# YCAV REMOTE EVAPORATOR APPLICATION INFORMATION

| ENGINEERING SUPPLEMENT | Supersedes: 201.21-ES1 (106) | Form 201.21-ES1 (707) |
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## GENERAL

This Engineering Supplement contains general recommendations and/or guidelines for outdoor air-cooled screw chillers with optional indoor DX evaporators. It is intended for use as a supplement to Form 201.21.NM1 (60 Hz models) and Form 201.21-NM2 (50 Hz models). Please refer to these forms for all installation, start-up, and operation instructions not outlined in this publication.

## BACKGROUND

Outdoor air-cooled chiller popularity has grown considerably over the last 15-to-20 years. This has occurred for many reasons, ranging from lower installation costs to lower maintenance requirements and costs versus water cooled chillers with outdoor cooling towers. In an effort to maximize the use of the available job-site space, consulting engineers are continually under pressure to locate outdoor equipment in areas where they will consume the least amount of space. However, there is still concern about the potential for DX evaporator water lines freezing up in areas where the outdoor temperature drops below 32°F (0°C). This is causing consulting engineers to issue chiller system designs with the unit's DX evaporator mounted remotely inside the building where freezing will not occur. This supplement addresses some of the issues that should be considered for this type of application.

This supplement is intended for applications with leaving liquid temperatures between 40° to 50°F (4.4° to 10°C). The factory should be consulted for suitability for other special applications such as process or ice-storage duties.

## PERFORMANCE CONSIDERATIONS

Since the DX evaporator is not mounted on the outdoor section, consideration should be given to adjusting the equipment's published performance due to the additional suction, liquid, and economizer piping which has been added to the system. The following adjustments should be considered for each 100 equivalent feet of piping added to the system.

Capacity in Tons X 0.97
Compressor KW Input X 0.99

OR

Rate the unit in YORKWorks setting the leaving water temperature 2°F lower than the actual design leaving water temperature.

***NOTE: REMOTE DX-EVAPORATOR APPLICATIONS ARE NOT PART OF THE SCOPE OF THE INDUSTRY ARI CERTIFICATION PROGRAM.***

**COMPONENT LOCATIONS**

It is prudent practice to design these systems so that the remote DX evaporator is as close to the outdoor section as possible. This assures optimum performance and reduces piping pressure penalties. If a close-coupled system cannot be accommodated, the following piping recommendations should be followed:

Maximum 100 equivalent feet of piping (which includes tees, elbows, fittings, etc)

**TYPICAL SYSTEM LAYOUTS**

Please refer to the illustrations for the typical system-layout arrangements. Figure 1 shows a typical outdoor section at the same level as the evaporator located inside of the building. Figure 2 is an example of the outdoor section installed above the indoor DX evaporator. Layouts with the DX evaporator located above the outdoor section ***are not approved for YCAV remote evaporator systems.***

All vertical risers should be lccated as close as possible to the evaporator skid. All horizontal suction-line segments should be sloped ¼" per linear foot in the direction of refrigerant flow towards the compressors. These guidelines are in place to avoid creating a suction line trap in the piping design. This may cause the refrigerant to condense on the off cycle and damage the compressor at unit start up. It can also create an oil trap at low loads, which is undesirable.

