

• IMPORTANT! •

**ComStar**

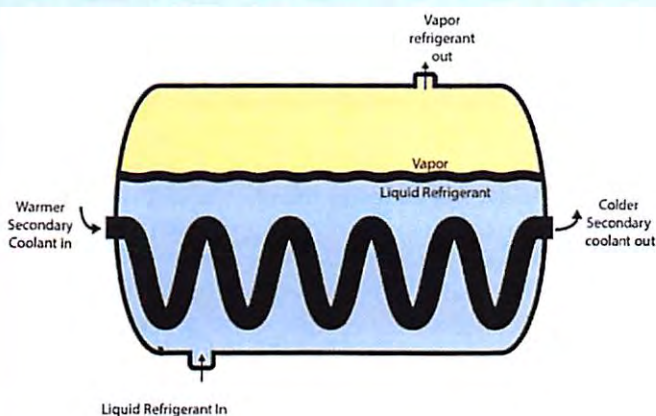
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## WHY SHOULD YOU REPLACE R22 WITH RS45 IN FLOODED CHILLER SYSTEMS?

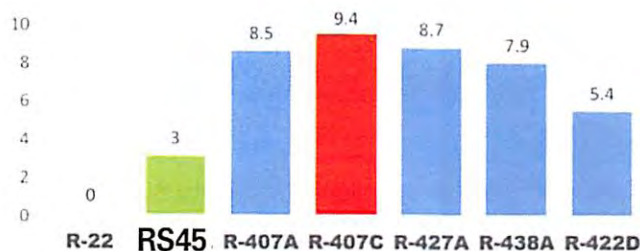


- RS45 is the only **TRUE** "drop-in" replacement for R22 in Flooded Systems.
- RS45 provides **LOW** glide and performance qualities equal to R22.
- RS45 **BLENDS** in seamlessly with existing R22 remaining in the system. See Note 1
- RS45 operates with **ALL** types of oil, **INCLUDING** mineral oil.
- RS45 requires **NO** system component changes. See Note 2

Flooded Chiller Diagram depicting liquid and vaporized refrigerant



The lower glide of RS45 creates a more stable temperature between the vapor and liquid



Comparison of glide for common R-22 alternatives at the same conditions.

Note 1: The system will not be harmed if RS45 is inadvertently mixed in with existing R22.

Note 2: Since RS45 has 40% greater mass flow than R22, the float expansion device will need to accommodate 40% greater mass flow.



**CONTACT YOUR REPRESENTATIVE  
& STOCK-UP ON COMSTAR'S RS45 TODAY.**



# RS-45

## Capacity

RS-45 is unique in being a capacity match for R22 across the range of applications where R22 is commonly found. No other refrigerant mirrors the

capacity of R22 at low temperature ( $-35^{\circ}\text{C}$  evap) & high temperature ( $+7^{\circ}\text{C}$  evap)

## Application Range

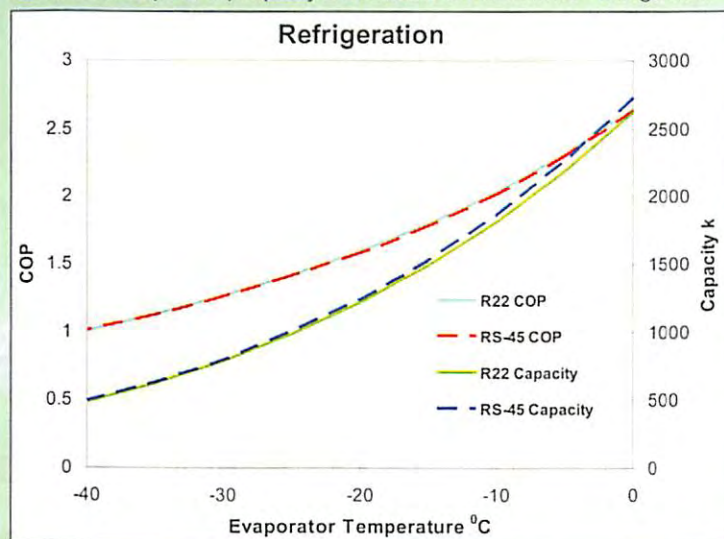
Owing to its unique thermodynamic properties, RS-45(R-434A) has a much wider application range when replacing R22. RS-45 is an excellent replacement for R22 both at high & low temperatures, which is illustrated in charts 1 & 2. In

addition RS-45 has very low glide and can be used in flooded evaporators and other applications where glide can affect performance.

## Lubricants

RS-45(R-434A) is suitable for use with both the traditional lubricants including mineral (MO) & alkylbenzene (AB) oils, & also the new synthetic lubricants including polyol ester (POE), polyalkylglycol (PAG) & others. The ability to use traditional lubricants both reduces cost and avoids the use of hygroscopic synthetic oils which can absorb moisture during maintenance.

Chart 1: RS-45(R-434A) Capacity & Coefficient of Performance - Refrigeration



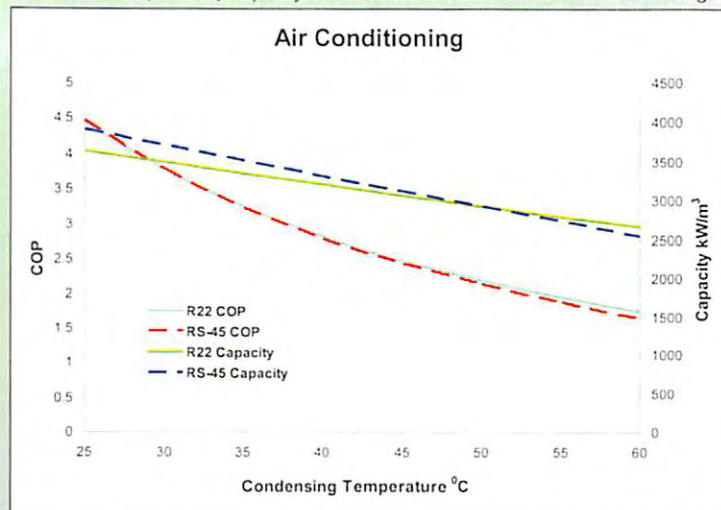
## Coefficient Of Performance

RS-45(R-434A) has a Coefficient of Performance which matches R22 as illustrated in charts 1 and 2

## Compression Ratio

RS-45 (R-434A) has a compression ratio which matches R22 across the range of applications where

Chart 2: RS-45(R-434A) Capacity & Coefficient of Performance - Air conditioning



R22 is commonly found.



# RS-45

## Flammability

RS-45(R-434A) is non flammable according to ASHRAE Standard 34 which includes non flammability as formulated & at worst case fractionation. RS-45

has an ASHRAE Safety Rating of A1 the same as R-22.

## Ozone Depletion Potential

RS-45 has no ability to deplete ozone with a zero ODP

## Glide

RS-45 is a near azeotropic blend with a glide of 1.5°C.

