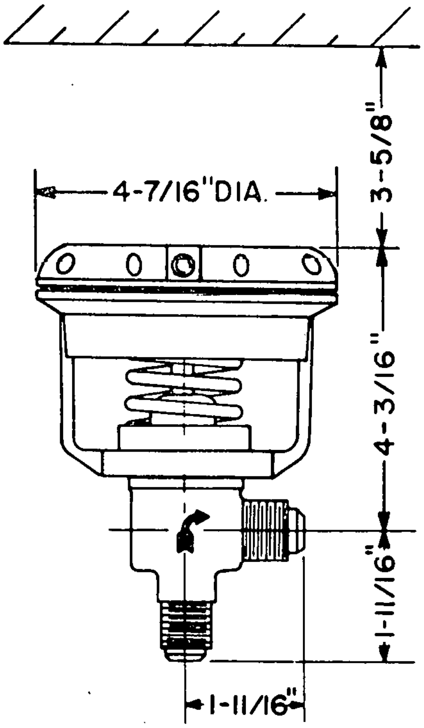
Valve Size (in.)	1/2			5/8
C_V Factor	0.9	1.5	2.0	2.9



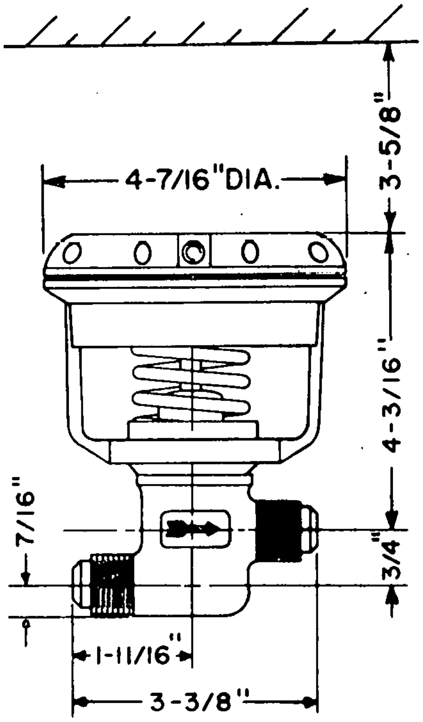
Sectional View V-3762
with Angle Body



Sectional View V-3762
with Offset Globe Body



Dimensions V-3762
with Angle Body



Dimensions V-3762
with Offset Globe Body

Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

V-4322 Mixing Valve
½" thru 2" Cast Brass Screwed Ends
150 PSIG Body Rating Piston Top

The Johnson V-4322 3-Way Mixing Valve is designed to regulate the flow of hot or cold water through coils or heat exchangers of all types.

This valve is accurately controlled by an exposed type V-3000 pneumatic actuator which has a synthetic rubber diaphragm in a die cast aluminum housing. The molded diaphragm design provides a constant diaphragm effective area throughout the stroke. The complete actuator assembly can be removed, by loosening a single set screw, without disturbing the remainder of the valve assembly. A completely enclosed actuator is available on order. Valve bodies, less actuators, can also be used with the T-3000 series of valve top thermostats.

V-4322 Valve with Optional Position Indicator

The valve has two modulating plugs which provide a characterized relationship between valve lift and flow at a constant pressure drop.

Specifications

PRODUCT		V-4322 3-WAY MIXING WATER VALVE
SIZES		1/2" THRU 2"
SERVICE CONNECTIONS		SCREWED CONNECTIONS
CONTROL AIR CONNECTION		BARB FOR 1/4" O.D. FLEXIBLE TUBING
NORMAL POSITION	UPPER PORT	CLOSED – CONTROL SIGNAL OPENS
	LOWER PORT	OPEN – CONTROL SIGNAL CLOSES
BODY RATING		150 psig (10.5 kp/cm²)
MAX. PRESSURE & TEMPERATURE		150 psig (10.5 kp/cm²); 281F (138C)
MAXIMUM CONTROL PRESSURE		30 psig (2.1 kp/cm²)
SPRING RANGES		4 TO 8 psig AND 9 TO 13 psig
VALVE PLUGS		CHARACTERIZED MODULATING
AMBIENT TEMPERATURE LIMITS		–10 TO 150F (–23 TO 65C)
MATERIAL	BODY	CAST BRASS
	ACTUATOR	DIE CAST ALUMINUM
	TRIM	BRASS
	STEM	STAINLESS STEEL
	STEM PACKING	SYNTHETIC ELASTOMER U-CUP
	DIAPHRAGM	SYNTHETIC RUBBER
	DISC	BRASS
FINISH	BODY	NATURAL BRASS
	ACTUATOR	GREEN ENAMEL
ACCESSORIES (ORDER SEPARATELY)		VALVE POSITION INDICATOR
		POSITIONER

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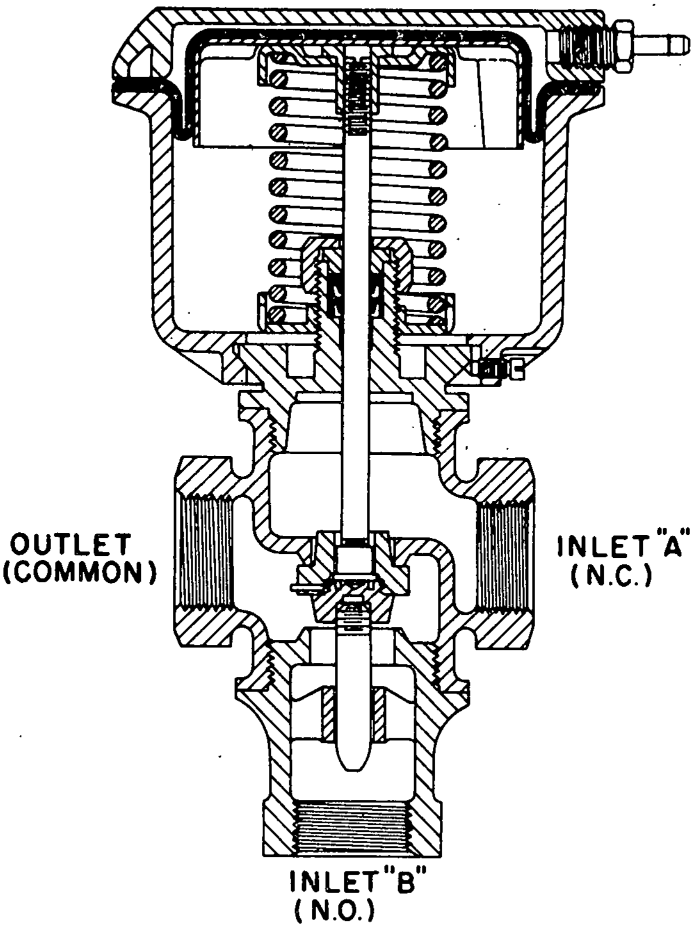
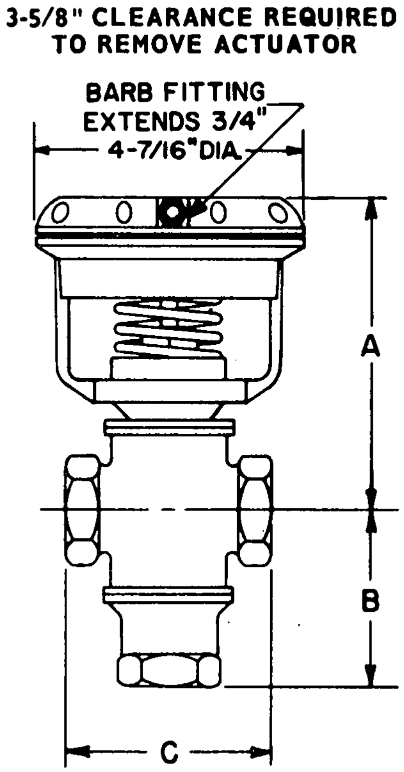
Installation

It is recommended that the V-4322 valve be mounted in an upright position. It must be piped so that the valve seats against the flow and arranged so that the actuator can be easily removed and replaced.

VALVE SIZE (in.)	DIMENSIONS (in.)		
	A	B	C
1/2	4-7/8	2-13/16	3-1/4
3/4	4-7/8	2-13/16	3-1/4
1	5-1/4	2-5/8	3-3/4
1-1/4	5-1/4	2-7/8	4-1/4
1-1/2	5-3/4	3-1/2	4-7/8
2	6-1/4	3-5/8	5-1/8



Sectional View V-4322 Valve



Dimensions V-4322 with Exposed V-3000 Actuator

C_V Factor

Valve Size (in.)	1/2			3/4	1	1-1/4	1-1/2	2
C_V Factor	1.6	3.2	4.3	5.3	8.6	13	21	30

17J1

JOHNSON CONTROL
DESIGN • MANUFACTURE • INSTALLATION

APPARATUS BULLETIN **V-4440**

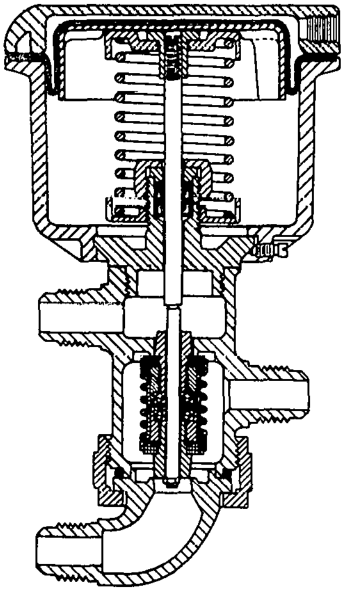
JOHNSON SERVICE COMPANY
MILWAUKEE, WISCONSIN AND PRINCIPAL CITIES

Johnson V-4440 Water Valve for 3 & 4 Pipe Systems

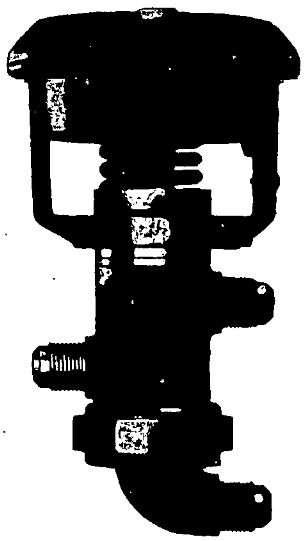
Cast Brass Body for 1/2" and 5/8" O.D. Tubing
S.A.E. 45° Flared Connections - 250 psi Body Rating

The Johnson V-4440 Water Valve is designed to regulate hot and cold water in a small room air conditioning three or four pipe system. The two-pipe supply system provides heating and cooling water to the room units at all times. The V-4440 valve has two inlets, the upper and lower connections, and one outlet, the center connection. The lower "Inlet" port is normally open and the upper "Inlet" port is normally closed. The two inlets are never open at the same time so there can be no mixing of hot and cold water. This valve, therefore serves a dual purpose, that of a switching valve, supplying either hot or cold water to the coil, and that of a control valve, modulating the flow of either the hot or cold water.

This valve is accurately controlled by an exposed type V-3000 pneumatic actuator which has a synthetic rubber diaphragm in a die cast aluminum housing. The molded diaphragm design provides a constant diaphragm effective area throughout the stroke.



V-4440 Sectional View



V-4440 with Optional Valve Position Indicator

The complete actuator assembly can be removed, by loosening a single set screw, without disturbing the remainder of the valve assembly. A completely enclosed actuator is available on order. Valve bodies, less actuators, can also be used with the T-3000 Series of valve top thermostats.

The V-4440 Valve body is constructed of cast red brass with 1/2 "and 5/8" O.D. tubing connections. The bottom service connection is available with a straight connector or with a 90° elbow.

The inner valve has two modulating plugs with replaceable composition discs, especially compounded for both the hot and cold water service.

Installation

It is recommended that the V-4440 valve be mounted in an upright position. It must be piped so the valve seats against the flow. If it is necessary to rotate the 90° elbow end connector, the union nut must be loosened prior to adjustment and then retightened.

V-4440 APPARATUS BULLETIN

JOHNSON CONTROL

DESIGN • MANUFACTURE • INSTALLATION

JOHNSON SERVICE COMPANY
MILWAUKEE, WISCONSIN AND PRINCIPAL CITIES

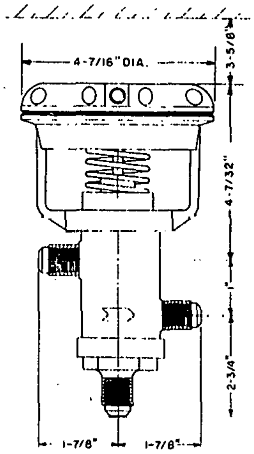
Specifications

MODEL		V-4440 VALVE
BODY PATTERN AND SIZE		3-WAY NON-MIXING WITH 1/2" OR 5/8" CONNECTIONS
SERVICE CONNECTIONS		FOR 1/2" (3/4"-16) AND 5/8" (7/8"-14) O.D., S.A.E. STANDARD FLARE WITH STRAIGHT CONNECTOR OR 90° ELBOW ON BOTTOM CONNECTION
NORMAL POSITION	UPPER PORT	CLOSED – AIR PRESSURE OPENS
	LOWER PORT	OPEN – AIR PRESSURE CLOSES
SPRING RANGES	SUPPLY VALVE	3 TO 6 psi OR 9 TO 12 psi
	RETURN VALVE	6 TO 9 psi
VALVE PLUGS		EQUAL PERCENTAGE CHARACTERISTICS
TRIM		BRASS
STEM		PHOSPHOR BRONZE
DISCS		REPLACEABLE COMPOSITION
STEM PACKING		SYNTHETIC ELASTOMER U-CUP
BODY RATING		250 psi (17.6 kp/cm²)
MAXIMUM PRESSURE/TEMPERATURE		250 psi (17.6 kp/cm²); 281F (138C)
MATERIAL	BODY	CAST RED BRASS
	ACTUATOR	DIE CAST ALUMINUM
FINISH	BODY	NATURAL BRASS
	ACTUATOR	GREEN ENAMEL
MAXIMUM CONTROL PRESSURE		30 psi
CONTROL AIR CONNECTION		1/8" F.P.T.
ACCESSORIES		VALVE POSITION INDICATOR
MAXIMUM AMBIENT TEMPERATURE		150F (65C)

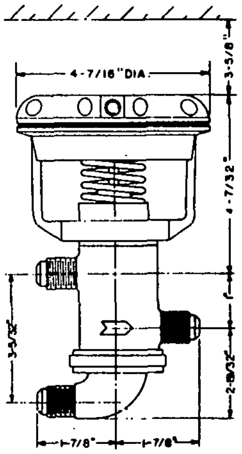
C_V Factor Table

Valve Size (in.)		1/2			5/8	
C_V Factor	Cold Water Inlet (N.C.)	1.4	2.4	2.4	4.1	4.1
	Hot Water Inlet (N.O.)	1.4	2.4	1.4	4.7	2.1

Dimensions



V-4440 with Straight Connector



V-4440 with 90° Elbow Connector

86B3

APPARATUS BULLETIN **V-5250**

JOHNSON CONTROL
DESIGN • MANUFACTURE • INSTALLATION

JOHNSON SERVICE COMPANY
MILWAUKEE, WISCONSIN AND PRINCIPAL CITIES

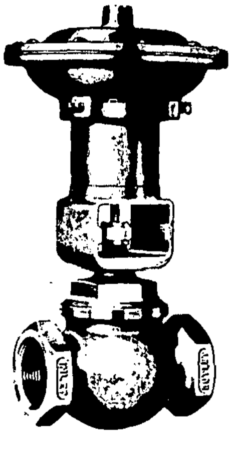
Johnson V-5250 Normally Open Diaphragm Valve for Steam or Water Applications

Modulating Plug
½" thru 2" Cast Brass

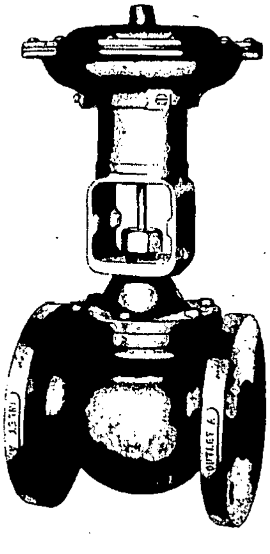
150 psi Body Rating
2½" thru 8" Cast Iron

The Johnson V-5250 is designed to regulate the flow of steam or hot and cold water under the control of a thermostat or humidostat on applications where modulating control is desired. Valve sizes ½" through 2" have a back seating feature that permits changing the stem packing without interrupting service to the system.

The valve is equipped with a diaphragm operator of ample size to assure accurate positioning of the inner valve. The diaphragm is enclosed in a metal housing for protection against dirt and damage. By loosening three set screws, the entire operator assembly can be removed without disturbing the remainder of the valve assembly.



Screwed Ends



Flanged Ends

Specifications

SERVICE		STEAM OR WATER (HOT OR COLD)
BODY PATTERN		GLOBE, SINGLE SEAT
NORMAL POSITION		OPEN — AIR PRESSURE CLOSES
SPRING RANGES		4 TO 8 psi, 9 TO 13 psi
INNER VALVE		EQUAL PERCENTAGE MODULATING PLUG
DISC		REPLACEABLE COMPOSITION
TRIM	½" — 2"	BRASS
	2½" — 8"	BRASS WITH SCREWED-IN SEAT
STEM PACKING	3-R	U-CUP, SILICONE
	4-R & 5-R	MOLDED RING (Steam)
		U-CUP, BUNA-N (Water)
	8-R	ASBESTOS ROPE
BODY RATING		150 psi (10.5 kp/cm²)
MAXIMUM OPERATING PRESSURE	STEAM	35 psi (2.5 kp/cm²)
	WATER	150 psi (10.5 kp/cm²)
MAXIMUM OPERATING TEMPERATURE	STEAM	281 F (140C)
	WATER	320 F (160C)
MATERIAL	BODY	HIGH GRADE CAST RED BRASS (½" — 2")
		HIGH TENSILE CAST IRON (2½" — 8")
	TOP	CAST ALUMINUM (3-R & 4-R)
		CAST IRON (5-R & 8-R)
	DIAPHRAGM	MOLDED REINFORCED RUBBER
SERVICE CONNECTIONS	½" — 1¼"	MALE UNION OUTLET, FEMALE INLET
	1½" & 2"	SCREWED ENDS
	2½" — 8"	FLANGED ENDS
MAXIMUM CONTROL PRESSURE		25 psi
CONTROL AIR CONNECTION		⅛" F.P.T.

Printed in U.S.A.

A Johnson V-9502 pilot positioner can be supplied with this valve. A valve position indicator is also available.

Inner Valve

This valve is furnished with a modulating plug inner valve which provides an equal percentage relationship between valve lift and valve flow at a constant pressure drop. The performance characteristic is shown in the Flow Curve.

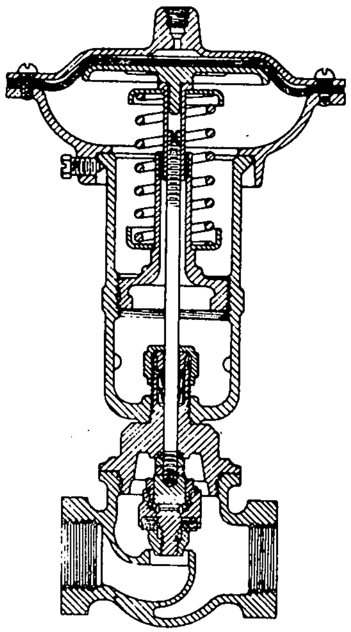
The modulating plug has a replaceable composition disc which, together with the single seat construction, assures 100% tight seating.

Installation

It is recommended that this valve be mounted in an upright position, piped so the inner valve seats against the flow, and arranged so the operator can be conveniently removed and replaced.

C_v Factor Table

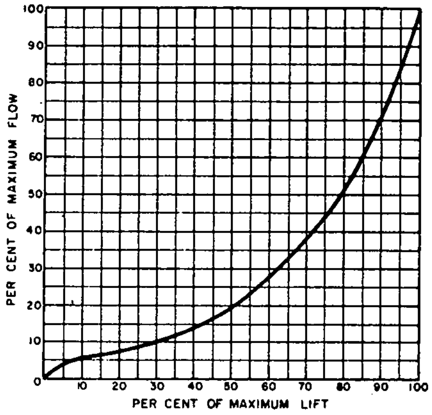
Valve Size (in.)	½			¾	1	1¼	1½	2	2½	3	4	5	6	8
C_v Factor	0.9	1.5	2.3	3.8	7.0	12	20	35	51	83	150	240	350	590



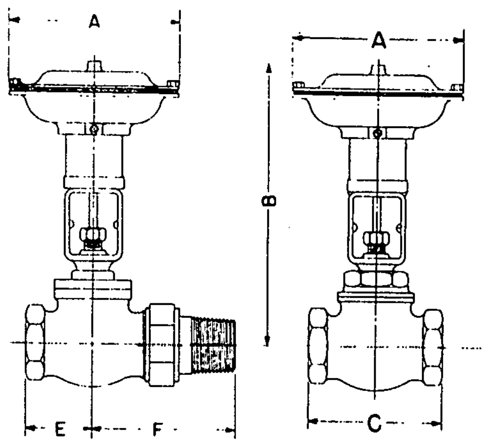
1½" and 2" Valve

Minimum Clearance to Remove Operator

3-R	1 5/16"
4-R	1 9/16"
5-R	2¾"
8-R	3 13/16"



Flow Curve



Dimensions and Maximum Seating Pressures

Valve Size (in.)	Top Size	Dimensions (in.)					Seating Pressure (psi) †
		A	B	C	E	F	
½	3-R	6	9 3/16		1⅜	2⅝	59
¾	3-R	6	9 13/16		1⅝	3	33
1	3-R	6	9 15/16		1⅞	3⅝	13.3
1¼	3-R	6	10⅛		2⅛	4⅛	7.5
1½	3-R	6	10¼	4⅝			4.1
2	3-R*	6	10¾	5⅛			2.8
	4-R	8⅛	12 7/16	5⅛			5.9
2½	4-R	8⅛	14	7¼			1.9
	5-R	11⅞	19¼	7¼			6.5
3	4-R*	8⅛	14 13/16	8⅝			1.2
	5-R	11⅞	20 3/16	8⅝			4.0
4	5-R	11⅞	21 13/16	10½			2.3
	8-R**	16½	26⅛	10½			5.5
5	5-R*	11⅞	22 3/16	12½			1.4
	8-R	16½	26⅞	12½			3.4
6	8-R	16½	28	14½			2.3
8	8-R	16½	31⅞	17½			1.3

†Maximum Seating Pressure per psi Control Pressure above upper spring range.
*Steam Applications
**Water Applications

3684

JOHNSON CONTROL

DESIGN • MANUFACTURE • INSTALLATION

APPARATUS BULLETIN V-5650

JOHNSON SERVICE COMPANY

MILWAUKEE, WISCONSIN AND PRINCIPAL CITIES

Johnson V-5650 Water Valve

with Rubber Diaphragm Operator

2½" thru 6" Modulating Plugs Three-Way Bypass Flanged Ends

Maximum Pressure 125 psi Maximum Temperature 320 F

The Johnson V-5650 Water Valve, Fig. 1, with rubber diaphragm operator is designed to accurately control large volume flow through coils, heat exchangers, cooling towers or process applications.

The diaphragm operator is available in three sizes to assure sufficient force to handle all seating pressures and line surges. The heavy duty, molded rubber diaphragm will remain resilient through years of service, and will consistently provide accurate response to controller demands. The diaphragm is enclosed in a strong metal housing which protects against dirt, tampering or damage. By loosening three set screws the entire operator assembly may be removed without disturbing the balance of the valve assembly.

Body

The V-5650 valve is furnished in a three-way bypass body pattern with flanged ends, 2½" through 6". The valve body is made of high grade cast iron. A unique construction feature of this valve permits "in line" servicing. All of the inner valve components, including the screwed-in seat rings, can be removed and replaced quickly and easily without removing the valve body from the pipe line. The maximum fluid pressure rating is 125 psi and maximum temperature rating is 320 F.

Inner Valve

This double seat valve has two modulating plugs especially designed to provide a linear relationship between valve lift and valve flow at a constant pressure drop, Fig. 2. Renewable composition discs which are especially compounded for liquid service assure 100 per cent tight seating. The total capacity input of this three-way valve is constant regardless of the position of the inner valve. The flow can be directed to either of the two outlets as required. Both plugs close against the flow thereby eliminating water hammer and slamming in the valve.

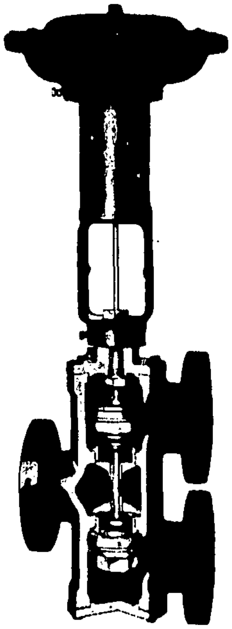


Fig. 1: Cutaway View of Johnson V-5650 Three-Way Bypass Water Valve

Spring Ranges

The V-5650 bypass valve is furnished with a 7 to 11 psi spring range.

Packing

The U-cup pressure sensitive packing, Fig. 3, utilizes the force of the liquid pressure to effect a positive seal. Advantages of this type of seal are:

a. No initial manual adjustment.

b. Automatic compensation for wear, thus

Printed in U. S. A.

V-5650 APPARATUS BULLETIN

JOHNSON CONTROL

DESIGN • MANUFACTURE • INSTALLATION

JOHNSON SERVICE COMPANY
MILWAUKEE, WISCONSIN AND PRINCIPAL CITIES

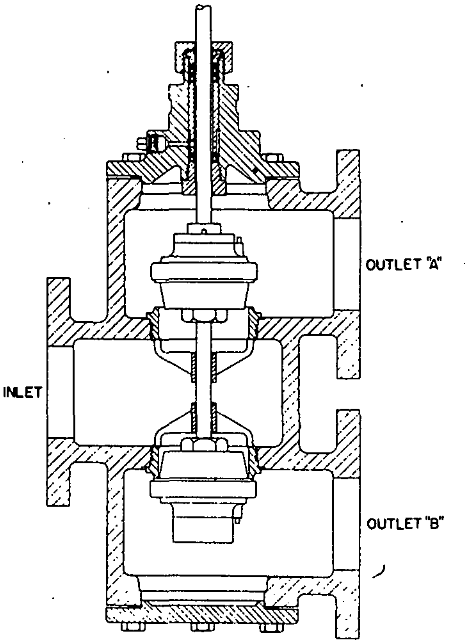


Fig. 2: Sectional View of V-5650 Valve

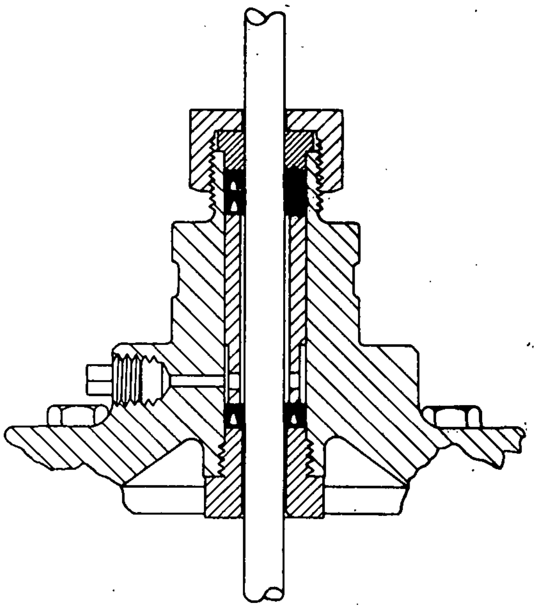


Fig. 3: Detail of Packing Gland with Upper and Lower U-Cups and Spacer

Specifications

SIZES		2½", 3", 4", 5", 6"
BODY PATTERN		THREE-WAY BYPASS
SERVICE		HOT OR COLD WATER
NORMAL POSITION	OUTLET "A"	OPEN — AIR PRESSURE CLOSES
	OUTLET "B"	CLOSED — AIR PRESSURE OPENS
SPRING RANGE		7 TO 11 psi
INNER VALVES		LINEAR PLUGS
DISCS		RENEWABLE COMPOSITION
TRIM		BRASS
STEM PACKING		U-CUPS
SEATS		BRASS, SCREWED-IN
BODY RATING		125 psi
MAXIMUM FLUID PRESSURE		125 psi
MAXIMUM FLUID TEMPERATURE		320 F
MATERIAL	BODY	HIGH GRADE CAST IRON
	TOP	DIE CAST ALUMINUM (4-R)
		CAST IRON (5-R, 8-R)
FINISH	BODY	DULL BLACK LACQUER
	TOP	NATURAL ALUMINUM (4-R)
		DULL BLACK LACQUER (5-R, 8-R)
SERVICE CONNECTIONS		125 psi FLANGED ENDS
OPERATOR DIAPHRAGM		MOLDED REINFORCED RUBBER
MAXIMUM CONTROL AIR PRESSURE		25 psi
CONTROL AIR CONNECTION		⅛" FEMALE PIPE THREAD

eliminating the need for periodic adjustments.

c. Friction is reduced to a minimum because the sealing force is proportional to fluid pressure.

d. Maximum, maintenance-free life.

Capacities

For convenience in selecting the proper valve capacity or valve size, a C_V Factor Table is given below:

C_V Factor Table

Valve Size	2½"	3"	4"	5"	6"
C_V Factor	68	103	194	298	414

Installation

It is recommended that this valve be mounted in an upright position. It must be piped so that the inner valves close against the flow.

Ordering Instructions

When ordering use:

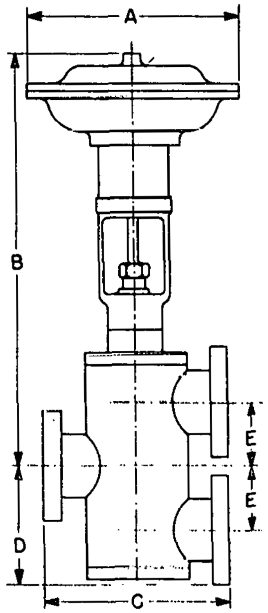
1. Standard equipment code number

If the standard equipment code number is not available, specify:

2. Bulletin number
3. Valve size
4. C_V factor
5. Operator size
6. Actual maximum operating temperature and pressure

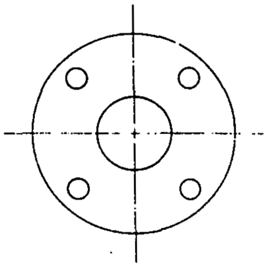
Dimensions

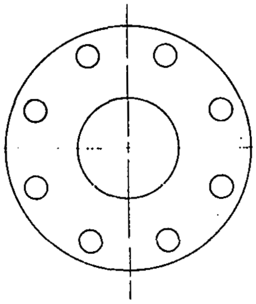
Body



Valve Size (in.)	Dimensions (in.)					
	Top	A	B	C	D	E
2½	4-R	8⅛	19⅞	9¼	7 7/16	4
	5-R	11⅞	27⅛	9¼	7 7/16	4
	8-R	16½	32 13/16	9¼	7 7/16	4
3	4-R	8⅛	20½	10⅜	8 1/16	4⅜
	5-R	11⅞	27¾	10⅜	8 1/16	4⅜
	8-R	16½	33 7/16	10⅜	8 1/16	4⅜
4	5-R	11⅞	29	12⅛	9 5/16	5¼
	8-R	16½	34 11/16	12⅛	9 5/16	5¼
5	5-R	11⅞	30⅞	13½	11⅜	6 3/16
	8-R	16½	36 9/16	13½	11⅜	6 3/16
6	5-R	11⅞	32⅝	15	13⅛	7¼
	8-R	16½	38 5/16	15	13⅛	7¼

Flange and Bolt Circle





VALVE SIZE (IN.)	DIA. OF FLANGE	THICKNESS OF FLANGE	DIA. OF BOLT CIRCLE	DIA. OF BOLT HOLES	NO. OF BOLT HOLES
2-1/2	7	11/16	5-1/2	3/4	4
3	7-1/2	3/4	6	3/4	4
4	9	1	7-1/2	3/4	8
5	10	1	8-1/2	7/8	8
6	11	1	9-1/2	7/8	8

Product Data —— Catalog Section V
Issue Date 37J4 Series 5840

JOHNSON CONTROLS

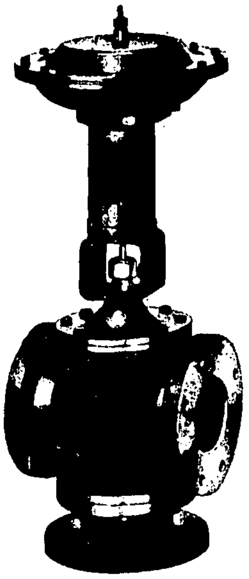
Johnson Controls, Inc.
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

V-5840 Mixing Valve
½" — 2" Cast Brass 2½" — 6" Cast Iron
150 psig Body Rating 281F Max. Temp.

The Johnson V-5840 is designed to mix water of different temperatures under the control of a thermostat or humidostat. The flow from either of the two inlets can be directed through the single outlet of this valve.

This valve is equipped with a molded reinforced synthetic rubber diaphragm actuator of ample size to assure accurate positioning of the valve plug. The diaphragm is enclosed in a strong metal housing for protection against dirt and damage. By loosening three set screws the entire actuator assembly can be removed as a separate unit without disturbing the remainder of the valve assembly.

A Johnson V-9502 pilot positioner can be supplied with this valve. A valve position indicator is also available.

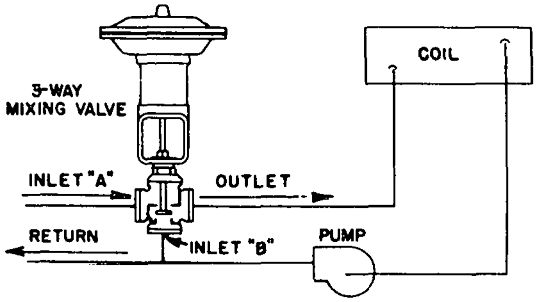


V-5840 3-Way Mixing Valve with Iron Body, Flanged Ends

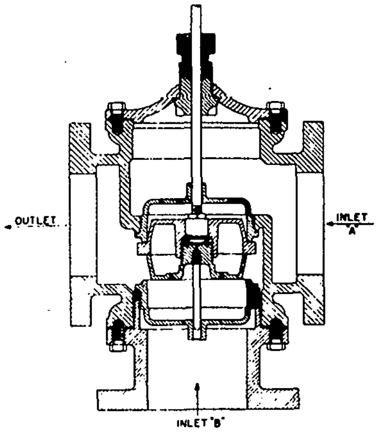
Installation Instructions

The V-5840 valve should preferably be installed in an upright position, and piped in such a manner that the inner valve always closes against the flow.

Typical Application



Piping Arrangement for Coil Control with Individual Pump. Valve Normally Closed to Supply



Sectional View of V-5840 Iron Body Mixing Valve with Flanged Ends

Cv Factor Table

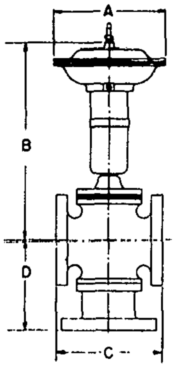
Valve Size (in.)	½		¾	1	1¼	1½	2	2½	3	4	5	6
C_V Factor	3.2	4.3	5.3	8.6	13	21	30	54	80	157	238	347

Specifications

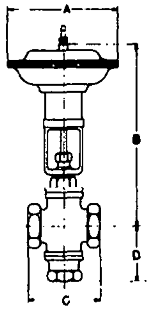
PRODUCT		V-5840 3-WAY MIXING VALVE
SIZES	BRASS BODY	1/2" THRU 2" SCREWED ENDS
	IRON BODY	2½" THRU 6" FLANGED ENDS
SERVICE		HOT OR COLD WATER (FOR OTHER FLUIDS, CONSULT THE FACTORY)
CONTROL AIR CONNECTION		BARB FOR 1/4" O.D. FLEXIBLE TUBING SUPPLIED FOR FIELD INSTALLATION
NORMAL POSITION	INLET "A"	CLOSED – CONTROL SIGNAL OPENS
	INLET "B"	OPEN – CONTROL SIGNAL CLOSES
BODY RATING		150 psig (10.5 kp/cm²)
MAXIMUM PRESSURE AND TEMPERATURE		150 psig (10.5 kp/cm²); 281F (140C)
MAXIMUM CONTROL PRESSURE		25 psig (1.7 kp/cm²)
SPRING RANGES		4 TO 8 psig; 9 TO 13 psig
VALVE PLUGS		CHARACTERIZED MODULATING
AMBIENT TEMPERATURE LIMITS		-10 TO 150F (-23 TO 66C)
SEAT	BRASS BODY	MACHINED INTEGRAL WITH BODY AND 3-WAY VALVE END
	IRON BODY	BRASS, SCREWED-IN SEAT RINGS
MATERIAL	BODY	BRASS (1/2" THRU 2")
		CAST IRON (2-1/2" THRU 6"
	ACTUATOR	ALUMINUM (3-R AND 4-R)
		CAST IRON (5-R AND 8-R)
	TRIM	BRASS (STAINLESS STEEL STEM)
	PACKING	U-CUP, SYNTHETIC ELASTOMER
	DIAPHRAGM	MOLDED REINFORCED SYNTHETIC RUBBER
	DISCS	BRASS
FINISH	BODY	NATURAL BRASS (1/2" THRU 2")
		DULL BLACK LACQUER (2-1/2" THRU 6")
	ACTUATOR	NATURAL ALUMINUM (3-R AND 4-R)
		DULL BLACK LACQUER (5-R AND 8-R)
ACCESSORIES (ORDER SEPARATELY)		VALVE POSITION INDICATOR
		POSITIONER

Dimensions

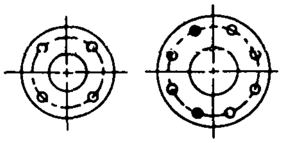
Valve Size (in.)	Top Size	Dimensions (in.)			
		A	B	C	D
½	3-R	6	9⅝	3¼	2 7/16
¾	3-R	6	9⅝	3¼	2 7/16
1	3-R	6	10	3¾	2⅝
1¼	3-R	6	10⅛	4¼	2⅞
1½	3-R	6	10¼	4⅞	3⅛
2	4-R	8⅛	12½	5⅛	3⅝
2½	5-R	11⅞	20 3/16	7¼	6 13/16
3	5-R	11⅞	20 13/16	8⅝	6 13/16
4	8-R	16½	26 3/16	10½	8 5/16
5	8-R	16½	26 13/14	12½	9 3/16
6	8-R	16½	28⅛	14½	9 15/16



Flanged



Screwed



Flange and Bolt Circle Dimensions (in.)

Valve Size (in.)	Dia. of Flange	Thickness of Flange	Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolt Holes
2½	7	11/16	5½	¾	4
3	7½	¾	6	¾	4
4	9	1	7½	¾	8
5	10	15/16	8½	⅞	8
6	11	15/16	9½	⅞	8

3-R	2"
4-R	2"
5-R	3"
8-R	4"

Minimum Clearance to Remove Diaphragm Assembly

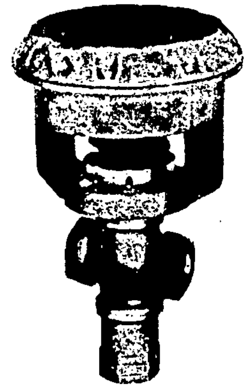
JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

PRODUCT DATA V-6143

JOHNSON V-6143
THREE-WAY SWITCHING AIR VALVE

3/8″ and 3/4″ Flat Discs   Bronze Body

125 psi Maximum Pressure



The Johnson V-6143 Diaphragm Three-Way Air Switching Valve is designed to switch the flow of air from one supply pressure to another, as in pneumatic temperature control applications.

This three-way valve body is equipped with a molded rubber diaphragm actuator of ample size to assure rapid positioning of the inner valve, according to controller demands. The diaphragm is enclosed in a strong, cast metal housing, forming a single unit, for protection against dirt, tampering or damage. By loosening one set screw the actuator assembly may be removed without disturbing the valve assembly.

The V-6143 valve body is furnished in a three-way, high grade steam bronze body pattern, in sizes 3/8" and 3/4", with screwed ends. This valve has bronze trim, the upper seat machined integral with the bronze body, the lower seat machined integral with the bronze three-way valve end, and with a maximum body rating of 125 psig.

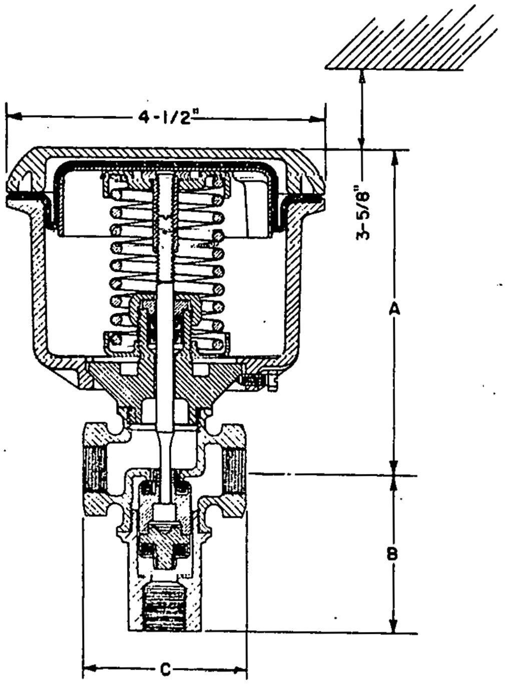
It is recommended that this valve be piped so the inner valves always seat against the flow.

SIZES		3/8" AND 3/4"
BODY PATTERN		THREE-WAY SWITCHING
SERVICE		AIR
NORMAL POSITION	INLET "A"	CLOSED – AIR PRESSURE OPENS
	INLET "B"	OPEN – AIR PRESSURE CLOSES
SPRING RANGE		3/8": 9 TO 11 psig; 3/4": 9 TO 13 psig
INNER VALVE		FLAT DISCS
DISC		RENEWABLE COMPOSITION
TRIM		BRONZE, UPPER SEAT MACHINED INTEGRAL WITH BODY, LOWER SEAT MACHINED INTEGRAL WITH THREE-WAY VALVE END
STEM PACKING		MOLDED U-CUP
BODY RATING		125 psig
MAXIMUM PRESSURE		125 psig
MATERIAL	BODY	HIGH GRADE STEAM BRONZE
	TOP	CAST ALUMINUM
FINISH	BODY	NATURAL BRONZE
	TOP	NATURAL ALUMINUM PAINTED GREEN
ACTUATOR DIAPHRAGM		MOLDED RUBBER
SERVICE CONNECTION		SCREWED ENDS
MAXIMUM CONTROL PRESSURE		30 psig
CONTROL AIR CONNECTION		1/8" FEMALE PIPE THREAD

PRODUCT
DATA
V-6143

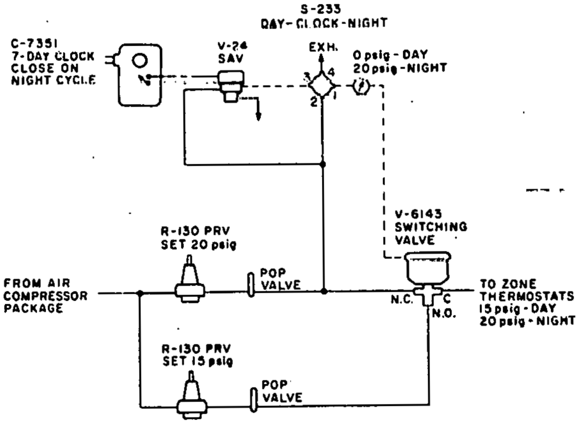
JOHNSON SERVICE COMPANY
507 EAST MICHIGAN STREET • MILWAUKEE, WISCONSIN 53201

VALVE SIZE (in.)	TOP SIZE	DIMENSIONS (in.)		
		A	B	C
3/8	V-3000	4-1/2	2-1/4	2-1/4
3/4	V-3000	4-15/16	2-13/16	3-1/4



Dimensions

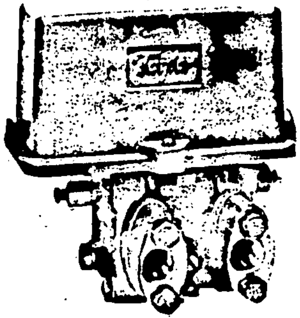
Mounting Bracket



Typical Application

300T SERIES PNEUMATIC DIFFERENTIAL PRESSURE TRANSMITTER

DESCRIPTION



The Taylor Pneumatic Differential Pressure Transmitter is a non-indicating force balance instrument transmitting 3 to 15 psig signals proportional to the differential produced by the primary element. A compact universal secondary with an extensive choice of primary materials and pressure ratings provide a versatile line of transmitter. Five different static pressure ratings and a choice of six diaphragm and trim materials are available. Spans from 1 to 800 inches of water, static pressure from 50 to 6000 psi and elevation and suppression capability from -800 to 600 inches of water, all add to the flexibility of this transmitter. Because no mechanical seals are used, the transmitter is applicable to full vacuum service.

The detail specifications following apply to all standard instruments used within the published parameters.

Basic Catalog No.	Span (Adjustable within the following limits) in. H_2O	kPa	Zero Point Limits (3 psi output) Max. Elevation in. H_2O	kPa	Max. Suppression in. H_2O	kPa	Upper Range Limit (15 psi Output) in. H_2O	kPa	Max. Working Pressure psig	kPa
→ 301T	1 to 7	0.25 to 1.8	-7	-1.8	6	1.55	7	1.8	50	350
302T	5 to 50	1.2 to 12.5	-50	-12.5	45	11.2	50	12.5	500	3,500
303T	20 to 250	5 to 62.5	-250	-62.5	230	57.5	250	62.5	1,500	10,000
304T	200 to 800	50 to 200	-800	-200	600	150	800	200	1,500	10,000
306T	20 to 250	5 to 62.5	-250	-62.5	230	57.5	250	62.5	3,000	20,000
307T	20 to 250	5 to 250	-250	-62.5	230	57.5	250	62.5	6,000	40,000
308T	200 to 800	50 to 200	-800	-200	600	150	800	200	6,000	40,000

Use suppression/elevation spring, Accessory (87) when elevation or suppression exceeds ±5% of actual span.

SPECIFICATIONS

Output Signal	3 to 15 psig (20 to 100 kPa) (0.2 to 1.0 Bar) (0.2 to 1.0 kg/cm^2)
Repeatability	±0.1% any span, (±0.2% for 301T)
Air Consumption	0.2 scfm (0.34 m^3/h)
Air Supply	20 psig (140 kPa) (1.4 kg/cm^2) recommended 18 psig (125 kPa) (1.3 kg/cm^2) minimum 25 psig (175 kPa) (1.8 kg/cm^2) maximum

Warning Use of a supply gas other than air can create a hazardous environment because a small amount of gas continuously vents to atmosphere.

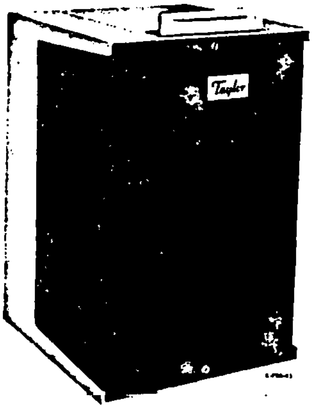
Zero Adjustability	±5% of actual span
Input Damping	On 316L sst diaphragm form, damping is continuously adjustable from 0.15 to 1.0 Hz corner frequency. Other forms have fixed damping: 3 sec for 63.2% response on 301T; 0.5 sec on all others.
Overrange Pressure	May be overranged to maximum stated working pressure
Calibrated Accuracy	±.25% typical (±0.5% for 301T Extra low range) (includes linearity, hysteresis and repeatability)
Allowable Vacuum	Full vacuum
Mounting Position	Universal. However, rezeroing may be required if transmitter is mounted more than 5° from vertical position
Ambient Temperature Limits	Secondary: -40°F (-40°C) minimum, 180°F (82°C) maximum Primary: -40°F (-40°C) minimum, 300°F (149°C) maximum

Weight

	301T	302T	303T	304T	306T	307T	308T
lb	36	25	13.5	12	15.5	27	15
kg	16.4	11.4	6.2	5.5	7.0	12.3	6.8

QUICK-SCAN® 1400 INTEGRATORS

DESCRIPTION



The 1410N Pneumatic Integrator receives a 3-15 psi input signal and provides a pulse (or optional contact closure) output, the rate of which is linearly proportional to the input magnitude. With the same pressure input signal the 1411N provides an output proportional to the square root of the input magnitude. The pulse outputs are calibrated from 0 to 200 pulses per hour to 0 to 20,000 pulses per hour and can actuate up to two external counters. The 1411N is standard with a low level cut-off adjustable from 0.5% to 5% input.

The Integrator consists of two components; a pressure to current transducer and an electronic integrator circuit board mounted in a single housing which has dimensions of approx. 6" x 6" x 9". This housing is designed for rear of panel mounting. Each integrator has a ¼" NPT input port for the pneumatic signal and two terminal blocks, one for the power supply and the other for the pulse output. The power supply is normally ac at 110, 117, 220, or 234 volts and 50 or 60 Hz. A 24 volt dc power supply is also available.

SPECIFICATIONS

Input signal	3 to 15 psig (0.2 to 1.0 kg/cm^2) (0.2 to 1.0 bar)
Cut-Off	0.5 to 5%
Output Signal	
Adjustable Full Span Count Rate	From 200 to 20,000 pulses per hour
Pulse Amplitude	44V decaying to approximately 10V in 80 ms.
Pulse Width	80 ms ±10%
Output Pulse	Not referenced to circuit common
Output signal can operate Counters with:	
Coil Rating	24V dc
Minimum Resistance	
Counter No. 1	300 ohms
Counter No. 2	210 ohms
Calibrated Accuracy	±0.5 % of input span ± one pulse
Ambient Temperature Limits	
Operating	+40°F Minimum, +120°F Maximum (+4°C, +49°C)
Storage	-40°F Minimum, +165°F Maximum (-40°C, +74°C)
Retransmitting contact	SPDT mercury-wetted reed relay
Contact Rating	50 VA at 2A maximum or 400V maximum non-inductive
Operating Position	Vertical (Instrument may be inclined up to 30° from vertical)
Electrical Classification	Codes B, L - CSA is the Approval Agency Code K - FM is the Approval Agency
Power Supply	
AC	117V ± 10%, 60 Hz 117V ± 10%, 50 Hz 234V ± 10%, 50 Hz 110V ± 10%, 50 Hz 220V ± 10%, 50 Hz
DC	24V dc to dc isolated
Power Consumption	
AC	6 watts, 10 VA
DC	6 watts at 24V
Dimensions (Nominal)	6" x 6" x 9" (150mm x 150mm x 225mm)
Weight	
Net	7.5 lb (3.4 kg) Approx.
Shipping	11 lb (5.0 kg) Approx.

QUICK-SCAN® 1400 TOTALIZER

DESCRIPTION


E-704-42

The Taylor 1415N Series Totalizers are a convenient way to mount electrical impulse totalizing and predetermining counters among QUICK-SCAN 1400 Series front-of-panel instruments.

The 1415N has one totalizing seven-digit counter mounted on a 3 in. x 6 in. x 24 in. (75mm x 150mm x 610 mm) slide.

The 1416N has two totalizing seven-digit counters mounted on a 3 in. x 6 in. x 24 in. (75mm x 150mm x 610 mm) slide.

The 1417N has a totalizing seven-digit counter and a predetermining counter mounted on a 3 in. x 6 in. x 24 in. (75mm x 150mm x 610mm) slide.

The 1418N has one predetermining counter mounted on a 3 in. x 6 in. x 24 in. (75mm x 150mm x 610mm) slide.

The predetermining counter has two six-digit displays. One display is for the adjustable preset count, which counts down toward zero as input pulses enter. The second display counts upward as input pulses enter. When the preset count is reached, a contact closure is made. This predetermining counter is standard with both manual and electrical reset, which resets the count-down display to the last preset value and simultaneously resets the count-up display to zero.

The totalizers are available with or without manual reset.

Counters have either 24V dc or 117V ac input coil rating with a maximum count rate of 36,000 counts per hour. All counters are designed to operate in conjunction with QUICK-SCAN 1400 Pneumatic Integrators (1410N & 1411N).

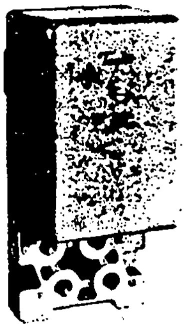
The totalizers are capable of being relay rack or panel mounted in Taylor Slide-Guide Instrument Mounting Trays.

SPECIFICATIONS

Input	
Coil Rating	24V dc (standard) 117V, 60 Hz (optional)
Speed	36,000 pulses per hour, maximum
On-Off Time	
On	50 ms, minimum
Off	50 ms, minimum
Reset	
Totalizing Counter	Optional manual push button
Predetermining counter	Manual push button and electrical (117V, ac, 20W) reset
Contact Rating SPDT or Predetermining	
DC	48V, 0.6A, maximum
AC	250V, 1.0A, maximum, non-inductive
Electrical Classification	Codes B, L - CSA is the Approval Agency Code K - FM is the Approval Agency
Ambient Temperature Limits	
Operating	+40°F minimum, +120°F maximum (+4°C, +40°C)
Maximum	+30°F minimum, +130°F maximum (-1°C, +54°C)
Storage	-40°F minimum, +165°F maximum (-40°C, +79°C)
Dimensions	3 in. x 6 in. x 24 in. (75mm x 150mm x 610mm)

Weight	1415N	1416N	1417N
Net	5.5 lb (2.5 kg)	6 lb (2.7 kg)	6.5 lb (3.0 kg)
Shipping	10.5 lb (4.8 kg)	11 lb (5.0 kg)	11.5 lb (5.2 kg)

375N PNEUMATIC COMPUTER
376N SQUARE ROOT EXTRACTOR



DESCRIPTION

The 375N computer accepts one or two input pressure signals and produces an output pressure signal which is proportional to the product or quotient of two inputs, or, the square root or square of one input.

The 376N square root extractor will accept any 3 to 15 psig signal from a differential pressure transmitter as its input and produce an output signal proportional to flow.

Basically, the difference between the 375N computer and the 376N square root extractor is the addition of two sensing nozzles and a gasketed function switching plate to the computer thus permitting quick conversion to multiplication, division, squaring or square root extraction. The computer has bias adjustments making it possible to handle suppressed or elevated ranges or inputs or outputs.

Basic Catalog No.	
375N	Multiplication, division, squaring and extraction
376N	Square root extractor

SPECIFICATIONS

Output Signal	3 to 15 psig (0.2 to 1.5 kg/cm^2)
Accuracy	±0.5% — *Note 1*
Repeatability	0.1%
Hysteresis	0.25% maximum 0.10% typical
Accuracy @ 0% Input (376N)	±0.5% (includes linearity, hysteresis and repeatability)
Speed of Response (63%)	0.02 sec squaring and multiplying 0.04 sec division and square root extraction
Ambient Temperature Limits	30°F (-1°C) minimum, 140°F (60°C) maximum
Air Supply	20 psig (18 psig minimum, 25 psig maximum)

Warning Use of a supply gas other than air can create a hazardous environment because a small amount of gas continuously vents to atmosphere.

Air Consumption	0.2 scfm (0.37m^3/h) maximum
Mounting	Universal bracket for 1 1/4 to 2 in. (32 to 50 mm) pipe. Also, wall or surface mounting.
Connections	E1 and E2 (inputs), air supply and output ports all 1/4 in. internal NPT
Weight	4 lb (1.8 kg)

MATERIALS OF CONSTRUCTION

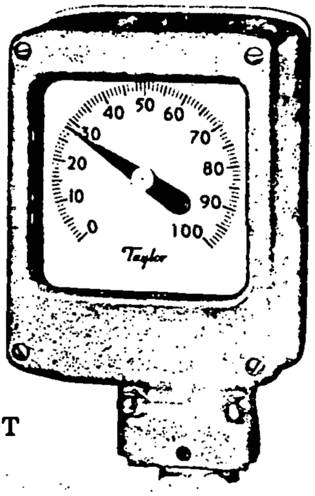
Manifold	Die-cast aluminum, epoxy cemented, with baked enamel finish
Cover	Drawn aluminum with baked enamel finish

Note:

1. From 4 to 100% of input for square root extraction, and 20 to 100% of denominator input for division.

TRANSCOPE® PNEUMATIC TRANSMITTER AND INDICATOR

• Large Dial Indication	11-3/4 in. (300mm) Long
• Single Package Pneumatics	Simplifies Maintenance
• Proven Actuating Elements	Interchangeable with FULSCOPE® Units
• Enclosed Motion Amplifier	Eliminates Dead Spot
• Low Cost Alarms	Servo Actuated

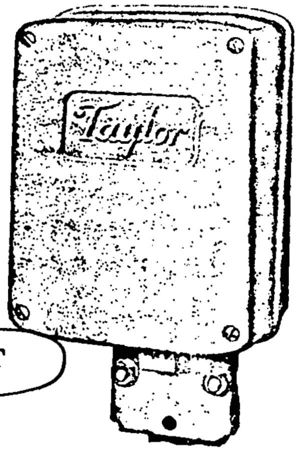


210T

DESCRIPTION

The 210T and 211T TRANSCOPE Pneumatic Transmitters are available for the measurement of temperature, pressure, volumetric pressure, liquid level, flow, force (load) or absolute pressure. They provide a pneumatic output signal proportional to the measured variable in the range of 3 to 15 psi (0.2 to 1.0 kg/cm^2). Both servo and measuring element driven alarms are available. For piped and mounted air supply sets, see File 7-1B.

The 210K is a TRANSCOPE Indicator only, matching the 210T in performance specifications and appearance. This indicator can also be equipped with measuring element driven alarms only.



211T

SPECIFICATIONS

Accuracy:
+Transmission Signal: ±0.5%
+Indication: ±1%
Threshold Sensitivity: 0.1%
Hysteresis: 0.1% of input span
Recommended Air Supply: 20 psi(1.4kg/cm^2)
Ambient Temperature Limits: −40° to +180°F (−40.0° to 82.2°C), or limit of primary element
Ambient Temperature Effect: ±0.5% for 50° change in case temperature between 50°F and 150°F; When supplied with TME's should be 25°F (-10°C) minimum, 167°F (75°C) maximum.
Suppression: Available on some elements. Consult individual Price Lists.
+For most primary elements

Case: 7-9/16 in. x 9-3/4 in. x 4-1/2 in. (192mm x 248mm x 125mm)
Material: Die cast aluminum
Finish: Grey Butoxy Resin
Weight: Approx. 9 lb. (4.1kg) for Pressure Transmitter with Bourdon Element
Mounting: Universal Bracket
Air Connections: ¼" Int. NPT
Bottom: Std. Back: Optional Δ
Scale: 11¾ in. (300mm) long, black figures and graduations on white
Glass: Std.-Double strength Plate. Optional: Safety glass, Antiglare or clear plastic.

Δ Not available on Terms, 36 & 42

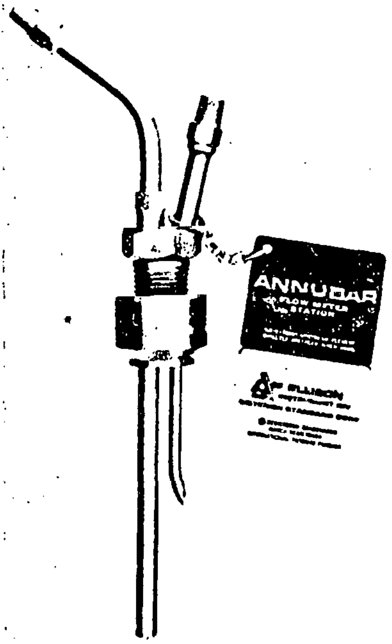
TECHNICAL & ORDERING DATA

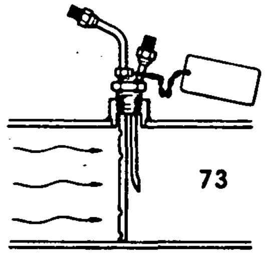
TYPE 73

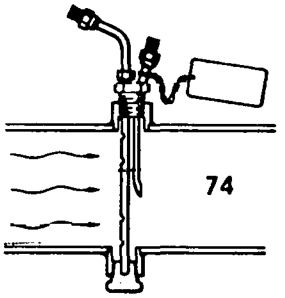
PIPE SIZES 1½" to 16"

TYPE 74

PIPE SIZES 3" to 36"







TYPE 73

STANDARD INSERT SENSOR.

MOUNTS THROUGH SINGLE ½" THREADED STEEL WELD COUPLING WHICH IS SUPPLIED. OPTIONAL COUPLING MATERIAL AVAILABLE IN 316SS, PVC, ALUMINUM, COPPER, OR POLYPROPYLENE.

TYPE 74

STANDARD INSERT SENSOR WITH SUPPORT ON BOTH SIDES OF PIPE FOR HIGHER VELOCITY FLOWS.

MOUNTS THROUGH ½" THREADED STEEL WELD COUPLING AND SUPPORTED ON OPPOSITE SIDE BY IDENTICAL ½" THREADED WELD COUPLING AND PLUG WHICH ARE SUPPLIED. OPTIONAL COUPLING MATERIAL AVAILABLE IN 316SS, PVC, ALUMINUM OR COPPER.

APPLICATIONS:

- MEDIUM VELOCITY FLOW
- PIPES, TUBES, DUCTS (CIRCULAR, RECTANGULAR, OR IRREGULAR SHAPES)
- SUITABLE FOR ALL PIPING MATERIALS

FITTINGS AVAILABLE:

#1 - ½" NPT
#2 - ¼" NPT
#3 - ⅛" NPT
#4 - ¼" COMPRESSION ADAPTER
#5 - BRASS VALVE WITH ¼" SAE FLARE
#6 - 303SS VALVE WITH ⅛" FEMALE NPT CONNECTIONS
#7 - ½" FEMALE NPT THREADED FITTINGS ON FLANGE
#8 - ½" SOCKET WELD FITTINGS ON FLANGE

AVAILABLE MATERIALS:

316SS
HASTELLOY C (#3 FITTING ONLY)
TITANIUM (#3 FITTING ONLY)

REQUEST DRAWING E-165, E-165A — TYPE 73
REQUEST DRAWING E-166 — TYPE 74

MAX. D.P. CHART

PIPE SIZES	TYPE 73	TYPE 74
1½"	650" (269)	
2"	393" (346)	
2½"	277" (414)	
3"	180" (516)	872" (1134
4"	104" (675)	506" (1488)
5"	66" (835)	322" (1864)
6"	46" (1020)	223" (2241)
8"	27" (1370)	128" (2981)
10"	17" (1740)	82" (3813)
12"	12" (2090)	57" (4559)
14"	10" (2360)	47" (5116)
16"	7" (2650)	35" (5928)
18"		28" (6868)
20"		22" (7683)
24"		15" (9373)
36"		7" (14,870)

1. Max. D.P.'s shown in inches H_2O, and apply to measured fluids.
2. Max. water flow rates in G.P.M. shown in parenthe
3. Max. flow rates for other fluids . ... use equations, p. & 18.

TEMPERATURE/PRESSURE RATINGS

TYPES 731-734, TYPES 741-744, TYPES 751-754,
TYPES 761-764
CHART E

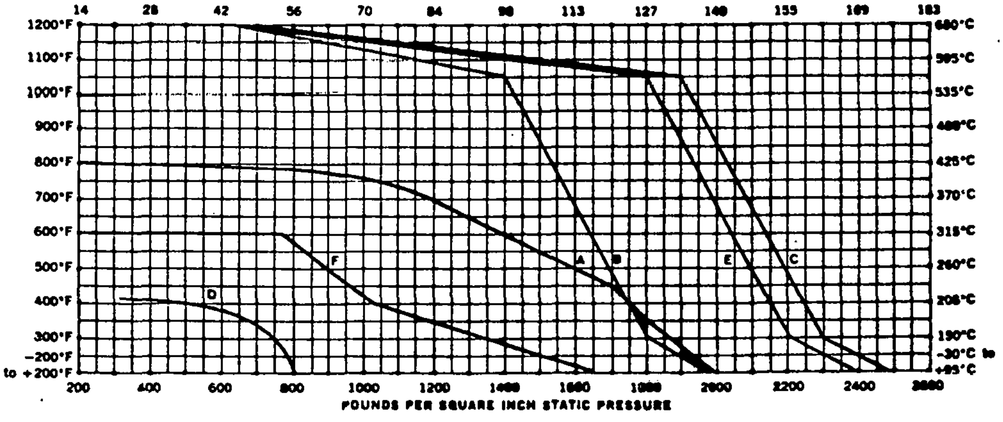
TYPES	SENSOR MTL.	COUPLING MTL.	CURVE LETTER
731-734	316SS	Steel (Stnd)	A
741-744	316SS	316SS	C
73 & 74	Hastelloy C	316SS	E
73 & 74	Titanium	316SS	F
751-754	304/316SS	Steel (Stnd)	A
761-764	304/316SS	316SS (Opt)	B
75 & 76	Hastelloy G	N/A	E
75 & 76	Titanium	N/A	F
#5 Fitting Brass Valves (Also Part #0408)			D
#6 Fitting Stainless Valves (Also Part #0403)			C

Maximum recommended static line pressures for safe continuous service based on working temperatures are shown. For safe working conditions, keep to the left of the curve listed for the type, material and size.

Fittings #7 and #8 limitations are contingent upon flage specifications.

Hex head #9 fitting ratings are contingent upon flange or weld specifications.

TYPES 731-734, TYPES 741-744, TYPES 751-754, TYPES 761-764
GRAPH E



McDONNELL

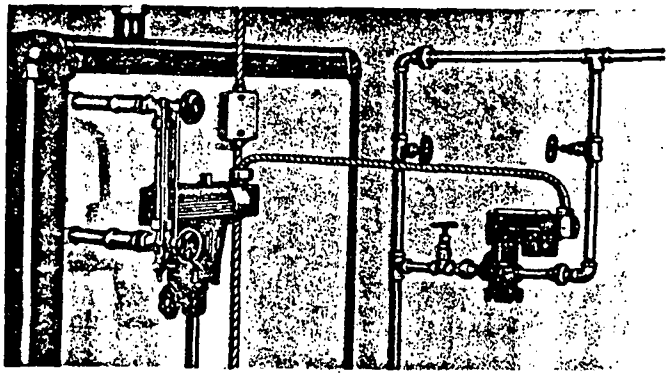
ELECTRIC WATER FEEDERS

The McDonnell No. 101 Electrical Water Feeder is designed for use on steam boilers up to 5000 sq. ft. capacity, to convert a low water cut-off installation into the equivalent of an electrical feeder and cut-off combination. The cut-off has the task of stopping the burner should the boiler water line drop below a minimum safe level. The No. 101 operates automatically to keep the water line above this safe level.

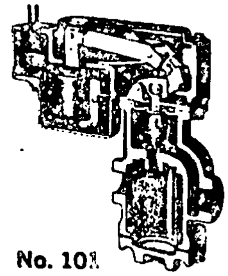
The No. 101 is controlled by a special "feeder" switch provided in all the McDonnell Cut-offs listed in selection table on page 5 opposite. The "feeder" switch operates at a level slightly higher than the cut-off point.

Adding the No. 101 to a cut-off installation eliminates the chore of adding water to boiler manually. It contributes to heating comfort, and minimizes danger of freeze-up during absence, by going into action immediately to maintain or restore a safe operating level. It can even forestall an unnecessary service call that might otherwise result from a slight temporary loss of water in the system.

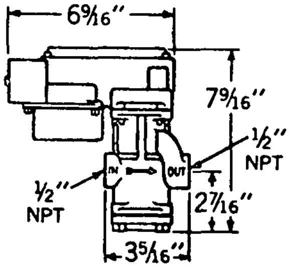
The No. 101 can be installed in any horizontal run of cold water supply pipe, either above or below the boiler water line.



No. 101 ELECTRIC WATER FEEDER



No. 101



The No. 101 Electric Water Feeder has the same packless construction, straight thrust valve action and built-in strainer perfected in other McDonnell Feeders. Closes drip tight after operating, against supply pressures up to 150 psi.

For Oil Boilers — The standard No. 101 is furnished with 115 V.A.C. coil. Also available with 230 V.A.C. coil. Both are listed by Underwriters Laboratories.

For Gas Boilers — The No. 101 is also available with low voltage coil and companion transformer for use on gas fired boilers having 24 volt control circuits. Order No. 101-24V (with transformer).

Product Number	No. 101	No. 101-24V
Shipping Weight	7½ lbs.	11¼ lbs.
Maximum Water Pressure	150 psi	
Maximum Boiler Pressure	25 psi	
Maximum Boiler Size	5,000 sq. ft. steam	

McDONNELL

MAKE-UP WATER FEEDERS

In higher pressure boiler feed systems a make-up feeder, like those shown below, is usually provided on the condensate receiver. It serves to add make-up water to receiver when necessary so there is always an adequate supply for boiler demand.

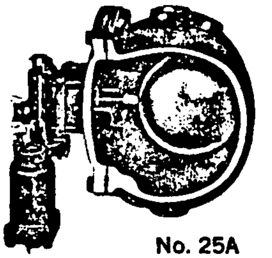
McDonnell Make-up Feeders provide large feeding capacity. Valves and seats are of stainless steel, and protected by a large integral strainer. Positive alignment of the valve is assured by McDonnell cam-and-roller, straight-thrust action.

These make-up feeders, and other McDonnell Feeders such as shown on Page 3, can also be used for many other liquid level control applications.

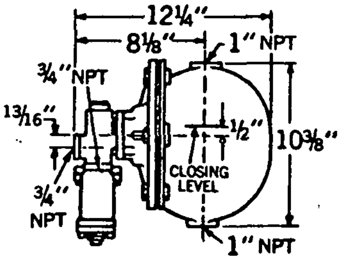
Water Feeding Capacity In Pounds Per Hour

Product Number	City Water Supply Pressure Minus Tank Pressure							
	10 psi	20 psi	30 psi	40 psi	50 psi	60 psi	70 psi	80 psi
No. 25A	3100	4500	5600	6550	7400	8150	8800	9400
21 Series	4100	6000	7500	8600	9600	10500	11300	12000

No. 25A MAKE-UP WATER FEEDER



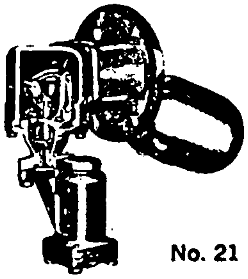
No. 25A



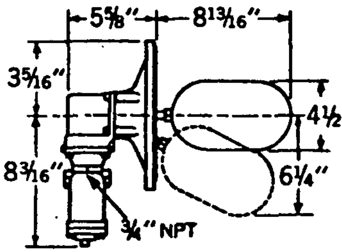
The McDonnell No. 25A is a dependable float-operated feeder used to add make-up water to condensate receiving tanks whenever necessary. It is mounted to the tank with 1" top and bottom equalizing lines and feeds water through a separate pipe. Has large capacity, with high temperature composition valve and monel seat.

Product Number	No. 25A
Shipping Weight	38½ lbs.
Maximum Body Pressure	35 psi
Maximum Water Supply Pressure	100 psi

21 SERIES MAKE-UP WATER FEEDERS



No. 21



For supplying make-up water to condensate receivers. Flange mounts right on side of receiver; this permits a saving in space, and a very simple piping arrangement. Make-up water is fed through the integral strainer, through the valve, and directly into the tank. Two flange sizes are available.

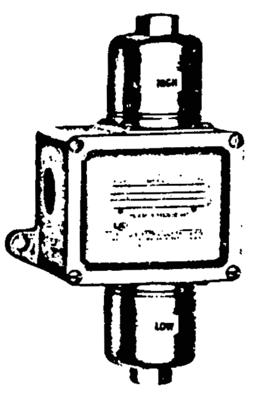
Product Number	No. 21	No. 221
Bolt Circle Diameter (6 Bolts)	5¾"	8½"
Shipping Weight	15¼ lbs.	22 lbs.
Maximum Receiver Pressure	35 psi	
Maximum Water Supply Pressure	150 psi	

DIFFERENTIAL PRESSURE CONTROLS

FEATURES

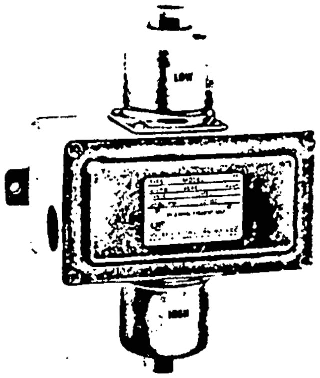
- Bellows actuated.
- Maintain difference between two source pressures.
- Range Limits: 0 to 90 PSID.
- Snap Switch Rating: 15 amps, 125/250 VAC, resistive SPDT contacts.

NOTE: *Models 127, 140 and 150 available with 316L stainless steel bellows.*



Type J21K . . . Single Switch.

Settings are adjusted internally via hex adjustment screws. Enclosure is die cast aluminum.



Type J27KB . . . Dual Switch.

Switches may be set up to 50% of range apart.

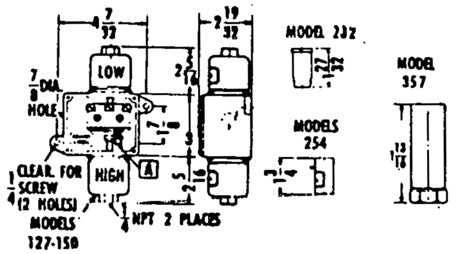
J21K Single Switch		SPECIFICATIONS					J27KB - Dual Switch	
Catalog† Model	On-Off Differential	Differential Pressure Range*	Sensor Material	Other Wetted Materials	Diff'l Proof* Pressure	Working Pressure Range	On-Off Differential	Catalog† Model
127 140	.4 — 6" Hg 2 — 6 oz	0 to 30" HgD 0 to 6	Brass Bellows	Brass	15 6	30 – 0" Hg Vac 30" Hg Vac – 30 PSI	.8 — 1.2" Hg 3 — 9 oz	127 140
232	5 — 11 oz	0 to 25	Phor. Bronze Bellows	Brass	25	30" Hg Vac – 110 PSI	5 — 15 oz	232
150 254	5 — 11 oz 2 — 4 PSI	0 to 40 0 to 90	Brass Bellows	Brass	40 90	30" Hg Vac – 180 PSI 30" Hg Vac – 200 PSI	5 — 15 oz 3 — 7 PSI	150 254
357	2 — 4 PSI	0 to 70	#347 St. St. Bellows	#347 St. St.	70	30" Hg Vac – 350 PSI	3 — 7 PSI	357

NOTES:
** PSID unless otherwise noted.*
†Many models in stock. Consult Price List for stock information.
***Differential Pressure Range** . . The limits of the difference between the two sensed pressures within which the snap switch may be adjusted to actuate and deactuate.*
***Differential Proof Pressure** . . . The maximum difference between the two sensed pressures to which the control may be exposed without harmful effect to performance (set point repeatability, etc.).*
***Working Pressure Range** . . . The pressure limits to which each sensor can safely be exposed as long as Differential Proof Pressure is not exceeded.*

For Diaphragm Differential Pressure Controls see Page 13 (300K Series)

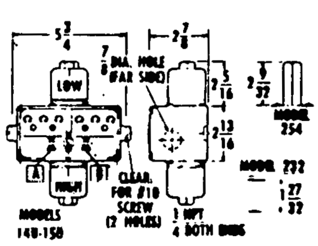
DIFFERENTIAL PRESSURE CONTROLS DIMENSIONS

J21K



APPROX. WT.
2 LBS. 7 OZ.

J27KB

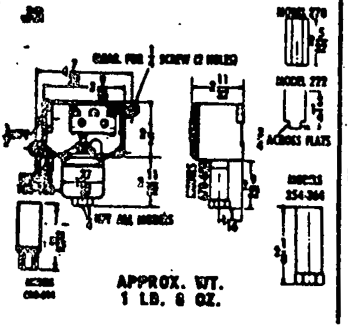


APPROX. WT.
2 LBS.

A and B = Adjustment

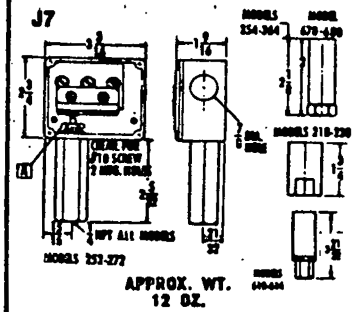
PRESSURE CONTROLS DIMENSIONS

J6



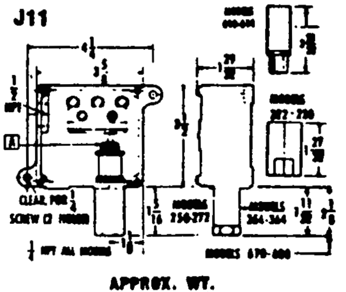
APPROX. WT.
1 LB. 6 OZ.

J7



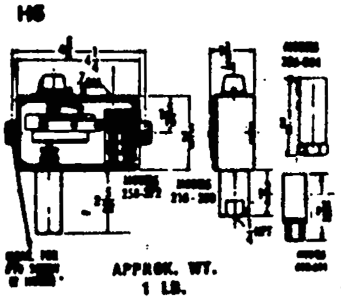
APPROX. WT.
12 OZ.

J11



APPROX. WT.
2 LBS. 7 OZ.

H6

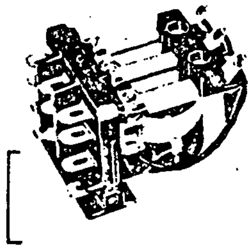


APPROX. WT.
1 LB.

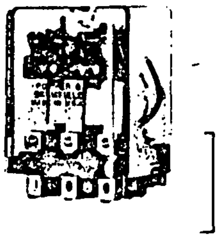
A = Adjustment

P&B AMP | POTTER & BRUMFIELD

KU SERIES



KU, KUM



KUP, KUMP

GENERAL PURPOSE

KU — open relay, 5 and 10 amps
KUP — enclosed, 5 and 10 amps
KUM — open relay, 15 amps
KUMP — enclosed, 15 amps

UL File E22575
C.S.A. File 15734

ENGINEERING DATA

KU Series relays comprise open styles KU and KUM, and enclosed styles KUP and KUMP. An exceptional wide choice of optional features is available with each series. Their quick-connect/solder terminals are a substantial cost saver on modern production lines. Several types of custom nylon sockets make the series convenient plug-in relays.

