

Supermarket Refrigeration Retrofit - Expansion Valve Adjustment

Technical Bulletin

Products: Genetron Performax® LT (R-407F),

Solstice® N40 (R-448A)

Bulletin#: 05 rev 0.0

Application: Refrigeration retrofit to R-448A and R-407F



Background

Refrigerants with an ozone depletion potential and/or a high global warming potential are being removed from many supermarket systems. These refrigerants are being replaced with non-ozone depleting, lower global warming refrigerants. The more common refrigerants being replaced are R-404A, R-507A, R-22, R-402A, and R-408A. These refrigerants can be replaced with Honeywell's Solstice N40 (R-448A) or Genetron Performax LT (R-407F).

Problem

Installing contractors need to know if a retrofit will affect expansion valves. With this knowledge the contractor can be prepared and will avoid expansion valve obstacles.

Resolution

This bulletin will address the impact of changing refrigerants on the expansion valve adjustment range. Bulletin 6 will address the impact on the valve capacity.

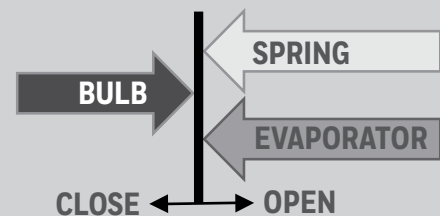
Three forces typically act on an expansion valve! These are the:

1. pressure from the expansion valve bulb²
2. evaporator pressure in the refrigerant piping acting on the valve
3. spring (adjustment) pressure

Example: How does the adjustment range change on an R-404A expansion valve when retrofitting to R-448A with a -25°F evaporator temperature?

The comparison of the R-404A and R-448A evaporator pressures and dewpoint temperatures help in understanding the valve opening and closing pressures.

Forces acting on TEV diaphragm



$$\text{Bulb pressure} = \text{Evaporator pressure} + \text{Spring pressure}$$

- The bulb pressure opens the valve (more flow / less superheat)
- The spring and evaporator pressures close the valve (less flow / more superheat)

From table 1 we can see that the operating **evaporator pressure** in the pipe, acting on the valve, is 3lbs lower (13.1-10.1) for R-448A. This results in an **opening** of the valve vs R-404A.

We also see that the **bulb pressure** is 3.2 lbs higher for R-448A. A higher bulb pressure also results in an **opening** of the valve.

The combination of the evaporator and bulb pressures is a total 6.2 pound opening force. Due to this, there will be instances where the spring may not have enough adjustment available to set the superheat. Flooding may occur.

Luckily there is an easy remedy. Installing an R-22 power element will change the bulb opening force to allow for adjustment.

With an R-22 power element the bulb pressure will be 5.7 pounds lower than R-404A (13.1 – 7.4 in table 2). This closing force will offset the 3lbs of evaporator pressure opening force. This results in a net 2.7lb closing force which will create the needed spring adjustment to allow superheat to be set.

Refer to table 3 for the closing force for different refrigerants and conditions as well as the impact of changing the power element to R-22.

Table 2: R-22 power element

R-404A TXV Bulb Pressure	
R-404A	13.1
R-448A	16.3
R-448A with R-22 Power Element	7.4

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Table 1: R-448A and R-404A pressures on an expansion valve

-25°F Evaporator					
	Evaporator Temperature (Avg of Dew and Bubble)	Bubble Temperature	Dew Temperature	R-404A TXV Bulb Pressure	Evaporator Pressure
R-404A	-25.0	-25.6	-24.4	→ 13.5	13.1
R-448A	-25.0	-30.5	-19.6	→ 16.7	10.1

Table 3: Impact of different retrofits on the expansion valves

Expansion Valve Pressures					
Original Refrigerant	New Refrigerant	Evaporator Temperature (Avg of Dew and Bubble)	Pressure Change	Valve Impact With Original Refrigerant Power Element	Valve Impact With R-22 Power Element
R-404A	R-448A or R-407F	-25	-6.2	(open)	0 (close)
R-404A		+20	-11.4	(open)	2.6 (close)
R-507		-25	-5.2	(open)	-0.35 (open)
R-507		+20	-12.0	(open)	2.02 (close)
R-408A		-25	-4.2	(open)	-0.1 (open)
R-408A		+20	-6.2	(open)	2.4 (close)
R-502		-25	-5.1	(open)	-0.25 (open)
R-502		+20	-6.9	(open)	2.1 (close)
R-402A		-25	-8.4	(open)	0.75 (close)
R-402A		+20	-16.3	(open)	3.8 (close)
R-22		-25	-0.3	(open)	NA
R-22		+20	1.9	(close)	NA

Note: These values do not take into account pressure drop of a distributor. Existence of a distributor would have a small lessening of the pressure effects.

- 1 These are general recommendations and may vary for different valve suppliers.
- 2 Assumption is made that refrigerant in the bulb is same as refrigerant noted on the valve. This is for simplicity and because manufacturers typically do not share bulb charges.
- 3 We will ignore superheat as it has negligible impact in this analysis

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