## Discharge Pressure

RS-45(R-434A) has similar discharge pressures to R22.

## Equipment Modifications

For the same duty RS-45(R-434A) has a higher liquid volume flow rate than R22 which may require retrofitting to optimize performance, notably the following:

Capillary tube: the length may need to be decreased, the diameter increased or a combination of both.

Expansion valve: recommendation is to that the TX valve is sized to accommodate a mass flow 40% greater than R22.

Liquid line: the diameter may need to be increased. On large systems with remote air-cooled condensers the liquid return line from the outlet of the condenser to the inlet of the receiver may also need to be modified.

However, it should be noted that the liquid viscosity of RS-45 is significantly lower than that of R22 (see

physical properties table) so that only modest changes to the liquid lines and expansion devices may be required.

Please refer to Conversion Procedures document for more information.

## Discharge Temperature

RS-45(R-434A) has a considerably lower discharge temperature than R22 which provides significant

operating benefits including a much lower risk of oil degradation.

Chart 3: RS-45(R434A) Glide

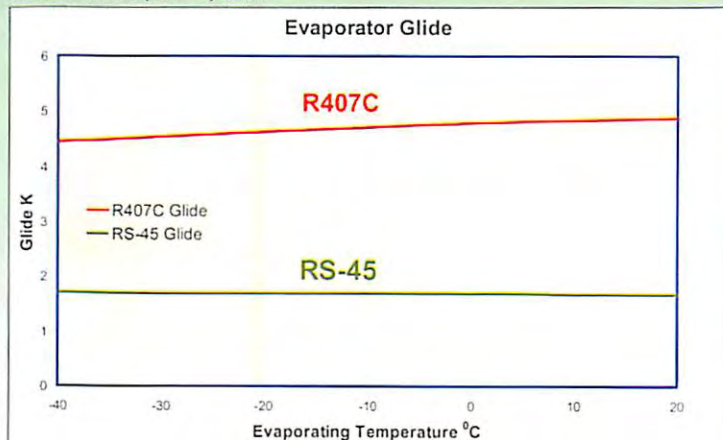
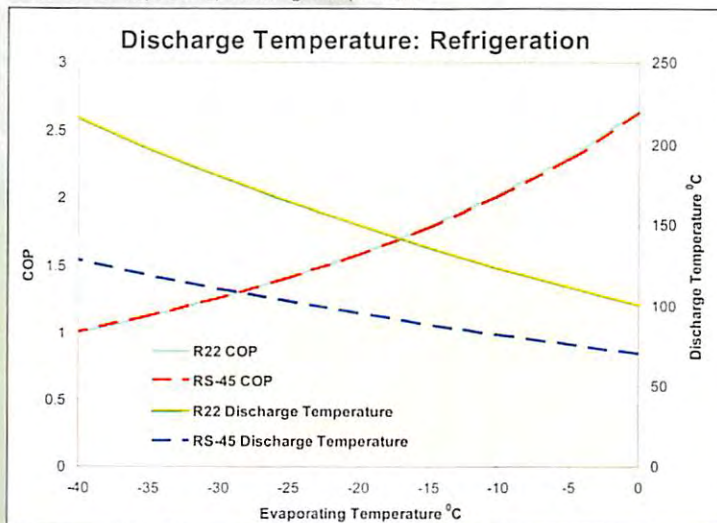
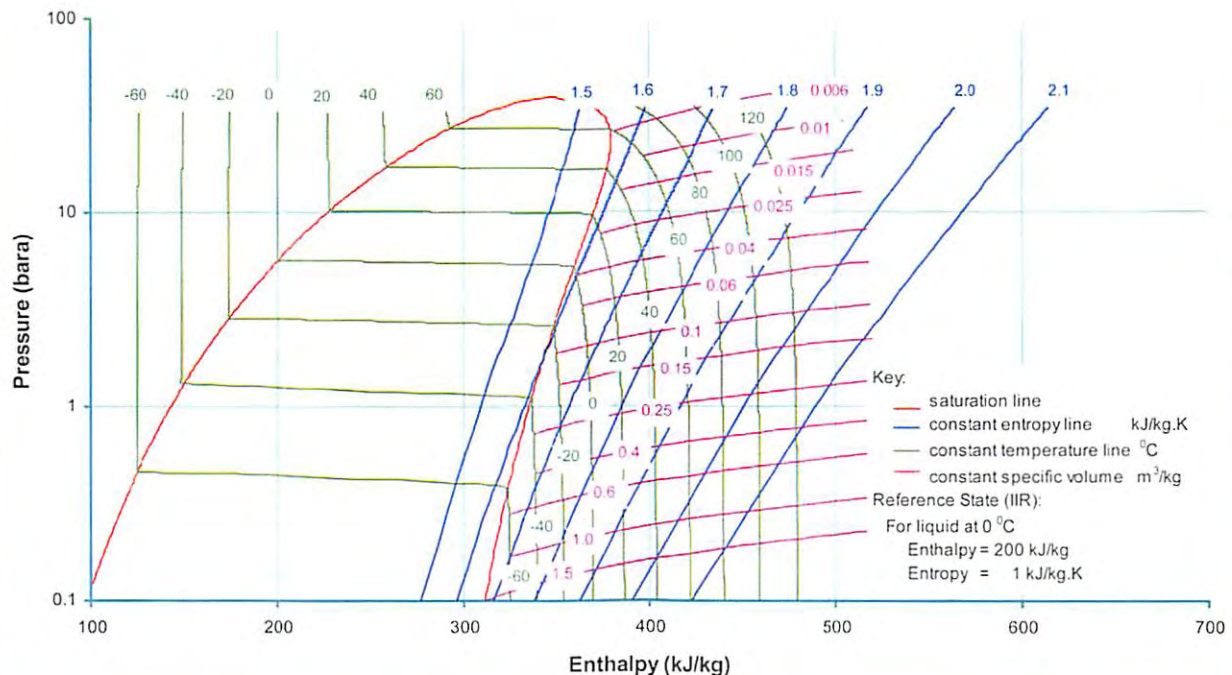


