AMERICAN EQUIPMENT SYSTEMS
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COMMERCIAL REFRIGERANT DESUPERHEATER
WASTE HEAT RECOVERY

INSTALLATION/OPERATION/MAINTENANCE MANUAL

AES DESUPERHEATER WASTE HEAT RECOVERY UNIT

APPLICATION : The successful application of an AES refrigerant desuperheater waste heat recovery unit (HRU) is dependant upon two basic factors; First is the available source of waste heat from air conditioning or refrigerant equipment. Second is a need to heat water, or other fluid. The cooling and water heating loads need not occur simultaneously, nor is it required that the HRU be capable of meeting the entire water heating load in order to be cost effective. However, since surplus water heating produces no savings, care should be taken to insure unnecessary HRU's are not applied.

In most commercial applications the HRU is connected to a storage tank where the recycled heat can be stored for later use. Very often the storage tank will be utilized to feed preheated water to a booster or final heater, prior to delivery at the point of use. For those applications where the hot water is used for a washdown process (periodic usage of large quantities of water) additional storage capacity is often desirable. If faster temperature recovery is desired , smaller storage capacity should be considered. In many reheat applications the 4,000 BTU's per ton will match the reheat requirement. In this application the desuperheater can be connected directly to the reheat coil.

AES heat recovery units can be applied to virtually any vapor compression refrigerating equipment (air conditioning, mid and low temperature refrigeration, and heat pumps) utilizing halocarbon refrigerants. AES HRU's can be applied to reciprocating, rotary, screw or scroll compressors. They are not compatible with centrifugal compressors, absorption units, or systems using R-717 (Ammonia) refrigerant. AES units are used primarily for heating or preheating domestic or process water, but may be used for other fluid heating applications as well. (Consult factory for other fluid heating , as pumps and other considerations may affect application).

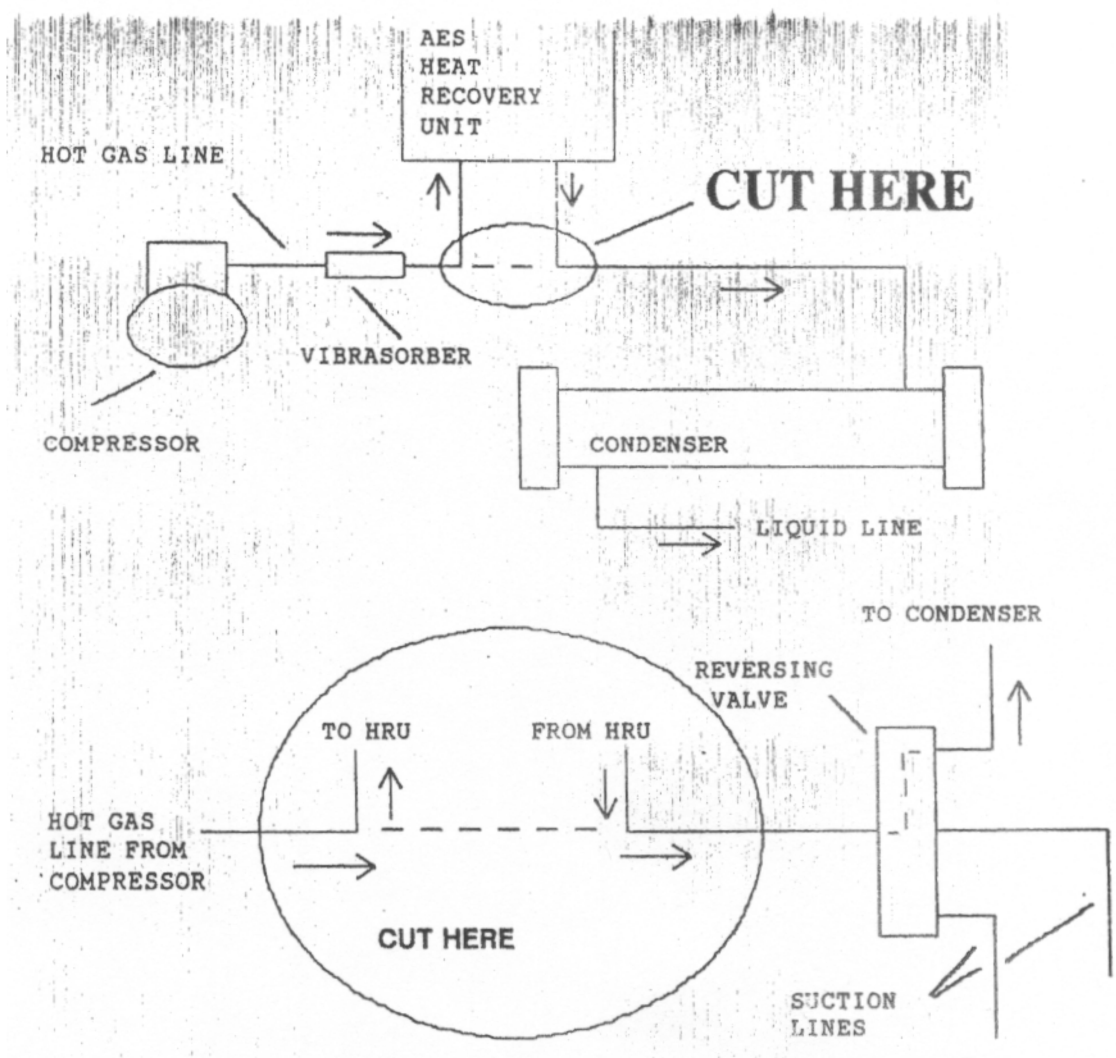
AES HRU's are available in various capacities (tons or H.P.) and design configurations to facilitate connection to many types or styles of cooling equipment. Many commercial cooling units employ two compressor circuits and refrigerant circuits in a single unit to provide capacity control. For these applications, the AES dual circuit units (***000* models with a "D" after the tons/ H.P. designator) provide two refrigerant circuits within a single unit. These same models may be applied to cooling equipment with multiple compressors (3 or more) and dual refrigerant circuits, providing the HRU's refrigerant circuits are sized for the capacity of the cooling equipment's circuits under full load operation.