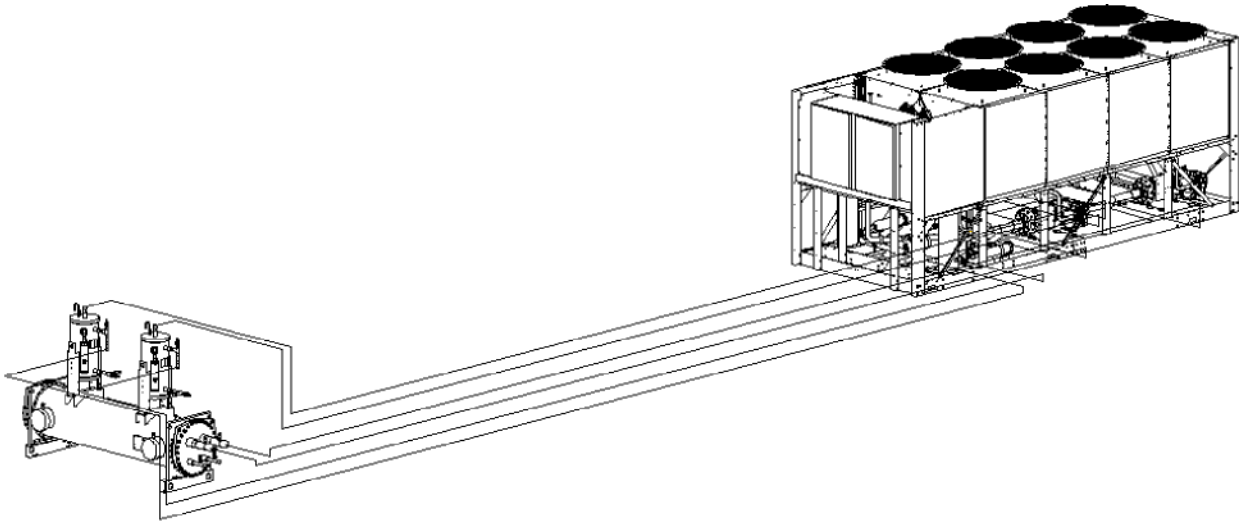

**FIGURE 1: EVAPORATOR AT THE SAME LEVEL AS THE OUTDOOR SECTION**

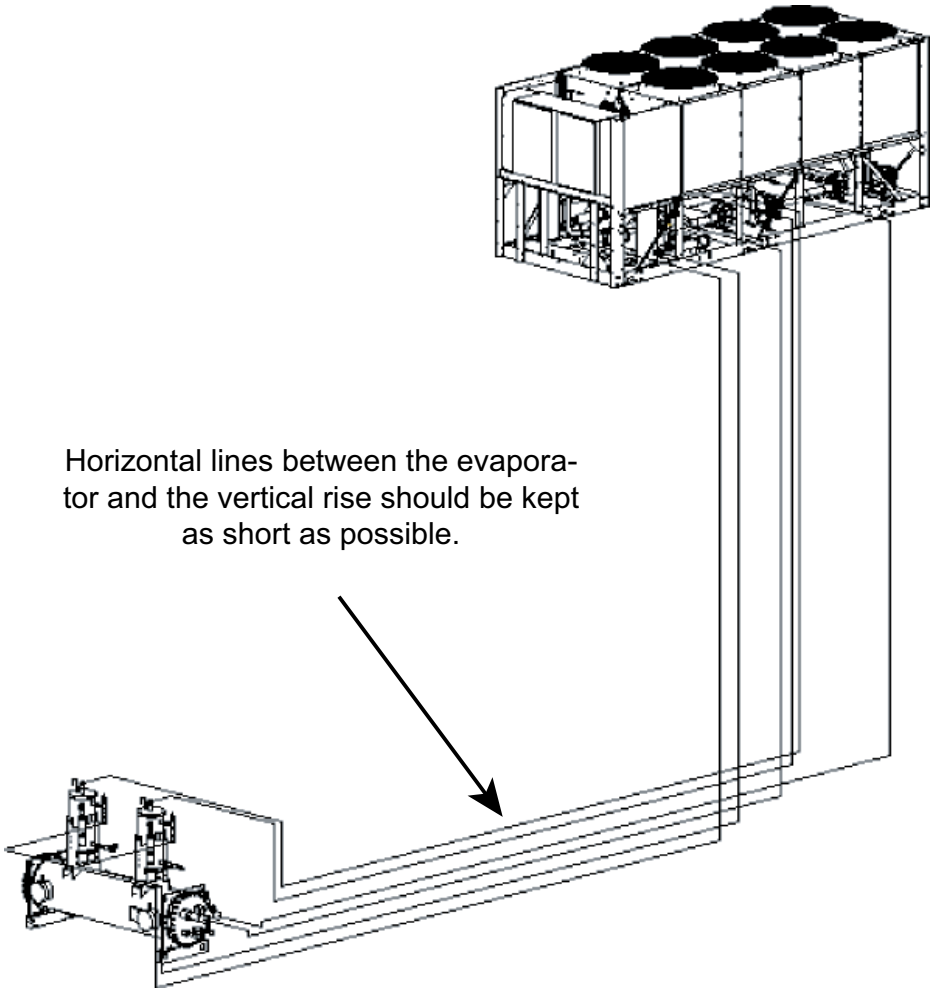


**FIGURE 2: EVAPORATOR BELOW OUTDOOR SECTION**

On a system where the evaporator is located below the outdoor section, the suction line must be sized for both pressure drop and oil return. In most cases, a double suction riser must be installed to ensure reliable oil return at reduced loads. Horizontal lines at the evaporator before the vertical rise should be sloped ¼" per linear foot toward the evaporator.