Chart 4: RS-45(R-434A) Discharge temperature





## RS-45 Pressure-Enthalpy Chart



## RS-45 Physical Properties

PROPERTY		RS-45	R22
Molecular Weight		105.3	86.5
Boiling point (1 atm)	°C	-44.9 <sup>(1)</sup>	-40.8
	°F	-48.8 <sup>(1)</sup>	-41.4
Temperature Glide	K	1.5	0
Critical Temperature	°C	77.83	96.1
	°F	172.1	204.8
Critical Pressure	bara	39.31	49.9
	psia	570.2	724
Liquid Density (25°C)	kg/m <sup>3</sup>	1096	1191
Density of saturated vapour (25°C)	kg/m <sup>3</sup>	53.1	44.2
Latent Heat of Vaporisation at boiling point	kJ/kg	190 <sup>(1)</sup>	234
Cv (25°C & 1 bara)	kJ/kg.K	0.775	0.559
Cp (25°C & 1 bara)	kJ/kg.K	0.861	0.662
Cp/Cv (25°C & 1 bara)		1.111	1.185
Vapour Pressure (25°C)	bara	11.8 <sup>(1)</sup>	10.4
	psia	163 <sup>(1)</sup>	151
Vapour Viscosity (25°C & 1 bara)	cP	0.0128	0.0126
Liquid Viscosity (25°C)	cP	0.140	0.166
Liquid Thermal Conductivity (25°C)	W/m.K	0.0665	0.0837
Surface Tension (25°C)	N/m	0.00528	0.00808
Specific heat of liquid (25°C)	kJ/kg.K	1.50	1.26
Ozone Depletion Potential	ODP	0	0.055
Flammability limit in air (1 atm)	vol%	none	none
Inhalation exposure (8 hr day & 40 hr week)	ppm	1000	1000



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<sup>(1)</sup> Bubble Point

1 February 2007



## **WHY RS45 CAN BE USED IN FLOODED/RECIRC SYSTEMS**

*RS45 is being used in over 8 large and small flooded/recirc. systems (and growing) around the world that were converted from R22. RS45 is the only refrigerant in the world that can be used in these types of systems because of the following:*

1. RS45 has a very low glide (1.5C) making it almost a azeotrope (like R22)...a necessity for flooded/recirc. systems
2. RS45 can match R22 in Capacity at low temperature (-31F).
3. RS45's Coefficient of Performance (COP) matches R22
4. RS45's compression Ratio matches R22.
5. RS45's discharge pressure is similar to R22
6. RS45's discharge temperature is considerably lower than R22 which is a operating benefit for the compressor and oil.
7. RS45 can be mixed with R22 without operating problems if all the R22 is inadvertently not evacuated from a system.
8. RS45 operates with all refrigerant oils including mineral oil.

No other company in the world has a R22 replacement refrigerant for flooded/recirc systems: not Dupont, Honeywell, Arkema, Mexichem, ICOR etc.

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***Questions about your R22 Flooded System and RS45 (CHECK OFF)***

**Company Name:** \_\_\_\_\_

**1. Motor Type & Horsepower**

- Open: (drive shaft seal may need to be replaced, see 6 Below)
- Semi-Hermetic: (should not have a gasket/seal issue with RS45)

**2. Compressor Type**

- Reciprocating: (should have no issues with RS45)
- Screw: (should have no issues with RS45)
- Centrifugal: (RS45 will not work in centrifugal systems)

**3. Saturated Suction Temperature, (low temp @ 19°F & below, high temp @ 20°F & above):**

**4. Chiller Evaporator Type, (Re: glide issues)**

- Tube and Tube: (should have no glide issues with RS45)
- Tube and Shell: (multi-pass type may lose some capacity)
- Plate Type: (should have no glide issues with RS45)
- Shell with Recirculated Liquid: (may lose some capacity)

**5. Expansion Device, (RS45 requires 40% more mass flow capacity)**

- TXV: (adjust opening or change to R404 valve)
- Manual Expansion Valve: (usually adjustment range is no issue)
- Electronic TXV: (usually adjustment range is no issue)
- Low Side Float: (usually nothing to do)
- High Side Float: (usually nothing to do)

**6. Evaporator "Oil Return System" type, (oil tends to build up in evap.)**

- None: (usually nothing to do)
- Liquid Distillation drawn from top of liquid level: (Best type for RS45)
- Liquid Distillation drawn from other locations: (may require POE oil)

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## **RS-45 POST FLOODED/RECIRC.CONVERSION** **CHECK LIST**

***After the conversion of an R22 flooded/recirc. system to RS-45, the following need to be monitored to refine the operating system:***

- (1) Suction and discharge pressures:*** Determine condensing & evaporating temperatures before and after conversion.
- (2) Suction line temperature leaving the low pressure receiver:*** Should be measured before & after conversion.
- (3) Air temperature entering & leaving the cooling Coils:*** Will determine if the recirculation rate in the cooling coils is correct, should be measured before & after conversion.
- (4) Evaporator Superheat:*** Measured before & after conversion to determine the refrigerant flow to evaporator & confirm heat transfer of the refrigerant.
- (5) System energy consumption:*** Should be compared after conversion.
- (6) Compressor oil levels:*** Should be monitored closely.

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# RS-45 (R-434A)

COMPOSITION	
HFC 125	
HFC 134a	
n-butane	
isobutane	
isopentane	
Chemical name	Pentafluoroethane/ 1,1,1,2-tetrafluoroethane/ n-butane/isobutane/ isopentane
Type	HFC blend
HCFC replacement	R22
Temperature glide	Approximately 1.5°C
Drop-In or long term	Both
Lubricant	MO/AB/POE
ODP	Zero
Atmospheric lifetime	32 years
GWP 100 year ITM	3130

RS-44 PHYSICAL PROPERTIES		RS-45	R22
Molecular weight	'C	105.3	86.5
Boiling point (1 atm)	'F	-44.9	-40.8
Temperature glide	'F	-48.8	-41.4
Critical temperature	'C	<2	0
	'F	77.8	96.1
Critical pressure	bara	172.1	204.8
	psia	39.3	49.9
Liquid density at 25°C	kg/m <sup>3</sup>	570	724
Density of saturated vapour at 25°C	kg/m <sup>3</sup>	1096	1191
Specific heat of liquid at 25°C	kJ/kg°C	53.1	44.2
Vapour pressure at 25°C	bara	1.50	1.26
	psia	11.8 (1)	10.4
Latent heat of vaporisation at boiling point	kJ/kg	163 (1)	151
Ozone Depletion Potential	ODP	190 (1)	234
Flammability limit in air (1 atm)	vol%	0	055
Inhalation exposure (8 hr day & 40 hr week)	ppm	None	None

(1) Bubble point

## TYPE and DESCRIPTION

RS-45 (R-434A) is a non-flammable HFC blend, which has a zero ODP and is also compatible with both traditional and synthetic lubricants. No oil change is required for most applications. RS-45 has significantly lower discharge temperatures than R-22 reducing or eliminating oil decomposition and improving system reliability.

RS-45 is suitable for use by Original Equipment Manufacturers (OEMs). It has cooling capacity and COP very similar to R-22.

## APPLICATIONS

RS-45 can be used to replace R-22 in medium and low temperature applications and in chillers with flooded evaporators.

appliances.

## SERVICE WORK

Because it is a blend, it is recommended that RS-45 be charged into systems in the liquid as opposed to the gaseous phase.

Since there is no need to change the existing lubricant, RS-45 is straightforward to use as the following procedure outlines.

