

Application Data

The *ASHRAE-15 Safety Standard for Refrigeration Systems* provides guidelines for sizing refrigerant relief valves and vent piping. Without attempting to provide a complete and thorough interpretation, this document provides the necessary data to properly determine piping requirements.

Relief valve sizing

YORK® YK Mod H units are supplied with pressure relieving devices that are correctly sized, selected, and installed on each unit. Owners, facility managers, or consulting engineers need relief valve rated discharge capacities [C_r] to adequately size relief vent piping from the chiller. *ASHRAE Standard 15-2019, Section 9.4*, provides guidelines for selecting the type of pressure-relief protection (relief valves, rupture discs, or fusible plugs), and *Section 9.7* provides the criteria for correctly sizing the relief valve and vent piping from the chiller.

Section 9.7.5 defines the **minimum required discharge capacity [C]** of the relief device as follows:

$$C = fDL \quad [\text{lb of air per minute (kg/s)}] \quad \text{Eq. 1}$$

Where:

- f = pressure relief capacity factor dependent on type of refrigerant and vessel design pressure or protected equipment {See Table 1, per *ANSI/ASHRAE Addendum a to ANSI/ASHRAE Standard 15-2019*}
- D = outside diameter of vessel in feet (m)
- L = length of vessel in feet (m)

ⓘ Note:

- When combustible materials are used within 20 ft (6.1 m) of a pressure vessel, multiply the value of f (or C as provided in tabular form) by 2.5.
- The formula is based on fire conditions. Other heat sources are calculated separately.

Table 1: Pressure relief capacity factor dependent on type of refrigerant and design pressure

<i>f</i> , pressure relief capacity factor dependent on type of refrigerant and design pressure				
Design pressure (psig)	R-134a		R-513A or R-1234ze	
	I-P	SI	I-P	SI
180	1.356	0.1105	1.504	0.1226
235	1.488	0.1213	1.668	0.1352
280	1.600	0.1300	1.808	0.1464

When one pressure-relief device or fusible plug is used to protect more than one pressure vessel, the required capacity is the sum of the capacities required for each pressure vessel.

Rated discharge capacities [C_r] for relief valves on YORK® YK Mod H equipment are provided in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Section 9.7.6 specifies that the rated discharge capacity of each relief device must be determined in accordance with the *ASME Boiler and Pressure Vessel Code* (paragraph UG-131, Section VIII,

Division I) and that pipe and fittings between the pressure-relief valve and the parts of the system it protects must have at least the area of the pressure-relief valve inlet area. *Section 9.7.2.3* requires vessels or systems with refrigerant capacity greater than 10 ft³ be provided with one or more rupture member(s) or a dual relief valve assembly. A single relief valve is adequate for all vessels less than 10 ft³ and low side vessels equipped with isolation valves. Additionally, any pressure vessel containing liquid refrigerant and that is capable of being isolated by stop valves requires over-pressure relief protection (*Section 9.7.2*).

For Chillers sourced from San Antonio only

Table 2: Refrigerant relief characteristics for evaporator with R-134a at 235 psig set pressure







































