

Long-Line Application Guideline



Residential Split System Air Conditioners and Heat Pumps Using R-22 Refrigerant

NOTE: Read the entire instruction manual before starting any system modification.

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This Long-Line Application Guideline applies to all Payne residential air conditioner and heat pump split systems that have a nominal capacity of 18,000 to 60,000 Btuh. This guideline provides required system changes and accessories necessary for any residential product having piping requirements greater than 50 ft or installations where indoor unit is located above outdoor unit. This guideline is intended to cover applications outside the standard Installation Instructions.

NOTE: The presale literature for outdoor unit must be referred to in conjunction with this guideline.

This guideline is for standard single-speed products.

SECTION 1—APPROVED SYSTEMS

Any residential indoor/outdoor unit combination listed in the outdoor unit presale literature is an approved system, EXCEPT the following:

- Indoor coils with capillary metering devices
- All equipment less than nominal 18,000 Btuh
- All 1/4-in. liquid line applications
- Any indoor furnace coil/fan coil not listed in outdoor unit presale literature
- Any application which has interconnecting tubing with an equivalent length greater than 175 ft

SECTION 2—REQUIRED FIELD-INSTALLED ACCESSORIES

PROCEDURE 1—GENERAL

Some required field-installed accessories may be standard features on certain outdoor units. Refer to outdoor unit presale literature. The following accessories may or may not be required depending on application:

- Compressor crankcase heater
- Liquid-line filter drier
- Start components, start capacitor and relay
- Liquid-line solenoid or hard shutoff thermostatic expansion valve (TXV)
- Outdoor unit cycle protector (5 minute)
- Wind baffles

PROCEDURE 2—ACCESSORY EXPLANATIONS

A. Crankcase Heater

Due to the increased system charge level of a long-line application, a crankcase heater must be installed. Since system charge level is greater than a normal application, refrigerant migration during off-cycle is a greater risk.

B. Liquid-Line Filter Drier

Long-line applications consist of many field-fabricated joints. Due to the increased risk of system contamination, an adequately sized liquid-line filter drier must be installed.

C. Start Components

Start components required for this guideline consist of a start capacitor and relay. Refer to outdoor unit presale literature for correct accessory kit. The presale literature indicates if a start capacitor and relay is a standard feature.

Start components are required due to increased charge level and application of the liquid-line solenoid or hard shutoff TXV. When a liquid-line solenoid or hard shutoff TXV is applied to system, the unit must have the ability to start against a higher liquid pressure. (See Section 5.) During off-cycle, the solenoid or hard shutoff TXV closes, trapping high pressure liquid in liquid line. At next on-cycle, the start components provide extra starting torque to overcome the higher liquid pressure.

The only outdoor units that do not require start components in any application are 3-phase units.

D. Liquid-Line Solenoid

The liquid-line solenoid is required to minimize off-cycle refrigerant migration. Migration is more apparent in long-line applications due to increased charge level and indoor and outdoor units being installed at different elevations.

There are 2 types of liquid-line solenoids: single flow and bi-flow. Section 5 covers particular applications, as well as accessory part numbers. The accessory solenoid part numbers are provided in outdoor unit presale literature.

E. Hard Shutoff TXV

A hard shutoff TXV may be substituted for a liquid-line solenoid in some applications. (See Section 5.) There are 2 types of hard shutoff TXVs: single flow for air conditioners and bi-flow for heat pumps. Accessory TXVs should be sized to the nominal tonnage of outdoor unit.

Refer to outdoor unit presale literature for accessory TXV part numbers.

F. Outdoor Unit Cycle Protector (5 minute)

The cycle protector is an optional accessory, but highly recommended. The purpose of cycle protection is to protect the compressor from short cycling and to ensure a longer run cycle. Long-line applications are frequently installed in apartments and condominiums where short cycles may occur due to equipment oversizing, tenants, and/or load swings.

If system on-cycle is too short, the cycle may not be long enough to ensure oil return. The cycle protector ensures that if a short cycle occurs, the next on-cycle will be increased. This is due to the load increasing during the 5-minute off-cycle.