Standard relays are furnished with .187″ terminals; .205″ terminals are available upon request. The open styles can be furnished with either a .218″ or a .125″ long locating tab and with or without a mounting stud.

Two styles of clear polycarbonate dust covers are available for the enclosed styles. One is plain, for use when the relay is mounted in a socket. This case also can be furnished with a stud-and-locating tab plate mounted on the end opposite the terminals. The other case has two slotted flanges for bracket mounting the relay directly to a chassis. The bracket-mount case is not suitable for socket mounting.

Relays with either type of dust cover (except the model with stud on end of case) can be furnished with a handy external push-button for checking circuits by manually operating the movable contacts. A hold-down spring can be furnished for socket-mounted styles also applicable to screw terminal sockets. When desired, the KUP and KUMP 120V and 240V AC types can be supplied with a neon lamp wired in parallel with their coils to indicate power is reaching the relay.

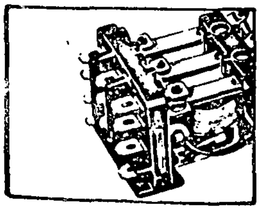
Reliability and long life of the Series is enhanced by long contact arms and a unique method of staking the stationary contacts, as well as barriers molded into the front.

Several types of custom nylon sockets are available. They accommodate all open* and plain case styles having .187″ terminals. The socket types are: solder, printed circuit, quick-connect, quick-connect with terminal barriers, and screw terminals. All are rated 10 amps.

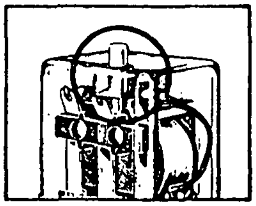
Standard KU and KUP relays are recognized under the Component Program of Underwriters' Laboratories, Inc. File No. E22575 and Canadian Standards Association, File No. 15734. Any electrical or mechanical deviations from standard relays are subject to re-examination by UL and C.S.A. UL approval on the KUM and KUMP is pending.

**Caution should be exercised in handling socket-mounted open relays due to the inherent shock hazard.*

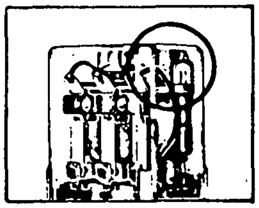
OPTIONAL FEATURES AVAILABLE



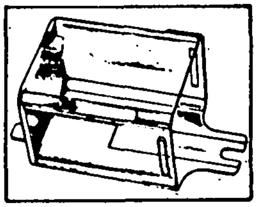
All models in this series are equipped with quick-connect terminals punched for soldering. .187″ terminals are standard but .205″ are available.



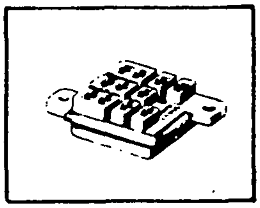
All enclosed relays (except with stud on end of case) are available with push-to-test button which operates the movable contacts for manually checking circuits.



A neon lamp wired in parallel with its coil to indicate that power is reaching the relay is available on enclosed 120V and 240V AC types.



Two styles of heat and shock resistant polycarbonate dust covers can be furnished. One plain, the other with slotted flanges for direct-to-chassis mounting.



Several socket types can be supplied.

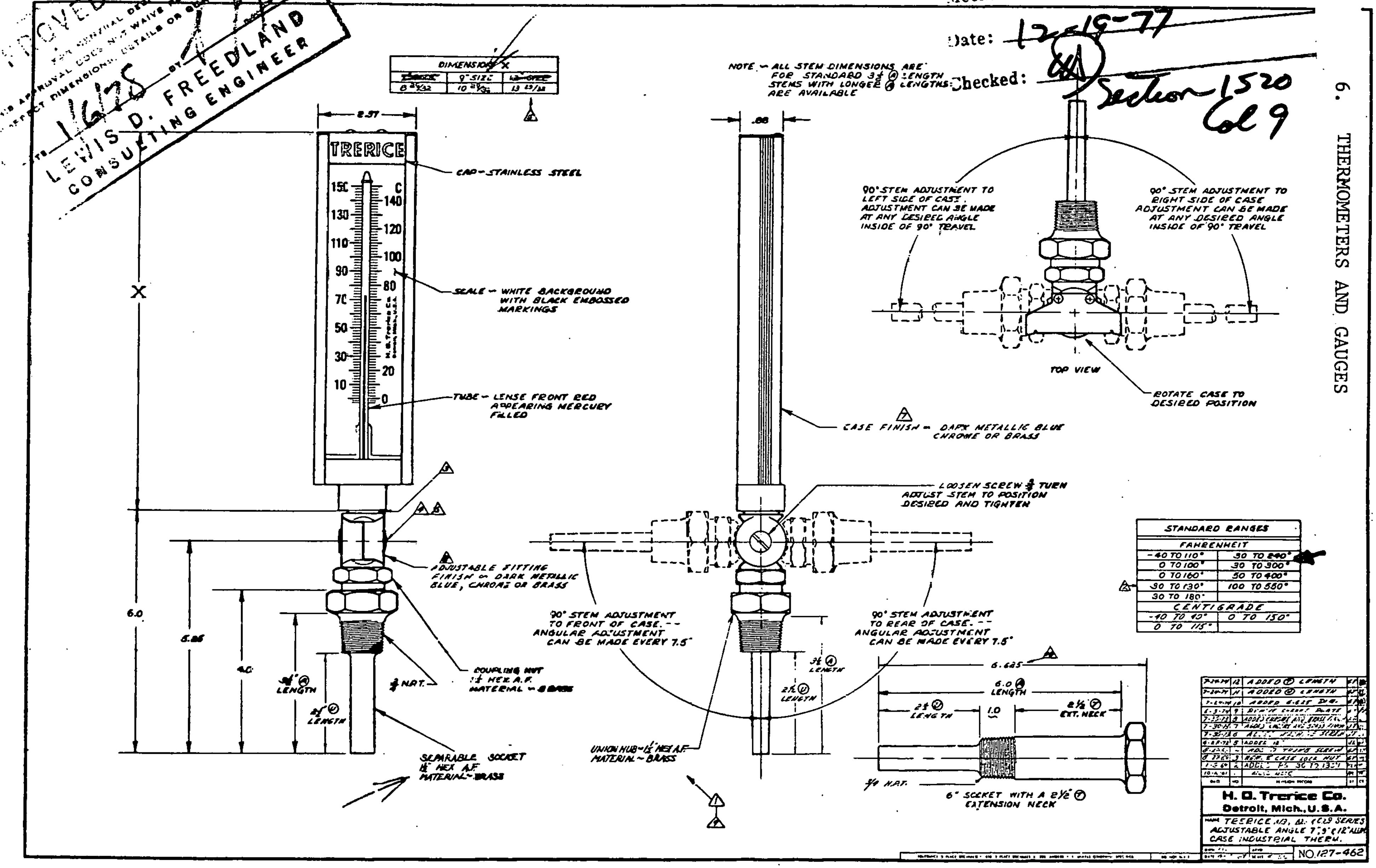
STEPHENS COLLEGE VISITORS CENTER
Columbia, Missouri

DRUMMOND-OFFICER
Mech. Contractors, Inc.

Date: 12-19-77
Checked: [illegible]

Section 1520
Col 9

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR CORRECT DIMENSIONS, DETAILS OR QUANTITIES
1/6/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER



NOTE – ALL STEM DIMENSIONS ARE FOR STANDARD 3½ Ⓐ LENGTH STEMS WITH LONGER Ⓐ LENGTHS ARE AVAILABLE

DIMENSION X		
~~7" CASE~~	9" SIZE	~~12" CASE~~
8 23/32	10 29/32	13 13/32

STANDARD RANGES	
FAHRENHEIT	
-40 TO 110°	30 TO 240°
0 TO 100°	30 TO 300°
0 TO 160°	50 TO 400°
30 TO 130°	100 TO 550°
30 TO 180°	
CENTIGRADE	
-40 TO 40°	0 TO 150°
0 TO 115°	

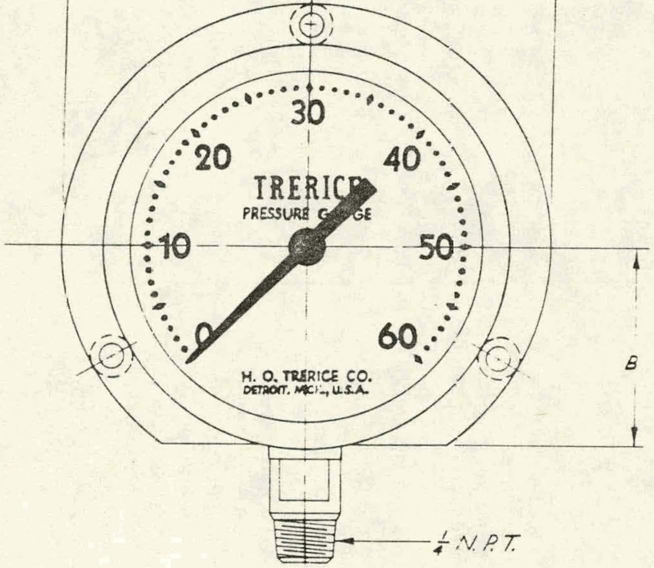
7-24-74	12	ADDED Ⓟ LENGTH	[illegible]	[illegible]
7-24-74	11	ADDED Ⓤ LENGTH	[illegible]	[illegible]
7-24-74	10	ADDED 6.625 DIM.	[illegible]	[illegible]
6-3-74	9	[illegible] PLATE	[illegible]	[illegible]
7-23-73	8	ADDED CHROME AND BRASS [illegible]	[illegible]	[illegible]
7-30-73	7	ADDED [illegible]	[illegible]	[illegible]
7-30-73	6	[illegible]	[illegible]	[illegible]
4-28-72	5	ADDED 12"	[illegible]	[illegible]
[illegible]	4	ADD [illegible] SCREW	[illegible]	[illegible]
8-27-69	3	REF. & CASE LOCK NUT	[illegible]	[illegible]
1-3-69	2	ADDED [illegible] 30 TO 130°	[illegible]	[illegible]
10-4-61	1	[illegible]	[illegible]	[illegible]
DATE	NO.	REVISION RECORD	BY	CK.

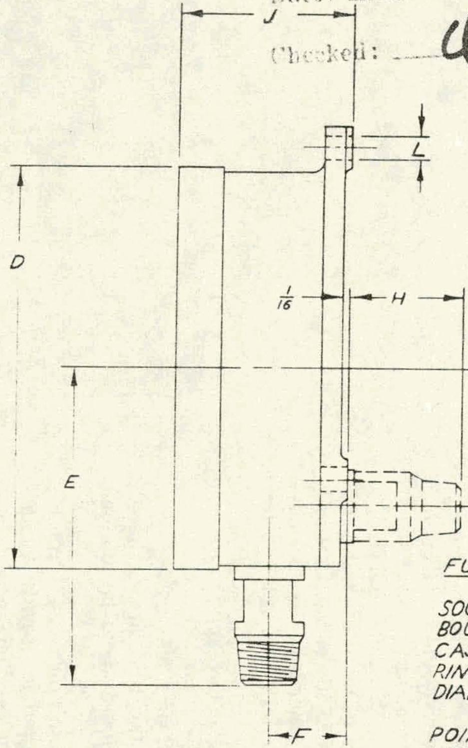
H. O. Trerice Co.
Detroit, Mich., U.S.A.

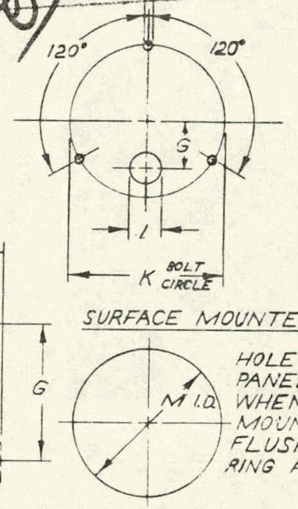
NAME TRERICE NO. AA 6C29 SERIES ADJUSTABLE ANGLE 7", 9" & 12" ALUM. CASE INDUSTRIAL THERM.

NO. 127-462

DRUMMOND-OFFICER
Mech. Contractors, Inc.
Date: 12-19-77
Checked:







HOLE SIZE IN PANEL REQUIRED WHEN FLUSH MOUNTING WITH FLUSH MOUNTING RING AND CLIPS

FURNISHED IN ALL STANDARD RANGES UP TO 1000 P.S.I.

SOCKET - BRASS
BOURDON TUBE - PHOS. BRONZE
CASE - BLACK FINISHED CASTALUMINUM
RING - BLACK FINISHED, CLOSE TYPE
DIAL - WHITE WITH BLACK FIGURES AND GRADUATIONS
POINTER - BLACK FINISHED
MOVEMENT - BRONZE BUSHED
ACCURACY - 1% OVER MIDDLE 1/2 OF RANGE, 1 1/2 % OVER BALANCE

NO. 600 SERIES PRESS. GAUGE DIMENSIONAL DATA

DIAL SIZE	A	B	D	E	F	G	H	J	K	L	M
*											
4 1/2"	5 7/8	2 25/64	4 13/16	3 53/64	15/16	1 5/8	1 7/16	2 1/8	5 3/8	7/32 I.D.	5 1/8
6"	7 5/8	3 9/64	6 5/16	4 37/64	15/16	1 5/8	1 7/16	2 1/8	7	9/32 I.D.	6 5/8
8 1/2"	10 1/4	4 3/8	8 3/4	5 13/16	31/32	1 5/8	1 13/32	2 1/4	9 5/8	9/32 I.D.	9 1/8

3

* FOR 3 1/2" SIZE SEE #127-601 & 127-605

STANDARD RANGES	
30" VAC. TO 0#	0 TO 60#
30" VAC. TO 15#	0 TO 100#
30" VAC. TO 30#	0 TO 160#
30" VAC. TO 60#	0 TO 200#
30" VAC. TO 100#	0 TO 300#
30" VAC. TO 150#	0 TO 400#
30" VAC. TO 300#	0 TO 600#
0 TO 15#	0 TO 800#
0 TO 30#	0 TO 1000#

DATE	NO.	REVISION RECORD	BY	CK
1-29-76	3	REMOVED 3 1/2" SIZE	J.L.	
8-12-65	2	ADDED FLUSH MOUNT. DIM.	J.L.	
8-10-65	1	REDRAWN, NO CHANGE	J.L.	

H. O. Trerice Co.
Detroit, Mich., U.S.A.

NAME DIMENSIONAL DRAWING OF NO. 600 SERIES PRESS. GAUGE

DWN. WL.
DATE 2-28-61
APVD. MYERS
SCALE 3/4" = 1"
NO. 127-324

TOLERANCE; 2 PLACE DECIMALS ± .010, 3 PLACE DECIMALS ± .005, ANGLES ± 1° UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE.

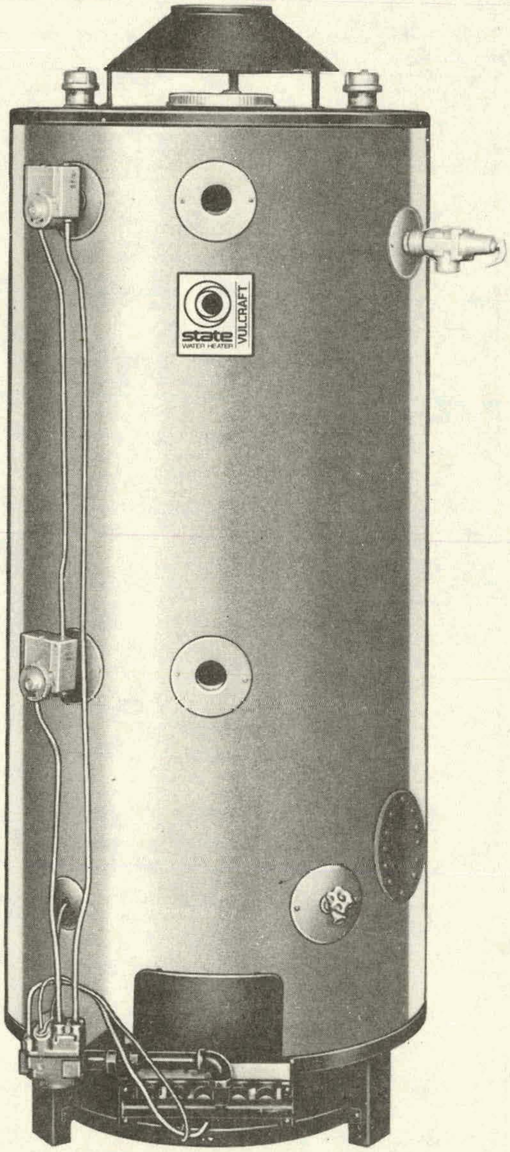
Commercial Gas-Fired Glasslined

7. HOT WATER HEATERS

100 gallon tank capacity
168 and 227 gallon per hour reheat capacity at 100° rise
199,900 and 270,000 BTU/HR input, natural and propane gas
ASME code model available
3-year limited warranty

state
WATER HEATERS

Models
100-199 ET4
100-270 ET4



The 100 gallon tank capacity gas-fired water heater is available in two models. Model 100-199 with a 199,900 BTU/hr. input, is for installation where heaters of less than 200,000 BTU/hr. must be used. Model 100-270 with a 270,000 BTU/hr. input, is for installation where heaters of more than 200,000 BTU/hr. may be used. The two models are otherwise identical. The 100's are design certified by the American Gas Association Laboratories and the National Sanitation Foundation for supplying 180°F, water both as an

(a) Type A Automatic Circulating Tank Heater, and
(b) Type B Automatic Storage Heater.

When used singly or in manifolded multiples as a "Type A" heater with separate storage tank the 100's are designed to provide sufficient gravity circulation and no circulation pump is required.

When used singly or in manifolded multiples as a "Type B" Storage Heater the 100's are constructed to provide a completely independent hot water system needing no separate storage tank, or pump. When installed with a mixing valve they can supply both 140°F. general use hot water and 180°F. sanitizing hot water simultaneously.

Engineering Features

Tank—Internal, multi-flue construction lined with durable high silica content glass best suited for commercial water heater applications involving large quantities of high temperature water.

Burner—Battery of patented design tubular units provide even distribution of heat to tank bottom and flue ways. Silent operation, with each burner performing at its optimum efficiency. Battery of burners contained in easily removable single unit tray.

Insulation—A 2" blanket of treated fiberglass completely enveloping the heater.

Hand-Hole Cleanout—Easily accessible cleanout located on front of tank for periodic removal of lime, scale, silt, sand or other foreign matter deposited in the tank.

Relief Valve—Each Vulcraft booster heater is supplied with factory installed ASME rated pressure-temperature relief valve.

Non-Electric Control System—A completely gas operated mechanical control system provides positive control and safety shut-off—avoiding down time due to failure of electrical components or supply. In the event of pilot outage the safety valve shuts off all gas supply to heater within seconds.

Electrolytic Protection—Multiple large extended rods of highest quality magnesium provide maximum cathodic protection of all internal tank surfaces.

Water Connection—Choice of top or front, hot and cold water connections.

Special ECO Feature—Each Vulcraft heater has a factory installed E.C.O. (energy cut off) switch.

Vulcraft

Commercial Gas-Fired Glasslined Water Heater

Models 100-199 ET4 / 100-270 ET4

Application Information

The following information is intended only as a general guide of typical installations for which the 100's are suited. For more detailed engineering and application information please consult the VULCRAFT Commercial Water Heating Engineering Handbook.

For maximum economy and utilization of floor space it is recommended that the 100's be installed singly or in manifolded multiples **without** using a storage tank in the majority of commercial installations. However, in certain special installations where tremendously large volumes of hot water are needed in a very brief time (such as institutional showers, industrial plant clean-up installations) it should be installed either singly or in multiples with a storage tank of 300 gallons to 1200 gallons.

Typical installations for approximate sizing of the heater are as follows:

Apartments—Average size apartments with no automatic washing equipment and standard shower heads up to 19 units per heater. If used in apartments with 2 baths 14 units per heater.

Restaurants and Institutional Food Service—Hot water requirements for this type of installation usually determined by dishwashing needs. The 100's can supply all hot water requirements for any door or hood type commercial dishwasher plus normal hot water requirements, when a mixing valve is used. The 100's can furnish the necessary water for conveyor type dishwashers using up to 162 gallons/hour. The above applications are figured supplying 180°F. water.

Final sizing of all installations should be done **ONLY** from the Engineering Handbook.

N.S.F. Model Nos.
100-199ENT4/100-270ENT4

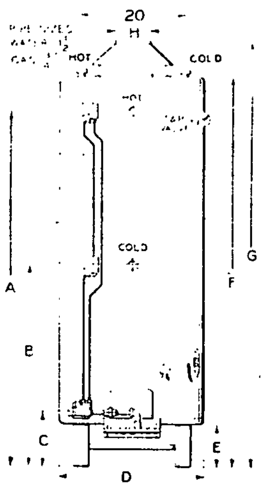
The 100's are design certified by the American Gas Association Laboratories and are constructed in accordance with Standard No. 5 of the National Sanitation Foundation for use with all types of dishwashing equipment. Extension legs available for compliance with NSF standards.

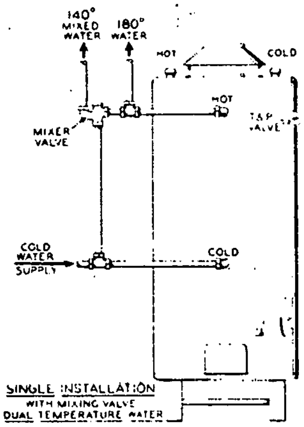
Available in Glasslined ASME model
Warranty: 3-Year only.
(100-270E2ASME)
ASME Shipping Weight 860 Lbs.

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

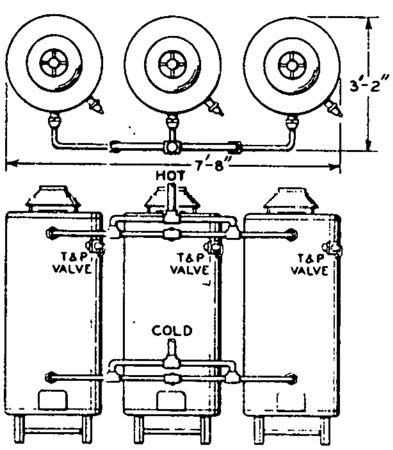
MODEL	100-199	100-270
TANK CAP. (GAL.)	100	
B.T.U./HR. NAT.	199,900	270,000
B.T.U./HR. PROP.	199,900	270,000
G.P.H. 100° RISE	168	227
A	69"	
B	39"	
C	9½"	
D	28"	
E	8"	
F	75"	
G	82"	
H (VENT)	7"	
GAS CONNECTION	¾"	
SHIPPING WEIGHT	650 LBS.	

150 lbs. hydrostatic working pressure





SINGLE INSTALLATION
WITH MIXING VALVE
DUAL TEMPERATURE WATER



state
INDUSTRIES, INC.

Ashland City, Tenn. 37015/Henderson, Nevada 89015

FORM VG128/177

Printed in USA

VULCRAFT
COMMERCIAL GAS HOT WATER HEATERS

-

SAFETY INSTALLATION OPERATION
MAINTENANCE PARTS

-

STATE STOVE & MFG. CO., INC.
ASHLAND CITY, TENN. 37015
AND
HENDERSON, NEVADA 89015

)TE: The first two pages have been deleted because of the inablility to reproduce readiable copies.

SAFETY

FOR SAFE OPERATION, PLEASE TAKE THE TIME TO READ THIS INSTRUCTION BOOK BEFORE ATTEMPTING TO INSTALL YOUR NEW WATER HEATER. THE INSTRUCTIONS IN THIS BOOK ARE INTENDED TO HELP YOU AVOID UNNECESSARY ACCIDENTS AND SERVICE COSTS BEYOND OUR CONTROL. PLEASE READ IT FIRST.

SAFETY HINTS

1. Before installation, check your installation instructions, applicable local codes and gas company requirements.
2. A new A.G.A. design certified temperature and pressure relief valve with limits no greater than 210° F. and 150 pounds pressure must be installed properly at time of heater installation. Three year models come equipped with a factory installed temperature and pressure relief valve.

   Failure to install, or an improperly installed temperature and pressure relief valve, will release the manufacturer from claims resulting from excessive temperature and pressures.
3. Installation clearances at rear and sides of heater must be no less than 6 inches. Heater must be located on a non-combustible floor.
4. Flue pipe clearance must be at least 6 inches from combustible surfaces.
5. Adequate combustion and ventilation air must be provided for proper combustion and vent action.
6. Apply pipe thread compound resistant to the action of liquified Petroleum gases.
7. Do not reduce flue pipe size below that of draft hood opening, nor alter draft hood or its relief openings.
8. Check all gas piping, including factory piping for leaks, using a soapy water solution or non-flamable leak detection fluid. The use of matches, candles, or open flame may cause an extreme fire hazard.
9. Consult your local gas utility to examine installation for propriety and safety.

CONTENTS

All appliances included in this manual were tested under "Title of Standards" ANS Z21,10.3

INSTALLATION

GENERAL INFORMATION

Pages 8 and 11-13 show detailed installation diagrams. Check them thoroughly for materials and method before starting installation to avoid possible errors and lost time.

TYPE OF GAS

Make sure gas supply is the same as specified on rating plate of heater. If rating plate specifies another type gas, **do not** install heater.

LOCATING THE HEATER
(See "Important" note, Page 22)

Locate heater as close to stack or chimney as possible. The stack or chimney must be free of soot or other obstructions.

Installation of water heater should be accomplished in such a manner that if its tank or other connections should leak, the resulting flow of water shall not cause damage to an adjoining area. Under no condition is the supplier nor the manufacturer to be held liable for any water damage in connection with this water heater.

FLUE PIPE SIZE AND INSTALLATION

All products of combustion and vent gases must be completely removed to the outside air without condensation in vent or spillage at draft hood. Horizontal runs of flue pipe must have ¼" per lineal foot min. upward pitch.

Use strong, gas tight pipe for proper venting with a cross-sectional area equal to that of the draft hood outlet. Observe clearances from all combustible material and provide vent outlet with an approved cap.

In addition to local ordinances and utility requirements consult the American Standards Association "Installation of Gas Piping and Gas Appliances in Buildings" as a guide.

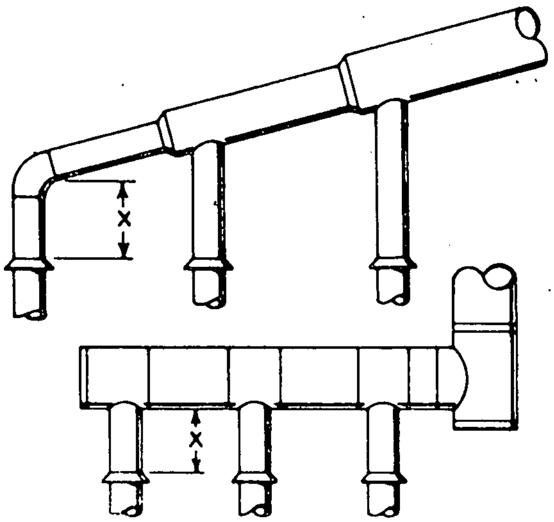
Where continuous or intermittent backdraft is found to exist, check chimney conditions. In some cases a blower type flue gas exhauster must be employed between the appliance and the stack to assure proper venting and correct combustion.

Combining vents as shown is satisfactory, providing the basic rules of good venting are observed. In either case, the vertical rise above draft hood (X) before any fittings, should be as great as possible. All venting connections should be made in accordance with local codes and ordinances.

300 LBS. PER SQ. IN. HYDROSTATIC TEST PRESSURE
150 LBS. PER SQ. IN. WORKING PRESSURE A.G.A.

MODEL NO.	SERIAL NO.
	1972

EQUIPPED FOR	INPUT	RECOVERY	CAPACITY
GAS	B.T.U./HR.	GALS./HR.	U.S. GALS.



When vents are combined, area of the combined vent should be equal to area of the largest single vent, plus 50% of area of all others joining it.

EXAMPLE: To combine two 6" vents with an 8" vent, the area of a combined vent should be one half area of two 6 inch inch vents (14 + 14) plus area of 8 inch vent (50) or 78 sq. inches. Referring to chart, 78 sq. inches require 10" diameter vent.

Vent Size	Square Inches	Vent Size	Square Inches
5"	20	10"	79
6"	28	12"	113
7"	38	14"	154
8"	50	16"	201
9"	64	18"	225

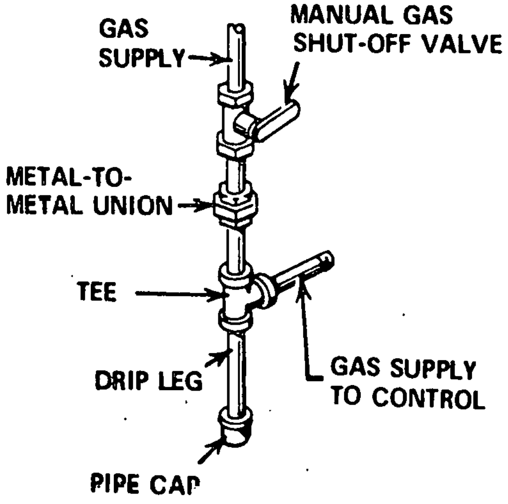
COMBUSTION AND VENTILATION AIR

It is imperative to have an adequate supply of combustion air for gas burning appliances. (One square inch for each 1,000 BTU input.) 70-725 requires a minimum of 1600 sq. inches combustion and vent air. Air is being drawn into combustion chamber from surrounding areas for combustion, as well as providing ventilation for proper vent action. Therefore, it is important that local codes be consulted when equipment is being installed in a closely confined area.

Where an exhaust fan is installed in the same room as heater, air will be drawn into the room through the chimney. Air supply openings must be large enough to admit air exhausted by the fan and that required by all gas burning appliances. A down-draft or back-draft will prevent proper combustion, causing soot which may result in serious damage to the heater. **(See "Important" note, Page 28).**

SIZE OF GAS SUPPLY LINE

Use gas supply line of adequate size to insure full gas input to heater. Porivde and install necessary pipes, fittings, valves, etc. to each heater as shown in illustration. Apply pipe thread compound resistant to the action of liquified petroleum gases.



Gas piping to heater(s) must be large enough to carry the full load without abnormal pressure drop. The following charts show recommended gas pipe size for heaters installed at various distances from gas meter, based on a pressure drop of 0.3 inch water column, and specific gravity of 0.6 (propane gas 1.53). If gas pressure at outlet of meter is less than 5 inches water column, use pipe one size larger than indicated in table.

GAS PIPE SIZES

Correct gas pipe size for heaters operating on
NATURAL GAS

Total Input BTU/hr	DISTANCE TO METER, IN FEET						
	30	60	90	120	150	180	210
65,000	½	¾	¾	¾	1	1	1
100,000	¾	1	1	1	1¼	1¼	1¼
150,000	¾	1	1	1¼	1¼	1¼	1¼
200,000	1	1¼	1¼	1¼	1¼	1¼	1¼
300,000	1¼	1¼	1¼	1½	1½	1½	1½
400,000	1¼	1½	1½	1½	2	2	2
500,000	1¼	1½	2	2	2	2	2
600,000	1½	2	2	2	2	2	2
750,000	1½	2	2	2	3	3	3

Correct gas pipe size for heaters operating on
MIXED GAS

Total Input BTU/hr	DISTANCE TO METER, IN FEET						
	30	60	90	120	150	180	210
65,000	¾	¾	¾	1	1	1	1
100,000	1	1	1	1¼	1¼	1¼	1¼
150,000	1	1	1¼	1¼	1¼	1¼	1¼
200,000	1	1¼	1¼	1¼	1¼	1½	1½
250,000	1¼	1¼	1¼	1½	1½	1½	1½
300,000	1¼	1½	1½	1½	1½	2	2
400,000	1¼	1½	2	2	2	2	2
500,000	1½	1½	2	2	2	2	2
600,000	1½	2	2	2	2	2	2½
750,000	2	2	2	2½	2	2½	2½

Correct gas pipe size for heaters operating on
MANUFACTURED GAS

Total Input BTU/hr	DISTANCE TO METER, IN FEET						
	30	60	90	120	150	180	210
65,000	¾	1	1	1¼	1¼	1¼	1¼
100,000	1	1	1¼	1¼	1¼	1¼	1¼
150,000	1¼	1¼	1¼	1½	1½	1½	1½
200,000	1¼	1¼	1½	1½	1½	2	2
250,000	1¼	1½	2	2	2	2	2
300,000	1¼	1½	2	2	2	2	2
400,000	1½	2	2	2	3	3	3
500,000	2	2	2½	2½	3	3	3
600,000	2	2½	2½	2½	3	3	3
750,000	2	2½	3	3	3	3	3

Correct gas pipe size for heaters operating on
LIQUEFIED PROPANE GASES

Total Input BTU/hr	DISTANCE TO METER, IN FEET						
	30	60	90	120	150	180	210
65,000	½	½	½	½	½	½	½
100,000	¾	¾	¾	1	1	1	1
150,000	¾	¾	1	1	1	1	1¼
200,000	¾	1	1	1¼	1¼	1¼	1¼
250,000	1	1	1	1¼	1¼	1¼	1¼
300,000	1	1¼	1¼	1¼	1¼	1¼	1¼
400,000	1¼	1¼	1¼	1¼	1½	1½	1½
500,000	1¼	1¼	1¼	1½	1½	1½	1½
600,000	1¼	1½	1½	1½	2	2	2
750,000	1¼	1½	2	2	2	2	2

GAS METER SIZE

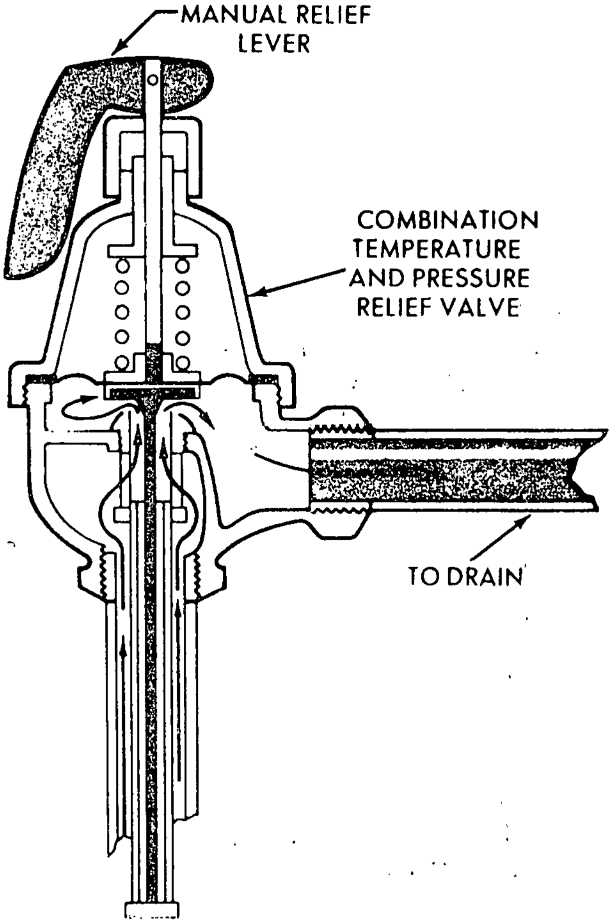
Be sure gas meter has adequate capacity for the complete building load, including new heater(s) and other gas burning appliances. Consult your local utility if meter is under sized.

GAS PRESSURE REGULATION

All water heaters described in this manual are furnished with a gas pressure regulator when equipped for natural gas.

The installer should check the outlet pressure by installing a manometer in provided "pressure tap" of the control. Pressure reading should be between 3.5 and 4.0 inch water column. Minor adjustments, if necessary, can be made with pressure adjusting screw, located on top of control.

Having established proper gas pressure settings, the heater should be checked for proper firing rate indicated on rating plate. If your installer is not equipped, nor familiar with the above procedures, contact your local gas company or gas dealer before lighting your heater.



WATER PRESSURE REGULATION

It is strongly recommended that fluctuations of water pressure and "water hammer" (both have damaging effect on tanks) be controlled by installation of a pressure reducing valve in cold water supply line; particularly when incoming pressures exceeds 60 psi. It is essential, however, to investigate the demands of all fixtures supplied by the hot water system before deciding on one pressure reducing valve in the main supply line. A multiple installation of such valves may be necessary throughout the system, due to wide variation in hot water demands.

CAUTION: Some pressure reducing valves permit the flow of water in one direction only. Due to water expanding when heated, it is a must that a pressure relief valve be used in conjunction with a pressure reducing valve.

TEMPERATURE AND PRESSURE RELIEF VALVE

To prevent possible danger of over heating, a temperature relief valve is a must. A new A.G.A. design certified valve with limits no greater than 210° F. and 150 pound pressure must be installed in provided relief valve opening.

Three year models are factory furnished with a properly sized combination temperature and pressure relief valve as standard equipment. It is an automatic reseating lever type, approved by ASME, so located in the water heater tank as to provide quickest sensing and proper functioning.

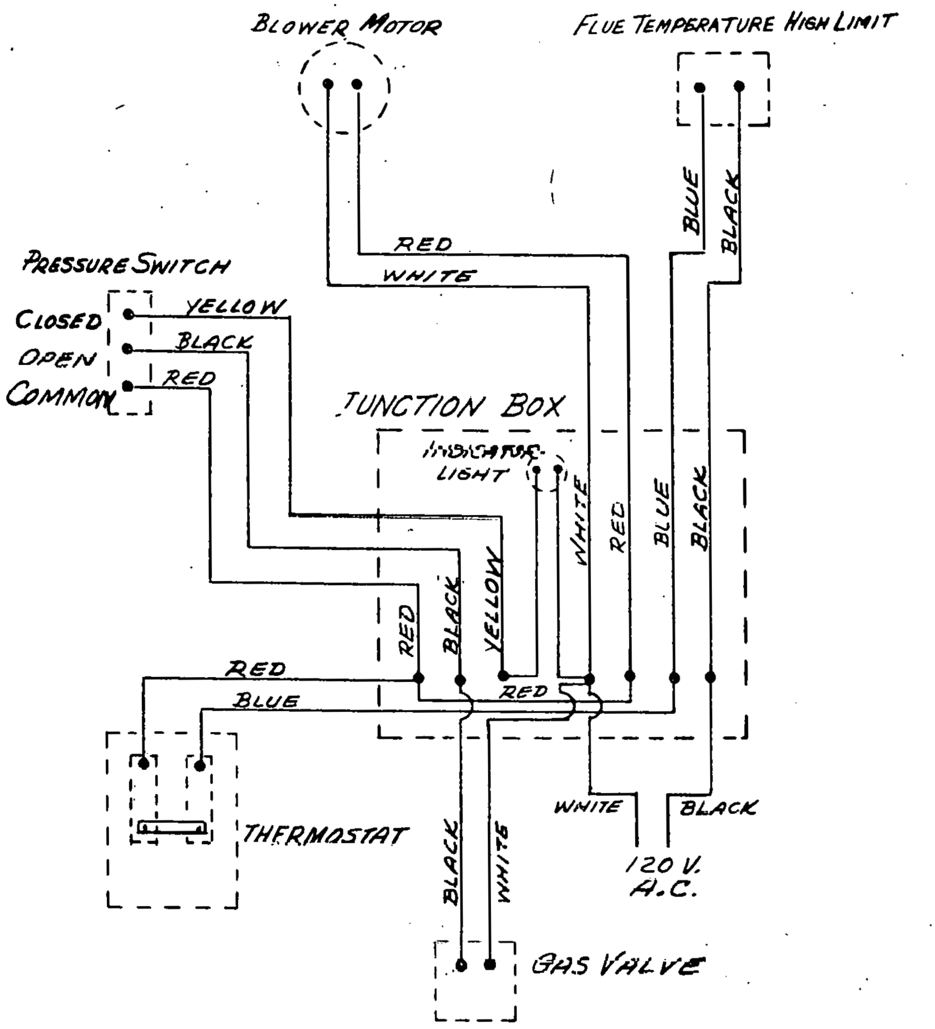
One year models are certified and equipped with an automatic gas shut off system actuated by high water temperature. A listed combination temperature and pressure relief valve shall be installed at time of installation of heater. Local codes shall govern installation of relief devices.

Install a pipe from relief valve outlet to an open drain, or other suitable drainage point not subject to freezing.

USE PIPE SIZE EQUIVALENT TO OUTLET OF "T&P" VALVE.

DO NOT REDUCE PLUG OR CAP OUTLET.

70-725 WIRING DIAGRAM



DIAGRAM, WIRING
70-725

IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH 105 °C. WIRE OR IT'S EQUIVALENT. 059182

MINIMUM LINE VOLTAGE WIRE – #14 AWG

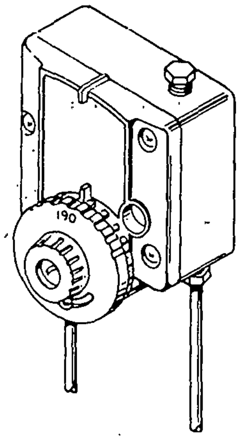
This water heater must be electrically "grounded" by the installer. Using a screw on the heater junction box, a wire must be run to connect the heater to an uninterrupted metallic ground.

NOTE: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE HEATER MUST BE REPLACED, IT MUST BE REPLACED WITH 105° C. THERMOPLASTIC AWM WIRE OR ITS EQUIVOLENT.

OPERATION

GENERAL INFORMATION

Before lighting heater, be certain heater and system is filled with water. Expel air by opening all hot water faucets. Close faucets and inspect system for leaks; repair, if necessary.

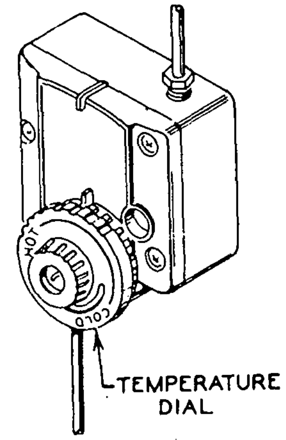


UPPER THERMOSTAT

Models: 80-180, 85-199, 85-250, 100-199, 100-260, 100-270, 75-360, & 70-500 have a fixed (non-adjustable) thermostat set at 190°.

LOWER THERMOSTAT

To vary temperature of delivered hot water, adjust temperature dial from approximately 110 degrees to 180 degrees F.



PILOT BURNER ADJUSTMENT, ALL MODELS

Remove pilot key cap. Turn pilot adjusting screw (counterclockwise to open, clockwise to close) until pilot burns with a strong blue flame. Do not allow pilot flame to rise off pilot or burn lazily. Replace pilot key cap.

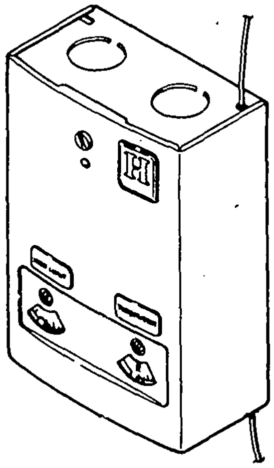
MAIN BURNER AIR ADJUSTMENT

These models have a metered air supply burner which requires no further adjustments.

70-725

THERMOSTAT

Serves a dual purpose. To set desired temperature adj. dial marked "heater". To set desired Hi Limit adj. dial marked "Hi Limit". DO NOT SET "HI LIMIT" BELOW SETTING OF DIAL MARKED "HEATER".



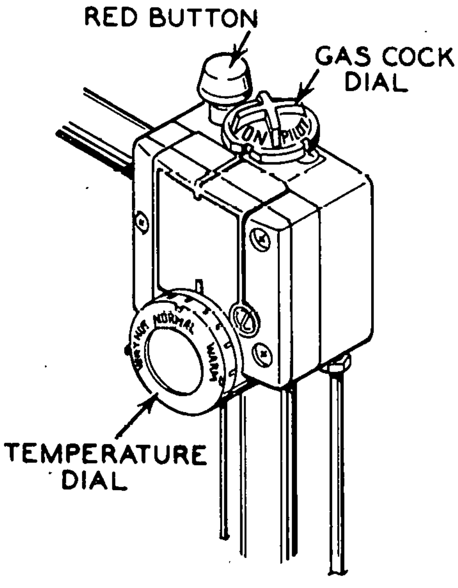
OPERATIONAL SEQUENCE

Thermostat calls for heat, completing a circuit thru the ECO, and then to blower. When blower has achieved sufficient venting the pressure switch activates the gas control value (indicator light goes off) and burn comes on.

FLUE TEMP HIGH LIMIT

Check for vent blockage.

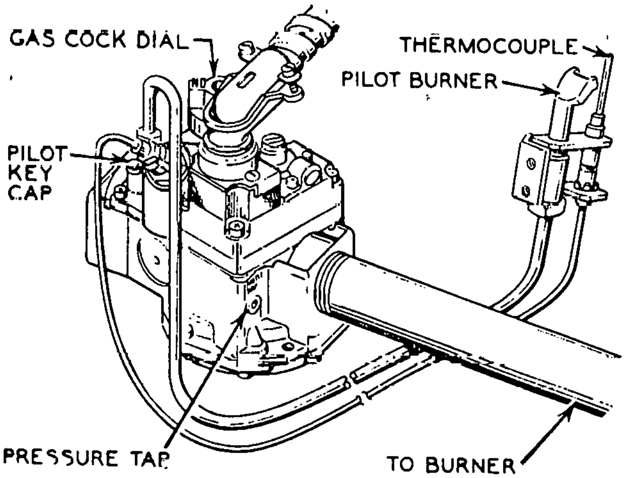
Turn current to heater off. Remove access cover on ECO located behind right side of blower. Push red reset button, replace access cover and restore current to heater.



LIGHTING INSTRUCTIONS FOR MODEL:

75-120, **100-90/100-75**

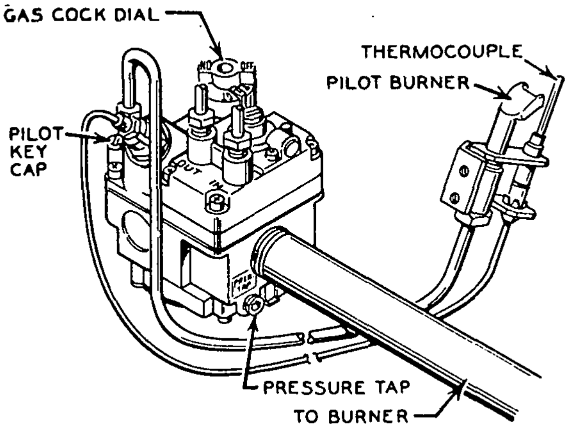
1. Turn gas cock dial to "OFF" position.
2. Wait five (5) minutes.
3. Turn gas cock dial to "PILOT" position.
4. Depress and hold red button for 60 seconds while lighting the pilot.
5. Release red button, (if pilot does not remain lighted, repeat step 4). Turn gas cock dial to "ON" position.
6. Set temperature indicator of thermostat to desired position.
7. To shut down heater, turn gas cock dial to "OFF".



LIGHTING INSTRUCTIONS FOR MODEL:

70-725

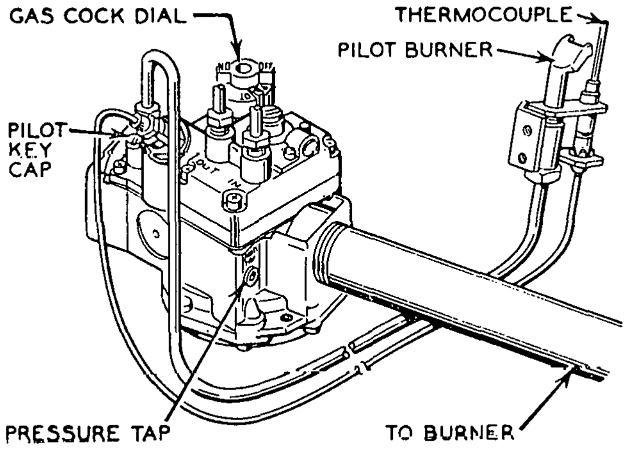
1. Turn gas cock dial to "OFF" position.
2. Wait five (5) minutes.
3. Turn gas cock dial to "PILOT" position.
4. Depress and hold gas cock dial for 60 seconds while lighting the pilot.
5. Release gas cock dial, (if pilot does not remain lighted, repeat step 4). Turn gas cock dial to "ON" position.
6. Set temperature indicator of heater thermostat to desired position.
7. To shut down heater, turn gas cock dial to "OFF".



LIGHTING INSTRUCTIONS FOR MODELS:

150, 199, 225, 310, 20-150, 80-180, 85-199, 85-250, 100-199, 100-260, 100-270, & 75-360.

1. Depress and turn gas cock dial to "OFF" position.
2. Wait five (5) minutes.
3. Turn gas cock dial to "PILOT" position.
4. Depress and hold gas cock dial for 60 seconds while lighting the pilot.
5. Release gas cock dial, (if pilot does not remain lighted, repeat step 4). Turn gas cock dial to "ON" position.
6. Set temperature indicator of lower thermostat to desired position.
7. To shut down heater, turn gas cock dial to "OFF".



LIGHTING INSTRUCTIONS FOR MODEL:

70-500

1. Depress and turn gas cock dial to "OFF" position.
2. Wait five (5) minutes.
3. Turn gas cock dial to "PILOT" position.
4. Depress and hold gas cock dial for 60 seconds while lighting the pilot.
5. Release gas cock dial, (if pilot does not remain lighted, repeat step 4). Turn gas cock dial to "ON" position.
6. Set temperature indicator of lower thermostat to desired position.
7. To shut down heater, turn gas cock dial to "OFF".

MAINTENANCE

1. Keep your heater clean and free of lint. Accumulation of lint under the heater, near the draft hood, or near the burner access door will cause an extreme fire hazard.

2. When mopping floor around heaters, do not splash water over gas controls for it will render them inoperative. Make certain that installer provides a drain pipe from outlet of relief valve to a drain to prevent relief water from flooding control and surrounding area.

3. Some particular water areas have excessive amounts of lime and minerals present (hard water). Periodic draining and cleaning will prevent the rapid buildups of such deposits. Replace cleanout gasket after removal of hand hold cleanout! If the sediments are not removed, a resulting rumbling and boiling noise will be heard. The manufacturer's warranty on this heater will not be valid if lime or scale deposits are allowed to accumulate excessively in the tank causing failure due to restricted heat transfer. (See Instruction Book).

   Removal of excessive sediments can be accomplished by using "Mag-Erad" or other suitable de-liming chemicals sold for cleaning tanks of sediment. Follow the manufacturers' guidelines for use.

4. This heater is provided with a magnesium anode which is important to the tank life. An occasional check should be made to determine if replacement is required.

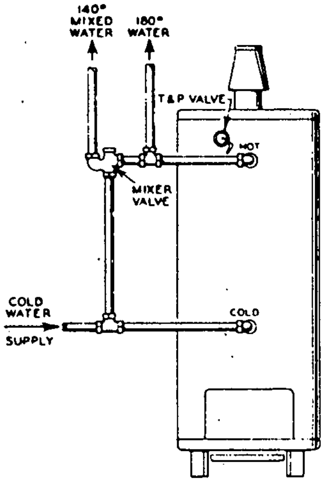
The following procedure is recommended for draining your water heater tank.

1. Shut off gas to water heater.
2. Shut off the cold water supply.
3. Open the drain valve on the tank, and a hot water outlet. Allow water to drain either to the desired level, or until tank is empty.

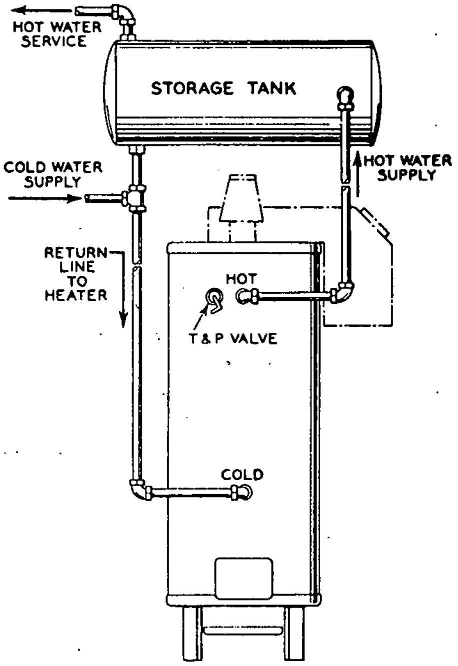
   When refilling tank, turn on water and allow it to run out the open hot water faucet, keeping the hot water faucet open until it is running smoothly and is free of entrapped air. Turn on gas to water heater and relight pilot.

INSTALLATION DIAGRAMS

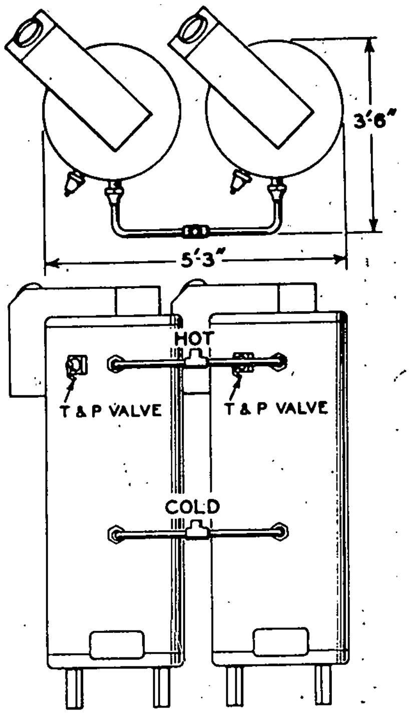
SINGLE INSTALLATION
with mixing valve
DUAL TEMPERATURE WATER



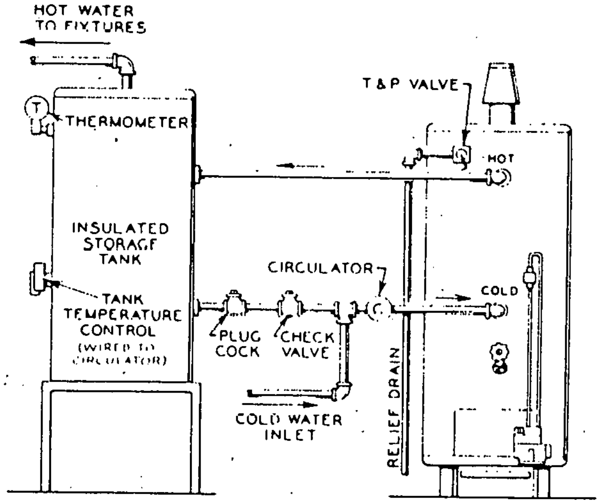
SINGLE INSTALLATION
with gravity flow circulation
to storage tank



DUAL MANIFOLD

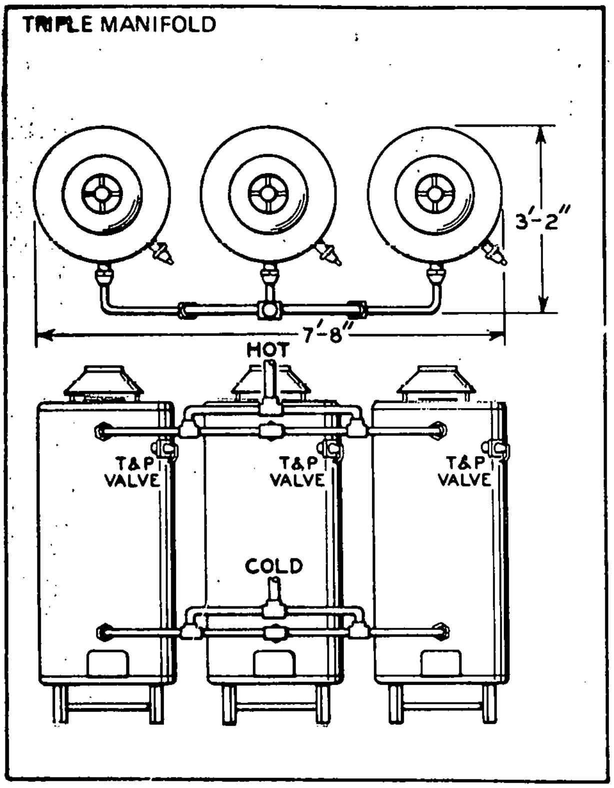


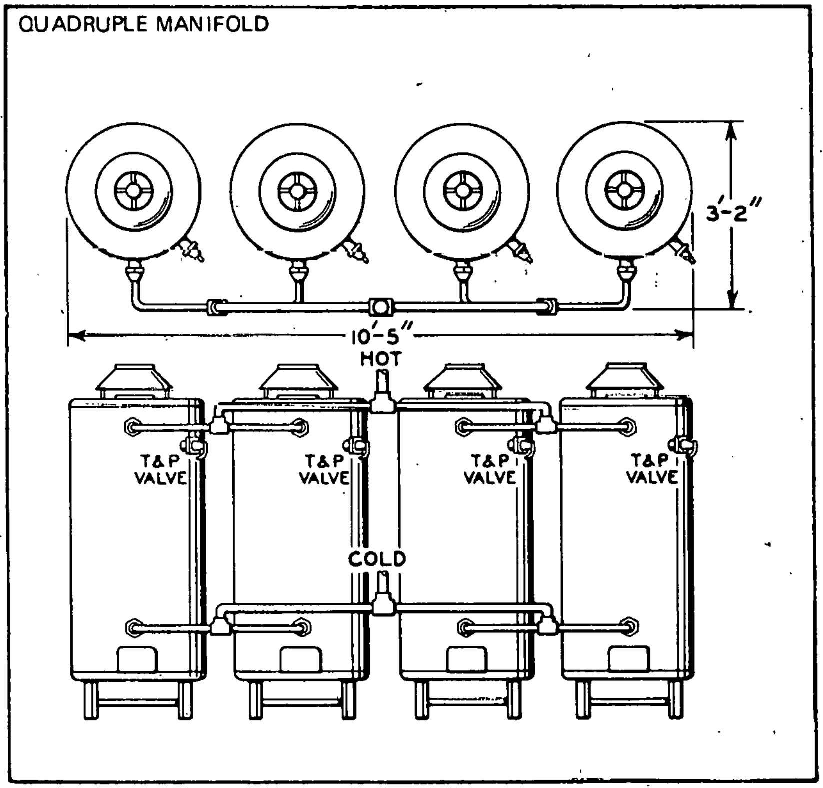
SINGLE INSTALLATION
with forced circulation to storage tank.

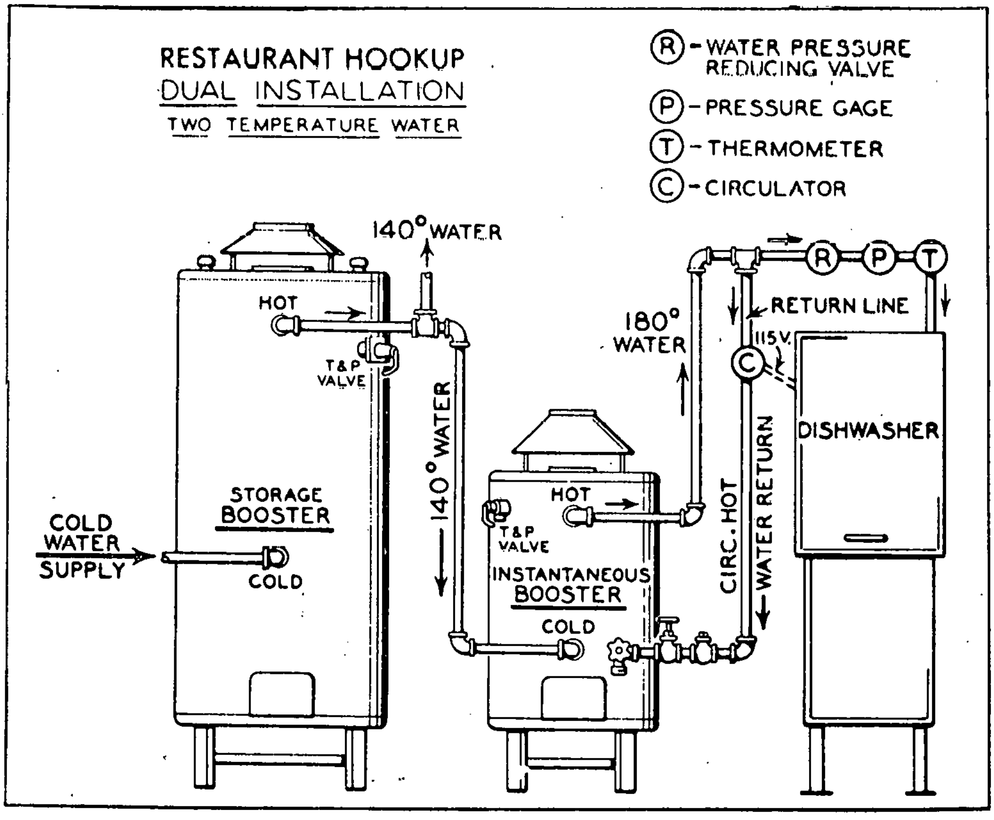


INSTALLATIONS WHERE HEATERS ARE MANIFOLDED: TWO (2) IMPORTANT CONDITIONS THAT MUST BE NOTED:

1. All heaters must be the same model.
2. All heaters must be evenly spaced to provide identical number of turns, length and size of pipes in each manifold. This is absolutely necessary to insure a balanced condition to all heaters in the installation.

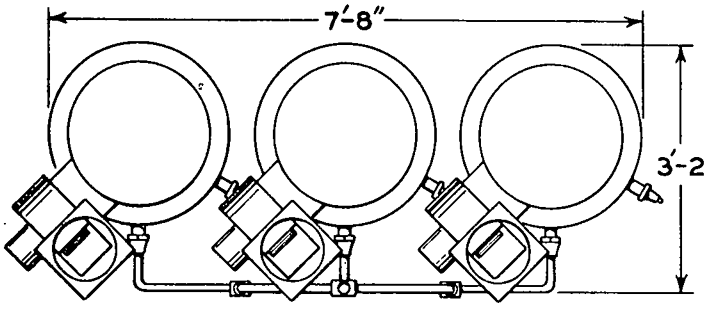

TRIPLE MANIFOLD

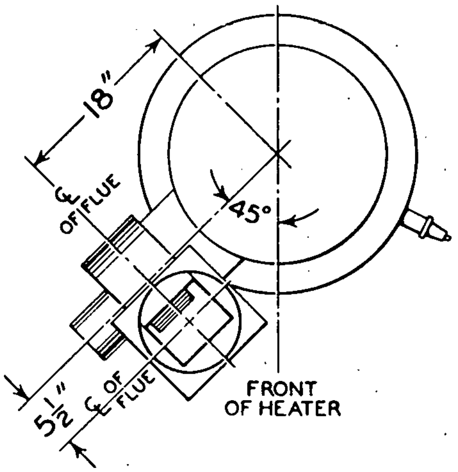

QUADRUPLE MANIFOLD

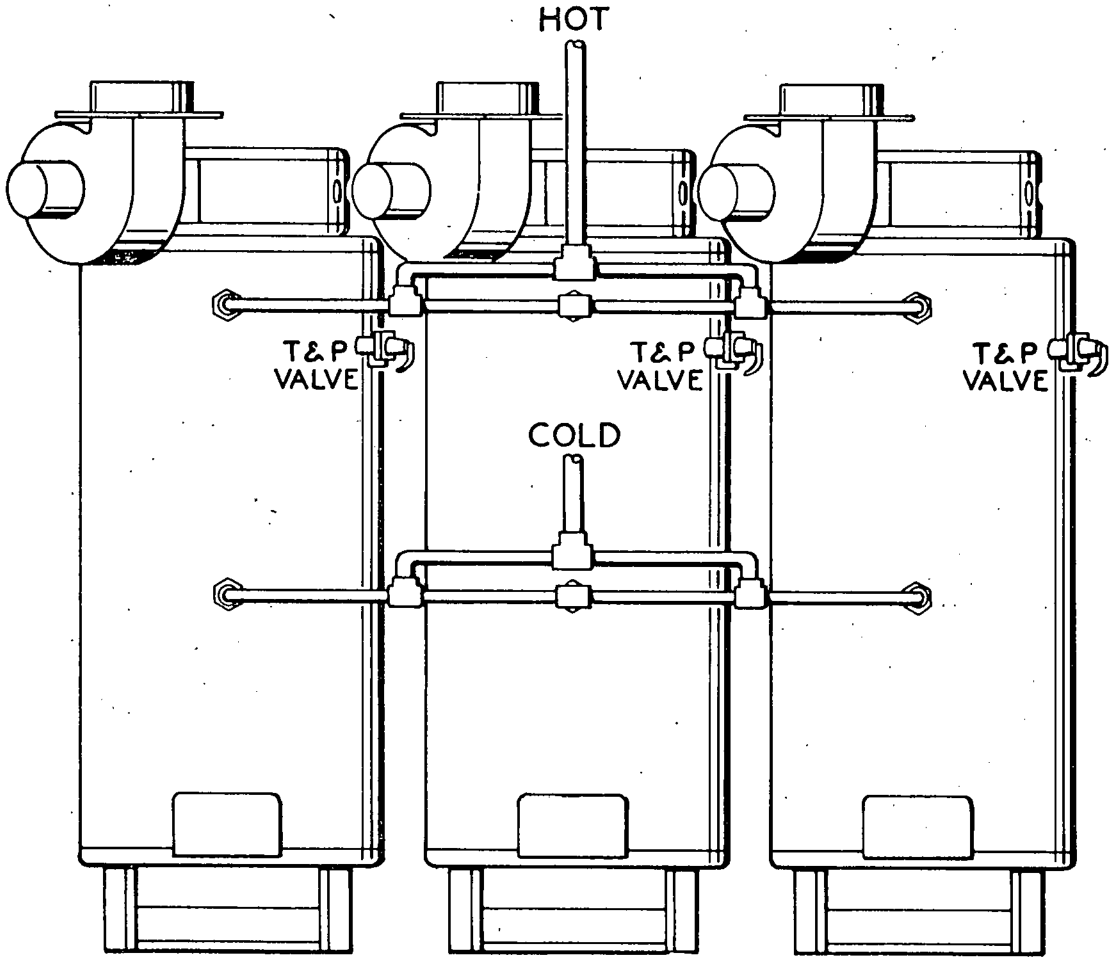

RESTAURANT HOOKUP
DUAL INSTALLATION
TWO TEMPERATURE WATER

Installations where heaters are manifoled: Two (2) important conditions that must be noted:

1. All heaters must be the same model.
2. All heaters must be evenly spaced to provide identical number of turns, length and size of pipe in each manifold. This is absolutely necessary to insure a balanced condition to all heaters in the installation.

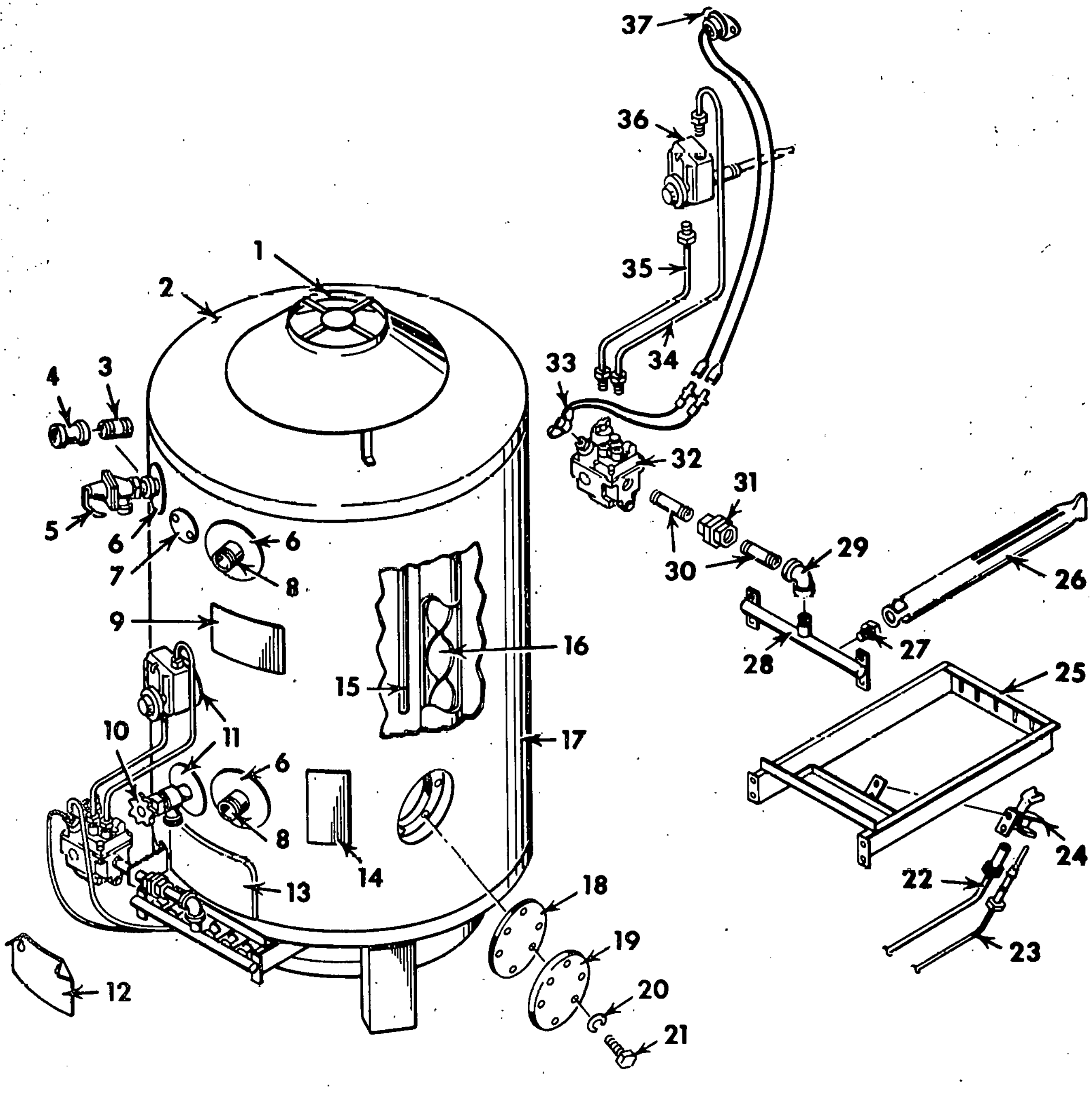






PARTS ILLUSTRATION

MODELS: 150, 199, 225, 310 and 20-150



REPAIR PARTS

MODELS: 150, 199, 225, 310 and 20-150

The following parts may be ordered through your plumber, a local plumbing supply co., or direct from factory. Parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS always give the following information:

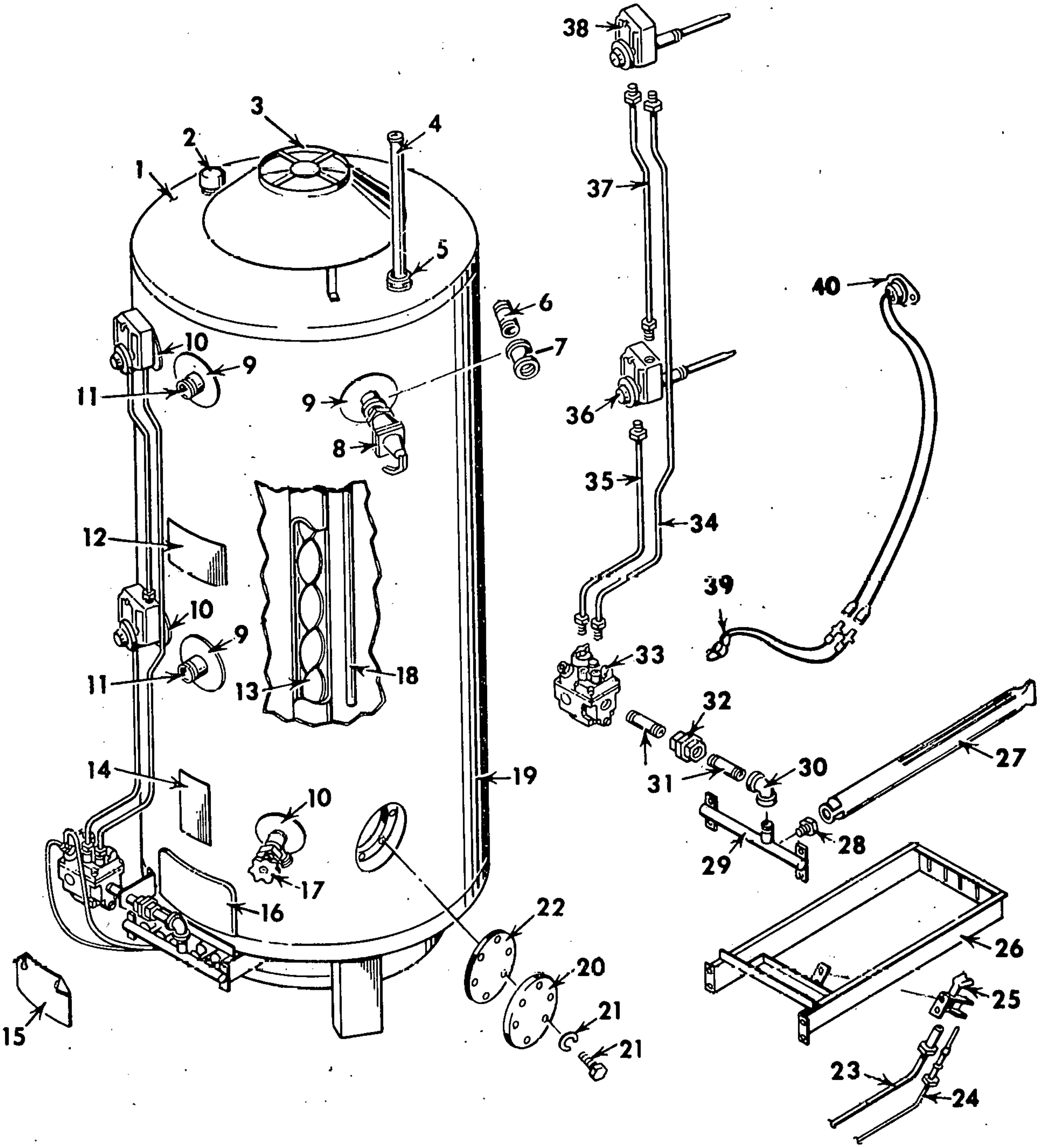
1.	Part Name	(such as "Draft Hood")
2.	Type of Gas	(found on model and rating plate located on jacket front.)
3.	Model Number	(found on model and rating plate located on jacket front — please show the complete number.)
4.	Serial Number	(found on model and rating plate located on jacket front — please show the complete number consisting of a capital letter and two (2) numbers, followed by a five (5) digit number; Example: G72-02761.)

ITEM NO.	DESCRIPTION OF PARTS	PART PRICES
1	Draft Hood	$ 10.95
2	Jacket Top	22.05
3	Nipple (T & P)	2.55
4	Coupling (T & P)	5.55
5	Temperature & Pressure Relief Valve***	80.25
6	Collar (Inlet, Outlet, and T & P)	1.95
7	E.C.O. Cover	2.40
8	Nipple (Water)	4.05
9	Name Plate	2.55
10	Drain	4.05
11	Collar (Drain & Thermostat)	1.95
12	Inner Door	3.75
13	Outer Door	2.10
14	Model & Rating Plate†	1.35
15	Magnesium Anode (ea.)	6.45
16	Flue Baffle (ea.)	5.70
17	Jacket	32.55
18	Cleanout Gasket	3.15
19	Cleanout Cover	3.15
20	Cleanout Lock Washer (ea.)	.90
21	Cleanout Bolt (ea.)	.90
22	Pilot Tubing w/Fittings	4.65
23	Thermocouple	5.70
24	Pilot Assembly (Natural or Propane)* each	4.05
25	Burner Support Tray	8.55
26	Burner (ea.)	9.00
27	Orfice (Natural or Propane) each*	1.20
28	Manifold (Gas)	8.70
29	Elbow (Gas)	1.80
30	Nipple (Gas) each	1.95
31	Union (Gas)	3.30
32	Control Valve (Natural or Propane)*	49.25
33	E.C.O. Connector**	3.30
34	Bleed Line w/Fittings (Long)	1.20
35	Bleed Line w/Fittings (Short)	1.20
36	Thermostat	32.25
37	ECO**	8.55

*Indicate Type Gas Required.
**Used On One Year Models Only.
***Used On Three Year Models Only.
†Replaced Only Upon Return Of Damaged Plate.

PARTS ILLUSTRATION

MODELS: 80-180, 85-199, 85-250, 100-199,
100-270, 75-360, and 70-500



REPAIR PARTS

MODELS: 80-180, 85-199, 85-250, 100-199, 100-270, 75-360, and 70-500.