Evaporator R-134a						
Shells	With isolation valves		Without isolation valves		C _r #air/min	Relief valve outlet size (NPT)
	Single relief valves		Dual relief valves (see Note)			
	Quantity of valves		Quantity of valves			
235 psig set pressure						
2C, 2D, 2E	1		2		1 at 55.9	1 in.
4C, 4D, 4E, 4F, 4G, 4H, 4I	1		2		1 at 55.9	1 in.
6A, 6B, 6C, 6D, 6E, 6F	1		2		1 at 55.9	1 in.
AC, AD, AE, AF	1		2		1 at 55.9	1 in.
BD, BE, BF	1		2		1 at 55.9	1 in.
CC, CD, CE, CG, CH, CK, CL, CN, CP, CQ, C1, C5, C9	1		2		1 at 55.9	1 in.
DC, DD, DE, DG, DH, DK, DL, DN, DP, DQ, D9	1		2		1 at 55.9	1 in.
ED, EE, EH, EI, EJ, EK, EM, EP, ER, E1, E3, E5, E9	1		2		1 at 55.9	1 in.
FC, FD, FE, FH, FI, FJ, FK, FM, FP, FR, F3, F5, F9	1		2		1 at 91.8	1 1/4 in.
GC, GE, GF, GK, GL, GN, GP, G1, G3, G5, G7, G9	1		2		1 at 91.8	1 1/4 in.
HC, HE, HF, HK, HL, HN, HP, H1, H3, H5, H7, H9	1		2		1 at 91.8	1 1/4 in.
JK, JL, JN, JP, JC, JE, JF	1		2		1 at 91.8	1 1/4 in.
KC, KE, KG, KK, KL, K1, K3, K5, K7, K9	1		2		1 at 91.8	1 1/4 in.
LC, LE, LG, LK, LL, L1, L3, L5, L7, L9	1		2		1 at 91.8	1 1/4 in.
MC, ME, MG, M1, M3, M5	1		2		1 at 91.8	1 1/4 in.
NC, NE, NG, N1, N3, N5	2		4		2 at 55.9	1 in.
OC, OE, OG, OK, OL, O1, O3, O5, O7, O9	1		2		1 at 91.8	1 1/4 in.
PC, PE, PG, PK, PL, P1, P3, P5, P7, P9	2		4		2 at 55.9	1 in.

Table 3: Refrigerant relief characteristics for evaporator with R-134a at 180 psig set pressure





















Evaporator R-134a						
Shells	With isolation valves		Without isolation valves		C _r #air/min	Relief valve outlet size (NPT)
	Single relief valves		Dual relief valves (see Note)			
	Quantity of valves		Quantity of valves			
180 psig set pressure						
QC, QE, QG, QK, QL, Q3, Q4, Q5, Q7, Q9	2		4		2 at 71.4	1 1/4 in.
RC, RE, RG, RK, RL, R3, R4, R5, R7, R9	2		4		2 at 71.4	1 1/4 in.
SC, SE, SG, SH, SK, S1, S2, S3, S4, S5, S7, S9	2		4		2 at 71.4	1 1/4 in.
TC, TE, TG, TH, TK, T1, T2, T3, T4, T5, T7, T9	2		4		2 at 71.4	1 1/4 in.
UC, UE, UG, UK, U1, U2, U3, U5, U7, U8, U9	2		4		2 at 71.4	1 1/4 in.
VC, VE, VG, VK, V1, V2, V3, V5, V7, V8, V9	2		4		2 at 71.4	1 1/4 in.
WC, WE, WG, WK, W1, W2, W3, W5, W6, W7, W9	2		4		2 at 71.4	1 1/4 in.
XC, XE, XG, X1, X3, X5, X6, X7, X9	2		4		2 at 71.4	1 1/4 in.
YC, YE, YG, YK, Y1, Y2, Y3, Y5, Y6, Y7, Y9	1		2		1 at 173	1 1/2 in.

Table 4: Refrigerant relief characteristics for condenser with R-134a at 235 psig set pressure











Condenser R-134a				
Shells	With or without isolation valves			
	Dual relief valves (see Note)			
	Quantity of valves		C _r #air/min	Relief valve outlet size (NPT)
235 psig set pressure				
2P, 2Q, 2R, 2S, 22, 23	2		1 at 55.9	1 in.
4P, 4Q, 4R, 4S, 42, 43, 44, 45	2		1 at 55.9	1 in.
6P, 6Q, 6R, 6S, 6T, 62, 63, 64	2		1 at 55.9	1 in.
AC, AD, AE, AF, AG	2		1 at 55.9	1 in.
BC, BD, BE, BF, BG	2		1 at 55.9	1 in.
CC, CD, CE, CF, CG, CI, CK, CL, CN, CP, C1, C2, C3, C4, C6, C7, C9	2		1 at 55.9	1 in.
DC, DD, DE, DF, DG, DI, DL, DN, DP, D6, D7, D9	2		1 at 55.9	1 in.
EC, EE, EG, EH, EJ, EK, EL, E1, E3, E5, E6, E7, E9	2		1 at 55.9	1 in.
FC, FE, FG, FH, FJ, FK, FL, F1, F3, F5, F6, F7, F9	2		1 at 91.8	1 1/4 in.