Refer to outdoor unit presale literature for accessory 5 minute cycle protector part number.

G. Wind Baffles

The use of wind baffles is required if strong prevailing winds are apparent at installation site. Strong prevailing winds reduce the ability of a heat pump to defrost. Rooftop installations are most likely to experience strong prevailing winds.

Wind baffles are usually applied on low-ambient kit installations. Refer to specified unit low-ambient kit instruction for detailed information on wind baffle construction.

SECTION 3—INTERCONNECTING TUBING SIZING

Table 1 lists recommended interconnecting vapor line diameters for equivalent total line lengths. All residential split systems installed in long-line applications must use **only 3/8-in. liquid lines**. Equivalent line length equals the linear length (measured) of interconnecting vapor tubing plus losses due to elbows. (See Table 2 and Fig. 1.) Liquid lines larger than 3/8-in. OD greatly increase charge quantity of the system. Excessive charge increases risk of migration and compressor damage. Table 1 provides the estimated percentage of nominal cooling capacity losses based on the standard required vapor line size versus what is selected for the long-line application. Since the vapor line is the discharge line in heating mode, losses are minimal.

Calculate the linear length of vapor tube required, adding any losses for the total number of elbows for application. (See Table 2.) Using this equivalent length, select desired vapor line size from Table 1. Subtract the nominal percentage loss from outdoor unit presale literature Detailed Cooling Capacities data for the given indoor/outdoor combination. Reference all notes of Table 1.

NOTE: When specifying vapor line insulation, be aware of the following standard practice:

All standard accessory tubing kits are supplied with 3/8-in. insulation on vapor line.

For minimal capacity loss in long-line application, 1/2-in. insulation should be specified.

For reference only, the close cell insulation material specified for accessory tubing kits is a compound of vinyl, neoprene, or nitrile blends of these polymers. Performance requirements include thermal range of 0° F to 200°F (-17.8° C to 93° C) and a maximum thermal conductivity of 0.28.

NOTE: Special consideration must be given to isolating interconnecting tubing from building structure. Isolate tubing so that vibration or noise is not transmitted into structure.

SECTION 4—METERING DEVICE SIZING

The metering device for a long-line application must be flexible enough to compensate for frictional losses due to long refrigerant lines and installed system design (indoor coil above or below outdoor unit.) The piston or TXV provides such flexibility.

The piston should be changed for both indoor coil and outdoor heat pump unit, depending on system configuration and line length. Tables 3 and 4 provide necessary changes for a given application.

Use Tables 3 and 4 when selecting correct piston size. Outdoor unit presale literature must be consulted to determine metering devices specified for standard applications. After determining standard application piston size(s), refer to Tables 3 and 4 as they relate to system design (outdoor unit above or below indoor unit) per equivalent length of tubing.

NOTE: If total equivalent horizontal length is **100 ft or longer**, both indoor and outdoor pistons must be **increased 1 full piston size**, in addition to changes required by Tables 3 and 4.

After finding appropriate change in piston size, add or subtract the **change** from original piston number. If piston size is **decreased**, round new piston number **down** to nearest common piston number found in Table 5. If piston size is **increased**, round new piston number **up** to nearest common piston number found in Table 5.

Table 1—Estimated Percentage of Nominal Cooling Capacity Losses*

UNIT NOMINAL SIZE (BTUH)	LONG-LINE VAPOR LINE DIAMETER (IN.)†	EQUIVALENT LINE LENGTH (FT)					
		50	75	100	125	150	175
18,000	5/8	5	7	9	12	12	14
	3/4	1	3	4	5	5	7
24,000	5/8	6	9	13	16	19	22
	3/4	0	1	1	2	3	4
30,000	5/8	6	8	10	13	15	17
	3/4	2	3	4	5	6	7
36,000	3/4	7	10	14	17	21	NR
	7/8	2	4	6	8	10	11
42,000	3/4	7	10	13	17	20	23
	7/8	3	4	6	7	8	10
	1-1/8	0	0	1	1	2	2
	3/4	10	14	18	22	NR	NR
48,000	7/8	4	6	7	9	11	13
	1-1/8	0	0	1	1	2	2
60,000	7/8	7	9	11	14	16	19
	1-1/8	1	2	2	3	3	4

* The estimated percentage of cooling capacity that must be subtracted from the Detailed Cooling Capacities data specified in outdoor unit presale literature for any given indoor/ outdoor combination.