***CAUTION – DO NOT PLACE THE EVAPORATOR SECTION ABOVE THE OUTDOOR SECTION UNDER ANY CIRCUMSTANCES. THE YCAV IS NOT DESIGNED TO BE OPERATED IN THIS MANOR. DOING SO WILL DAMAGE THE CHILLER***

**INSTALLATION RECOMMENDATIONS**

Please refer to the field installation drawing that is shipped with the equipment and the Installation, Operation, Maintenance Form 201.21.NM1 (60 Hz models) and Form 201.21-NM2 (50 Hz models) for more details and guidelines. These include recommendations for field wiring, field-piping brazing with nitrogen, leak checking, refrigerant charging, checking the superheat and sub-cooling, and other pertinent information.

**REFRIGERANT PIPING**

When the unit has been located in its final position, the unit piping may be connected. Normal installation precautions should be observed in order to ensure reliable operation, serviceability, and maximum operating efficiencies. System piping should conform to ASHRAE guidelines. All piping design and installation is the responsibility of the user. After electrical and piping connections are completed, refer to Unit Installation, Operation and Maintenance Manual (Form 201.21.NM1 [60 Hz] and Form 201.21-NM2 [50 Hz]) for unit start-up instructions.

Specified expansion valves, filter driers, sight glasses and liquid line solenoid valves are YORK supplied and factory installed. Refrigerant field piping is supplied and installed by others.

## YORK ASSUMES NO WARRANTY RESPONSIBILITY FOR SYSTEM OPERATION OR FAILURES DUE TO IMPROPER PIPING OR PIPING DESIGN.

### REFRIGERANT PIPING SIZING

The system designer must select suction, liquid, and economizer line sizes that will meet full-load capacities and provide for proper oil return at minimum system operation. The designer should follow the guidelines and practices presented in the latest edition of the YORK DX Piping Guide, Engineering Supplement Form 050.40-ES2(102) or the ASHRAE Refrigeration Systems Handbook. Considerations should be given to:

1. Suction line pressure drop due to refrigerant flow.
2. Suction line capacity for oil return.
3. Liquid line pressure drop due to refrigerant flow.
4. Liquid line pressure drop (or gain) due to vertical rise of the liquid line.

A solid column of liquid refrigerant to the feed valve must always be maintained. Refrigerant vapor in the liquid line will measurably reduce valve capacity and poor system performance can be expected.

When the DX evaporator is located below the outdoor section, the suction line sizing must be checked for proper oil return. The YORK DX Piping Guide, Engineering Supplement Form 050.40-ES2(102) or the ASHRAE Refrigeration Handbook contains tabular data that will aid the designer in this. If a single suction riser does not allow for proper oil return, double suction risers will be required to accomplish this. Suction lines must be insulated to help maintain optimum system performance. When suction and economizer lines are greater than 25 feet, an extra oil trap is recommended for each 25 feet of vertical rise from the DX evaporator up to the outdoor section.

Provisions should be made for contraction and expansion of ¾ ” per 100 feet of copper piping.

ECONOMIZER LINE SIZING:

After extensive testing and engineering work, the design for the YCAV remote evaporator has been configured with the flash tank economizer system mounted on the evaporator skid. Therefore, three piping lines (suction, liquid, and economizer line) per circuit will be needed from the outdoor section to the remote evaporator. To aid in the design of the economizer line, the following line size recommendations are provided.

| EquivalentLine Length | Line SizeRequired |
|---|---|
| 0 – 49 ft | 1 5/8” |
| 50 – 175 ft | 2 1/8” |

REFRIGERANT PIPING REFERENCE:

For more details, refer to the YORK DX Piping Guide, Engineering Supplement Form 050.40ES2(102) or the ASHRAE Refrigeration Handbook, Chapter 2.