Table 4: Refrigerant relief characteristics for condenser with R-134a at 235 psig set pressure

















Condenser R-134a				
Shells	With or without isolation valves			
	Dual relief valves (see Note)			
	Quantity of valves		C _r #air/min	Relief valve outlet size (NPT)
JG, JJ, JK, JL, J9	2		1 at 91.8	1 1/4 in.
2V, 2W, 2X	2		1 at 91.8	1 1/4 in.
KC, KE, KG, KK, KL, K0, K1, K2, K3, K5, K7, K9	2		1 at 91.8	1 1/4 in.
LC, LE, LG, LK, LL, L0, L1, L2, L3, L5, L7, L9	2		1 at 91.8	1 1/4 in.
OC, OE, OG, OK, OL, O1, O3, O5, O7, O9	2		1 at 91.8	1 1/4 in.
PC, PE, PG, PK, PL, P1, P3, P5, P7, P9	2		1 at 91.8	1 1/4 in.
4W, 4X, 47, 48, 49	2		1 at 91.8	1 1/4 in.
5W, 5X, 57, 58, 59	4		2 at 55.9	1 in.
QC, QE, QG, QK, QL, Q1, Q3, Q5, Q7, Q9	2		1 at 91.8	1 1/4 in.
RC, RE, RG, RK, RL, R1, R3, R5, R7, R9	2		1 at 91.8	1 1/4 in.
SC, SE, SG, SK, S1, S2, S3, S4, S5, S7, S9	4		2 at 55.9	1 in.
6W, 6X, 67, 68, 69	4		2 at 55.9	1 in.
7W, 7X, 77, 78, 79	4		2 at 55.9	1 in.
TC, TE, TG, TK, T1, T2, T3, T4, T5, T7, T9	4		2 at 55.9	1 in.
UC, UE, UG, UH, UK, U1, U3, U9	4		2 at 55.9	1 in.

Table 4: Refrigerant relief characteristics for condenser with R-134a at 235 psig set pressure
















Condenser R-134a				
Shells	With or without isolation valves			
	Dual relief valves (see Note)			
	Quantity of valves		C _r #air/min	Relief valve outlet size (NPT)
VC, VE, VG, VH, VK, V1, V3, V9	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
WC, WG, W1, W3, W4, W5, W6, W7, W9	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
87, 89	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
97, 99	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
YC, YG, Y1, Y2, Y3, Y4, Y5, Y7, Y9	2		1 at 91.8	1 1/4 in.
	2		2 at 55.9	1 in.
ZC, ZG, Z1, Z3, Z4, Z5, Z6, Z7, Z9	4		2 at 91.8	1 1/4 in.
1V, 1W, 1X	2		1 at 91.8	1 1/4 in.
3V, 3W, 3X	2		1 at 91.8	1 1/4 in.
0W, 0X, 07, 08, 09	4		2 at 91.8	1 1/4 in.

Table 5: Refrigerant relief characteristics for evaporator with R-513A or R-1234ze at 235 psig set pressure









Evaporator R-513A or R-1234ze						
Shells	With isolation valves		Without isolation valves		C _r #air/min	Relief valve outlet size (NPT)
	Single relief valves	Dual relief valves (see Note)	Dual relief valves (see Note)			
	Quantity of valves	Quantity of valves	Quantity of valves			
235 psig set pressure						
2C, 2D, 2E	1		2		1 at 55.9	1 in.
4C, 4D, 4E, 4F, 4G, 4H, 4I	1		2		1 at 55.9	1 in.
6A, 6B, 6C, 6D, 6E, 6F	1		2		1 at 55.9	1 in.
AC, AD, AE, AF	1		2		1 at 55.9	1 in.