The following parts may be ordered through your plumber, a local plumbing supply co., or direct from factory. Parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS always give the following information:

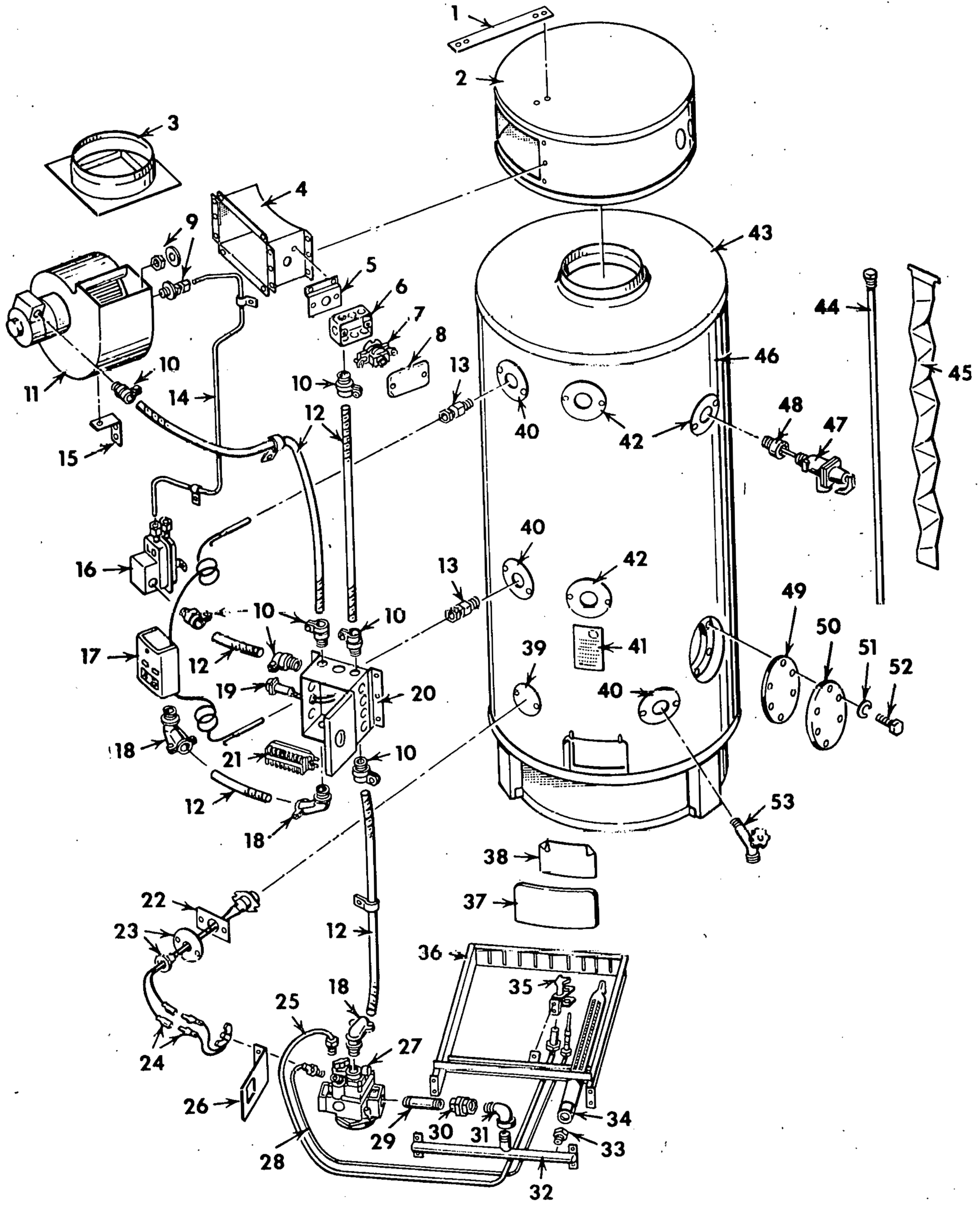
1. Part Name	(such as "Draft Hood")
2. Type of Gas	(found on model and rating plate located on jacket front.)
3. Model Number	(found on model and rating plate located on jacket front – please show the complete number.)
4. Serial Number	(found on model and rating plate located on jacket front – please show the complete number consisting of a capital letter and two (2) numbers, followed by a five (5) digit number; Example: G72-02761.)

ITEM NO.	DESCRIPTION OF PART	PART PRICES	
		80-180, 85-199, 85-250 100-199, 100-270	75-360 70-500
1	Jacket Top	$ 22.05	$ 22.05
2	Nipple Cap	7.05	–
3	Draft Hood	10.95	10.95
4	Dip Tube	3.90	–
5	Water Nipple (top)	4.05	–
6	Nipple (T & P)	2.55	2.55
7	Coupling (T & P)	5.55	5.55
8	Temperature and Pressure Relief Valve	80.25	80.25
9	Collar (inlet, outlet and T & P)	1.95	1.95
10	Collar (drain and thermostat)	1.95	1.95
11	Water Nipple (front or rear)	4.05	4.05
12	Name Plate	2.55	2.55
13	Flue Baffle	5.70	5.70
14	Model and Rating Plate†	1.35	1.35
15	Inner Door	3.75	3.75
16	Outer Door	2.10	2.10
17	Drain	4.05	4.05
18	Magnesium Anode (ea.)	10.35	10.35
19	Jacket	72.00	72.00
20	Cleanout Cover	3.15	3.15
21	Cleanout Lock Washer & Bolt	1.80	1.80
22	Cleanout Gasket	3.15	3.15
23	Pilot Tubing w/fitting	4.65	4.65
24	Thermocouple	5.70	5.70
25	Pilot Assembly (Natural or Propane)*	4.05	4.05
26	Burner Support Tray	8.55	8.85
27	Burner (ea.)	9.00	11.25
28	Orfice (Natural or Propane) each*	1.20	1.20
29	Manifold (Gas)	8.70	9.30
30	Elbow (Gas)	1.80	1.80
31	Nipple (Gas)	1.95	1.95
32	Union (Gas)	3.30	4.50
33	Control Valve (Natural or Propane)*	49.25	51.75
34	Bleed Line w/fittings (Long)	1.20	1.20
35	Bleed Line w/fittings (Short)	1.20	1.20
36	Thermostat (Lower) (adjustable)	32.25	32.25
37	Bleed Line w/fittings (Short)	1.20	1.20
38	Thermostat (Upper) (fixed)	32.25	32.25
39	ECO Connector**	3.30	3.30
40	ECO**	8.55	8.55

*Indicate type of gas required.
**Used on one year models only.
†Replaced only upon return of damaged plate.

PARTS ILLUSTRATION

MODEL: 70-725



REPAIR PARTS

MODEL: 70-725

The following parts may be ordered through your plumber, a local plumbing supply co., or direct from factory. Parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS always give the following information:

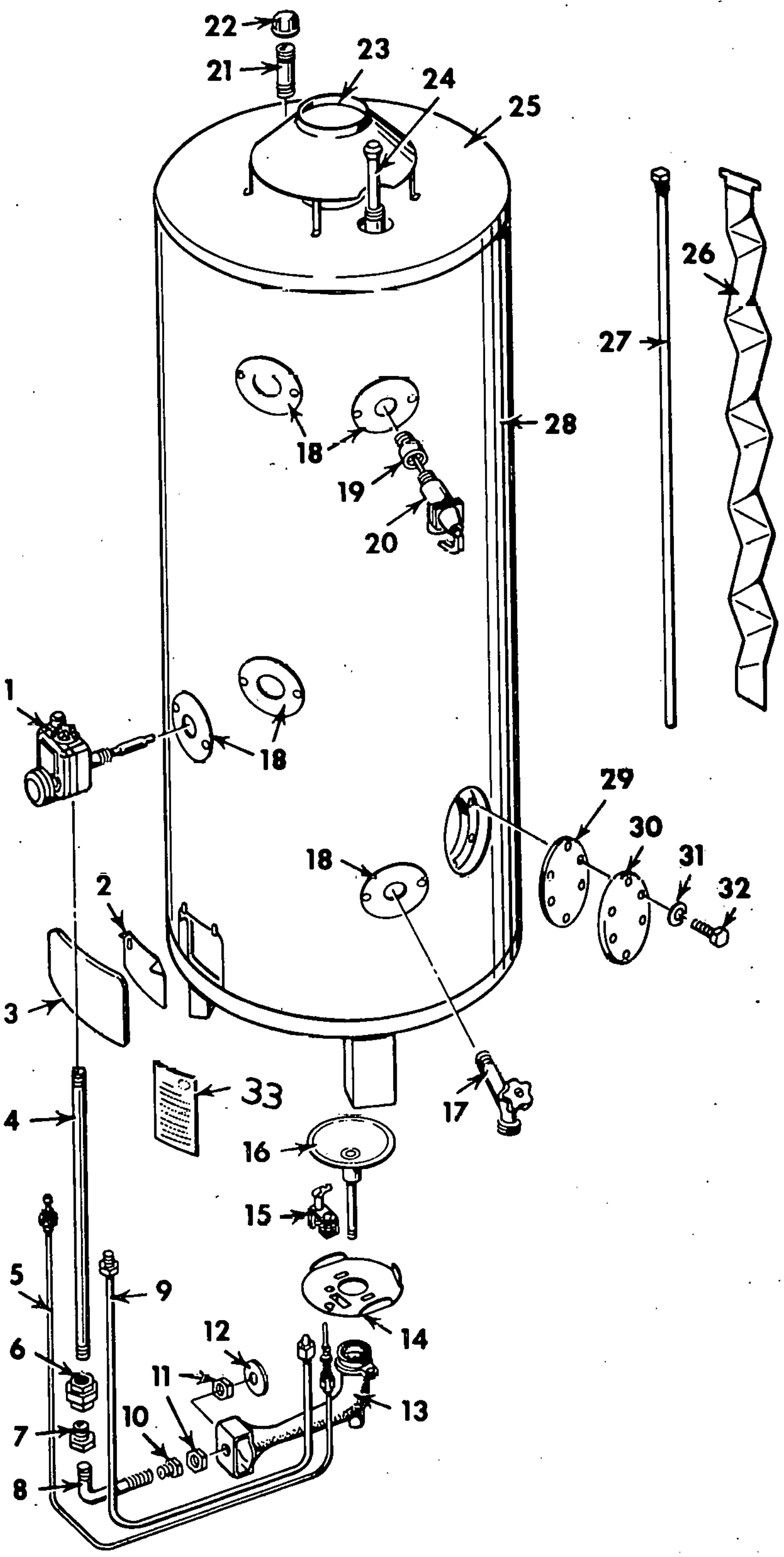
1.	Part Name	(such as "Draft Hood")
2.	Type of Gas	(found on model and rating plate located on jacket front.)
3.	Model Number	(found on model and rating plate located on jacket front—please show the complete number.)
4.	Serial Number	(found on model and rating plate located on jacket front—please show the complete number consisting of a capital letter and two (2) numbers, followed by a five (5) digit number; Example: G72-02761.)

ITEM NO.	DESCRIPTION OF PARTS	PART PRICE
1	Duct Assembly Support Bracket	$ 1.20
2	Duct Top Assembly	14.55
3	Flue Collar Assembly	5.25
4	Blower - Duct Collar Assembly	6.30
5	Support Bracket (Flue Temp. Hi Limit)	1.65
6	Junction Box (Flue Temp. Hi Limit)	3.67
7	Flue Temperature Hi Limit	5.55
8	Access Cover (Flue Temp. Hi Limit)	1.50
9	Pressure Tubing Retainer Assembly	10.05
10	Straight Conduit Connector (ea.)	2.55
11	Blower Assembly	164.25
12	Conduit (specify length)	1.80 per ft.
13	Thermostat Blub Coupling	7.35
14	Pressure Tubing	1.05
15	Blower Support Bracket	1.35
16	Pressure Switch	57.75
17	Hi Limit & Thermostat	76.05
18	90° Conduit Connector (ea.)	3.75
19	Indicator Light	3.00
20	Junction Box	23.55
21	Terminal Block	21.15
22	E.C.O. Retainer Plate*	2.55
23	E.C.O. Cover w/Hole & Bushing*	2.40
24	E.C.O.*	11.85
25	Pilot Tubing Assembly	4.65
26	Bracket (Gas Control Valve)	2.55
27	Gas Control Valve (Nat. or Propane)	137.25
28	Thermocouple	5.70
29	Nipple (Gas)	1.95
30	Union (Gas)	4.50
31	Elbow (Gas)	1.80
32	Manifold	9.30
33	Orifice (Nat. or Propane)***	1.20
34	Burner	11.25
35	Pilot (Nat. or Propane)***	4.05
36	Burner Support Tray	8.55
37	Outer Door	2.10
38	Inner Door	3.75
39	E.C.O. Cover Plate	1.95
40	Collar (Drain, Thermostat Bulb) (ea.)	1.95
41	Model & Rating Plate†	1.35
42	Collar (Inlet, Outlet, T & P) (ea.)	1.95
43	Jacket Top	22.05
44	Anode Rod (ea.)	10.35
45	Flue Baffle (ea.)	5.70
46	Jacket	72.00
47	Temperature & Pressure Relief Valve**	80.25
48	Nipple (T & P)	8.10
49	Cleanout Gasket	3.15
50	Cleanout Cover	3.15
51	Cleanout Lock Washer	.90
52	Cleanout Bolt (ea.)	.90
53	Drain	4.05

†Replaced Only Upon Return Of Damaged Plate.
*Used Only On One Year Models.
**Used Only On Three Year Models.
***Indicate Type Of Gas Required.

PARTS ILLUSTRATION

MODEL: 75-120



REPAIR PARTS

MODEL: 75-120

The following parts may be ordered through your plumber, a local plumbing supply co., or direct from factory. Parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS always give the following information:

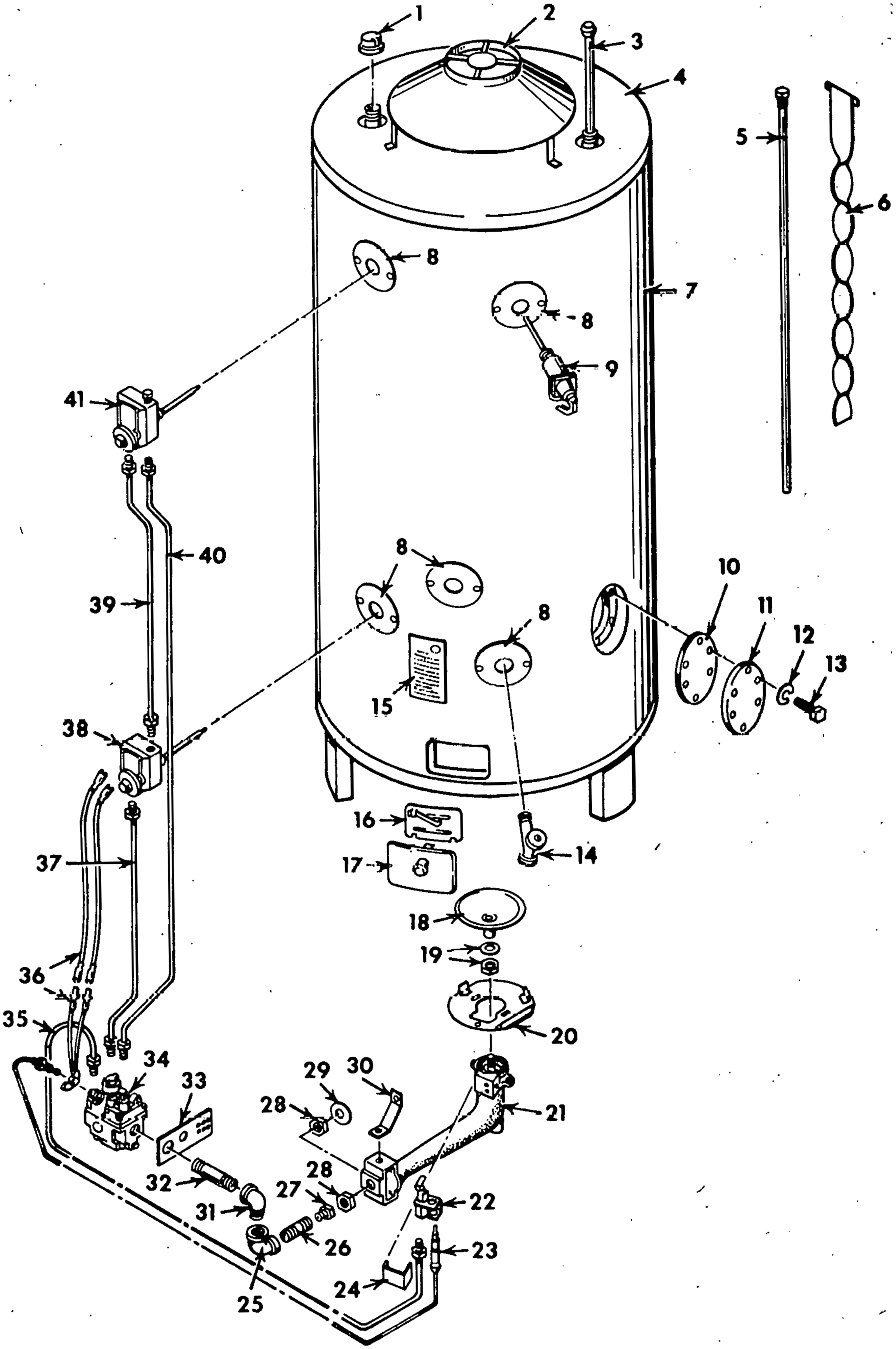
1. Part Name (such as "Draft Hood")
2. Type of Gas (found on model and rating plate located on jacket front.)
3. Model Number (found on model and rating plate located on jacket front—please show the complete number.)
4. Serial Number (found on model and rating plate located on jacket front—please show the complete number consisting of a capital letter and two (2) numbers, followed by a five (5) digit number; Example: G72-02761.)

ITEM NO.	DESCRIPTION OF PARTS	PART PRICE
1	Gas Control Valve	$ 45.60
2	Inner Door	3.75
3	Outer Door	2.10
4	Nipple 20¾ (Gas)	3.45
5	Thermocouple	5.70
6	Union (Gas)	3.15
7	Bushing (Gas)	3.15
8	Manifold Nipple (Gas)	3.15
9	Pilot Tubing (w/fittings)	4.65
10	Orifice (Nat or Propane)*	1.20
11	Locknut (Gas)	1.35
12	Air Shutter	2.25
13	Burner	15.75
14	Burner Shield	2.10
15	Pilot (Nat or Propane)*	4.20
16	Flame Spreader Assembly	2.55
17	Drain	4.05
18	Collar (Drain, Gas Control, Inlet, Outlet, T & P)	1.95
19	Nipple (T & P)	2.55
20	Temperature & Pressure Relief Valve**	80.25
21	Nipple (Hot Water Nipple Outlet)	5.70
22	Nipple Cap (Hot Water Nipple Outlet)	7.05
23	Draft Hood Assembly	5.25
24	Dip Tube	2.70
25	Jacket Top	6.30
26	Flue Baffle	1.95
27	Anode Rod	10.35
28	Jacket	28.80
29	Cleanout Gasket	3.15
30	Cleanout Cover	3.15
31	Cleanout Lock Washer (ea.)	.90
32	Cleanout Bolt (ea.)	.90
33	Model & Rating Plate†	1.35

†Replaced only upon return of damaged plate.
*Indicate type of gas required.
**Used only on three year models.

PARTS ILLUSTRATION

MODEL: 100-260



REPAIR PARTS

MODEL 100-260

The following parts may be ordered through your plumber, a local plumbing supply co., or direct from factory. Parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS always give the following information:

1. Part Name	(such as "Draft Hood")
2. Type of Gas	(found on model and rating plate located on jacket front.)
3. Model Number	(found on model and rating plate located on jacket front—please show the complete number.)
4. Serial Number	(found on model and rating plate located on jacket front—please show the complete number consisting of a capital letter and two (2) numbers, followed by a five (5) digit number; Example: G72-02761.)

ITEM NO.	DESCRIPTION OF PARTS	PART PRICE
1	Pipe Cap (Hot Water Nipple Outlet)	$ 7.05
2	Draft Hood Assembly	10.95
3	Dip Tube	3.90
4	Jacket Top	22.05
5	Anode Rod (ea.)	10.35
6	Flue Baffle	5.70
7	Jacket	72.00
8	Collar (Drain, Thermostat, Inlet, T & P)	1.95
9	Temperature & Pressure Relief Valve**	80.25
10	Cleanout Gasket	3.15
11	Cleanout Cover	3.15
12	Cleanout Lock Washer	.90
13	Cleanout Bolt	.90
14	Drain	4.05
15	Model & Rating Plate†	1.35
16	Inner Door	3.75
17	Outer Door	2.10
18	Flame Spreader Assembly	2.55
19	Nut & Washer (Flame Spreader Assembly)	.90
20	Burner Shield	2.10
21	Burner	15.75
22	Pilot (Natural or Propane)*	4.05
23	Thermocouple	5.70
24	Pilot Shield	1.50
25	Elbow (Gas)	1.80
26	Nipple (Gas)	1.95
27	Orfice (Natural or Propane) each*	1.20
28	Locknut (Gas)	1.35
29	Air Shutter	1.35
30	Burner Support Bracket	1.35
31	Elbow (Gas)	1.80
32	Nipple (Gas)	1.95
33	Gas Control Bracket	2.55
34	Gas Control Valve	49.25
35	Pilot Tubing	4.65
36	ECO Assembly***	11.85
37	Tubing (Gas)	1.20
38	Thermostat (Lower)	32.25
39	Tubing (Gas)	1.20
40	Tubing (Gas)	1.20
41	Thermostat (Upper)	32.25

† Replaced only upon return of damaged plate.

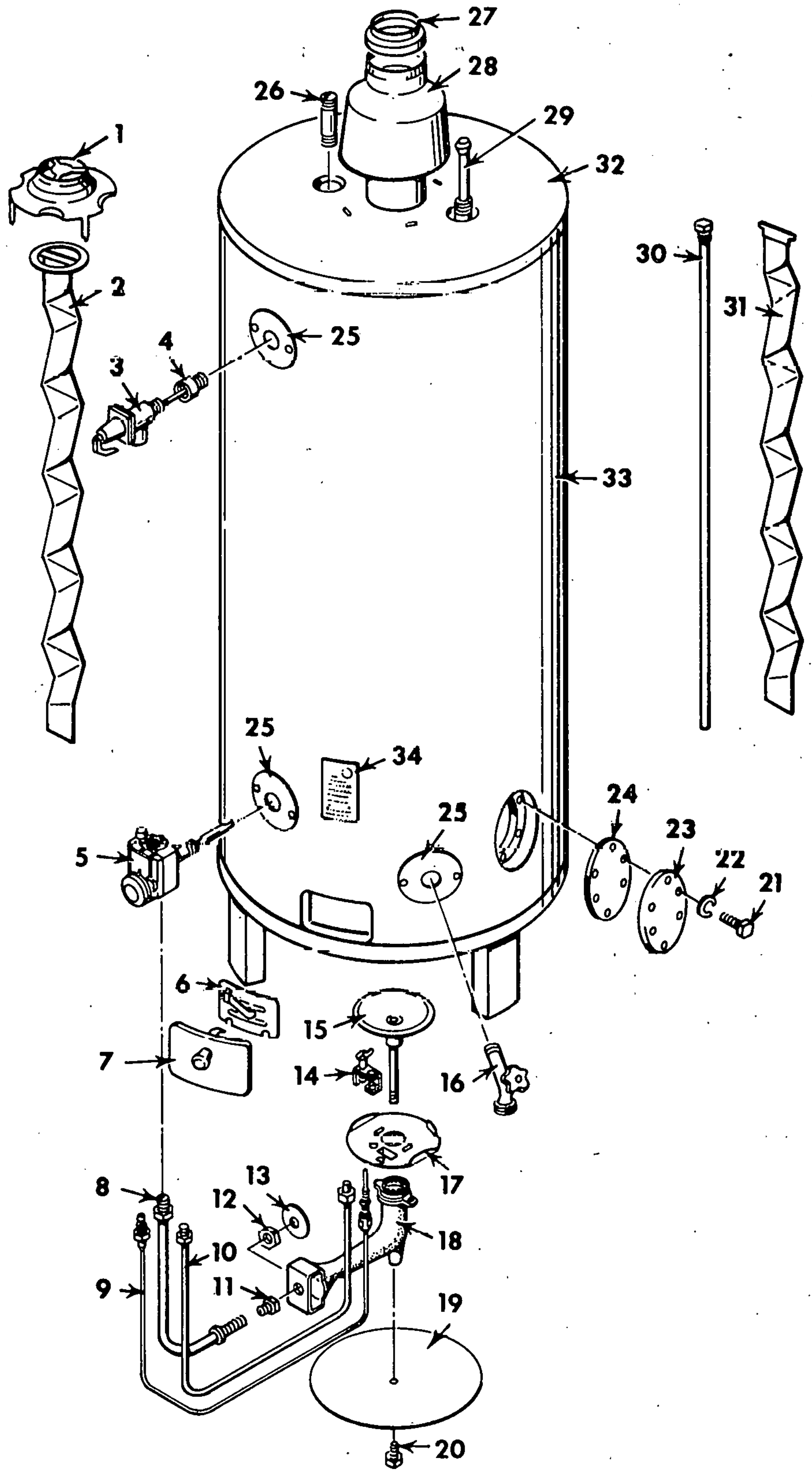
* Indicate type of gas required.

** Used on three year models only.

*** Used on one year models only.

PARTS ILLUSTRATION

MODELS: 100-90/100-75



REPAIR PARTS

MODELS: 100-90/100-75

The following parts may be ordered through your plumber, a local plumbing supply co., or direct from factory. Parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS always give the following information:

1. Part Name (such as "Draft Hood")
2. Type of Gas (found on model and rating plate located on jacket front.)
3. Model Number (found on model and rating plate located on jacket front—please show the complete number.)
4. Serial Number (found on model and rating plate located on jacket front—please show the complete number consisting of a capital letter and two (2) numbers, followed by a five (5) digit number; Example: G72-02761

ITEM NO.	DESCRIPTION OF PARTS	PART PRICE
1	Draft Hood Assembly (100-75)	$ 10.95
2	Flue Baffle (100-75)	5.70
3	Temperature & Pressure Relief Valve**	80.25
4	Nipple (T & P)	8.10
5	Gas Control Valve (Nat. or Propane)*	45.60
6	Inner Door	3.75
7	Outer Door	2.10
8	Manifold Tubing Assembly	5.70
9	Thermocouple	3.45
10	Pilot Tubing w/Fitting	4.65
11	Orifice (Nat. or Propane) (ea.) (Specify Model)*	1.20
12	Locknut (Gas)	1.35
13	Air Shutter	2.25
14	Pilot (Nat. or Propane)*	4.05
15	Flame Spreader Assembly	2.55
16	Drain	4.05
17	Burner Shield	2.10
18	Burner	8.70
19	Radiation Shield (100-90)	3.10
20	Securing Nut (Radiation Shield) (100-90)	.90
21	Cleanout Bolt (ea.)	.90
22	Cleanout Lock Washer (ea.)	.90
23	Cleanout Cover	3.15
24	Cleanout Gasket	3.15
25	Collar (Drain, Gas Control and T & P)	1.95
26	Nipple (Hot Water Outlet)	4.05
27	Flue Restrictor Ring	3.10
28	Draft Hood Assembly (100-90)	10.95
29	Dip Tube (Specify Model)	3.90
30	Magnesium Anode	10.35
31	Flue Baffle (100-90)	6.30
32	Jacket Top	28.80
33	Jacket	48.00
34	Model & Rating Plate†	1.35

*Indicate Type Of Gas Required.

**Used Only On Three Year Models.

†Replace Only Upon Return Of Damaged Plate.

PERFORMANCE

			G.P.H. RECOVERY CAPACITY @ DEGREE F. RISE										
MODEL	TYPE GAS	BTU. INPUT	40	50	60	70	80	90	100	110	120	130	140
150	Nat.-Propane	150,000	315	252	210	180	157	141	126	115	105	97	91
199	Nat-Propane	199,900	420	336	280	240	210	186	168	153	140	129	120
225	Nat-Propane	225,000	473	378	315	270	236	210	189	172	157	145	135
310	Nat.	310,000	650	520	433	372	326	289	259	237	217	201	186
	Propane	290,000	610	488	406	349	305	270	242	222	203	187	174
20-150	Nat-Propane	150,000	315	252	210	180	157	141	126	115	105	97	91
75-120	Nat.	120,000	253	205	168	144	126	112	101	92	84	78	72
	Propane	100,000	210	168	140	120	105	93	84	76	70	65	60
80-180	Nat.-Propane	180,000	378	302	252	216	189	168	151	137	126	116	108
85-199	Nat-Propane	199,900	420	336	280	240	210	186	168	153	140	129	120
85-250	Nat-Propane	250,000	526	420	350	300	263	233	210	191	175	162	150
100-75	Nat-Propane	75,000	155	104	103	88	77	69	63	56	52	48	44
100-90	Nat.-Propane	90,000	187	150	125	107	94	83	76	68	61	58	53
100-199	Nat.-Propane	199.900	420	336	280	240	210	186	168	153	140	129	120
100-260	Nat. Propane	260,000	546	437	364	313	273	242	218	198	182	168	156
100-270	Nat.-Propane	270,000	567	454	378	324	284	252	227	207	190	175	162
75-360	Nat.-Propane	360,000	756	605	504	434	378	335	302	275	252	233	216
70-500	Nat.	500,000	1050	840	700	600	525	467	420	382	350	324	300
	Propane	480,000	1001	806	673	576	504	448	403	367	334	311	289
70-725	Nat.-Propane	725,000	1523	1210	1015	870	761	677	609	554	509	468	435

IMPORTANT

In beauty shops, barber shops, cleaning establishments and self-service laundries with dry cleaning equipment, it is imperative that the heater or heaters be installed so combustion and ventilation air be taken from outside by means of louvers or screens.

R. A. BEHRMANN and ASSOCIATES, INC.

Manufacturers' Agents

HEATING – AIR CONDITIONING – SOLAR PRODUCTS

- 631-4400 AREA CODE 314
- 4173 HOFFMEISTER AVE.
- ST. LOUIS, MISSOURI 63125

8. BOILERS

January 5, 1979

INSTALLATION AND MAINTENANCE INSTRUCTIONS

JOB:	Stephens College Visitors Center Columbia, Missouri
ENGINEER:	Lewis D. Freedland Minneapolis, Minnesota
CONTRACTOR:	Drummond Officer Mechanical Contractors Columbia, Missouri
PREPARED BY:	Donald W. Behrmann

PUBLICATION LIST

Publication No.	Equipment Referred to
C-542	Type EGH Series 2 Commercial Gas Boiler
MC-3182-178 WP	Erecting and Operating Instructions for Weil-McLain Type EGH Gas Boilers
550-110-151	Installation & Operating Instructions for Weil-McLain Type EGH Boiler
	Wiring Diagram for Weil-McLain EGH Boiler

SPECIALISTS IN HYDRONIC – STEAM – SOLAR EQUIPMENT

ABSORBTION COOLING
AIR CONDITIONING UNITS-
GAS AND ELECTRIC
BASEBOARD RADIATION
CAST IRON & COPPER
WATER TREATMENT
BOILERS-STEEL & CAST IRON
CIRCULATORS-HOT WATER
CONVECTORS
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EXPANSION TANKS
UNIT HEATERS-ALL TYPES
SPECIALTIES-HOT WATER
RADIATORS-CAST IRON
PUMPS CENTRIFUGAL
FIN TUBE-COMMERCIAL
HEAT EXCHANGERS

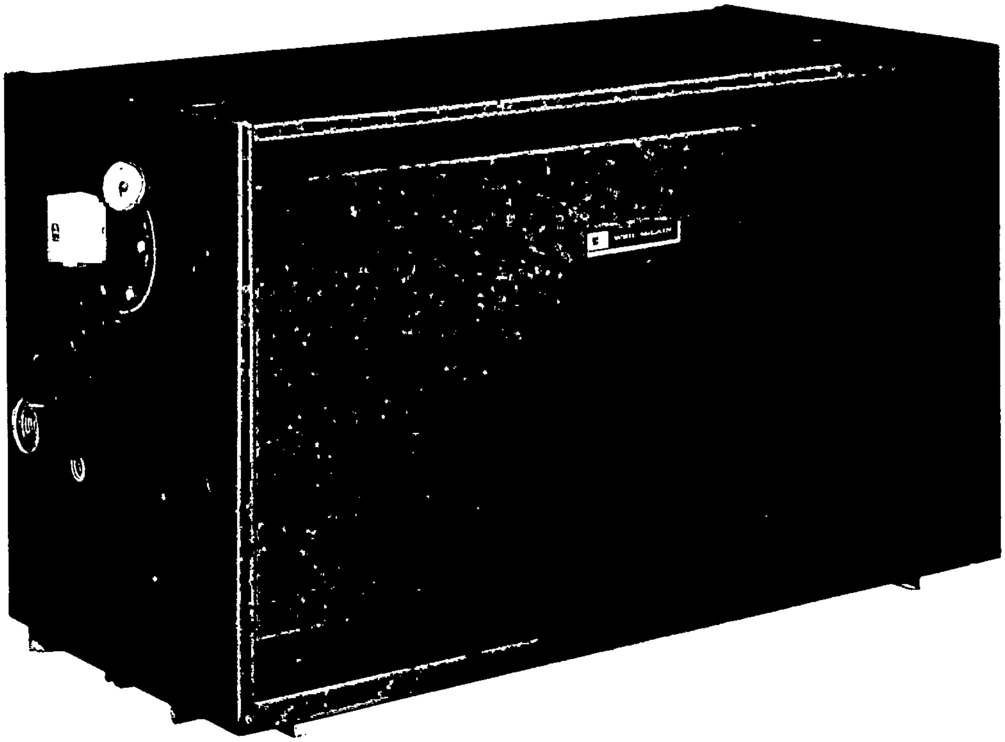
203

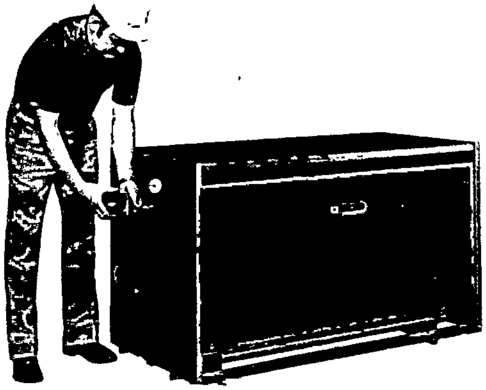
WEIL-McLAIN

TYPE EGH

SERIES 2

COMMERCIAL GAS BOILER





NET LOAD RANGE

HOT WATER:
243,500 to
382,600 BTU/Hr.

STEAM:
875 to
1,375 sq. ft.

Design Certified by
American Gas Association

Net ratings are approved by
The Hydronics Institute

Built in accordance
with the requirements
of the ASME Boiler and
Pressure Vessel Code

AMERICA'S MOST COMPLETE LINE OF CAST IRON BOILERS
RESIDENTIAL...COMMERCIAL...INDUSTRIAL...INSTITUTIONAL

TYPE EGH
COMMERCIAL GAS BOILER
WEIL-McLAIN

The Weil-McLain Type EGH is a medium-capacity cast iron boiler for heating apartments, large residences, commercial and institutional buildings. It is available in five sizes for hot water or steam with net I-B-R ratings from 243,500 to 382,600 BTU/Hr.; 875 to 1,375 square feet steam.

The EGH incorporates design and construction features for ease of installation, space conservation, easy servicing and cleaning, fuel efficiency and long, trouble-free life. Outstanding features include compact design, insulated steel jacket, tankless heaters for water and steam, aluminized steel burners and, of course, Weil-McLain cast iron construction.

STANDARD EQUIPMENT

Assembled Section Block
Insulated Jacket
Horizontal to Vertical Draft Hood
Aluminized Steel Burners
Combination Gas Control Valve (includes main gas valve, pressure regulator, three position gas cock, pilot filter, and pilot adjustment), for 24 volt
100% Shutoff
Thermocouple
Non-Linting Pilot Burner (EGH-85 and 95 only)
Heater Cover Plates (for boilers without tankless heater)
Safety Control Wire
Electrical Junction Box
40 VA Transformer (except self-generating system)
For EGH-105 through 125 only:
  Electronic Controls (Flame Rectification System) not mounted

For Water Boilers

Built-in Air Eliminator
30 P.S.I. ASME Safety Relief Valve
Combination Pressure-Temperature Gauge
High-Limit Control

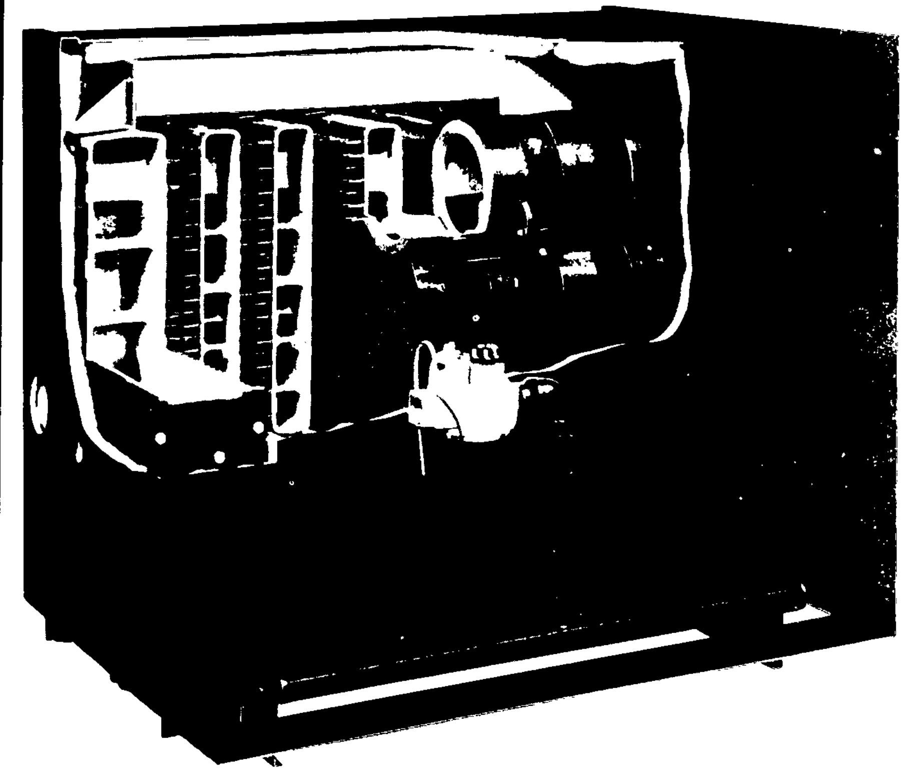
For Steam Boilers

ASME Safety Valve
Steam Pressure Gauge
High-Limit Pressure Control
Gauge Cocks
Gauge Glass
Low-Water Cutoff
With Tankless Heater(s):
  Operating Control

ADDITIONAL EQUIPMENT

Tankless Heaters—for water or steam
Storage Heater
Thermostat
Low-Water Cutoff and Feeder Combination
Electronic Controls (Flame Rectification System) for EGH-85 and 95

DESIGN FEATURES



Cast iron sections for corrosion resistance and extra-long life.

A.G.A. design certified for natural and propane gas . . . develops full capacity as rated by A.G.A. and I-B-R.

Compact design saves boiler room space, simplifies handling and installation. The EGH is only 33¾" high; 27⅛" deep.

Tankless heaters for water or steam available as additional equipment.

Aluminized steel burners feature quiet ignition and extinction . . . no air adjustment necessary.

Steel jacket finished in attractive blue hammerloid . . . completely insulated with one-inch fiberglass . . . clear of the floor to prevent rust.

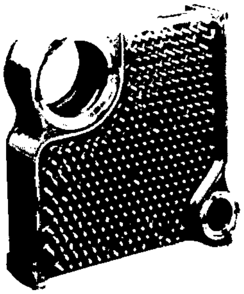
Built-in air eliminator in water boilers saves the cost of a separate device.

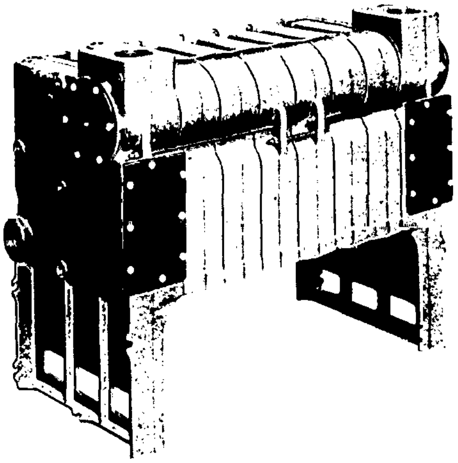
Horizontal to vertical draft hood reduces headroom requirements.

Factory-assembled sections and factory-assembled burners and burner drawer reduce installation time.

Designed for easy servicing and cleaning with vertical flueways, top cleaning, and accessible burners.

CAST IRON CONSTRUCTION...FACTORY-ASS ED SECTIONS





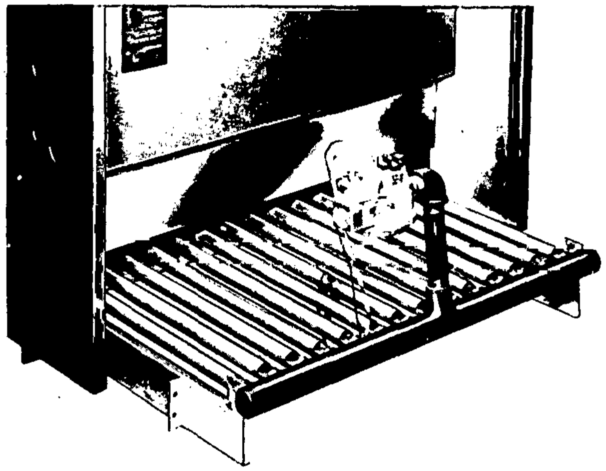
EGH Boiler sections are made of durable cast iron for extra-long life. The sections are not face-ground, but retain the tough original skin which is extremely resistant to the corrosive effects of combustion by-products and condensation.

The vertical flue passages are studded with tips which cause the hot gases to swirl about, scrubbing the entire surface of each section for maximum heat transfer and increased efficiency.

The EGH Boiler is shipped with the sections factory assembled in one block. If desired, the installer can separate the boiler into two blocks to simplify handling since short draw rods are used between the two intermediate sections in the middle of the assembly.

A special high-temperature mastic sealant is used between sections to assure a gastight assembly and consistently high efficiency. The flexible sealant allows for expansion and contraction, *is impervious to heat and* moisture, and will last the life of the sections. A flexible elastomer sealing *ring in each port opening* assures a watertight seal. Individual sections as well as the assembled section block are *hydrostatically tested* before shipping.

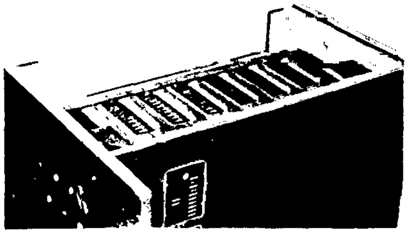
B RS AND BURNER ASSEMBLY



The EGH Boiler is design certified for natural and propane gas. One-piece, high-temperature, aluminized steel burners feature high efficiency, excellent flame characteristics, and quiet ignition and extinction. Burners provide fixed primary air . . . no air adjustment required for approved gases.

To simplify handling and reduce installation time, the burners and manifold are assembled in a burner drawer which slides easily into the boiler.

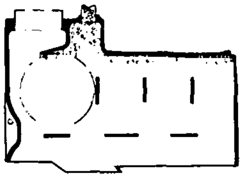
EASY CLEANING AND SERVICING



All heating surfaces in the EGH Boiler can be easily cleaned to maintain continued high operating efficiency. Removing the top jacket panel and the collector hood exposes all flueways for straight-through cleaning.

The jacket door and burner access panel are easily removed for access to the burners. The front and back steel base panels are lined with high-temperature insulating material; end sections rest on the floor.

BUILT-IN AIR ELIMINATOR



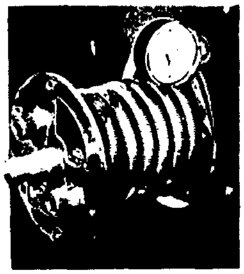
Type EGH water boilers have a cast-in air eliminator . . . no need for a separate air eliminating device. As shown in the illustration, rising air bubbles are diverted to the expansion tank through a ¾-inch tapping located next to the supply outlet.

TANKLESS WATER HEATERS — OPTIONAL

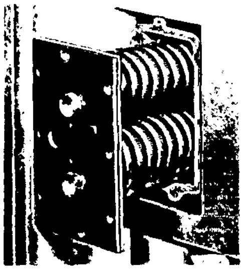
EGH Boilers may be equipped with one or two tankless domestic water heaters.

Water boiler heaters are installed in the upper port opening on either side of the boiler. Large heating surface and high location assure efficient production of domestic hot water for kitchen, laundry, and bath.

Steam boiler heaters are installed in the front of the two end sections well below the waterline for summer operation.



WATER HEATER



STEAM HEATER

TANKLESS WATER HEATER CAPACITIES

Boiler Number	Heater Number	Intermittent Draw GPM* 100° F. Av. Temp. Rise	Continuous Draw GPM** 100° F. Av. Temp. Rise	Inlet and Outlet Tappings	Temp. Control Tapping
WATER					
EGH-85	E-626	4.00	2.80	½"	¾"
EGH-95	E 632	4.25	3.20	½"	¾"
EGH-105	E-632	4.50	3.60	½"	¾"
EGH-115	E-632	4.50	4.00	½"	¾"
EGH-125	E-632	4.50	4.40	½"	¾"
STEAM					
EGH-85	35-S-29	3.25	2.80	¾"	¾"
EGH-95	35-S-29	3.50	3.20	¾"	¾"
EGH-105	35-S-29	3.50	3.60	¾"	¾"
EGH-115	35-S-29	3.75	4.00	¾"	¾"
EGH-125	35-S-29	3.75	4.40	¾"	¾"

Weil-McLain ratings based on 60 PSIG domestic water pressure at heater.

**Gallons of water per minute heated from 40° to 140° F. with 200° F. boiler water temperature.*

***Continuous draw — no recovery period.*

NOTE: For two heaters, multiply heater ratings by 2.

STORAGE HEATER

Water Boiler Size	Storage Heater Number	180° Boiler Water	212° Boiler Water
		Heater Capacity Gals. 40°-140° Rise	Heater Capacity Gals. 40°-140° Rise
EGH-85 through EGH-125	62-2-E	50 in 3 hours	70 in 3 hours
RECOMMENDED STORAGE TANK		50-90 Gallons	75-125 Gallons

RATINGS

Boiler Number*	A.G.A. Input MBH+	A.G.A. Gross Output MBH+	Net I-B-R Ratings** Sq. Ft. Steam	Steam MBH+	Water MBH+	Net Sq. Ft. Water ▲	Boiler H.P.	Supply Tappings No. & Size	Return Tappings No. & Size	Dimensions — Inches D	W	Gas Connection Size† Natural	Propane	Draft Hood Outlets No. & Size	Chimney and Breeching Size***	Approx. Shipping Weight Lbs.
EGH-85	350	280	875	210.1	243.5	1,620	8.4	2–3″	2–2½″	9	38¼	¾″	¾″	1–9″	9″	84
EGH-95	400	320	1000	240.1	278.3	1,855	9.6	2–3″	2–2½″	10	42½	¾″	¾″	1–10″	10″	880
EGH-105	450	360	1125	270.1	313.0	2,085	10.8	2–3″	2–2½″	10	46¾	1″	1″	1–10″	10″	975
EGH-115	500	400	1250	300.1	347.8	2,320	11.9	2–3″	2–2½″	12	51	1″	1″	1–12″	12″	1070
EGH-125	550	440	1375	350.1	382.6	2,550	13.1	2–3″	2–2½″	12	55¼	1″	1″	1–12″	12″	1145

*When ordering, add to boiler number "S" for Steam; "W" for Water. Add "-1WT" for water boiler with one tankless heater; "-2WT" for water boiler with two tankless heaters. Add "-1ST" for steam boiler with one tankless heater; "-2ST" for steam boiler with two tankless heaters. Add "WHS" for water boiler with storage heater.

+MBH refers to thousands of BTU per hour.

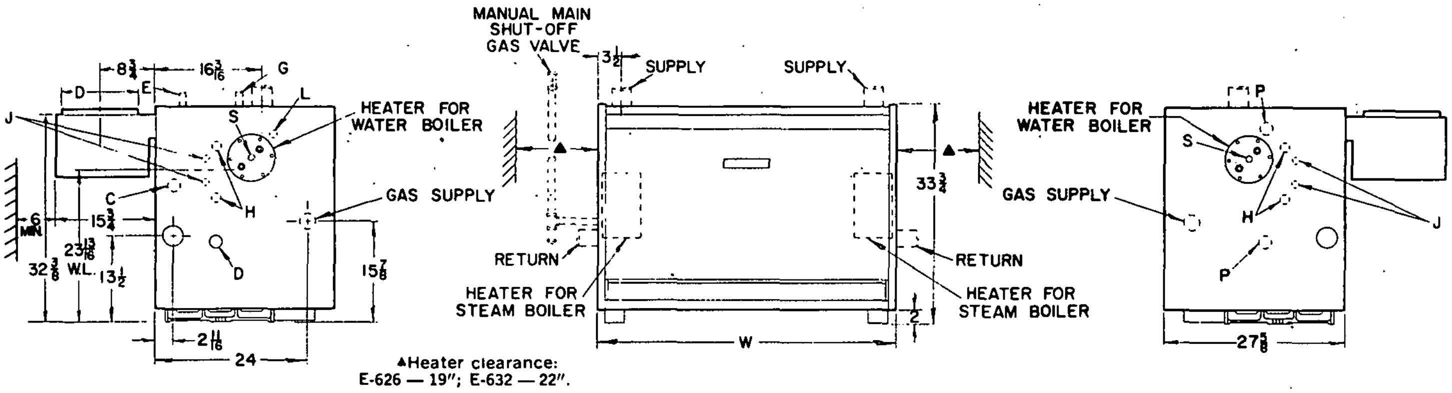
**Net I-B-R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pick-up. Steam ratings are based on a piping and pick-up allowance of 1.333; water ratings on an allowance of 1.15. An additional allowance should be made for *unusual piping and pick-up loads*. Consult Customer Services Department. Ratings shown are for elevations up to 2,000 feet. For elevations above 2,000 feet, ratings should be reduced at the rate of 4 percent for each 1,000 feet above sea level.

▲Based on average water temperature of 170° F. in radiators.

†Sizes shown are gas connection sizes. Gas piping from meter to boiler to be sized according to local utility requirements.

***In special cases where surrounding conditions permit, chimney height may be reduced by 10 ft.

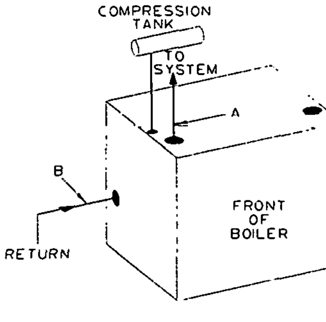
Note: Water boilers tested for 50 P.S.I. working pressure; also available upon special request at 80 P.S.I. working pressure.



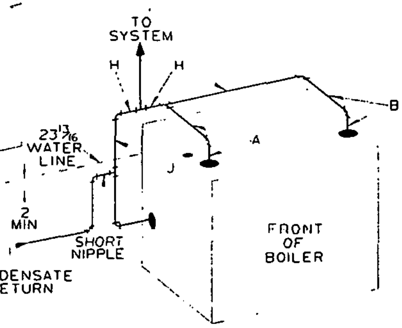
LEFT SIDE FRONT RIGHT SIDE

RECOMMENDED PIPING CONNECTIONS

Note: Supply and return sizes for water boilers refer to minimum size of pipe connected to boiler for 20° or higher temperature drop between supply and return.



WATER BOILERS



STEAM BOILERS

WATER BOILER SIZE	PIPE SIZE A (Supply)	B (Return)
EGH-85 & EGH-95	2″	2″
EGH-105 thru EGH-125	2½″	2½″

STEAM BOILER SIZE	RISER PIPE SIZE A	B	HEADER* H	EQUALIZER J
EGH-85 & EGH-95	2″	2″	3″	1½″
EGH-105	2½″	2½″	3″	1½″
EGH-115 & EGH-125	2½″	2½″	4″	1½″

*24 minimum from waterline to header

CONTROL TAPPINGS

LOCATION	SIZE	STEAM	WATER
C	¾″	Probe Type Low Water Cutoff	Plugged
D	¾″	Drain	Drain
E	¾″	Safety Valve	Safety Relief Valve
G	¾″	Plugged	Piping to Compression Tank or Auto Air Vent
H	½″	Gauge Glass and/or Low Water Cutoff	Low Water Cutoff
J*	⅜″	Try Cock Tappings	—
L	¼″	Plugged	Combination Pressure-Temperature Gauge
P	1″	Low Water Cutoff, Pressure Limit Control and Pressure Gauge; or Low Water Cutoff and Feeder Combination; or Low Water Cutoff and Pump Control	Low Water Cutoff; or Low Water Cutoff and Feeder Combination; or Low Water Cutoff and Pump Control
S	1½″ (Steam)	Skim Tapping	—
	¾″ (Water)	—	Limit Control

*Available only on special request.

NOTE: Limit Control and Supply Piping must be on the same end of the boiler.

NOTE: When an internal type water heater is installed, use the tapping in the heater for an additional operating control.

Erecting and Operating Instructions

TYPE EGH GAS BOILERS

Weil-McLain

CAUTION GENERAL INSTRUCTIONS

Open all boxes, except the ones containing the jacket, and check the contents against the packing lists. In case of any shortage or damage, notify the transportation company immediately.

As you face the front of the boiler, the side of the boiler to your left will be referred to in these instructions as the Left End (LE); the side of the boiler to your right will be referred to as the Right End (RE).

Locate boiler to provide the following minimum clearances of 4" at back and sides and 18" at front to non-combustible material, 18" on all sides when walls are combustible material.

The Type EGH boiler is design certified by the American Gas Association and approved by Canadian Gas Association for use with natural and propane gases. **Note: The installation must comply with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code, the local utilities and any additional national, state, insurance, or local code requirements having jurisdiction. Boilers must be installed in accordance with our instructions so as not to void our warranty.**

CHIMNEY OR VENT REQUIREMENTS

The chimney or vent should be examined to be certain that it is properly constructed and clear.

The chimney or vent should not be smaller than the size recommended under Ratings-Engineering Data-Dimensions.

Advice regarding recommended practice and material for flue connections can usually be obtained from the local gas utility or the **American National Standard** Z223.1—1974 National Fuel Gas Code in the United States or CGAB149 Installation Code for Gas Burning Appliances and Equipment in Canada.

The breeching connection must be well above the bottom of the chimney to avoid stoppage. The breeching connection must not enter the chimney so far as to obstruct the chimney. A thimble or slip joint should be installed so the breeching may be removed for cleaning. The breeching should slope upward toward the chimney at least ¼ inch per lineal foot and should not be smaller than the size shown under Ratings-Engineering Data-Dimensions. Also refer to Breeching Erection.

CAUTION AIR SUPPLY FOR COMBUSTION

Sufficient clean air must be available to the boiler room at all times. For installation in an enclosed utility or boiler room without an outside wall, a minimum of 1 square inch of opening for each 1,000 BTU per hour of boiler input with not less than a 100 square inch opening should be provided.

In confined areas without good ventilation, openings directly to the outside with a minimum free area of 1 square inch for each 4,000 BTU per hour of boiler input should be provided.

BOILER FOUNDATION

If a boiler foundation is required see chart and Figure 1 below. This boiler is not to be used on combustible flooring.

BOILER FOUNDATION SIZE — INCHES			
Boiler No.	L	Boiler No.	L
EGH-85	40¼	EGH-115	53
EGH-95	44½	EGH-125	57¼
EGH-105	48¾		

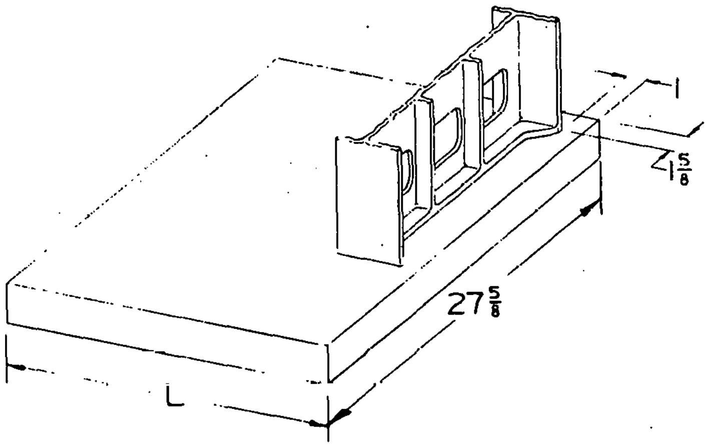


FIGURE 1

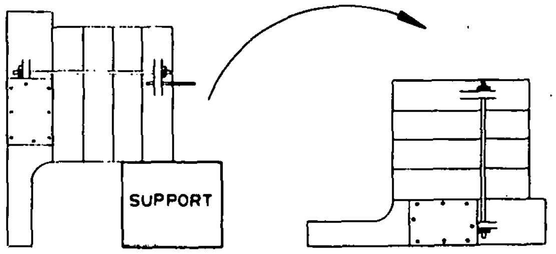


FIGURE 2

Form No. MC-3182-178 W

Where the EGH Block Assembly may need to be taken apart for handling thru tight places:

1. Put a support under center of block. Support must be within ½ inch of block.
2. Remove short center draw rods.
3. Tip half blocks on end as shown in sketch. **Be careful as they are heavy.** Save Elastomer sealing rings and save the high temperature mastic which is used to provide gas-tight seal between section.
4. After moving half blocks into desired location, clean port surfaces with clean, dry rag. DO NOT USE OIL. Place sealing rings in recessed ports, replace mastic in section grooves.
5. Re-assemble block in reverse order. CAUTION: Keep fingers free.

INSTALLATION OF INDIRECT WATER HEATER

For a water or steam boiler ordered with an internal type indirect water heater, remove the heater opening cover plate and install heater as shown in Figure 3.

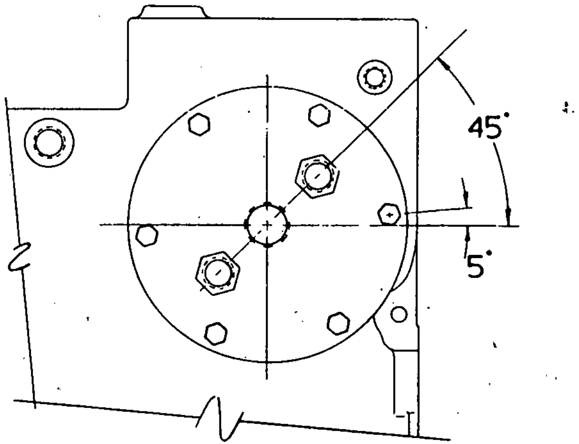


FIGURE 3

HYDROSTATIC PRESSURE TEST OF BOILER

The individual sections and the complete boiler have been pressure tested at the factory; however, the boiler should be tested at the job to insure that the water-tight seal was maintained during shipment or after reassembly at the job site.

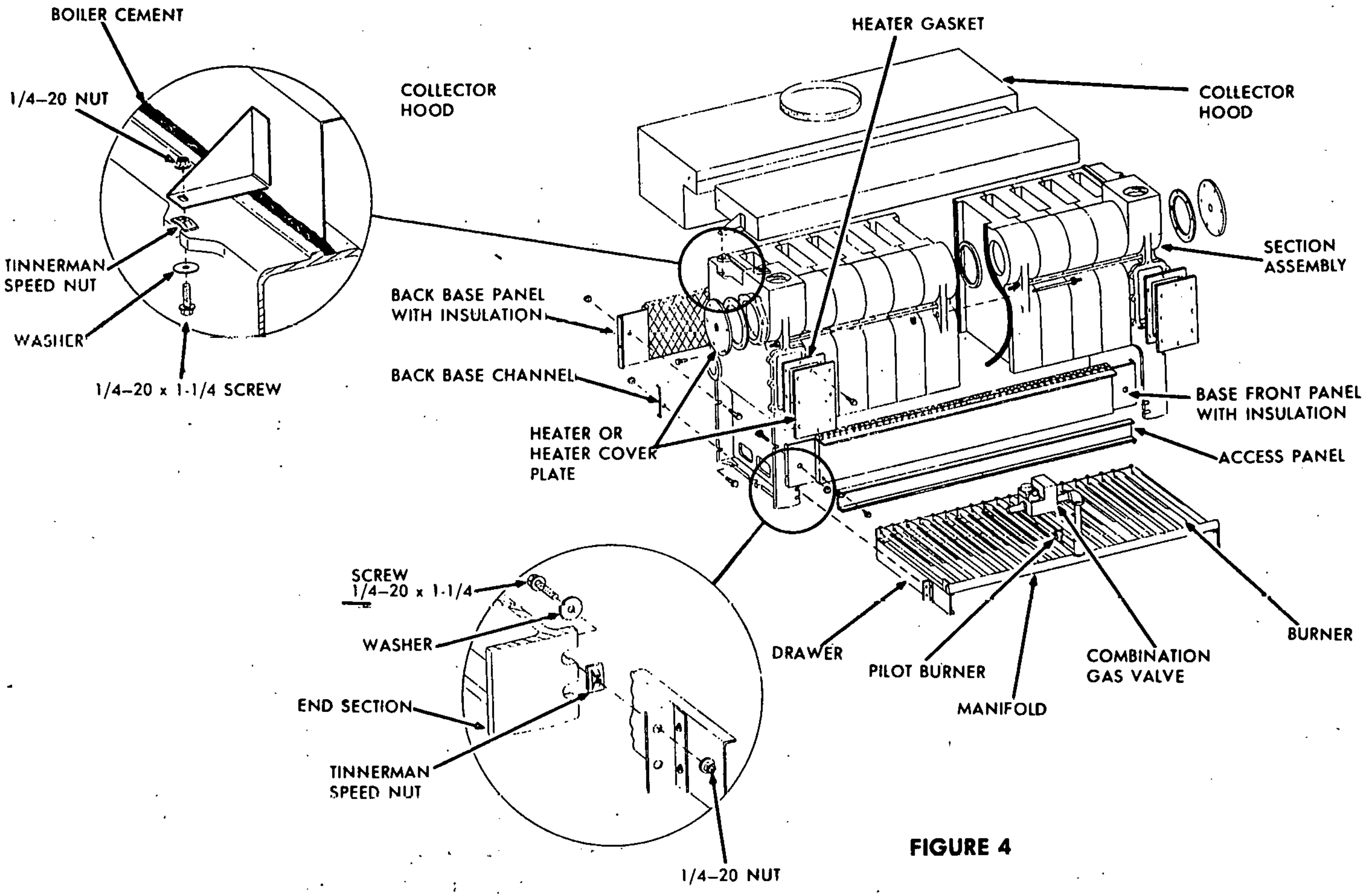


FIGURE 4

1. Fill the boiler with water. Completely purge all air. Test the boiler with water pressure not exceeding 75 psi.
2. Inspect the boiler for leaks.
3. Drain the boiler and remove plugs from tappings that will be used for controls and accessories. See Control Tapping Table. **Tighten all heater plate bolts.**

INSTALLATION OF FLUE COLLECTOR HOOD

Set the Flue Collector Hood on the boiler as shown in Figure 4. Use boiler cement furnished to provide gas tight seal.

INSTALLATION OF FRONT AND REAR BASE PANELS

See Figure 4 for installation. Note: Front and rear base panels are insulated. Run bead of boiler cement along top of each base panel before fastening in place.

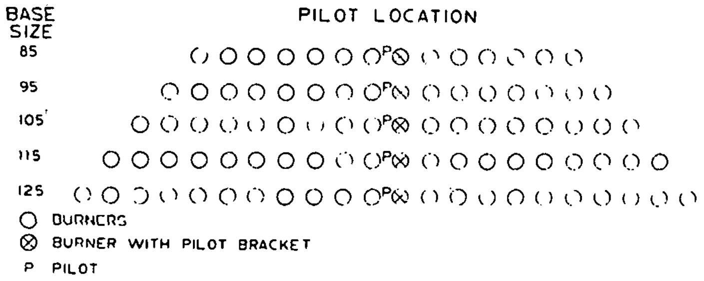


FIGURE 5

INSTALLATION OF DRAWER ASSEMBLY AND FRONT ACCESS PANEL

The Drawer Assembly consists of the burner drawer, main burners, gas manifold, safety pilot burner, etc. See Figures 4 and 5 for installation.

ORIFICE DRILL SIZES		
Type of Gas	Heating Value BTU/Cu. Ft.	Standard Orifice Drill Size
Natural	1,000 - 1,140	No. 41
Proprane	2,500	No. 54

ATTACH THE JACKET AND DRAFT HOOD

1. Remove the proper knockout discs from the panels as shown in the tapping table under Ratings-Engineering Data-Dimensions.
2. Follow the separate Jacket Erecting Instructions packaged in the jacket carton.
3. **Attach the Draft Hood to the Flue Collector Hood with sheet metal screws. If the Draft Hood is altered, the AGA design certification and CGA approval become void.**

CAUTION BREECHING ERECTION (also refer to Chimney or Vent Requirements)

Connect from the draft hood outlet to the chimney or vent with full-sized (same diameter as draft hood outlet) breeching. Where the installation permits, vertical venting of the combustion gases to the outside from the draft hood outlet will afford best performance at lowest total cost. Where the boiler must be connected to a chimney or remote vent the horizontal breeching should slope upward at least ¼ inch per lineal foot toward the chimney or vent. **A vertical height of 3 feet to 5 feet of breeching before any elbow or horizontal breeching is recommended to reduce chances of flue gas spillage** at the draft hood. Long horizontal breechings, excessive numbers of elbows or tees, or other obstructions which restrict the flow of combustion gases should be avoided.

SUPPLY AND RETURN PIPING

The system supply and return piping should be attached to the boiler before the controls are installed to avoid control damage. **Recommended piping arrangements for forced hot water and steam boilers are shown on the following pages and the minimum recommended pipe sizes are listed for each piping arrangement.** The system supply piping may be connected before the jacket is erected. **The system return piping must be connected after the jacket is erected.**

WATER BOILER RECOMMENDED PIPING CONNECTIONS

Refer to the RATINGS page for recommended piping connections and pipe sizes for forced hot water boilers. Consult Weil-McLain Customer Services Department for application information when applying the boiler to a gravity hot water system.

The water boiler is provided with a built-in air eliminator in the left end section only, and no external air elimination device is required. Refer to the tapping table under Ratings-Engineering Data-Dimensions for tapping locations. Any horizontal compression tank piping must pitch upward at least 1 inch for each 5 feet of piping toward the compression tank.

Where the boiler is used with a radiant panel system or other low water temperature applications (i.e. converted gravity systems, etc.), a boiler by-pass piping

arrangement should be used to assure higher boiler water temperatures for optimum boiler operation. To install a by-pass, locate a tee in the return piping between the circulator and the boiler and another tee in the supply piping. Use the same size by-pass piping as the supply and return. Locate a valve in the by-pass piping and another valve in the supply piping between the boiler and the tee. Locate a thermometer in the supply piping just beyond the by-pass connection so the system water temperature can be determined. Adjust the valves to provide 200°F. to 220°F. boiler water temperature with the system water temperature at the maximum desired.

STEAM BOILER PIPING

Refer to the RATINGS page for recommended piping connections and minimum recommended pipe sizes for steam boilers.

The satisfactory operation of any steam heating system depends upon adequate return of condensate to the boiler to maintain a steady water level and avoid the introduction of excessive amounts of raw make-up water. Where condensate return is not adequate, a low water cut-off and pump control, condensate receiver, and condensate boiler feed pump should be installed. Consult Weil-McLain Customer Services Department for application information.

INSTALL BOILER CONTROLS

Water Boiler:

1. Be sure the Pressure Relief Valve, the Combination Pressure-Temperature Gauge, and all Limit Controls are installed in the proper tappings as indicated in the Control Tapping Table under Ratings-Engineering Data-Dimensions.
2. The relief valve outlet should be piped near to the floor, close to a drain when available. Do not pipe the relief valve discharge to any area where freezing temperatures could occur.
3. Plug all unused tappings.

Steam Boiler:

1. Be sure the Steam Safety Valve is installed in the proper tapping as indicated in the tapping table under Ratings-Engineering Data-Dimensions.
2. The safety valve outlet should be piped to a floor drain or near to the floor. Do not pipe the safety valve discharge to any area where freezing temperatures could occur.

PIPING FOR STANDARD LOW WATER CUT-OFF FOR STEAM BOILERS

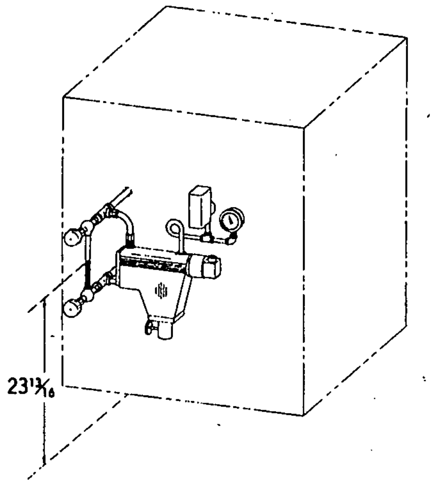


FIGURE 6

*Water Line Dimension measured from bottom of boiler section leg where it rests on the boiler room floor or boiler foundation.

PIPING FOR OPTIONAL WATER LEVEL CONTROLLERS FOR STEAM BOILERS

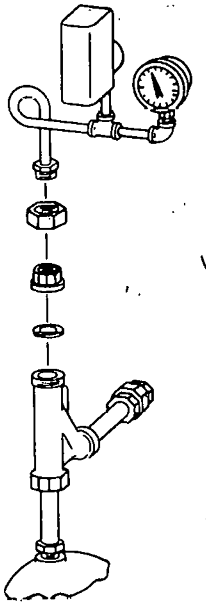
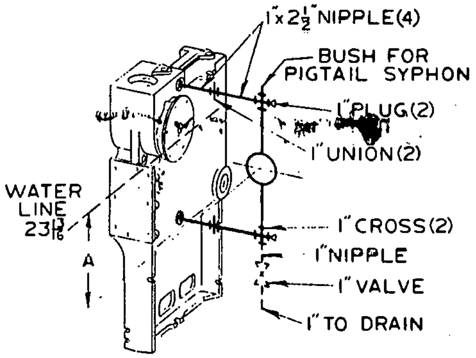


FIGURE 7A



L.W.C.O.	DIM A.
No. 61	2¼"
No. 63	2¼"
No. 51-2, 51-S-2	2¼"
No. 150, 157	2¼"
No. 93, 94	3⅜"

FIGURE 7B

3. Install the standard Low Water Cut-off as shown in Figure 6.
   a. The No. 101 electric water feeder may be added to the standard low water cut-off, if desired.
   b. The No. 47-2 water feeder and low water cut-off combination (not standard) may be substituted and installed as illustrated in Figure 7A.
   c. The use of water level controls with 1" I.P.S. connections is illustrated in Figure 7B.
4. Install gauge glass cocks, glass, pressure gauge and pressure limit control in the proper tappings.
5. Plug all unused tappings.

TANKLESS HEATER HOOK-UP
(forced hot water or steam boilers only)

An operating control with small differential scale is recommended. The operating control must be installed in the temperature control tapping in the heater plate.

If a Flow Regulating or Automatic Mixing Valve is desired or required refer to manufacturer's installation instructions.

In hard water areas, it is advisable to soften the cold domestic supply water to the tankless heater to prevent lime build-up.

SCHEMATIC STORAGE HEATER PIPING
(forced hot water boiler only)

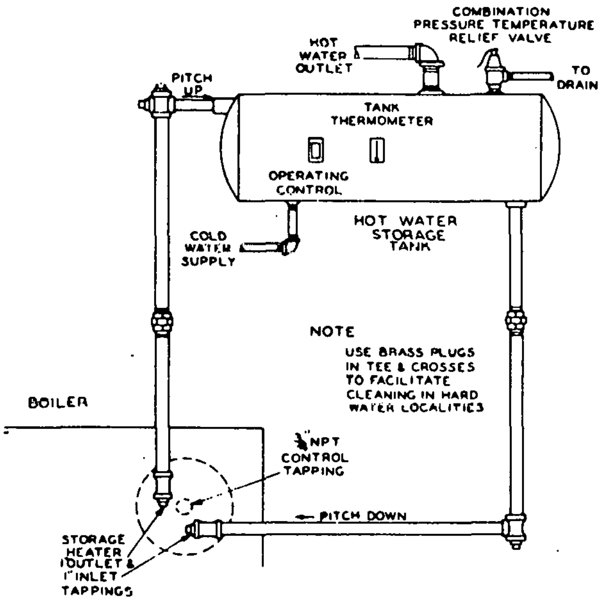


FIGURE 8

TYPE EGH STEAM AND FORCED HOT WATER BOILER TANKLESS HEATER RATINGS

Boiler Number	Heater Number	Intermittent Draw GPM* 100°F. Av. Temp. Rise	Continuous Draw GPM** 100°F. Av. Temp. Rise	Inlet and Outlet Tappings	Temp. Control Tapping
Water					
EGH-85	E626	4.00	2.80	½"	¾"
EGH-95	E632	4.25	3.20	½"	¾"
EGH-105	E632	4.50	3.60	½"	¾"
EGH-115	E632	4.50	4.00	½"	¾"
EGH-125	E632	4.50	4.40	½"	¾"
Steam					
EGH-85	35-S-29	3.25	2.80	¾"	¾"
EGH-95	35-S-29	3.50	3.20	¾"	¾"
EGH-105	35-S-29	3.50	3.00	¾"	¾"
EGH-115	35-S-29	3.75	4.00	¾"	¾"
EGH-125	35-S-29	3.75	4.40	¾"	¾"

Note: When two heaters are installed, multiply heater ratings by 2. Weil-McLain ratings based on 60 PSIG domestic water pressure at heater
*Gallons of water per minute heated from 40° to 140° F. with 200° F. boiler water temperature.
**Continuous draw—no recovery period.

STORAGE HEATER HOOK-UP
(forced hot water boiler only)

The 62-2-E Storage Heater can not be used with any size of steam boiler. The storage tank should be located as high as possible above the boiler. A vertical type storage tank may be used provided the bottom of the tank can be located above the top of the boiler. To maintain gravity circulation, the horizontal flow piping from the storage heater to the tank must pitch upward at least 1 inch for each 10 feet of piping; the horizontal return piping from the storage tank to the heater must pitch downward at least 1 inch for each 10 feet of piping. The return piping should not be located below the heater. Use as few elbows and pipe fittings as possible.

STORAGE HEATER RATINGS
(forced hot water boilers only)

Water Boiler Size	Storage Heater No.	180° Boiler Water Heater Cap. Gals. 40° - 140° Rise	212° Boiler Water Heater Cap. Gals. 40° - 140° Rise
EGH-85 thru 125	62-2-E	50 in 3 hours	70 in 3 hours
Recommended Storage Tank		50 Gallons	75 Gallons

SIZE GAS SUPPLY PIPING

The gas supply piping must be sized to provide the proper inlet gas pressures when the boiler is operating at the published rated input. For natural gas, the inlet gas pressure to the manual main shut-off gas valve should be 5.0 to 14.0 inches water column. If the inlet natural gas pressure exceeds 14.0 inches water column, a one hundred per cent lock-up type gas pressure regulator should be installed, limiting gas pressure to 14.0 inches water column.

For propane, the inlet gas pressure to the manual main shut-off gas valve should be 11.0 to 13.0 inches water column; the gas pressure regulator (furnished by the gas-supplier) must be adjusted to provide lock-up pressures not exceeding 14.0 inches water column.

Determine the measured length piping from the gas meter to the boiler. Add to the measured length the additional length for each elbow or tee. Refer to the Pipe Delivery Schedule Table and determine the pipe size.

CAUTION INSTALL THE GAS CONTROL ASSEMBLY, GAS SUPPLY PIPING, AND PILOT LINE TUBING

The gas controls for the Type EGH boiler are shipped pre-assembled. Remove the knockout disc from the jacket end panel at the end of the boiler to which the gas supply is to be piped.

The gas supply piping should be installed in accordance with the **American National Standard** Z223.1—1974 National Fuel Gas Code in the United States or CGAB149 Installation Code for Gas Burning Appliances and Equipment in Canada.

The pipe joint compound (pipe dope) must be resistant to propane and should be applied **sparingly** only to the male threads of the pipe joints.

1. Connect from the gas meter to the gas control. Where the gas connection size is smaller than the calculated pipe size, reduce the gas supply piping only at the inlet to the gas valve. A drip leg must be installed at the inlet of the gas connection to the boiler. The local utility may require that the drip leg be extended all the way to the floor. If an additional manual main shut-off gas valve is required, it should be located in the gas supply piping according to the local utility requirements. The gas supply piping must be supported by external hangers; not by the boiler or its accessories.

   a. Carefully uncoil the pilot thermal element lead and attach to the connection on the gas valve body. Refer to enclosed instruction from the gas valve manufacturer for pilot thermal element lead connections.

   b. Use the ¼ inch aluminum tubing provided to connect the pilot to the gas valve.

2. Open the manual shut-off valve at the gas meter and completely purge the air from the gas supply piping.

3. Check all gas connections for leaks using a soapy solution. Liability for damage resulting from the use of a flame can not be assumed by the manufacturer.

CAUTION WIRING THE BOILER

The boiler must be electrically grounded in accordance with the National Electrical Code, ANSI CI-1971, if an external electrical source is utilized. Attach wiring label shipped with boiler to inside of jacket door panel.

A Strain Relief Bushing and Adapter must be used at each point where the safety circuit wiring passes through a control case (see Figure 12) to protect the safety circuit wiring insulation.

24-Volt Systems:

For boilers without a combination limit control and relay, secure the electrical junction box to the inside of the jacket left end panel using the No. 8 - 32 x ½" machine screws and nuts provided. Secure the control transformer to the junction box.

PIPE DELIVERY SCHEDULE TABLE

Pipe Delivery Schedule						Additional Length of Pipe to Be Added for Each Elbow or Tee Bend in Piping	
*Adjusted Length of Gas Supply Piping in Feet	▲ Capacity of Pipe Sizes in Cubic Feet of Gas Per Hour					Pipe Size in Inches	Additional Length of Pipe in Feet
	1"	1¼"	1½"	2"	2½"		
10'	520	1,050	1,600	3,050	4,800	1"	2.2'
20'	350	730	1,100	2,100	3,300	1¼"	2.9'
30'	285	590	890	1,650	2,700	1½"	3.3'
40'	245	500	760	1,450	2,300	2"	4.3'
50'	215	440	670	1,270	2,000	2½"	5.1'
75'	175	360	545	1,020	1,650	—	—
100'	150	305	460	870	1,400	—	—
150'	120	250	380	710	1,130	—	—

*Include measured length of gas supply piping and allowance in feet for number and size of fittings.
▲Flow capacity determined from Dr. Pole's Formula; Specific Gravity—0.60; Presure Loss—0.30" W.C.