EQUIPMENT MOUNTING: The HRU may be floor mounted or suspended from above, however the unit must be horizontal (pipe stubs in horizontal orientation) to prevent trapping of oil in the refrigerant circuit or air in the water circuit. It is best if the HRU can be mounted above the condenser inlet to promote oil and refrigerant drain down into the condenser during the compressor off cycle. Mounting should be as close as feasible to the compressor to minimize refrigerant line length. Units should be mounted to provide adequate space for pump maintenance. Mechanically cleanable HRU's (models ADM & SDM) should be mounted so as to provide adequate space on the cleanable end for tube cleaning brush handles.

REFRIGERATION CIRCUIT CONNECTION AND INSTALLATION: proper operation of the cooling equipment should be verified prior to installation of the HRU. The HRU is not intended to correct problems in cooling equipment and may not perform satisfactorily if applied to poorly operating cooling systems. Refrigerant piping design should take into consideration proper oil movement under all compressor(s) load conditions and appropriate traps, risers, and other components applied where necessary. All refrigerant piping should be insulated to reduce heat loss. Insulation should be coated or protected if subject to damage from exposure.

After proper operation has been verified, the refrigerant charge must be isolated (pumped down) or removed from the compressor discharge (hot gas) line. In some systems, the refrigerant charge may be isolated by pumping the refrigerant into a different part of the system, which is the case with split system heat pumps. Other systems may require the refrigerant charge be removed from the system. If removal is required, care should be taken to comply with all applicable regulations governing refrigerant discharge as well as the equipment manufactures recommendations for refrigerant removal.

With the discharge line free of refrigerant pressure, make a cut in the line between the compressor discharge and the condenser inlet. For heat pumps, the cut should be made between the compressor discharge and the reversing valve. Run properly sized refrigerant grade tubing (refer to Trane, ASHRAE, or other manuals for line sizing recommendations) between the discharge line and the " refrigerant in" stub on the HRU. Under not circumstances should the discharge line be down sized from the existing compressor discharge. It may be desirable to install a vibration isolator and/or a discharge muffler in this line if vibration and/or sound is a factor. Connect another line between the "refrigerant out" line and the condenser (or heat pump reversing valve) inlet line. While the system is depressurized, liquid or suction filter dryers should be replaced or installed. (Installation of dryers in the hot gas line is not recommended). Refrigerant lines should be purged with nitrogen during brazing of pipe joints to prevent oxidized particles from forming within the tube. After brazing, joints should be pressure tested to assure no leaks exist. (Figure R-101)



TO CONNECT HRU TO HEAT PUMP SYSTEMS, MAKE CONNECTION BETWEEN COMPRESSOR AND REVERSING VALVE.