Table 5: Refrigerant relief characteristics for evaporator with R-513A or R-1234ze at 235 psig set pressure































Evaporator R-513A or R-1234ze						
Shells	With isolation valves		Without isolation valves		C _r #air/min	Relief valve outlet size (NPT)
	Single relief valves		Dual relief valves (see Note)			
	Quantity of valves		Quantity of valves			
BD, BE, BF	1		2		1 at 55.9	1 in.
CC, CD, CE, CG, CH, CK, CL, CN, CP, CQ, C1, C5, C9	1		2		1 at 55.9	1 in.
DC, DD, DE, DG, DH, DK, DL, DN, DP, DQ, D9	1		2		1 at 55.9	1 in.
ED, EE, EH, EI, EJ, EK, EM, EP, ER, E1, E3, E5, E9	1		2		1 at 55.9	1 in.
FC, FD, FE, FH, FI, FJ, FK, FM, FP, FR, F3, F5, F9	1		2		1 at 91.8	1 1/4 in.
GC, GE, GF, GK, GL, GN, GP, G1, G3, G5, G7, G9	1		2		1 at 91.8	1 1/4 in.
HC, HE, HF, HK, HL, HN, HP, H1, H3, H5, H7, H9	1		2		1 at 91.8	1 1/4 in.
JK, JL, JN, JP, JC, JE, JF	1		2		1 at 91.8	1 1/4 in.
KC, KE, KG, KK, KL, K1, K3, K5, K7, K9	1		2		1 at 91.8	1 1/4 in.
LC, LE, LG, LK, LL, L1, L3, L5, L7, L9	2		4		2 at 55.9	1 in.
MC, ME, MG, M1, M3, M5	1		2		1 at 91.8	1 1/4 in.
NC, NE, NG, N1, N3, N5	2		4		2 at 55.9	1 in.
OC, OE, OG, OK, OL, O1, O3, O5, O7, O9	2		4		2 at 55.9	1 in.
PC, PE, PG, PK, PL, P1, P3, P5, P7, P9	2		4		2 at 55.9	1 in.

Table 6: Refrigerant relief characteristics for evaporator with R-513A or R-1234ze at 180 psig set pressure











Evaporator R-513A or R-1234ze						
Shells	With isolation valves		Without isolation valves		C _r #air/min	Relief valve outlet size (NPT)
	Single relief valves		Dual relief valves (see Note)			
	Quantity of valves		Quantity of valves			
180 psig set pressure						
QC, QE, QG, QK, QL, Q3, Q5, Q7, Q9	2		4		2 at 71.4	1 1/4 in.
RC, RE, RG, RK, RL, R3, R4, R5, R7, R9	2		4		2 at 71.4	1 1/4 in.
SC, SE, SG, SH, SK, S1, S2, S3, S4, S5, S7, S9	2		4		2 at 71.4	1 1/4 in.
TC, TE, TG, TH, TK, T1, T2, T3, T4, T5, T7, T9	2		4		2 at 71.4	1 1/4 in.

Table 6: Refrigerant relief characteristics for evaporator with R-513A or R-1234ze at 180 psig set pressure













Evaporator R-513A or R-1234ze						
Shells	With isolation valves		Without isolation valves		C _r #air/min	Relief valve outlet size (NPT)
	Single relief valves		Dual relief valves (see Note)			
	Quantity of valves		Quantity of valves			
UC, UD, UE, UG, UK, U1, U2, U3, U5, U7, U8, U9	2		4		2 at 71.4	1 1/4 in.
VC, VD, VE, VG, VK, V1, V2, V3, V5, V7, V8, V9	2		4		2 at 71.4	1 1/4 in.
WC, WE, WG, WK, W1, W2, W3, W5, W6, W7, W9	1		2		1 at 173	1 1/2 in.
XC, XE, XG, X1, X3, X5, X6, X7, X9	1		2		1 at 173	1 1/2 in.
YC, YE, YG, YK, Y1, Y2, Y3, Y5, Y6, Y7, Y9	1		2		1 at 289	1 1/2 in.