† Vapor line diameter that may be selected for a long-line application. If smaller vapor lines are selected but not specified within the table, large capacity losses will occur and defrost capabilities will be reduced. If larger vapor lines are selected but not specified within the table, refrigerant oil return will be impaired due to velocity losses. NR—Not recommended due to excessive loss of capacity.

EXAMPLE:

An 042 size heat pump is 75 ft above an 042 size fan coil.

The 042 size heat pump presale literature specifies a size 80 indoor piston and size 63 outdoor piston.

To establish correct indoor piston size for a 75 ft vertical separation, refer to Table 3. For a 75 ft equivalent line length, the piston change is -5. Therefore subtract 5 from the original indoor piston size of 80:

$$80 - 5 = 75$$

Table 5 provides common piston sizes. In this instance, 75 is not listed, therefore round DOWN to next piston size, which would be 74.

To establish correct outdoor piston size for a 75 ft vertical separation, refer to Table 4. For a 75 ft equivalent line length, the piston change is +4. Therefore add 4 to the original outdoor piston size of 63:

$$63 + 4 = 67$$

Since 67 is listed in Table 5, that is the piston which should be used. If a 67 size piston were not listed, it would be necessary to round UP to next piston size.

TXVs may be used instead of pistons for indoor metering devices. Some fan coils are equipped with a hard shutoff bi-flow TXV standard, and no change is required. When sizing an accessory TXV for long-line applications, TXV should be the same nominal tonnage as outdoor unit. Refer to presale literature for kit part numbers.

SECTION 5—LIQUID-LINE SOLENOID AND TUBING CONFIGURATION

As noted in Section 2, there are 2 types of liquid-line solenoids: 1 for single-flow applications and the other for bi-flow applications. The purpose of having 2 solenoids is to minimize the valves internal pressure drop in accordance with refrigerant flow direction. The bi-flow solenoid is designed to have minimal refrigerant pressure drop in either flow direction, which makes it suitable for heat pump usage. Refer to Table 6 for liquid-line solenoid kit part numbers.

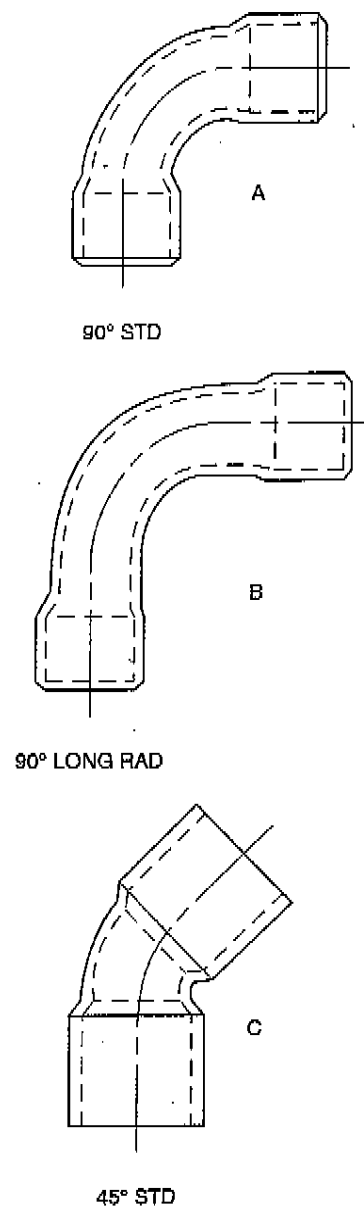
NOTE: When installing a liquid-line solenoid, the system may require a minimum 60-va low-voltage transformer.