## LUBRICANTS

RS-45 is compatible with both mineral and alkylbenzene oils found in R22 systems, and also with the polyolester lubricants. Therefore, there is no need to change the lubricant although compressor manufacturers' recommendations regarding lubricity should be followed.

## MATERIALS COMPATIBILITY

RS-45 is compatible with all materials commonly used in refrigeration systems previously charged with R22.

In general, materials which are compatible with R22 can be used with RS-45. It is recommended to check equipment manufacturer's retrofit literature and obtain recommendations from equipment manufacturers with regard to materials' compatibility. In older systems, replacement of some may be required.

## ENVIRONMENTAL DATA

None of the components of RS-45 contains chlorine so that it has no ability to deplete the ozone layer.

As with all hydrofluorocarbons (HFCs), RS-45 does have a direct global warming potential (GWP), but this is counterbalanced by the low Total Equivalent Warming Impact (TEWI) of the system.

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## CONVERSION PROCEDURE FOR REPLACING R-22 WITH RS-434A)

- (1) Ensure the right equipment is available, e.g. recovery unit and cylinders, container for recovered lubricant, vacuum pump, weighing scales, replacement drier etc.
- (2) Record baseline data to establish the normal operating conditions for the equipment.
- (3) Recover the R-22 and weigh the recovered R22 to determine amount of RS-45 to be charged.
- (4) Replace the filter/drier.
- (5) RS-45 requires approximately 40% greater liquid flow than R-22 so adjustments or modifications to the expansion device and/or liquid line may be required.
- (6) Evacuate the system and liquid charge with RS-45. Begin with approximately 90% of the R-22 charge and add as needed to reach desired evaporator superheat or condenser sub cooling. If the system is fitted with a refrigerant sight-glass and the sight-glass is not indicating a full charge additional RS-45 may be added. Avoid overcharging the system. Depending on the system very small bubbles in the sight-glass may be normal with refrigerant blends
- (7) Start the system and check baseline data, adjust the expansion device if required. All pressure controls should be adjusted to match the pressure temperature relationship of RS-45 as needed.
- (8) On larger systems with oil sight-glasses, monitor the oil level and add more oil if required to maintain the correct level in the compressor. If the oil level does not stabilize some of the oil can be removed from the system and replaced with POE oil. Up to 25% of the system oil can be replaced with POE. Starting with an initial 10% and followed by increments of 5% until the oil level stabilizes.
- (9) Check system thoroughly for leaks.
- (10) Clearly label system as charged with RS-45 and type of oil used.

**Note:** 1. Systems with inherent poor oil return, such as systems with unusually long suction lines and/or low temperature systems may have improved oil return capabilities with Alylbenzene or polyolester oils.  
2. Flooded chillers with evaporator oil recovery systems may require POE oil for proper operation. Contact RSI for more information and recommendations.



## RS SERIES R-22 REPLACEMENTS

R#	Trade Name	Description	Oil Type	Temp Range	Applications	Expansion Devices	Retrofit Procedures	Efficiency Changes	Service Aspects
R-424A	RS-44	R-22 Drop-in NO OIL CHANGE	MO,AB, POE	Air Conditioning (+20F to +50F)	Rooftops,splits>window, heat pumps, etc. Plate type & tube in tube non-flooded chillers	TXV, Cap tube, fixed orifice	Collect baseline data Recover R-22 Evacuate to 500 microns Liquid charge to 90% then add as needed Adjust superheat on TXV Adjust pressure controls Check SST and SCT	Performance similar to R-22 Energy useage lower	Expect Suction Pressures to be 10-15 psig lower. Expect Discharge Pressures to be 20 to 25 psig lower.
				MT Refrigeration (+20F to +50F)	Walk-in coolers, beverage coolers, display cases, etc.	TXV, Cap tube, fixed orifice	Same as above	Same as above	
R-434A	RS-45	R-22 Drop-in NO OIL CHANGE	MO,AB, POE	A/C & Process Chillers (-40F to +50F)	Flooded & Non-flooded	TXV	Collect baseline data Recover R-22 Evacuate to 500 microns Liquid charge to 90% then add as needed. Check & adjust superheat Larger TXV may be needed Adjust pressure controls Check SST and SCT	Performance and energy useage Similar to R-22	Expect Suction Pressures to be 5-10 psig higher. Expect Discharge Pressures to be 20 to 30 psig higher.
				MT & LT Refrigeration (-40F to +50F)	Coolers, freezers, Display cases, Ice machines,etc	TXV	Same as above	Same as above	Same as above

Note: Saturated suction temperature and saturated condensing temperature should be similar after conversion.

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# GENERAL REPLACEMENT GUIDE



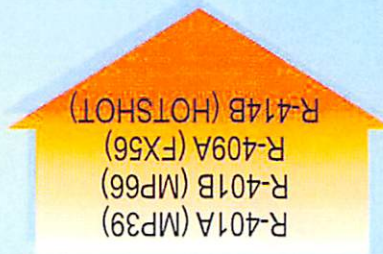
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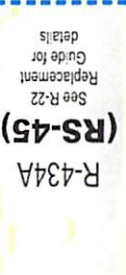
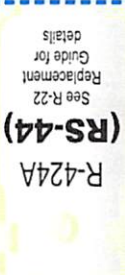
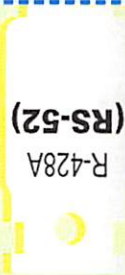
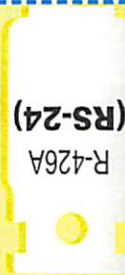


**HCFC**

JANUARY 2010



**HFC**



## R-22 REPLACEMENT GUIDE

### R-22 AIR CONDITIONING

#### CHILLERS

#### AIR SYSTEMS

Shell & Tube  
(Flooded and  
Non-flooded)

R-434A (RS-45)

R-424A (RS-44)

R-424A (RS-44)

R-424A (RS-44)

Tube & Tube

Plate Type

All Types

### R-22 REFRIGERATION



R-434A (RS-45)



R-424A (RS-44) Saturated Suction Temperature

- 1) ASHRAE Safety Rating A1 (non-flammable)
- 2) Zero ODP
- 3) No oil change required
- 4) No retrofit needed for most applications
- 5) Low glide, near azeotropic

RS-45 • RS-52

RS-24 • RS-44



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## RS-24

### PRESSURE / TEMPERATURE COMPARISON

Values shown: "HG and PSIG" \*Denotes "HG"