Figure R-101

With the refrigerant piping complete, the system should be thoroughly evacuated using a high vacuum pump to remove any air or moisture that has entered the system. Once evacuated, the isolated refrigerant charge may be released and all applicable refrigerant valves opened. The system is now ready to be charged and returned to normal operation. It is recommended that no water be introduced into the HRU heat exchangers prior to establishing proper cooling system operation, as this may result in over charging the compressor. This is especially important for charging of systems where temperature/pressure charts are used to determine proper charge. System should be charged per the manufactures methods and recommended specifications.

WATER PIPING AND TANK CONNECTION: The water pipe should be of a type approved for the application and sized to carry the rated water flow. It may be necessary to upsize the water pipe to make up for the pressure losses incurred with multiple fittings or long piping runs. The piping circuit should be designed to provide a closed loop between the HRU and the storage tank (Figure W-101), similar to a hot water circulating loop. All water piping should be insulated to reduce heat loss. Insulation should be coated or protected if subject to damage from exposure.

For best performance, the water supplied to the HRU should be the coldest water available from the storage tank. This is usually accomplished by connecting (via a Tee) to the cold water line feeding the storage/heater tank. If the cold water feed is connected to the bottom of the storage tank, a screenstrainer should be installed in the water supply line, upstream of the pump, to prevent foreign material from being pulled into the pump impeller. Connect the return water line from the HRU to the storage/heater tank, usually into the drain port (via a Tee) behind the drain valve. Heat will rise, concentrating the hottest water at the top of the tank. Connection of the return line into the hot water feed line is not recommended as intermittent HRU pump operation may cause water temperature fluctuations. If the return water line is connected at the top of the storage tank, a dip tube of at least ten inches will insure proper water mixture. Installation of an automatic air vent at the highest point in the system may be desirable to eliminate air in the circuit. Once water piping is installed leak test all fittings and joints prior to insulating. All piping should be flushed to remove any foreign matter and all air purged from piping and HRU prior to
placing system in operation.

ISOLATION/ DRAIN VALVES: Isolate the HRU from the water beating system for cleaning and maintenance. This may be accomplished by installing valves (gate, ball, or globe) on the supply and return lines, between the tank and the HRU. If such valves are used, a pressure relief valve located on either line (supply or return), between the HRU
and the isolation valves, should be installed. This will allow venting of excess water pressure if the HRU is allowed to operate with the isolation valves closed. (Figure W-102A)