### REFRIGERANT AND OIL CHARGE

The unit and remote evaporator will be pressure-tested, run tested, and shipped with a nitrogen holding charge. An initial oil charge will also be included in the compressor. (**Additional oil charge will need to be added to the unit after field piping is complete.**) Oil separator oil level should be maintained so that the oil level is visible in the sight glass. (Refer to IOM Form 201.21.NM1 [60 Hz] and Form 201.21-NM2 [50 Hz])

The operating refrigerant charge for the system must be added after all refrigerant piping is installed, leak-checked and evacuated. Refer to Physical Data in the Installation, Operation and Maintenance Manual Form 201.21.NM1 [60 Hz] and Form 201.21-NM2 [50 Hz] for unit charge.

***NOTE: AFTER PIPING IS COMPLETE, INSURE ALL SHUT-OFF VALVES (INCLUDING DRAIN AND FILL VALVES) ARE OPEN BEFORE EVACUATING THE SYSTEM TO ENSURE ALL OF THE HOLDING CHARGE IS EVACUATED.***

After placing the system into operation, it is important to verify that the proper refrigerant charge has been installed by checking sub-cooling. Refer to Pre-Startup section in Form 201.21.NM1 (60 Hz models) and Form 201.21-NM2 (50 Hz models) for sub-cooling checking procedures.

**OTHER DESIGN CONSIDERATIONS**

BRAZED CAPS:

The Brazed Caps on the piping connections must be removed in the field to install refrigerant piping. The holding charge should be relieved through the service valve located on the liquid line connection before removing the brazed caps. If, when opening the service valve, no nitrogen is relieved, the system should be tested to ensure no leak in the refrigerant tubing exists before piping installation.

SERVICE VALVES:

Suction service valve should be installed where needed to facilitate servicing of the unit. It is recommended that the plans and specifications include service valves. These can be included as either part of the chiller package (shipped loose for field installation) or as contractor supplied parts to be installed with the refrigerant piping.

PIPING CONNECTION POINTS:

The liquid line will need to be sized based on ASHRAE guidelines as mentioned above. For most applications it will be sized at 1-5/8” or 2-1/8” diameter copper depending on equivalent length of line. In order to assure proper pumpdown capability, please refer to the following table and figures for design changes needed to accommodate the added line capacity. If the available additional charge in the designed liquid line is greater than the maximum available additional capacity listed in Table A for the chiller model used, the design must include one of the following.

**PUMP DOWN/LIQUID LINE RECEIVER REQUIREMENTS:**

The liquid line will need to be sized based on ASHRAE guidelines as mentioned above. For most applications it will be sized at 1-5/8” or 2-1/8” diameter copper depending on equivalent length of line. In order to assure proper pumpdown capability, please refer to the following table and figures for design changes needed to accommodate the added line capacity. If the available additional charge in the designed liquid line is greater than the maximum available additional capacity listed in the Table for the chiller model used, the design must include one of the following.

A. The shutoff valve and filter drier must be moved and installed with the remote evaporator piping per each circuit. See Figure 3. (Preferred Alternative)

OR

B. A receiver must be installed between the condenser coil and the shutoff valve (located above the filter drier) per each circuit. The receiver must have a design working pressure of 350 psig and be sized to accept the quantity of refrigerant in the actual length of the liquid line. See Figure 4. (Optional if it is desired to keep the liquid line valve with the outdoor section for pumpdown.)

SUCTION TEMPERATURE SENSORS AND PRESSURE TRANSDUCERS:

The suction temperature sensors and pressure transducers for each circuit will be factory provided for field installation. All are to be installed 6 to 15 linear feet from the evaporator. The suction temperature sensors should be positioned at the 4 o’clock or 8 o’clock position on the piping. The preferred location is on a straight run of pipe after at least one elbow. If after more than one elbow, the elbows must be located close together after exiting the evaporator. The location of the straight pipe run should be more than 2 feet past the elbow on the side of the pipe (4 or 8 o’clock) opposite

the outside radius of the elbow, if the customer supplied piping makes this possible. The suction pressure transducers should be positioned at the 12 o'clock position on the piping. The customer will need to provide ¼" NPT connections on their suction line piping to accommodate the pressure transducers. The temperature sensors should be strapped (using 2 copper straps) securely to the outside of the pipe, after the pipe has been cleaned lightly with sandpaper to ensure full metal-to-metal contact. Both the pipe and sensor should then be covered with insulation. Wire harnesses for the suction temperature sensors and pressure transducers are both factory provided for field installation.