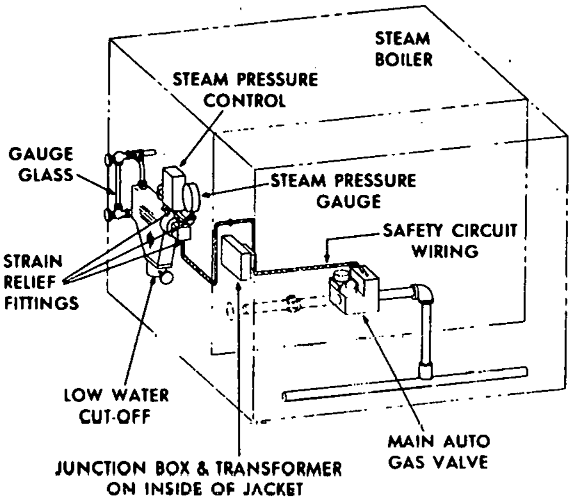


FIGURE 9

24-VOLT SYSTEM STEAM BOILER WIRING

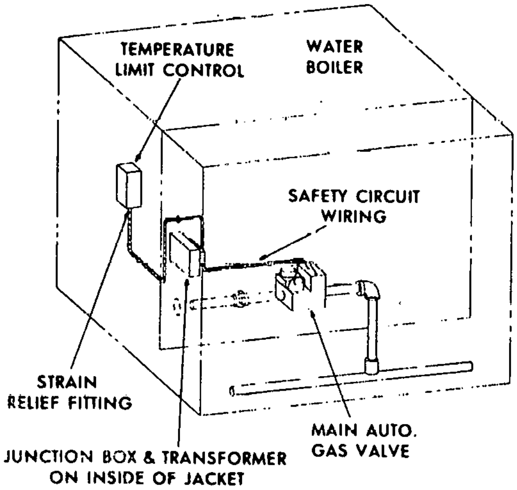


FIGURE 10

SELF GENERATING SYSTEM GRAVITY HOT WATER BOILER WIRING

Bring the supply wiring to the boiler. For non-packaged boilers used for forced hot water, a transformer with receptacle for plug-in circulator relay is furnished (relay not standard).

The electrical supply wiring to the boiler should be No. 14 gauge or heavier wire in conduit, as required, and should have a properly sized fused disconnect. The operating and safety circuit wiring should be no smaller than 18 A.W.G. or its equivalent. All wiring must be installed in accordance with the requirements of the National Electrical Code and Canadian Electrical Code and any additional, national, state, or local code requirements having jurisdiction. All safety circuit wiring should be N.E.C. Class 1.

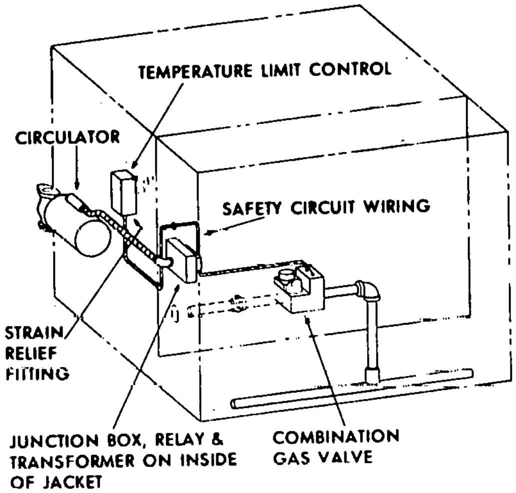


FIGURE 11

24-VOLT SYSTEM FORCED HOT WATER WIRING

Self Generating Control Systems (EGH-85 and 95 ONLY):

All wiring in the self generating circuit should be of the solid type to provide the least possible resistance in the circuit. Determine the wire length to be used in the safety and thermostat circuits and refer to table for the recommended minimum thermostat and safety circuit wire size according to the wire length.

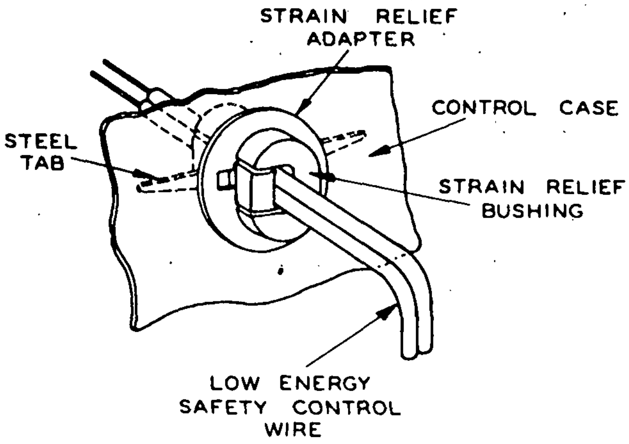
SELF GENERATING CONTROL SYSTEMS RECOMMENDED WIRE SIZES

Recommended Minimum Thermostat Wire Sizes According to Wire Lengths	
Wire Length	Wire Size
16 Feet	22 Guage
25 Feet	20 Guage
40 Feet	18 Guage
64 Feet	16 Guage
100 Feet	14 Guage

CAUTION

OPERATING AND SAFETY CHECK OUT SEQUENCE

1. Be sure the boiler and system are filled properly (see Filling Steam and Water Boilers on the boiler operating instruction card). **The internal use of petroleum based sealing or cleaning compounds will damage this boiler.**



INSERT STRAIN RELIEF ADAPTER AND BUSHING ASSEMBLY INTO ELECTRICAL KNOCKOUT IN CONTROL CASE. SECURE BY TURING DOWN THE TWO STEEL TABS.

Strain relief bushing and adapter must be used on all low-energy safety control wire to conform with NEC Class 1 wiring.

FIGURE 12

2. Be sure that all air has been purged from the gas piping and that the piping has been tested for gas leaks.
3. **Refer to operating instruction label on boiler jacket for lighting the safety pilot burner.**
4. While the burners are operating, move the indicator on the limit control below the actual boiler water temperature or steam pressure, the electrically operated main gas valve should close and the main burners go off. Move the indicator on the limit control above the boiler water temperature or pressure and the main burners should ignite.
5. If the boiler is equipped with a low water fuel cut-off, test the cut-off operation while the main burners are operating by opening the blow-off valve and observe that the main burners go off. Restore the water to the proper water line and the main burners should again ignite.
6. Test the switching action of any additional electrical safety controls using the procedure outlined in Steps 4 and 5.
7. Set the high limit control according to the design requirements of the heating system.
8. Set the room thermostat to the desired room temperature

BURNERS

No primary air adjustment is necessary on burners for natural or propane gases.

MEASURE GAS INPUT TO BOILER

For proper input, the gas pressure at the burner manifold should be 3.5 inches water column for natural gas and 11.0 inches water column for propane gases.

Measure the gas input to the boiler by reading the rate of flow at the gas meter. Be sure all other appliances connected to the same meter are shut off. The measured rate of flow in cubic feet per hour multiplied by the heating value in BTU per cubic foot of the gas should check with the input shown on the boiler rating plate.

If the actual input is within 5 percent of the rated boiler input, adjust the gas pressure regulator to obtain the required gas flow. The gas pressure regulator is located on the gas valve body. To adjust remove the regulator adjustment screw cap and turn the adjustment screw **clockwise** to increase or **counter-clockwise** to decrease the gas flow.

If the actual input is more than 5 percent off the rated input, change orifice sizes.

ADDITIONAL INSTRUCTIONS

Before leaving the job, make sure the unit checks electrically. Be sure the room thermostat is set to the desired room temperature and that the limit control is set according to the design requirements of the heating system. For additional information on maintenance and operation of the controls employed, refer to the manufacturer's instructions supplied with the controls.

The wiring diagram label, rating plate, non-combustible floor label, and operating instruction label must be mounted on the boiler jacket.

CAUTION BOILER SERVICE AND MAINTENANCE

The boiler Operating Instructions are included in this booklet which must be left with the owner. Review this information with the owner and be sure he receives all instructions.

WHEN THE BOILER IS USED WITH A REFRIGERATION SYSTEM

When the boiler is used in conjunction with a refrigeration system, the chilled medium should be piped in parallel with the boiler with an appropriate valving arrangement to prevent the chilled water from entering the boiler. If the boiler is connected to heating coils located in air handling units where it may be exposed to refrigerated air circulation, the boiler piping system must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

RATINGS

Boiler Number*	A.G.A. Input MBH+	A.G.A. Gross Output MBH+	Net I-B-R Ratings**			Net Sq. Ft. Water ▲	Boiler H.P.	Supply Tappings No. & Size	Return Tappings No. & Size	Dimensions — Inches		Gas Connection Size†		Breeching and Draft Hood Outlet Size	Chimney Size***	Approx. Shipping Weight Lbs.
			Sq. Ft. Steam	Steam MBH+	Water MBH+					D	W	Natural	Propane			
EGH-85	350	280	875	210.1	243.5	1,620	8.4	2—3″	2—2½″	9	38¼	¾″	¾″	1–9″	9″ x 20′	825
EGH-95	400	320	1000	240.1	278.3	1,855	9.6	2—3″	2—2½″	10	42½	¾″	¾″	1–10″	10″ x 20′	915
EGH-105	450	360	1125	270.1	313.0	2,085	10.8	2—3″	2—2½″	10	46¾	1″	1″	1–10″	10″ x 20′	1005
EGH-115	500	400	1250	300.1	347.8	2,320	11.9	2—3″	2—2½″	12	51	1″	1″	1–12″	12″ x 20′	1095
EGH-125	550	440	1375	350.1	382.6	2,550	13.1	2—3″	2—2½″	12	55¼	1″	1″	1–12″	12″ x 20′	1185

*When ordering, add to boiler number "S" for Steam; "W" for Water. Add "-1WT" for water boiler with one tankless heater; "-2WT" for water boiler with two tankless heaters. Add "-1ST" for steam boiler with one tankless heater; "-2ST" for steam boiler with two tankless heaters. Add "WHS" for water boiler with storage heater.

+MBH refers to thousands of BTU per hour.

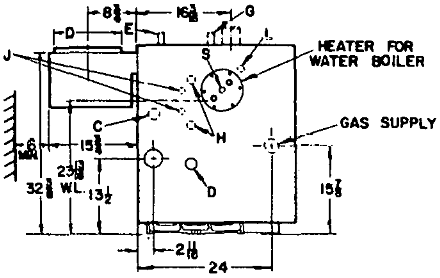
**Net I-B-R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pick-up. Steam ratings are based on a piping and pick-up allowance of 1.333; water ratings on an allowance of 1.15. An additional allowance should be made for unusual piping and pick-up loads. Consult Customer Services Department. Ratings shown are for elevations up to 2,000 feet. For elevations above 2,000 feet, ratings should be reduced at the rate of 4 percent for each 1,000 feet above sea level.

▲Based on average water temperature of 170° F. in radiators.

†Sizes shown are gas connection sizes. Gas piping from meter to boiler to be sized according to local utility requirements.

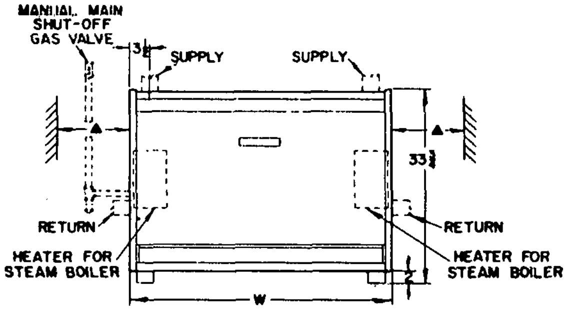
***In special cases where surrounding conditions permit, chimney height may be reduced by 10 ft.

Note: Water boilers tested for 50 P.S.I. working pressure; also available upon special request at 80 P.S.I. working pressure.

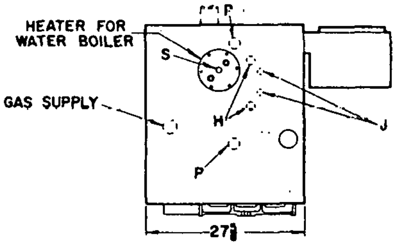


LEFT SIDE

▲Heater clearance:
E-626 — 19″; E-632 — 22″.

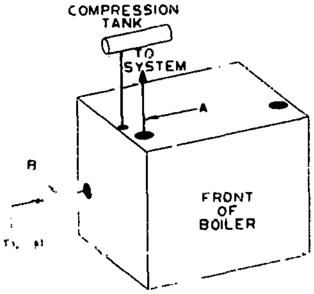


FRONT



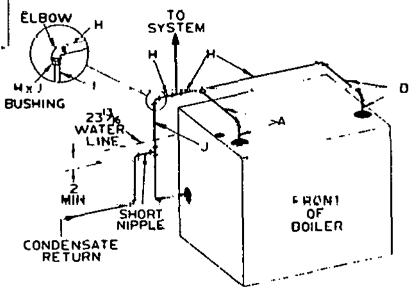
RIGHT SIDE

RECOMMENDED PIPING CONNECTIONS



WATER BOILERS

Note: Supply and return sizes for water boilers refer to minimum size of pipe connected to boiler for 20° or higher temperature drop between supply and return.



STEAM BOILERS

WATER BOILER SIZE	PIPE SIZE	
	A (Supply)	B (Return)
EGH-85 & EGH-95	2″	2″
EGH-105 thru EGH-125	2½″	2½″

STEAM BOILER SIZE	RISER PIPE SIZE		HEADER* H	EQUALIZER J
	A	B		
EGH-85 & EGH-95	2″	2″	3″	1½″
EGH-105	2½″	2½″	3″	1½″
EGH-115 & EGH-125	2½″	2½″	4″	1½″

*24 minimum from waterline to header

CONTROL TAPPINGS

LOCATION	SIZE	STEAM	WATER
C	¾″	Probe Type Low Water Cutoff	Plugged
D	¾″	Drain	Drain
E	¾″	Safety Valve	Safety Relief Valve
G	¾″	Plugged	Piping to Compression Tank or Auto Air Vent
H	½″	Gauge Glass and/or Low Water Cutoff	Low Water Cutoff
J*	⅜″	Try Cock Tappings	—
L	¼″	Plugged	Combination Pressure-Temperature Gauge
P	1″	Low Water Cutoff, Pressure Limit Control and Pressure Gauge; or Low Water Cutoff and Feeder Combination; or Low Water Cutoff and Pump Control	Low Water Cutoff; or Low Water Cutoff and Feeder Combination; or Low Water Cutoff and Pump Control
S	1½″ (Steam)	Skim Tapping	—
	¾″ (Water)	—	Limit Control

*Available only on special request.

NOTE: Limit Control and Supply Piping must be on the same end of the boiler.

NOTE: When an internal type water heater is installed, use the tapping in the heater for an additional operating control.

WEIL-McLAIN

Michigan City
Indiana 46360

A Division of Wylain, Inc.

PLEASE HANG THESE INSTRUCTIONS NEAR THE BOILER

START-UP, SERVICE AND MAINTENANCE INSTRUCTIONS for WEIL-McLAIN GAS BOILERS

Below, the procedure is outlined for starting your Weil-McLain Boiler including instructions for the care of your heating system. All mechanical equipment needs occasional attention. The boiler should be inspected, cleaned and if necessary, adjusted once a year. We recommend that your serviceman be called as he has been trained for the job and will have the necessary instruments to check your boiler. This will assure you that the operation of your heating system will remain highly efficient. Your Weil-McLain boiler will give you a lifetime of heating comfort, if you follow the few simple suggestions listed on this card.

IMPORTANT—The internal use of petroleum based sealing or cleaning compounds will damage your boiler.

FILLING STEAM AND WATER BOILERS

Do not fill the boiler (except for leakage tests) until the boiler is ready to be fired. **CAUTION: Do not add large quantities of cold feed water to any hot boiler!**

Steam Systems: The boiler should be filled to the normal water line and fired for about 15 minutes at a low rate sufficient to keep the boiler at steaming temperature with the steam vented to drive off dissolved gases (also see Skimming Steam Boilers).

Water Sytems: The boiler and the entire system should be filled and heated to approximately 210°F for about 15 minutes to drive off dissolved gases. Before filling the system, make sure all the system air vents are closed. Open the hand water feed valve and beginning on the lower floor, open the air vents (one at a time) until water starts to flow; then, close the vent. Repeat this throughout the building until all heat distributing units are filled with water. Close the hand water feed valve when the correct boiler pressure is reached. After the system is in operation, keep the system filled with water by occasionally opening the air vents allowing any entrapped air to escape and adding enough make up water to maintain the correct system pressure. If your system is provided with a purge valve located in the system return piping, connect a garden hose to the drain valve located above the purge valve. Close the purge valve and open the hand water feed valve and allow the system to purge all air. Where the system has more than one circuit, purge each circuit separately by opening each balancing valve one at a time. When the system is purged of all air, close the drain cock located above the purge valve and open the purge valve. Fill the boiler and the entire system to the correct pressure. **Air in the system can interfere with circulation of water and prevent the heat distributing units from properly heating.**

TO START THE BOILER

1. Be sure the main electric switch in the boiler electrical circuit is turned to the **off** position.
2. CAUTION: Make sure that the manual main shutoff valve and the pilot valve have been closed for at least five minutes before lighting the safety pilot burner.
3. Remove the jacket door and access panel.
4. Follow the "Starting up Boiler Instructions" on the operating instruction plate which is mounted on the Jacket Panel.

IF BOILER FAILS TO START, CHECK THE FOLLOWING

1. Check for loose connections and blown fuses.
2. Be sure the high limit control setting is above the boiler temperature or pressure.
3. Make sure that gas is turned on at meter.
4. Be sure pilot is burning.
5. Make sure manual main shut-off valve is open.
6. If the above checks do not eliminate the trouble, call in your serviceman.

MEASURE GAS INPUT TO BOILER

For proper aspiration, the gas pressure at the burner manifold should be at least 3.5 inches water column for natural gases and 10.0 inches water column for propane gases.

Measure the gas input to the boiler by reading the rate of flow at the gas meter. Be sure any other appliances connected to the same meter are shut off. The measured rate of flow in cubic feet per hour multiplied by the heating value in B.T.U. per cubic foot of the gas employed should check with the input shown on the boiler rating plate. If the actual input is within 5 percent of the rated input, adjust the gas pressure regulator to obtain the required gas flow. To adjust the gas input, remove the cap on the pressure regulator and turn the adjusting screw clockwise to increase the gas flow or counterclockwise to decrease the gas flow. If the actual input is more than 5 percent off the rated boiler input, change orifice sizes and again measure the gas input to the boiler.

SKIMMING STEAM BOILERS

All new boilers and steam and water piping contain oil, grease, chips, and other foreign matter. It is essential to clean new steam heating boilers to remove these materials in order to avoid overheating of boiler metal, foaming and priming, and high maintenance costs on strainers, traps, and vents. The boiler installer should use the following procedure to clean oil, grease, and other impurities from the new boiler.

1. Close the valve in the building steam supply main(s).
2. Provide a full sized skim line, with valve, from the

boiler skim tapping and run this line to a convenient floor drain.

3. Fire the boiler at a low rate sufficient to keep the boiler at steaming temperature allowing the steam, along with entrained water and impurities, to discharge through the skim piping to the drain.
4. Feed the water to the boiler as required to maintain proper water level in the gauge glass. It may be necessary to cycle the burners to prevent a rise in steam pressure above several pounds.
5. Continue the boiling and skimming process for at least two hours or until the water leaving the skim line is clear of all grease, oil and impurities. On unusual jobs, the skimming procedure may require repeating one or more times. CAUTION — THE USE OF CLEANERS IS NOT RECOMMENDED!
6. Drain boiler and, while boiler is warm but NOT HOT and without steam pressure, remove safety valve and insert a hose nozzle into the opening. Flush all interior surfaces of the boiler with water under full pressure until all traces of dirt and impurities are removed and the drain water runs clear.
7. Replace safety valve; close drain cock, fill with fresh water to the water line. Start burners and steam for 15 minutes to remove all dissolved gases; stop burners.
8. Drain boiler sufficiently to remove skim piping; plug skim tapping; refill boiler to waterline.
9. To prevent the return of impurities to the boiler from new or old piping systems, waste all condensate for several days or until no impurities are contained in the condensate. NOTE — IT IS IMPERATIVE THAT FEEDWATER BE SUPPLIED TO MAINTAIN THE CORRECT WATER LEVEL AND THAT A LOW WATER CUTOFF IS OPERATIVE!

BOILER SERVICE AND MAINTENANCE

Leaks in the boiler and piping system must be repaired at once. The use of makeup water in large quantities is undesirable and may damage the boiler after an extended period of time. If serious leaks occur, stop the burners and gradually reduce boiler pressure or temperature. Do not attempt to make repairs while a steam boiler has pressure or hot water boiler temperatures are above 130°F.

Foaming or priming may occur in a steam boiler and cause large quantities of water to pass out into the steam main. It can be observed by violent fluctuations of water level, in the gauge glass. This trouble may be caused by dirt, oil, or precipitates in the boiler water, too high a boiler water level, a high overload on the boiler (i.e., the sudden release of boiler steam pressure into the mains by action of fast operating valves), or the addition of too much boiler water treatment. With serious foaming or priming, stop the burners and decrease boiler load. Then alternately blowdown and slowly feed fresh water several times. If trouble persists, it may be necessary to skim the boiler one or more additional times.

Any problem in regard to large amounts of makeup water, extreme foaming or priming, scale in the boiler, or internal corrosion or pitting, should be referred to a company specializing in boiler water chemistry. DO NOT try "Homemade cures" or boiler "patent medicines" on the market under various trade names, or serious damage to the boiler, personnel, and property may result.

Frequently check the boiler water level in the gauge glass of steam boilers, and check the boiler operating pressure of steam or water boilers. Test the low water cutoff by opening its blowdown valve to remove dirt, rust, and sediment, and observe that burners stop as the water level approaches the bottom of the water gauge glass (gauge glass on steam boilers only).

On steam boilers, open the water gauge glass blowdown valve and blow clear; close blowdown valve. If water gauge glass leaks or breaks, close both gauge glass cocks and repair; open gauge cocks after repairing.

Periodically, check the seal afforded by any gasket installed on the boiler or heating system (i.e., heater, heater opening cover plate, circulator, etc.). If necessary, thoroughly tighten all bolts to restore the water-tight seal.

Periodically test boiler safety or relief valve to make sure it opens at the proper pressure. Make sure that the valve reseats and does not leak. Replace any defective or leaking valve.

Periodically check and if necessary, clean the boiler flues. The frequency of cleaning will depend upon the fuel uses, the flame adjustments, boiler temperature, draft conditions, and other job factors. Protect the burners and controls from dust and dirt during cleaning.

DO NOT DRAIN BOILER during periods of shutdown unless heating system is exposed to freezing temperatures. On steam boilers, open boiler blowdown valve and flush till clear while under steam pressure. On water boilers open boiler drain cock to remove impurities that have settled to the bottom of the boiler. Refill as required to correct water line for steam boilers or the correct pressure for water boilers. Turn off all electrical power connections to the boiler and its auxiliaries. Clean all carbon, rust, and other deposits from the fire-side of the boiler heating surfaces in order to protect the boiler from the corrosive action of combustion deposits (see Cleaning Boiler Heating Surfaces). If the water side of the boiler must be cleaned or inspected, open the blowdown valve and drain the boiler. Hose the inside of the boiler with high pressure water to remove sludge and sediment, flush again. Replace plugs and jacket panels when all traces of sludge and sediment have been removed. Dry insides of boiler thoroughly, or refill with fresh water and heat to release dissolved gases (see Filling Steam and Water Boilers). Repeated draining and filling of the boiler and/or the heating system can lead to the same consequences as adding too much makeup water—this is mainly true where the makeup water is "hard" and the same precautions must be used as indicated in an earlier paragraph under column heading Boiler Service and Maintenance.

SHUT DOWN OF BOILER

1. Turn off main electric switch in the boiler electrical circuit.
2. Close manual main shut-off gas valve.
3. Close pilot valve.
4. Open the boiler drain cock to remove impurities that may have settled to the bottom of the boiler; it may be necessary to drain one or two gallons of water until all traces of sediment are gone. Refill the boiler to the proper water level or pressure (see Filling Steam and Water Boilers). Boiler water does not have

to be crystal clear for proper operation, but should be free of any sludge or sediment.

5. During severe winter weather have heating system operation checked periodically or thoroughly drain your heating and plumbing systems.

CLEANING THE MAIN BURNERS

At the start of every heating season, it is most advisable to inspect and, if necessary, clean the main burners of any dust or lint or any other foreign particles that may have accumulated in the burners. To clean the burners, attach a piece of metal tubing to the hose end of a hand air pump (or tire pump). Bend one end of the metal tubing to form a 90 degree angle and pump air through the openings at the top of each main burner. If the main burners can not be properly cleaned in this manner, it will be necessary to remove and thoroughly clean the burners.

CLEANING BOILER HEATING (fire-side) SURFACES

At the end of every heating season, it is advisable to inspect and if necessary clean the flues in the boiler. Soot is an effective insulator and prevents the hot gases from heating the boiler water as efficiently as possible. Normally this boiler will be cleaned from the top as described below.

1. Remove the top jacket panel of the boiler.
2. Remove the cleanout opening cover or the flue opening cover at the top of the boiler sections.
3. Remove the burners, if not already removed for cleaning, to avoid brushing soot and dirt into the burner openings or extinguish the pilot and cover all the main burners with heavy papers.
4. Insert a wire flue brush vertically through openings between sections and scrub all flue surfaces vigorously.
5. Replace the clean burners or remove papers which covered the main burners.
6. Replace the cleanout opening cover making sure the original gas-tight seal is maintained between the cover and the boiler sections.
7. Replace jacket top panel.
8. Start the boiler according to the procedures outlined in these instructions under column heading "To Start The Boiler".

WATER BOILER CONTROLS

CIRCULATOR CARE:

Never operate the circulator without water.

A. Follow lubricating instructions on circulators that are provided with oil cups or oil holes.

B. Follow venting instruction on circulators with water lubricated bearings which require no oil.

BOILER PRESSURE: The initial fill pressure of the boiler and entire system should be according to the design requirements of the heating system (in general, the fill pressure for most heating systems would be to 12 pounds per square inch). When the system is heated to the limit control setting, the system pressure may rise up to the relief valve opening pressure. Normal system pressure will fluctuate between the fill pressure, when the system is cold; and rise to maximum pressure (just below the relief valve opening pressure), when the system is hot.

BOILER WATER TEMPERATURE: Modern hot water heating systems with "closed" type expansion tanks may operate at water temperatures up to 250°F. The high limit control must be set according to the design requirements of the heating system, during severe winter weather, you may find that this temperature setting need to be raised or lowered depending upon characteristics of your system.

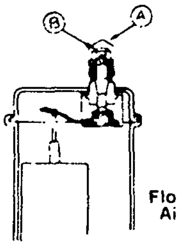
COMPRESSION TANK: Compression tank is employed with hot water heating systems to accept the increased water volume which results from heating the system water. The compression tank on a closed hot water heating system should provide adequate pressurization under all system operating conditions. Frequent opening of the pressure relief valve can be the result of an undersized compression tank because provisions for the necessary expanded water volume has not been provided. Compression tanks may be of the open, closed, or closed diaphragm type.

Open Type Expansion Tank: Open type expansion tanks are located above the highest heat distributing unit in the system usually in a closet or attic space and equipped with a gauge glass and an overflow pipe to a drain. The open type expansion tank and drain piping should not be located in any area where freezing temperatures could occur.

Closed Type Expansion Tank: Closed type expansion tanks are welded gas-tight and are usually located just above the boiler but may be located at any point in the heating system. In order to utilize the built-in air elimination system on the boiler, the closed type compression tank must be piped to the air elimination tapping on the boiler. When the system is initially filled with water, a cushion of air is trapped within the tank and this air cushion is compressed to provide the initial fill pressure. When the system is heated, the expansion of the system water further compresses the air cushion and provides the additional space required for the additional water volume. A rapid increase in boiler pressure with frequent opening of the pressure relief valve during warm-up of the boiler and heating system usually indicates a "waterlogged" compression tank. Your serviceman should be called to correct this condition by partially draining the compression tank to again establish an air cushion.

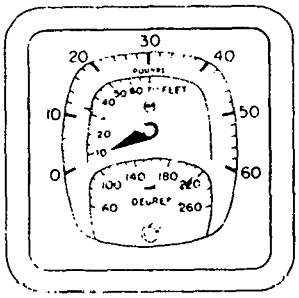
Closed Diaphragm Type Compression Tank: Closed diaphragm type compression tanks are welded gas-tight and a rubber diaphragm is employed to separate the air cushion from the system water. The closed diaphragm type expansion tank may be located at any point within the heating system but is usually located as close to the boiler as possible. Where a closed diaphragm type expansion tank is employed, an automatic air eliminating device should be installed in the air elimination tapping on the boiler to provide system air control. Before the initial fill of the heating system, the closed diaphragm type compression tank should be charged with air (by means of a tire pump) to a pressure equal to the initial fill pressure; the tank pressure may be checked by means of an air pressure gauge. As the system is filled, water will not enter the tank until the system pressure exceeds the tank charge. When the system is heated, the expansion of the system water causes the diaphragm to flex and further compress the air cushion and additional space is provided for the additional water volume. Since the system water is separated from the air cushion by means of a diaphragm, absorption of the air cushion by the system water is eliminated.

FLOAT TYPE AIR VENT: If your system is equipped with a Float Type Air Vent(s) which automatically expells air from the heating system, when the system is filled with water, loosen cap A slowly so that particles of dirt or scale are not deposited on the valve seat by the escaping air. Should dirt or scale lodge on the valve seat causing it to leak, remove cap and push the valve core B in by hand to permit water to flush the valve seat clean. Release the valve core quickly and replace cap. For normal operation and venting, unscrew the cap at least two turns.



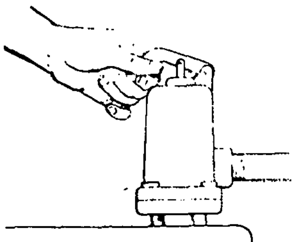
Float Type Air Vent

PRESSURE-TEMPERATURE-ALTITUDE GAUGE: This gauge indicates the boiler pressure in pounds-per-square-inch and in feet of water column (altitude) above the boiler by the moveable hand. The fixed hand may be changed to indicate the proper position for the moveable hand on manually filled hot water heating systems. For those systems with automatic fill valves, the fixed hand is usually left at the zero setting. The third hand indicates the boiler water temperature in degrees fahrenheit.



Combination Pressure-Temperature-Altitude Gauge

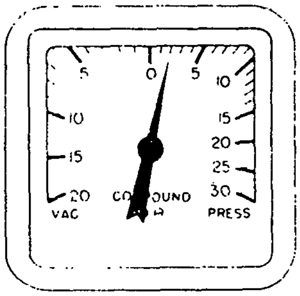
WATER RELIEF VALVE: Check the relief valve at least once a year by pulling the handle and allowing a small quantity of water to flow. Be sure the relief valve reseats properly and is entirely free from seepage. If the relief valve sticks or appears to be clogged, it should be repaired or replaced immediatley. The relief valve outlet should pe piped to a floor drain or near the floor. The relief valve discharge must not be piped to any area where freezing temperatures could occur.



Manually opening Pressure Relief Valve.

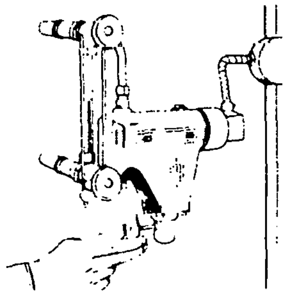
STEAM BOILER CONTROLS

BOILER PRESSURE. Steam boiler pressures may range up to 15 psig maximum, but in normal service usually will not exceed 12 to 13 psig and may be much less, possibly operating under vacuum conditions at certain times. The compound gauge used for steam boilers indicates steam pressure in pounds per square inch (psig) and boiler vacuum in inches of mercury (hg).



Pressure Gauge.

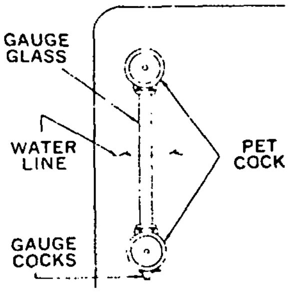
CLEANING LOW WATER CUT-OFF. Accumulated sediment in the low water cut-off should be flushed out through a blow-off valve provided for this purpose at least once each month of heating system operation.



Flushing Low Water Cut-off.

CLEANING THE GAUGE GLASS. This may be done by closing the lower gauge glass cock and carefully opening the petcock below the glass to blow water and sediment out of the gauge glass by steam pressure. Then slowly open the lower gauge glass cock, allowing a small amount of water to flush out through the open petcock. Close and fully open the lower gauge cock. The water level should immediately rise to its proper level. If gauge glass breaks, close off both gauge cocks and loosen glass retaining nuts to remove gauge glass. Replace broken gauge glass with new gauge glass made of heavy pyrex. DO NOT USE THIN WALL GLASS TUBING!

CHECKING THE SAFETY VALVE. The safety valve should open at 15 psig to prevent excessive boiler pressure. Manually open the safety valve once each year by pulling the valve lever or handle and allowing a small amount of steam to escape. This will help to assure proper operation of the safety valve if boiler pressures reach 15 psig. Be sure that the valve reseats properly and does not leak steam. If the safety valve sticks or appears to be clogged it should be repaired or replaced immediately by your serviceman. Side outlet safety valves should be piped to a floor drain or near the floor.



Gauge glass.

INSTALLATION & OPERATING INSTRUCTIONS

FOR

TYPE EG & EGH BOILER WITH HONEYWELL Q179D PILOT AND RA890F PRIMARY RELAY

1. Remove standard pilot burner and install Q179D electronic pilot in its place using the thermocouple, pilot tubing, and mounting screws furnished with the boiler.

2. Mount Q270A sub-base on adjacent wall, close to the boiler. *Do not mount on boiler jacket.*

3. Wire from sub-base to boiler controls and fused disconnect in accordance with diagrams on reverse side of these instructions.
   NOTE: All wiring must be installed in accordance with the requirements of the National Electrical Code or Canadian Electrical Code and any additional national, state, or local code requirements having jurisdiction. All safety circuit wiring should be N.E.C. Class 1.

4. Mount RA890F and its cover to sub-base after wiring is completed.

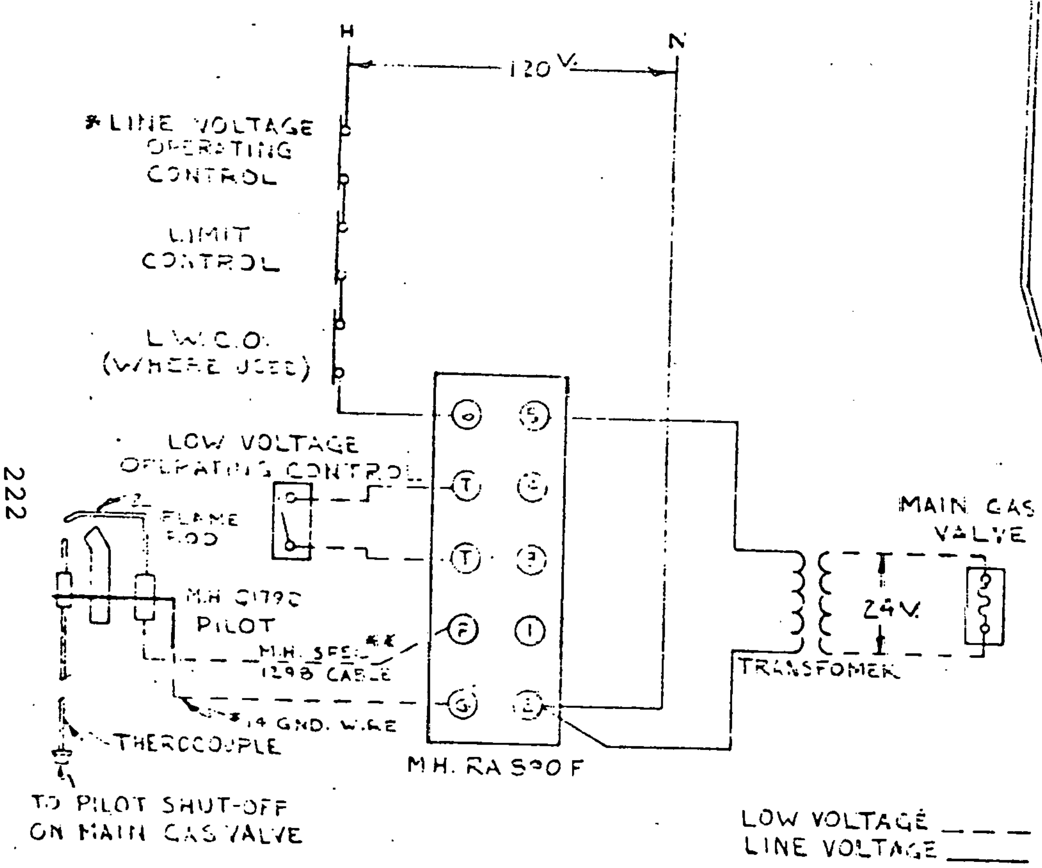
OPERATING INSTRUCTIONS

Refer to operating instruction plate on boiler and follow directions.

SEQUENCE OF OPERATION

On a call-for-heat by the controller, terminals 3 and 4 are energized. If the pilot flame is proven, terminal 4 is de-energized and terminal 5 is energized powering the main gas valve. Normal operation will continue until a normal shutdown caused by high limit, low water, or operating control action. Loss of pilot flame signal during operation will result in de-energizing the main gas valve circuit, and the control locks out in 15 seconds. If the pilot flame drops low enough, the thermocouple will drop out shutting off the pilot gas (100% safety shutoff). Follow normal lighting and startup procedures, and then reset the lockout button on the RA890 control.

-- OVER FOR WIRING DIAGRAMS --

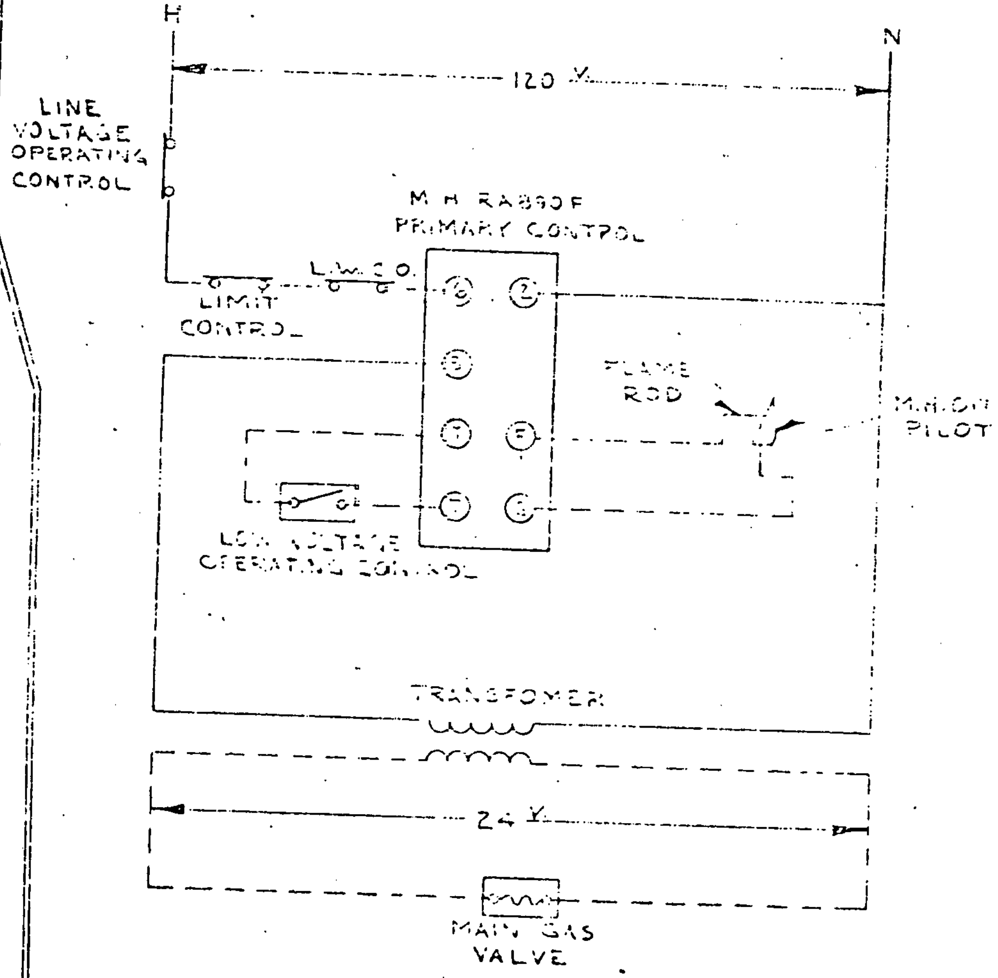


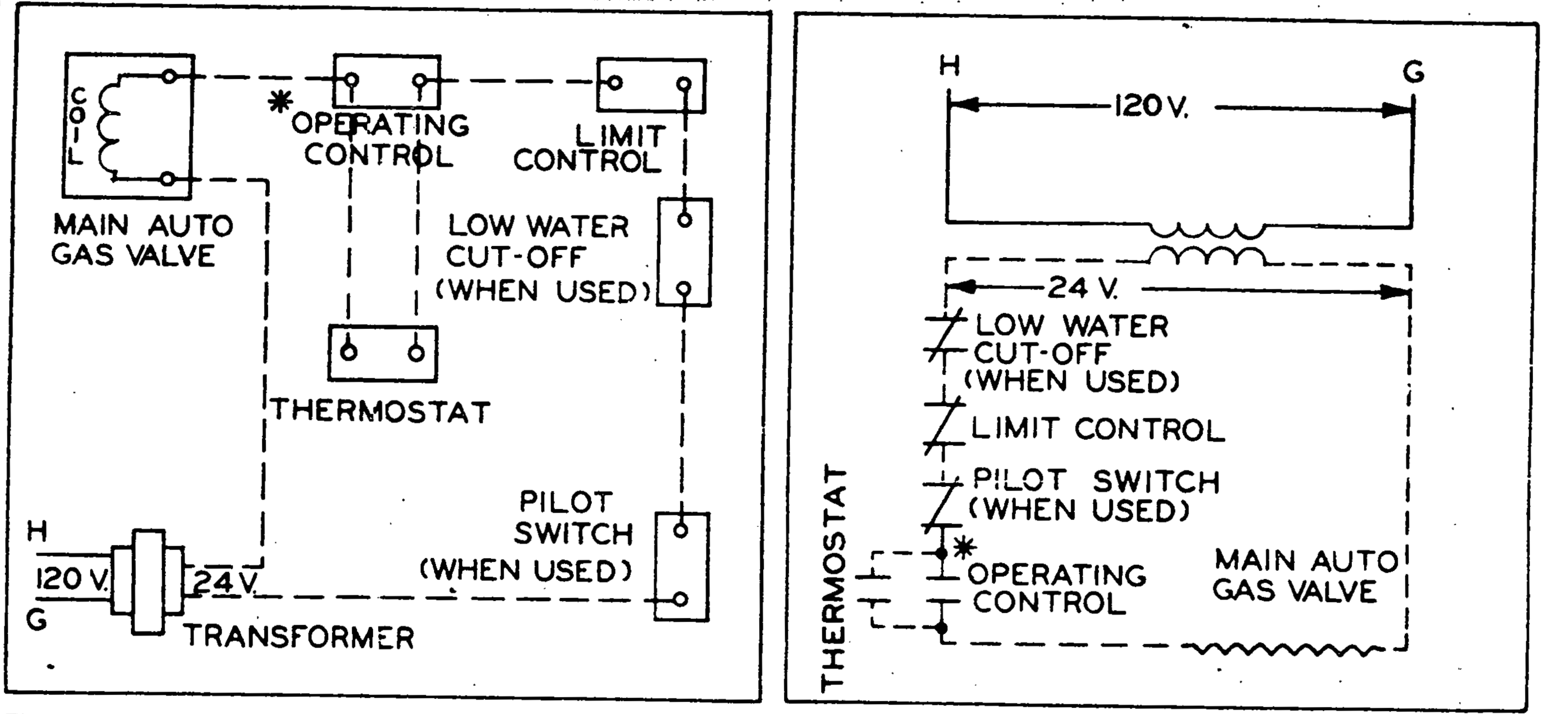
* LINE VOLTAGE OR LOW VOLTAGE OPERATING CONTROL CAN BE USED. IF LINE VOLTALE OPERATOR IS USED Ⓣ & Ⓣ TERMINALS MUST BE JUMPERED.

**MUST BE USED IN HEAT ZONE.

NOTE:

PILOT LINK LOCATED NEXT TO TEST JACK MUST BE CLIPPED.





WEIL-McLAIN COMPANY, INC., HYDRONIC DIVISION, MICHIGAN CITY, INDIANA
All wiring should be installed in accordance with local requirements. For zoning and other information see control manufacturers' instruction sheets packed with boiler. If any of the original wire as supplied with the appliance must be replaced, it must be replaced with 90°C thermoplastic wire or its equivalent.

*OPERATING CONTROL FOR STEAM TANKLESS HEATER

550224752

SCHEMATIC WIRING DIAGRAM FOR EGH-105-W NATURAL GAS-FIRED BOILER EQUIPPED WITH SPECIAL CONTROLS.

DATE: December 28, 1977

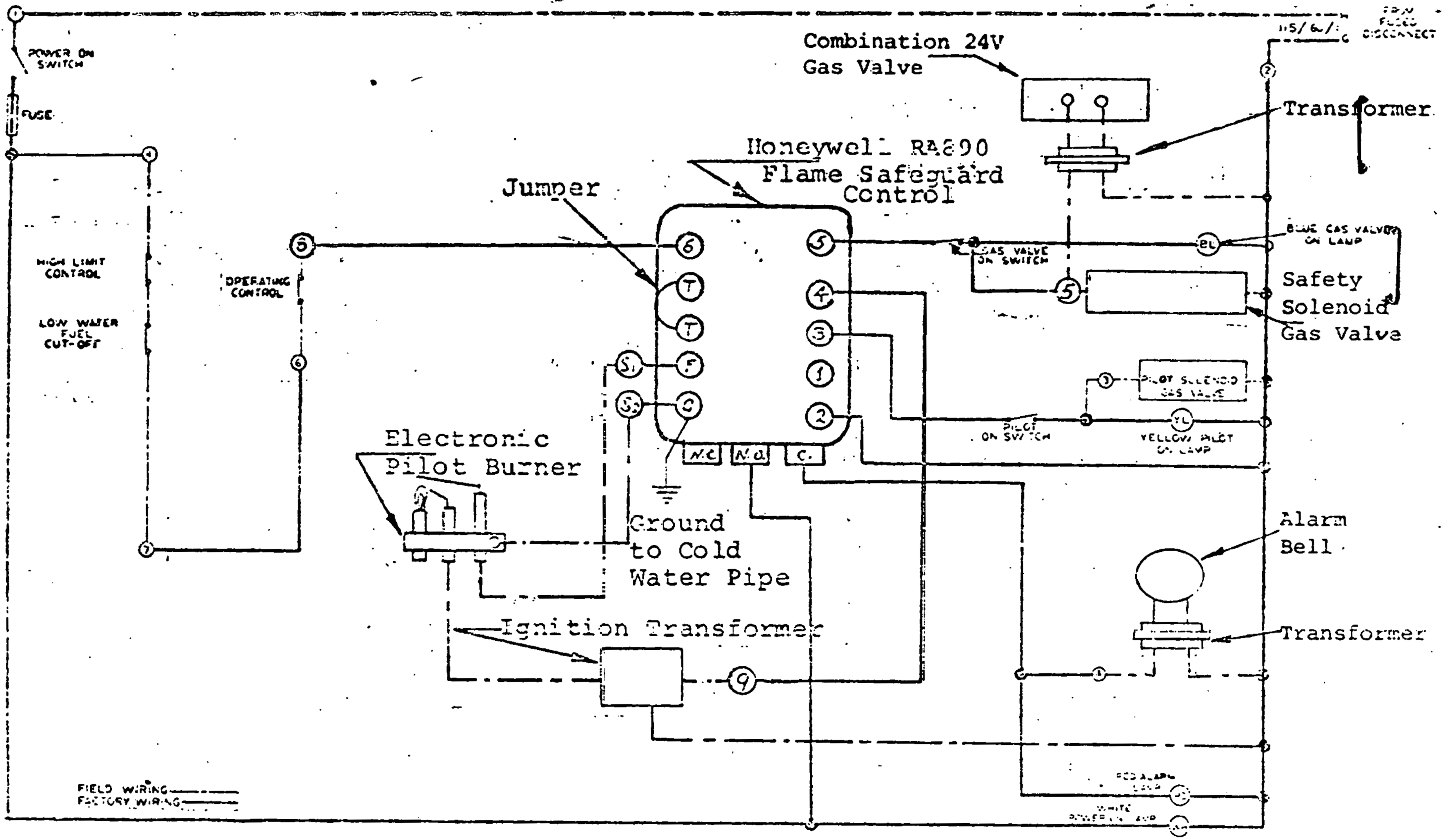
DWN. WKN WKN

CKD: ND

APP: W

MICHIGAN CITY INDIANA

NO. SWD-5511-A



NOTES: (1) ALL WIRING MUST BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE AND ANY ADDITIONAL NATIONAL, STATE, OR LOCAL CODE REQUIREMENTS HAVING JURISDICTION.

(2) ALL SAFETY CIRCUIT WIRING MUST BE N.E.C. CLASS 1.

JOB: Stephens College Visitor Center
Columbia, Missouri

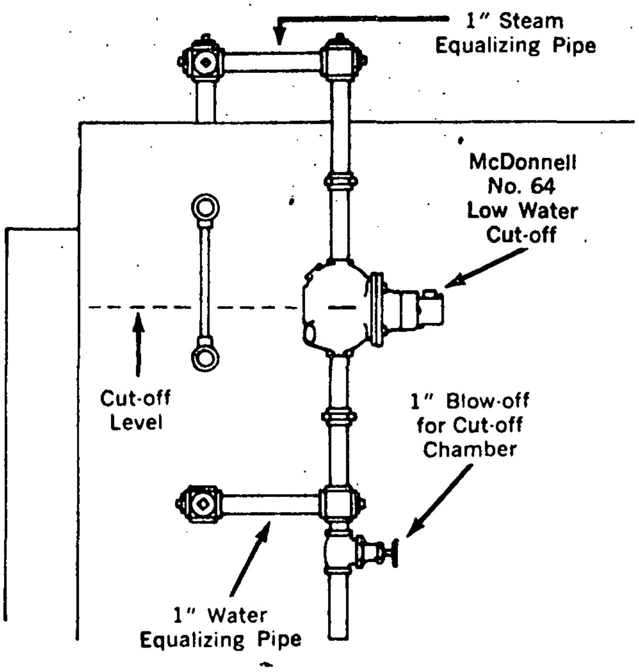
AGENT: R. A. Behrmann & Assoc., Inc.
St. Louis, Missouri

CONTRACTOR: Drummond Officer Mech. Cont.

INSTALLATION DETAILS
McDONNELL No. 64 Low Water Cut-off on Steam Boilers

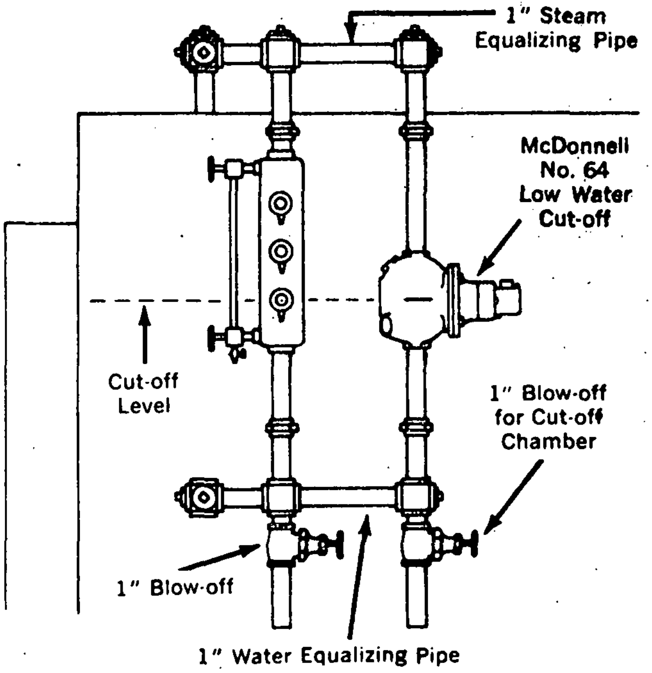
(Maximum Boiler or Body Pressure 50 psi)

For All Cast Iron Boilers with Water Glass in Front Section



1. Connect 1" steam equalizing line to any available opening in the boiler other than the steam flow line.
2. Connect 1" water equalizing line to tapping in the front section of the boiler. If boiler manufacturer has not provided a specific tapping, it is recommended that a 1" tapping be made in the front section 6" below bottom of the water glass.
3. Cut-off line on No. 64 float bowl should be set at approximately ½" of water visible in the gauge glass.
4. Install separate blow-off valve for draining and testing the low water cut-off.

For All Boilers with Independent Water Columns



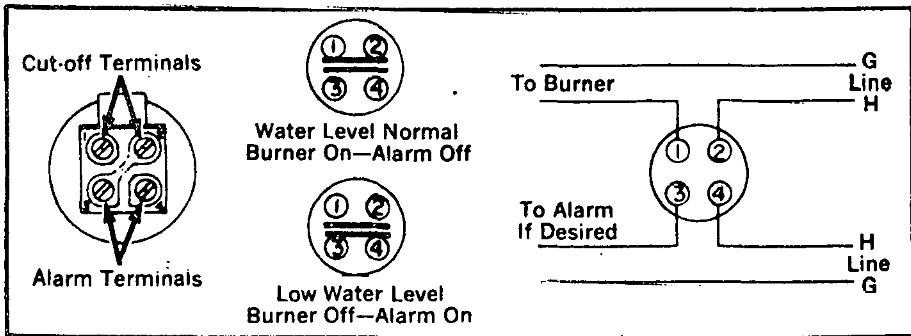
1. Connect 1" steam equalizing line to water column equalizing pipes as illustrated.
2. Connect 1" water equalizing line to water column equalizing pipes as illustrated.
3. Cut-off line on No. 64 float bowl should be set at approximately ½" of water visible in the gauge glass.
4. Install separate blow-off valve for draining and testing the low water cut-off.

IMPORTANT

Test the No. 64 before turning it over to owner. Turn on the burner. Open the blow-off valve, causing the water line in the float chamber to drop. When the float drops to below the low water cut-off point, the burner will shut off and the alarm (if used) will be actuated.

Instruct Boiler Attendant to flush bowl once a week during the heating season.

Schematic Wiring No. 64



Electrical Ratings:

(Underwriters Listed)

AMPERE RATING

Motor Duty	115 V.A.C.	230 V.A.C.
Full Load	7.4	3.7
Locked Rotor	44.4	22.2

PILOT DUTY
115 or 230 V.D.C.-57.5 VA
115 or 230 V.A.C.-125 VA

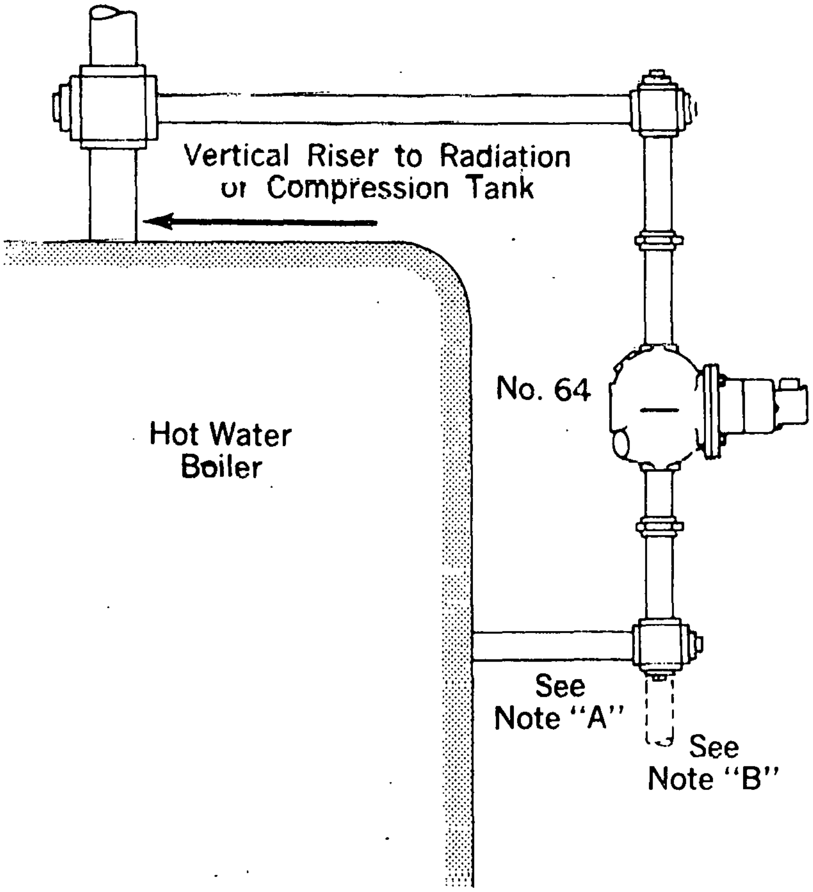
McDONNELL & MILLER ITT
3500 N. Spaulding Avenue, Chicago, Illinois 60618
Tel: (312) 267-1600

Bulletin No. I-64A
Printed in U.S.A.

INSTALLATION DETAILS
McDONNELL No. 64 Low Water Cut-off on Hot Water Boilers

(Maximum Boiler or Body Pressure 50 psi)

For either cast iron or steel hot water heating boilers, McDonnell No. 64 Low Water Cut-offs can easily be installed with 1" piping by following one of the drawings and instructions on this page. The purpose of the No. 64 is to stop the burner in event of a low water condition. Therefore any location of the No. 64 above the lowest safe water level established by the boiler manufacturer is suitable.

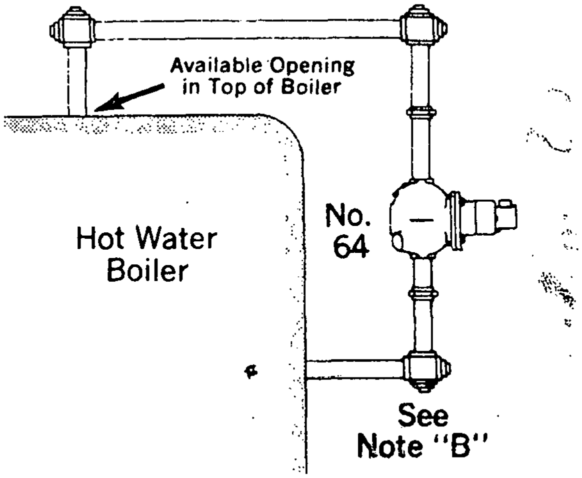


Connect the upper equalizing pipe to the riser going to the radiation or to the compression tank.

Connect the lower equalizing pipe to any available opening in the side of the boiler.

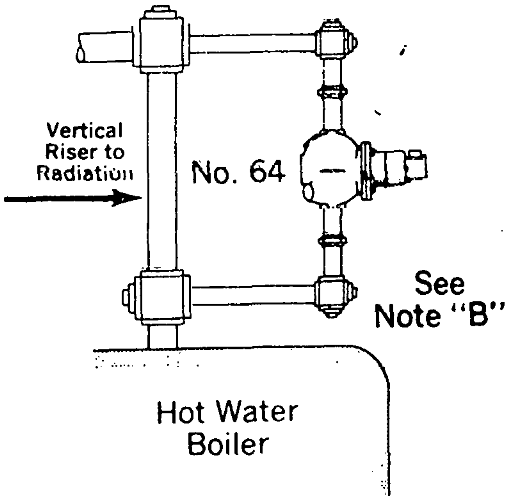
Note "A" — If no opening is available in the side of the boiler, connect the lower equalizing pipe into a tee at the drain connection, or into the return line.

Note "B" — Where it is necessary to drain the equalizing piping and float chamber, a drain valve may be installed in a vertical pipe below the lower equalizing piping cross connection.



An alternate method of installation is to connect the upper equalizing pipe into an available opening in the top of the boiler as indicated in the above drawing.

Caution — If this method is used, the No. 64 should be installed below the top of the boiler as shown. If the No. 64 is located above the top of the boiler an air pocket will be created; the cut-off will stay in the "off" position and the burner will remain "off." An air vent must be installed at the top of the upper vertical equalizing pipe to eliminate the air pocket.



Still another alternate method of installation is to connect the upper and lower equalizing pipes into the riser supplying the radiation.

Caution— The horizontal upper equalizing pipe should not be above the horizontal run of the riser. If such an installation should be made, an air pocket will be created, and an air vent would be required to eliminate the air.

For wiring diagram and electrical ratings see other side.

R. A. BEHRMANN and ASSOCIATES, INC.

Manufacturers' Agents

HEATING – AIR CONDITIONING – SOLAR PRODUCTS

631-4400 AREA CODE 314
4173 HOFFMEISTER AVE.
ST. LOUIS, MISSOURI 63125

January 5, 1978

SUBMITTAL

JOB: Stephens College Visitors Center
Columbia, Missouri

ENGINEER: Lewis D. Freedland
Minnespolis, Minnesota

CONTRACTOR: Drummond Officer Mechanical Contractors
Columbia, Missouri

SUBMITTED BY: Riback Supply Co.
Columbia, Missouri

Quantity	Description
1	Weil-McLain EGH-105-W Natural Gas Fired Hot Water Boiler. Submittal S-5511-A.
	Schematic Wiring Diagram No. SWD-5511-A
	Gas Train Piping Diagram No. GPD-5511-A

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR
CONTRACT DOCUMENTS DETAILS OR QUANTITIES
DATE 3/6/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

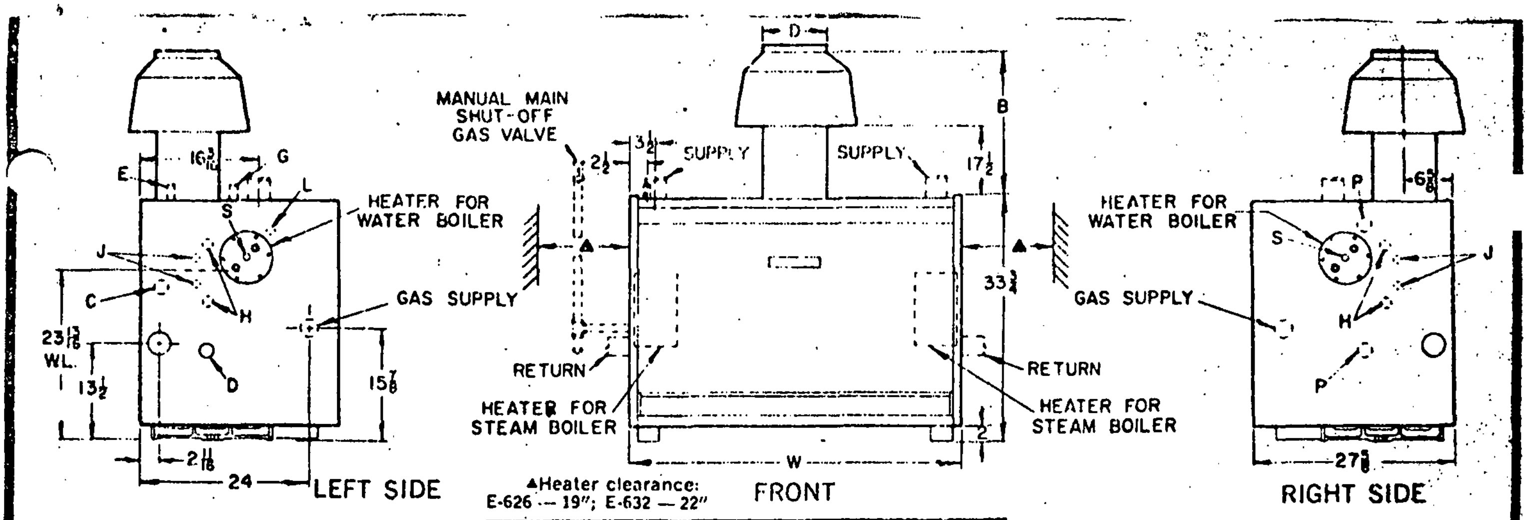
SPECIALISTS IN HYDRONIC – STEAM [illegible] AIR EQUIPMENT

ABSORPTION COOLING
AIR CONDITIONING UNITS
GAS AND ELECTRIC
BASEBOARD RADIATION
CAST IRON & COPPER

WATER TREATMENT
BOILERS-STEEL & CAST IRON
CIRCULATORS-HOT WATER
CONVECTORS
WATER HEATERS

CONVERTORS
SOLAR SYSTEMS
FAN & COIL UNITS
EXPANSION TANKS
UNIT HEATERS-ALL TYPES

SPECIALTIES-HOT WATER
RADIATORS-CAST IRON
PUMPS, CENTRIFUGAL
FIN TUBE-COMMERCIAL
HEAT EXCHANGERS



▲Heater clearance: E-626 — 19"; E-632 — 22"

EGH GAS BOILERS

DIMENSIONS		
B	D	W
30-3/32	10	46-3/4

TYPE OF GAS	INLET GAS PRESSURE REQUIRED INCHES W.C.	GAS BURNER MANIFOLD PRESSURE INCHES W.C.	A.G.A. INPUT M.B.H.	A.G.A. GROSS OUTPUT M.B.H.	NET I=B=R RATINGS	
					SQUARE FEET STEAM	WATER M.B.H.
Natural	7.0	3.5	450	360	--	313.0

NET SQUARE FEET WATER	BOILER H.P.	A.S.M.E. WORKING PRESSURE P.S.I.G.	SUPPLY OUTLETS NUMBER & SIZE	RETURN INLETS NUMBER & SIZE	DRAFT HOOD OUTLETS NO. & SIZE	MINIMUM CHIMNEY & BREECHING SIZE
2,085	10.8	30	Two 3"	Two 2½"	One 10"	10" I.D. (Min.)

DESCRIPTION	QTY.	MANUFACTURER	PART NO.
Electronic Control System, including:	1	Weil-McLain	
Prewired Control Panel	1	Weil-McLain	
Flame Safeguard Control	1	Honeywell	RA890F
Flame Safeguard Control Mounting Base	1	Honeywell	Q270A
Electric Pilot Burner w/Ignition Electrode and Flame Rod	1	Honeywell	Q179C
Ignition Transformer, 120/6,000 Volt	1	Honeywell	
Flame Rod Wire	8 Ft.	Thermo Wire Co.	20XE 7/28
Ignition Cable	7 Ft.	Electric Auto. Lite	PN100474
Cobination Pilot Solenoid Gas Valve and Pressure Regulator, 1/4" N.P.T.	1	Maxitrol	C400Y
Fuse Holder	1	Bussman	HKP-HH
Fuse, 15 Amp.	1	Bussman	MTH-6
Indicating Lamps:	4	Weil-McLain	
1. Power On - White			
2. Ignition On - Yellow			
3. Gas Valve on - Blue			
4. Flame Failure - Red			
Terminal Block	1	Curtis Company	Type WT

BOILER NO. JOB	EGH-105-W Stephens College Visitor Center Columbia, Missouri	WEIL-McLAIN HYDRONIC DIVISION MICHIGAN CITY INDIANA
DATE	December 28, 1977	No. S-5511-A

Form MCL-3202-8/75 1M

Sheet 2 of 2

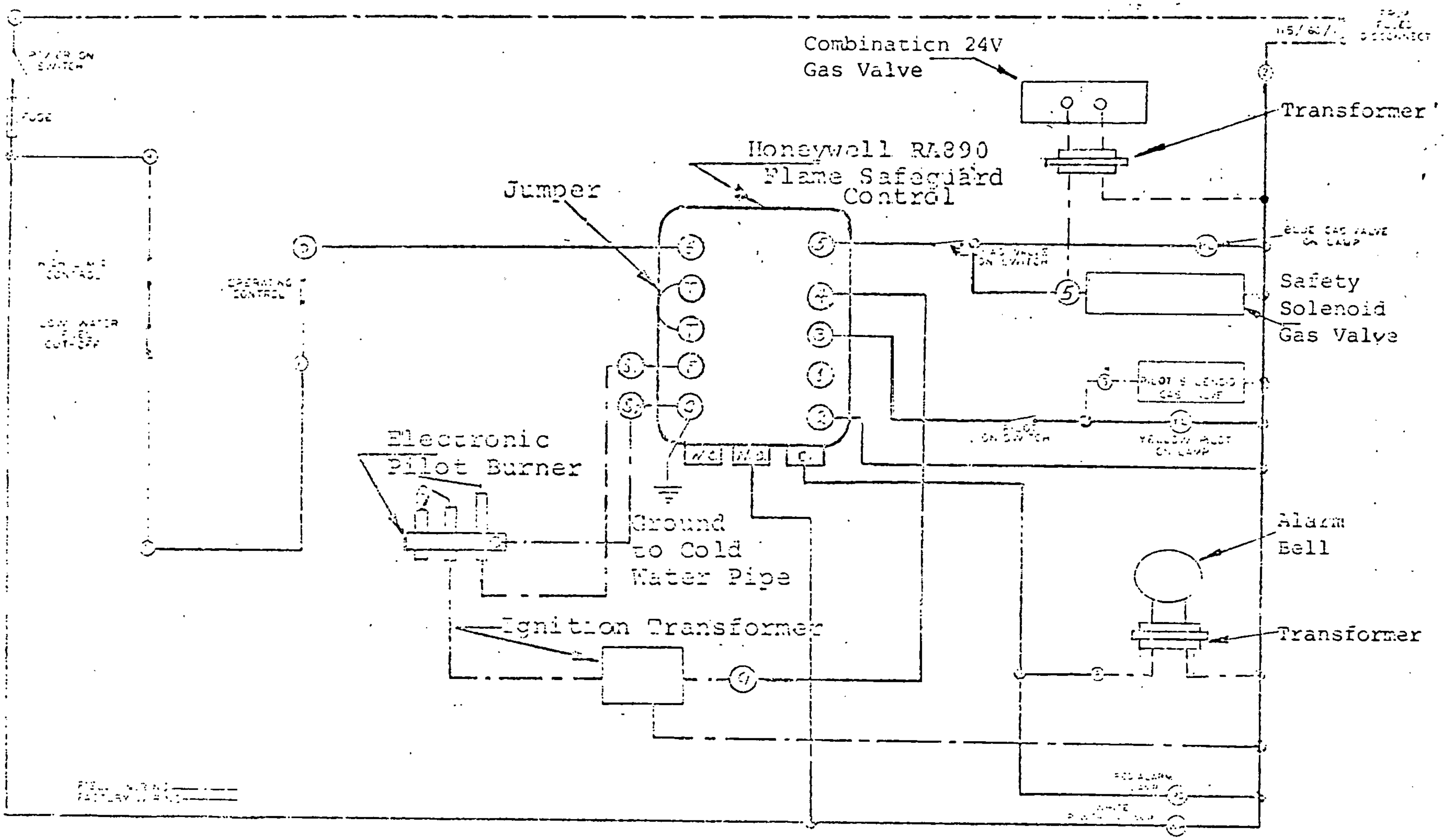
DESCRIPTION	QTY.	MANUFACTURER	PART NO.
Toggle Switch, SPST	3	McGill Mfg. Co.	3190-0003
ASME Pressure Relief Valve (set to relieve at 30 PSIG), 3/4"	1	Watts	330
Compound-Pressure-Temperature-Gauge (0-100 PSIG, 40°F.-270°F., 4½" Dial).	1	Marshalltown	Fig. 117
High Temperature Limit Control	1	White-Rodgers	11C19
Low Water Cut-Off	1	McDonnell-Miller	No. 64
Combination Gas Control Valve, including Automatic Gas Valve, Three Position Manual Gas Cock Knob, Gas Pressure Regulator, Pilot Filter, Pilot Adjustment, and Pilot Shut-Off, 1" x 1"	1	Robertshaw	7000ERHC
Thermocouple, 48"	1	Honeywell	Q309A
Safety Pilot Burner (Thermally Supervised)	1	Honeywell	Q337
Control Transformer, 120/24 Volt, 40VA	1	Basler	E-8982-AC-D46
Alarm Bell and Transformer	1	Faraday	504/9214
Safety Solenoid Gas Valve, 1" N.P.T., 120 Volt	1	General Controls	K3A

NOTES;
1. Control system complies with factory mutual requirements for "Standard Risk Installations".
2. Alarm bell to ring for flame failure.

Agent: R. A. Behrmann & Assoc., Inc.
St. Louis, Missouri
Re: P. O. No. 2390
Contractor: Drummond Officer Mech. Co.

No. S-5511-A

Date: December 29, 1977



NOTES: (1) ALL WIRING MUST BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE AND ANY ADDITIONAL NATIONAL, STATE, OR LOCAL CODE REQUIREMENTS HAVING JURISDICTION.

(2) ALL SAFETY CIRCUIT WIRING MUST BE N.E.C. CLASS 1.

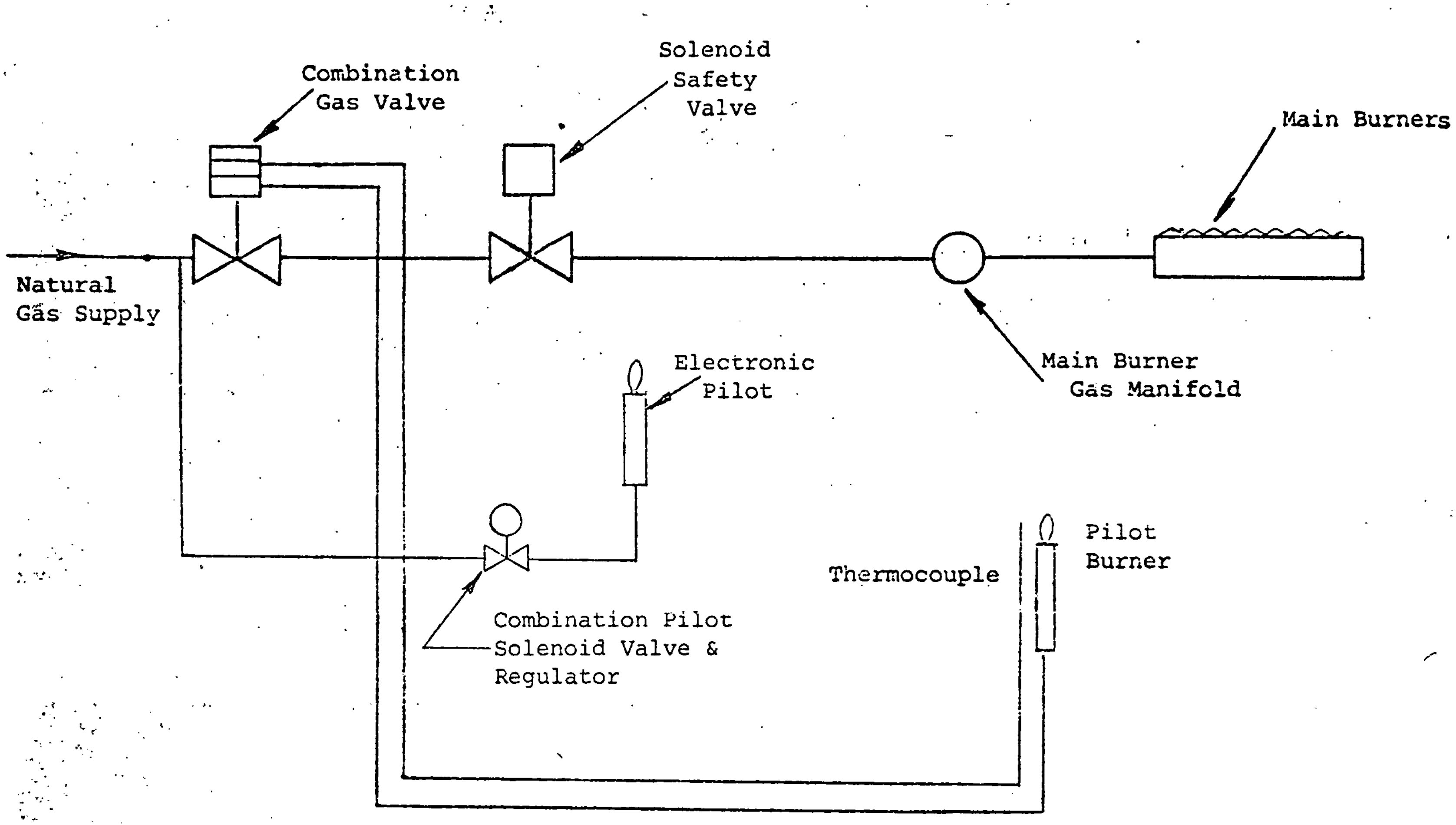
JOB: Stephens College Visitor Center
Columbia, Missouri
AGENT; R. A. Behrmann & Assoc., Inc.
St. Louis, Missouri
CONTRACTOR; Drummond Officer Mech. Cont.

SCHEMATIC WIRING DIAGRAM FOR EGH-105-W NATURAL GAS-FIRED BOILER EQUIPPED WITH SPECIAL CONTROLS.

DATE: December 28, 1977

DWN: WKN WKN | CKD: ALA | APP: VV | NO. SWD-5511-A

MICHIGAN CITY INDIANA



SCHEMATIC GAS PIPING DIAGRAM

NOTES:
1. Refer to Submittal Record No. S-5511-A for size and part numbers of gas controls.
2. Inlet gas pressure to be 7" W.C. to 14" W.C.