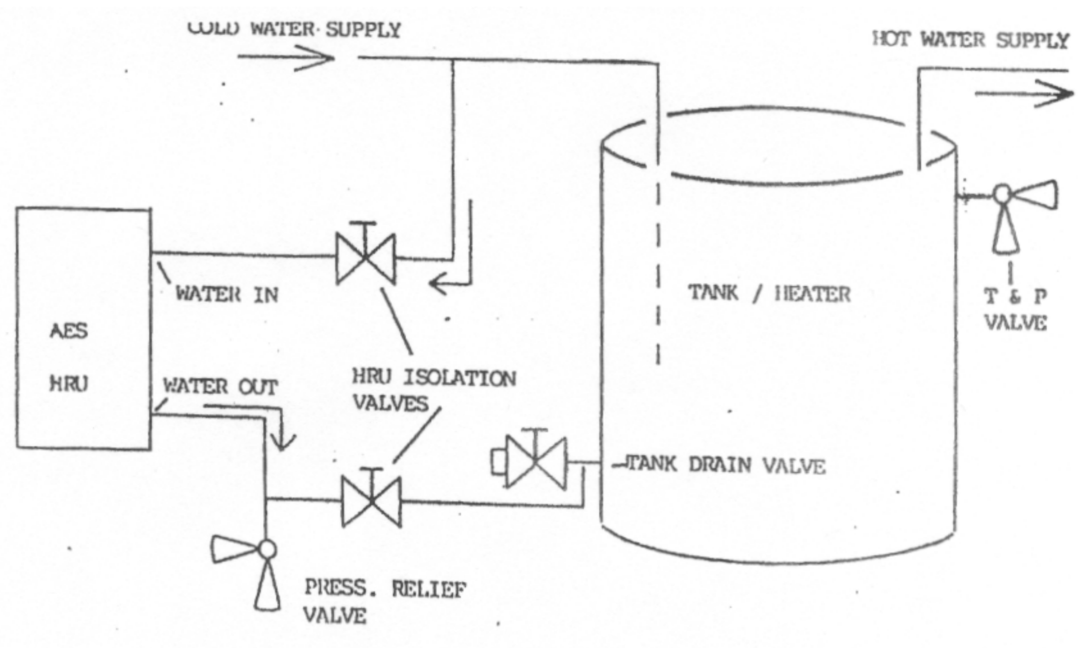


Figure W-102A

ISOLATION/ DRAIN VALVES: Isolate the HRU from the water heating system for cleaning and maintenance. This may be accomplished by installing valves (gate, ball, or globe) on the supply and return lines, between the tank and the HRU. If such valves are used, a pressure relief valve located on either line (supply or return), between the HRU and the isolation valves, should be installed. This will allow venting of excess water pressure if the HRU is allowed to operate with the isolation valves closed. (Figure W-102A) Drain valves will facilitate descaling of heat exchanger water tubes or draining of the system for freeze protection. The drain valves should be installed, one in each line, between the isolation valves and the HRU at the lowest point in the water piping. These valves also make it easier to purge air from the system prior to returning the HRU to service. (Figure W-102B)

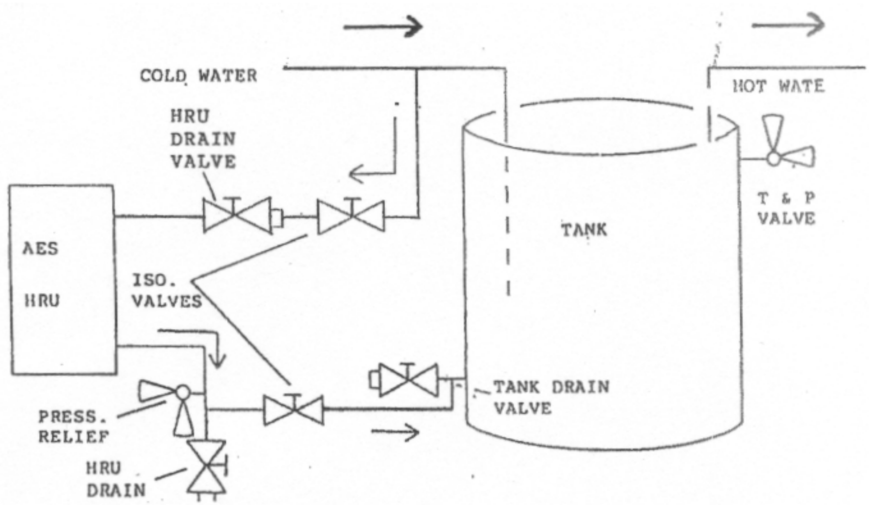
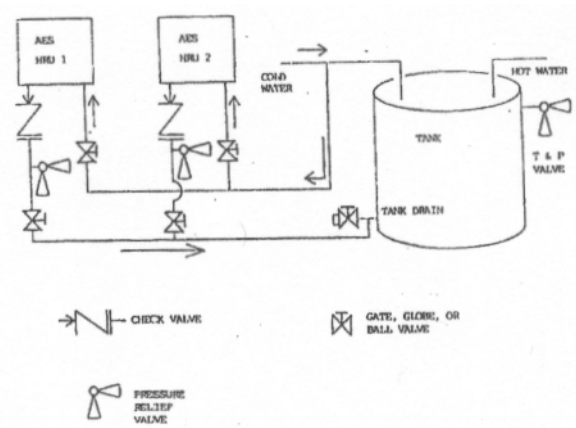


Figure W-102B

MULTIPLE HRU'S CONNECTED TO STORAGE TANK: Can be accomplished by sizing the supply and return water lines for the combined water flow of all HRU's and connecting the HRU's in parallel to the supply/return lines. A check valve should be installed in the "water out" stub of each HRU, upstream of the connection to the return line, to prevent short circuiting of water through inactive HRU's. (Figure W-103)

Figure W-103



MULTIPLE TANKS, PARALLEL: Tank may be connected together in a parallel configuration to increase storage capacity. The piping should be designed to balance water flow through all tanks, and delivery of heated (or preheated) water evenly from all tanks. (Figure W-104)