TEMPERATURE		RS-24 Liquid Bubble Pt.	RS-24 Vapor Dew Pt.	R-12
C	F	PSIG	PSIG	PSIG
-40	-40	12.6*	16.3*	11.1*
-38	-36.4	10.8*	14.8*	9.3*
-36	-32.8	8.9*	13.1*	7.3*
-34	-29.2	6.7*	11.3*	5.1*
-32	-25.6	4.4*	9.3*	2.8*
-30	-22	1.9*	7.2*	0.4*
-28	-18.4	0.4	4.9*	1.1
-26	-14.8	1.8	2.4*	2.5
-24	-11.2	3.3	0.2	3.9
-22	-7.6	4.9	1.5	5.5
-20	-4	6.6	3.0	7.2
-18	0.4	8.5	4.7	9.3
-16	3.2	10.5	6.5	10.8
-14	6.8	12.6	8.3	12.8
-12	10.4	14.8	10.3	14.9
-10	14.0	17.2	12.5	17.1
-8	17.6	19.7	14.7	19.4
-6	21.2	22.4	17.2	21.9
-4	24.8	25.2	19.7	24.5
-2	28.4	28.2	22.4	27.2
0	32.0	31.4	25.3	30.1
2	35.6	34.7	28.3	33.1
4	39.2	38.2	31.5	36.3
6	42.8	41.9	34.9	39.6
8	46.4	45.9	38.5	43.1
10	50.0	49.9	42.3	46.7
12	53.6	54.3	46.3	50.5
14	57.2	58.8	50.5	54.5
16	60.8	63.5	54.9	58.7
18	64.4	68.5	59.5	63.1
20	68.0	73.7	64.4	67.6
22	71.6	79.2	69.5	72.3
24	75.2	84.9	74.9	77.3
26	78.8	90.9	80.5	82.4
28	82.4	97.1	86.4	87.7
30	86.0	103.6	92.5	93.3
32	89.6	110.4	98.9	99.1
34	93.2	117.4	105.6	105.1
36	96.8	124.8	112.6	111.3
38	100.4	132.8	119.9	117.8
40	104.0	140.5	127.6	124.5
42	107.6	148.7	135.5	131.5
44	111.2	157.4	143.8	138.7
46	114.8	166.3	152.4	146.2
48	118.4	175.6	161.3	154.0
50	122.0	185.3	170.7	162.0
52	125.6	195.3	180.4	170.3
54	129.2	205.7	190.4	178.9
56	132.8	216.4	200.9	187.8
58	136.4	227.5	211.8	197.0
60	140.0	239.1	223.0	206.5

## RS-44

### PRESSURE / TEMPERATURE COMPARISON

Values shown: "HG and PSIG" \*Denotes "HG"

TEMPERATURE		RS-44 Liquid Bubble Pt.	RS-44 Vapor Dew Pt.	R-22
C	F	PSIG	PSIG	PSIG
-50	-58.0	12.7*	18.7*	11.4*
-48	-54.4	10.9*	17.3*	9.4*
-46	-50.8	8.9*	15.9*	7.2*
-44	-47.2	6.7*	14.3*	4.8*
-42	-43.6	4.3*	12.5*	2.2*
-40	-40.0	1.8*	10.5*	0.3
-38	-36.4	0.5	8.4*	1.6
-36	-32.8	1.9	6.1*	3.4
-34	-29.2	3.5	3.6*	5.1
-32	-25.6	5.2	0.9*	6.9
-30	-22.0	6.9	0.9	8.9
-28	-18.4	8.8	2.5	11.0
-26	-14.8	10.9	4.2	13.2
-24	-11.2	13.1	5.9	15.6
-22	-7.6	15.4	7.8	18.1
-20	-4	17.8	9.8	20.8
-18	0.4	20.4	12.0	24.3
-16	3.2	23.2	14.3	26.7
-14	6.8	26.2	16.8	29.9
-12	10.4	29.2	19.4	33.3
-10	14.0	32.5	22.2	36.8
-8	17.6	35.9	25.1	40.6
-6	21.2	39.6	28.3	44.6
-4	24.8	43.5	31.6	48.7
-2	28.4	47.5	35.1	53.1
0	32.0	51.8	38.8	57.7
2	35.6	56.3	42.7	62.5
4	39.2	60.9	46.9	67.6
6	42.8	65.8	51.2	72.9
8	46.4	71.0	55.8	78.4
10	50.0	76.4	60.6	84.2
12	53.6	82.1	65.8	90.3
14	57.2	88.0	71.1	96.6
16	60.8	94.2	76.7	103.3
18	64.4	100.6	82.5	110.2
20	68.0	107.4	88.7	117.4
22	71.6	114.4	95.2	124.9
24	75.2	121.7	101.9	132.7
26	78.8	129.4	109.0	140.8
28	82.4	137.3	116.3	149.3
30	86.0	145.6	124.0	158.1
32	89.6	154.2	132.1	167.2
34	93.2	163.1	140.4	176.7
36	96.8	172.3	149.2	186.6
38	100.4	182.0	158.3	196.8
40	104.0	192.0	167.8	207.4
42	107.6	202.3	177.7	218.4
44	111.2	213.1	187.9	229.8
46	114.8	224.2	198.6	241.7
48	118.4	235.7	209.7	253.9
50	122.0	247.7	221.3	266.6
52	125.6	260.0	233.3	279.7
54	129.2	272.8	245.7	293.3
56	132.8	286.0	258.7	307.4
58	136.4	299.7	272.2	321.9
60	140.0	313.8	286.1	337.0

## RS-45

### PRESSURE / TEMPERATURE COMPARISON

Values shown: "HG and PSIG" \*Denotes "HG"

TEMPERATURE		RS-45 Liquid Bubble Pt.	RS-45 Vapor Dew Pt.	R-22
C	F	PSIG	PSIG	PSIG
-50	-58.0	6.9*	10.1*	11.4*
-48	-54.4	4.5*	7.9*	9.4*
-46	-50.8	1.9*	5.6*	7.2*
-44	-47.2	0.45	3.0*	4.8*
-42	-43.6	1.9	0.2*	2.2*
-40	-40.0	3.5	1.4	0.3
-38	-36.4	5.2	3.0	1.8
-36	-32.8	7.1	4.7	3.4
-34	-29.2	9.1	6.4	5.1
-32	-25.6	11.2	8.4	6.9
-30	-22.0	13.4	10.5	8.9
-28	-18.4	15.8	12.7	11.0
-26	-14.8	18.3	15.1	13.2
-24	-11.2	21.1	17.6	15.6
-22	-7.6	23.9	20.3	18.1
-20	-4	27.0	23.2	20.8
-18	0.4	30.2	26.3	24.3
-16	3.2	33.6	29.5	26.7
-14	6.8	37.2	32.9	29.9
-12	10.4	41.0	36.5	33.3
-10	14.0	45.1	40.3	36.8
-8	17.6	49.3	44.4	40.6
-6	21.2	53.7	48.6	44.6
-4	24.8	58.4	53.1	48.7
-2	28.4	63.3	57.8	53.1
0	32.0	68.5	62.8	57.7
2	35.6	73.9	68.0	62.5
4	39.2	79.6	73.5	67.6
6	42.8	85.6	79.2	72.9
8	46.4	91.8	85.2	78.4
10	50.0	98.3	91.5	84.2
12	53.6	105.1	98.1	90.3
14	57.2	112.2	105.0	96.6
16	60.8	119.6	112.2	103.3
18	64.4	127.3	119.7	110.2
20	68.0	135.4	127.5	117.4
22	71.6	143.8	135.7	124.9
24	75.2	152.5	144.3	132.7
26	78.8	161.6	153.1	140.8
28	82.4	171.0	162.4	149.3
30	86.0	180.9	172.0	158.1
32	89.6	191.0	182.0	167.2
34	93.2	201.6	192.5	176.7
36	96.8	212.6	203.3	186.6
38	100.4	224.0	214.5	196.8
40	104.0	235.8	226.2	207.4
42	107.6	248.1	238.4	218.4
44	111.2	260.8	251.0	229.8
46	114.8	274.0	264.0	241.7
48	118.4	287.6	277.6	253.9
50	122.0	301.8	291.6	266.6
52	125.6	316.4	306.2	279.7
54	129.2	331.5	321.4	293.3
56	132.8	347.7	337.1	307.4
58	136.4	363.3	353.3	321.9
60	140.0	380.1	370.2	337.0