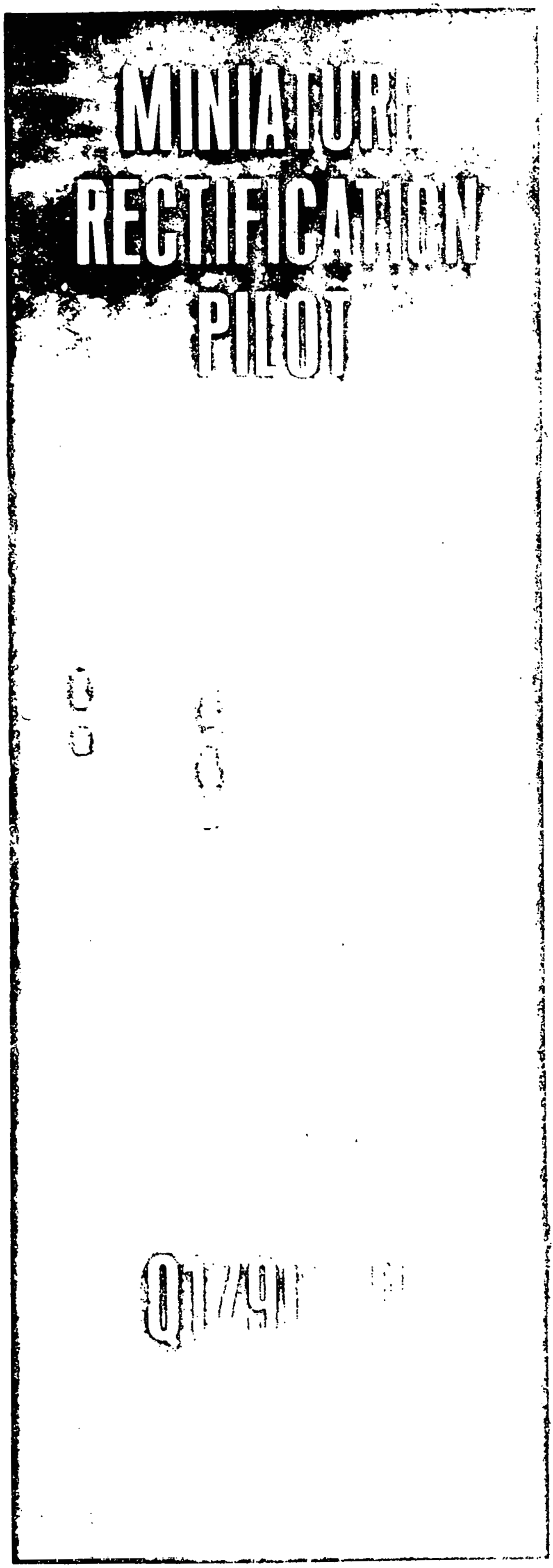
DATE: December 28, 1977
DRAWN: WKN WKN
APPROVED: ND
WEIL-McLAIN
No. GPD-5511-A
BOILER: EGH-105-W
JOB: Stephens College Visitor Center
Columbia, Missouri

Honeywell

THESE GAS PILOT BURNER ASSEMBLIES PROVE THE PILOT FLAME ON INDUSTRIAL OR COMMERCIAL GAS OR GAS PILOT IGNITED OIL BURNERS.

- Utilize the flame rectification principle.
- Q179C is a combination pilot burner and rectifying flame rod flame detector. It also includes an ignition electrode, making it suitable for applications requiring interrupted or intermittent electrically ignited gas pilot.
- Q179C may be used with Q624 solid state spark generator or other suitable ignition transformer.
- Q179D has a thermocouple adapter in place of the ignition electrode and is suitable for use on continuous (standing pilot) burning pilot applications.
- Q179D may be used with a Q309 or Q340 thermocouple or Q313 thermopile generator.
- Primary aerated type burner equipped with a stainless steel target to stabilize the flame and provide correct flame rod area to ground area ratio for maximum flame current.
- Kanthal electrode(s) are mounted in ceramic insulators.
- Side or end mounting brackets available.
- Dual and single wing burner targets are available.
- The Q179C and D are functional replacements for the Q179A and B, respectively.
- Flame rod, ignition electrode, and their insulators are factory installed and adjusted for proper operation. No field adjustment required.

J.B.
REV. 8-77 (.03)



MODELS:

Q179C Miniature Rectification Pilot. Includes ignition electrode for intermittent or interrupted ignition applications; use with Q624 solid state spark generator or other suitable ignition transformer. Includes natural gas orifice.

Q179D Miniature Rectification Pilot. Thermocouple adapter is furnished in place of ignition electrode for use with Q309 or Q340 thermocouple or Q313 thermopile in continuous pilot applications. Includes natural gas orifice.

MOUNTING: See Fig. 1 for mounting options and burner target configurations. See Fig. 2 for mounting dimensions.

BURNER: Primary aerated. Stainless steel target provides correct flame ground. Correctly positioned flame electrode (and ignition electrode with Q179C) are furnished with each burner. The pilot burner has 3 target configurations–dual wing, single wing right-hand, and single wing left-hand (Fig. 1). Single wing targets are for use with Q179C only.

TARGET WINGSPAN: Single wing–13/16 inch [20.6 mm]; Dual wing–1 inch [25.4 mm], except 2 inches [50.8 mm] on Q179C1074 and Q179D1032.

TYPE OF GAS: Natural; for LP gas order LP orifice separately (see Accessories).

NATURAL GAS ORIFICE SIZE: .026 inch [.66 mm] diameter for dual wing target or .024 inch [.61 mm] diameter for single wing target.

ELECTRODE(S): Kanthal.

ELECTRODE INSULATOR(S): Ceramic.

MOUNTING DIMENSIONS: See Fig. 2.

UNDERWRITERS LABORATORIES INC. COMPONENT RECOGNIZED: File No. MH9928, Guide No. MCUR2.

CANADIAN STANDARDS ASSOCIATION CERTIFIED: File No. LR29652; Guide No. 140-A-2.

AMERICAN GAS ASSOCIATION DESIGN CERTIFIED: Report No. G-140-1-4.

THERMAL RATING: See Fig. 3.

INLET FITTINGS: 1/4 inch compression coupling factory-installed on all models. For other available fittings, see Accessories.

THERMOCOUPLE FOR Q179D: Order a Q309 or Q340 thermocouple or Q313 thermopile. Screw thermocouple or thermopile into adapter, using attachment nut with thermocouple or thermopile.

REPLACEMENT PARTS:

Orifices–

Part No. 388146AF, for natural gas single wing target, .024 inch [.61 mm] diameter.

Part No. 388146AG, for natural gas double wing target, .026 inch [.65 mm] diameter.

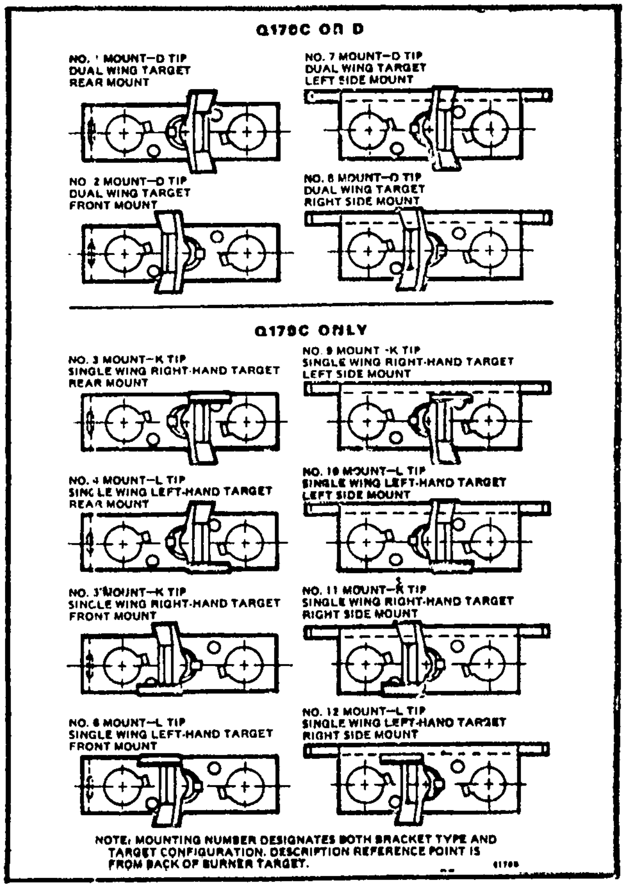


FIG. 1–MOUNTING OPTIONS AND BURNER TARGET CONFIGURATIONS.

(continued on page 3)

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–

1. **MODEL NUMBER.**
2. **TYPE OF BURNER TARGET AND MOUNT BY MOUNT NUMBER.**
3. **Q309 OR Q340 THERMOCOUPLE OR Q313 THERMOPILE FOR Q179D.**
4. **ACCESSORIES, 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.

ACCESSORIES:

High Temperature Cable—over 125 F [52 C].

Flame rod lead—Part No. R1298020 (specify length), rated at 400 F [204 C].

Ignition lead—Part No. R1061012 (specify length), rated at 350 F [177 C].

LP Orifice—for both single and dual wing burner targets. Part No. 388146KD, .016 inch [.41 mm] diameter.

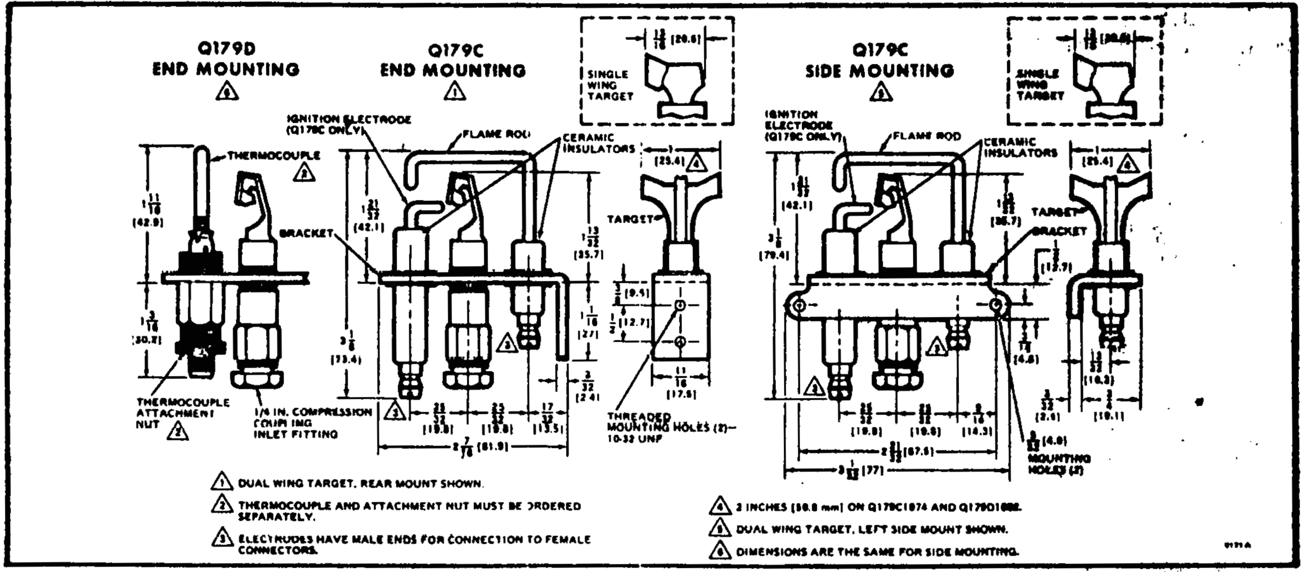
Electrode Connectors—must be ordered separately.

Straight or right angle spark plug type electrode connectors can be obtained at any automotive store (2 required).

Part No. 37356, female Rajah connector can be used as alternate (2 required).

Bleed Burner Clip—

Part No. 389860-2. Two installation holes provided on mounting bracket.



1 DUAL WING TARGET, REAR MOUNT SHOWN.

2 THERMOCOUPLE AND ATTACHMENT NUT MUST BE ORDERED SEPARATELY.

3 ELECTRODES HAVE MALE ENDS FOR CONNECTION TO FEMALE CONNECTORS.

4 2 INCHES [50.8 mm] ON Q179C1074 AND Q179D1032.

5 DUAL WING TARGET, LEFT SIDE MOUNT SHOWN.

6 DIMENSIONS ARE THE SAME FOR SIDE MOUNTING.

FIG. 2—APPROXIMATE MOUNTING DIMENSIONS, IN INCHES [MILLIMETRES IN BRACKETS], AND ARRANGEMENT OF PARTS.

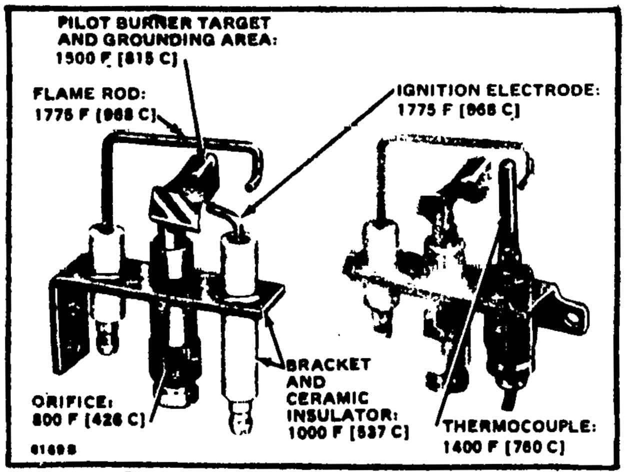


FIG. 3—MAXIMUM TEMPERATURES.

NOTE: All models have an identification number (not O.S. number) stamped in the bracket to indicate (1) model number, (2) burner tip style, (3) mounting bracket style, and (4) date code. The following complete Ordering Specification numbers cross reference to the metal-stamped identification numbers on the devices.

O.S. NUMBER	IDENTIFICATION NUMBER[a]		
Q179C1009	Q179C	D1	XXX
Q179C1017	Q179C	K3	XXX
Q179C1025	Q179C	L4	XXX
Q179C1033	Q179C	D7	XXX
Q179C1041	Q179C	D8	XXX
Q179C1058	Q179C	L10	XXX
Q179C1066	Q179C	K11	XXX
Q179C1074[b]	Q179C	D1	XXX
Q179D1008	Q179D	D1	XXX
Q179D1016	Q179D	D7	XXX
Q179D1024	Q179D	D8	XXX
Q179D1032[b]	Q179D	D1	XXX

[a] XXX will be the date code.

[b] With 2 inch [50.8 mm] wingspan dual wing target.

CAUTION

1. Installer must be a trained, experienced serviceman.
2. Turn off gas supply before installing Q179.
3. Disconnect power supply to flame safeguard relay before beginning installation.
4. Conduct a thorough checkout when installation is completed.

Follow instructions provided by burner manufacturer if available. If no instructions are furnished, use the following recommendations.

MOUNTING

The Q179 side and end mounting brackets have 2 holes for mounting. These 2 holes are threaded in the end mounting bracket to accept 10-32 UNF screws. (Screws not furnished.)

The pilot must be mounted rigidly in an upright or nearly upright position. Tilt from vertical must not exceed 15 degrees. The pilot should be positioned where it will ignite the main burner under all normal pressures and ambient conditions.

All models come with a factory-installed 1/4 inch compression coupling inlet fitting.

GAS PRESSURE REGULATION

Use a pressure regulator in the line supplying the Q179 pilot. Do not exceed a maximum gas pressure of 8 inch water column. The minimum gas pressure must be 2 inch water column to assure reliable lightoff of the main flame.

INSTALL THE Q179

Install the pilot so pilot flame has full contact with the gas stream from the main burner heads or jets. The pilot should fire in the same direction as the draft at the mounting point, rather than at right angles to the draft. Keep the pilot burner below or behind the main burner so that the burner frame and refractory will help protect the pilot from radiant heat. Location of the pilot in the secondary airstream will also provide considerable cooling.

CAUTION

The flame rod, ignition electrode and their insulators are NOT field adjustable. Any attempt at adjustment may result in cracked insulators which will require complete pilot burner changeout.

DO NOT INSTALL THE Q179–

- –where ambient temperatures exceed those specified.
- –where excessive draft turbulence may bend the pilot flame away from the main burner or flame electrode.
- –where the ignition electrode is within arcing distance of any metal other than the pilot burner target.
- –where the flame electrode contacts any metal part of the installation.
- –where the flame electrode is closer than 1 inch [25.4 mm] from a radiant refractory.

INSTALL THERMOCOUPLE OR THERMOPILE (Q179D)

Screw thermocouple or thermopile into thermocouple adapter and tighten (Fig. 4).

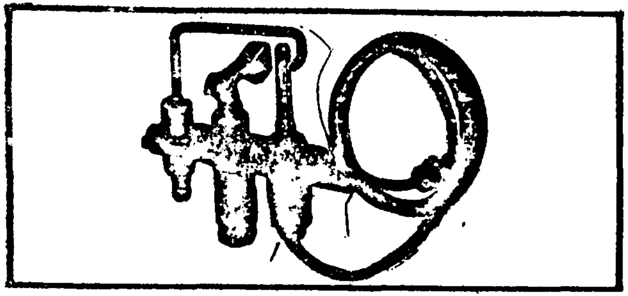


FIG. 4—THERMOCOUPLE INSTALLED ON Q179D.

WIRING

CAUTION

Disconnect power supply before connecting wiring to prevent electrical shock or equipment damage.

All wiring must comply with applicable codes and ordinances.

High tension wire, of a type found acceptable by a nationally recognized testing agency, must be used for the wiring to the ignition electrode. High tension wires should be rated electrically equivalent to type GTO-10 and should be good for the temperature and humidity encountered in the application. If the ignition lead is exposed to high temperature, 125 F [52 C], use Honeywell ignition cable, rated at 350 F [177 C], or equivalent. See Accessories.

For wiring between the "F" terminal of the flame safeguard primary and the flame electrode, use wire with moisture-resistant insulation. Number 14 single-conductor TW wire is adequate. However, those portions of the leadwire exposed to temperatures over 125 F [52 C] should also be heat-resistant. For both heat- and moisture-resistant applications, use Part No. R1298020 Cable (rated at 400 F [204 C] continuous duty), or equivalent.

Run a ground wire from the pilot burner to the relay to assure a continuous, unchanging ground. Run ground wire from pilot burner bracket to "G" terminal on flame safeguard primary. Do not rely on the pilot gas line for adequate ground connection.

[illegible]

If draft conditions are severe, it may be necessary to install a sheet metal baffle to reduce excess draft turbulence at the pilot flame.

Check to insure that the main valve opens only when pilot flame is strong enough to ignite main burner.

Be sure you have the proper orifice for the gas being used so the pilot burns with a medium hard flame. A medium hard flame will produce the best signal in the flame detector circuit.

The flame detector relay may pull in and drop out if excess secondary air velocity or a severe draft condition causes the pilot flame to make unstable contact with the flame electrode or target.

Current through flame electrode and flame should be 1.5 microamperes or more for stable performance. This is less than previously expected 2 μA signal, but 1.5 μA is more than adequate if signal is steady. The open circuit output of Q309 or Q340 thermocouple should be at least 18 mV at 2.5 inch water column.

If a strong steady flame signal can't be obtained for proper primary flame safeguard operation, check the following:

Cracked insulators.
Loose or bad connections.
Improper burner grounding.
Incorrect wire type.
Wet or damp wire insulation to flame rod.
Insufficient combustion air.
Gusts or drafts across burner target.
Incorrect gas pressure.

HONEYWELL MINNEAPOLIS, MINN. 55408 INTERNATIONAL Sales Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.
PRINTED IN U.S.A.

ATTENTION HEATING CONTRACTOR: This warranty is for the building owner and should be given to him or placed in sight near the boiler.

Date Installed – [illegible] 10, 1978

Stephens [illegible] Center

Model [illegible] – 105

Ser #

WEIL-McLAIN

A Division of Wylain, Inc.

Michigan City, Indiana 46360

Limited Warranty

Weil-McLain warrants that its cast iron boilers are free from defects in materials and workmanship for one year after installation only, and only to the extent of furnishing new parts for any found to be defective in manufacture.

This warranty does not cover:

1. Components that are part of the heating system but were not furnished by Weil-McLain as a part of the product.
2. The workmanship of any installer of Weil-McLain cast iron boilers. In addition, this warranty does not assume any liability of any nature for unsatisfactory performance caused by improper installation. The boiler must have been installed by a heating contractor whose principal occupation is the sale and installation of plumbing, heating and/or air conditioning equipment.
3. Any costs for labor for removal and re-installation of the alleged defective part, transportation to Weil-McLain if necessary, and any other materials necessary to perform the exchange.
4. Improper burner adjustments, control settings, care, or maintenance. Information is included in the Installation Instructions, Start-Up, Service and Maintenance Instructions, and other printed technical material furnished by Weil-McLain with the boiler.

This warranty does not extend to anyone except the first purchaser at retail, and only when the boiler is in the original installation site.

IMPLIED WARRANTIES FOR PARTICULAR PURPOSE AND MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THE EXPRESS WARRANTY. MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY.

Some states do not allow the exclusion of limitation of incidental or consequential damages, so the above limitations may not apply to you.

For prompt warranty service, notify the installer who, in turn, will notify the Weil-McLain distributor from whom he purchased the boiler. If this action does not result in warranty service, contact Weil-McLain Customer Services Department, Blaine Street, Michigan City, Indiana 46360 with details in support of the warranty claim. Alleged defective part or parts must be returned through trade channels in accordance with the Weil-McLain procedure currently in force for handling returned goods for the purpose of inspection to determine cause of failure. Weil-McLain will furnish the new part(s) to an authorized Weil-McLain distributor who, in turn, will furnish the part(s) to the heating contractor who installed the boiler. If you have any questions about the coverage of this warranty, contact Weil McLain at the address below.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WEIL-McLAIN

A Division of Wylain, Inc.
Customer Services Department
Blaine Street
Michigan City, Indiana 46360

Form MC-3299(677)

STERLING SUBMITTAL AND INSTALLATION SCHEDULE

STERLING RADIATOR CO., INC. - 260 NORTH ELM STREET, WESTFIELD, MASSACHUSETTS 01085

DESIGN CONDITIONS

SEE ATTACHED CATALOG FOR SPECIFICATIONS & DIMENSIONS

AVG. WATER TEMP. 180°F

STEAM PRESSURE ______

ENTERING AIR 65°

PRIME COAT TO BE PAINTED IN FIELD BY OTHERS.

PROJECT Visitors Center, Stephens Colleg

LOCATION Columbia, Missouri

REPRESENTATIVE MESA, Inc., St. Louis, Missouri

ARCHITECT Sovrik, Mathre, Sathrum, Guanbecic

ENGINEER Lewis A. Freedland, Minneapolis, Minn.

CONTRACTOR Drummond-Officer Mechanical Contr.

PREPARED BY SWS DATE 1/23/78 PAGE 1 OF 2

ELEMENT .020 GAUGE							HANGERS				BACKS		COVER 16 GAUGE					ACCESSORIES *			
Room Number	Catalog Number	Quantity	TOTAL ELEMENT LENGTH	MBH REQUIRED	M.B.H. Furnished	ELEMENT Lengths	Brackets	Ball Bearing Hangers			Partial Backplate		JVA-S-11 ARR'T. Style	TOTAL LENGTH	Enclosures: 11" slope top 16 ga. fronts, 20 ga. partial backs with knob operated dampers. Sealer gasket. TO BE FIELD MEASURED.		Damper	NO ACCESS DOORS 4" WS	3" LEC	3" REC	
108A	C-35	1	21'0	20.9	21.4	12'-9'	14	14					W-W	44'4"	4 pcs. 7'0", 1 pc. 6'0" =34??			2			
108B	"	1	21'0	20.9	21.4	12'-9'	14	14					W-W	44'4"	4 pcs. 7'0", 1 pc. 6'0" =34??			2			
105	"	1	3'6	3.3	3.6	3'6"	4	4			FURNISHED IN 8'0" LENGTHS		W-W	9'6"	5'-4'			2			
103	"	1	4'0"	3.7	4.1	4'0"	4	4					W-W	9'6"	5'-4'			2			
101	"	1	3'6"	3.3	3.6	3'6"	4	4					W-W	9'6"	5'-4'			2			
114	"	1	10'0	9.8	10.2	10'0"	5	5					W-W	14'0"	7'-6'6"		ALL WITH DAMPERS	2			
300	"	1	2'6"	2.2	2.6	2'6"	2	2					W-E	5'0"	5'			1	1		

C-35 ELEMENT: 1" copper tube, 3¼" x 3¼" aluminum fins, 50 fins/ft.

1020 BTU LF @ 180° AWT

REC - R. H. End	RWS - R. H. Wall Sleeve (specify width)	RVC - R. H. Valve Compartment	IC - Inside Corner
LEC - L. H. End	IWS - Intermediate W/S (specify width)	CVC - Centervalve Compartment	OC - Outside Corner
RECD - R. H. End w/ad	LWS - L. H. Wall Sleeve (specify width)	LVC - L. H. Valve Compartment	CC - Column Cover
LECD - L. H. End w/ad	RWSD - R. H. Wall Sleeve w/ad (3 3/8" wide)	RWSS - R. H. Wall Sleeve Support	(specify dimensions)

STERLING SUBMITTAL AND INSTALLATION SCHEDULE

STERLING RADIATOR CO., INC. - 260 NORTH ELM STREET, WESTFIELD, MASSACHUSETTS 01085

PROJECT Visitors Center, Stephens College
LOCATION Columbia, Missouri
REPRESENTATIVE MESA, Inc., St. Louis, Missouri
ARCHITECT Sovrik, Mathre, Sathrum, Guanbecic
ENGINEER Lewis A. Freedland, Minneapolis, Minn.
CONTRACTOR Drummond-Officer Mechanical Contr.
PREPARED BY SWS DATE 1/23/78 PAGE 1 OF 2

DESIGN CONDITIONS

SEE ATTACHED CATALOG FOR SPECIFICATIONS & DIMENSIONS
AVG. WATER TEMP. 180°F
STEAM PRESSURE
ENTERING AIR 65°

PRIME COAT, TO BE PAINTED IN FIELD BY OTHERS.

238

ELEMENT .020 GAUGE							HANGERS		BACKS	COVER 16 GAUGE				ACCESSORIES * NO ACCESS DOORS		
Room Number	Catalog Number	Quantity	TOTAL ELEMENT LENGTH	MBH REQUIRED	M.B.H. Furnished	ELEMENT Lengths	Brackets	Ball Bearing Hangers	Partial Backplate	JVA-S-11 ARR'T Style	TOTAL LENGTH	Enclosures: 11" slope top 16 ga. fronts, 20 ga. partial backs with knob operated dampers. Sealer gasket. TO BE FIELD MEASURED.	Damper	4" WS	3" LEC	3" REC
11	C-35	1	1'0"	.9	1.0	1'0"	3	3	FURNISHED IN 8'0" LENGTHS	W-W	8'4"	8'0"	ALL WITH DAMPERS	2		
13	"	1	3'6"	3.5	3.6	3'6"	5	5		E-W	14'0"	7'0" - 6'0"		1	1	
14	"	1	1'6"	1.1	1.6	1'6"	2	2		E-E	5'0"	5'0"			1	1
15	"	1	1'0"	.5	1.0	1'0"	2	2		E-E	2'3"	2'0"			1	1
19	"	1	34'0	34.	34.6	12'-12'-10'	14	14		W-W	44'4"	4 pcs. 7'0", 1 pc. 6'0"		2		
19	"	1	16'0	16	16.3	8'-8'	12	12		W-W	29'6"	1 pc. 8'0", 3 pcs. 7'0"		2		
18	"	1	11'0"	10.7	11.2	11'	9	9		W-W	24'6	3 pcs. 8'0"		2		
17	"	1	5'0"	4.6	5.1	5'0"	4	4		W-W	8'9"	5'0" - 3'6"		2		
16	"	1	4'6"	4.4	4.6	4'6"	4	4		W-W	9'0"	5'0" - 3'6"		2		
102	"	1	4'6"	4.5	4.6	4'6"	4	4		W-W	9'6"	5'0" - 4'0"		2		
104	"	1	5'0"	5.0	5.1	5'0"	4	4		W-W	9'6"	5'0" - 4'0"		2		
106	"	1	4'6"	4.5	4.6	4'6"	4	4		W-W	9'6"	5'0"-4'0"		2		

CONTINUED ON PAGE TWO

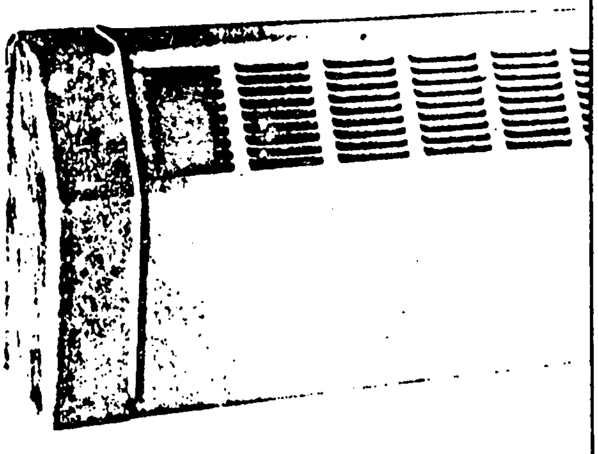
Checked: KD
Date: 1-30-78
Sealer

APPROVED AS NOTED
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR CORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 3/6/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

KEY TO ACCESSORIES

REC - R. H. End
LEC - L. H. End
RECD - R. H. End w/ad
LECD - L. H. End w/ad
RWS - R. H. Wall Sleeve (specify width)
IWS - Intermediate W/S (specify width)
LWS - L. H. Wall Sleeve (specify width)
RWSD - R. H. Wall Sleeve w/ad (8 3/8" wide)
RVC - R. H. Valve Compartment
CVC - Centervalve Compartment
LVC - L. H. Valve Compartment
RWSS - R. H. Wall Sleeve Support
IC - Inside Corner
OC - Outside Corner
CC - Column Cover
(specify dimensions

VERSA-LINE finned-tube by STERLING®



SPECIFICATION

ENCLOSURE
STYLE — "S" Low Profile.
OUTLET — Slope — Louvered.
LENGHTS — 2', 3', 3'6", 4', 5', 6', 7', 7'6", 8'.
MATERIAL — ~~18 Gauge~~ C.R.S.
16 ~~& 14~~ Gauge ~~Available~~.

BACKPLATE
~~TYPE — Full~~
~~LENGTHS — 2', 3', 3'6", 4', 5', 6', 7', 7'6", 8'~~
TYPE — Partial
LENGTHS — 8' Only
MATERIAL — 20 Gauge C.R.S.
~~18 Gauge Full B/P Available~~

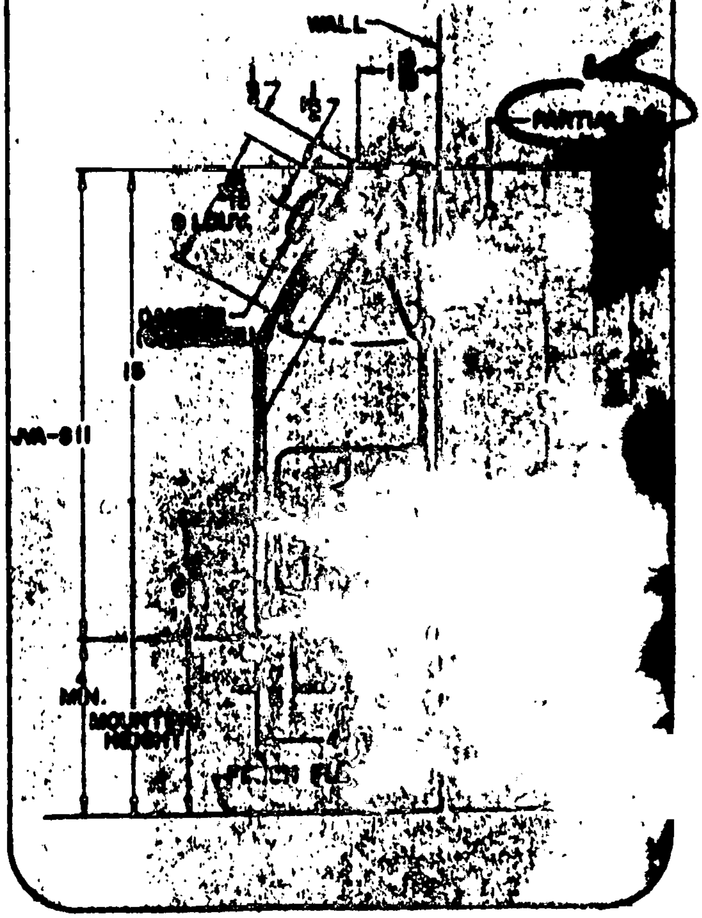
ELEMENT
LENGTHS — 1' to 12' ~~in 1" increments~~.
MATERIAL — Stl. or Cu./Alum. See Pg.
36 for working pressures.

HANGERS — Combination Hanger/Bracket with Cradle.

AIR SEAL — (~~Option~~al) Urethane Gasket.

DAMPER — (~~Optional~~) knob ~~or tamper proof~~.

ACCESSORIES — Shown on page 34



STYLE "S"
SLOPING TOP — LOW PROFILE
"J" TYPE

~~STEEL Elements~~
COPPER/ALUMINUM Elements

ELEMENT STEEL PRESS. TUBE STEEL FINS	ENCL' HGT.	TIERS AND CENTERS	MOUNTING HEIGHT	STEAM 215° FACTOR 1.0	HOT WATER						
					240° FACTOR 1.25	230° FACTOR 1.14	220° FACTOR 1.06	210° FACTOR .95	200° FACTOR .86	190° FACTOR .78	180° FACTOR .69
S-133 1¼" I.P.S. 3¼" FINS 32 FINS PER LIN. FT. FINS .024" THICK	11"	1	15"	920	1150	1050	970	870	790	720	640
S-134 1¼" I.P.S. 3¼" FINS 40 FINS PER LIN. FT. FINS .024" THICK	11"	1	15"	1120	1400	1280	1180	1060	960	870	770

ELEMENT COPPER TUBE ALUMINUM FINS FINS .020" THICK	ENCL' HGT.	TIERS AND CENTERS	MOUNTING HEIGHT	STEAM 215° FACTOR 1.00	HOT WATER						
					240° FACTOR 1.25	230° FACTOR 1.14	220° FACTOR 1.06	210° FACTOR .95	200° FACTOR .86	190° FACTOR .78	180° FACTOR .69
C-35 1" TUBE 3¼" FINS 50 FINS PER LIN. FT. FINS .020" THICK	11"	1	15"	1480	1850	1690	1550	1410	1270	1150	1020
C-135 1¼" TUBE 3¼" FINS 50 FINS PER LIN. FT. FINS .020" THICK	11"	1	15"	1390	1740	1590	1460	1320	1200	1080	960

When ordering elements specify fin thickness. Example: S-144 with .024" fins. • The ratings above include factors shown below for recommended mounting height. Two tier ratings are based on 6" spacing between elements. Ratings are in BTU per hour per lineal foot of active length. Active length is catalog ordering length less 5" on steel elements and 4" on copper elements. • The water ratings applicable to water flow rates of three or more feet per second have been determined by applying factors shown to steam ratings • Steel elements painted black. Copper elements unpainted. • If the unit is to be installed at a different height than that recommended, the rating must be adjusted as follows:

RATING MULTIPLIED BY:

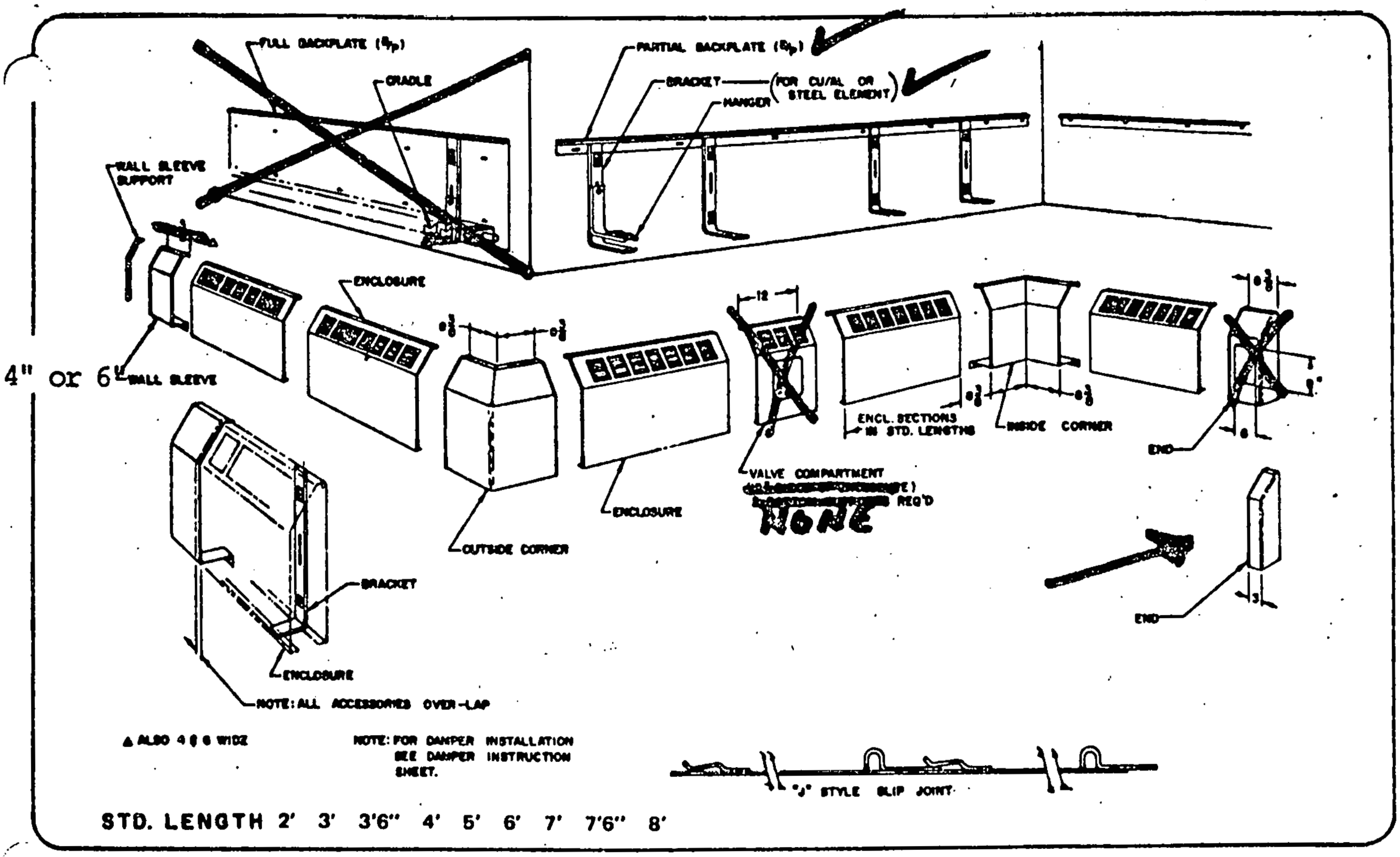
$$\frac{\text{FACTOR FROM TABLE B FOR THE ACTUAL MOUNTING HEIGHT}}{\text{FACTOR FROM TABLE B FOR THE RECOMMENDED MOUNTING HEIGHT}}$$

TABLE B

MOUNTING HGT. IN IN.	18 or less	19	20	21	22	23	24	25	26	27	28	29	30	32	34	36	38 or more
FACTOR 4¼" OFFSET	1.100	1.100	1.100	1.093	1.087	1.080	1.073	1.067	1.060	1.053	1.047	1.040	1.033	1.020	1.013	1.007	1.000
FACTOR 5¼" OFFSET	1.100	1.100	1.100	1.099	1.092	1.085	1.079	1.072	1.065	1.059	1.052	1.045	1.039	1.025	1.016	1.003	1.000

Enclosure Ordering Description "JV" VERSA LINE, "A" 3¼" Fin Size, "S" Sloping Top Enclosure, 11" (Enclosure Heights
EXAMPLE:JVA-S11 is VERSA LINE for 3¼" Fin Size, Sloping Enclosure 11" High.

STYLE S — SLOPING TOP INSTALLATION AND ACCESSORY DETAILS

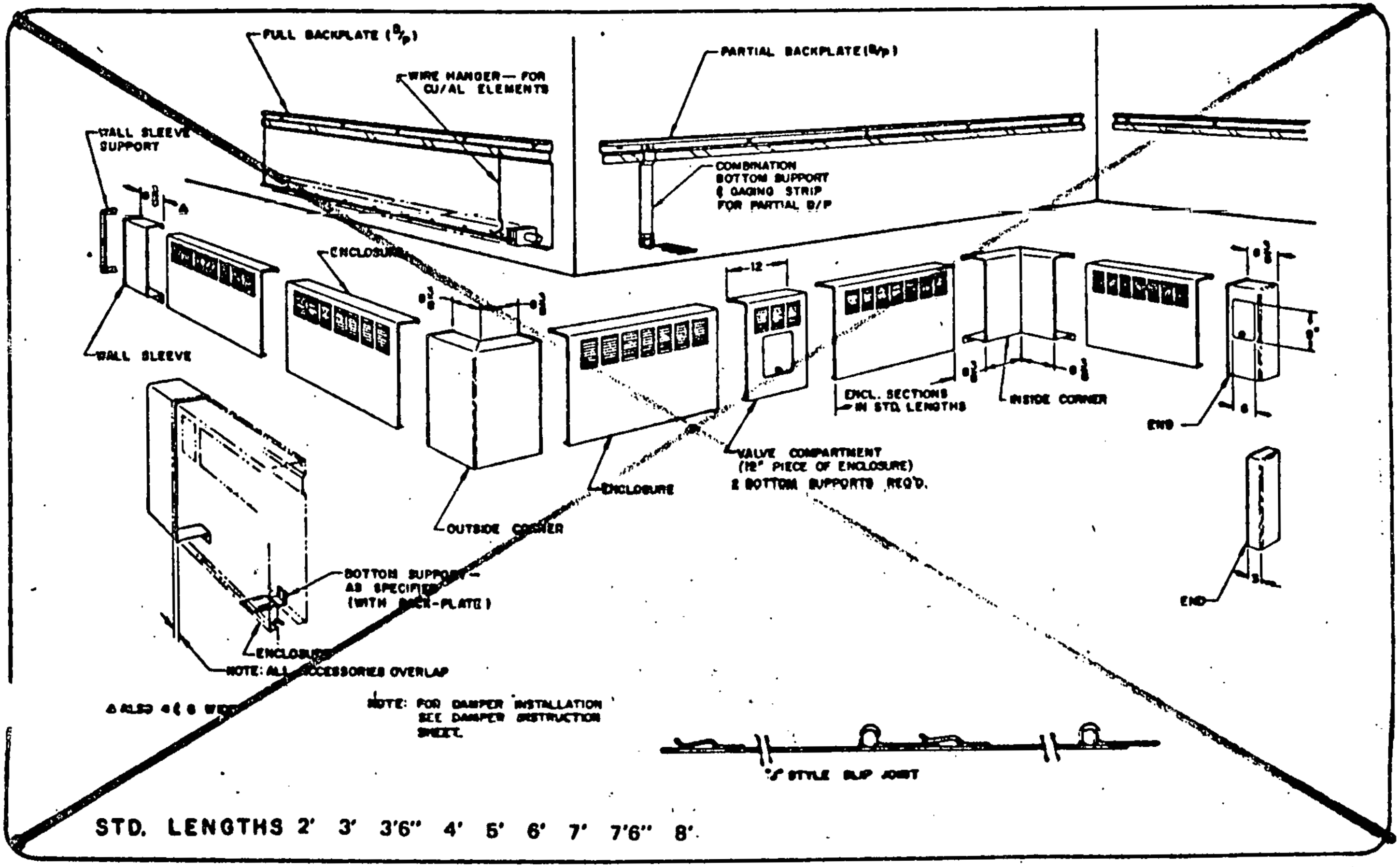


▲ ALSO 4 & 6 WIDE

NOTE: FOR DAMPER INSTALLATION SEE DAMPER INSTRUCTION SHEET.

STD. LENGTH 2' 3' 3'6" 4' 5' 6' 7' 7'6" 8'

STYLE F, T and FT INSTALLATION AND ACCESSORY DETAILS



▲ ALSO 4 & 6 WIDE

NOTE: FOR DAMPER INSTALLATION SEE DAMPER INSTRUCTION SHEET.

STD. LENGTHS 2' 3' 3'6" 4' 5' 6' 7' 7'6" 8'

10. AIR HANDLING UNITS, CONVECTOR, CABINET HEATERS, PURGE UNIT, CHILLER, CONDENSING UNIT, AND FAN COIL UNITS

TRANE SUBMITTAL DATA

ARCHITECT
Sovik, Mathre, Sathrum, Quanbeck

ENGINEER
Lewis D. Freeland

PROJECT AND LOCATION
Visitors Center Stephens College

ORDER DATE | CUSTOMER ORDER NO | CUSTOMER ACCOUNT NO

SOLD TO
Drummond-Officer Mechanical Contractors
Post Office Box 935
Columbia, Missouri 65201

ZIP CODE

APPROVAL STAMP

[illegible]
[illegible] Contractors, Inc.
Date: 4-7-78
Checked: [illegible]
Section 1520 Col 3
" 1530 Col 1, 2 & 3

ITEM | QTY. | DESCRIPTION

We respectfully, resubmit the attached equipment data and drawings for approval with the following notations and changes.

1) Solar Purge Unit - Performance and capacity data based on 50% glycol solution.

2) Shell & Tube Chiller - Unit remains unchanged with exception of refrigerant temperature being revised to 37°F.

3) Condensing Unit - CU-1, 2, & 3 remain unchanged. CU-4 has been changed from Model RAUC-506 to Model RAUB-626 to provide a refrigerant temperature of 37° in the remote chiller.

4) Fan Coil Units - Heating GPM and pressure drops have been changed to reflect single coil operation. Heating data is based on 100° F EWT and 50% Glycol.

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR CORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 4/17/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

THE TRANE COMPANY - LA CROSSE, WISCONSIN 54601

SUBMITTAL DATA

APPROVAL STAMP

ARCHITECT
Sovik, Mathre, Sathrum, Quanbeck

ENGINEER
Lewis D. Freedland

PROJECT
Stephens College Visitor's Center

ORDER DATE	CUSTOMER ORDER NUMBER	CUSTOMER ACCOUNT NO
1/11/78	1801-11	Q3-43-5212-6

SOLD TO
Drummond-Officer Mechanical Contractors
Post Office Box, 935
Columbia, Missouri 65201
(INCLUDE ZIP CODE)

TAG: Solar Purge Unit ☐ CLIMATE CH. ☐ TORRIVENT ☐ CAB FAN ☐ CENT A.C. CONDENSER

UNIT

QUAN OF UNITS	SIZE	MODEL (1)	Submittal Drawing
1	21	T21 DISCHARGE Arrg. C (Top Front Vert. Disch.) ZONES	

SCFM	ESP	TSP	BHP	RPM	DIAMETER	TYPE	NUMBER OF FANS
10,000	.53	.53	2.33	526	16.5"	FC	2

COILS

COIL SPECIFICATIONS										CAPACITY			FLUID				COIL NO.
QTY PER UNIT	COILS	COIL TYPE (2)	SIZE WIDE	SIZE LONG	SERIES	TUBES ROWS	TUBES MAT (3)	SUPPLY	TURBS CKT (4)	KW / MBH	EAT DB/WB	LAT DB/WB	TYPE (5)	GPM OR PRESS	TEMP IN OUT	WATER ΔP FEET OF H2O	812
	PREHEAT SECTION																
1	FIRST CASING	W	30	99	18	4	A	R	0	300	70	98	HW	15	150/104	0.6	12
	SECOND CASING																
	MULTI ZONE																

ACCESSORIES

1 Hood over motor

1 Gasketed panels

1 Two coats inside & out - CRB paint per S.E.S. 3-6.01

Above Data Based on 50% Glycol Solution.

INLET VANES ☐ AUTOMATIC (by others) ☐ MANUAL

ISOLATORS: ☒ FLOOR ☐ CEILING ☐ RIS ☐ SPRING by others

1 DRIVE: 526 RPM ☐ FIXED ☒ VARIABLE ☐ 2 MHP ☒ 1.5 MHP ☐ ENCL. BELT GD.

MOTOR

1 MOTOR 3 HP 208 V 60 CY 3 PH 1750 RPM ☒ OPEN ☐ SPECIAL

MOUNT ☒ RIGHT ☐ LEFT

MAGNETIC STARTER

remote 2 button PB station

1 Nema Type 1 - Size 0 - 208/60/30 with / Nema Type 4

MODEL 1
LP - Low Pressure
MP - Med. Pressure
HP - High Pressure
DT - Draw Thru
MZ - Multi Zone
DD - Double Duct
SC - Spray Coil
T - Torrivent or Cabinet Fan
TC - Condenser

COOLING COILS 2
W - Standard Water
D - Drainable
DD - Double Circuit
- Drainable
K - Cleanable
F - Refrigerant - 12
F 2 - Refrigerant - 22

HOT WATER COILS 2
A - Single Pass Opposite End Connections
WS - Two Pass Same End Connections

STEAM COILS 2
A - Single Pass Opposite End Connections
N - Non Freeze Opposite End Connections

TUBE MATERIAL 3
A - Standard Copper
C - .035 Red Brass
D - .049 Red Brass

TURBULATORS 4

CIRCUITS
Tubes Fed

FLUID TYPE 5
12 - Refrigerant - 12
22 - Refrigerant - 22
CW - Chilled Water
HW - Hot Water
ST - Steam
SP - Special

MECHANICAL SPECIFICATIONS – STANDARD CLIMATE CHANGERS

CASINGS – Removable Panels Phosphatized and Painted
COILS – Plate Fins – Seamless copper tubes with galvanized steel casings. All coils are pitched in the unit
FANS – Forwardly Curved – in LP and MP units in Size 31 and smaller
Backwardly inclined in HP units Size 25 and smaller. Air Foil in LP and MP Sizes 35 and larger and HP Sizes 31 and larger
BEARINGS – 200,000 hour average life – Greasable
DRAIN PANS – Extended under both Fan and Coil Section on all cooling units. Pan is covered with 1/2" foam in place insulation

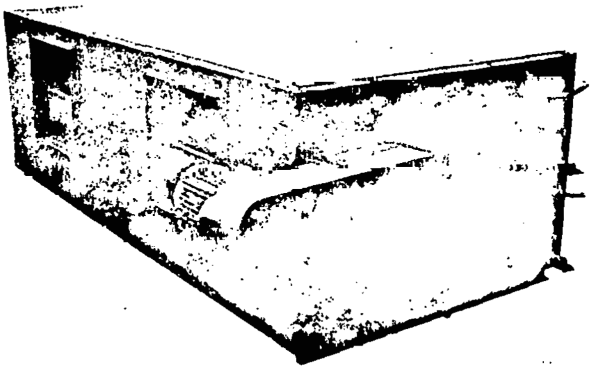
SALES ORDER NUMBER
K03-E743

SHEET 1 OF 1

CLCH-S-3
JUNE, 1975
SUPERSEDES CLCH-S-3
DATED JANUARY, 1975

LOW AND MEDIUM PRESSURE DRAW-THRU CLIMATE CHANGERS®

SIZE NO. 17, 21, 25 AND 31



MECHANICAL SPECIFICATIONS

UNIT CASING — Constructed of high grade steel reinforced and braced with steel angle framework. Sectionalized construction consisting of fan section, coil section and drain pan. Removable panels in fan and coil sections provide access to all internal parts. Hanger or bolt holes prepunched at the factory.

UNIT INSULATION — All panels insulated with a 1 inch glass fiber blanket, securely fastened. (Optional) Neoprene coated 1 inch blanket insulation. Drain pan has seamless, 1/2" cellular, spray foamed-in-place insulation. (Optional) — drain pan has inner and outer pan. Inner pan galvanized steel with blanket insulation between pans.

TABLE 1 – METAL GAUGES

COMPONENT		UNIT SIZES			
		NO. 17	NO. 21	NO. 25	NO. 31
FAN SECTION	DISCHARGE PANEL	14	14	14	14
	END PANEL	14	14	12	12
	END STIFF. ANGLE	12	12	12	12
COIL SECTION	END PANEL HORIZ. VERT.	18 16	18 16	10 16	18 16
	INLET FRAME	14	14-12	14-12	12
	SUPPORT CHANNELS	10	10	10	10
REMOVABLE PANELS	HORIZONTAL UNIT TOP PANELS	18	18	18	18
	VERTICAL UNIT FRONT AND BACK PANELS	18	18	18	18
DRAIN PAN, HORIZONTAL		16	14	14	14
DRAIN PAN, VERTICAL		16	14	14	14

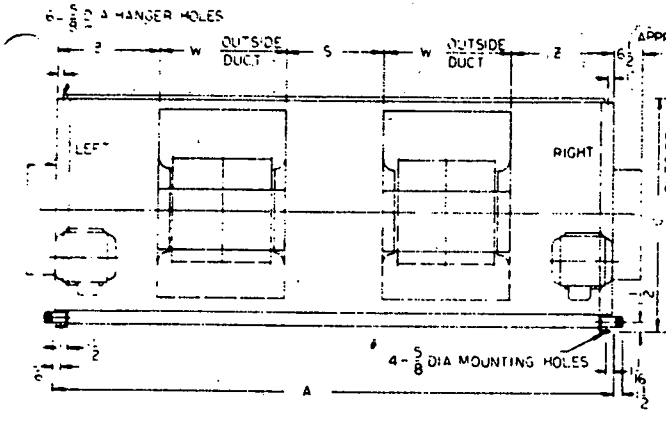
CENTRIFUGAL FANS — Double width, double inlet, forward curved multi-blade type. Table 10 lists fan sizes. Shaft operates below its first critical speed. Fan bearings externally mounted grease lubricated ball bearings for 200,000 hour average life. Fan housing die-formed and air tight. All fans statically and dynamically balanced, and tested after being installed in factory assembled fan section.

COILS — Continuous plate type fins, Sigma-Flo® II configurated, aluminum or copper fins. Fin collars drawn and belled, bonded to the tubes by mechanical expansion of the tubes. No soldering or tinning is used in the bonding process. Coils removable through access panels.

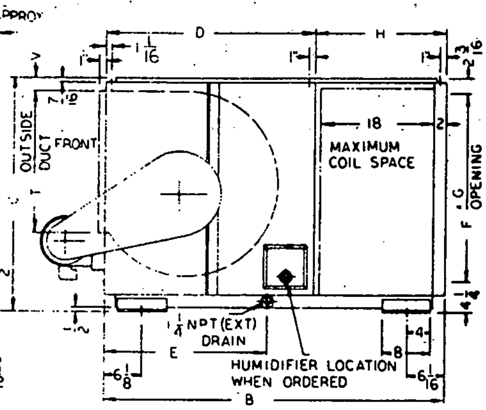
UNIT AND ACCESSORY FINISH — Casing and all accessories, except the coil, chemically cleaned, phosphatized, and coated with baked-on enamel.

ACCESSORIES — Opposed blade type face and bypass dampers locked to slotted damper rods rotating in rust-proof nylon bushing. Bypass duct completely insulated. Filter and mixing boxes designed to hold low or high velocity, 2 inch permanent or throwaway type filters. Flat filter boxes access doors on both sides; all other filter and combination filter-mixing boxes with large, single access door. Mixing box damper blades of the parallel type set for merging of air stream inside the box. Blades locked to slotted rods rotate in nylon bushings.

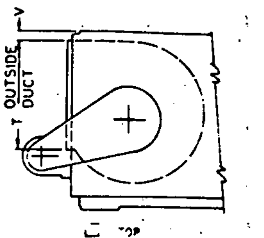
BASIC HORIZONTAL UNIT



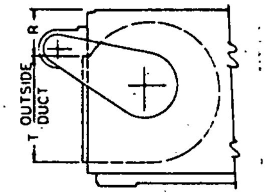
☐ LOW PRESSURE
MEDIUM PRESSURE



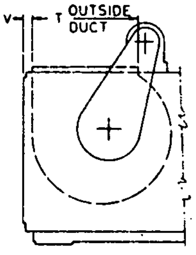
FAN DISCHARGE ARRANGEMENTS



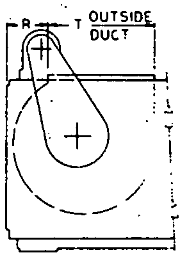
☐ 1 TOP HORIZONTAL



☐ 2 BOTTOM HORIZONTAL



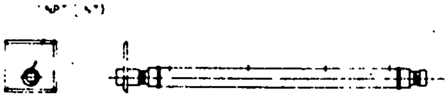
☐ 3 FRONT VERTICAL ●



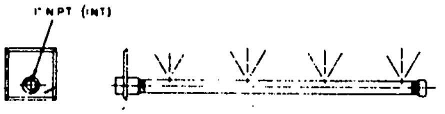
☐ 4 BACK VERTICAL ●

● NOT AVAILABLE ON 31

HUMIDIFIERS

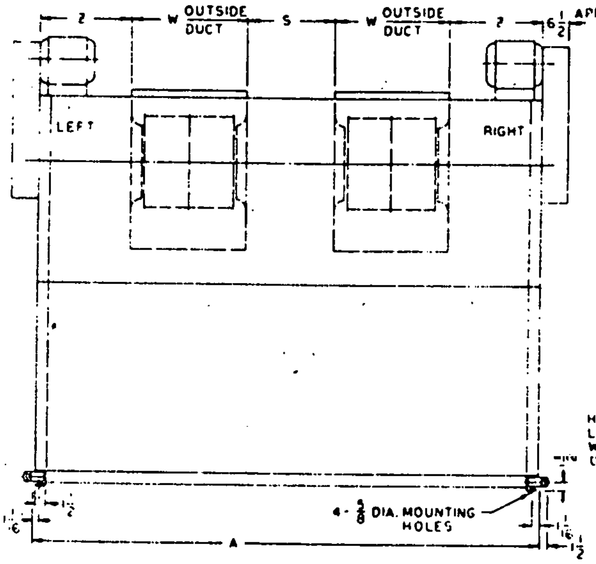


☐ STEAM GRID

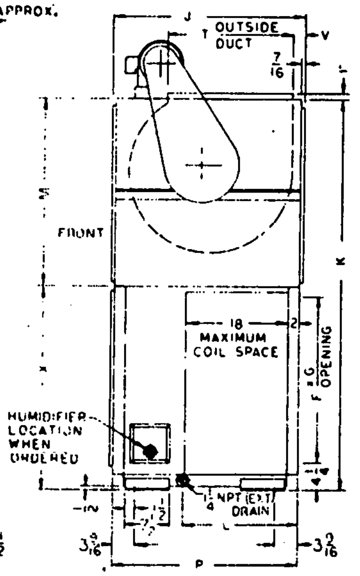


☐ WATER SPRAY

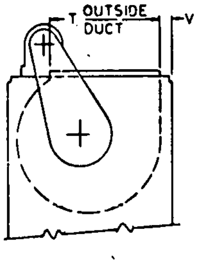
BASIC VERTICAL UNIT



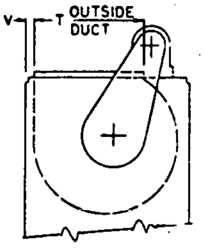
☐ LOW PRESSURE
☒ MEDIUM PRESSURE



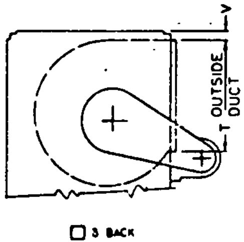
FAN DISCHARGE ARRANGEMENTS



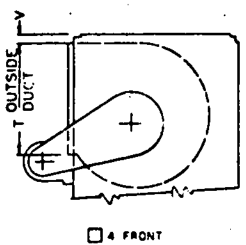
☐ 1. BACK VERTICAL



☒ 2. FRONT VERTICAL



☐ 3 BACK HORIZONTAL ●



☐ 4 FRONT HORIZONTAL ●

● NOT AVAILABLE ON 31

TABLE 2

[illegible]	[illegible]	A	B	C	D	E	F	G	H	J	K	L	M	P	X	LOW PRESSURE R	S	T	V	W	Z	MEDIUM PRESSURE R	S	T	V	W	Z
17	30/[illegible]	91	$53\frac{13}{16}$	$35\frac{15}{16}$	$32\frac{1}{16}$	[illegible]	$29\frac{1}{2}$	87	$20\frac{3}{4}$	$33\frac{7}{8}$	[illegible]	$21\frac{1}{4}$	$33\frac{1}{16}$	33	$3[illegible]\frac{1}{2}$	$11\frac{5}{8}$	$18\frac{1}{2}$	$19\frac{3}{4}$	$2\frac{1}{2}$	$20\frac{1}{4}$	16	$11\frac{3}{4}$	$20\frac{1}{2}$	$18\frac{1}{4}$	$3\frac{7}{8}$	$18\frac{1}{4}$	17
21	30/92	100	$53\frac{13}{16}$	$35\frac{15}{16}$	$33\frac{1}{16}$	$25\frac{15}{16}$	$29\frac{1}{2}$	105	$20\frac{3}{4}$	$33\frac{7}{8}$	$68\frac{9}{16}$	$21\frac{1}{4}$	$33\frac{1}{16}$	33	$35\frac{1}{2}$	$9\frac{25}{32}$	$29\frac{7}{8}$	$22\frac{1}{16}$	$2\frac{1}{32}$	$22\frac{1}{8}$	$17\frac{7}{16}$	$10\frac{19}{32}$	$31\frac{5}{8}$	$19\frac{3}{4}$	$3\frac{17}{32}$	$20\frac{3}{8}$	$18\frac{5}{16}$
25	33/105	115	$57\frac{13}{16}$	$39\frac{15}{16}$	$37\frac{1}{16}$	$28\frac{15}{16}$	$33\frac{1}{2}$	111	$20\frac{3}{4}$	$37\frac{7}{8}$	$76\frac{9}{16}$	$25\frac{1}{4}$	$37\frac{1}{16}$	37	$39\frac{1}{2}$	$11\frac{3}{32}$	$30\frac{5}{8}$	$24\frac{7}{16}$	$2\frac{11}{32}$	$24\frac{3}{8}$	$17\frac{13}{16}$	$11\frac{25}{32}$	$32\frac{3}{4}$	22	$4\frac{3}{32}$	$22\frac{1}{4}$	$18\frac{7}{8}$
31	[illegible]	115	$57\frac{13}{16}$	$49\frac{15}{16}$	$37\frac{1}{16}$	[illegible]	[illegible]	111	$20\frac{3}{4}$	[illegible]	[illegible]	[illegible]	$3[illegible]\frac{1}{16}$	37	$49\frac{1}{2}$	$19\frac{1}{4}$	$29\frac{1}{4}$	$27\frac{3}{16}$	$1\frac{7}{16}$	$25\frac{3}{4}$	$16\frac{5}{8}$	$20\frac{5}{16}$	$30\frac{1}{2}$	$24\frac{3}{8}$	$3\frac{3}{16}$	$24\frac{1}{2}$	$17\frac{3}{4}$

TABLE 8 -- APPROXIMATE OPERATING WTS. (LESS MOTORS*)

	UNIT MODEL NUMBER																		
	3	6	7	8	9	10	12	14	17	21	24	25	31	35	41	50	63	73	86
DRAW-THRU CLIMATE CHANGERS																			
CASING ONLY	205	275	....	400		460	700	750	875	1120		1255	1420	2100	2540	2750	4270	4710	5030
2 ROW	291	424		570		677	978	1060	1229	1534		1725	2082	2832	3558	3708	5529	5850	6390
4 ROW	328	487		657		785	1108	1213	1418	1785		2094	2418	3198	3797	4260	6218	6710	7420
6 ROW	368	552		742		891	1243	1369	1607	1993		2256	2778	3616	4261	4794	6929	7560	8440
8 ROW	406	618		828		988	1373	1520	1781	2216		2518	3108	3984	4699	5330	7611	8320	9330
COIL MODULE																			
CASING ONLY	110	195	..	235		245	325	400	430	530		590	645	715	830	900	1000	1300	1600
2 ROW	196	344		405		462	603	710	784	944		1060	1307	1447	1710	1800	3270	3410	3430
4 ROW	233	407		492		570	733	863	973	1175		1429	1643	1813	1949	2352	3959	4270	4460
6 ROW	273	472		577		676	870	1019	1162	1403		1591	2303	2231	2413	2886	4670	5120	5480
8 ROW	311	538		663		773	998	1170	1326	1626		1053	2333	2499	2851	3422	5352	5880	6370
ACCESSORIES																			
FLAT FILTER BOX																			
THROWAWAY	28	38	42	45	54	68	73	76	92	113	120	120	135	170	180	210	335		
LOW VELOCITY PERMANENT	33	47	52	56	67	84	91	97	117	145	155	155	183	222	234	284	426		
HIGH VELOCITY PERMANENT	51	63	69	75	91	108	120	131	156	193	207	207	257	306	338	365	582		
MEDIUM FILTER BOX																			
THROWAWAY	76	101	131	144	167	171	178	228	247	303	324	324	355	370	456	520	565	655	775
LOW VELOCITY PERMANENT	84	117	149	162	191	195	204	260	284	340	373	373	413	429	546	631	695	805	950
HIGH VELOCITY PERMANENT	96	141	181	190	227	231	248	312	347	428	456	456	513	557	706	799	935	1085	1275
HIGH CAPACITY BOX																			
THROWAWAY	111	148	155	170	180	192	229	260	278	330	398	398	425	470	535	590	680	–	
LOW VELOCITY PERMANENT	120	166	184	194	208	223	261	305	324	393	468	468	512	574	660	735	865		
HIGH VELOCITY PERMANENT	136	198	217	230	257	271	317	360	396	409	576	576	648	742	852	950	1160		
ROLL FILTER	80	114		142		158	187	204	219	250		290	363	430	475	500	750	870	1025
COMB. FILT-MIX BOX																			
THROWAWAY	115	168	200	248	255	286	300	315	358	400	490	490	620	710	730	885	1133	1310	1550
LOW VELOCITY PERMANENT	122	184	217	266	279	310	324	345	393	441	540	540	686	780	874	997	1265	1465	1730
HIGH VELOCITY PERMANENT	134	208	249	298	315	346	368	397	456	521	625	625	786	906	1035	1165	1505	1740	2060
DELUXE COMB. FILTER MIX BOX																			
THROWAWAY	193	240	263	352	369	376	407	474	501	586	604	604	732	986				—	—
LOW VELOCITY PERMANENT	200	256	280	370	393	400	431	504	536	627	654	654	798	1056					
HIGH VELOCITY PERMANENT	212	280	312	402	429	436	475	556	600	707	739	739	898	1182					
MIXING BOX	82	118	122	160	175	182	256	270	319	340	380	380	437	519	623	750	869	1010	1185
EXTERNAL FACE AND BYPASS	40	58	79	96	100	112	154	161	170	216	241	292	417	457	470	618	925	1070	1265
INTERNAL FACE AND BYPASS	30	53	74	77	92	100	109	113	124	184	211	223	327	334	363	441	535		
FACE DAMPERS	39	55	65	91	102	106	111	115	142	225	232	232	237	312	370	446	543		–
STRAIGHT THRU DISCHARGE PLENUM	50	65	90	100	130	110	130	150	170	180	200	200	300	400	400			–	
WALL INTAKE BOX																			
STEEL	90	110	110	150	220	240	270	300	310	480	600	600	725	800	930	1140	1450		
ALUMINUM	40	50	50	75	105	170	115	115	115	255	300	380	460	525	605	745	940	–	

* SEE TABLE 9 FOR MOTOR WEIGHTS

TABLE 9 – APPROXIMATE MOTOR WEIGHTS

MOTOR HORSEPOWER	1/4	1/3	1/2	1	1½	2	3	5	7½	10	15	20	25	30	40	50	60	75
MOTOR WT. (LBS.)	20	20	25	33	44	44	71	82	127	144	187	214	263	300	409	460	560	640

TABLE 10 -- FAN SIZES

UNIT SIZE	LOW PRESSURE		MEDIUM PRESSURE	
	NO.	SIZE	NO.	SIZE
NO. 17	2	15"	2	13½"
NO. 21	2	16½"	2	15"
NO. 25	2	18¼"	2	16½"
NO. 31	2	20"	2	18¼"

TABLE 11 – WATER AND STEAM COILS

COIL TYPE	HEADER HEIGHT	CONNECTION SIZE		
		SUPPLY	RETURN	DRAIN & VENT
W - WATER	18. 24. 30. 33	2½ N.P.T.	2½ N.P.T.	—
D - DRAINABLE	18. 24. 30. 33	2½ N.P.T.	2½ N.P.T.	½ N.P.T. (EXT.)
DD - DRAINABLE	18. 24. 30. 33	2½ N.P.T.	2½ N.P.T.	½ N.P.T. (EXT.)
K - CLEANABLE	18. 24. 30. 33	2½ N.P.T.	2½ N.P.T.	—
P2 - WATER	12, 18, 24, 30	3/4 N P T	3/4 N.P.T.	—
P4 - WATER	12, 18, 24, 30	1 N.P.T.	1 N.P.T.	—
P8 - WATER	18, 24, 30	1¼ N.P.T.	1¼ N.P.T.	—
A - STEAM	18. 24. 30. 33	2½ N.P.T.	1 N.P.T.	—
AW - HOT WATER	18. 24. 30. 33	2½ N.P.T.	2½ N.P.T.	—
WC - HOT WATER	12. 18	1 N.P.T.	1 N.P.T.	—
WC - HOT WATER	24	1¼ N.P.T.	1¼ N.P.T.	—
WC - HOT WATER	30. 33	2½ N.P.T.	2½ N.P.T.	—
N. NS	12	1½ N.P.T.	1 N.P.T.	—
N. NS	18	2 N.P.T.	1 N.P.T.	—
N. NS	24	2½ N.P.T.	1¼ N.P.T.	—
N. NS	30. 33	3 N.P.T.	1¼ N.P.T.	—

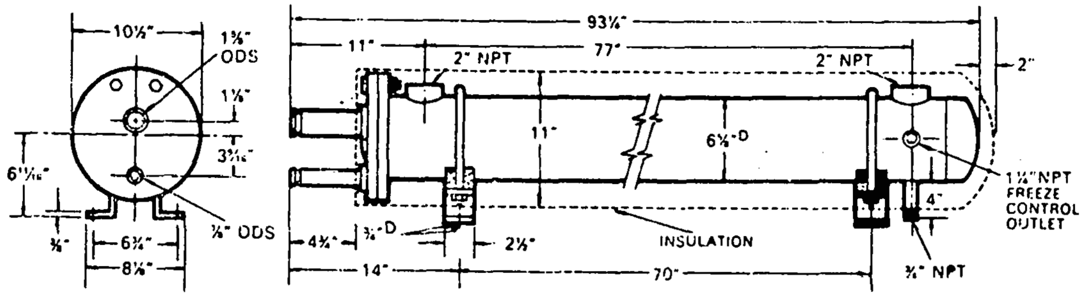
All 12" header height coils, Types A, AW, D, K, and W, supply 1¼ N.P.T., return 1¼ N.P.T.
Above connections internal except drain and vent.

TABLE 12 – TYPE F1 AND F2 REFRIGERANT COILS

HEADER HEIGHT	NO. OF CIR-CUITS	CONNECTIONS		NO. OF CIR-CUITS	CONNECTIONS		NO. OF CIR-CUITS	CONNECTIONS	
		LIQUID	SUCTION		LIQUID	SUCTION		LIQUID	SUCTION
12	2	⅞ O.D.	1⅜ O.D.	4	⅞ O.D.	1⅝ O.D.	8	1⅛ O.D.	2⅛ O.D.
18	2	⅞ O.D.	1⅜ O.D.	3	⅞ O.D.	1⅝ O.D.	6	1⅛ O.D.	2⅛ O.D.
24	2	⅞ O.D.	1⅜ O.D.	4	⅞ O.D.	1⅝ O.D.	8	1⅛ O.D.	2⅛ O.D.
30	2	⅞ O.D.	1⅜ O.D.	4	⅞ O.D.	1⅝ O.D.	5	1⅛ O.D.	2⅛ O.D.
33	3	⅞ O.D.	1⅝ O.D.	7	1⅛ O.D.	2⅛ O.D.	11	1⅛ O.D.	2⅛ O.D.

HEADER HEIGHT	NO. OF CIR-CUITS	CONNECTIONS		NO. OF CIR-CUITS	CONNECTIONS	
		LIQUID	SUCTION		LIQUID	SUCTION
12	—	—	—	—	—	—
18	12	1⅜ O.D.	2⅛ O.D.	—	—	—
24	16	2 - 1⅜ O.D.	2 - 2⅛ O.D.	—	—	—
30	10	1⅜ O.D.	2⅛ O.D.	20	2 - 1⅜ O.D.	2 - 2⅛ O.D.
33	22	2 - 1⅜ O.D.	2 - 2⅛ O.D.	—	—	—

DIMENSIONS (continued)



Only the REFA—67 is straight tubed, fixed tube sheet construction. Construction materials are cast iron heads, copper tubes with aluminum spline, remainder steel.

SCHEDULE

MODEL NUMBER	OUTSIDE TUBE AREA SQ. FT.	GALLONS OF WATER IN SHELL	LBS. R-12 OR R-22 IN TUBE (¾ FULL)	APPROX. SHPG. WT. LBS.
REFA-67*	34	7	5	295
REFA-86	58	11	8	353
REFA-87	68	13	10	396
REFA-106	102	17	14	524
REFA-107	119	20	17	583
REFA-126	160	24	22	713
REFA-127	186	28	26	796
REFA-146	199	30	28	954
REFA-147	232	34	32	1056
REFA-166	284	38	40	1182
REFA-167	329	44	46	1308
REFA-186	355	50	50	1450
REFA-187	412	58	58	1600
REFA-206	479	62	67	1975
REFA-207	553	70	77	2160
REFA-246	735	88	103	2700
REFA-247	849	100	119	3230

*Available with one refrigerant circuit only. Fixed tube sheet design
All units are stocked, except 24" diameter.

TRANE® AIR CONDITIONING

SUBMITTAL DATA

ARCHITECT
Sovik, Mathre, Sathrum, Quanbeck

ENGINEER
Lewis D. Freeland

PROJECT AND LOCATION
Visitors Center Stephens College

ORDER DATE	CUSTOMER ORDER NO.	CUSTOMER ACCOUNT NO.

SOLD TO
Drummond- Officer
Mechanical Contractors, Inc.
P. O. Box 935
Columbia, Missouri 65201
ZIP CODE

APPROVAL STAMP

ITEM | QTY. | DESCRIPTION

Condensing Unit Performance Data

Tag	Model	Nominal Capacity (MBH)	Comp. H.P.	F.L.A.	Elect.	Ambient
CU-1,3, & 4	RAUB-626	70 MBH	6 ¼	29.5	208/60/3°	95°
CU-2	RAS-83	85 MBH	7 ½	42.4	208/60/3°	95°

LES
FICE

SALES ORDER NUMBER

SHEET ____ OF ____

SUBMITTAL DATA

SELECTION PROCEDURE

USE OF CONDENSING UNIT CAPACITY TABLES

Capacity data for RAUB/RAS/RAUA units with BH, BRCA, BU, EU or EH units is in Table 3-1. Use of capacity curves is not necessary for these combinations.

Selection Example

Given Conditions:

1) Outdoor Design: 95 DB, 75 WB
2) Indoor Design: 80 DB, 67 WB
3) Total Load: 90,500 Btuh
4) External Static Pressure: 0.2", 3600 cfm
5) A BH fan-coil unit is required

Required:

1) Select proper unit combination
2) Fan, speed and motor horsepower

Solution:

1) Enter Table 3-1. RAS8 — BH70 capacity is 87 0 MBH. Since cfm is 20% over rating point, use capacity correction factor shown in Table 4-1 of 1.04. This meets required 90,500 Btuh.
2) Enter Table 9 3. A BH70 at 3600 cfm and a 0.2" external static pressure requires 1.68 BHP at 918 rpm. An oversized motor is required.

Determining Leaving Conditions

Occasionally, it may be necessary to determine air-off-the-coil conditions. These can be found with Charts 2-1 and 2-2 and the Trane Psychrometric Chart. Using conditions from the capacity table example:

1. Determine the Leaving Wet Bulb Temperature
   a. $\frac{\text{Total cooling load in Btuh}}{\text{CFM}} = \frac{Q}{\text{CFM}}$

$$\frac{Q}{\text{CFM}} = \frac{90{,}500 \text{ Btuh}}{(3600) \text{ CFM}} \qquad 25.1 \text{ Btuh/CFM}$$

   b. Enter Chart 2-1 at 25.1 Btuh/CFM and 67 F entering wet bulb. Leaving wet bulb is 58.2F.

2. Determine Leaving Dry Bulb Temperature
   a. Determine entering dew point by referring to Trane Psychrometric Chart at entering conditions of 80 F DB/ 67 F WB. Dew point is 60.5 F.
   b. From Chart 2-2, at 60.5 F DP and 58.2 F leaving WB, leaving DB is 60.5 F.

CHART 2-1 Leaving Wet Bulb Temperature Determination

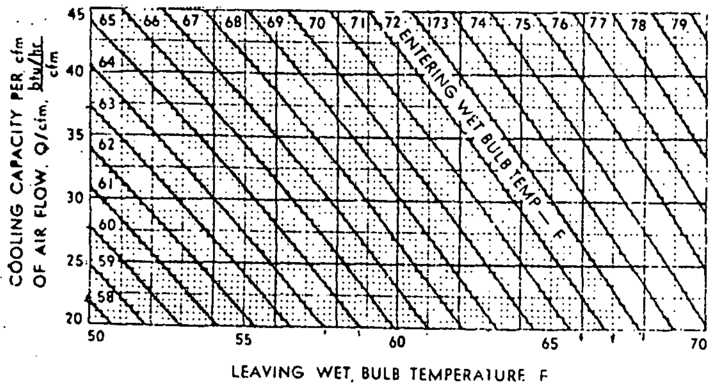
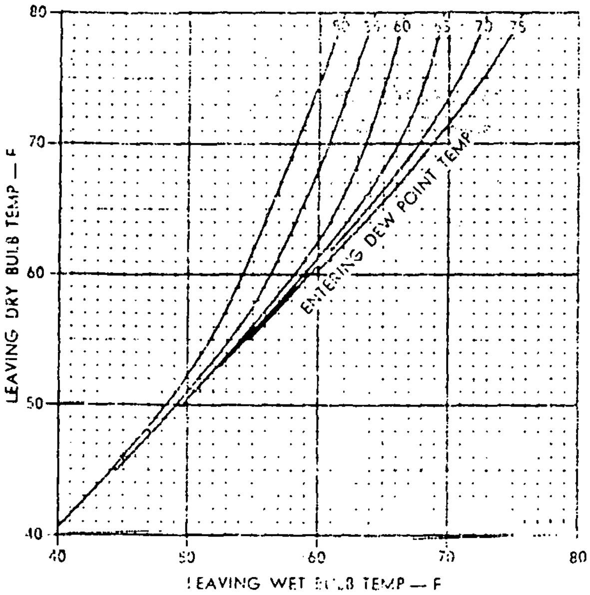


CHART 2-2 Leaving Dry Bulb Temperature Determination



USE OF CONDENSING UNIT CAPACITY CURVES

To select Trane RAUB 6¼ and RAS 7½ and RAUA 10 to 15 ton units with Central Station Climate Changers or direct expansion coils, it is necessary to use condensing unit capacity curves, Charts 5-1 thru 7-1, pages 5-7.