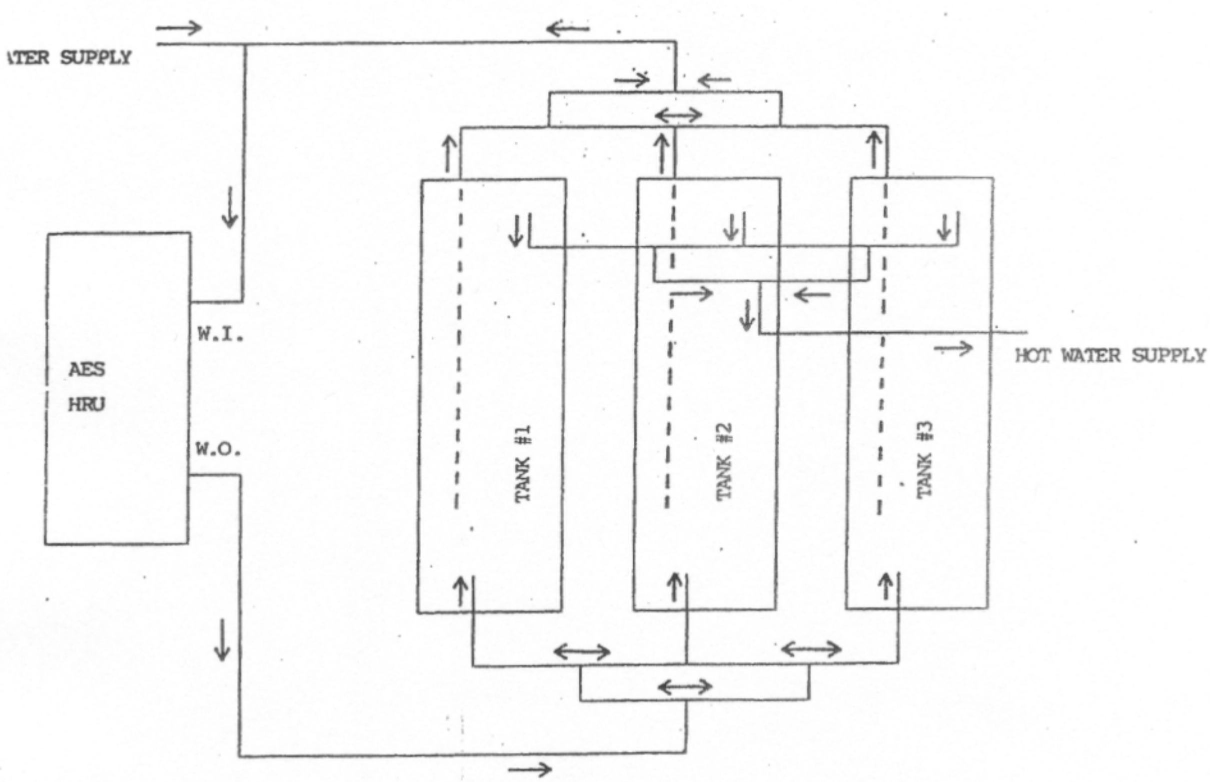


figure W-104

Multiple tanks connected in parallel to HRU for increased storage capacity. Tanks should be manifolded so as to provide for even flow to and from all tanks.

MULTIPLE TANKS, SERIES: It is common to use a storage tank (s) to store water preheated by the HRU. The preheated water is then supplied to the booster, or final heater. The piping should feed the hottest water from the preheat tank (hot water supply port) as the supply water (cold port) to the final/booster heater. It may also be desirable to install a bypass for the cold water supply so that the storage tank(s) can be isolated, if desired. (Figure W-105)