Each type of solenoid has an indicator flow arrow stamped on the valve body. When solenoid is closed (not energized) and pressure is applied in direction of flow arrow, complete shutoff occurs. If pressure is applied against direction of flow arrow, leakage through valve occurs. When determining proper installation of valve within liquid line, 2 considerations must be made:

1. Direction of flow arrow
2. Where solenoid is installed in system.

TXVs can only be substituted for liquid-line solenoids in single-flow air conditioning systems. Bi-flow TXVs allow liquid migration to coldest point during off cycles which could allow liquid into compressor.

Fig. 2 through 5 detail proper installation of liquid-line solenoid and provide applications where TXVs may be substituted. Reference all notes of the appropriate figures.



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Fig. 1—Tube Bend Losses

Table 2—Fitting Losses in Equivalent Ft

TUBE SIZE OD (IN.)	REFERENCE DIAGRAM IN FIG. 1		
	A	B	C
5/8	1.6	1.0	0.8
3/4	1.8	1.2	0.9
7/8	2.0	1.4	1.0
1-1/8	2.6	1.7	1.3

SECTION 6—CHARGING INFORMATION

Weigh in appropriate refrigerant charge, then use the standard practices of superheat charging method for piston applications and subcooling charging method for TXV applications to confirm correct charge. The standard charging methods can be found on outdoor unit information plate, in unit Installation Instructions, or in the Service Manual. Since total system charge is increased for long-line application, it may be necessary to calculate the additional refrigerant charge. Since long-line applications only involve 3/8-in. liquid lines, the additional refrigerant charge required is 0.6 oz of Refrigerant 22 (R-22) per ft of 3/8-in. liquid line over 15 ft.

EXAMPLE:

To calculate additional charge required for a 25-ft line set:
 $25 \text{ ft} - 15 \text{ ft} = 10 \text{ ft} \times 0.6 \text{ oz/ft} = 6 \text{ oz of additional charge}$

The rating plate charge of a given outdoor unit is for a standard application of 15 ft of interconnecting tubing. The rating plate charge can be found on outdoor unit rating plate or in outdoor unit presale literature. Long-line applications do not require additional oil charge.

Table 3—Calculation of Indoor Piston No.

OUTDOOR UNIT ABOVE INDOOR	
FT	PISTON CHANGE
0-25	0
26-50	-3
51-75	-5
76-100	-7
101-125	-9
126-150	-10
OUTDOOR UNIT BELOW INDOOR	
FT	PISTON CHANGE
0-25	0
26-50	+4

Table 4—Calculation of Outdoor Piston No.

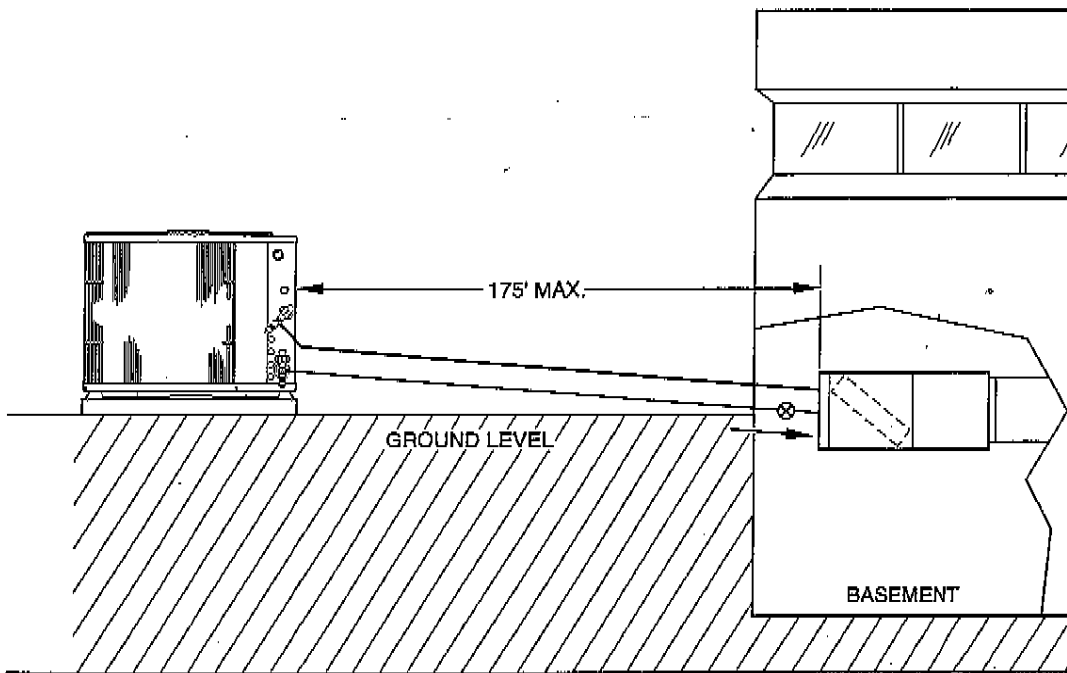
OUTDOOR UNIT ABOVE INDOOR	
FT	PISTON CHANGE
0-50	0
51-75	+4
76-100	+6
101-125	+8
126-150	+10
OUTDOOR UNIT BELOW INDOOR	
FT	PISTON CHANGE
0-50	0