Selection Example

Given Conditions:

1) Cooling Load 175,450 Btuh (Vent. and Room)
2) Condensing Unit Ambient Air 95 DB
3) Evaporator Entering Air 6 000 CFM, 80 DB/67 WB
4) Evaporator fan, HP required: 3 HP

Required:

1) Select condensing unit
2) Select evaporator coil to be used with RAUA unit. See selection procedure in Trane Cooling Coil catalog.

Solution:

1) If evaporator fan motor is located in airstream, heat gain from motor must be included in total loads.

$$\text{Heat Gain} = \frac{\text{BHP x .746 KW/HP x 3413 Btuh/KW}}{\text{Motor Efficiency}}$$

$$= \frac{3 \times .746 \times 3413}{.90} = 8490 \text{ Btuh}$$

2) Total Load Cooling Load + Motor Heat Gain 175,450 Btuh + 8490 Btuh 183,940 Btuh.
3) Examination of Trane Condensing Unit curves on pages 5 - 7 reveals RAUA 15 will deliver required 183,940 Btuh. Compressor suction temperature will be 40.5 F at 95 ambient.
4) Suction temperature at evaporator coil can be determined by calculating pressure drop in suction line. In normal applications, where compressor suction temp. is between 40 and 50, suction line is sized for pressure drop psi, evaporator suction will be 2 F higher. In selection example, coil suction will be 42.5 F.

TABLE 8-1 Condensing Unit General Data (Model RAUB, RAS & RAUA)

MODEL	RAUB 6	RAS8	RAUA 100**	RAUA 125***	RAUA 150**
CONDENSER COIL	(2) 25 X 78	24 X 130	(2) 21.25 X 78	(2) 23.75 X 78	(2) 23.75 X 78
FACE AREA (SQ. FT.)	13.54	21.65	23.1	25.7	25.8
R 22 SHIPPING CHARGE	2 LB	2 LB.	2-2 LB.	2-2 LB.	2-2 LB
CHARGING WT *	12½ LB	21¾ LB	2-9½ LB.	2-13 LB.	2-15¾ LB
CONDENSER FAN DIAM. & TYPE	1 20'' PROP	2 20'' PROP	3-20'' PROP.	3-20'' PROP	3-20'' PROP
NOMINAL CFM	4440	6400	10,580	11,030	11,380
NOMINAL RPM	1540	825	1725	1725	1725
STD. FAN DRIVE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
ARI SOUND RATING NUMBER****	23.0	20.0	22.0	22.0	22.0

*Includes indoor coil and 50' of line

**Two compressors and two independent, complete refrigerant circuits.

***Charge determined from use with BH15

****SRN based on testing at ARI standard 270 (the RAUA 125 and 150 are not listed with ARI)

TABLE 8-2 Electrical Characteristics for Condensing Units (Models RAUB, RAS & RAUA)

MODEL	HP	RPM	VOLTS	CYCLES	PHASE	AMPS (EA. MTR)		MAX START CURRENT (AMPS)
						F.L.	L.R.	
				COMPRESSOR MOTORS				
RAUB 626	6¼	3450	208-240	60	3	25.2	156	156.0
RAUB 624	6¼	3450	440-480	60	3	12.6	79	79.0
RAS 83	7½	3450	208-240	60	3	38.0	179	179.0
RAS 84	7½	3450	440-480	60	3	19.0	90	90.0
RAUA 1003	5 (2)	3450	208-240	60	3	22.0	118	140.8
RAUA 1004	5 (2)	3450	440-480	60	3	11.0	62	73.0
RAUA 1253	6¼ (2)	3450	208-240	60	3	26.0	156	162.0
RAUA 1254	6¼ (2)	3450	440-480	60	3	13.0	79	92.0
RAUA 1503	7½ (2)	3450	208-240	60	3	33.0	179	212.0
RAUA 1504	7½ (2)	3450	440-480	60	3	16.5	90	108.5
				CONDENSER FAN MOTORS				
RAUB 626	¼ (1)	1540	208-240	60	1	4.3	11.0	11.0
RAUB 624	¼ (1)	1540	440-480	60	1	2.2	5.5	5.5
RAS 83	⅓ (2)	825	208-240	60	1	2.2*	4.4	8.8
RAS 84	⅓ (2)	825	440-480	60	1	1.2*	2.1	4.2
RAUA 1003	½ (3)	1725	208-240	60	1	4.1*	11.0	33.0
RAUA 1004	½ (3)	1725	440-480	60	1	2.1*	5.5	16.5
RAUA 1253	½ (3)	1725	208-240	60	1	4.1*	11.0	33.0
RAUA 1254	½ (3)	1725	440-480	60	1	2.1*	5.5	16.5
RAUA 1503	½ (3)	1725	208-240	60	1	4.1*	11.0	33.0
RAUA 1504	½ (3)	1725	440-480	60	1	2.1*	5.5	16.5

*Amp draws for each motor

NOTE: Full load amps based on 230 volts and 460 volts.

TABLE 8-3 Electrical Component Sizing*

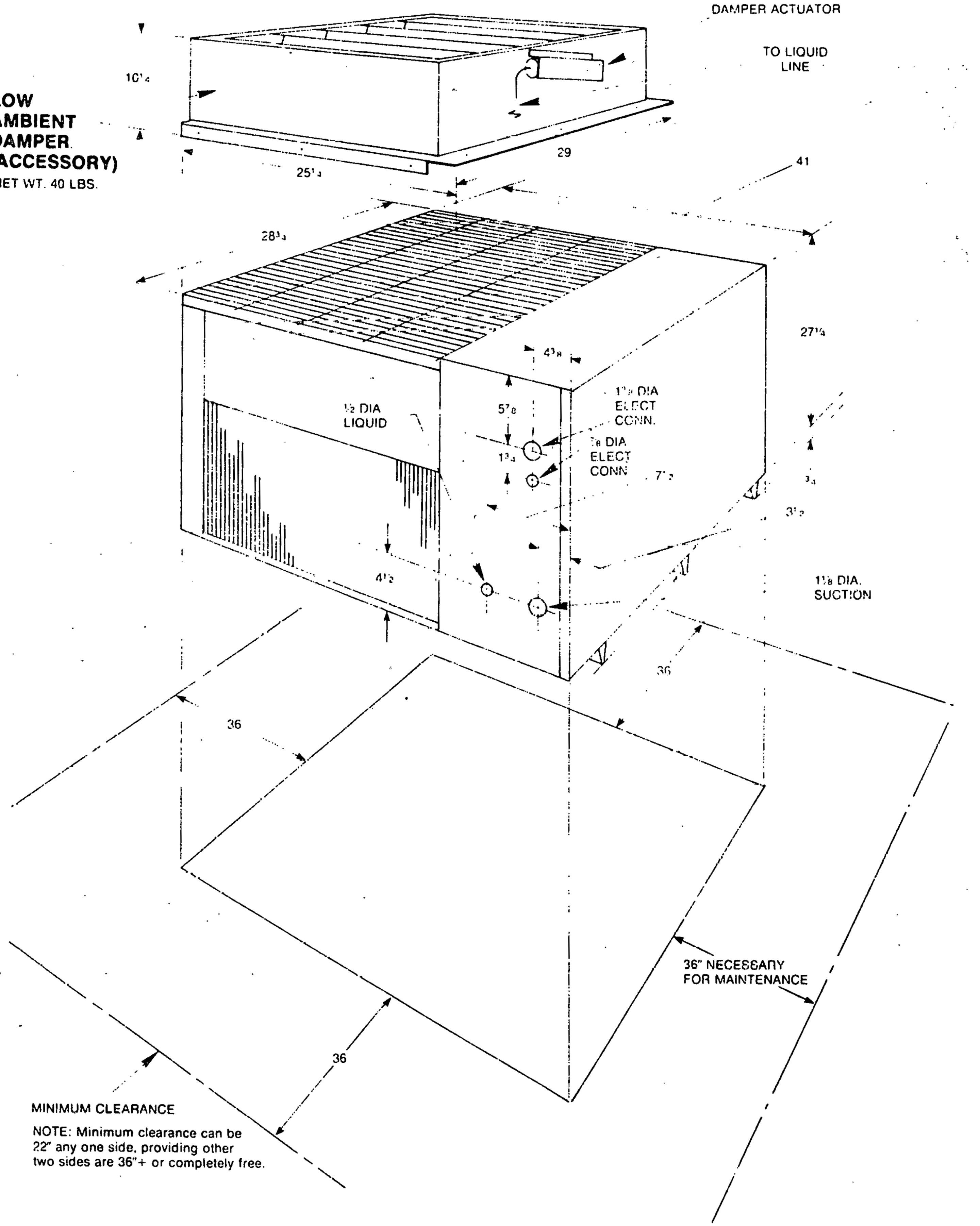
MODEL	UNIT OPERATING VOLTAGE	MINIMUM LINE WIRE SIZE		MAXIMUM LINE LENGTH-FT	MAXIMUM FUSE SIZE	DUAL ELEMENT SIZE
		CU	AL			
RAUB 626	208-240	8AWG	6AWG	77	60	50
RAUB 624	440-480	12AWG	10AWG	125	20	25
RAS 83	208-240	6AWG	4AWG	68	80	70
RAS 84	440-480	10AWG	10AWG	177(74AL)	45	35
RAUA 1003	208-240	3AWG	2AWG	86	80	80
RAUA 1004	440-480	8AWG	6AWG	137	40	35
RAUA 1253	208-240	3AWG	1AWG	82	90	90
RAUA 1254	440-480	8AWG	6AWG	120	45	40
RAUA 1503	208-240	2AWG	0AWG	66	110	100
RAUA 1504	440-480	6AWG	4AWG	152	60	50
BU 7	115	12AWG	10AWG	15	40	25
	230	14AWG	12AWG	37	25	15
BH 7	115	12AWG	10AWG	15	40	25
	230	14AWG	12AWG	37	20	15
BH 10	208	14AWG	12AWG	49	15	15
	230	14AWG	12AWG	62	15	15
	460	14AWG	12AWG	217	15	15
BH 15	208	14AWG	12AWG	28	25	20
	230	14AWG	12AWG	36	25	15
	460	14AWG	12AWG	145	15	15

*Information in this table based on minimum operating voltages

ROUGHING-IN DIMENSIONS

ALL DIMENSIONS APPROXIMATE. CERTIFIED PRINTS ON REQUEST

RAUB 6 NET WT. 300 LBS.



LOW AMBIENT DAMPER (ACCESSORY)
NET WT. 40 LBS.

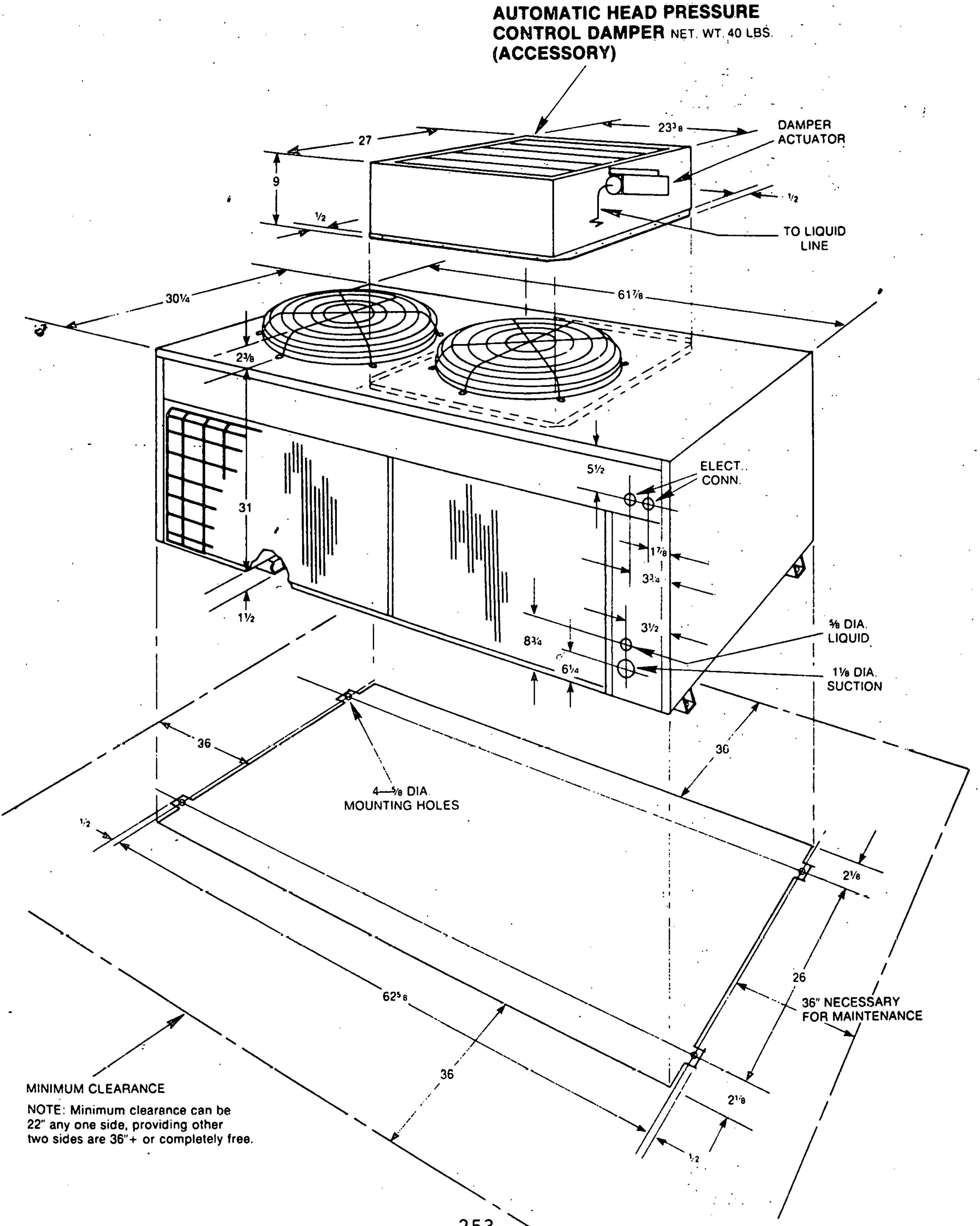
MINIMUM CLEARANCE

NOTE: Minimum clearance can be 22" any one side, providing other two sides are 36"+ or completely free.

ROUGHING-IN DIMENSIONS

ALL DIMENSIONS APPROXIMATE. CERTIFIED PRINTS ON REQUEST

RAS 8 **NET WT. 340 LBS.**



NOTE: Minimum clearance can be 22" any one side, providing other two sides are 36"+ or completely free.

MECHANICAL SPECIFICATIONS

CONDENSING UNITS (RAUB, RAS, RAUA)

All condensing unit components assembled on common base. Units completely weatherproofed and include hermetic compressor(s), condenser coil, fan(s) and motor(s), refrigerant reservoir, charging valve, all controls and holding charge of R-22. Units comply with ARI Standards 210 and 270.

CASINGS

Zinc-coated steel, phosphatized, coated and epoxy resin primer and finished with baked-on green enamel. Heavy duty coil guards standard on RAUB 6 and RAS 8. Coil guards offered as an accessory on RAUA 10, 12½ and 15. Unit mounting rails and drain holes standard on all units.

FANS

Upflow, direct-drive aluminum propeller fans, statically and dynamically balanced. Heavy-duty, permanently-lubricated motors with built-in thermal overload protection.

COMPRESSOR

Hermetically sealed 3,600 rpm compressor. Overloads and inherent winding thermostat protection included for compressor motor. Crankcase heater is standard. Two compressors in 10 to 15-ton units, one in other sizes. Time delay prevents simultaneous starting.

CONDENSER COIL

RAUB 6 and RAS 8 two-row with ⅜-inch O.D. seamless copper tubes. Heavy aluminum fins mechanically bonded to tubes. Factory pressure and leak tested at 450 psi.

RAUA 10 to 15 half V shape, one-row, configurated aluminum fin secondary surface mechanically bonded to primary surface of ⅜-inch O.D. seamless copper tubing. Coils tested to 425 psi working pressure.

REFRIGERATION CIRCUITS

Single circuit on RAUB 6 and RAS 8. Two independent circuits on RAUA 10, 12½ and 15. Subcooling, and access valves in suction and liquid lines standard. Refrigerant filter drier(s) ship with each unit for field installation.

CONTROLS

High and low pressure cut-outs, contactors and internal overload protection on all motors. Controls automatic resetting, but prevented from cycling by lockout relay reset by switching thermostat. 24-volt transformer for thermostat only with 220-volt system control.

LOW AMBIENT OPERATION

MODELS	OPERATION TO	ACCESSORIES
RAUB 6	40 F	None
RAUB 6	0 F	Damper
RAS 8	30 F	None
RAS 8	0 F	Damper
RAUA 10, 12½, 15	30 F	None
RAUA 10, 12½, 15	0 F	Two-speed motor

BLOWER COIL AND EVAPORATOR COIL INDOOR SECTIONS

BLOWER COIL UNITS (BH, BU)

GENERAL

Fan cooling units consisting of cooling coil, drain pan assembly, centrifugal fans, fan relay, filters and insulated cabinets. Units comply with ARI Standard 210.

EVAPORATOR COIL UNITS (EH, EU)

GENERAL

Evaporator coils consisting of cooling coil, expansion valve, drain pan assembly and insulated casing. Coils comply with ARI Standard 210.

(BH, BU, EH, EU)

Two-row Sigma-Flo® design. Aluminum fin secondary surface mechanically bonded to primary surface of ⅝-inch O.D. seamless copper tubing. Leak tested to 300 psi. expansion valve(s) and R-22 holding charge standard. Dual circuits on BH 100 to 150.

CASINGS (BH, BU, EH, EU)

Heavy-gauge steel, phosphatized and finished with baked-on gray green enamel. Insulated with permanent, fireproof glass fiber.

DRAIN PAN (BH, BU, EH, EU)

Welded galvanized steel and insulated. Threaded pipe connection standard.

FANS (BH, BU)

Forward-curved centrifugals with adjustable belt drive. Motors permanently lubricated and with inherent overload protection.

FILTERS (BH, BU)

One-inch throwaway-type standard.

ACCESSORIES (BH, BU)

Accessories include discharge plenums, permanent filter sets, inlet grilles, mounting base, isolators, oversized motors, and hot water, steam and electric heating coil kits. Heating coils do not fit in BH 7.

THE **TRANE** COMPANY - LA CROSSE, WISCONSIN 54601

DATE SHIPPED	BILL OF LADING NO.	INVOICE DATE	ORDER-INVOICE NO.
/			SQ3-E744

ARCHITECT
Souik, Mathre, Sathrum, Quanbeck

ENGINEER
Lewis D. Freedland

OJECT
Stephens College Visitor's Center

TERMS-30 DAYS NET: Net 30
F.O.B.: Scranton, Frt. Allowed
NO. INVOICE COPIES

MARK PACKAGES
Shipper to notify Drummond-Officer at (314) 449-0571 24 hours before delivery. Identify as Fan Coil Units".

ORDER DATE	CUSTOMER ORDER NUMBER	CUSTOMER ACCOUNT
1/11/78	1801-11	Q3-43-5212-6

SHIP VIA: Best Way

COLLECT ☐ PREPAID ☒

SOLD TO
Drummond-Officer Mechanical Contractors
Post Office Box 935
Columbia, Missouri 65201
(INCLUDE ZIP CODE)

SHIP TO
Drummond-Officer Mechanical Contractors
c/o Stephens College Visitor's Center
Columbia, Missouri 65201
(INCLUDE ZIP CODE)

SHIP WITH:

ITEM	QUAN	B.O.	ORDERING NUMBER	DESCRIPTION	PRODUCT CODE	PRICING
A	5		B12 D003	VCAB Fan Coils (Type A)		
B	2		B12 D004	VCAB Fan Coils (Type B)		
C	2		B12 D006	VCAB Fan Coils (Type C)		

ENTERED

Shipment wanted
☐ OR SOONER
☐ SPECIFIED DATE
☐ HOLD UNTIL DATE CONFIRMED

☐ HOLD FOR APPROVAL
SPECS OK
NO. OF PRINTS
☐ APPROVAL NOT REQUIRED

PPD. TRANSPORTATION

ORDER CLASS

JOB NO.	CREDIT AUTHOR.	TAX STATUS	TAX CODE	TAX AMOUNT

FICE SALES MEN & RATE

BILLING NO.

SALES ORDER NUMBER
SQ3-E744

SHEET 1 OF 3

TRANE
AIR CONDITIONING

VERTICAL FAN COIL UNITRANE SPECIFICATIONS

SOLD TO: Drummond-Officer

CUSTOMER ORDER NO.: 1801-11

TAG: FCU- Type A
ooms 301, 302, 303, 304, & 305

ITEM A | QTY. 5 | APPROVAL DWG.

COIL CONN. | L.H. X | R.H. | SERIAL NO.

MODEL NO. B12A003 | CFM 300

	A	VERT. CONCEALED		K	LOW VERT. CONCEALED	LIST PRICE
X	B	VERT. CABINET		L	LOW VERT. CABINET	
	H	VERT. RECESSED				
X	1	INTEGRAL DISCHARGE				
	2	QUADRIFUSER DISCHARGE				
	3	DUCT COLLAR DISCHARGE				
X	2	RETURN AIR TOE SPACE				
	[illegible]	BACK 25 PCT. FRESH AIR OPENING				
	5	BACK 100 PCT. FRESH AIR OPENING				
	6	FRONT INTEGRAL RETURN AIR GRILLE				
X	AD	STANDARD WATER COIL		DE	H-RISE & AUX. ELECTRIC	
	DD	H-RISE COIL		AL	STD. & AUX. WATER	
	AE	STD. & AUX. ELECTRIC		DL	H-RISE & AUX. WATER	
COIL SERVICE		KW			VOLT PH WIRE	
X	E-2	1" THROWAWAY		E-4	[illegible]	
	E-3	1" PERMANENT		E-5	[illegible]	
	F-2	AUTO AIR VENT	X	F-3	MANUAL AIR VENT	
	G-1	1-SPD. 115 60 1 RW-SHP		G-5	3-SPD. 230 60 1 PSC	
	G-2	3-SPD. 115 60 1 SHP		G-6	3-SPD. 230 60 1 PSC	
X	G-3	3-SPD. 115 60 1 PSC		G-7	3-SPD. 230 60 1 SHP	

H. 31 Motor speed switch

CONTROL DWG.

J.

CONTROL VALVE FACTORY MOUNTED ☐ YES ☐ NO

VALVE PKG. DWG.

K.

DAMPER OPER. DWG.

FINISH: Baked enamel

ACCESSORIES & SPECIAL FEATURES

UNIT LIST PRICE

ITEM LIST TOTAL

SPACE BELOW THIS LINE FOR FACTORY USE ONLY

UNIT BASIC DWG.

CONTROL DWG.

VALVE PKG. DWG.

DAMPER CONTROL DWG.

TAG: FCU- Type B
Room 202 and Room 201

ITEM B | QTY. 2 | APPROVAL DWG.

COIL CONN. | L.H. X | R.H. | SERIAL NO.

MODEL NO. B12A004 | CFM 400

	A	VERT. CONCEALED		K	LOW VERT. CONCEALED	LIST PRICE
X	B	VERT. CABINET		L	LOW VERT. CABINET	
	H	VERT. RECESSED				
X	1	INTEGRAL DISCHARGE				
	2	QUADRIFUSER DISCHARGE				
	3	DUCT COLLAR DISCHARGE				
X	2	RETURN AIR TOE SPACE				
	[illegible]	BACK 25 PCT. FRESH AIR OPENING				
	5	BACK 100 PCT. FRESH AIR OPENING				
	6	FRONT INTEGRAL RETURN AIR GRILLE				
X	AD	STANDARD WATER COIL		DE	H-RISE & AUX. ELECTRIC	
	DD	H-RISE COIL		AL	STD. & AUX. WATER	
	AE	STD. & AUX. ELECTRIC		DL	H-RISE & AUX. WATER	
COIL SERVICE		KW			VOLT PH WIRE	
X	E-2	1" THROWAWAY		E-4	REPLACEABLE MEDIA	
	E-3	1" PERMANENT		E-5	1" RENEWABLE MEDIA	
	F-2	AUTO AIR VENT	X	F-3	MANUAL AIR VENT	
	G-1	1-SPD. 115 60 1 RW-SHP		G-5	3-SPD. 230 60 1 PSC	
	G-2	3-SPD. 115 60 1 SHP		G-6	3-SPD. 230 60 1 PSC	
X	G-3	3-SPD. 115 60 1 PSC		G-7	3-SPD. 230 60 1 SHP	

H. 31 Motor speed switch

CONTROL DWG.

J.

CONTROL VALVE FACTORY MOUNTED ☐ YES ☐ NO

VALVE PKG. DWG.

K.

DAMPER OPER. DWG.

FINISH: Baked enamel

ACCESSORIES & SPECIAL FEATURES

UNIT LIST PRICE

ITEM LIST TOTAL

SPACE BELOW THIS LINE FOR FACTORY USE ONLY

UNIT BASIC DWG.

CONTROL DWG.

VALVE PKG. DWG.

DAMPER CONTROL DWG.

SALES ORDER NUMBER: SQ3-E744

SHEET 2 OF 3

COPY

SOLD TO **Drummond-Officer**

CUSTOMER ORDER NO. **1801-11**

TAG
FCU - Type C
Room 203 and Room 204

TAG

ITEM C	QTY. 2	APPROVAL DWG.	
COIL SUPPLY	L.H. X	R.H.	SERIAL NO.
MODEL NO. B12AO 06		CFM 600	

						LIST PRICE
	A	VERT. CONCEALED		K	LOW VERT. CONCEALED	
X	B	VERT. CABINET		L	LOW VERT. CABINET	
	H	VERT. RECESSED				
X	1	INTEGRAL DISCHARGE				
	2	QUADRIFUSER DISCHARGE				
	3	DUCT COLLAR DISCHARGE				
X	2	RETURN AIR TOE SPACE				
	3	BACK 25 PCT. FRESH AIR OPENING				
	5	BACK 100 PCT. FRESH AIR OPENING				
	6	FRONT INTEGRAL RETURN AIR GRILLE				
XX	AC	STANDARD WATER COIL		DE	HI-RISE & AUX. ELECTRIC	
	DC	HI-RISE COIL		AL	STD. & AUX. WATER	
	AE	STD. & AUX. ELECTRIC		DL	HI-RISE & AUX. WATER	
COIL SERVICE		KW			VOLT PH WIRE	
X	E-2	1" THROWAWAY		E-4	1" REPLACEABLE MEDIA	
	E-3	1 2" PERMANENT		E-5	1 2" RENEWABLE MEDIA	
	F-2	AUTO AIR VENT	X	F-3	MANUAL AIR VENT	
	G-1	2-SPD. 115 60 1 RW-SHP		G-5	3-SPD. 230 50 1 PSC	
	G-2	3-SPD. 115 60 1 SHP		G-6	3-SPD. 230 60 1 PSC	
X	G-3	3-SPD. 115/60/1 PSC		G-7	3-SPD. 230 50 1 SHP	

H. 31 **Motor speed switch**

CONTROL DWG.

J.

CONTROL VALVE FACTORY MOUNTED ☐ YES ☐ NO

VALVE PKG. DWG.

K.

DAMPER OPER. DWG.

FINISH

Baked enamel

ACCESSORIES & SPECIAL FEATURES

UNIT LIST PRICE

ITEM LIST TOTAL

ITEM	QTY.	APPROVAL DWG.	
COIL SUPPLY	L.H.	R.H.	SERIAL NO.
MODEL NO.		CFM	

						LIST PRICE
	A	VERT. CONCEALED		K	LOW VERT. CONCEALED	
	B	VERT. CABINET		L	LOW VERT. CABINET	
	H	VERT. RECESSED				
	1	INTEGRAL DISCHARGE				
	2	QUADRIFUSER DISCHARGE				
	3	DUCT COLLAR DISCHARGE				
	2	RETURN AIR TOE SPACE				
	3	BACK 25 PCT. FRESH AIR OPENING				
	5	BACK 100 PCT. FRESH AIR OPENING				
	6	FRONT INTEGRAL RETURN AIR GRILLE				
	AC	STANDARD WATER COIL		DE	HI-RISE & AUX. ELECTRIC	
	DC	HI-RISE COIL		AL	STD. & AUX. WATER	
	AE	STD. & AUX. ELECTRIC		DL	HI-RISE & AUX. WATER	
COIL SERVICE		KW			VOLT PH WIRE	
	E-2	1" THROWAWAY		E-4	1" REPLACEABLE MEDIA	
	E-3	1 2" PERMANENT		E-5	1 2" RENEWABLE MEDIA	
	F-2	AUTO AIR VENT		F-3	MANUAL AIR VENT	
	G-1	2-SPD. 115 60 1 RW-SHP		G-5	3-SPD. 230 50 1 PSC	
	G-2	3-SPD. 115 60 1 SHP		G-6	3-SPD. 230 60 1 PSC	
	G-3	3-SPD. 115 60 1 PSC		G-7	3-SPD. 230 50 1 SHP	

H.

CONTROL DWG.

J.

CONTROL VALVE FACTORY MOUNTED ☐ YES ☐ NO

VALVE PKG. DWG.

K.

DAMPER OPER. DWG.

FINISH

ACCESSORIES & SPECIAL FEATURES

UNIT LIST PRICE

ITEM LIST TOTAL

[illegible]

UNIT BASIC DWG.
CONTROL DWG.
VALVE PKG. DWG.
DAMPER CONTROL DWG.

UNIT BASIC DWG.
CONTROL DWG.
VALVE PKG. DWG.
DAMPER CONTROL DWG.

SALES ORDER NUMBER
SQ3-E744

SHEET 3 OF 3

TRANE AIR CONDITIONING **SUBMITTAL DATA**

ARCHITECT
Sovik, Mathre, Sathrum, Quanbeck

ENGINEER
Lewis D. Freeland

PROJECT AND LOCATION
Visitors Center Stephens College

ORDER DATE | **CUSTOMER ORDER NO.** | **CUSTOMER ACCOUNT NO**

SOLD TO
Drummond- Officer
Mechanical Contractors, Inc.
P. O. Box 935
Columbia, Missouri 65201
ZIP CODE

APPROVAL STAMP

ITEM | **QTY.** | **DESCRIPTION**

FAN COIL DATA*

		COOLING				HEATING		
TAG	CFM	TOT	SENS	GPM	WPD	MBH	GPM	WPD
Type A	300	4.9	4.1	1.3	2.3	7.0	2.2	7.1
Type B	400	4.5	3.7	1.2	1.2	8.1	2.2	5.5
Type C	600	6.0	5.1	1.6	3.9	11.9	2.4	6.5

*Data Based On:
-45° EWT Cooling
-10° ΔT
-78°/68° EAT
-High Fan Speed
-100° EWT Heating @ 50% Glycol

ES OFFICE

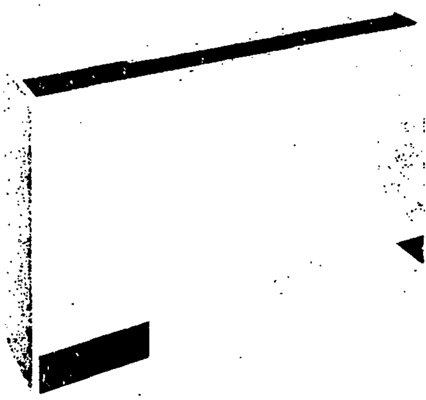
SALES ORDER NUM

SHEET ____ **OF** ____
SUBMITTAL DATA

TRANE®

SUBMITTAL

B3511-3002



FAN-COIL UNITRANE

200-600 CFM VERTICAL CABINET MODEL B

MECHANICAL SPECIFICATIONS

BASIC UNIT—Basic unit includes chassis, coil, drain pan with polystyrene insulating liner, plastic auxiliary drain pan, fan wheel(s) and housing(s), and motor. The chassis is the structural frame, constructed of 18 gauge galvanized steel, and continuous from top of unit to floor. Unit is acoustically and thermally insulated with heavy density glass fiber insulation.

UNIT CASING—Paneling is of 18 gauge steel. All cabinet parts are rigidized by channel forming. End panel is removable for piping access. Top panel is galvanized. Discharge grille is recessed to resist condensate formation. Discharge grille louvers are 15 degrees from vertical.

Hinged access door is flush with top. Front panel removable without the use of tools. Front and top panels thermally and acoustically insulated with heavy density glass fiber insulation.

FINISH—All steel surfaces are cleaned, phosphatized and flow coated with baked-on primer paint. Optional spray applied baked enamel finish in one of seven decorator colors is available.

COILS—All water coils are burst tested at 450 PSI (air) and leak tested at 300 PSI (air under water).

Maximum main coil (AO or DO) working pressure is 300 PSIG. Maximum entering water temperature is 275 F. Tubes and U-bends are ⅝" OD copper. Connections are expanded to accept standard ⅝" OD copper tubing.

Maximum auxiliary coil (L) working pressure is 200 PSIG. Maximum entering water temperature is 220 F. Tubes are 7/16" OD copper. Connections are expanded to accept standard ½" OD copper tubing.

FANS—The fan wheels are centrifugal forward-curved, double-width of molded, reinforced glass fiber material. Fan wheels and housings are corrosion resistant. Fan housings are molded, fiber-reinforced material.

FILTERS—Filters are concealed from sight and removable without displacing front panels. Filters are either throwaway, permanent aluminum mesh (cleanable), renewable or replaceable media with permanent frame.

DAMPERS—All dampers are 18 gauge steel. Single piece, counter-balance 100% return and fresh air mixing damper seals on unit filter and gasket material. 25% fresh air damper (with operator) is single piece, sealing on filter to prevent blow-through. 25% manual damper is set by thumbscrews.

MOTORS—All motors are run tested in assembled units. All motors are integrally thermally protected. Motors are capable of starting at 78% of rated voltage and operating at 90% of rated voltage on all speed settings. Motors can be operated at 10% over voltage without undue magnetic noise and with a temperature rise by the winding resistance method not exceeding 60 C (shaded pole) and 50 C (PSC) at full speed, and 65 C and 55 C respectively at reduced speeds.

TABLE I—Motor RPM

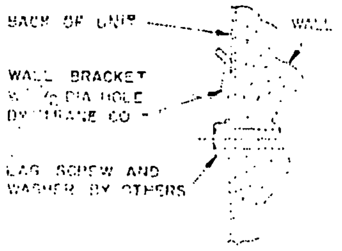
MOTOR	VOLTAGE	MOTOR RPM	
		UNIT SIZE	
		02-03	04-06
G1 (RWSP)	115/60/1	1100/500	1075/500
G2 (SP)	115/60/1	1100/900/700	1075/900/700
G3 (PSC)	115/60/1	1100/900/700	1075/900/700
G7 (SP)	230/60/1	1100/900/700	1075/900/700

FAN-COIL UNITRANE

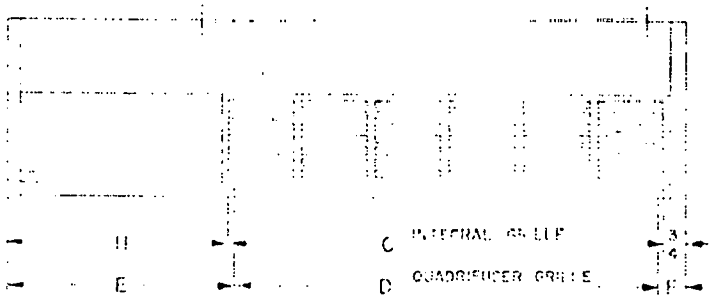
200-600 CFM VERTICAL CABINET MODEL B

TABLE 2 – UNIT DIMENSIONS

UNIT SIZE	CFM	NO OF FANS	A	B	C	D	E	F	G	H	J
02	200	1	31 1/2	20	19 3/4	18	11 7/8	1 5/8	17	19 15/16	19 3/4
03	300	1	39 1/2	28	27 3/4	27	11 3/8	1 1/8	25	27 15/16	27 3/4
04	400	2	43 1/2	32	31 3/4	31 1/2	11 5/16	11/16	29	31 15/16	31 3/4
06	600	2	55 1/2	44	43 3/4	40 1/2	12 5/8	2 3/8	41	43 15/16	43 3/4

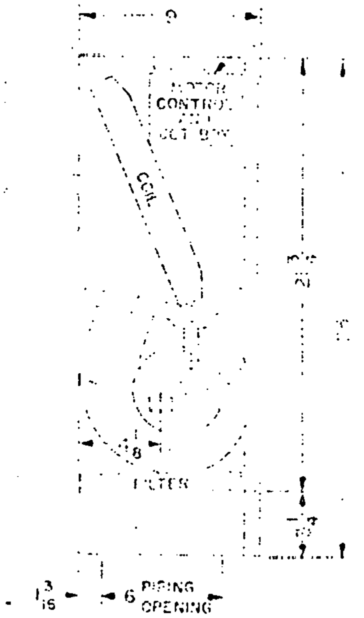


DETAIL 'A'

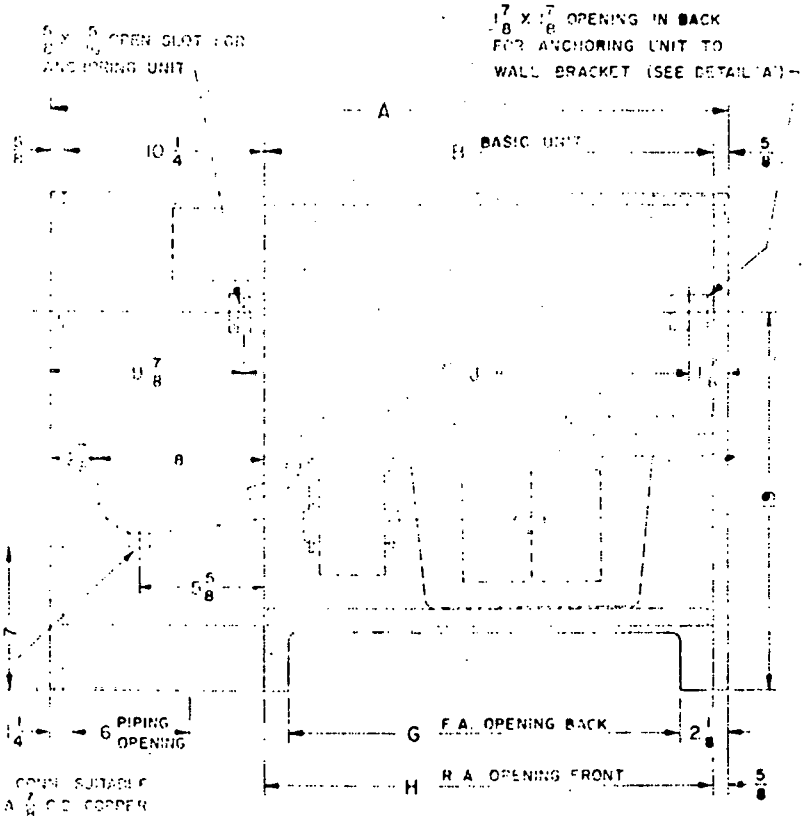


TOP VIEW

NOTE:
- SEE MOTOR CONTROL SUBMITTAL FOR ELECTRICAL ROUGHING-IN DETAILS
- JUNCTION BOX FURNISHED UNLESS OTHERWISE SPECIFIED.



SIDE VIEW



PLASTIC DRAIN CONN SUITABLE FOR CLAMPING A 7/8 O.D. COPPER TUBE (CLAMP BY TRANE CO) OR A 1 NOM SCHEDULE 40 ABS PLASTIC PIPE (NO CLAMP REQ)

UNIT SHOWN WITH OUTLET #1, INLET #2.

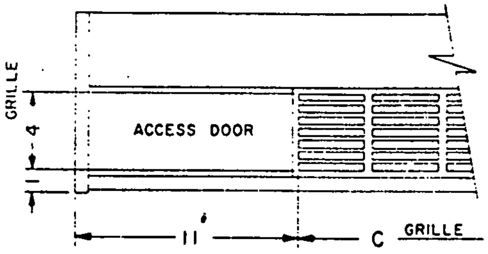
FRONT VIEW

NOTE
LEFT HAND UNIT SHOWN
RIGHT HAND OPPOSITE

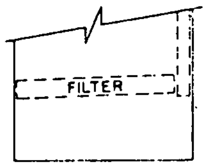
C 3511-3002 C

OUTLETS

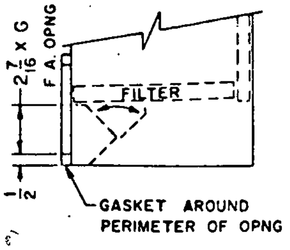
INLETS



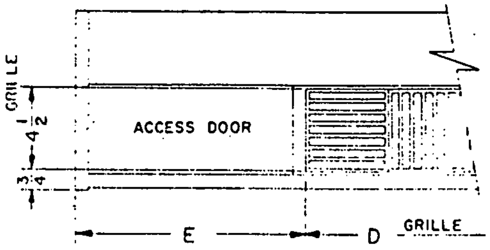
☒ 1. INTEGRAL GRILLE



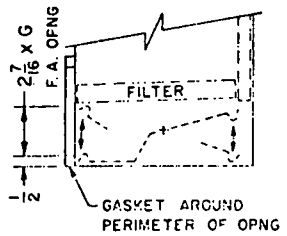
☒ 2. RETURN AIR TOE SPACE



☐ 3. 25% FRESH AIR BACK



☐ 2 QUADRIFUSER GRILLE

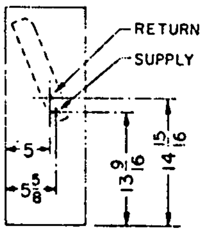


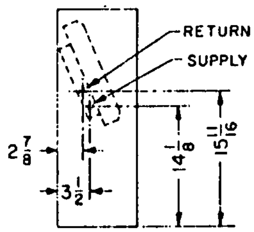
☐ 5. 100% FRESH AIR BACK

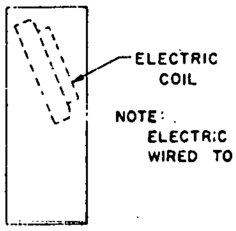
COOLING COILS

AUX HEATING COILS

NOTE:
AUXILIARY COIL CONNECTIONS ARE ON SAME END AS COOLING COIL CONNECTIONS.







NOTE:
ELECTRIC ELEMENTS ARE FACTORY WIRED TO JUNCTION BOX.

☒ AO
1-ROW WATER COIL

☐ AL
TYPE AO COIL W/ 1-ROW AUX HOT WATER COIL

☐ AE
TYPE AO COIL W/AUX ELECTRIC COIL

☐ DO
2-ROW WATER COIL HIGH TEMP RISE

☐ DL
TYPE DO COIL W/1-ROW AUX HOT WATER COIL

☐ DE
TYPE DO COIL W/ AUX ELECTRIC COIL

NOTE
SWEAT $\frac{5}{8}$ O.D. TUBES TO FEMALE COOLING COIL CONNECTIONS.
SWEAT $\frac{1}{2}$ O.D. TUBES TO FEMALE HEATING COIL CONNECTIONS.

FAN-COIL UNITRANE® ELECTRIC CONTROL PACKAGE

TWO-SPEED SWITCH
(Unit-Mounted)

THREE-SPEED SWITCH
(Unit-Mounted)

CONTROL DESCRIPTION

Manual fan speed selection — place fan motor speed switch at desired position.

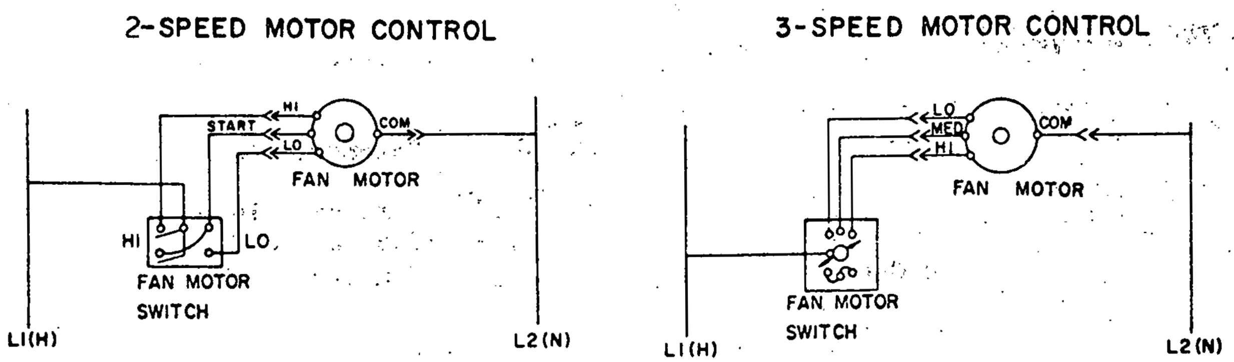
FEATURES

1. Designed and wired to conform to the National Electrical Code as a standard feature and for Underwriters' Laboratories Listing when indicated below and on order write-up.
2. Factory tested for electrical continuity.

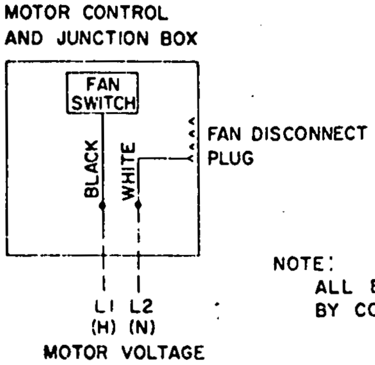
GENERAL NOTE

1. UniTrane control components (electric water valves excepted) are provided as standard for 115 through 240 volts.

CONTROL PACKAGE ORDER NUMBER .... H21 TWO SPEED MOTOR
[✓ H31 THREE SPEED MOTOR]
UNIT MODEL .... VERTICAL
UNIT SIZE .... 200-600 CFM
SYSTEM .... TWO PIPE
CONTROL .... TWO OR THREE SPEED SWITCH (USED WITHOUT ELECTRIC WATER VALVE)
NATIONAL ELECTRICAL CODE CONFORMANCE .... STANDARD
UNDERWRITERS' LABORATORIES LISTING .... YES
__ NO
MOTOR VOLTAGE .... [✓ 115/60/1]
230/50/1

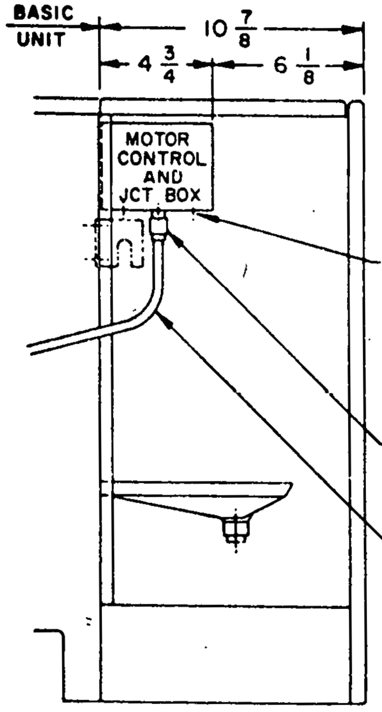


LINE DIAGRAMS



NOTE:
ALL BROKEN LINE WIRING BY CONTRACTOR.

CONTRACTOR WIRING DIAGRAM



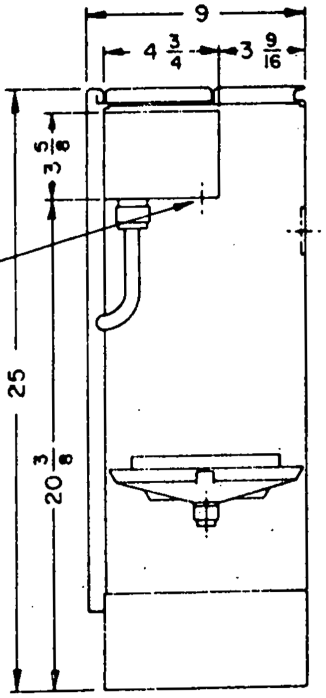
NOTE:
VERTICAL CABINET MODEL IS SHOWN, OTHER VERTICAL MODELS ARE SIMILAR

NOTE:
THREE 7/8 DIAMETER KNOCKOUTS AVAILABLE IN BOTTOM OF CONTROL BOX FOR CUSTOMER CONNECTION.

FAN DISCONNECT PLUG

FAN MOTOR CORD

FRONT VIEW
(FRONT PANEL REMOVED)



END VIEW
(END PANEL REMOVED)

THE TRANE COMPANY - LA CROSSE, WISCONSIN 54601

DATE SHIPPED	BILL OF LADING NO.	INVOICE DATE	ORDER-INVOICE NO.
			SQ3-E745

ARCHITECT: Soiuk, Mathre, Sathrum, Quanbeck

TERMS-30 DAYS NET: Net 30

F.O.B.: Scranton, Frt. Allowed

NO. INVOICE:

ENGINEER: Lewis D. Freeland

MARK PACKAGES: Mark bill of lading, "Shipper to notify Drummond Officer at (314) 449-0571 24 hours before delivery. Identify as Force-Flo".

PROJECT: Stephens College Visitor's Center

ORDER DATE: 1/11/78

CUSTOMER ORDER NUMBER: 1801-11

CUSTOMER ACCOUNT NO: Q3-43-5212-6

SHIP VIA: Best Way

COLLECT ☐ PREPAID ☒

SOLD TO:
Drummond-Officer Mechanical Contractors
Post Office Box 935
Columbia, Missouri 65201
(INCLUDE ZIP CODE)

SHIP TO:
Drummond-Officer Mechanical Contractors
c/o Stephens College Visitor's Center
Columbia, Missouri 65201
(INCLUDE ZIP CODE)

SHIP WITH:

ITEM	QUAN.	B.O.	ORDERING NUMBER	DESCRIPTION	PRODUCT CODE	PRICING
A	1		H46-A003	Vertical Recessed Force-Flo		
B	1		H46-A003	Vertical Recessed Force-Flo		

Shell White 3.24 8.93/1.8

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR
INCORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 3/6/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

ENTERED

Shipment wanted: ☐ OR SOONER ☐ SPECIFIED DATE ☐ HOLD UNTIL DATE CONFIRMED

☐ HOLD FOR APPROVAL

NO. OF PRINTS

☐ APPROVAL NOT REQUIRED

SPECS. OK

PPD. TRANSPORTATION

ORDER CLASS | JOB NO. | CREDIT AUTHOR. | TAX STATUS | TAX CODE | TAX AMOUNT

SALES ORDER NUMBER: SQ3-E745

OFFICE SALES MEN & RATE

BILLING: ☐ LUMP SUM

NO.: P

SHEET 1 OF 2

VERTICAL FORCE FLO SPECIFICATIONS

SOLD TO: **Drummond-Officer**

CUSTOMER ORDER NO.: **1801-11**

TAG: **Stair "A"**

ITEM A	QTY. 1		APPROVAL DWG.		
COIL SUPPLY	☐ L.H.	☒ R.H.	SERIAL NO.		
MODEL NO. H46-A003			CFM 300		
	B	VERT. CABINET		M	INVERTED VERT.CAB
	F	VERT. CAB. WALL HUNG		N	INVERTED VERT. REC.
X	H	VERT. RECESSED			
	1	INTEGRAL DISCHARGE			
	3	DUCT COLLAR DISCHARGE			
X	4	FRONT INTEGRAL DISCHARGE			
	1	INTEGRAL GRILLE INLET			
	2	RETURN AIR TOE SPACE			
	4	DUCT COLLAR			
	5	BACK 100 PCT. FRESH AIR OPENING			
X	6	FRONT INTEGRAL RETURN AIR GRILLE			
X	AO	STANDARD WATER COIL		EO	ELECTRIC COIL
	BO	STEAM COIL		FO	STEAM DISTR. COIL
COIL SERVICE		SINGLE HT. ☐ DUAL HT. ☐		VOLT	PH
X	E-2	1" THROWAWAY		E-4	1" REPLACEABLE MEDIA
	E-3	1/2" PERMANENT		E-5	2" RENEWABLE MEDIA
	F-2	AUTO AIR VENT	X	F-3	MANUAL AIR VENT
	G-1	2-SPD. 115/60/1 RW-SHP		G-5	3-SPD. 230/50/1 PSC
X	G-2	3-SPD. 115/60/1 SHP		G-6	3-SPD. 230/60/1 PSC
	G-3	3-SPD. 115/60/1 PSC		G-7	3-SPD. 230/50/1 SHP
H. 31		Motor switch - unit mounted			
		CONTROL DWG.			

FINISH: **Baked enamel**

ACCESSORIES & SPECIAL FEATURES

CAPACITY DATA

BTU/HR. 21.7
CFM 300
ENT. AIR TEMP. 65°
ENT. WATER TEMP. 180°
GPM 1.25
PD. FT. 0.4
STEAM PSI

UNIT LIST PRICE

ITEM LIST TOTAL

TAG: **Stair "B"**

ITEM B	QTY. 1		APPROVAL DWG.		
COIL SUPPLY	☒ L.H.	☐ R.H.	SERIAL NO.		
MODEL NO. H46-A003			CFM 300		
	B	VERT. CABINET		M	INVERTED VERT.CAB
	F	VERT. CAB. WALL HUNG		N	INVERTED VERT. REC.
X	H	VERT. RECESSED			
	1	INTEGRAL DISCHARGE			
	3	DUCT COLLAR DISCHARGE			
X	4	FRONT INTEGRAL DISCHARGE			
	1	INTEGRAL GRILLE INLET			
	2	RETURN AIR TOE SPACE			
	4	DUCT COLLAR			
	5	BACK 100 PCT. FRESH AIR OPENING			
X	6	FRONT INTEGRAL RETURN AIR GRILLE			
X	AO	STANDARD WATER COIL		EO	ELECTRIC COIL
	BO	STEAM COIL		FO	STEAM DISTR. COIL
COIL SERVICE		SINGLE HT. ☐ DUAL HT. ☐		VOLT	PH
X	E-2	1" THROWAWAY		E-4	1" REPLACEABLE MEDIA
	E-3	1/2" PERMANENT		E-5	1 2" RENEWABLE MEDIA
	F-2	AUTO AIR VENT	X	F-3	MANUAL AIR VENT
	G-1	2-SPD. 115/60/1 RW-SHP		G-5	3-SPD. 230/50/1 PSC
X	G-2	3-SPD. 115/60/1 SHP		G-6	3-SPD. 230/60/1 PSC
	G-3	3-SPD. 115/60/1 PSC		G-7	3-SPD. 230/50/1 SHP
H31		Motor switch - unit mounted			
		CONTROL DWG.			

FINISH: **Baked enamel**

ACCESSORIES & SPECIAL FEATURES

CAPACITY DATA

BTU/HR. 21.4
CFM 300
ENT. AIR TEMP. 65°
ENT. WATER TEMP. 180°
GPM 1.20
PD. FT. 0.4
STEAM PSI

UNIT LIST PRICE

ITEM LIST TOTAL

SPACE BELOW THIS LINE FOR FACTORY USE ONLY

UNIT BASIC DWG.

CONTROL DWG.

SPACE BELOW THIS LINE FOR FACTORY USE ONLY

UNIT BASIC DWG.

CONTROL DWG.

SALES ORDER NUMBER

SQ3-E745

SHEET 2 OF 2

FORCE-FLO CABINET HEATER
200-600 CFM VERTICAL RECESSED
MODEL H

MECHANICAL SPECIFICATIONS

BASIC UNIT — Basic unit includes 18 gauge steel chassis, coil, fan board, fan(s), fan housing(s) and motor. Chassis is acoustically and thermally insulated with heavy density glass fiber insulation.

CABINET — Front panel is constructed of 16 gauge steel and provides four-side overlap. Panel may be removed by lifting two screws. Front panel is cleaned, bonderized, phosphatized and flow-coated with baked-on primer. Optional final finish of spray applied baked-on enamel. Prime and final finishes meet Corps of Engineers' Specifications CE 301.35 and CE 301.37 (salt spray test).

WATER COILS — Configurated aluminum fins with continuous fin collars and sleeved coil end supports are mechanically bonded to 5/8 inch OD copper tubes. Maximum working pressure 300 psig, factory burst tested at 450 psig (air) and leak tested at 300 psig (air under water). Maximum entering water temperature is 275 F.

STEAM COILS — Configurated aluminum fins with continuous fin collars and sleeved coil end supports are mechanically bonded to 1 inch OD copper tubes. Maximum working pressure is 75 psig, factory leak tested at 250 psig (air under water). Maximum entering steam temperature is 325 F for standard coil and 400 F for steam distributing coil.

ELECTRIC COILS — Fin-tube type construction with resistance elements inserted in tubes. Wiring is factory completed and includes unit mounted magnetic contactors, high temperature cutout control and fan override switch.

FANS — Fan wheels are centrifugal, forward-curved, double width. Constructed of molded, thermo-plastic material and reinforced with fiber glass. Fan housings are molded polyester resin, fiber reinforced.

FILTERS — Replaceable by removing front panel. Filter options include: (1) 1 inch throw-away of woven glass fiber, (2) ½ inch permanent, cleanable aluminum mesh, (3) ½ inch permanent frame with renewable Scotfoam media and (4) 1 inch permanent frame with replaceable woven glass fiber.

ELECTRICAL PERFORMANCE — All cataloged units are wired in accordance with the National Electrical Code. Available optionally as Listed by Underwriters' Laboratories, Incorporated. Junction box for motor cord provided only when speed control is ordered.

MOTORS — All motors have integral thermal overload protection. Motors operate satisfactorily at 90% of rated voltage on all speed settings and at 10% overvoltage without undue magnetic noise. Temperature rise by winding resistance method does not exceed 60C (shaded pole) and 50C (PSC) on high speed. All motors are factory run tested in assembled unit prior to shipping.

TABLE I—Motor RPM

MOTOR	VOLTAGE	MOTOR RPM	
		UNIT SIZE	
		02-03	04-06
G1 (RWSP)	115 60 1	1100 500	1075 500
G2 (SP)	115 60 1	1100 900 700	1075 900 700
G3 (PSC)	115 60 1	1100 900 700	1075 900 700
G7 (SP)	230 50 1	1100 900 700	1075 900 700

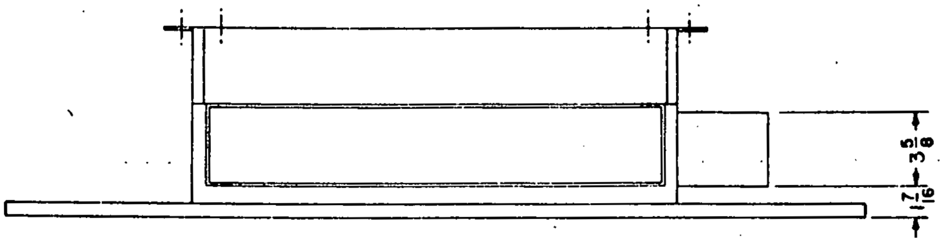
FORCE-FLO CABINET HEATER

200-600 CFM VERTICAL RECESSED

MODEL H

TABLE 2 – UNIT DIMENSIONS

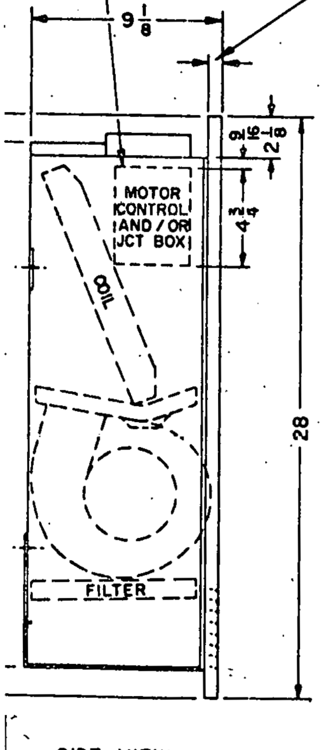
	UNIT SIZE	CFM	NO OF FANS	A	B	C	D	E	F	G
	02	200	1	39	20	15 3/4	19 11/16	17 1/2	15 3/4	22
✓	03	300	1	47	28	23 3/4	27 11/16	25 1/2	23 3/4	30
	04	400	2	51	32	27 3/4	31 11/16	29 1/2	27 3/4	34
	06	600	2	63	44	39 3/4	43 11/16	41 1/2	39 3/4	46



TOP VIEW

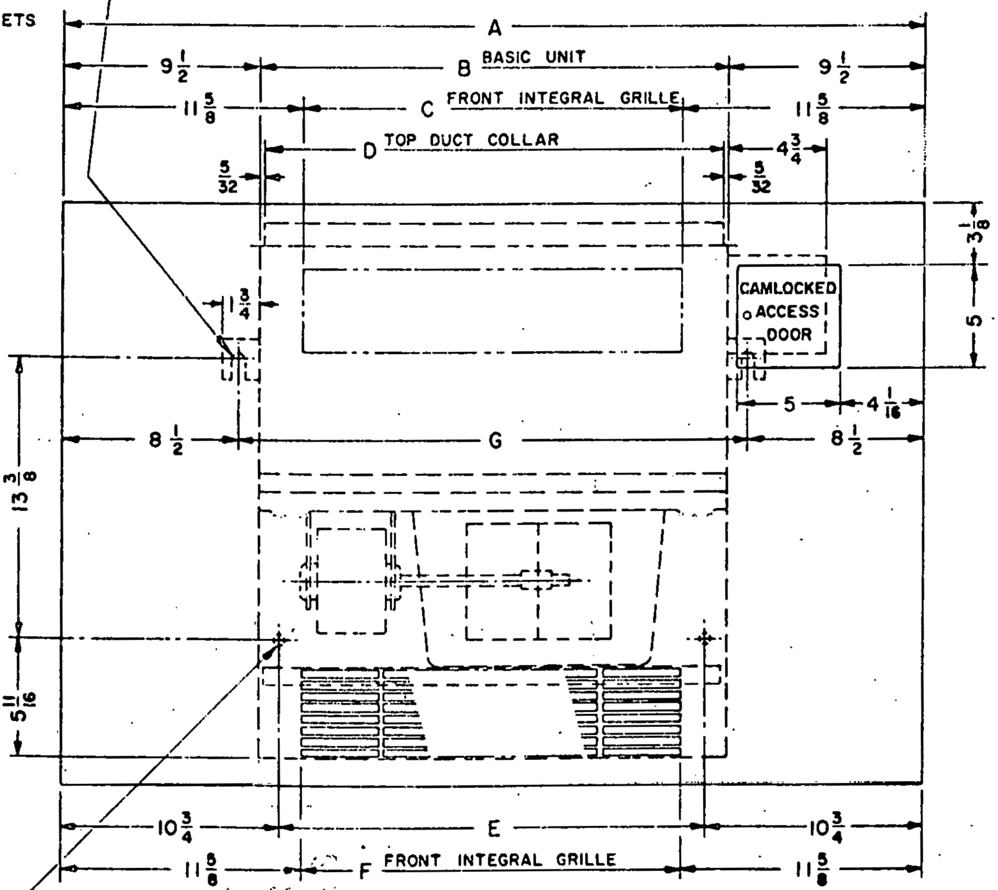
TE:
- SEE MOTOR CONTROL SUBMITTAL FOR ELECTRICAL ROUGHING-IN DETAILS.
- JUNCTION BOX FURNISHED UNLESS OTHERWISE SPECIFIED.
- MOTOR CONTROL AND ACCESS DOOR ALWAYS ON RIGHT HAND SIDE OF UNIT.

NOTE:
SEE AVAILABLE OUTLETS FOR PANEL DEPTH.



SIDE VIEW

TWO 5/8 X 1 5/16 OPEN SLOTS FOR ANCHORING UNIT.

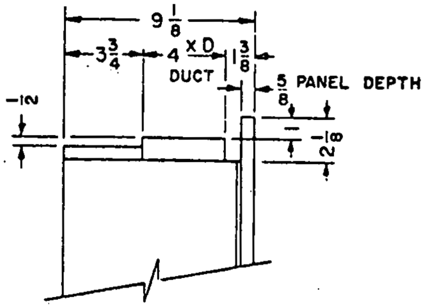


TWO 1/2 DIA HOLES FOR ANCHORING UNIT.

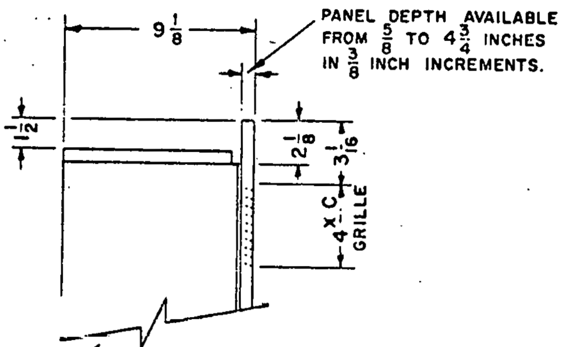
UNIT SHOWN WITH OUTLET #3, INLET #6.

FRONT VIEW

OUTLETS

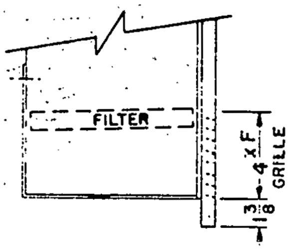


☐ 3. TOP DUCT COLLAR



☑ 4. FRONT INTEGRAL GRILLE

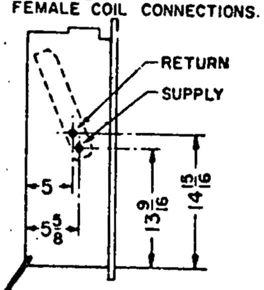
INLETS



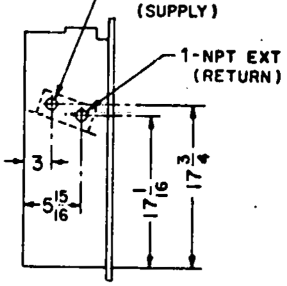
☑ 6. FRONT INTEGRAL GRILLE

HEATING COILS

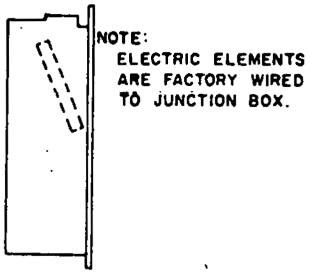
OTE:
SWEAT 5/8 O.D. TUBES TO FEMALE COIL CONNECTIONS.



☑ AO
I-ROW WATER COIL

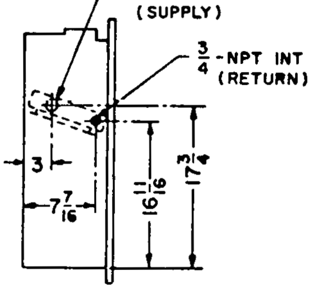


☐ BO
I-ROW STEAM COIL



NOTE:
ELECTRIC ELEMENTS ARE FACTORY WIRED TO JUNCTION BOX.

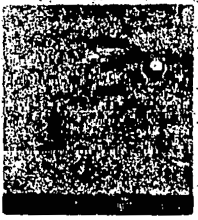
☐ EO
ELECTRIC COIL – AVAILABLE WITH R.H. UNIT ONLY.



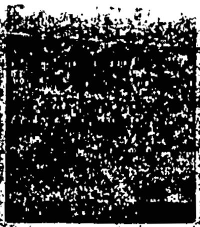
☐ FO
I-ROW STEAM DISTRIBUTING COIL

COMMERCIAL AIR CONDITIONING DIVISION

FORCE-FLO
CABINET
HEATER
ELECTRIC
CONTROL
PACKAGE



TWO-SPEED SWITCH
(Unit-Mounted)



THREE-SPEED SWITCH
(Unit-Mounted)

CONTROL DESCRIPTION

Manual fan speed selection — place fan motor speed switch at desired position.

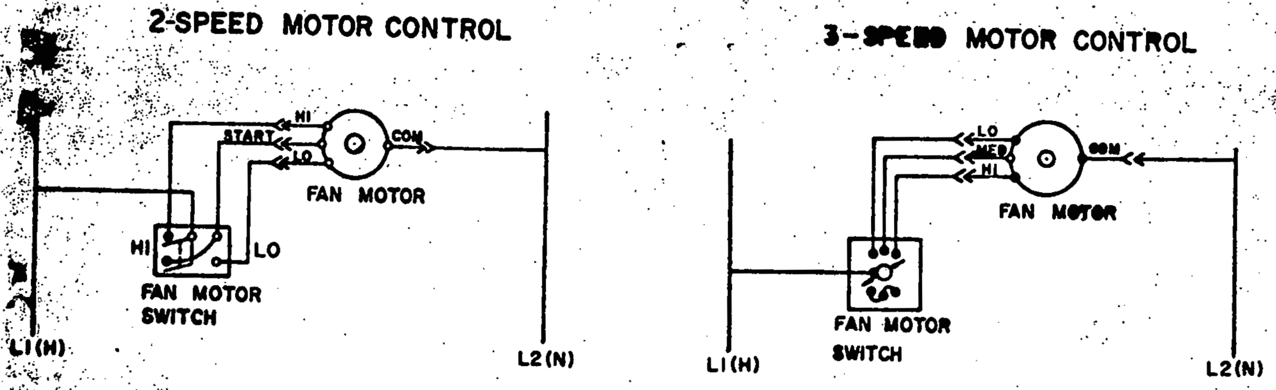
FEATURES

1. Each Force-Flo Cabinet Heater control package is designed and wired to conform to the National Electrical Code as a standard feature and for Underwriters' Laboratories Listing when indicated below and on order write-up.

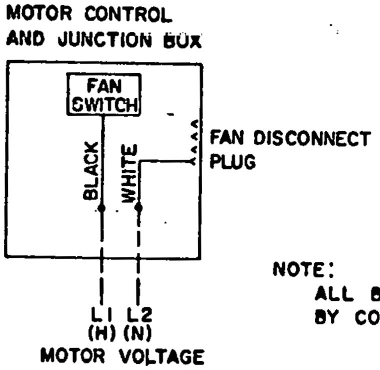
GENERAL NOTE

1. Force-Flo control components are provided as standard for 115 through 240 volts.

CONTROL PACKAGE ORDER NUMBER .... ☐ H21 TWO-SPEED SWITCH
☑ H31 THREE-SPEED SWITCH
UNIT MODEL .... VERTICAL AND HORIZONTAL
UNIT SIZE .... 200-600 CFM
NATIONAL ELECTRICAL CODE CONFORMANCE .... STANDARD
UNDERWRITERS' LABORATORIES LISTING .... ☐ YES
☐ NO
MOTOR VOLTAGE .... ☑ 115/60/1
☐ 230/50/1

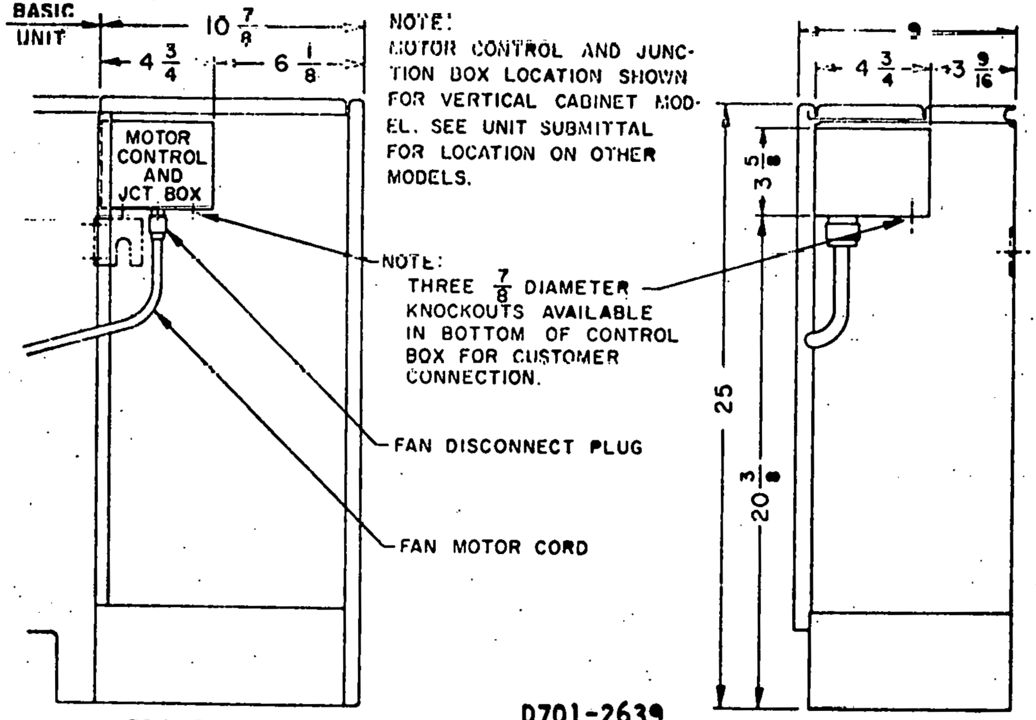


LINE DIAGRAMS



NOTE:
ALL BROKEN LINE WIRING BY CONTRACTOR.

CONTRACTOR WIRING DIAGRAM



NOTE:
MOTOR CONTROL AND JUNCTION BOX LOCATION SHOWN FOR VERTICAL CABINET MODEL. SEE UNIT SUBMITTAL FOR LOCATION ON OTHER MODELS.

NOTE:
THREE 7/8 DIAMETER KNOCKOUTS AVAILABLE IN BOTTOM OF CONTROL BOX FOR CUSTOMER CONNECTION.

FAN DISCONNECT PLUG

FAN MOTOR CORD

FRONT VIEW
(FRONT PANEL REMOVED)

D701-2639

END VIEW
(END PANEL REMOVED)

TRANE® Convector-Water or Steam

DATE SHIPPED	BILL OF LADING NO.	INVOICE DATE	ORDER-INVOICE NO.
			SQ3-E746

TERMS-30 DAYS NET	F.O.B.	NO. INVOICE COPIES
Net 30	Scranton, Frt. Allowed	

ARCHITECT
Souik, Mathre, Sathrum, Quanbeck

ENGINEER
Lewis D. Freeland

PROJECT
Stephens College Visitor's Center

MARK PACKAGES
Mark bill of lading, "Shipper to notify Dru
Officer at (314) 449-0571 24 hrs. before
delivery. Identify as Convectors".

ORDER DATE	CUSTOMER ORDER NO.	CUSTOMER ACCOUNT NO.
1/11/78	1801-11	Q3-43-5212-6

SHIP VIA
Best Way

COLLECT ☐ PREPAI ☒

SOLD TO
Drummond-Officer Mechanical Contractors
Post Office Box 935
Columbia, Missouri 65201

(INCLUDE ZIP CODE)

SHIP TO
Drummond-Officer Mechanical Contractors
c/o Stephens College Visitors Center
Columbia, Missouri 65201

PRODUCT CODE 13

SHIP WITH

ITEM	QTY.	TYPE	SIZE (INCHES)			RE-CESS	PANEL GAGE	DMPR.	CAPACITY DATA					TAGGING	PRICING			
			DPTH	LGTH	HGTH				EAT	PSIG OR H_2O TEMP.	ΔT H_2O	EDR	MBH		UNIT TRADE	ADD PER EDR	EXTENSION UNIT	EXTENSION EDR
A	1	RG	6	44	32				65°	180	20		6.5					
B	2	SW	8	56	26				65°	180	20		13					
C	1	SW	4	38	24				65°	180	20		3.7					
D	1	SW	6	38	26				65°	180	20		6.5					

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR
CORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 3/7/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

DRUMMOND-OFFICER
Mech. [illegible]
Date:
Checked:

SUPPLEMENTARY INFORMATION:

Item A to have Inlet Grille

Item A to have Bottom Overlap - Type RG

Items A, B, C & D to have Baked Enamel Finish SHELL WHITE 3.24 8.93/18

PAPERWORK ENTERED	Shipment wanted ☐ OR SOONER ☐ NOT BEFORE ☐ HOLD UNIL DATE CONFIRMED	☐ HOLD FOR APPROVAL ____ PRINTS REQUIRED ☐ APPROVAL NOT REQUIRED	SPECS. OK	PREPAID TRANS.

ORDER CLASS	JOB NO.	CREDIT OK	TAX OR PERMIT NUMBER	TAX CODE	AMOUNT

OFFICE SALES MEN & RATE

BILLING
☐ LUMP SUM
☐ NET PACK

NO.
P
S

SALES ORDER NUMBER
SQ3-E746

SHEET 1 OF 1

FILE INFORMATION

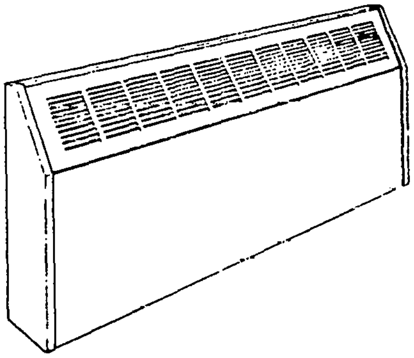
DIVISION TAB – TRANE HEATING PRODUCTS
PRODUCT TAB – CONVECTORS
LITERATURE ITEM – Submittal

LITERATURE FILE NO.

CON · S · 1

SUBMITTAL

OCTOBER, 1977



CONVECTORS

WALL MOUNTED, FREE STANDING AND RECESSED

ELEMENTS

Convector elements are suitable for use with hot water or two-pipe steam systems. Elements are constructed of seamless copper tubes, non-ferrous fins, cast iron headers, ribbed steel side plates and steel element end supports. Fins contain flanged collars to provide proper fin spacing and permanent contact with the tubes which are expanded mechanically into the fin collars. Tubes are expanded and "rolled" into the headers with additional strength provided by tapered brass bushings.

Element support assemblies are mounted to vertical unit brackets which provide ample end panel clearance. Vertical brackets are adjustable to allow pitching of elements.

All elements shall withstand 100 lb. air pressure factory tested under water.

CABINETS

Free Standing and Wall Mounted cabinets contain recessed and framed outlet frilles. Fronts are secured at the top by a mounting channel and at the bottom by two front panel gasteners on all Wall and Floor Mounted units. Cabinets and fronts are phosphatized and painted inside and out with one coat of grey primer. Front and top panels are 16 or 14 gauge steel.

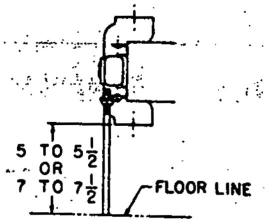
Extruded grille unit contains anodized, aluminum grille which locks to wall mounting channel and the front panel.