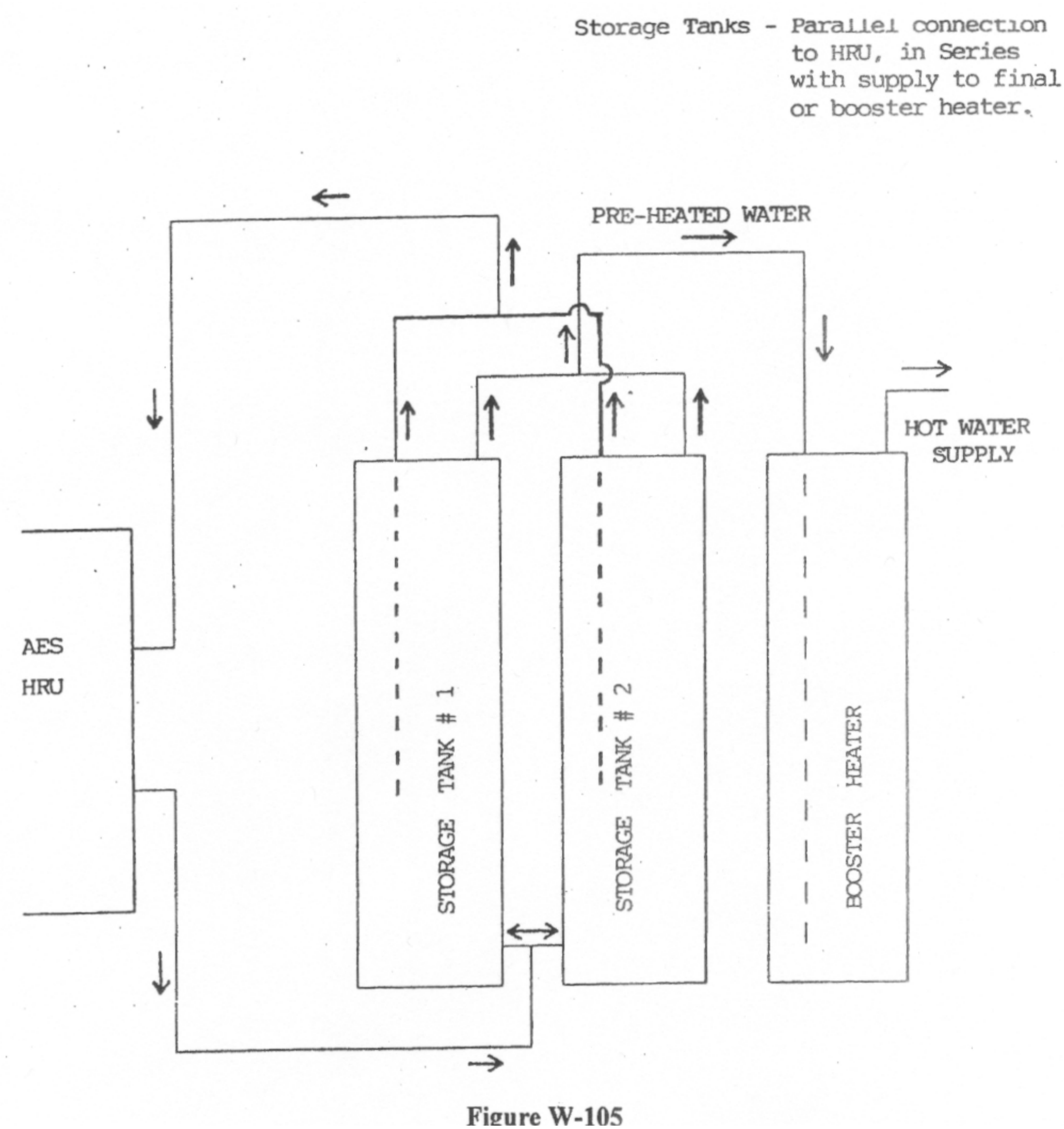


Figure W-105

ELECTRICAL- CONTROLS AND CONNECTION: There are many methods and strategies for controlling HRU's. Active HRU's are prewired and equipped with a water limit thermostat and circulator pump. A power supply to operate the pump is required. Pump operation should be simultaneous with compressor operation, cycling on and off with the compressor until the desired water temperature is reached. The most common method is to take power from the terminal (load) side of the compressor contactor so that power is available to the pump whenever the compressor is energized and the water thermostat is closed. This connection method requires the pump and compressor voltage to be compatible.
(Figure E-101). Electrical wiring should be properly sized to handle the applied load (circulator pump) and should be done in accordance with all applicable codes and standards.

If compressor and pump voltages are different, control relays or refrigerant pressure controls (fan cycle control) may be used to switch power to the pump, (Figure E-102). Pressure controls may also be used to control refrigerant head pressure.