**TABLE: Maximum Actual Liquid Line Piping Length Allowed Without Modification**

| YCAV Model | | Max Length (ft) |
|---|---|---|
| 60Hz | 50Hz | |
| 157SA/PA | 569SA/PA | 32 |
| 157EA/VA | 569EA/VA | 23 |
| 177SA/PA | 639SA/PA | 23 |
| 177EA/VA | 639EA/VA | 23 |
| 187SA/PA | 679SA/PA | 23 |
| 187EA/VA | 679EA/VA | 57 |
| 197EA/VA | 719EA/VA | 49 |
| 207SA/PA | 739SA/PA | 18 |
| 207EA/VA | 739EA/VA | 49 |
| 227SA/PA | 819SA/PA | 49 |
| 227EA/VA | 819EA/VA | 62 |
| 247SA/PA | 889SA/PA | 46 |
| 247EA/VA | 889EA/VA | 57 |
| 267SA/PA | 969SA/PA | 57 |

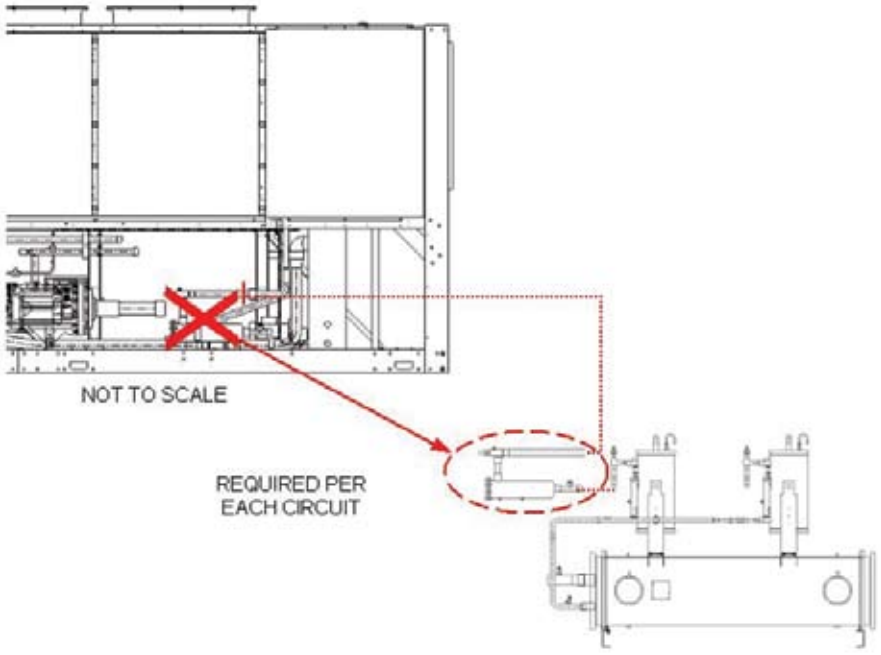


**FIGURE 3**

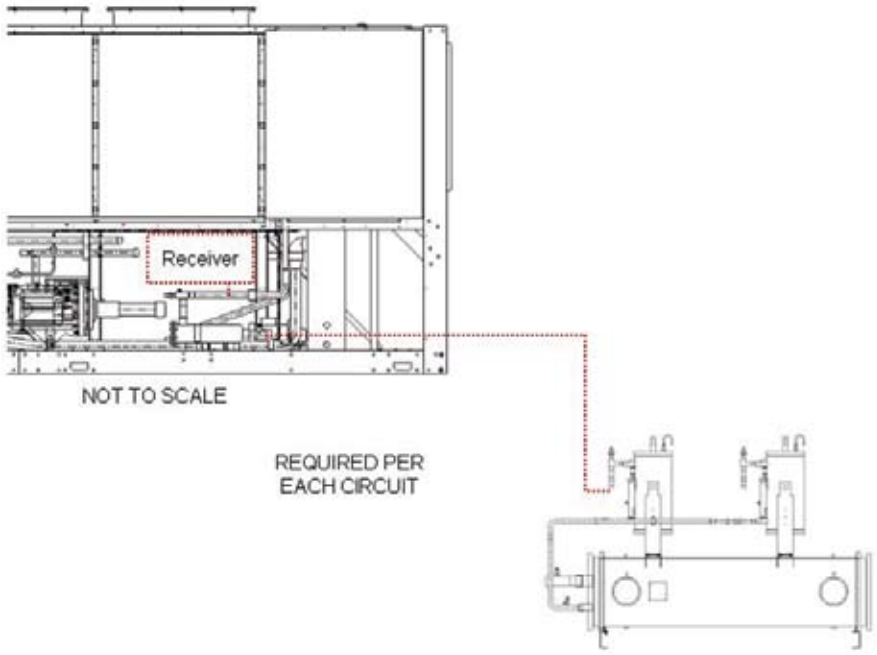


**FIGURE 4**

OIL TRAPS:
All horizontal suction lines should be pitched at least 1/4" per linear foot in the direction of the refrigerant flow, to aid in the return of oil to the compressor. All suction lines with a vertical rise exceeding 3 feet should have a trap at the bottom and the top of the riser. (See the YORK DX Piping Guide, Engineering Supplement Form 050.40-ES2(102) for trap details) Suction lines with a vertical rise exceeding 25 feet should be trapped every 25 feet.

PRESSURE RELIEF VALVES:
The suction line includes a factory mounted relief valve. Additional relief valves are required on any section of field mounted refrigerant line that has a potential to be subject to hydrostatic expansion.

## ELECTRICAL WIRING

The chiller is shipped with all factory-mounted controls and power wiring for all components located in the chiller package. Factory supplied wire harnesses will be included for the flash tank feed control valve, drain control valve, level sensor, suction temperature and suction pressure sensor. Refer to factory drawings provided with the unit for wire harness details. Field control wiring will be necessary for the flow switch, water temperature sensors, and the evaporator heater.

All wiring connections (incoming power, etc.) will be covered in the Installation, Operation and Maintenance Manual, Form 201.21.NM1 (60 Hz models) and Form 201.21-NM2 (50 Hz models).