Table 5—Common Piston Sizes

PAYNE	CHATLEFF	PAYNE	CHATLEFF
—	32	65	65
—	33	67	67
35	35	—	68
—	36	70	70
—	37	—	71
38	38	73	73
—	39	—	74
40	40	76	76
—	41	78	78
42	42	80	80
—	43	—	81
—	45	82	82
46	—	84	84
—	47	86	86
49	49	88	88
51	51	—	89
52	52	90	90
—	53	—	92
55	55	93	93
57	57	96	96
59	59	98	98
61	61	101	101
—	62	104	104
63	63	109	—

Table 6—Liquid-Line Solenoid Kit Part Numbers

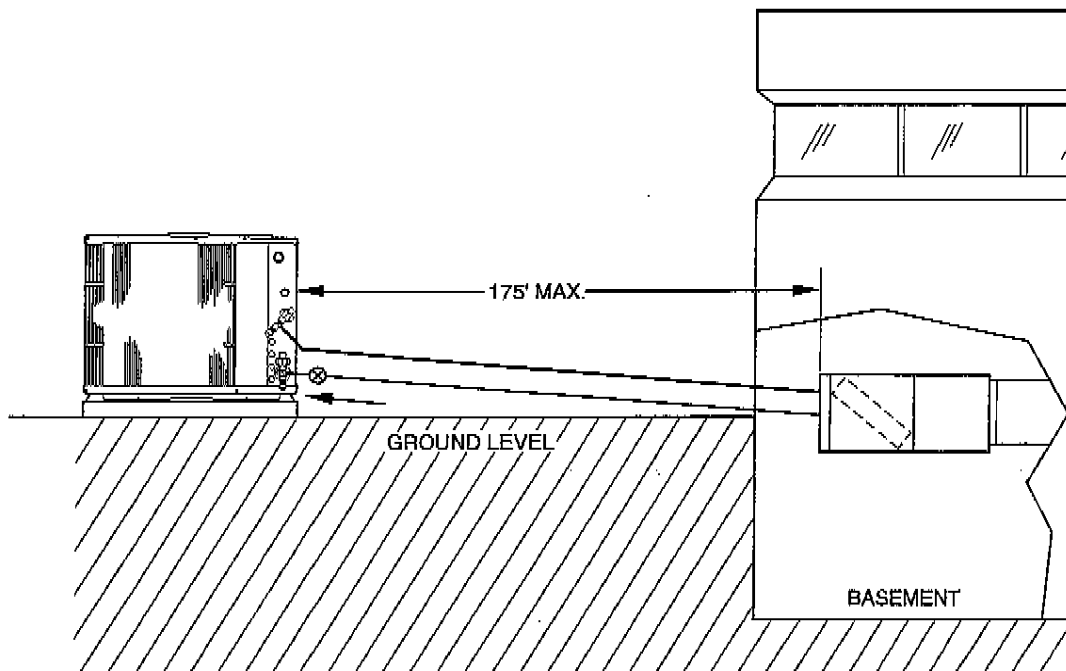
TYPE OF VALVE	PART NO.
Single Flow	KAALS0101LLS
Bi-Flow	KHALS0101LLS