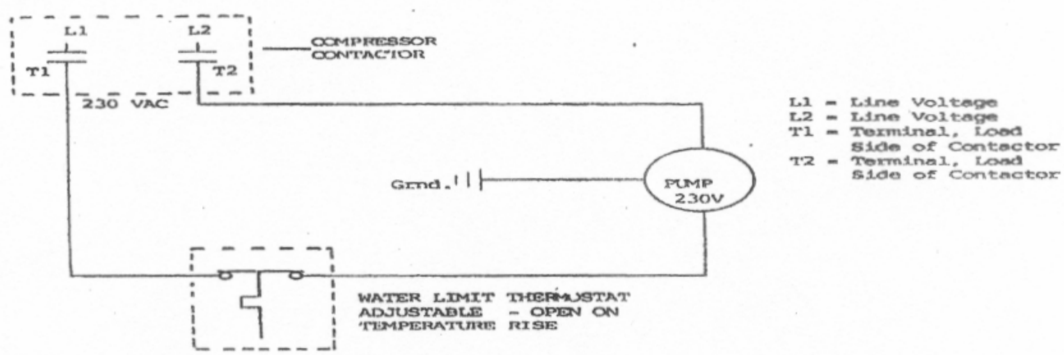


figure E - 101

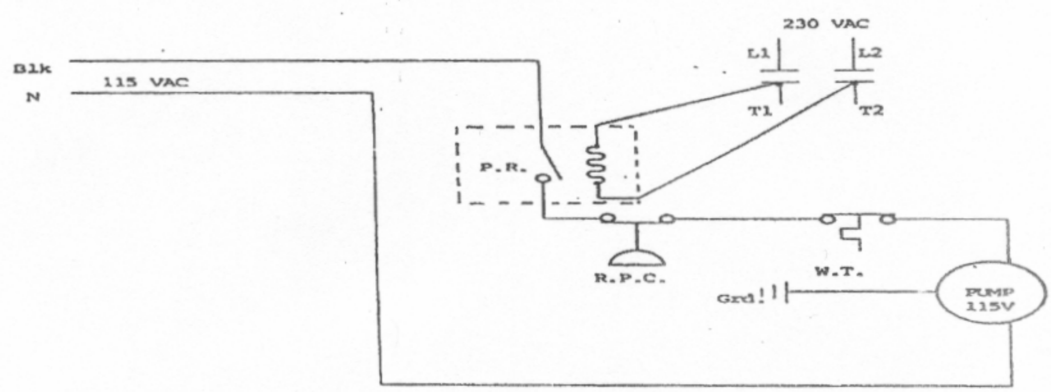


figure E - 102

Blk = Power Leg - 115 V
N = Neutral
P.R. = Pump Control Relay SPST
R.P.C. = Refrigerant Pressure Control
W.T. = Water Limit Thermostat
L1, L2 = Line Voltage Side, Compressor Contactor
T1, T2 = Load Side, Compressor Contactor

WATER TEMPERATURE CONTROL: May be accomplished with high limit water thermostats or water temperature valves. Water tempering valves allow hotter water storage and different temperatures to water lines. Example : Restaurants need higher temperature to dishwashers and a lower temperature to sinks.

REFRIGERANT PRESSURE CONTROL: Can be used to prevent overcooling of refrigerant by the HRU, which can cause refrigerant head pressure to drop below normal operating levels. This control opens on a fall in refrigerant pressure, interrupting power supply to the circulating pump and should be wired in series with the water limit thermostat. It may also be used to switch power to the HRU when pump voltage is not compatible with the HVACR equipment to which it is applied.

WATER FLOW CONTROL VALVES: This control should be mounted on the "water out" line of the HRU and is designed to limit water flow based on refrigerant pressure. An increase in refrigerant pressure will open the valve wider, allowing more flow. The refrigerant pressure sensor must be connected to a high pressure line (refrigerant), and if possible, should be connected to a liquid line port.

FREEZE PROTECTION: As with any water filled device, the HRU is subject to damage by freezing. Units that are expected to encounter such conditions should be mounted inside the conditioned space, drain of all water, or otherwise protected. A freeze thermostat may be used that will sense water pipe temperatures, closing on temperature fall, to activate the circulating pump. This will circulate warm water from the storage tank through the heat exchanger and water pipes to prevent freezing. The same control may be used to activate a heat tape. For the freeze thermostat to work, it must have a constant power source available and be wired in parallel around all other controls. (Figure E-103). CAUTION: A power failure will render this type of freeze protection inoperative.