FIELD SUPPLIED CONTROL WIRING:
The field mounted and remote evaporator components listed below will require connection to the control panel.

1. **Flow Switch**: A chilled water flow switch (either by YORK, or by others) **must** be installed in the leaving water piping of the evaporator. There should be a straight horizontal run of at least 5 diameters on each side of the switch. Adjust the flow switch paddle to the size of the pipe in which it is installed. (See manufacturer's instructions furnished with the switch.)

The flow switch must not be used to stop and start the chiller. It is intended ONLY as a safety switch. Interlock the flow switch with the start/stop contacts. If the start/stop contacts are activated by an inductive load (water pump contactor, etc.), the relay/contactor coil must be suppressed.

**YORK ASSUMES NO WARRANTY RESPONSIBILITY FOR DAMAGE CAUSED BY EQUIPMENT CYCLED DIRECTLY FROM A FLOW SWITCH.**

2. **Entering Water Temp Sensor**: Fill the temperature well to a depth of 3 inches with heat conductive compound. Insert the sensor in the well and ensure it is placed on the bottom of the well. Assemble a proper length of cable between the sensor and the microprocessor board. For more detail and wire-type information refer to the factory documents shipped with the unit.

3. **Leaving Water Temp Sensor**: Fill the temperature well to a depth of 3 inches with heatconductive compound. Insert the sensor in the well and ensure it is placed on the bottom of the well. Assemble a proper length of cable between the sensor and the microprocessor board. For more detail and wire-type information refer to the factory documents shipped with the unit.

4. **Evaporator Heater**: Connect the Evaporator Heater wiring to the junction box located under unit condenser coils. For more detail and wire-type information refer to the factory documents shipped with the unit.

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