## RS-52

### PRESSURE / TEMPERATURE COMPARISON

Values shown: "HG and PSIG" \*Denotes "HG"

TEMPERATURE		RS-52 Liquid Bubble Pt.	RS-52 Vapor Dew Pt.	R-502
C	F	PSIG	PSIG	PSIG
-50	-58.0	2.5*	3.8*	6.0*
-48	-54.4	0	1.2*	3.0*
-46	-50.8	1.5	0.8	0
-44	-47.2	3.2	2.4	0.6
-42	-43.6	4.9	4.0	2.5
-40	-40.0	6.7	5.8	4.1
-38	-36.4	8.7	7.7	6.0
-36	-32.8	10.8	9.7	7.8
-34	-29.2	13.0	11.9	9.8
-32	-25.6	15.4	14.3	12.0
-30	-22.0	17.9	16.7	14.0
-28	-18.4	20.7	19.4	16.5
-26	-14.8	23.6	22.2	19.1
-24	-11.2	26.6	25.2	21.9
-22	-7.6	29.8	28.4	24.8
-20	-4	33.3	31.7	27.5
-18	0.4	36.9	35.3	31.4
-16	3.2	40.8	39.0	34.7
-14	6.8	44.8	43.0	37.7
-12	10.4	49.1	47.2	41.4
-10	14.0	53.6	51.6	45.4
-8	17.6	58.3	56.3	49.6
-6	21.2	63.3	61.2	53.9
-4	24.8	68.5	66.3	58.5
-2	28.4	74.0	71.7	63.4
0	32.0	79.8	77.4	68.4
2	35.6	85.8	83.3	73.7
4	39.2	92.1	89.5	79.3
6	42.8	98.8	96.0	85.1
8	46.4	105.7	102.9	91.1
10	50.0	112.9	110.0	97.4
12	53.6	120.4	117.4	104.0
14	57.2	128.3	125.2	110.9
16	60.8	136.5	133.3	118.0
18	64.4	145.0	141.8	125.4
20	68.0	153.9	150.8	133.2
22	71.6	163.2	159.7	141.3
24	75.2	172.8	169.3	149.7
26	78.8	182.9	179.2	158.3
28	82.4	193.3	189.6	167.2
30	86.0	204.1	200.0	176.6
32	89.6	215.4	211.5	186.4
34	93.2	227.0	223.0	196.4
36	96.8	239.1	235.1	206.7
38	100.4	251.7	247.6	217.4
40	104.0	264.7	260.6	228.5
42	107.6	278.3	274.0	240.0
44	111.2	292.2	288.0	252.0
46	114.8	306.7	302.5	264.3
48	118.4	321.8	317.5	276.9
50	122.0	337.4	333.0	290.1
52	125.6	353.5	349.2	303.7
54	129.2	370.1	365.9	317.7
56	132.8	387.4	383.3	332.2
58	136.4	405.4	401.3	347.1
60	140.0	424.0	420.0	362.6





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## “RS” SERIES OF DROP-IN ZERO ODP REFRIGERANTS

Application	Existing System Type		
	R-12	R-22	R-502
Air Conditioning			
Automotive	RS-24	RS-44	
Chillers Recip/Screw/DX	RS-24	RS-44, RS-45	
Flooded systems		RS-45	
Commercial	RS-24	RS-44	
Dehumidifiers	RS-24	RS-44	
Heat Pump		RS-44	
Industrial process cooling	RS-24	RS-44, RS-45	
Split System		RS-44	
Spot Coolers		RS-44	
Roof Top		RS-44	
Window/Wall		RS-44	

Application	Existing System Type		
	R-12	R-22	R-502
Refrigeration			
Beverage Coolers	RS-24	RS-44	
Cold Storage	RS-24	RS-45	RS-52
Display Cases	RS-24	RS-45	RS-52
Domestic Refrigerators/Freezers	RS-24		
Frozen Drink Machines	RS-24	RS-44, RS-45	RS-52
Ice Cream Dipping Cabinets	RS-24		RS-52
Ice Machines	RS-24	RS-44, RS-45	RS-52
Ice Rinks	RS-24	RS-45	RS-52
Mobile Refrigeration	RS-24	RS-44	RS-52
Flooded systems		RS-45	RS-52
Process Cooling	RS-24	RS-44, RS-45	RS-52
Water Coolers	RS-24	RS-44	
Walk-In Coolers/Freezers	RS-24	RS-44	RS-52

All of the “RS” series of refrigerants are *drop-in* refrigerants and can be used both with traditional lubricants (eg mineral and alkyl benzene oils) and the new synthetic lubricants such as polyol esters. They provide a simple & low cost method of switching away from CFCs & HCFCs including the interim ozone depleting blends. Brief summary of these novel refrigerants:

### RS-24 (R426A)

Particularly effective as a replacement for R12 in mobile air conditioning, but can also be used across the range of applications where R12 was commonly found.

### RS-44 (R424A)

Suitable to replace R22 in air conditioning applications including heat pumps & water coolers, & can be used in systems with a capillary as well as an expansion device.

### RS-45 (R434A)

Replacement for R22 in new equipment for OEMs & for service work across the range of applications & temperatures including air conditioning & low temperature refrigeration. RS-45 is a capacity match for R22 & particularly applicable in larger systems.

### RS-52 (R428A)

RS-52 is similar to R507 in its performance, has similar pressures & is near azeotropic with a glide of <1°C. RS-52 has been designed as a replacement for R502 and the interim ozone depleting blends (eg R402A, R408A, R403B etc), but is also an excellent replacement for R22 at low temperatures where the system is designed to withstand R502 pressures & condenser capacity. In systems where oil return could be an area of potential concern, eg long & complex pipelines, it may be necessary to replace some of the oil charge with a POE lubricant.