Table 7: Refrigerant relief characteristics for condenser with R-513A or R-1234ze at 235 psig set pressure














Condenser R-134a				
Shells	With or without isolation valves			
	Dual relief valves (see Note)			
	Quantity of valves		C _r #air/min	Relief valve outlet size (NPT)
235 psig set pressure				
2P, 2Q, 2R, 2S, 22, 23	2		1 at 55.9	1 in.
4P, 4Q, 4R, 4S, 42, 43, 44, 45	2		1 at 55.9	1 in.
6P, 6Q, 6R, 6S, 6T, 62, 63, 64	2		1 at 55.9	1 in.
AC, AD, AE, AF, AG	2		1 at 55.9	1 in.
BC, BD, BE, BF, BG	2		1 at 55.9	1 in.
CC, CD, CE, CF, CG, CI, CK, CL, CN, CP, C1, C2, C3, C4, C6, C7, C9	2		1 at 55.9	1 in.
DC, DD, DE, DF, DG, DI, DL, DN, DP, D6, D7, D9	2		1 at 55.9	1 in.
EC, EE, EG, EH, EJ, EK, EL, E1, E3, E5, E6, E7, E9	2		1 at 55.9	1 in.
FC, FE, FG, FH, FJ, FK, FL, F1, F3, F5, F6, F7, F9	2		1 at 91.8	1 1/4 in.
JG, JJ, JK, JL, J9	2		1 at 91.8	1 in.
2V, 2W, 2X	2		1 at 91.8	1 1/4 in.
KC, KE, KG, KK, KL, K0, K1, K2, K3, K5, K7, K9	2		1 at 91.8	1 1/4 in.

Table 7: Refrigerant relief characteristics for condenser with R-513A or R-1234ze at 235 psig set pressure





























Condenser R-134a				
Shells	With or without isolation valves			
	Dual relief valves (see Note)			
	Quantity of valves		C _r #air/min	Relief valve outlet size (NPT)
LC, LE, LG, LK, LL, L0, L1, L2, L3, L5, L7, L9	2		1 at 91.8	1 1/4 in.
OC, OE, OG, OK, OL, O1, O3, O5, O7, O9	2		1 at 91.8	1 1/4 in.
PC, PE, PG, PK, PL, P1, P3, P5, P7, P9	2		1 at 91.8	1 1/4 in.
4W, 4X, 47, 48, 49	4		2 at 55.9	1 in.
5W, 5X, 57, 58, 59	4		2 at 55.9	1 in.
QC, QE, QG, QK, QL, Q1, Q3, Q5, Q7, Q9	2		1 at 91.8	1 1/4 in.
RC, RE, RG, RK, RL, R1, R3, R5, R7, R9	4		2 at 55.9	1 in.
SC, SE, SG, SK, S1, S2, S3, S4, S5, S7, S9	4		2 at 55.9	1 in.
6W, 6X, 67, 68, 69	4		2 at 55.9	1 in.
7W, 7X, 77, 78, 79	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
TC, TE, TG, TK, T1, T2, T3, T4, T5, T7, T9	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
UC, UE, UG, UH, UK, U1, U3, U9	4		2 at 55.9	1 in.
VC, VE, VG, VH, VK, V1, V3, V9	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
WC, WG, W1, W3, W4, W5, W6, W7, W9	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
87, 89	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
97, 99	4		2 at 91.8	1 1/4 in.