Recessed units have a one piece front panel offered in a choice of 16 or 14 gauge steel with integral, free-flow grille perforations. Panel edges are formed back at top and sides with 1/4" radius. All corners are drawn and panel edges are straight and in the same plane.

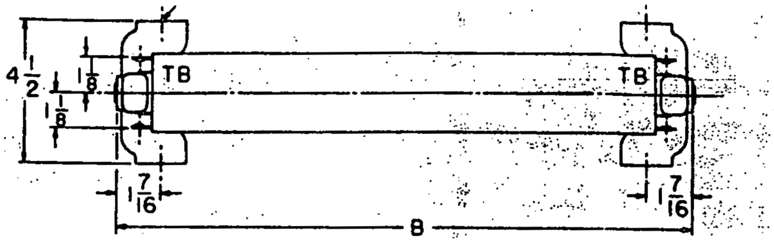
Dampers are factory installed and are operated by a chain and dial assembly. In the closed position, heating capacity is reduced 70 percent.

DESCRIPTION OF TYPES

W - Flat Top, Wall Mounted
AW - Flat Top, Wall Mounted With Extruded Aluminum Outlet Grille
SW - Sloping Top, Wall Mounted
FG - Free Standing With Inlet Grille
FK - Free Standing With Arched Inlet
AG - Free Standing, Inlet Grille, Extruded Aluminum Outlet Grille
AK - Free Standing, Arched Inlet, Extruded Aluminum Outlet Grille
SFG - Sloping Top, Free Standing With Inlet Grille
SFK - Sloping Top, Free Standing With Arched Inlet
RG - Fully Recessed With Inlet Grille
RK - Fully Recessed With Arched Inlet
SG - Semi Recessed With Inlet Grille
SK - Semi Recessed With Arched Inlet



☐ **MOUNTING LEG**

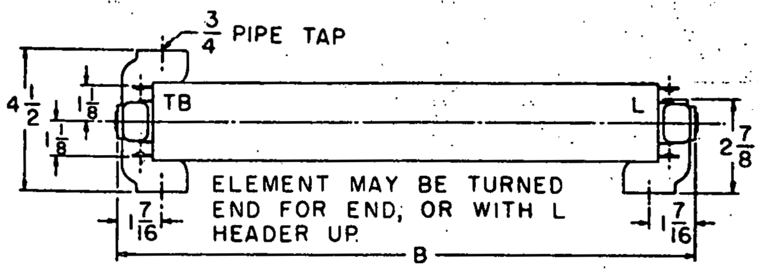


☐ **ELEMENT-TB-TB**

TABLE 1 – Element Dimensions

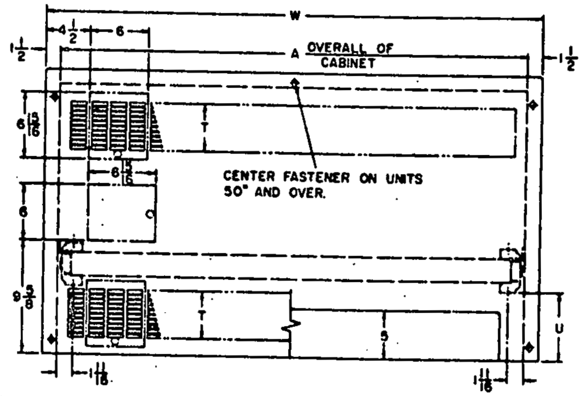
LENGTH B	25½	31½	37½	43½	49½	55½	61½

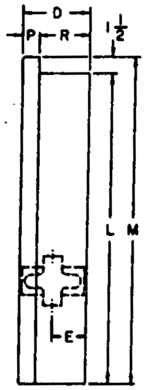
All Dimensions are given in inches.



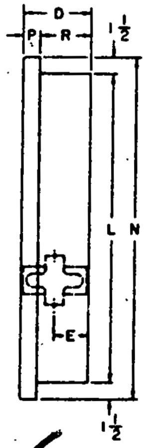
☐ **ELEMENT-TB-L**

RECESSED-TYPES RG, RK, SG AND SK





☐ **TYPES RK, RG, SK, SG THREE SIDE OVERLAP**



☒ **TYPES RG, SG FOUR SIDE OVERLAP**

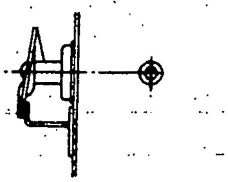
TABLE 2 – Cabinet Dimensions

LENGTH W	29	35	41	47	53	59	65

TABLE 3 – Cabinet Dimensions, Recessed Units

TYPE RK, RG, SK, SG																							
DEPTH "D" — 4								DEPTH "D" — 6								DEPTH "D" — 8							
E	L	M	N	P	R	T	U	E	L	M	N	P	R	T	U	E	L	M	N	P	R	T	U
2	14	15½	17	7/16 OR 1½	3 5/16 OR 2½	4	4¼	3	16	17½	19	7/16 OR 2½	5 5/16 OR 3½	5	5⅛	4	20	21½	23	7/16, 2½ OR 4½	7 7/16, 5½ OR 3½	5	5⅛
	18	19½	21			5	5⅛		20	21½	23						26	27½	29				
	24	25½	27						26	27½	29						32	33½	35				
	30	31½	33						32	33½	35						38	39½	41				
	36	37½	39						38	39½	41												

ACCESS DOOR FASTENERS



CAMLOCK FASTENER

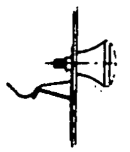
☐ **ALLEN HEAD**

TABLE 4 – Unit Minimum Height (DimL) Limitations For Access Doors

DEPTH	ACCESS DOOR IN PANEL	ACCESS DOOR IN INLET GRILLE	ACCESS DOOR IN OUTLET GRILLE	
			WITH DAMPER	WITHOUT DAMPER
4	24	18	24	18
6	26	20	26	20
8	26	20	26	20

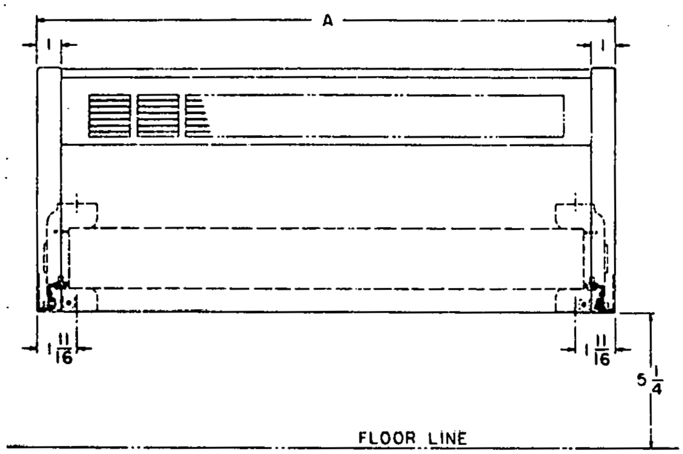
NOTE: ADD 2" TO TAPPING DIMENSION "U" WHEN ACCESS DOOR IS LOCATED IN INLET GRILLE.

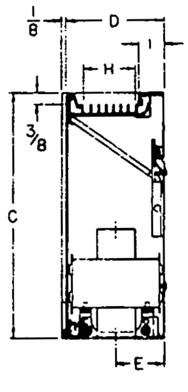
All Dimensions are given in inches.



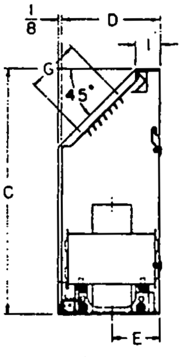
☐ **SPRING CATCH**

WALL MOUNTED-TYPES SW, AW AND W

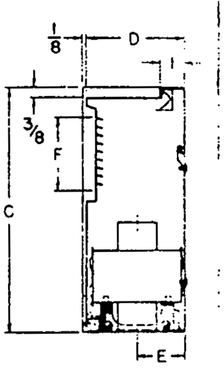




☐ TYPE AW



☒ TYPE SW



☐ TYPE W

TABLE 5 – Cabinet Dimensions, All Types

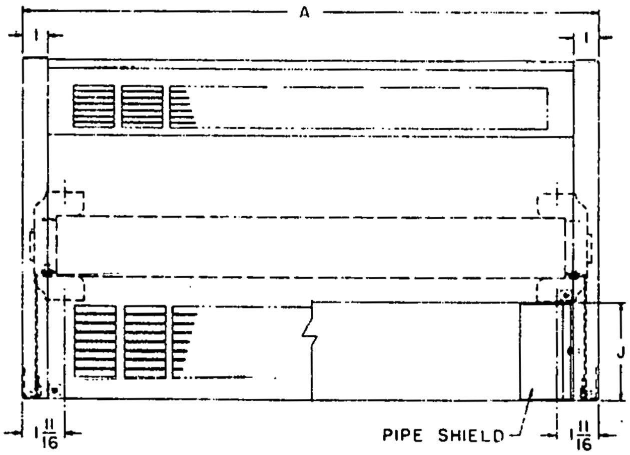
LENGTH A	26	32	38	44	50	56	62

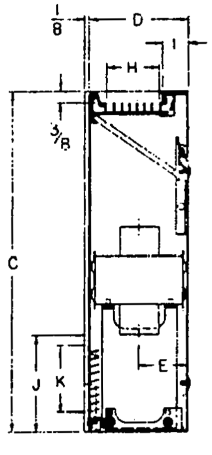
All Dimensions are given in inches.

TABLE 6 – Cabinet Dimensions, Wall Mounted Units

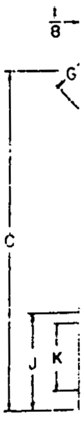
TYPE W & SW												TYPE AW					
DEPTH "D" — 4				DEPTH "D" — 6				DEPTH "D" — 8				DEPTH "D" — 4			DEPTH "D" — 6		
C	E	F	G	C	E	F	G	C	E	F	G	C	E	H	C	E	H
10	2	3	2 ⅝	12	3	4	4 ⅝	16	4	5	7 ⅜	10	2	2 ⅛	12	3	4
14				16				20				14			16		
18				20				26				18			20		
24				26				32				24			26		
30				32								30			32		

FREE STANDING-TYPES SFG, SFK, AG, AK, FG AND FK





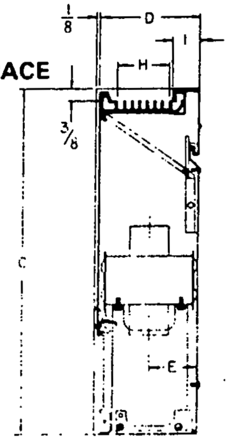
☐ TYPE AG



☐ T

All Dimensions are given in inches.

OPEN KICK SPACE



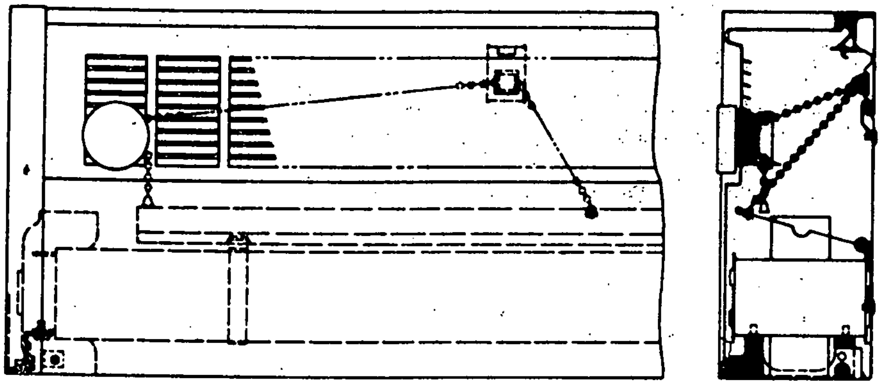
☐ TYPE AK

☐ T

TABLE 7 – Cabinet Dimensions, Free Standing Units

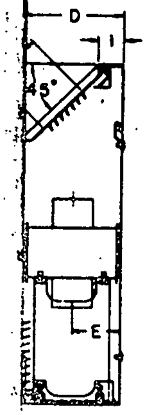
TYPE FG, FK, SFG & SFK																		TYPE AG & AK									
DEPTH "D" — 4						DEPTH "D" — 6						DEPTH "D" — 8						DEPTH "D" — 4					DEPTH "D" — 6				
C	E	F	G	J	K	C	E	F	G	J	K	C	E	F	G	J	K	C	E	H	J	K	C	E	H	J	K
14	2	3	2 ⅝	4	3	16	3	4	4 ⅝	4	3	20	4	5	7 ⅜	4	3	14	2	2 ⅛	4	3	16	3	4	4	3
18				4	3	20				4	3	26				6	5	18			4	3	20			4	3
24				6	5	26				6	5	32				6	5	24			6	5	26			6	5
30				6	5	32				6	5	38				6	5	30			6	5	32			6	5
36				6	5	38				6	5							36			6	5	38			6	5

"J" DIMENSION IS FOR : FK, SFK AND AK UNITS ONLY

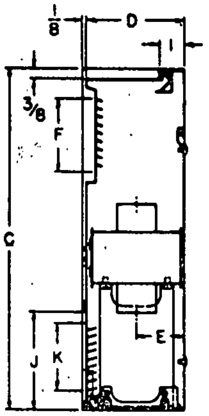


DETAIL OF DAMPER MOUNTING — ALL UNITS (TYPE W SHOWN)

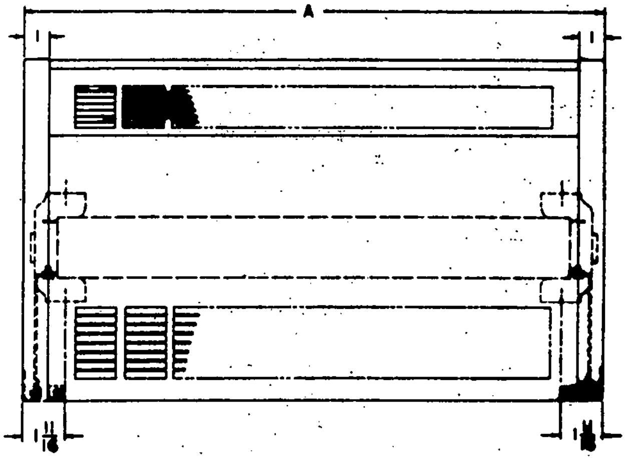
☐ DAMPER



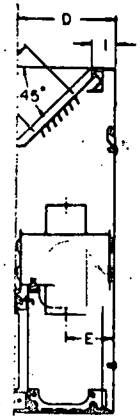
YPE SFG



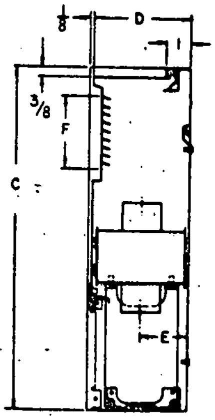
☐ **TYPE FG**



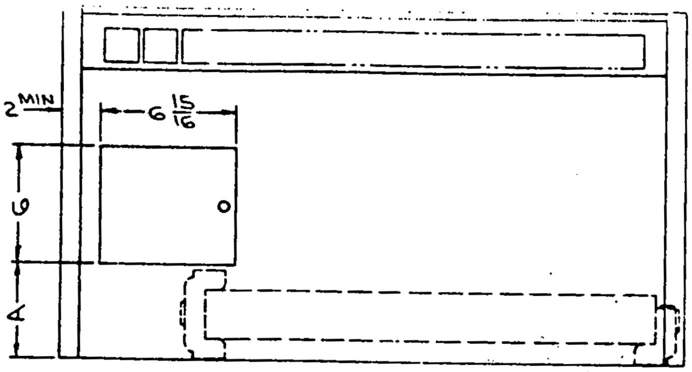
DETAIL OF FREE STANDING CONVECTOR WITH FRONT INLET GRILLE



YPE SFK

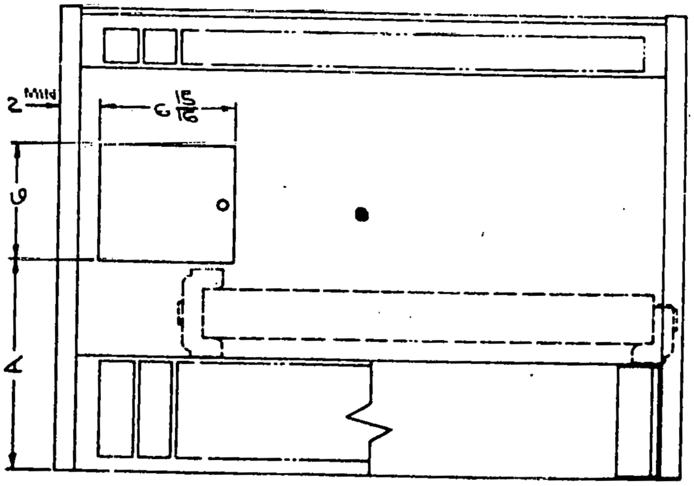


☐ **TYPE FK**



TYPE W, SW AND AW WALL MOUNTED CONVECTOR

END POCKET OPTIONAL



TYPE FK, FG, SFK, SFG, AK and AG FREE STANDING CONVECTOR

END POCKET OPTIONAL

TABLE 8 – Minimum Height and Dimensional Limitations for Camlock and Spring Catch Access Doors

DEPTH	HEIGHT	CONVECTOR TYPE											
		W		SW		AW		FK-FG		SFK-SFG		AK-AG	
		A DIMENSION											
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
4	10	●		●		●		■		■		■	
	14	●		●		4½	6⅛	●		●		●	
	18	4½	6¼	4½	7⅞	4½	10⅛	●		●		8½	10⅛
	24	4½	12¼	4½	13⅞	4½	16⅛	10½	12¼	10½	13⅞	10½	16⅛
	30	4½	18¼	4½	19⅞	4½	22⅛	10½	18¼	10½	19⅞	10½	22⅛
	36	■		■		■		10½	24¼	10½	25⅞	10½	28⅛
6	12	●		●		●		■		■		■	
	16	●		●		4½	8⅛	●		●		●	
	20	4½	7¼	4½	7⅞	4½	12⅛	●		●		8½	12⅛
	26	4½	13¼	4½	13⅞	4½	18⅛	10½	13¼	10½	13⅞	10½	18⅛
	32	4½	19¼	4½	19⅞	4½	24⅛	10½	19¼	10½	19⅞	10½	24⅛
	38	■		■		■		10½	25¼	10½	25⅞	10½	30⅛
8	16	●		●		■		■		■		■	
	20	4½	6¼	4½	5⅞	■		●		●		■	
	26	4½	12¼	4½	11⅞	■		10½	12¼	10½	11⅞	■	
	32	4½	18¼	4½	17⅞	■		10½	18¼	10½	17⅞	■	
	38	■		■		■		10½	24¼	10½	23⅞	■	

● Access door not available

■ Convector not available in this size

NOTE:

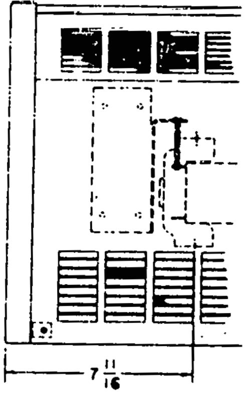
Access door will be furnished at minimum locations unless otherwise specified on sales order.

Access doors can be furnished without end pockets.

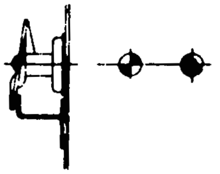
Access doors not available in outlet or inlet grilles.

All Dimensions are given in inches.

6" END POCKET



ACCESS DOOR FASTENERS



CAMLOCK FASTENER

☐ ALLEN HEAD

☐ SPRING CATCH

THE **TRANE** COMPANY - LA CROSSE, WISCONSIN 54601

SUBMITTAL DATA

ARCHITECT
Soink, Mathre, Sathrum, Quanbeck

ENGINEER:
Lewis D. Freeland

PROJECT:
Stephens College Visitor's Center

ORDER DATE	CUSTOMER ORDER NUMBER	CUSTOMER ACCOUNT NO
1/11/78	1801-11	Q3-43-5212-6

SOLD TO
Drummond-Officer Mechanical Contractors
Post Office Box 935
Columbia, Missouri 65201
(INCLUDE ZIP CODE)

APPROVAL STAMP

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR CORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 2/17/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

Section 1530 cc

DRUMMOND-OFFICER
Mech. Contractors, Inc.
Date: 1-24-78
Checked: WD

TAG: **AHU-3** | CLCH 50 | 2808-3713 | SUBMITTAL DRWG.

QUAN OF UNITS: **1** | SIZE: **6**

MODEL (1): ☐ 1-LPH ☐ 2-MPH ☒ 3-LPV ☐ 4-MPV ☐ 5-LPMZ ☐ 6-MPMZ ☐ 7-LPDD ☐ 8-MPDD
☐ 1-AFLPH ☐ 3-AFLPV ☐ 5-AFLPMZ ☐ 7-AFLPDD

FAN

DISCHARGE ARRANGEMENTS
☒ FC ☐ AF ☐ BI
☐ 8" EXT. CASING

HORIZONTAL: ☐ 1-TOP H ☐ 2-BOTTOM H ☐ 3-FRONT V ☐ 4-BACK V

VERTICAL: ☒ 1-BACK V ☐ 2-FRONT V ☐ 3-BACK H ☐ 4-FRONT H

MULTI-ZONE: ☐ 1-FRT RODS TOP ☐ 2-FRT RODS BOT ☐ 3-TOP RODS FRT ☐ 4-TOP RODS BACK ☐ ZONES (#)

DOUBLE DUCT: ☐ 1-FRT ☐ 2-TOP

2000 SCFM	1/2" ESP	1.2 TSP	.65 BHP	949 RPM

COIL SPECIFICATIONS / CAPACITY / FLUID / COIL NO. 812

QTY PER UNIT	COILS	COIL TYPE (2)	SIZE WIDE	SIZE LONG	SERIES	TUBES Rows	TUBES Mat'l (3)	SUPPLY	TURBS/CIRC (4)	KW/MBH	EAT DB WB	LAT DB/WB	TYPE (5)	GPM OR PRESS	TEMP IN OUT	WATER ΔP FEET OF H_2O	COIL NO.
	PREHEAT SECTION																
1	FIRST IN CASING	WC	~~18~~	45	16	1	A	L	0	27.9	50	73	HW	8.6	100/94	1.0	
1	SECOND IN CASING	WC	~~18~~	45	15	1	A	L	0	27.9	50	73	HW	2.7	180/141	0.2	
1	~~MULTI ZONE HOT DECK~~	F2	18	45	15	4	A	L		68.3	80/67	56/55	22		42°		

ACCESSORIES

INT. F & BP ☐ F-1 RODS R ☐ F-2 RODS L
EXT. F & BP ☐ G-1 w/duct R ☐ G-2 w/duct L ☐ G-3 L/duct R ☐ G-4 L/duct L ☐ G-5 w/duct R ☐ G-6 w/duct L
1 FILTER BOX ☒ J-FLAT ☐ K-MED ☐ L-HIGH ☐ LESS FILTERS ☒ 1-TA ☐ 2-LV PERM ☐ 3-HV PERM
COMB F/M BOX ☐ M-90 OPENING ☐ BOT/BACK ☐ TOP/BACK ☐ N-OPP ☐ RODS ☐ R ☐ L
FILTERS ☐ 1-TA ☐ 5-TA ☐ 2-LV PERM ☐ 6-LV PERM ☐ 3-HV PERM ☐ 7-HV PERM
MIXING BOX ☐ O-90 OPENING ☐ BOT/BACK ☐ TOP/BACK ☐ P-OPP ☐ 1 ☐ 2 RODS ☐ R ☐ L
PREHEAT COIL SECTION ☐ S ELECTRIC PREHEAT ☐ U
HUMIDIFIERS WATER SPRAY ☐ T-1R ☐ T-2L STEAM GRID ☐ T-3R ☐ T-4L
MZ BAFFLE ☐ V-1 40 HD ☐ V-2 60 HD ☐ V-3 70 HD ☐ V-7 22 HD ☐ V-4 40 CD ☐ V-5 60 CD ☐ V-6 70 CD ☐ V-8 22 CD
GALV. DRAIN PAN LINER ☐ DT ☐ BT

ORDERING NUMBER

1 **Magnetic starter Nema Type 1, Size 00, 200/60/30**
1 **Two button push button station Nema Type 1**

DRIVE

ISOLATORS: ☒ FLOOR ☐ CEILING ☐ RIS ☐ SPRING **by others**
1 DRIVE: 949 RPM ☒ VARIABLE ☐ 1.2 MHP ☒ 1.5 MHP ☐ ENCL. BELT GD
1 MOTOR 1 HP 208 V 60 C 3 PH SHAFT FRAME ☐ R ☒ L
TYPE open RPM 1750

MODEL (1)
LP - Low Pressure
MP - Med. Pressure
AF - Airfoil
MZ - Multi-Zone
DD - Double Duct
H - Horizontal
V - Vertical

COOLING COILS (2)
W - Standard Water
D - Drainable
DD - Double Circuit Drainable
K - Cleanable
F 1 - Refrigerant - 12
F 2 - Refrigerant - 22

HOT WATER COILS (2)
AW - Single Pass Opposite End Connections
WS - Two Pass Same End Connections

STEAM COILS
A - Single Pass Opposite End Connections
N - Non Freeze Opposite End Connections
NS - Non Freeze Same End Connections

TUBE MATERIAL (3)
A - Standard Copper
C - .035 Red Brass
D - .049 Red Brass

TURBULATORS (4)
O - Without
T - With

CIRCUITS
Tubes Fed

FLUID TYPE (5)
12 Refrigerant - 12
22 Refrigerant - 22
CW - Chilled Water
HW - Hot Water
ST - Steam
SP - Special

MECHANICAL SPECIFICATIONS - STANDARD CLIMATE CHANGERS

CASINGS - Removable Panels Phosphatized and Painted
COILS - Plate Fins - Seamless copper tubes with galvanized steel casings. All coils are pitched in the unit.
FANS - Forwardly Curved - in LP and MP units in Size 31 and smaller.
Backwardly Inclined in LP units Size 35 and larger.
Air Foil in MP and AFLP units Size 35 and larger.
BEARINGS - 200,000 hour average life - Greasable.
DRAIN PANS - Extended under both Fan and Coil Section on all cooling units. Standard Pans covered with 1 2" foam-in-place insulation. Drain pan with liner has glass fiber insulation.

SALES ORDER NUMBER
KQ3-E741

SHEET 1 OF 3

SUBMITTAL DATA

THE TRANE COMPANY - LA CROSSE, WISCONSIN 54601

SUBMITTAL DATA

ARCHITECT

ENGINEER:

PROJECT:

ORDER DATE	CUSTOMER ORDER NUMBER	CUSTOMER ACCOUNT NO.

SOLD TO

(INCLUDE ZIP CODE)

APPROVAL STAMP

APPROVED AS NOTED
FOR GENERAL DESIGN ONLY
THIS APPROVAL DOES NOT WAIVE RESPONSIBILITY FOR
CORRECT DIMENSIONS, DETAILS OR QUANTITIES
DATE 7/12/78 BY
LEWIS D. FREEDLAND
CONSULTING ENGINEER

TAG: **AHU-2** CLCH 50 2808 - 3713 SUBMITTAL DRWG.

FAN

QUAN OF UNITS: **1** SIZE: **6**

MODEL 1: ☐ 1-LPH ☐ 2-MPH ☒ 3-LPV ☐ 4-MPV ☐ 5-LPMZ ☐ 6-MPMZ ☐ 7-LPDD ☐ 8-MPDD
☐ 1 AFLPH ☐ 3-AFLPV ☐ 5 AFLPMZ ☐ 7-AFLPDD

DISCHARGE ARRANGEMENTS
☒ FC ☐ AF ☐ BI
☒ 8" EXT. CASING

HORIZONTAL: ☐ 1-TOP H ☐ 2-BOTTOM H ☐ 3-FRONT V ☐ 4-BACK V
VERTICAL: ☒ 1-BACK V ☐ 2-FRONT V ☐ 3-BACK H ☐ 4 FRONT H
MULTI-ZONE: ☐ 1-FRT RODS TOP ☐ 2-FRT RODS BOT ☐ 3-TOP RODS FRT ☐ 4-TOP RODS BACK ☐ ZONES (#)
DOUBLE DUCT: ☐ 1-FRT ☐ 2-TOP

3000 SCFM **5/8"** ESP **2.0** TSP **1.68** BHP **1221** RPM

COILS

COIL SPECIFICATIONS										CAPACITY			FLUID				COIL NO.
QTY PER UNIT	COILS	COIL TYPE (2)	SIZE		SERIES	TUBES		SUPPLY	TURBS / CIRC (4)	KW / MBH	EAT	LAT	TYPE (5)	GPM OR PRESS	TEMP IN OUT	WATER PR FEET OF H2O	812
			WIDE	LONG		Rows	Mat'l (3)				DB WB	DB WB					
	PREHEAT SECTION																
1	FIRST IN CASING	W	18	45	18	4	A	L	T	110.2	60	94	HW	11	100/60	6.1	
1	SECOND IN CASING	WC	18	45	16	1	A	L	0	110.2	60	94	HW	11	100/80	1.5	
1	3rd in casing ~~MULTI HOT DECK~~	F2	18	45	15	4	A	L		84.5	80/67	57.8/55.7	22		41°		

ACCESSORIES

INT. F & BP ☐ F-1 RODS R ☐ F-2 RODS L
EXT. F & BP ☐ G-1 w/duct R ☐ G-2 w/duct L ☐ G-3 L/duct R ☐ G-4 L/duct L ☐ G-5 w/duct R ☐ G-6 w/duct L
1 FILTER BOX ☐ J-FLAT ☒ K-MED ☐ L-HIGH ☐ LESS FILTERS ☐ 1-TA ☒ 2-LV PERM ☐ 3 HV PERM
COMB F/M BOX ☐ M-90 OPENING ☐ BOT/BACK ☐ TOP/BACK ☐ N-OPP ☐ RODS ☐ R ☐ L
FILTERS ☐ 1-TA ☐ 5-TA ☐ 2 LV PERM ☐ 6 LV PERM ☐ 3 HV PERM ☐ 7-HV PERM
MIXING BOX ☐ O-90 OPENING ☐ BOT/BACK ☐ TOP/BACK ☐ P-OPP ☐ 1 ☐ 2 RODS ☐ R ☐ L
PREHEAT COIL SECTION ☐ S ELECTRIC PREHEAT ☐ U
HUMIDIFIERS WATER SPRAY ☐ T-1R ☐ T-2L STEAM GRID ☐ T-3R ☐ T-4L
MZ BAFFLE ☐ V-1 40 HD ☐ V-2 60 HD ☐ V-3 70 HD ☐ V-7 22 HD ☐ V-4 40 CD ☐ V-5 60 CD ☐ V-6 70 CD ☐ V-8 22 CD
GALV. DRAIN PAN LINER ☐ DT ☐ BT

ORDERING NUMBER

1 Magnetic starter Nema Type 1, Size 0, 208/60/3Ø
~~1 Two Button Push Button Station Nema Type 1~~ ~~by others~~

DRIVE

ISOLATORS: ☒ FLOOR ☐ CEILING ☐ RIS ☐ SPRING
1 DRIVE. **1221** RPM ☒ VARIABLE ☐ 1.2 MHP ☒ 1.5 MHP ☐ ENCL. BELT GD.
1 MOTOR: **2** HP **208** V **60** CY **3** PH SHAFT FRAME ☐ R ☒ L
TYPE **open** RPM **1750**

MECHANICAL SPECIFICATIONS – STANDARD CLIMATE CHANGERS

CASINGS – Removable Panels Phosphatized and Painted
COILS – Plate Fins – Seamless copper tubes with galvanized steel casings. All coils are pitched in the unit.
FANS – Forwardly Curved – in LP and MP units in Size 31 and smaller.
Backwardly Inclined in LP units Size 35 and larger.
Air Foil in MP and AFLP units Size 35 and larger.
BEARINGS – 200,000 hour average life – Greasable.
DRAIN PANS - Extended under both Fan and Coil Section on all cooling units. Standard Pan is covered with 1/2" foam-in-place insulation. Drain pan with liner has glass fiber insulation.

MODEL 1
LP - Low Pressure
MP - Med. Pressure
AF - Airfoil
MZ - Multi-Zone
DD - Double Duct
H - Horizontal
V - Vertical

COOLING COILS 2
W - Standard Water
D - Drainable
DD - Double Circuit Drainable
K - Cleanable
F 1 – Refrigerant - 12
F 2 – Refrigerant - 22

HOT WATER COILS 2
AW - Single Pass Opposite End Connections
WS - Two Pass Same End Connections

STEAM COILS 3
A - Single Pass Opposite End Connections
N - Non Freeze Opposite End Connections
NS - Non Freeze Same End Connections

TUBE MATERIAL
A - Standard Copper
C - .036 Red Brass
D - .049 Red Brass

TURBULATORS 4
C - Without
T - With

CIRCUITS
Tubes Fed

FLUID TYPE 5
12 - Refrigerant - 12
22 - Refrigerant - 22
CW - Chilled Water
HW - Hot Water
ST - Steam
SP - Special

SALES ORDER NUMB
KQ3-E741

SHEET 2 OF 3

THE TRANE COMPANY - LA CROSSE, WISCONSIN 54601

SUBMITTAL DATA

ARCHITECT:

ENGINEER:

PROJECT:

ORDER DATE	CUSTOMER ORDER NUMBER	CUSTOMER ACCOUNT NO

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APPROVAL STAMP

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DATE 3/12/78 BY

LEWIS D. FREEDLAND
CONSULTING ENGINEER

TAG: **AHU-1** CLCH 50 2808 - 3713 SUBMITTAL DRWG.

QUAN OF UNITS: 1 SIZE: 6

MODEL (1): ☐ 1-LPH ☐ 2-MPH ☒ 3-LPV ☐ 4-MPV ☐ 5-MPMZ ☐ 6-MPMZ ☐ 7-LPDD ☐ 8-MPDD
☐ 1-AFLPH ☐ 3-AFLPV ☐ 5-AFLPMZ ☐ 7-AFLPDD

FAN

DISCHARGE ARRANGEMENTS
☒ FC ☐ AF ☐ BI
☒ 8" EXT. CASING

HORIZONTAL: ☐ 1-TOP H ☐ 2-BOTTOM H ☐ 3-FRONT V ☐ 4-BACK V

VERTICAL: ☒ 1-BACK V ☐ 2-FRONT V ☐ 3-BACK H ☐ 4-FRONT H

MULTI-ZONE: ☐ 1-FRT RODS TOP ☐ 2-FRT RODS BOT ☐ 3-TOP RODS FRT ☐ 4-TOP RODS BACK

DOUBLE DUCT: ☐ 1-FRT ☐ 2-TOP ☐ ZONES (#)

2000 SCFM 1/2" ESP 1.50 TSP .77 BHP 1042 RPM

COIL SPECIFICATIONS / CAPACITY / FLUID — COIL NO. 812

QTY PER UNIT	COILS	COIL TYPE (2)	SIZE WIDE	SIZE LONG	SER IF	TUBES ROWS	TUBES (3)	CIR- CUITS	TURBS OF	KW / MBH	EAT DB WB	LAT DB WB	TYPE	GPM OR PRESS.	TEMP IN/OUT	PRESSURE DROP
	PREHEAT SECTION															
1	FIRST IN CASING	W	~~18~~	45	16	4	A	L	0	65.8	50 ~~60~~	81 ~~[illegible]~~	HW	14.7	100/91	0.5
1	SECOND IN CASING	W	~~18~~	45	10	2	A	L	0	65.8	50 ~~60~~	81 ~~[illegible]~~	HW	3.5	180/142	0.1
	~~MULTI ZONE HOT DECK~~ 3rd in Casing	F2	18	45	15	4	A	L		65.2	80/67	57/56	22		42°	

ACCESSORIES

INT. F & BP ☐ F-1 RODS R ☐ F-2 RODS L

EXT. F & BP ☐ G-1 w/duct R ☐ G-2 w/duct L ☐ G-3 w/duct R ☐ G-4 w/duct L ☐ G-5 w/duct R ☐ G-6 w/duct L

1 FILTER BOX ☒ J FLAT ☐ K MED ☐ L HIGH ☐ LESS FILTERS ☒ 1 TA ☒ 2 LV PERM ☐ 3-HV PERM

COMB F/M BOX ☐ M-90 OPENING ☐ BOT/BACK ☐ TOP/BACK ☐ N OPP ☐ RODS ☐ R ☐ L

FILTERS ☐ 1-TA ☐ 5 TA ☐ LV PERM ☐ 6 LV PERM ☐ HV PERM ☐ 7 HV PERM

MIXING BOX ☐ O-90 OPENING ☐ BOT/BACK ☐ TOP/BACK ☐ P-OPP ☐ 1 ☐ 2 RODS ☐ R ☐ L

PREHEAT COIL SECTION ☐ S ELECTRIC PREHEAT ☐ U

HUMIDIFIERS WATER SPRAY ☐ T-1R ☐ T-2L STEAM GRID ☐ T-3R ☐ T-4L

MZ BAFFLE ☐ V-1 40 HD ☐ V-2 60 HD ☐ V-3 20 HD ☐ V-4 22 HD ☐ V-4 40 CD ☐ V-5 60 CD ☐ V-6 70 CD ☐ V-8 22 CD

GALV. DRAIN PAN LINER ☐ DT ☐ BT

1 Magnetic starter Nema Type 1, Size 00, 208/60/3Ø
1 Two button push button station Nema Type 1

ORDERING NUMBER

DRIVE

ISOLATORS: ☒ FLOOR ☐ CEILING ☐ RS ☐ SPRING — by others

1 DRIVE: 1042 RPM ☒ VARIABLE ☐ 1.2 MHP ☒ 1.5 MHP ☐ ENCL. BELT GD

1 MOTOR: 1 HP 208 V 60 CY 3 PH SHAFT FRAME ☐ R ☒ L
open TYPE 1750 RPM

MODEL
LP - Low Pressure
MP - Med. Pressure
AF - Airfoil
MZ - Multi-Zone
DD - Double Duct
H - Horizontal
V - Vertical

COOLING COILS
W - Standard Water
D - Drainable
DD - Double Circuit Drainable
K - Cleanable
F 1 – Refrigerant - 12
F 2 – Refrigerant - 22

HOT WATER COILS
AW - Single Pass Opposite End Connections
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STEAM COILS
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MECHANICAL SPECIFICATIONS – STANDARD CLIMATE CHANGERS

CASINGS – Removable Panels Phosphatized and Painted
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FANS – Forwardly Curved - in LP and MP units in Size 31 and smaller
Backwardly Inclined in LP units Size 35 and larger.
Air Foil in MP and AFLP units Size 35 and larger
BEARINGS – 200,000 hour average life - Greasable.
DRAIN PANS – Extended under both Fan and Coil Section in all cooling units. Standard Pan is covered with 1/2" foam-in-place insulation. Drain pan with liner has glass fiber insulation.

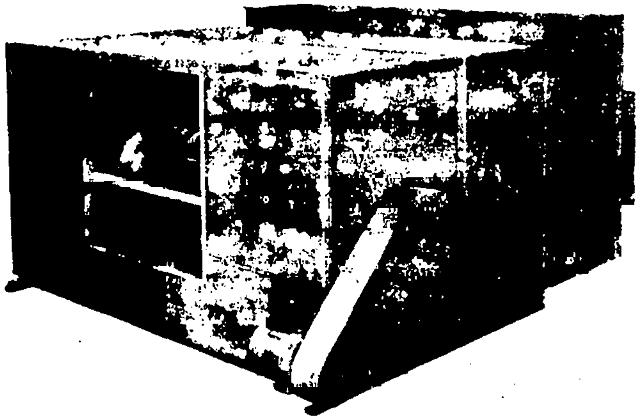
SALES ORDER NUMBER
KQ3-E741

SHEET 3 OF 3

SUBMITTAL DATA

LOW AND MEDIUM PRESSURE DRAW-THRU CLIMATE CHANGERS®

SIZE NO. 3 AND 6



MECHANICAL SPECIFICATIONS

UNIT CASING — Constructed of high grade steel reinforced and braced with steel angle framework. Sectionalized construction consisting of fan section, coil section and drain pan. Removable panels in fan and coil sections provide access to all internal parts. Hanger or bolt holes prepunched at the factory.

UNIT INSULATION — All panels insulated with a 1 inch glass fiber blanket, securely fastened. (Optional) Neoprene coated 1 inch blanket insulation. Drain pan has seamless, 1/2" cellular, spray foamed-in-place insulation. (Optional) — drain pan has inner and outer pan. Inner pan galvanized steel with blanket insulation between pans.

TABLE 1 – METAL GAUGES

COMPONENT		UNIT SIZES	
		NO. 3	NO. 6
FAN SECTION	DISCHARGE PANEL	16	16
	END PANEL	16	16
	END STIFF ANGLE	14	14
COIL SECTION	END PANEL HORIZ. VERT.	20 18	20 18
	INLET FRAME	14	14
	SUPPORT CHANNELS	10	10
REMOVABLE PANELS	HORIZONTAL UNIT TOP PANELS	20	20
	VERTICAL UNIT FRONT AND BACK PANELS	20	20
DRAIN PAN, HORIZONTAL		16	16
DRAIN PAN, VERTICAL		16	16

CENTRIFUGAL FANS — Double width, double inlet, forward curved multi-blade type. Table 10 lists fan sizes. Shaft operates below its first critical speed. Fan bearings externally mounted grease lubricated ball bearings for 200,000 hour average life. Fan housing die-formed and air tight. All fans statically and dynamically balanced, and tested after being installed in factory assembled fan section.

COILS — Continuous plate type fins, Sigma-Flo® II configurated, aluminum or copper fins. Fin collars drawn and belled, bonded to the tubes by mechanical expansion of the tubes. No soldering or tinning is used in the bonding process. Coils removable through access panels.

UNIT AND ACCESSORY FINISH — Casing and all accessories, except the coil, chemically cleaned, phosphatized, and coated with baked-on enamel.

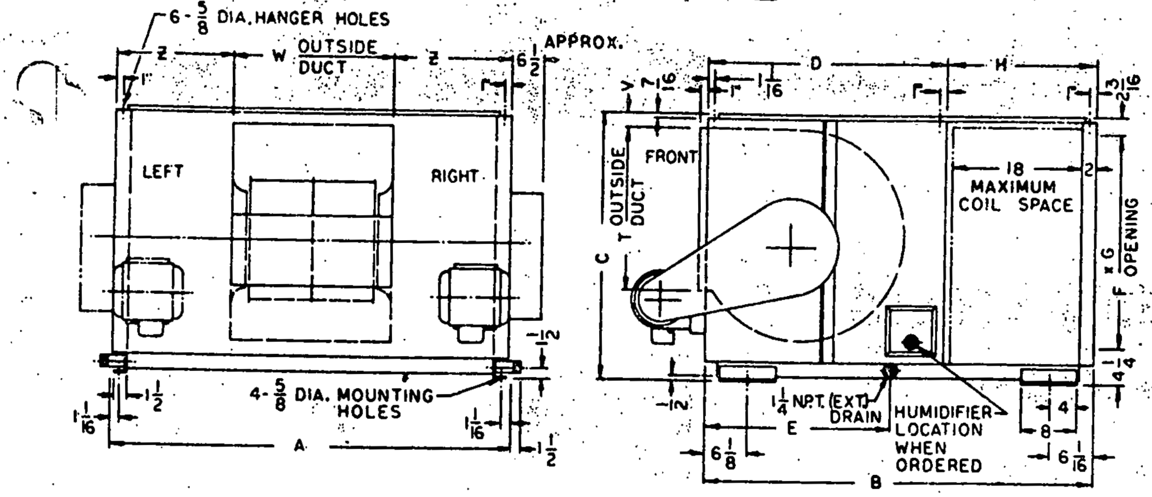
ACCESSORIES — Opposed blade type face and bypass dampers locked to slotted damper rods rotating in rust-proof nylon bushing. Bypass duct completely insulated. Filter and mixing boxes designed to hold low or high velocity, 2 inch permanent or throwaway type filters. Flat filter boxes access doors on both sides; all other filter and combination filter-mixing boxes with large, single access door. Mixing box damper blades of the parallel type set for merging of air stream inside the box. Blades locked to slotted rods rotate in nylon bushings.

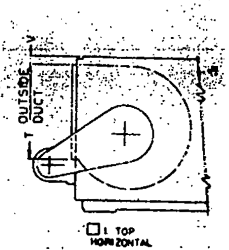
THE TRANE COMPANY — LA CROSSE, WISCONSIN 54601

☐ LOW PRESSURE

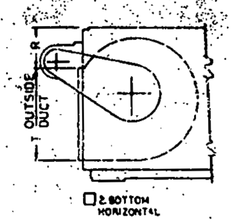
☐ MEDIUM PRESSURE

FAN DISCHARGE ARRANGEMENTS



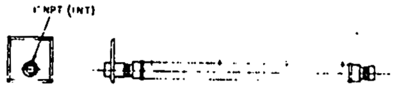


☐ 1. TOP HORIZONTAL

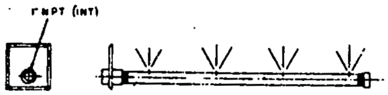


☐ 2. BOTTOM HORIZONTAL

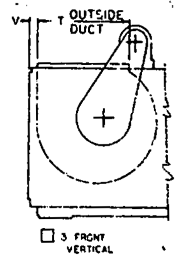
HUMIDIFIERS



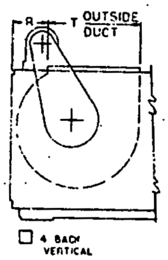
☐ STEAM GRID



☐ WATER SPRAY



☐ 3. FRONT VERTICAL

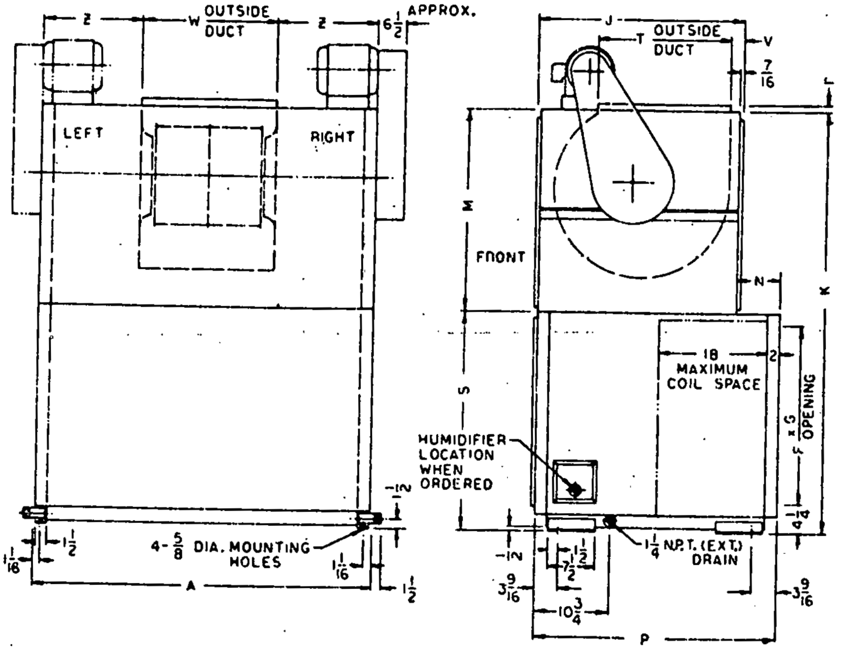


☐ 4. BACK VERTICAL

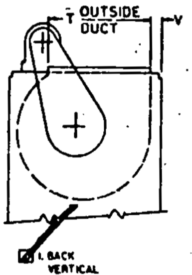
BASIC VERTICAL UNIT

☑ LOW PRESSURE

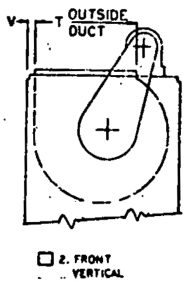
☐ MEDIUM PRESSURE



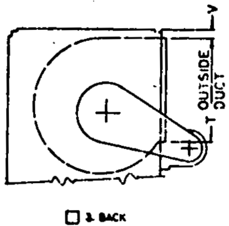
FAN DISCHARGE ARRANGEMENTS



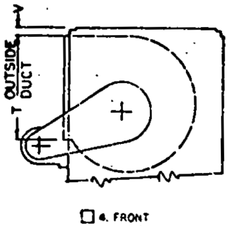
☑ 1. BACK VERTICAL



☐ 2. FRONT VERTICAL



☐ 3. BACK HORIZONTAL



☐ 4. FRONT HORIZONTAL ●

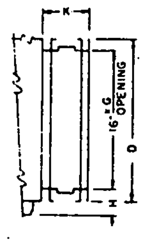
● NOT AVAILABLE ON 31

TABLE 2

																LOW PRESSURE					MEDIUM PRESSURE				
	UNIT SIZE	COIL SIZE	A	B	C	D	E	F	G	H	J	K	M	N	P	S	R	T	V	W	Z	R	T	V	W
	✓ 3	18 X 24	34	$41\frac{13}{16}$	$23\frac{15}{16}$	$21\frac{1}{16}$	$20\frac{15}{16}$	$17\frac{1}{2}$	30	$20\frac{3}{4}$	$21\frac{7}{8}$	$44\frac{9}{16}$	$21\frac{1}{16}$	7	28	$23\frac{1}{2}$	$7\frac{5}{16}$	$12\frac{3}{16}$	$2\frac{3}{8}$	$12\frac{1}{8}$	$10\frac{15}{16}$	$7\frac{29}{32}$	$10\frac{3}{16}$	$3\frac{25}{32}$	$10\frac{1}{2}$
✓	6	18 X 45	55	$43\frac{13}{16}$	$25\frac{15}{16}$	$23\frac{1}{16}$	$21\frac{15}{16}$	$19\frac{1}{2}$	51	$20\frac{3}{4}$	$23\frac{7}{8}$	$48\frac{9}{16}$	$23\frac{1}{16}$	5	28	$25\frac{1}{2}$	$5\frac{13}{16}$	$16\frac{9}{16}$	$1\frac{1}{2}$	$16\frac{7}{16}$	$19\frac{9}{32}$	$6\frac{11}{32}$	$14\frac{5}{16}$	$3\frac{7}{32}$	$14\frac{1}{4}$

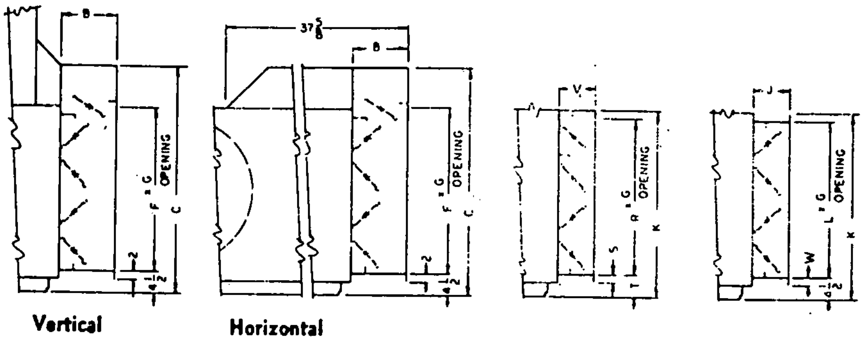
	MEDIUM PRESSURE
UNIT SIZE	Z
3	$11\frac{3}{4}$
6	$20\frac{3}{8}$

PRE-HEAT COIL



PRE-HEAT COIL

FACE AND BYPASS DAMPERS



☐ EXTERNAL FACE AND BYPASS DAMPER WITH DUCT ☐ INTERNAL FACE AND BYPASS DAMPER ☐ FACE DAMPER

TABLE 3

	UNIT SIZE	D	G	H	K A COIL	K AW COIL	K N COIL	K NS COIL	K WS COIL	K 2 ROW W COIL
	3	21	30	5	6 3/4	6 3/4	8	8	6 3/4	9 1/4
	6	21 1/2	51	6						

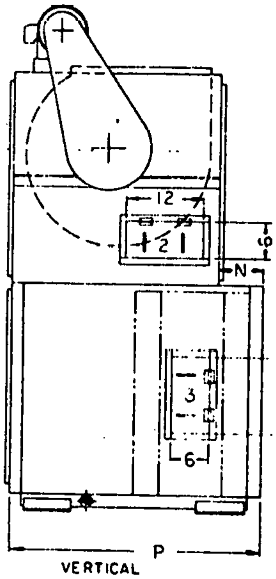
TABLE 4

	UNIT SIZE	B	C	F	G	J	K	L	R	S	T	V	W
	3	8 1/16	28 3/4	17 1/4	29 1/4	7	23 1/2	17	17 1/4	1 7/8	4 3/8	6 1/4	2
	6	7 9/16	31 1/16	19 1/4	50 1/4	7 1/2	25 1/2	19 1/4	19	2	4 1/2	5 3/4	1 7/8

ACCESS DOORS

VERTICAL
☐ LOCATION 2
☐ LOCATION 3

HORIZONTAL
☐ LOCATION 1
☐ LOCATION 3



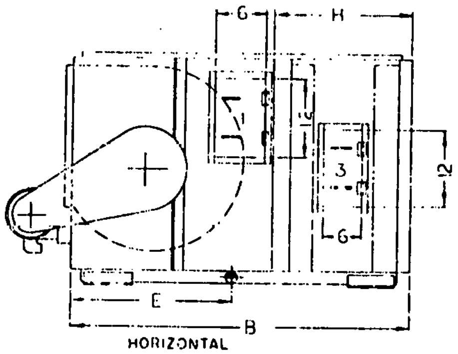
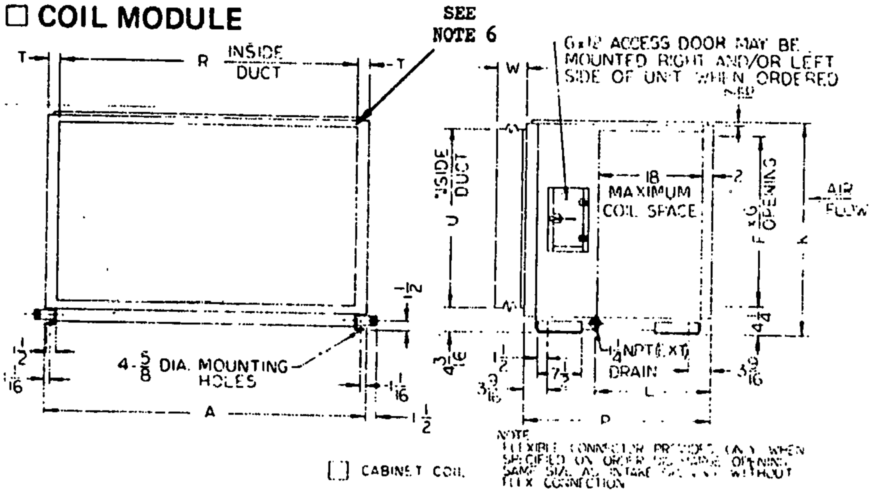


TABLE 5

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	40 3/4	28 3/4	5	36	[illegible]
	[illegible]	51 [illegible]	[illegible]	3	36	27 3/[illegible]

[illegible] TO TABLE 3 FOR OTHER DIMENSION

☐ COIL MODULE



NOTE
FLEXIBLE CONNECTOR PROVIDED ONLY WHEN SPECIFIED ON ORDER [illegible] OPENING SAME SIZE AS INTAKE [illegible] WITHOUT FLEX CONNECTION

☐ CABINET COIL

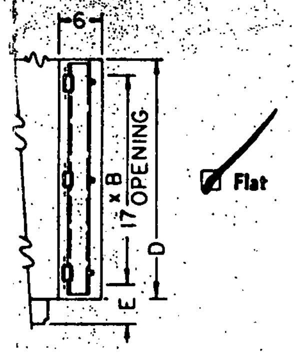
TABLE 6

	UNIT SIZE	A	F	G	K	L	P	SAME SIZE FAN SECTION P	SAME SIZE FAN SECTION T	SAME SIZE FAN SECTION U	SAME SIZE FAN SECTION W	ONE SIZE SMALLER FAN SECTION R	ONE SIZE SMALLER FAN SECTION T	ONE SIZE SMALLER FAN SECTION U	ONE SIZE SMALLER FAN SECTION W
	3	34	17 1/2	30	22 [illegible]	17 1/4	[illegible]	30 [illegible]	1 [illegible]/16	[illegible]	[illegible]			-	-
	[illegible]	55	19 1/2	51	25 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30	[illegible]	[illegible]	[illegible]

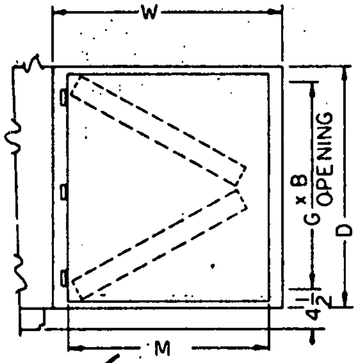
GENERAL NOTES

1. Connection sides for coils, damper rods and motor drive positions are determined by facing front of unit. Arrangement drawings shown indicate right side of unit.
2. Drives, coils and damper rods may be furnished right or left hand side as specified on the order.
3. Drain pan connections are provided on both right and left hand sides. External drain piping may be connected to either side.
4. Damper drive rods are 7/16" diameter with 1/2" adapter.
5. For ceiling suspension, accessory mounting legs bolted to accessories similar to that shown on Page 4. Legs will project 2-1/16" above Horizontal Climate Changers. No other change in leg dimensions.
6. 4-5/8" diameter holes in top corners, 1" from edges for ceiling mounting.

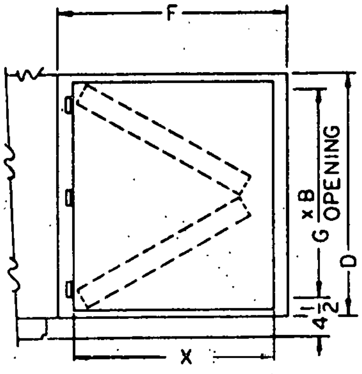
FILTER BOXES



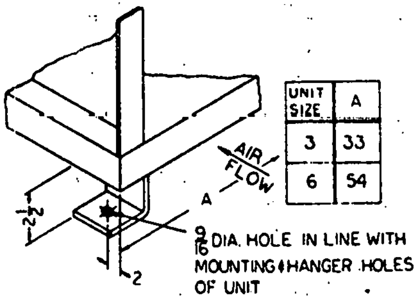
☑ Flat



☑ Medium Capacity



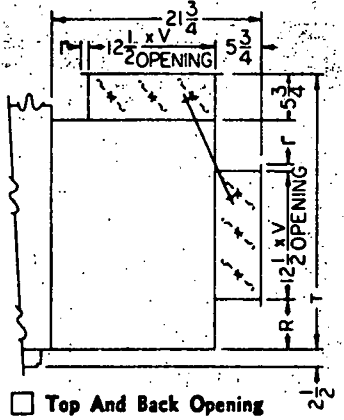
☐ High Capacity



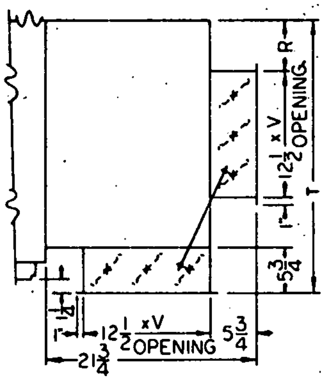
UNIT SIZE	A
3	33
6	54

Mounting Leg-Medium and High Capacity Filter Boxes, Floor Mounting. See General Note 5.

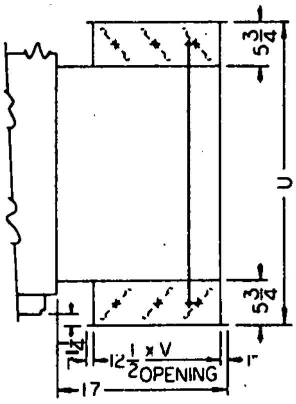
MIXING BOXES



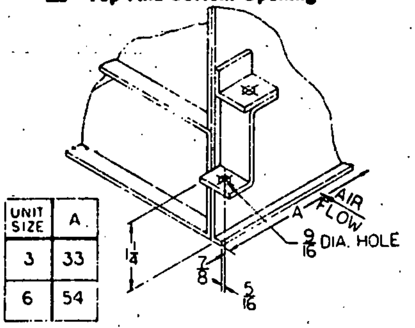
☐ Top And Back Opening



☐ Back And Bottom Opening



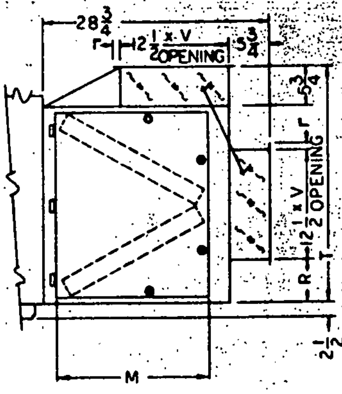
☐ Top And Bottom Opening



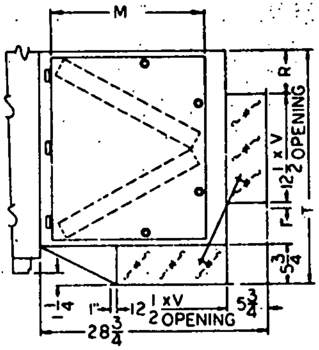
UNIT SIZE	A
3	33
6	54

Mounting Leg-Mixing and Combination Filter-Mixing Boxes, Back and Bottom or Top and Bottom, Opening Floor Mounting. Top and Back or Top and Bottom Opening, Ceiling Mounting. See General Note 5.

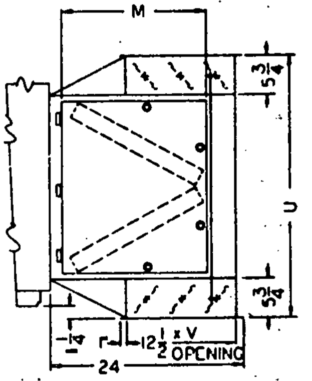
COMBINATION FILTER-MIXING BOXES



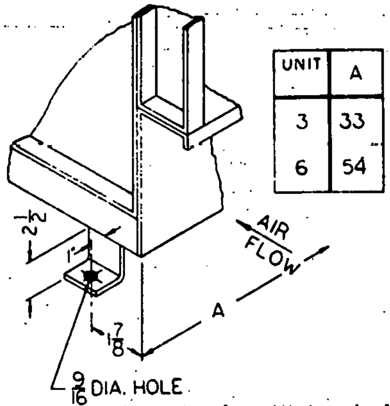
☐ Top And Back Opening



☐ Back And Bottom Opening



☐ Top And Bottom Opening



UNIT	A
3	33
6	54

Mounting Leg-Mixing And Combination Filter-Mixing Boxes, Top and Back Opening, Floor Mounting, or Bottom and Back Opening, Ceiling Mounting. See General Note 5.

TABLE 7

		FILTERS																			
	UNIT SIZE	FLAT		MEDIUM CP.		HIGH CAP		COMB BOX		B	D	E	F	G	M	R	T	U	V	W	X
		NO	SIZE	NO	SIZE	NO	SIZE	NO	SIZE												
	3	1	20 X 25	2	16 X 25	2	20 X 25	2	16 X 25	30	21	4 1/2	23 3/4	17	17 7/8	4 1/4	24 3/4	28 1/2	29 1/4	19 3/4	21 3/8
	6	2	20 X 25	4	16 X 25	4	20 X 25	4	16 X 25	51	23	5 1/2	23 1/2	19	17	5 1/4	26 3/4	30 1/2	50 1/4	19 3/8	21 1/8

	UNIT MODEL NUMBER																		
	3	6	7	8	9	10	12	14	17	21	24	25	31	35	41	50	63	73	86
DRAW-THRU CLIMATE CHANGERS																			
CASING ONLY	205	275	—	400	—	480	780	750	875	1120	--	1255	1420	2100	2540	2750	4270	4710	5030
2 ROW	291	424		570		677	978	1080	1229	1594		1725	2082	2832	3558	3708	5529	5850	6390
4 ROW	328	487		657		786	1106	1213	1418	1765		2084	2418	3198	3797	4260	6218	6710	7420
6 ROW	368	552		742		881	1243	1380	1607	1983		2256	2778	3616	4261	4794	6929	7980	8440
8 ROW	406	618		828		980	1373	1520	1781	2216		2518	3108	3984	4699	5330	7611	8320	9330
COIL MODULE																			
CASING ONLY	110	195	—	235	--	245	325	400	430	530	-	580	645	715	830	900	1000	1300	1800
2 ROW	196	344		405		462	803	710	784	944		1080	1307	1447	1710	1800	3270	3410	3430
4 ROW	233	407		492		570	733	863	973	1175		1429	1643	1813	1949	2352	3959	4270	4460
6 ROW	273	472		577		676	870	1019	1162	1403		1591	2003	2231	2413	2886	4670	5120	5480
8 ROW	311	538		663		773	908	1170	1326	1626		1853	2333	2409	2851	3422	5352	5880	6370
ACCESSORIES																			
FLAT FILTER BOX																			
THROWAWAY	28	38	42	45	54	68	73	76	92	113	120	120	135	170	180	210	335	—	—
LOW VELOCITY PERMANENT	33	47	52	56	67	84	91	97	117	145	155	155	183	222	234	284	426		
HIGH VELOCITY PERMANENT	51	63	69	75	91	108	120	131	156	193	207	207	257	306	338	365	582		
MEDIUM FILTER BOX																			
THROWAWAY	76	101	131	144	167	171	178	228	247	303	324	324	358	370	456	520	565	655	775
LOW VELOCITY PERMANENT	84	117	149	162	191	195	204	280	284	348	373	373	413	429	546	631	695	805	950
HIGH VELOCITY PERMANENT	96	141	181	190	227	231	248	312	347	428	456	456	513	557	706	799	935	1065	1275
HIGH CAPACITY BOX																			
THROWAWAY	111	148	135	170	180	192	229	260	278	330	398	398	425	470	535	590	680	—	—
LOW VELOCITY PERMANENT	120	166	184	194	208	223	261	305	324	393	468	468	512	574	660	735	865		
HIGH VELOCITY PERMANENT	136	198	217	230	257	271	317	360	396	469	576	576	648	742	852	950	1160		
ROLL FILTER	80	114	--	142	·	158	187	204	219	250	· ·	290	363	430	475	500	750	870	1025
COMB. FILT-MIX BOX																			
THROWAWAY	115	168	200	248	255	286	300	315	358	400	490	490	620	710	790	885	1133	1310	1550
LOW VELOCITY PERMANENT	122	184	217	266	279	310	324	345	393	441	540	540	686	780	874	997	1265	1465	1730
HIGH VELOCITY PERMANENT	134	208	249	298	315	346	368	397	456	521	625	625	786	906	1035	1165	1505	1740	2060
DELUXE COMB. FILTER MIX BOX																			
THROWAWAY	193	240	263	352	369	376	407	474	501	586	604	604	732	906	--	—	—	—	—
LOW VELOCITY PERMANENT	200	256	280	370	393	400	431	504	536	627	654	654	798	1056					
HIGH VELOCITY PERMANENT	212	280	312	402	429	436	475	556	600	707	739	739	896	1182					
MIXING BOX	82	118	122	160	175	182	256	270	319	340	380	380	437	519	623	750	869	1010	1185
EXTERNAL FACE AND BYPASS	40	58	79	96	100	112	154	161	170	216	241	292	417	457	470	618	925	1070	1265
INTERNAL FACE AND BYPASS	30	53	74	77	92	100	109	113	124	184	211	223	327	334	363	441	535	—	---
FACE DAMPERS	39	55	65	91	102	106	111	115	142	225	232	232	297	312	370	446	543	—	—
STRAIGHT THRU DISCHARGE PLENUM	50	65	90	100	130	110	130	190	170	180	200	200	300	480	400	--	—	—	---
WALL INTAKE BOX																			
STEEL	90	110	110	150	220	240	270	300	310	480	600	600	725	800	930	1140	1450	—	—
ALUMINUM	40	50	50	75	105	170	115	115	115	255	380	380	480	525	605	745	940	-	--

* SEE TABLE 9 FOR MOTOR WEIGHTS

TABLE 9 – APPROXIMATE MOTOR WEIGHTS

MOTOR HORSEPOWER	1/4	1/3	1/2	1	1½	2	3	5	7½	10	15	20	25	30	40	50	60	75
MOTOR WT. (LBS.)	20	20	25	33	44	44	71	82	127	144	187	214	263	300	409	460	560	640

TABLE 10 -- FAN SIZES

UNIT SIZE	LOW PRESSURE		MEDIUM PRESSURE	
	NO.	SIZE	NO.	SIZE
NO. 3	1	9"	1	7½"
NO. 6	1	12¼"	1	10½"

TABLE 11 – WATER AND STEAM COILS

COIL TYPE	HEADER HEIGHT	CONNECTION SIZE		
		SUPPLY	RETURN	DRAIN & VENT
W - WATER	18, 24, 30, 33	2½ N.P.T.	2½ N.P.T.	–
D - DRAINABLE	18, 24, 30, 33	2½ N.P.T.	2½ N.P.T.	½ N.P.T. (EXT.)
DD - DRAINABLE	18, 24, 30, 33	2½ N.P.T.	2½ N.P.T.	½ N.P.T. (EXT.)
K - CLEANABLE	18, 24, 30, 33	2½ N.P.T.	2½ N.P.T.	–
P2 - WATER	12, 18, 24, 30	3/4 N.P.T.	3/4 N.P.T.	–
P4 - WATER	12, 18, 24, 30	1 N.P.T.	1 N.P.T.	–
P8 - WATER	18, 24, 30	1¼ N.P.T.	1¼ N.P.T.	–
A - STEAM	18, 24, 30, 33	2½ N.P.T.	1 N.P.T.	–
AW - HOT WATER	18, 24, 30, 33	2½ N.P.T.	2½ N.P.T.	–
WC - HOT WATER	12, 18	1 N.P.T.	1 N.P.T.	–
WC - HOT WATER	24	1¼ N.P.T.	1¼ N.P.T.	–
WC - HOT WATER	30, 33	2½ N.P.T.	2½ N.P.T.	–
N, NS	12	1½ N.P.T.	1 N.P.T.	–
N, NS	18	2 N.P.T.	1 N.P.T.	–
N, NS	24	2½ N.P.T.	1¼ N.P.T.	–
N, NS	30, 33	3 N.P.T.	1¼ N.P.T.	–

All 12" header height coils, Types A, AW, D, K, and W, supply 1¼ N.P.T., return 1¼ N.P.T. Above connections internal except drain and vent.

TABLE 12 – TYPE F1 AND F2 REFRIGERANT COILS

HEADER HEIGHT	NO. OF CIR-CUITS	CONNECTIONS		NO. OF CIR-CUITS	CONNECTIONS		NO. OF CIR-CUITS	CONNECTIONS	
		LIQUID	SUCTION		LIQUID	SUCTION		LIQUID	SUCTION
12	2	⅞ O.D.	1⅜ O.D.	4	⅞ O.D.	1⅜ O.D.	8	1⅜ O.D.	2⅛ O.D.
18	2	⅞ O.D.	1⅜ O.D.	3	⅞ O.D.	1⅜ O.D.	6	1⅛ O.D.	2⅛ O.D.
24	2	⅞ O.D.	1⅜ O.D.	4	⅞ O.D.	1⅜ O.D.	8	1⅜ O.D.	2⅛ O.D.
30	2	⅞ O.D.	1⅜ O.D.	4	⅞ O.D.	1⅜ O.D.	5	1⅛ O.D.	2⅛ O.D.
33	3	⅞ O.D.	1⅜ O.D.	7	1⅜ O.D.	2⅛ O.D.	11	1⅜ O.D.	2⅛ O.D.

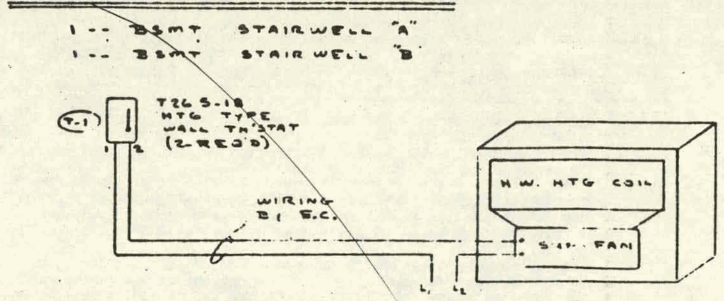
HEADER HEIGHT	NO. OF CIR-CUITS	CONNECTIONS		NO. OF CIR-CUITS	CONNECTIONS	
		LIQUID	SUCTION		LIQUID	SUCTION
12	–	–	–	–	–	–
18	12	1⅜ O.D.	2⅛ O.D.	–	–	–
24	16	2 - 1⅜ O.D.	2 - 2⅛ O.D.	–	–	–
30	10	1⅜ O.D.	2⅛ O.D.	20	2 - 1⅜ O.D.	2 - 2⅛ O.D.
33	22	2 - 1⅜ O.D.	2 - 2⅛ O.D.	–	–	–

12" and 18" coils with 1 circuit have 5/8 OD liquid and suction connections.

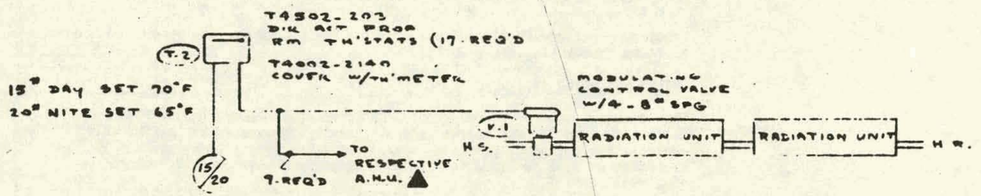
11. AS BUILT DRAWINGS

FLOOR MOUNTED UNIT HEATERS

1 -- BSMT STAIRWELL "A"
1 -- BSMT STAIRWELL "B"



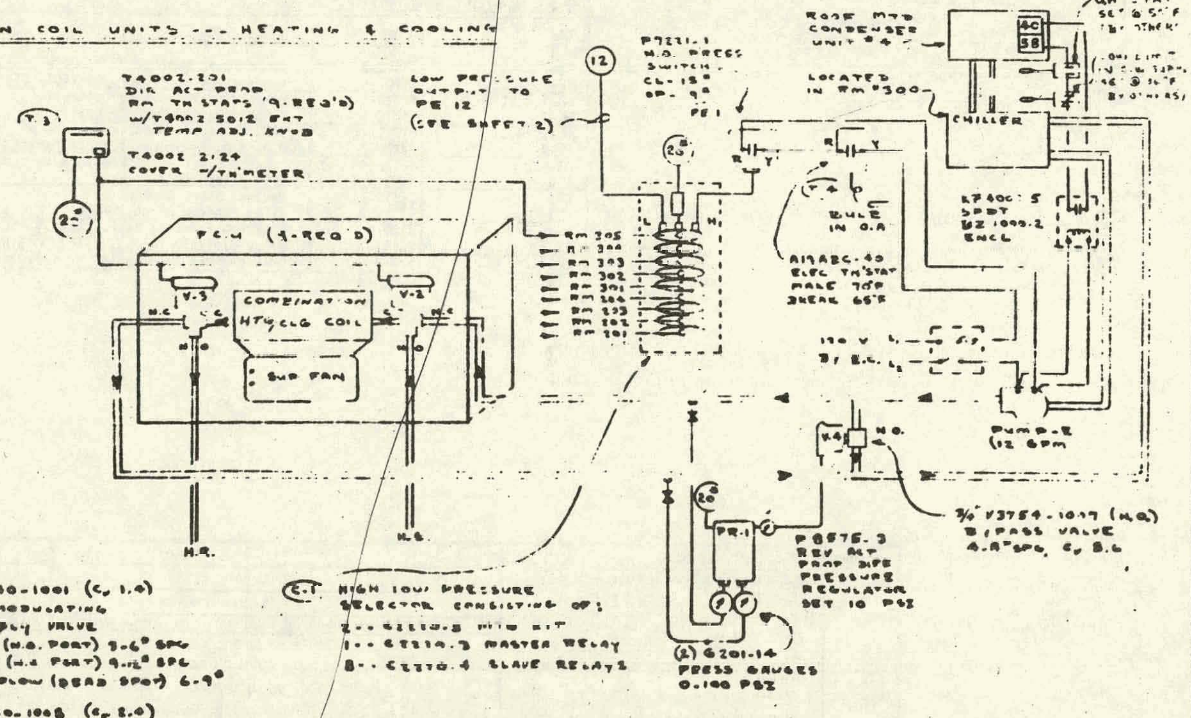
FINNED TUBE RADIATION AND CONVECTORS



	RM TH'STAT LOCATION	TOTAL MBH PER VALVE	VALVE	Cv	SIZE	CONNECTION
BSMT	Room #11	0.9	V3762-1023	0.9	½"	SAE FLARE
	14	1.1, 0.5	V3762-1023	0.9	½"	" "
	16	4.4	V3762-1023	0.9	½"	" "
	17	4.6	V3762-1023	0.9	½"	" "
	18 ▲	10.7	V3762-1020	1.5	½"	" "
	17 ▲	16.0	V3762-1021	2.0	½"	" "
	11	34.0	V3754-1003	4.4	½"	SCREW GLOBE
	21	6.2	V3762-1023	0.9	½"	SAE FLARE
1ST FL	Room 101 ▲	3.3	V3762-1023	0.9	½"	" "
	104 ▲	4.5, 5.0, 4.5	V3762-1021	2.0	½"	" "
	103 ▲	3.7, 3.3	V3762-1023	0.9	½"	" "
	108A ▲	20.9	V3762-1022	2.9	5/8"	" "
	108A	20.9	V3762-1022	2.9	5/8"	" "
	112	3.3	V3762-1023	0.9	½"	"
	114 ▲	9.8	V3762-1020	1.5	½"	"
	116	6.2	V3762-1022	0.9	½"	
2ND FL	Room 225 ▲	13.0	V3762-1020	1.5	½"	"
	224 ▲	13.0	V3762-1020	1.5	½"	
3RD FL	Room 300	2.2	V3762-1023	0.9	½"	

▲ ROOM THERMOSTAT ALSO CONTROLS RESPECTIVE AHU-1 (BSMT) AHU-2 (1ST FL), AHU-3 (2ND FL)

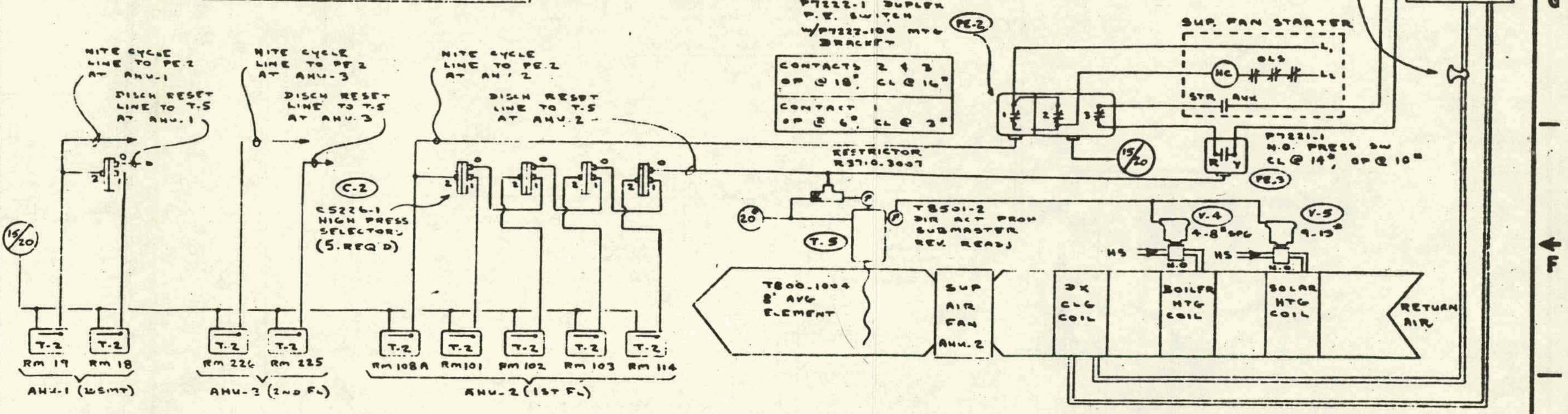
FAN COIL UNITS --- HEATING & COOLING



AHU DISCHARGE RESET SCHEDULE	
HIGHEST RM TEMP	T-5 SET PT
69°F (0# OUTPUT)	90°F
72°F (7.5# OUTPUT)	65°F
75°F (15# OUTPUT)	40°F
SET T-5 FOR 50°F RESET ON 15# DIAL	

AIR HANDLING UNITS #1, #2 AND #3

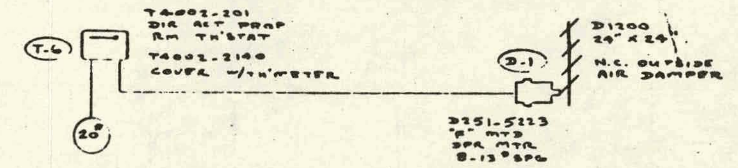
(AHU-2 SHOWN BELOW IS TYPICAL FOR AHU-1 & 3)



T4502-203 DIR ACT PROP RM TH'STATS (9-REQ'D)
(ALSO CONTROLS RADIATION VALVES)
SET T-2 SENSITIVITY = 2.5 #/°F

UNIT	SOLAR VALVE V-5 (9-13# SPG)				BOILER VALVE V-4 (4-8# SPG)			
	GPM	VALVE CODE	SIZE	Cv	GPM	VALVE CODE	SIZE	Cv
AHU-1	6.6	V3754-1006	½"	4.4	14.7	V3754-1007	¾"	8.6
AHU 2	10.0	V3754-1008	¾"	8.6	11.0	V3754-1007	¾"	8.6
AHU-3	2.8	V3754-1005	½"	2.2	8.6	V3754-1003	½"	4.4

BASEMENT ROOM #11 VENTILATION



Unit Heaters:

Room thermostats T-1 cycles their respective supply fan to maintain desired entrance stairwell space temperature.