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- A liquid-line (single-flow) solenoid or hard shutoff TXV must be installed at indoor unit. The solenoid must be within 2 ft of indoor unit with flow arrow pointing toward indoor unit.
- Vapor line should slope toward indoor unit.
- The above requirements provide refrigerant migration protection during off-cycle due to temperature or slight elevation differences between indoor and outdoor units.
- Maximum equivalent line length is 175 ft between indoor and outdoor units.

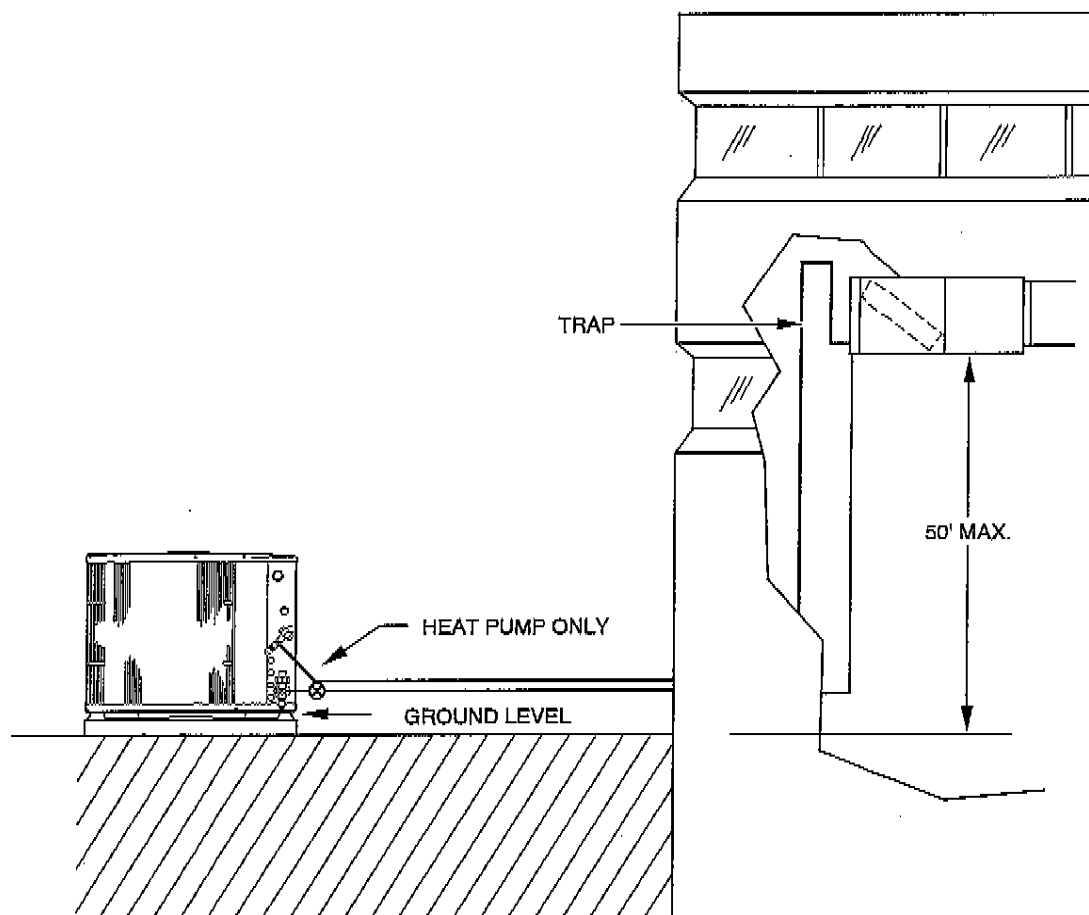
Fig. 2—Application with Air Conditioner Installed in a Horizontal Configuration



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- A liquid-line solenoid must be installed within 2 ft of outdoor unit with flow arrow pointing toward outdoor unit.
- Vapor line should slope toward indoor unit.
- The above requirements provide refrigerant migration protection during off-cycle due to temperature or slight elevation differences between indoor and outdoor units.
- Maximum equivalent total line length is 175 ft between indoor and outdoor units.

