SIMPLIFYING REFRIGERANT CONVERSIONS WITH RS-44 (424A)

Conversion Case Study

Location: Kingston Ontario Canada

Owner: Kincore Holdings Ltd.
80 King St., Kingston, Ontario
Representative: Andrew Silverthorne

Contractor: G.T. Air Systems
662 Progress Ave., Kingston, Ontario
Representative: Neil Glenn

Reason for conversion: The contractor and owner were concerned about the pending phase out of HCFC-22 and in exploring the non-ozone depleting replacement options. RS-44 (R424A) was selected because no retrofitting was required and the product is the same in terms of toxicity and flammability as HCFC-22. The actual conversion took only 2 hours from start to finish.

Equipment: York Roof top A/C model D7CG06009925A
Nominal Capacity: 5 Ton
Date: Aug. 8, 2005
Original Refrigerant Charge: 6 lb, 8 oz R-22
Replacement Refrigerant Charge: 6 lb, 8oz RS-44

Refrigerant	**R-22**	**RS-44**	
Time	10 am	12 pm	2 hours
Baseline Data	Before	After	Difference
Suction Pressure (PSIG)	60	48	-12 psig
Discharge Pressure (PSIG	220	210	-10 psig
Condenser Air On Temp F	80.1	83	+2.9 F
Condenser Air Off Temp F	101	104	+3 F
Ambient Temp F	80.1	83	+2.9F
Evaporator Air On Temp F	72.4	70	-2.4F
Evaporator Air Off Temp F	53.2	53.2	0 F
Compressor Amps (Average L1, L2, L3)	13.2	12.6	-.6 amps
Voltage Average (L1-L2, L2-L3, L1-L3)	204.3	203	-1.3 Volts
Discharge Temp F	-	-	-
Suction Temp F	-	-	-
Evaporator Superheat	-	-	-

Comparison Diagnosis

Condenser Temperature Differential
In this case the difference before and after is only 0.1F. This would indicate the heat being rejected by the condenser is very similar to what it was with R-22 although the air entering conditions are not quite the same. It is difficult to make an accurate determination with only one set of readings before and after. Although this data is an indicator that the capacity of the system is very similar to what it was before the retrofit.

Suction Pressure
A drop of 12 PSIG in suction pressure may at first glance appear to be a problem. However one must compare the pressure temperature relationship of the replacement refrigerant RS-44 with R-22 at the same conditions. R-22 at 60 psig is equivalent to 35 F. RS-44 at 48 psig (Dew point) is equivalent to 39 F and RS-44 at 48 psig (bubble point) is equivalent to 30 F. This would indicate that the average temperature 34.5 F in the evaporator is very close to what it was with R-22. RS-44 is a refrigerant blend and therefore does have glide. When calculating temperature pressure relationships of blends, it is recommended to use the Dew Point when measuring superheat and the Bubble Point when measuring sub-cooling. The benefit of lower suction pressures for equivalent evaporator temperature is, fewer loads on the compressor and a reduction in compressor motor amperage.

Discharge Pressures
A drop of 10 PSIG is not normally a concern and when comparing the pressure temperature relationships of R-22 and RS-44 this type of reduction would be expected.

The benefit to lower discharge pressures is fewer loads on the compressor and reduced compressor motor amperage.

Evaporator Temperature Differential
In this case the differential dropped from 19.2 F to 16.8 F a difference of 2.4 F. However the air entering temperature also dropped by the same amount from 72.4 F to 70 F and the air off temperature remained the same at 53.2 F. It would be helpful to have more data at similar conditions to make a more accurate determination. However considering the ambient outside temperature is 2.9 F higher and the Evaporator Air Off temperature is similar it can be an indication that the system is maintaining the space temperature at least as well as before.

Compressor Amperage
In this case an average reduction of .6 amps per leg which is equivalent to a
5% reduction in energy usage while the compressor is running. A comparison of run times at similar load conditions would have to be made to accurately compare energy usage before and after.

Voltage:
In this case the voltage was very similar and can be discounted as a factor in these comparisons. It should be noted however that voltages can vary substantially throughout the day at building sites and can be enough to affect amperages on this type of equipment.

Ambient Temperatures
Ambient temperatures in Canada's climate vary tremendously from season to season and from coast to coast. The most important issue is to compare baseline data at similar ambient conditions to give an accurate comparison for diagnostic purposes.

In addition to comparing baseline data for a short term period the contractor and owners also decided to compare operational data over the long term between two identical roof top A/C units one operating on R-22 and the other operating on RS-44.

Both are York Roof Top A/C Model D7CG06009925A
Nominal Capacity: 5 Ton

The following is the data taken over a 30-day period.

R-22

Date	Time	Suct Press	Disch Press	Amb Temp	Amps L1	Amps L2	Amps L3	Volts	Evap In	Evap Out
Aug 8	AM	69	230	87	13.0	14.7	12.7	204	75	61
Aug 16	PM	70	225	78	13.1	14.9	12.9	205	73	58
Aug 23	PM	71	228	80	13.3	14.9	12.9	205	71	56
Aug 30	PM	69	228	81	12.9	14.2	12.7	206	73	58
Sep 8	PM	67	220	75	12.7	14.2	12.5	206	72	57

RS-44 (R424A)

Date	Time	Suct Press	Disch Press	Amb Temp	Amps L1	Amps L2	Amps L3	Volts	Evap In	Evap Out
Aug 8	AM	48	210	83	12.6	13.6	11.6	204	70	53.2
Aug 16	PM	49	208	78	12.8	13.9	11.6	205	71	54.3
Aug 23	PM	50	208	80	12.5	13.6	11.6	205	71.5	55
Aug 30	PM	50	210	81	12.9	13.9	11.9	206	70.5	55.2
Sep 8	PM	51	207	75	12.3	13.5	11.5	206	71	55.8

The data above is consistent with the previous data and overall shows lower suction and discharge pressures, lower amperage, and lower evaporator air on and air off temperatures.

This conversion would have to be considered a success based on the data provided.