Finned Tube Radiation and Convectors:

Room thermostats T-2 modulate their respective radiation valve or valves V-1 to maintain desired space temperature. The set point of T-2 is automatically reset from 70°F on day cycle to 65°F on nite cycle.

FAN COIL UNITS:

On a rise in space temperature the normally open heating port of supply valve V-2 is modulated toward a closed position (3-6# range). From 6-9# output from thermostat T-3, there is no water flow thru valve V-2. During the dead zone, coil return valve V-3 is switched to divert the return water to the chilled return main. On a continued rise in space temperature the normally closed cooling port of supply valve V-2 is modulated toward an open position (9-12# range).

When any room thermostat calls for cooling, the chilled water system and chilled water pump "E" are energized provided outside temperature is above 70°F as sensed by thermostat T-4. The chilled water system when energized will provide 45°F chilled water supply temperature.

Room thermostats T-3 are provided with external temperature adjustment knobs and are not reset from day to nite settings with the central changeover system. If the apartment is not occupied, T-3 is to be set at 65°F in the heating season and 80°F in the cooling season.

As the cooling ports of valves V-2 are modulated, the system pressure will fluctuate. Pressure regulator PR-1 modulates system bypass valve V-3 to maintain constant system differential pressure regardless of position of valves V-2.

Air Handling Units #1, #2 and #3:

On day cycle (15# Main Air), contacts #2 and #3 of pressure switch PE-2 are closed to energize supply fans for continuous operation.

Submaster thermostat T-5 modulates solar heating coil valve V-5 in sequence with boiler heating coil valve V-4 to maintain desired discharge air temperature. Boiler heating coil valve V-6 is modulated open only if sufficient heat can not be provided from solar heating coil. The set point of T-5 is reset by space thermostat with the greatest call for cooling thru action of high pressure selector relays C-2.

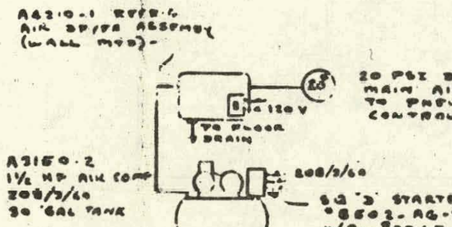
On a rise in space temperature after heating coil valves V-4 and V-5 are fully closed, submaster thermostat T-5 energizes DX cooling coil valve and roof mounted condenser unit to maintain desired supply air temperature.

On nite cycle (20# main air), contacts #2 and #3 of pressure switch PE-2 are opened to de-energize supply fan and cooling system. With thermostat T-2 cycles supply fan thru action of contact #1 of pressure switch PE-2 to maintain desired nite reduced space temperature.

Basement Room #11 Ventilation:

On a rise in space temperature, room thermostat T-6 modulates outside air damper D-1 toward an open position.

CONTROL AIR SUPPLY SYSTEM



DRAWING TITLE
ROOM CONTROL OF:
1. UNIT HEATERS
2. DIRECT RADIATION
3. FAN COIL UNITS
4. AHU #1, #2, #3
5. RM #11 VENTILATION

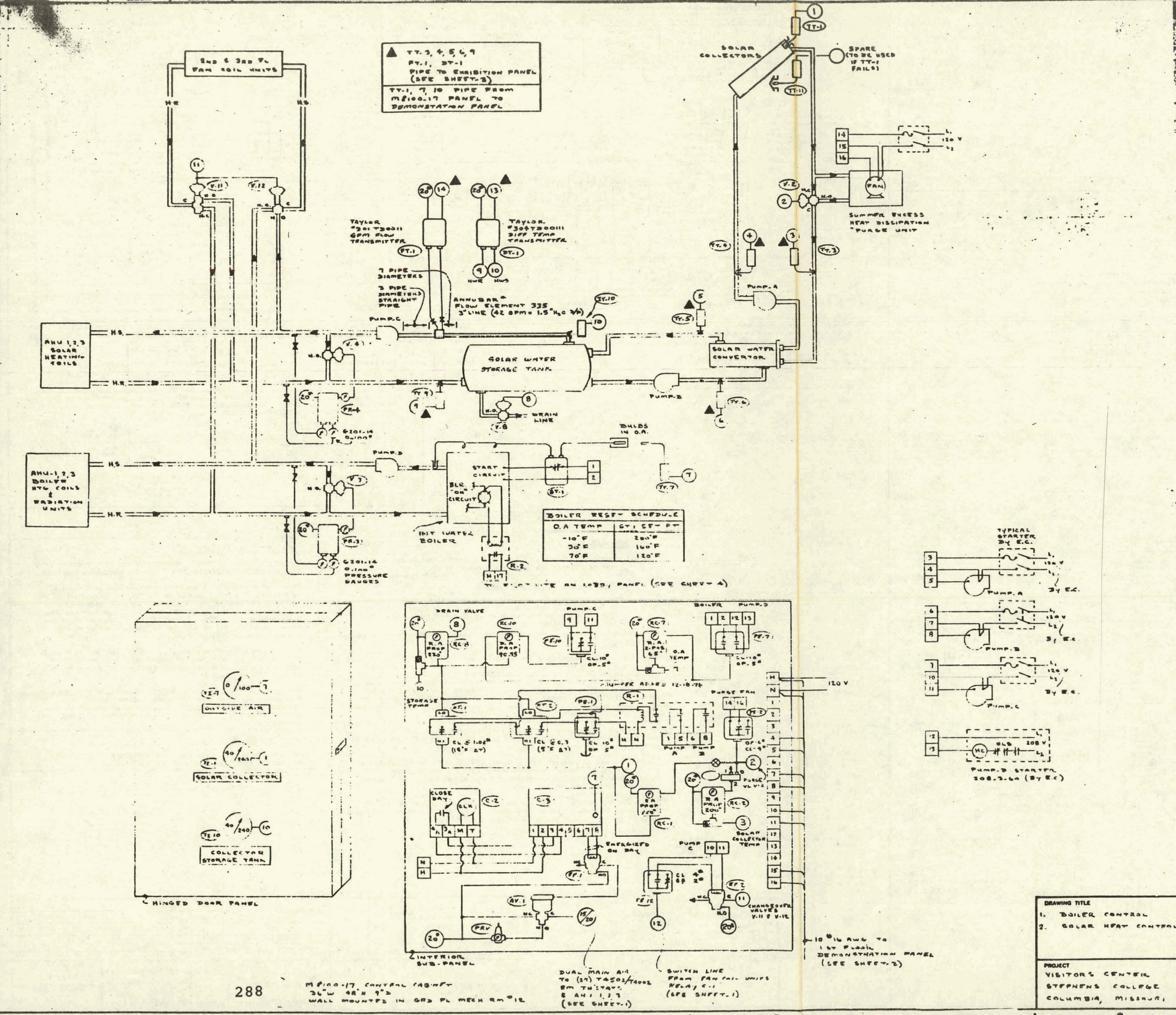
PROJECT
VISITORS CENTER
STEPHENS COLLEGE
COLUMBIA, MISSOURI

REFERENCE DRAWINGS	NO	REVISION — LOCATION	BY	DATE	
	B	AS BUILT	W.S.	7-2-79	JB
	A	VALVE SCHEDULE (V-4 & V-5)		7-12-78	JB

SALES ENGR. WM. BROSKY
APPLICATION ENGR.
DRAWN BY / DATE
APPROVED BY D.W. DATE 1-27-78

JOHNSON CONTROLS
Systems & Services Division
2128 S. HANLEY RD
ST. LOUIS MO 63144
(314) 645-0637

CONTRACT NUMBER 7034-26
DRAWING NUMBER 1 OF 4



BOILER RESET SCHEDULE

O.A. TEMP	ST-1 SET-PT
-10°F	200°F
30°F	160°F
70°F	120°F

288

[illegible]

[illegible] Pumps [illegible] and [illegible] provided collector temperature is [illegible] higher than solar water storage tank temperature. [illegible] continue to run until [illegible] collector temperature drops to 3°F higher than solar water storage temperature.

Receiver Controller RC-2 modulates purge valve V-2 to prevent solar supply water to converter unit from rising above 200°F. When valve V-2 is [illegible] open to the purge unit, pressure electric switch PE-2 energizes the fan in the purge unit to cool the solar water.
Pump "B" [illegible]

When outside temperature drops below 65°F, receiver controller RC-7 [illegible] pump "C" thru action of PE-10 provided solar water storage tank temperature is above [illegible]°F as sensed by temperature transmitter TT-10 and controller RC-10.

Pump "C" supplies solar heated water to AHU #1, 2 and 3 heating coils and 2nd and 3rd floor fan coil units. If solar system can not supply sufficient heat required by the fan coil units, pressure switch PE-12 energizes solenoid air valve EP-2 to position changeover valves V-11 and V-12 to circulate boiler heated water through the fan coil piping loop.

Receiver controller RC-8 modulates drain valve V-8 toward an open position, if storage water temperature rises above 200°F.

Pressure regulator PR-4 modulates bypass valve V-4 to prevent system differential pressure from rising above 20 PSI.

BOILER HOT WATER SYSTEM:

When outdoor temperature drops below 65°F, receiver controller RC-7 energizes circulated pump "D" and boiler control circuit. Submaster thermostat ST-1 controls the boiler to maintain desired hot water supply temperature. The set point of ST-1 is reset inversely in accordance with outdoor temperature (See reset table).

Pressure regulator PR-3 modulates bypass valve V-3 to prevent system differential pressure from rising above 20 PSI.

SPACE TEMPERATURE "DAY-NITE" CHANGEOVER SYSTEM:

Program clock C-2 on nite cycle de-energizes solenoid air valve EP-1 to switch dual supply air main to 20 PSI. At 20 PSI the space thermostats are indexed to maintain reduced space temperature. (See sheet-1 for nite cycle).
Program clock C-2 is set to close its contact 4 hours prior to the time that the building is to be occupied. At some point during this period, controller C-3 energizes solenoid air valve EP-1 to return the system to day space temperature settings (15 PSI) to insure that the building is at desired temperature at the time of occupancy.

Controller C-3 compares the outdoor air temperature to the fixed Building "U" (heat loss) factor to determine optional time which the system is to be returned to day setting.

FIELD MOUNTED CONTROL DEVICES:

TAG	CODE	DESCRIPTION
TT-1,3,4,5,6,9,10	T5210-4	Temp Transmitter, 40-240°F w/T800-1605 1mm. well
TT-7	T5210-114	Temp Transmitter, 0-100°F
ST-1	A19FBC-4	Submaster Th'stat, 1:1 Ratio, w/Well 14A 602 [illegible] well
PR-3,4	P8575-3	Rev Act Prop Diff Pressure Regulator, Set 20 PSI
V-2	V4322-1031	1-1/2" Mixing Valve, 4-8# SPG, C_v 21
V-3	V5250-575	2" N.O. Valve, 4-8# SPG, C_v 26
V-4	V5250-575	2" N.O. Valve, 4-8# SPG, C_v 26
V-8	V3752-1029	1-1/2" N.O. Valve, 4-8# SPG, C_v 20
V-11	V5650-13	2-1/2" Diverting Valve, 9-13# SPG, C_v 68
V-12	V5840-476	2-1/2" Mixing Valve, 9-13# SPG, C_v 54
C-4	C-5226	PNEUMATIC SIGNAL TRANSMITTER
R-2	KB4000S	SPST RELAY 120 V. COIL, w/WB1000-2 [illegible]

PANEL MOUNTED CONTROL DEVICES:

TAG	CODE	DESCRIPTION
TI-7	T5502-2	Temperature Indicator, 0-100°F Dial
TI-1, 10	T5502-5	Temperature Indicator, 40-240°F Dial
RC-1,2,8,10	T5312-1	Proportional Receiver Controller
RC-7	T5312-3	2-Position Receiver Controller
PE-2,10,12,1	P7221-1	SPDT Pressure Electric Switch
PE-7	P7220-2	D.P. N.O. Pressure Electric Switch
DT-1,2	J21K-140	"United Elect" Diff Pressure Switch
R-1	KUP14A15-115	3PDT Relay w/120 V. Coil
C-3	C7510-1	Optimal Start Controller
C-2	C7351-2	7-Day Program clock, "Make" 4 Hrs prior to occupancy
PRV	R130-4	Pressure Reducing Valve, Set 15 PSI
AV-1	V6143-1	3-Way Air Valve, 3/8", 9-11# Spring
EP-1,2	V24-2	Solenoid Air Valve w/120 V. Coil

DRAWING TITLE
1. BOILER CONTROL
2. SOLAR HEAT CONTROL

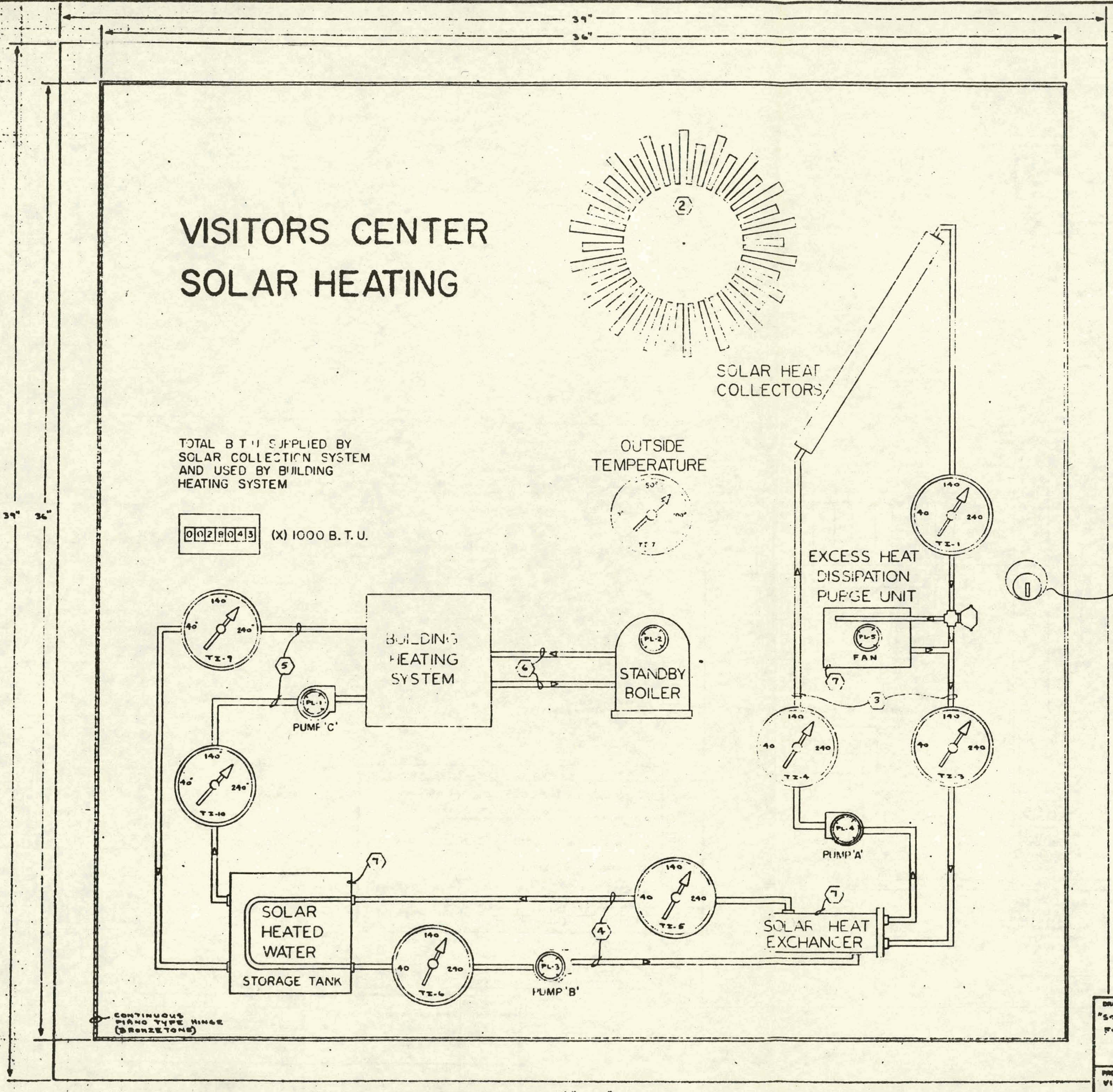
REFERENCE DRAWINGS	NO.	REVISION — LOCATION	ECN	DATE	BY
	2	MISC.		7-2-79	JB
	1	AS INSTALLED		12.18.78	BW

SALES ENGR. Wm. Brosky
APPLICATION ENGR.
DRAWN BY / DATE
APPROVED BY BW DATE 1-27-78

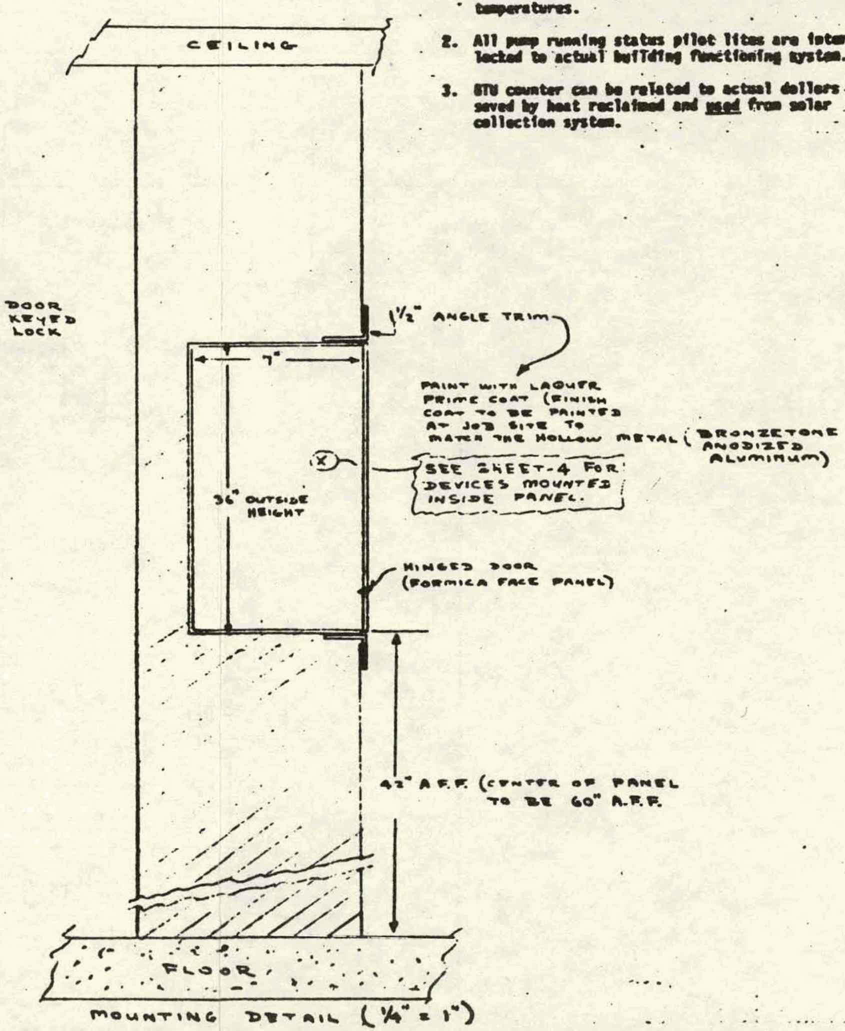
PROJECT
VISITORS CENTER
STEPHENS COLLEGE
COLUMBIA, MISSOURI

JOHNSON CONTROLS
Systems & Services Division
2128 S. HANLEY RD
ST. LOUIS MO, 63144
(314) 645.0637

CONTRACT NUMBER 7034.25
DRAWING NUMBER 2 OF 4



SCALE : 1/2" = 1"



MOUNTING DETAIL (1/4" = 1")

COLOR CODING

1	[illegible]
2	Sun Insert (not printed) Formica — Brick Orange #041 [illegible] Finish
3	Solar Loop— Inscribed & color filled to match Brick Orange #041 (Formica color)
4	Heat Exchanger Loop—Inscribed & color filled to match Persimmon #874 (Formica color)
5	Bldg. Heating Loop—Inscribed & color filled to match Poppy #081 (Formica color)
6	Boiler Heating Loop—Inscribed & color filled to match Scarlet #848 (Formica color)
7	Equipment Outlines, Lettering, Sun Face, Sun Rays, Etc—Inscribed and Black filled
8	All letters and numbers (except title) to be Helvetica Regular style
9	Title lettering to be Helvetica Medium style

EQUIPMENT LEGEND

Tag	Code	Description
TI-1,3,4,5,6,9,10	T5802-5	2 1/2" Pneu Temp Indicator 40 to 240°F Range
TI-7	T5802-2	2 1/2" Pneu Temp Indicator 0 to 100°F Range
PL-1,2,3,4,5	B-0099	120 V Pilot Lite w/Grn Lens
C-1	#8352	"Taylor" 7-Digit B.T.U. Counter

1. All indicated temperatures are actual system temperatures.

2. All pump running status pilot lites are interlocked to actual building functioning system.

3. BTU counter can be related to actual dollars saved by heat reclaimed and used from solar collection system.

DRAWING TITLE
"SOLAR DEMONSTRATION PANEL"
FORMICA GRAPHIC FACE PANEL

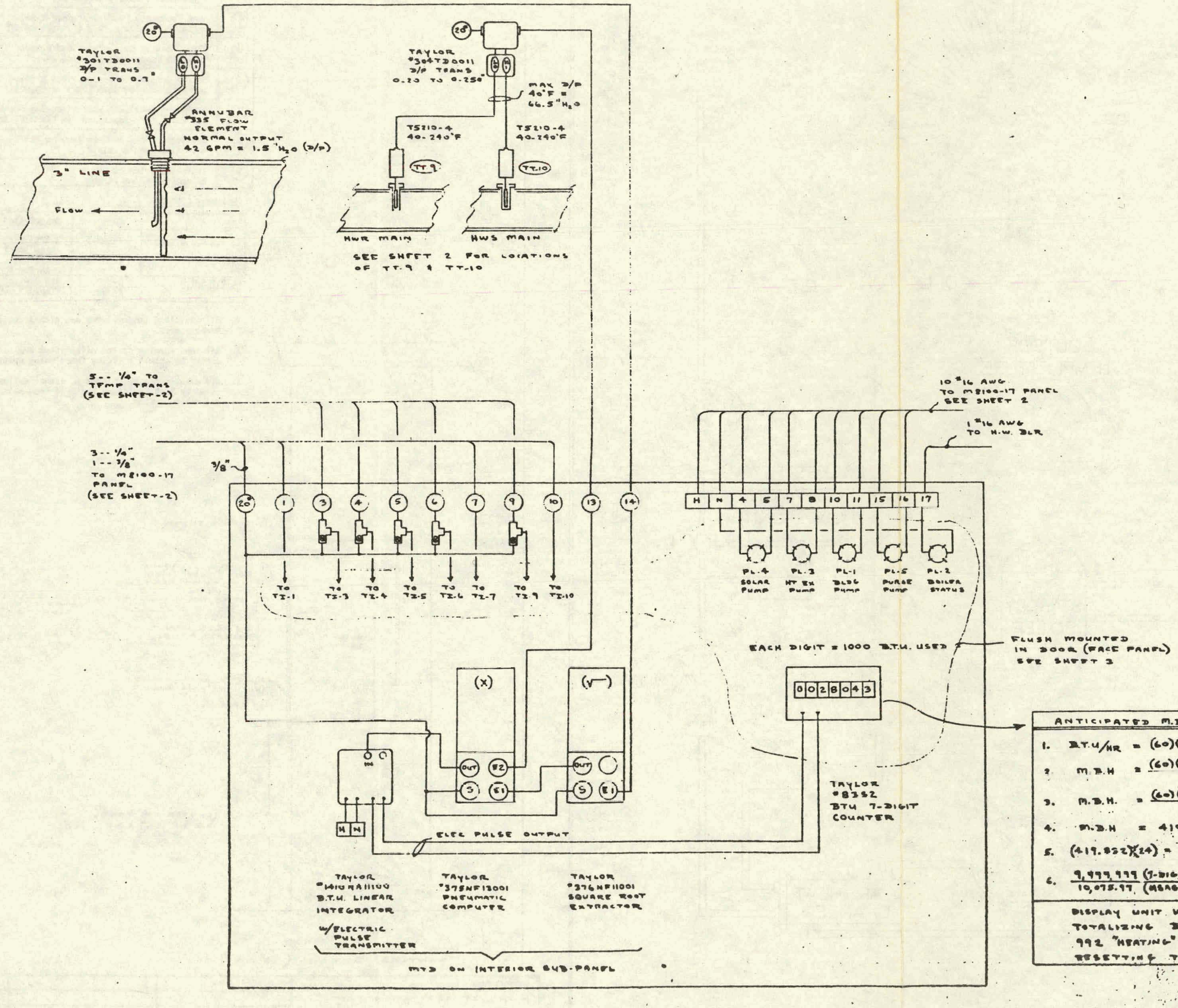
REFERENCE DRAWINGS	NO.	REVISION — LOCATION	BY	DATE

SALES ENGR.
W.M. SEGOBY

APPLICATION ENGR.

PROJECT
VISITORS CENTER,
STEPHENS COLLEGE
COLUMBIA, MISSOURI

JOHNSON CONTROLS
Systems & Services Division



ANTICIPATED M.B.H. DISPLAY USAGE

1. $B.T.U/HR = (60)(8.33)(\Delta T_{H_2O})(GPM)$
2. $M.B.H = \frac{(60)(8.33)(\Delta T_{H_2O})(GPM)}{1000}$
3. $M.B.H. = \frac{(60)(8.33)(20)(42)}{1000} = 419.832$
4. $M.B.H = 419.832$
5. $(419.832)(24) = 10,075.97$ "1000 BTU/DAY"
6. $\frac{9,999,999 \text{ (7-DIGIT DISPLAY)}}{10,075.97 \text{ (USAGE/DAY)}} = 992$ DAYS

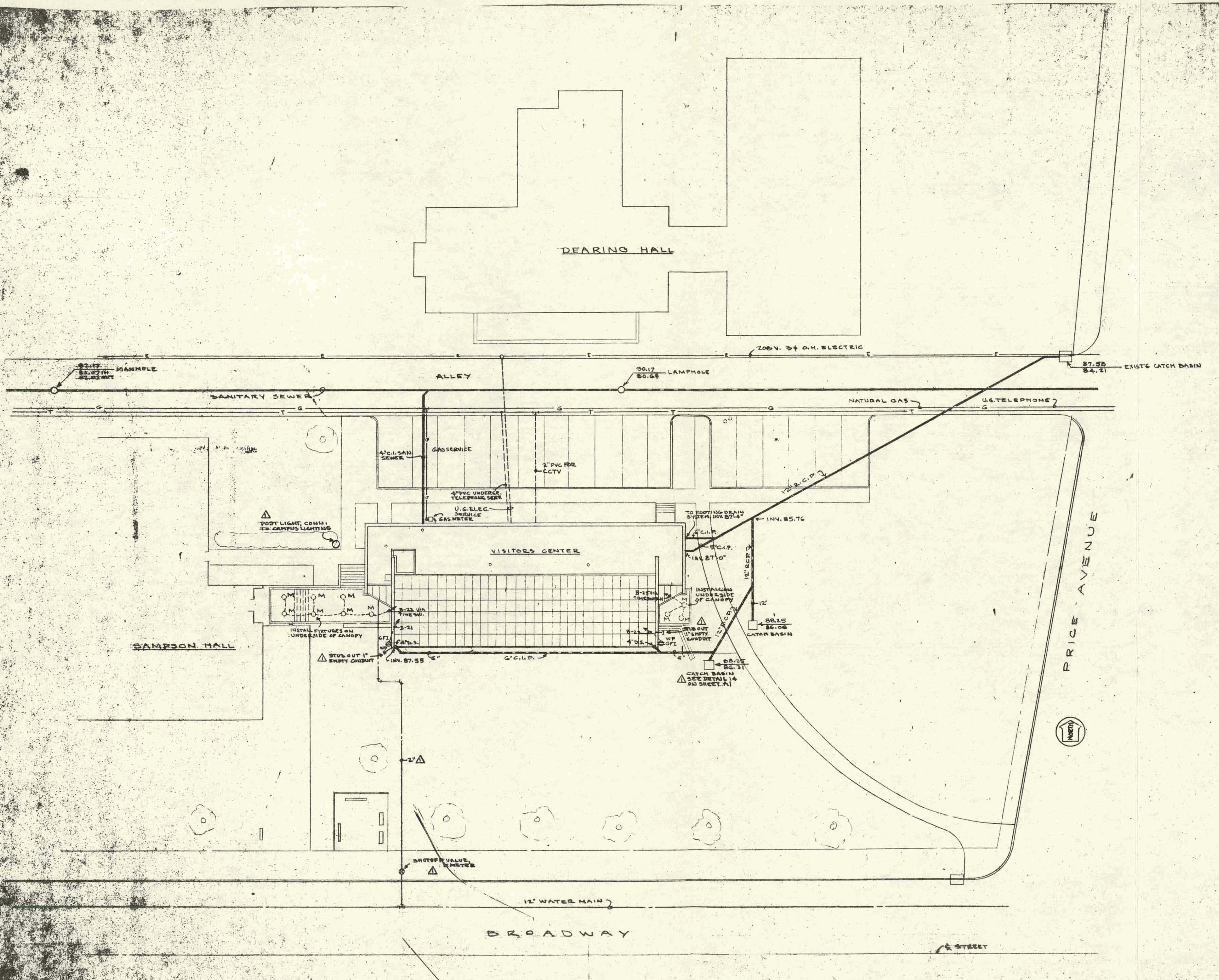
DISPLAY UNIT WILL BE CAPABLE OF TOTALIZING B.T.U. USAGE FOR 992 "HEATING" DAYS BEFORE RESETTING TO ZERO

1000 B.T.U/HR = M.B.H.

DRAWING TITLE
"SOLAR DEMONSTRATION PANEL"
INTERIOR PIPING & WIRING

PROJECT
VISITORS CENTER
STEPHENS COLLEGE
COLUMBIA, MISSOURI

JOHNSON CONTROLS
Systems & Services Division



SITE PLAN

SCALE: 1/16" = 1'-0"

291

Sövik Mathre Sathrum Quanbeck Architects | 205 South Water Street | Box 390 | Northfield Minnesota 55057 | 507 645 4461 | 612 335

MARK	DATE	DESCRIPTION
△	[illegible]	REVISED TO "AS-BUILT" CONDITION

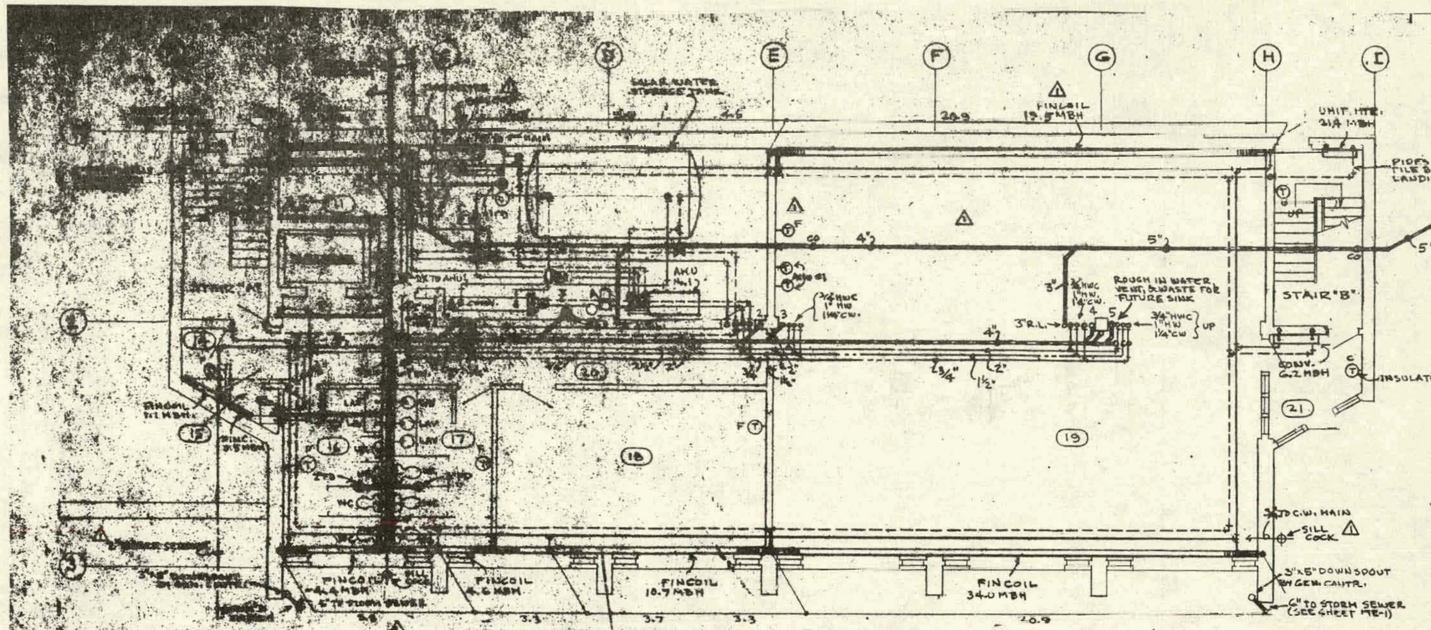
LEWIS D. FREEDLAND CO.
CONSULTING ENGINEERS
1804 FRANCE AVE. SOUTH
MINNEAPOLIS, MINNESOTA 55416
PHONE (612) 927-9376

ERDA SOLAR
COOPERATIVE
AGREEMENT
NO. [illegible]

VISITORS CENTER

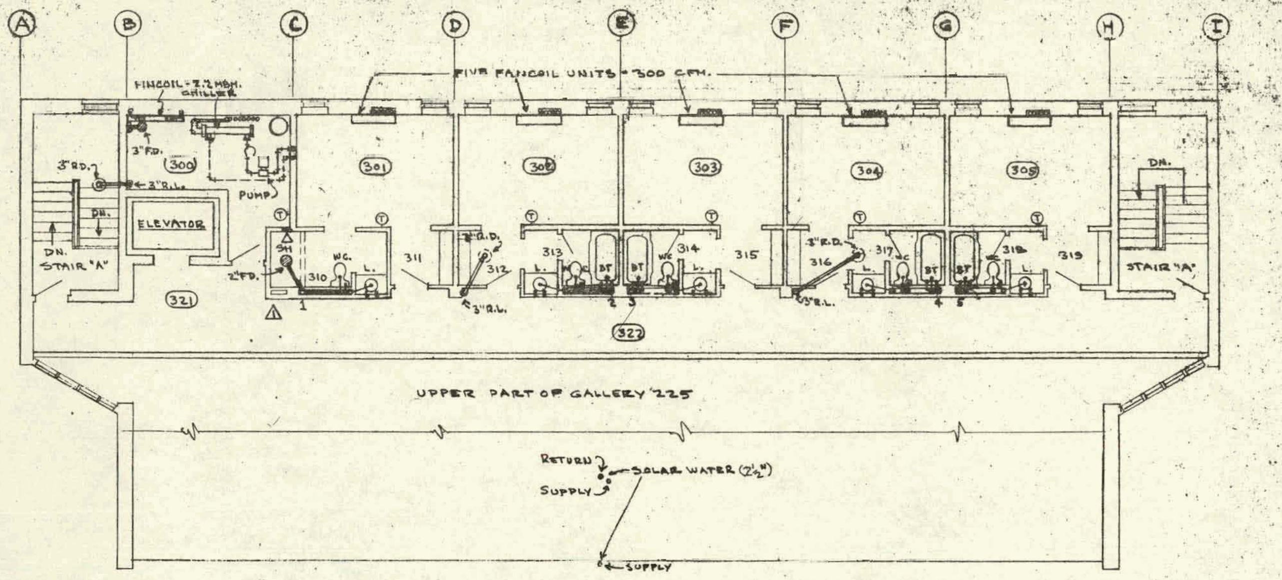
STEPHENS COLLEGE COLUMBIA, MISSOURI

ME1



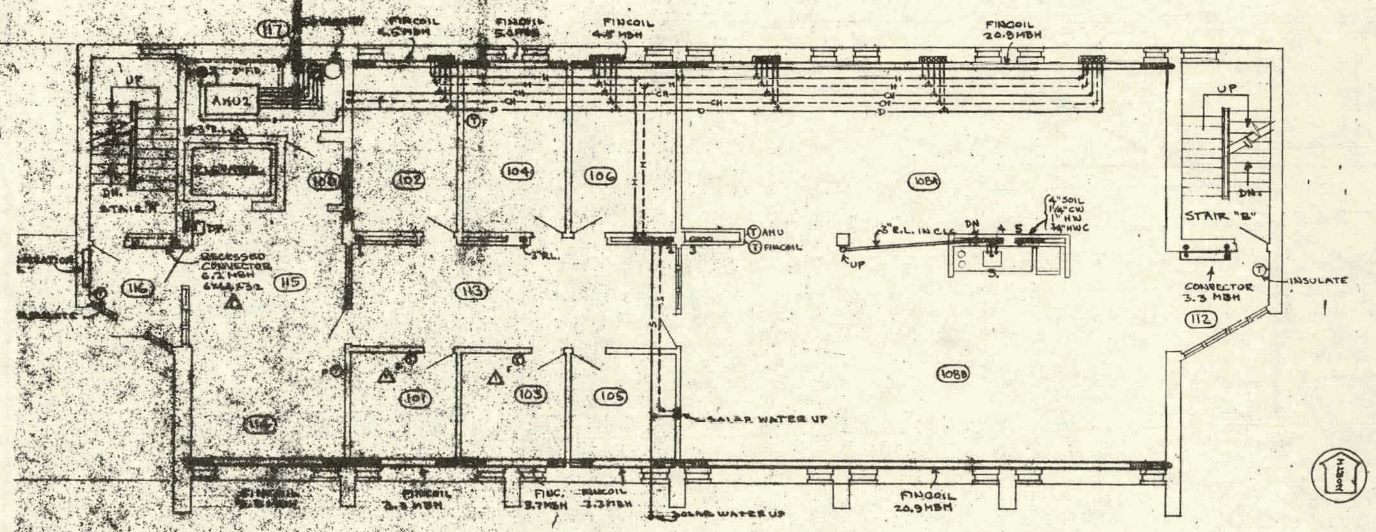
GROUND FLOOR PLAN

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



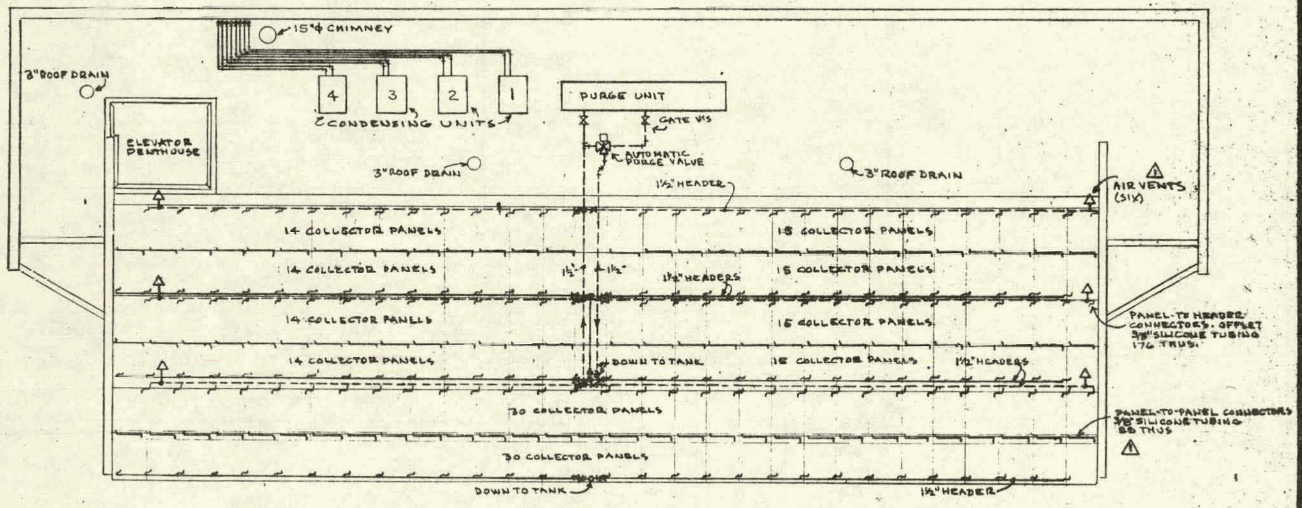
THIRD FLOOR PLAN

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



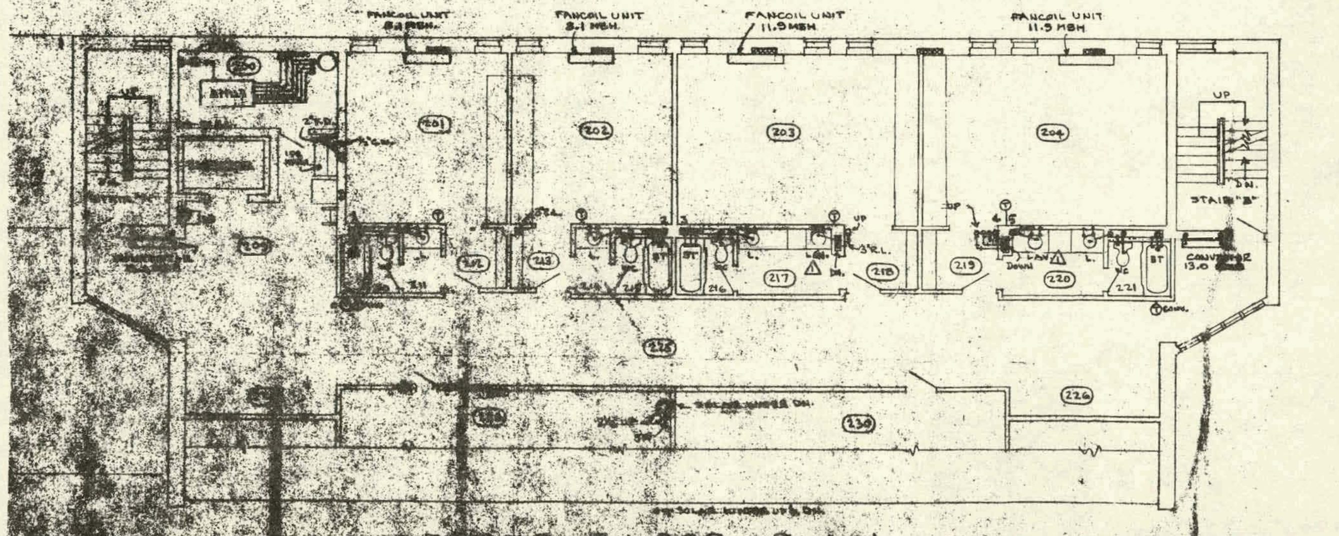
FIRST FLOOR PLAN

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

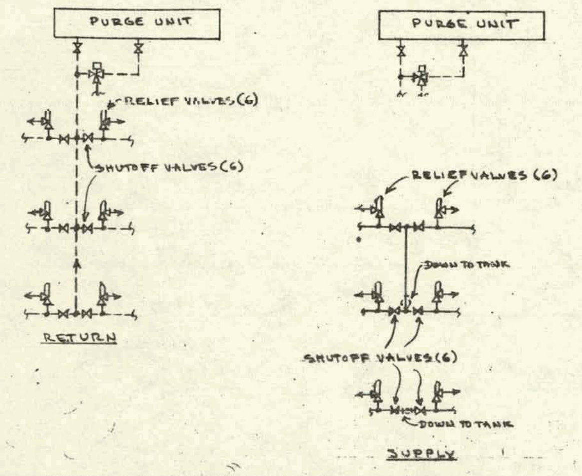


ROOF PLAN

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



SECOND FLOOR PLAN



HEADER CONNECTIONS TO S&R MAINS

NOT TO SCALE

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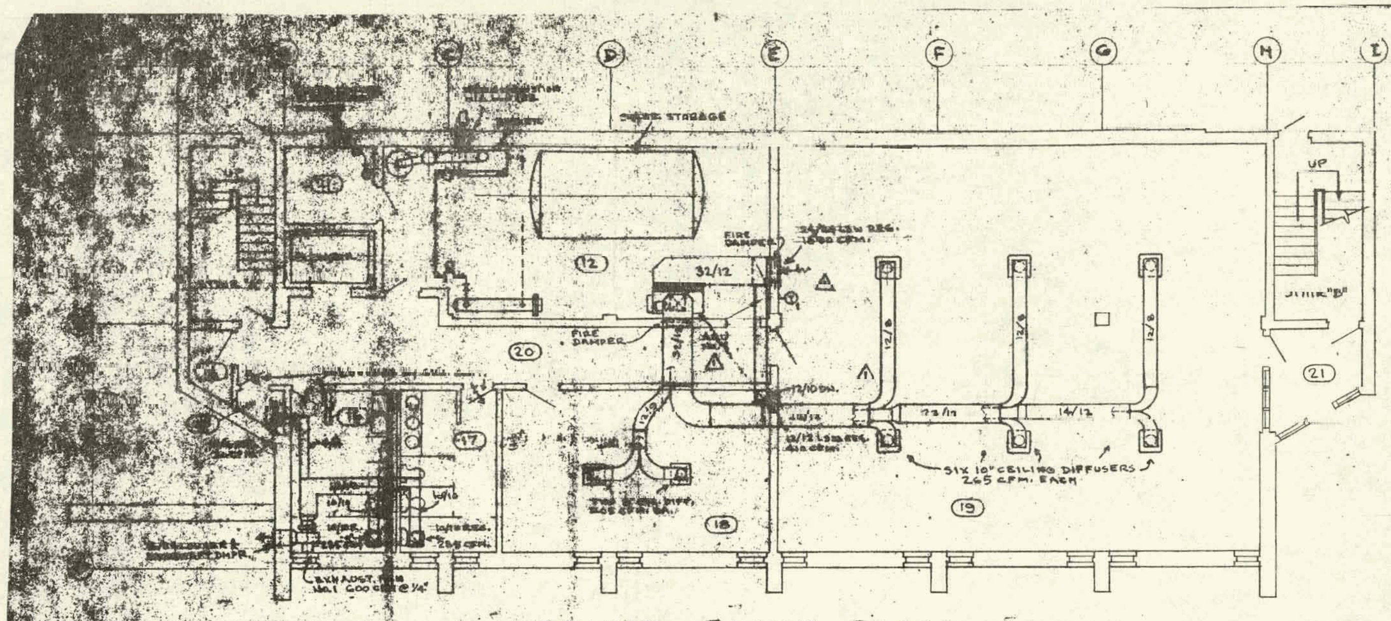
VISITORS CENTER

ERDA SOLAR COOPERATIVE AGREEMENT

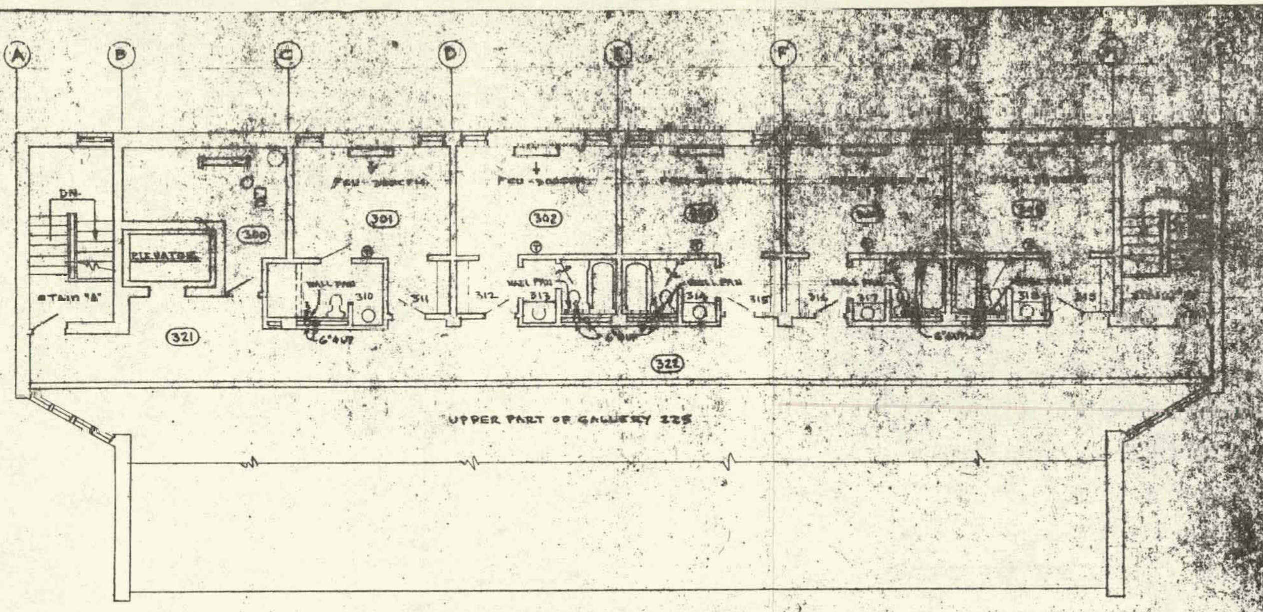
LEWIS D. FREEDLAND CO.
CONSULTING ENGINEERS
3804 FRANCE AVE. SOUTH
MINNEAPOLIS, MINNESOTA 55416

	Date	Description	By
△	[illegible]	REVISED TO "AS-BUILT" CONDITIONS	[illegible]

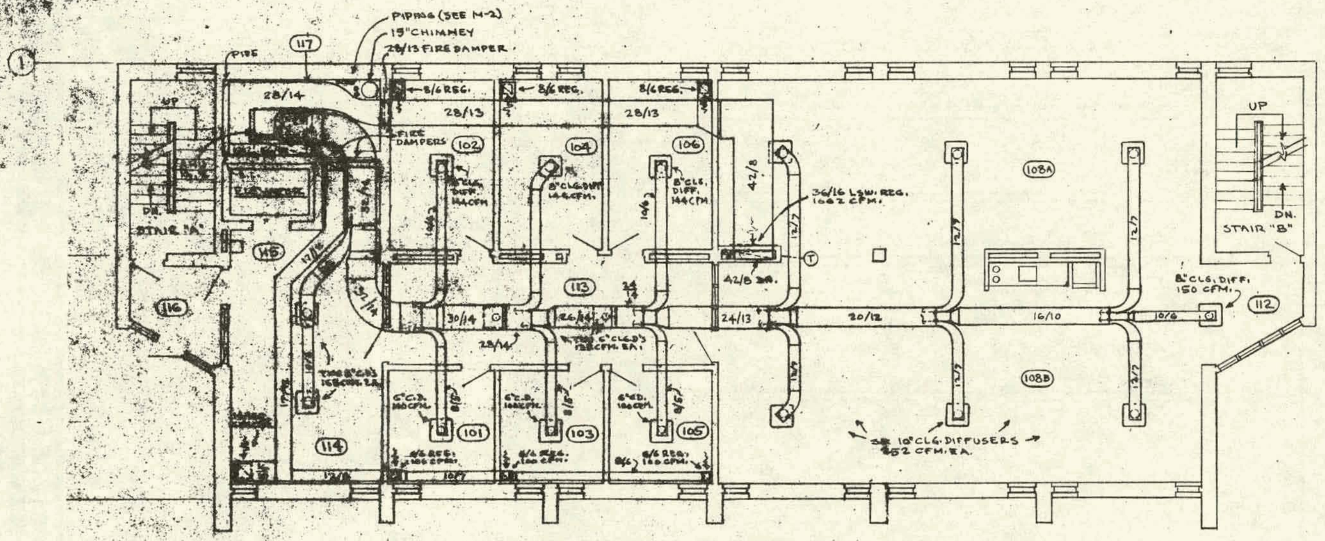
M2



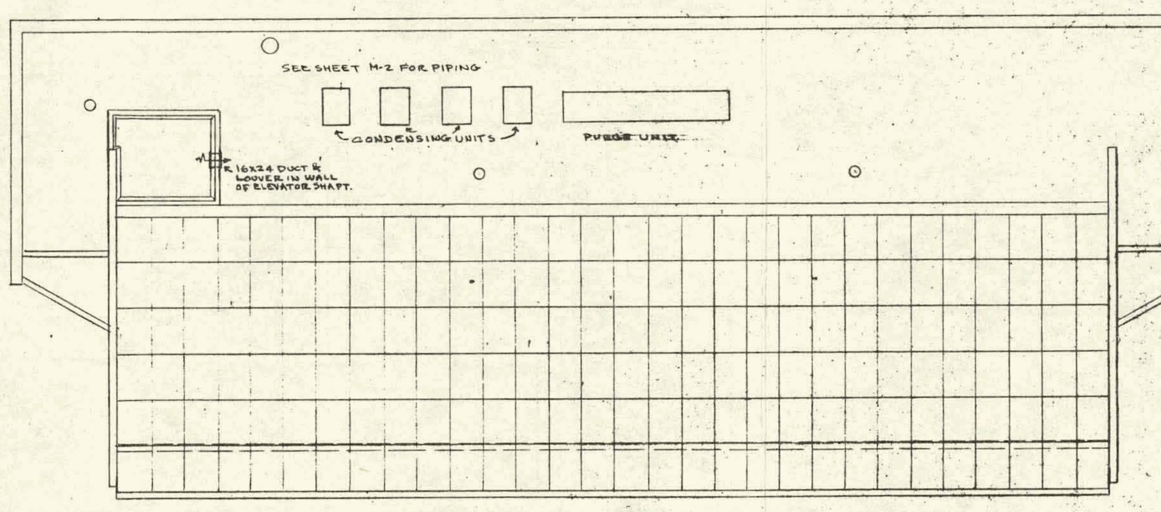
GROUND FLOOR PLAN
SCALE: 1/8" = 1'-0"



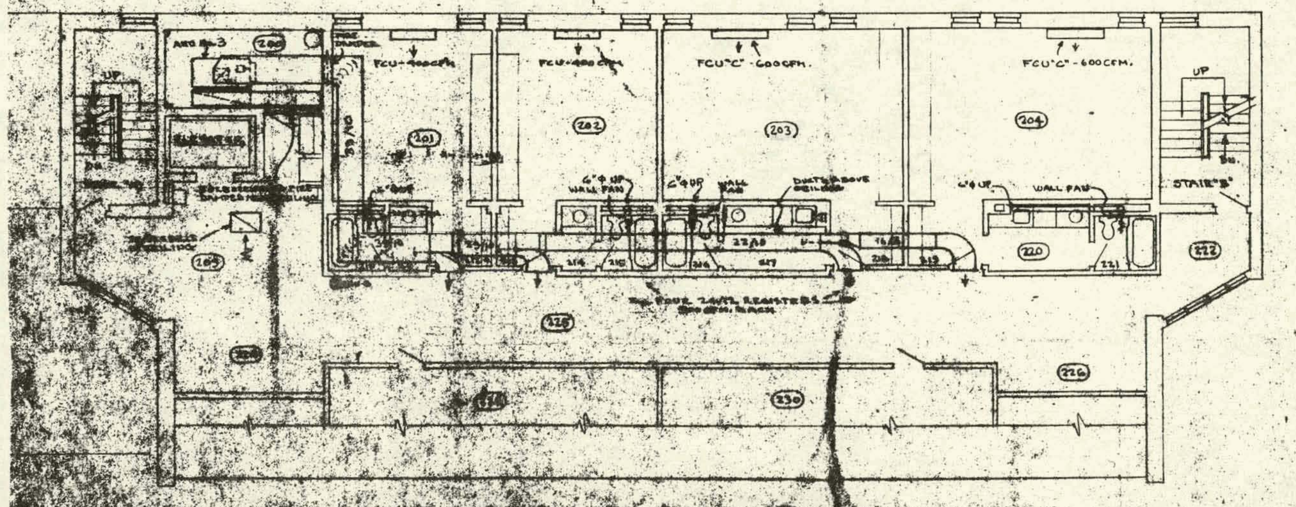
THIRD FLOOR PLAN
SCALE: 1/8" = 1'-0"



FIRST FLOOR PLAN
SCALE: 1/8" = 1'-0"



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



SECOND FLOOR PLAN

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M3

[illegible] UNITS (CARRIER TYPE 42VB)	A	B	C		
[illegible] NO. (CFM)	300	400	600		
TOTAL COOLING, MBH	4.9	4.5	6.9		
TOTAL HEATING, MBH	7.0	8.1	11.9		
COOLING GPM	1.3	1.2	1.6		
HEATING GPM	1.0	1.2	1.5		

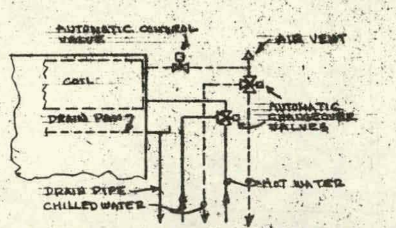
ALL UNITS; COOLING WATER=45°ENT., 56° LVG. HEATING WATER=100°ENT., 80° LVG. ENT. AIR=78° & 68°. MOTORS=120/60/1, 3-SPEED, PERM. SPLIT CAPACITOR.

AIR HANDLING UNITS & CONDENSING UNITS (CARRIER) UNIT MARK →	1	2	3	4	REMARKS
AHU MODEL No. 39B-	050	060	050	–	
AIR DELIVERY, CFM.	2000	3000	2000	–	
ESP, INCHES W.C.	1/2"	5/8"	1/2"	–	
OUTSIDE AIR, %	25	10	20	–	
TOTAL COOLING, MBH	65.2	84.5	68.3	–	
TOTAL HEATING, MBH	65.8	110.2	27.9	–	EACH OF 2 COILS
MOTOR H.P.	1 1/2	2	1 1/2	–	
COND. UNIT MODEL	38CC060	38BA009	38CC060	38CC060	
C.U. AMPS	25.0	43.2	25.0	25.0	

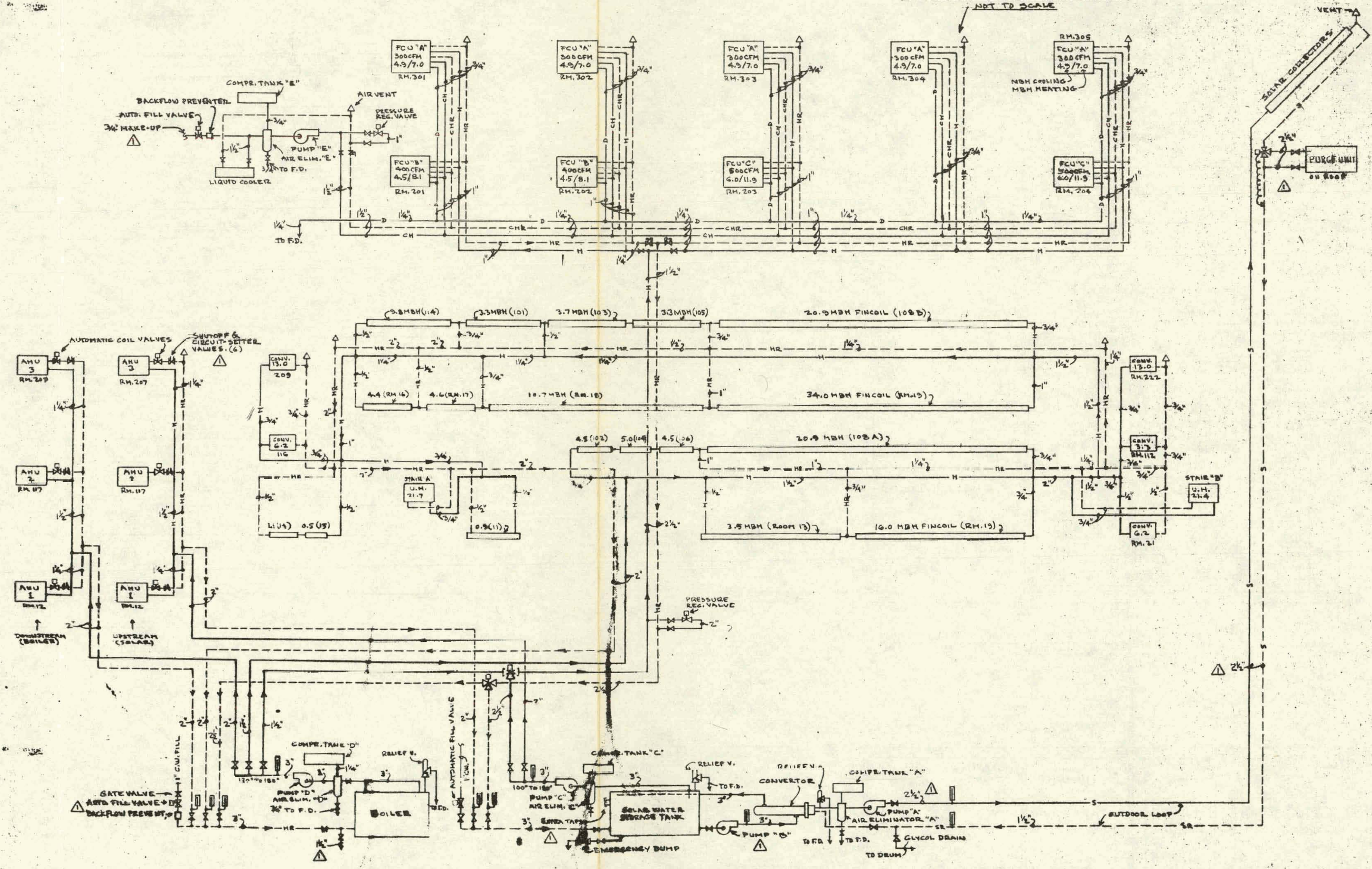
ALL UNITS: COOLING = DX, HEATING WATER ENT. TEMP.: SOLAR 100°F, BOILER WATER 180°F. MOTORS 208/60/3, WITH MAG. STARTERS.

PUMPS & SPECIALTIES (BELL & GOSSETT) MARK →	A	B	C	D	E
MODEL No. (PUMP)	PD35	HD3	PD35	PD37	1PR
DELIVERY, GPM.	45	60	42	64	12
HEAD, FT.	16	13	19	21	15
MOTOR HP.	1/2	1/3	1/2	3/4	1/6
AIR ELIMINATOR	R2	R2	R3	R3	R2
COMPRESSION TANK	28270	80	60	100	24

MOTORS 1/3 HP & LESS = 120/60/1, MOTORS LARGER THAN 1/2 HP = 208/60/3.



TYPICAL FAN-COIL CONNECTIONS
NOT TO SCALE



HYDRONIC SYSTEMS DIAGRAM
NOT TO SCALE

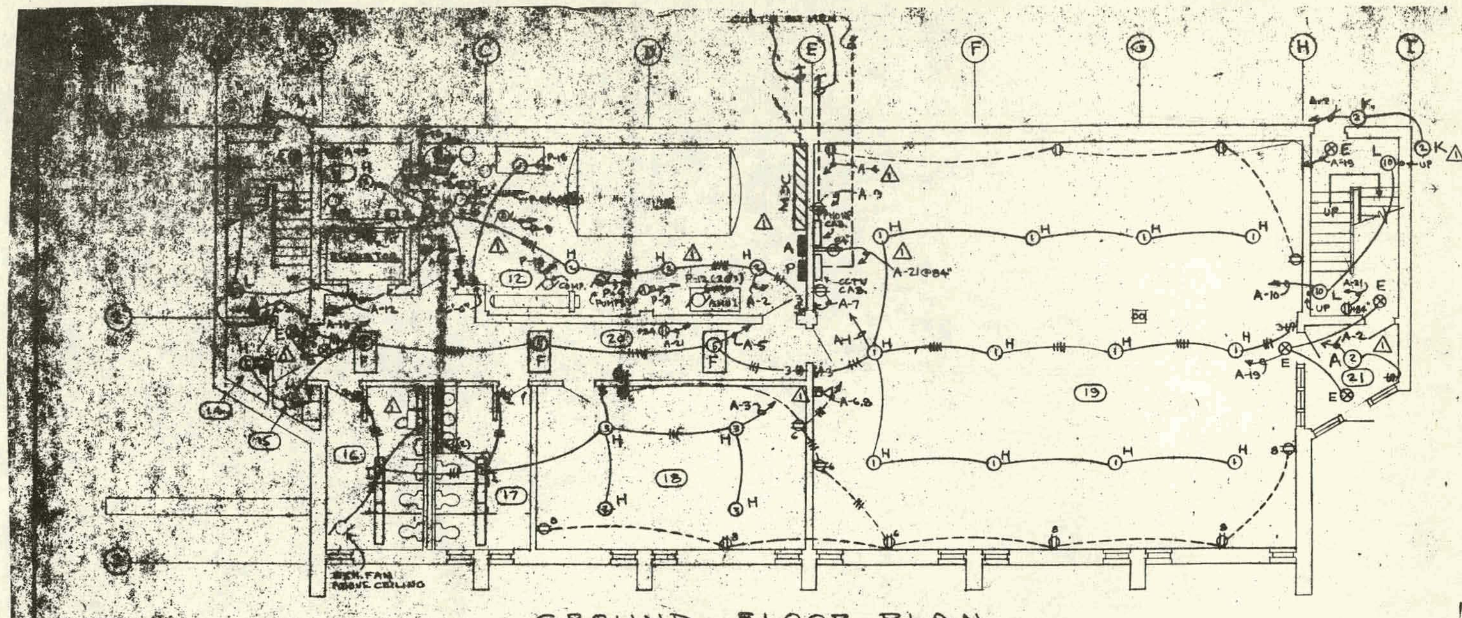
Sövik Mathre Sathrum Quanbeck Architects Planners | 205 South Water Street | Box 190 | Northfield Minnesota 55057 | 507 645 4461 | 612 336 [illegible]

VISITORS CENTER

ERDA SOLAR COOPERATIVE [illegible]

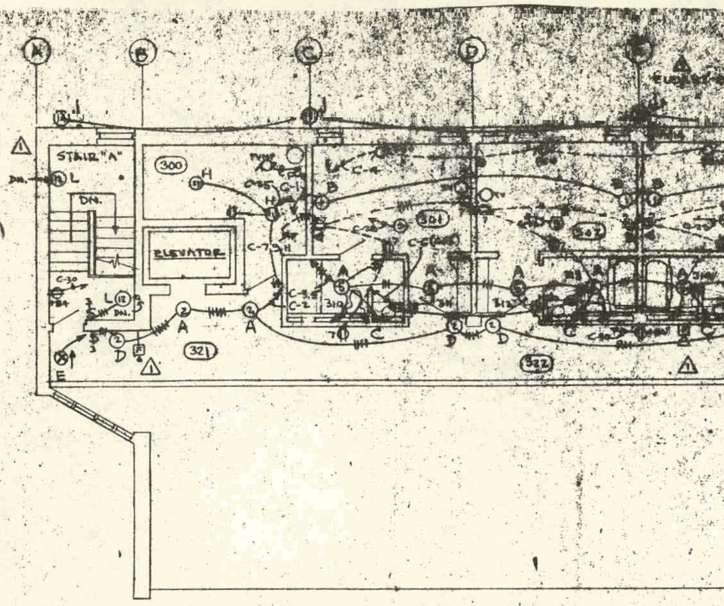
LEWIS D. ENGLAND CO. [illegible]

M4



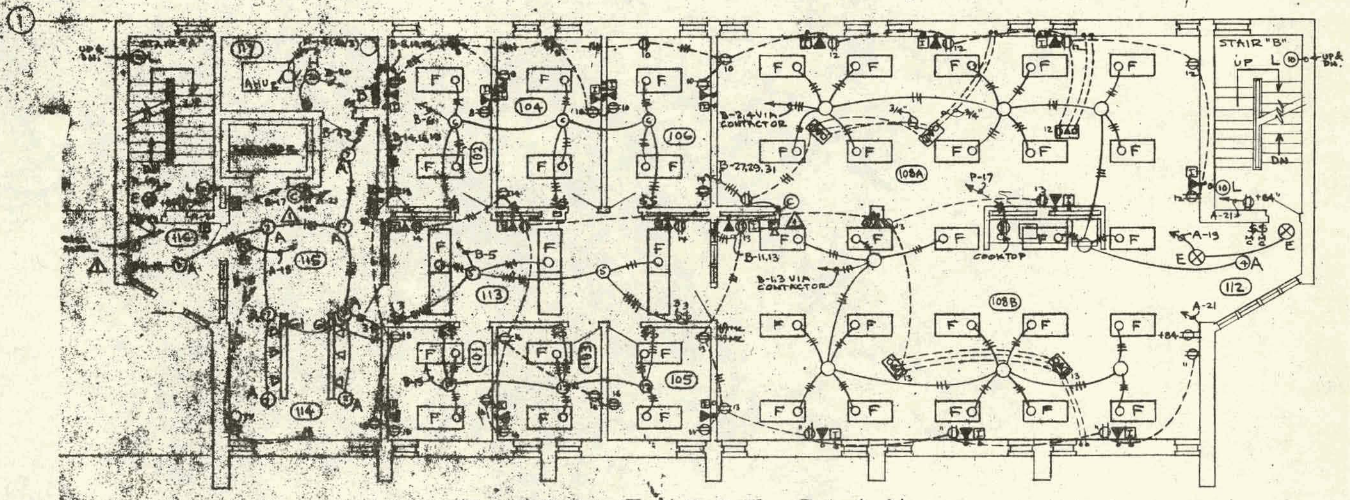
GROUND FLOOR PLAN

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



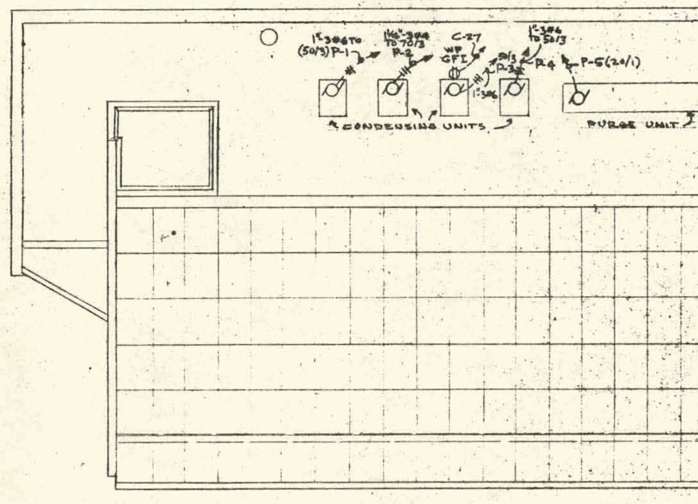
THIRD FLOOR PLAN

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



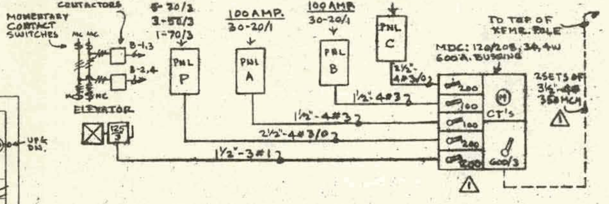
FIRST FLOOR PLAN

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



ROOF PLAN

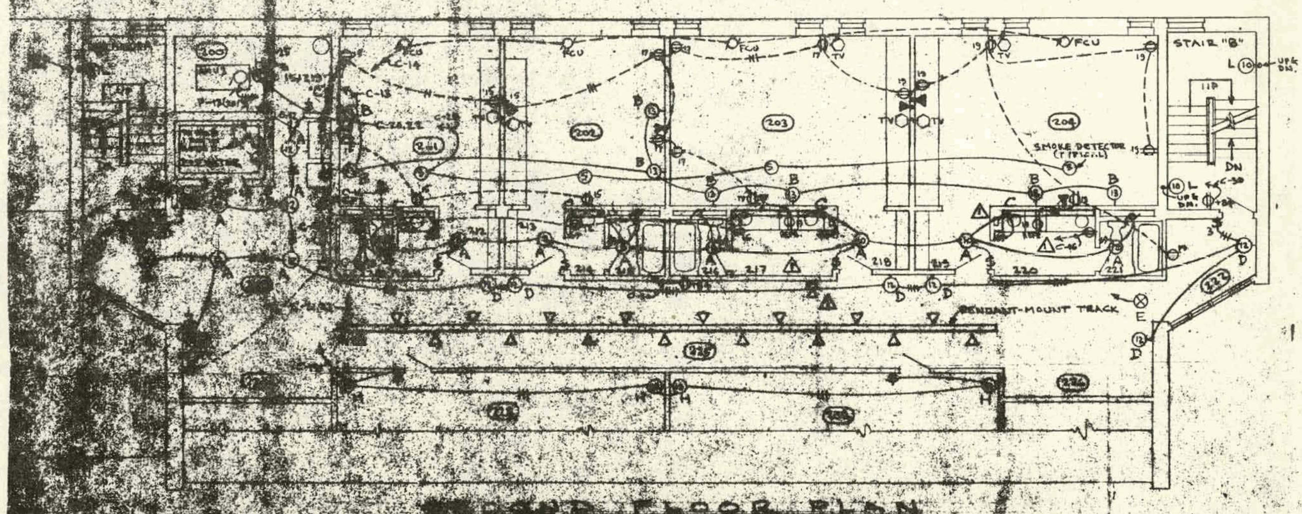
SCALE: 1/8" = 1'-0"



ELECTRICAL DISTRIBUTION

NOT TO SCALE

NOTES
1. VERIFY WITH OWNER, LOCATION OF RECEPTACLES, PHONE OUTLETS & INTERCOM OUTLETS.
2. NOTE THAT OUTLETS IN OFFICES ON 1ST FLOOR ARE 120V., TELEPHONE, & INTERCOM IN 3-GANG BOX.
3. EXTEND 3/4" CONDUIT FROM TELEPHONE & INTERCOM OUTLETS TO ACCESSIBLE CEILING SPACE.
4. EXTEND 1/2" CONDUIT FROM BOX-TO-BOX (IN SERIES) FOR ALL TV OUTLETS, HOME RUN TO CCTV PANEL.
5. REFER TO ARCHITECTURAL PLANS FOR CEILING PATTERNS, LIGHT FIXTURE LOCATIONS, ETC.
6. SWITCH ALL TOILET FANS IN PARALLEL WITH TOILET LIGHT FIXTURES.
7. ALL TYPE "F" FIXTURES SHALL BE WIRED SO THAT THE TWO INNER LAMPS CAN BE SWITCHED SEPARATELY FROM THE TWO OUTER LAMPS.
⚠8. TWO-GANG BOXES IN ROOMS 201, 202, 203, 204, 301, 302, 303, 304, 305.



SECOND FLOOR PLAN

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SOLAR COOPERATIVE

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E2

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