Table 7: Refrigerant relief characteristics for condenser with R-513A or R-1234ze at 235 psig set pressure

Condenser R-134a				
Shells	With or without isolation valves			
	Dual relief valves (see Note)			
	Quantity of valves		C _r #air/min	Relief valve outlet size (NPT)
YC, YG, Y1, Y2, Y3, Y4, Y5, Y7, Y9	2		1 at 91.8	1 1/4 in.
	2		1 at 55.9	1 in.
ZC, ZG, Z1, Z3, Z4, Z5, Z6, Z7, Z9	4		2 at 91.8	1 1/4 in.
1V, 1W, 1X	2		1 at 91.8	1 1/4 in.
3V, 3W, 3X	2		1 at 91.8	1 1/4 in.
0W, 0X, 07, 08, 09	2		1 at 223	1 1/2 in.

Where: C_r = Rated capacity of YORK® supplied relief valve(s).

- ① **Note:** A dual relief valve consists of one three-way shut off valve and two single relief valves. The valve configuration does not allow both valves to be shut off at the same time, and valves are sized such that each relief valve has sufficient discharge capacity when used alone. Line sizing must be based on the capacity of one valve for each dual relief assembly. This permits safe removal of either relief valve for repair or replacement, while maintaining vessel protection.

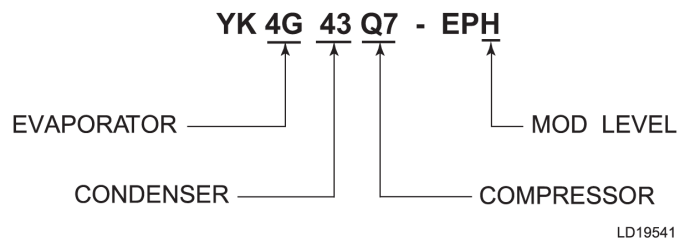






Table 8: Key

C _r #air/min	Quantity of operable valves	Example
1 at ##.##	1	
1 at ##.##	2	
2 at ##.##	1	
2 at ##.##	2	

Vent line sizing

Piping: *ASHRAE Standard 15-2019, Section 9.7.8*, outlines acceptable relief piping locations and sizing. Summarized, the relief piping must vent refrigerant at least 15 ft (4.57 m) above ground level (for exceptions, refer to *ASHRAE Standard 15-2019, Section 9.7.8.2.a*) and at least 20 ft (6.1 m) from any window, ventilation opening, pedestrian walkway, or building exit. The discharge piping must prevent a discharged refrigerant from being sprayed directly on personnel and prevent foreign material or debris from entering the piping. Additionally, discharge piping for a fusible plug or rupture disc must have provisions to prevent plugging the pipe in the event of a discharge by the plug or disc.

As indicated in YORK® installation instructions, each vent line must contain a dirt trap in the vertical section to allow collection and removal for any stack condensation or debris (must comply with *Section 9.7.8.2.f*). The piping must be arranged to avoid strain on the relief valves; Johnson Controls recommends the use of a flexible connector. The vent line must be sized in accordance with *ANSI/ASHRAE Standard 15* and local code, but must not be smaller than relief valve outlet sizes provided in Table 2, Table 3, Table 4, Table 5, Table 6, or Table 7.

Common header: *Section 9.7.9.3.3* allows for multiple relief devices on the same or multiple units to be connected into a common line or header. The sizing of the common discharge header and vent piping for relief devices expected to operate simultaneously must be based on the sum of their outlet areas, with due allowance for the pressure drop in all downstream sections and back-pressure resulting from the discharge of multiple relief devices.

Maximum length: *Section 9.7.9.3.1* and *Appendix D* define the maximum length of discharge piping downstream of the pressure-relief device as follows:

$$L = \frac{0.2146d^5(P_0^2 - P_2^2)}{fC_r^2} - \frac{d * \ln(P_0 / P_2)}{6f} \quad [feet] \quad Eq.(2)a$$

$$\left[L = \frac{7.4381 \times 10^{-15} d^5 (P_0^2 - P_2^2)}{fC_r^2} - \frac{d * \ln(P_0 / P_2)}{500f} \right] \quad [meters] \quad Eq.(2)b$$

Where:

- L = equivalent length of discharge piping, ft (m)
- C_r = rated capacity as stamped on the device in lb/min (kg/s)
- f = Moody friction factor in fully turbulent flow (see Table 10)
- d = inside diameter of pipe or tube, in. (mm)
- \ln = natural logarithm
- P_2 = absolute pressure at outlet of discharge piping, psi (kPa)
- P_0 = allowed back pressure (absolute) at the outlet of pressure release device, psi (kPa)
- P_0 = (0.15 x relief valve set pressure + atmospheric pressure)

For YK Mod H equipment:

- P_0 = 50.0 for 235 psig set pressure

The *ASHRAE Standard 15 User's Manual* provides that, when the length of vent pipe exceeds approximately 220 diameters ($L/d > 220$), the first term in equation (2)a or (2)b can be used to solve for the diameter, d .

An average friction factor $f = 0.02$ can be used when the pipe size is not known.

$$d = 1.36 * \left(\frac{fLC_r^2}{P_0^2 - P_2^2} \right)^{0.2} \quad \text{[inches]} \quad \text{Eq. (3)a}$$

$$\left[d = 2521 * \left(\frac{fLC_r^2}{P_0^2 - P_2^2} \right)^{0.2} \right] \quad \text{[millimeters]} \quad \text{Eq. (3)b}$$

Table 9 lists the maximum lengths of vent piping for various YK relief valve capacities and pipe sizes vented to atmosphere.

① **Note:** Use this document only as a guideline for estimating; it is subject to changes made in *ASHRAE Standard 15* or overriding local code.

Table 9: Maximum length (ft) of discharge piping

Rated relief valve capacity, C, (lb air / min.)	Relief valve pressure setting, psig											
	180						235					
	Nominal pipe size, in. (calculations based on schedule 40 pipe)											
	1 1/4	1 1/2	2	2 1/2	3	4	1 1/4	1 1/2	2	2 1/2	3	4
43.5	30	79	324	847	0	0	30	79	324	847	0	0
55.9							24	68	289	761		
71.4	4	20	108	300	976							
87.5		9	67	194	648							
91.8								15	93	265	876	
112								5	55	169	576	
143			13	57	220	994			25	93	340	
148									22	85	315	
173			3	31	141	666						
179									8	49	204	940
184									7	45	191	887
204									1	32	148	712
235										17	103	524
255										10	82	438
291										1	55	324
321											38	258
357											24	199

Table 10: Steel pipe dimensions (sch. 40)

	Nominal pipe size (in.)								
	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6
I. D. (in.)	1.049	1.380	1.610	2.067	2.469	3.068	4.026	5.047	6.065
Friction factor	0.0225	0.0209	0.0202	0.0190	0.0182	0.0173	0.0163	0.0155	0.0149

Example 1: Maximum length - Single vent line per relief valve

YK4C4PQ4-EKH is to be installed in the equipment room. The relief valves will be vented to atmosphere, using standard schedule 40 pipe, at a distance 40 ft from the valves.

Solution

From Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7:

- 4 Evaporator has one 1 1/4 in. valve, 91.8 lb of air/min, 235 psig set pressure.
- 4 Condenser has one (dual) 1 in. valve, 55.9 lb of air/min each valve, 235 psig set pressure.

Evaporator

Using Table 9, scan down the first column to find the rated discharge capacity [C_r] of 91.8. Next, follow that row across to intersect a 235 psig set pressure column with a length that meets or exceeds the 40 ft requirement. The first intersection (for 1 1/2 in. diameter pipe) has a value of 15 ft, which does not meet the 40 ft minimum requirement. At the next intersection, we find that **2 in. diameter pipe** is good for a maximum of 93 ft, which satisfies the job requirements.

Alternatively, since $L/d > 220$, equation (3) can be used, assuming $f = 0.02$. The required pipe diameter is given by the following equation:

$$d = 1.36 * \left(\frac{fLC^2}{P_0^2 - P_2^2} \right)^{0.2} = 1.36 * \left(\frac{(0.02)(40)(91.8)^2}{50.0^2 - 14.7^2} \right)^{0.2} = 1.689''$$

From Table 10, we see that **2 in. diameter pipe** is the smallest size having an inside diameter of 1.689 in. or more.