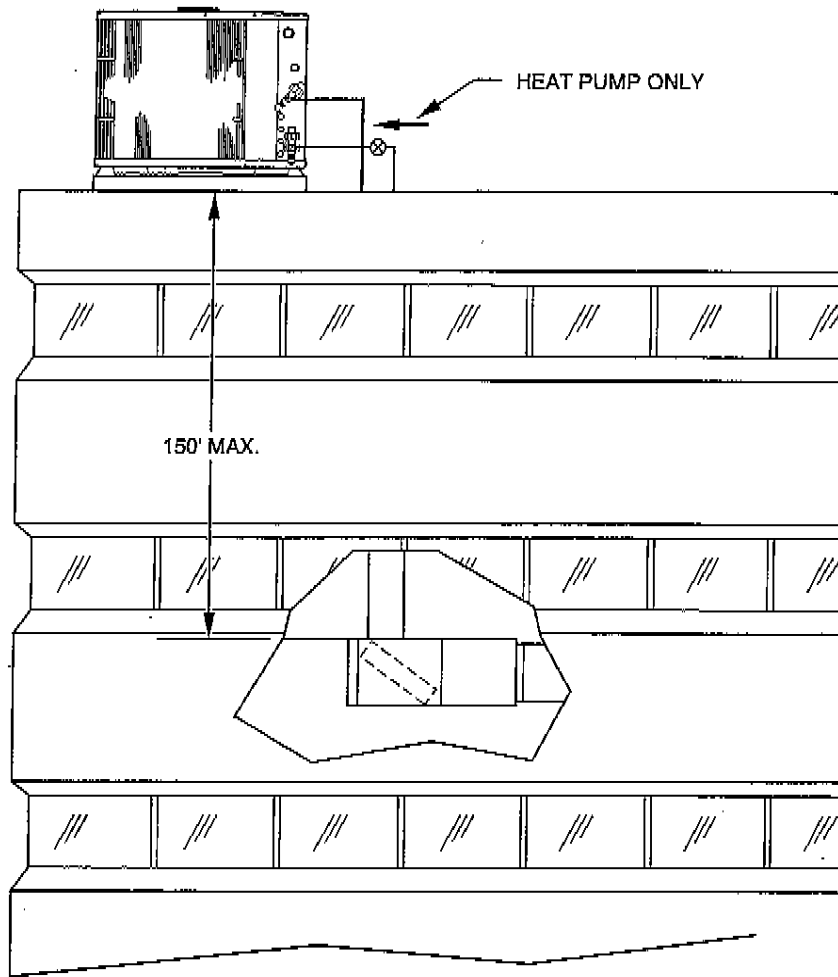
Fig. 3—Application with Heat Pump Installed in a Horizontal Configuration



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- Heat pump—A liquid-line (bi-flow) solenoid must be installed within 2 ft of outdoor unit with flow arrow pointing toward outdoor unit.
- Air conditioner—No solenoid required.
- An inverted vapor line trap must be installed at indoor unit. The top peak of trap must be greater than height of indoor coil.
- The above requirements provide protection against condensed refrigerant collecting in vapor line and maintain a solid liquid line during off-cycle.
- Maximum elevation between units is 50 ft. Maximum equivalent total line length is 175 ft.

Fig. 4—Application with Air Conditioner or Heat Pump Installed with Indoor Unit Above Outdoor Unit



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- Heat pump—A liquid-line (bi-flow) solenoid must be installed within 2 ft of outdoor unit.
- Air conditioner—No solenoid is required.
- The above requirements provide protection against refrigerant migration to compressor when outdoor temperature is lower than indoor temperature.
- Maximum elevation between units is 150 ft. Maximum equivalent total line length is 175 ft.

Fig. 5—Application with Air Conditioner or Heat Pump Installed Above Indoor Unit