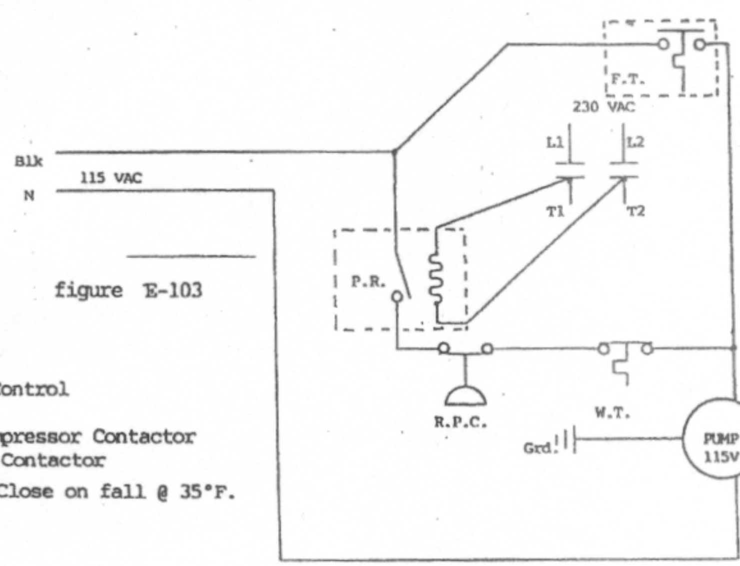


figure E-103

Blk = Power Leg - 115 V
N = Neutral
P.R. = Pump Control Relay SPST
R.P.C. = Refrigerant Pressure Control
W.T. = Water Limit Thermostat
L1, L2 = Line Voltage Side, Compressor Contactor
T1, T2 = Load Side, Compressor Contactor
F.T. = Freeze Thermostat, N.O. Close on fall @ 35°F.

START UP AND TESTING: After all aspects of the HRU installation are complete, the system should be started and tested to make certain it is operating properly. There should be a measurable difference in the temperature between the " refrigerant in" and " refrigerant out" lines, the " refrigerant out" being the cooler of the two. At the same time, there should be a similar difference in the temperature of the " water in" and "water out lines, the " water out" being warmer of the two lines. The temperature difference is dependant upon the water flow rate, entering refrigerant and water temperatures, and will vary depending upon conditions. The following formula can be used to determine approximate BTUH heat exchange can be compared to the listed performance curves.

Q= 500xGPM x T.D.
Q= BTUH
500= 60 min./hr. x 8.33 lbs/gallon
GPM= gallons/min. Water flow rate
T.D. = Temperature Difference (leaving water temperature - entering water temperature)
NOTE: A flow gauge is required to determine water flow rate

MAINTENANCE & OPERATION: Operation of the HRU should be automatic, if properly installed and controlled. Periodic equipment/control checks and performance testing will indicate if maintenance or repair is necessary.

When making a performance comparison, make certain that conditions are reasonably similar (i.e. entering refrigerant temperature, entering water temperature, etc.) widely varying test conditions will not give a clear indication if maintenance is required or effective.

WATER TUBE DESCALING (Chemically Cleanable Models) ADC***#* and SDC***#* The water tubes may be descaled by circulating a metal safe descaler through the water tubes of the heat exchanger/HRU assembly. To do this, isolate the HRU from the water heating system and relieve water pressure from the HRU. Electrically disconnect the circulator pump to prevent dry run. Circulate descaler solution through the HRU using an appropriate pump until water tubes are clean. (Follow descaler manufactures instructions for use. After cleaning, flush HRU and piping with clean water to remove descaler and sediment. Purge all air from HRU and piping, connect pump power, and return system to operation.

WATER TUBE DESCALING (Mechanically Cleanable Models) ADM***#* and SDC***#*.
The mechanically cleanable units can be descaled by brushing the water tubes with a wire brush, rather than by circulating chemical solutions. Isolate the HRU from the water heating system and relieve pressure on the HRU. Open the rear access panel and remove threaded brass plug in the end of the water tubes. Descale by brushing with appropriate sized wire brush (tube=l/2" O.D.) Flush tubes with clean water and reinstall brass plugs using approved thread compound. Purge air from HRU and piping and return system to operation.

NOTE: THE SUREST METHOD OF FREEZE PROTECTION IS TO DRAIN THE SYSTEM OF ALL WATER IF SUBJECT TO FREEZING CONDITIONS. IF SYSTEM IS DRAINED, DISCONNECT ELECTRICAL SUPPLY TO PUMP.
TO PREVENT POSSIBLE PUMP DAMAGE DUE TO DRY RUN. BE CERTAIN TO REMOVE ALL AIR FROM THE SYSTEM AND RECONNECT ELECTRICAL SUPPLY TO PUMP UPON RETURNING THE SYSTEM TO OPERATION.

THIS MANUAL IS PRODUCED BY AMERICAN EQUIPMENT SYSTEMS, A DIVISION OF TREVOR-MARTIN CORPORATION AND IS INTENDED TO BE USED AS AN AID TO THE INSTALLATION OF AES HEAT RECOVERY UNITS. VARIOUS APPLICATIONS MAY REQUIRE SYSTEM DESIGNS AND INSTALLATION PROCEDURES DIFFERING FROM THOSE DESCRIBED IN THIS MANUAL. CONSULT FACTORY OR OTHER QUALIFIED PERSONNEL FOR ASSISTANCE WITH SPECIAL APPLICATIONS.