Condenser

Using Table 9, scan down the first column to find the rated discharge capacity [C_r] of 55.9. Next, follow across to intersect a 235 psig set pressure column with a length that meets or exceeds the 40 ft requirement. The first intersection (for 1 1/4 in. diameter pipe) has a value of 24 ft, which does not meet the 40 ft minimum requirement. At the next intersection, we find that **1 1/2 in. diameter pipe** is good for a maximum of 68 ft, which satisfies the job requirements.

Alternatively, since $L/d > 220$, equation (3) can be used, assuming $f = 0.02$. The required pipe diameter is given by the following equation:

$$d = 1.36 * \left(\frac{fLC^2}{P_0^2 - P_2^2} \right)^{0.2} = 1.36 * \left(\frac{(0.02)(40)(55.9)^2}{50.0^2 - 14.7^2} \right)^{0.2} = 1.385''$$

From Table 10, we see that **1 1/2 in. diameter pipe** is the smallest size having an inside diameter of 1.385 in. or more.

Example 2: Maximum length – Common header vent line

YK6B4SQ7-ESH is to be installed in the equipment room. The relief valves will be vented to atmosphere, using standard schedule 40 pipe, at a distance 70 ft from the valves.

Solution

From Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7:

- 6 evaporator has one 1 1/4 in. valve, 91.8 lb of air/min each valve, 235 psig set pressure.
- 4 condenser has one (dual) 1 in. valve, 55.9 lb of air/min each valve, 235 psig set pressure.

The minimum line size of a common header application is based on the sum of the relief device discharge areas and the sum of the rated discharge capacities.

First, sum the discharge areas of the relief valves using actual I.D. values from Table 10:

$$\begin{aligned}\Sigma \pi r^2 &= \Sigma 0.25\pi d^2 = 0.25\pi (\Sigma d^2) \\ \Sigma d^2 &= (1.380^2 + 1.049^2) = 3.005 \\ d_{(\min)} &= (6.01)^{1/2} = 1.73''\end{aligned}$$

From Table 10, we see that 2 in. pipe (2.5067 in. I.D.) is the minimum size which meets or exceeds the sum of the relief valve discharge areas.

Next, sum the rated discharge capacities [C_r] to determine required flow capacity.

$$C_r(\text{sum}) = 1 (91.8) + 1 (55.9) = 147.7 \text{ lb. air / min}$$

① Note: Evaporator relief valves are sized such that gas is discharged quickly enough to prevent vessel damage at the discharge pressure. Therefore, refrigerant is discharged from the evaporator before the system pressure reaches 235 psig (condenser relief valve set pressure) in a fire condition. It is conservative to use the cumulative rated discharge capacities at the higher pressure.

Using Table 9, scan down the first column to find the rated discharge capacity [C_r] of 148. Next, follow that row across to intersect a 235 psig set pressure column with a length that meets or exceeds the 70 ft requirement. The first intersection (for 2 in. diameter pipe) has a value of 22 ft, which does not meet the 70 ft minimum requirement. At the next intersection, we find that **2 1/2 in. diameter pipe** is good for a maximum of 85 ft, which satisfies the job requirements.

Alternatively, since $L/d > 220$, equation (3) can be used, assuming $f = 0.02$:

$$d = 1.36 * \left(\frac{fLC^2}{P_0^2 - P_2^2} \right)^{0.2} = 1.36 * \left(\frac{(0.02)(70)(147.7)^2}{50.0^2 - 14.7^2} \right)^{0.2} = 2.28''$$

From Table 10, we see that **2 1/2 in. diameter pipe** is the smallest size having an inside diameter of 2.28 in. or more.

Other methods

Equation (2) can be used to calculate the maximum length of vent piping for any relief valve rating and pipe or tubing diameter. *Table 9.7.9.3 in ASHRAE Standard 15-2019* also lists flow capacities for various set pressures and line lengths.