# RS-45 (R434A)

## THE ANSWER TO REPLACING R22 IN LARGER SYSTEMS FOR OEMs

R134a, R407C & R410A have been presented as the main replacements for R22 in air conditioning and refrigeration applications. These refrigerants have different physical properties compared to R22:

**R134a:** has a considerably lower capacity than R22 (-33%) which means bigger & more expensive equipment is required.

**R407C:** has a wide glide of over 5°C which can cause operating problems including icing up & fractionation. Field leaks may require a total recharge.

**R410A:** operating pressures more than 50% higher than R22 which requires a complete re-design of equipment & restricts its use to smaller systems. R410A can only be used in larger systems by adding more compressors which substantially increases system cost.

**RS-45 (R434a)** has been formulated to avoid these problems and, in particular, to replace R22 in larger systems with a competitive total cost of equipment while matching the main thermodynamic properties of R22. RS-45 is unique in being able to mirror R22 at both high & low temperatures:

Table 1 – Comparative properties: Air Conditioning

+7 deg C evap +45 deg C cond		R22	R134a	RS-45 R434A	R410A	R407C
Discharge pressure	Bar	17.91	12.05	19.81	28.19	19.3
Discharge temp	Deg C	111	89	81	104	97
Capacity	kJ/m3	3062	2049	3115	4467	3189
Capacity % R22			67	102	146	104
COP	System	2.49	2.57	2.44	2.36	2.48
Compression ratio		3.02	3.39	3.02	2.98	3.20
Glide	Deg C	0	0	1.5	0.1	5



Table 2 – Comparative properties: Refrigeration

-35 deg C evap +35 deg C cond		R22	R134a	RS-45 R434A	R410A	R407C
Discharge pressure	Bar	14.07	9.25	15.55	22.15	15.02
Discharge temp	Deg C	197	140	120	180	160
Capacity	kJ/m3	619	345	632	946	597
Capacity % R22			56	102	153	96
COP	System	1.13	1.19	1.13	1.08	1.14
Compression ratio		11.4	15.1	11.4	10.8	13
Glide	Deg C	0	0	1.5	0.1	5

## Why use RS-45 (R434A)?

- Particularly suited to larger systems where R410A is not a practical option, R407C has a high glide, & R134a requires much larger equipment.
- A single replacement for R22 mirroring its performance across the application range of air conditioning & refrigeration.
- Near azeotropic with glide 70% lower than R407C
- Avoids costly re-tooling to high pressure R410A
- Same compressors for RS-45 as R22. No need to “bank” compressors like R410A to increase system capacity. As a result, RS-45 is a considerably lower cost option.
- Same compression ratio as R22
- Similar Coefficient of Performance to R22 & 3% higher than R410A
- Similar pressures to R22 & considerably lower pressures than R410A
- Compatible with traditional as well as synthetic lubricants.

## Lubricants

RS-45 (R434A) is suitable for use with mineral, alkylbenzene & polyol ester lubricants. R134a, R407C & R410A should not be used with MO & AB oils.

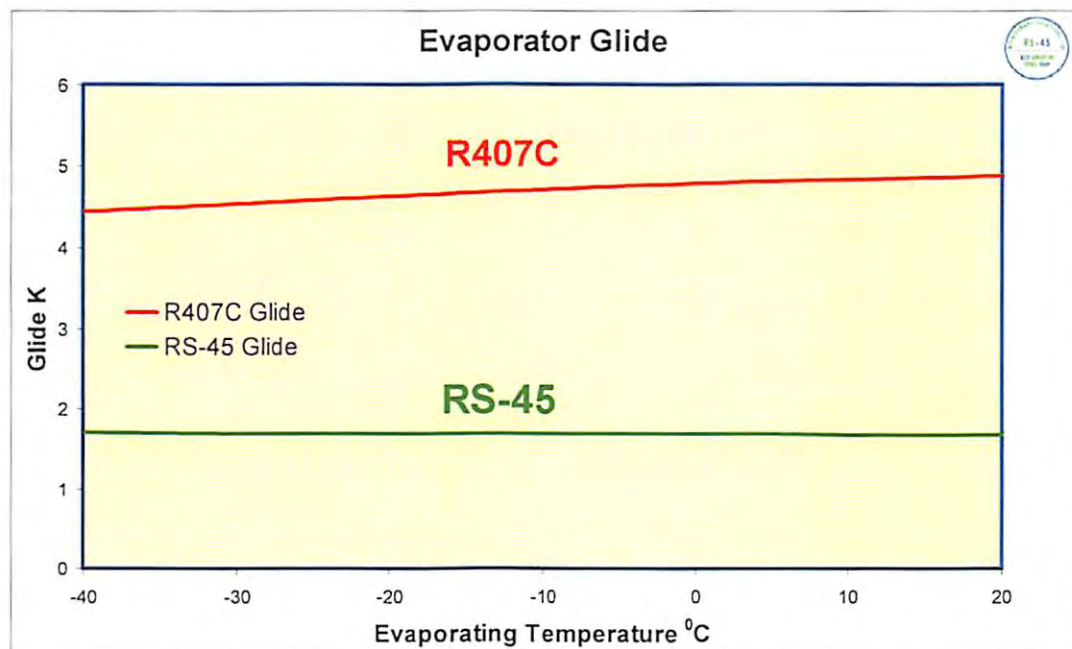
## Compressors

R22 compressors can be used with RS-45 (R434A). The higher pressures of R410A restrict its use to smaller systems owing to the lack of availability of large capacity compressors rated for R410A. Larger systems using R410A require adding extra compressors at significant cost.

## Glide

RS-45 (R434A) has a glide of 1.5°C which compares to R407C with a glide exceeding 5°C. Consequently, RS-45 has a wider application range & avoids the problems of icing up, fractionation & reduced performance. R407C should not be used in shell & tube evaporators where RS-45 (R434A) is a suitable option to replace R22.

Table 3: RS-45 (R434A) - Glide





## Coefficient of Performance

RS-45 (R434A) has a COP which is 3% higher than R410A & similar to R22. Efficiencies can be optimized by installing a heat exchanger in the suction line which is often readily accommodated in bigger systems.

## Capacity

RS-45 (R434A) has a cooling capacity which matches R22 at both high (+7<sup>0</sup>C evap) & low temperatures (-35<sup>0</sup>C evap). RS-45 is, therefore, a single replacement for R22 across the temperature range.



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*EXCLUSIVE USA MANUFACTURER AND DISTRIBUTOR  
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## **FOLLOWING ARE CASE STUDIES**

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# FLOODED CHILLER CONVERSION FROM R22 TO RS-45 (R434A) (Houston, TX Chemical Plant)



ComStar International Inc. thanks the HVAC service company, STAR Service Inc. of Houston, TX/New Orleans, LA, specifically Brian Keating (Project Manager), who performed this conversion with the assistance of Advanced Refrigerant Technologies, LLC of League, TX. The process involved converting an R22 Flooded System to the unique capacity match of RS-45 (R434A).

## SPECIFICATIONS OF R22 FLOODED SYSTEM TO BE CONVERTED

- 3 carrier 5H80 compresses driven by 75HP motors in direct drive, tandem configuration.
- System utilizes independent discharge oil separators.
- System shares common discharge and suction with check valves on the discharge line.
- Oil system utilizes a typical oil skimmer line configuration, skimmed off of the evaporator at 60% desired liquid flooded level.
- Utilizes a suction surge drum to promote liquid free suction gas.
- Refrigerant/oil mixture is delivered to a batch oil pot, is heated to 120°F. Oil is then pressurized by discharge oil separator gas and superheated refrigerant pressure.
- R22 refrigerant change of approximately 3,000 lbs.
- Alkyl benzene 300 oil is being utilized.



## COMPARATIVE RESULTS & COMMENTS

Table showing results of R22 prior to conversion and RS-45 post conversion.

R22 to RS-45 (R-434a) Comparison

	R22	RS-45 (R-434a)
Suction pressure	50 psig	50 psig
Suction superheat	> 5°F	11°F
Discharge	189 psig	175 psig
Discharge superheat	40°F	45°F
Evap Refrigerant temp	26°F	24.8°F
Entering process temp	57°F	48°F
Leaving process temp	47°F	38°F
Evaporation approach	21°F	12.8°F
Oil pressure compressor #1	22 psig dp	35 psig dp
Oil pressure compressor #2	35 psig dp	45 psig dp
Oil pressure compressor #3	N/A	50 psig dp
Oil type	300 alkyl benzene	300 alkyl benzene

## PREPARATION OF FLOODED R-22 SYSTEM

- Removed approximately 3,000 lbs. of R22 refrigerant and alkyl benzene oil.
- Serviced two of three compressors and changed out several critical system components.
- Performed leak checks.
- Performed vacuum/dehydration process, pulled system to depth of 2mm HG until a depth of 1.5mm HG was achieved.
- Holding period of six hours at a minimal rise of 100 microns.
- Charged system with 2000 lbs. of RS-45.

## STAR SERVICE'S CONCLUSIONS

**Initial start-up:** At the initial startup after conversion, the system was not exposed to significant load conditions. A steam heat exchanger was utilized to simulate minimal heat load conditions. Each compressor was started and allowed to carry the load independently. All compressors performed load demand tasking with exceptional performance operation. Each test resulted in a low discharge pressure of 160 PSI. Suction pressure was easily achievable at 50 PSI and oil pressure was ranging from 45 lbs. to 65 lbs. DP. At that time, compressors were run under low load conditions.

**Day 3 of testing:** Load requirement demands were increased to normal operating conditions of system requirement. Upon exposure to additional heat load requirements, the increased amount of suspended vapor dropped the liquid receiver level to below desired level. An additional 500 lbs. of RS-45 was added to meet the demand requirements of the normal operating conditions (heat load demand). Due to the low ambient conditions, the system still operated with relatively low discharge pressure of 175 PSI. Suction pressure was still easily achievable at 50 PSI and oil pressure DP was achievable. The approach on the evaporator dropped to 10°F (from 15) due to a lack of excessive oil in the evaporator. Furthermore, it appears that the retrofit should be considered easily achievable and the outcome should receive satisfactory results. Also the close pressure temperature relationship characteristics would not require substantial PLC control modifications or PSV replacement.



# BENEFITS OF RS-45 (R434A) OVER OTHER ALTERNATIVES:



SPEED	PERFORMANCE	LOW INVESTMENT	SUSTAINABLE
-------	-------------	----------------	-------------

As the working pressures of RS-45 (R434A) are lower than 24 bar, there was no need to change the safety valves and other parts rated to 24 bar (348 PSI) which would have been necessary with a conversion to R404A, R507, R422A or R428A.

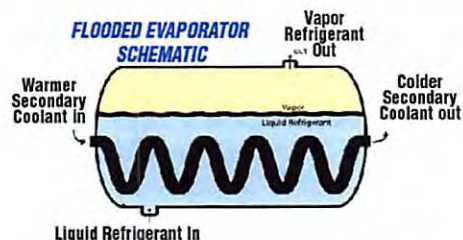
Since RS-45 (R434A) is compatible with all refrigeration oils, including mineral oils, installations using this lubricant do not need to move to a POE, which would have been necessary with R404A, R507, R407C or R427A, thereby reducing the conversion time, cost of oil, emergence of new leaks and the constraints imposed by the use of very hygroscopic lubricants.

RS-45 (R434A) low temperature glide of 3°F enables the system to be directly charged with RS-45. From a technical standpoint, there is no need to remove the remaining refrigerant because no fractionation of the mixture would occur as would happen with R404A and R507. However, good practice protocol and EPA guidelines call for refrigerants not to be mixed.

RS-45 (R434A) achieves good condensation and it is therefore unnecessary to change the condensers or make any changes in this regard as would be the case with R404A and R507.

Owners can continue to use an A1 safety classification product, thus avoiding toxic or flammable chemicals like ammonia and hydrocarbons, respectively, which, amongst other things, also requires a major overhaul of facilities.

RS-45 (R434A) does not involve any significant loss of cooling power compared to R22 in contrast to what would happen with R422D, R417A, R407C and R427A.



Note 1: Use in liquid overfeed, flooded, recirc and DX systems.  
 Note 2: The system will not be harmed if RS45 is inadvertently mixed in with existing R22.  
 Note 3: Since RS45 has 40% greater mass flow than R22, the float expansion device will need to accommodate 40% greater mass flow.



Comparison of glide for common R22 alternatives at the same conditions. Flooded systems require ultra low glide refrigerants.

For more info visit [www.comstarproducts.com](http://www.comstarproducts.com) or call 1-800-328-0142



# Ice Rinks . . .

The *Only* low cost replacement for R22 is RS45!

Made in the U.S. and proven in Europe  
for over 12 years

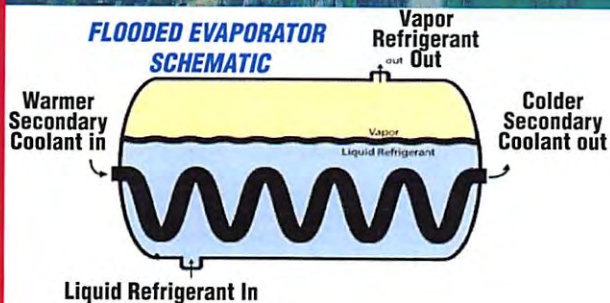


- ✓ TRUE "drop-in" replacement for R22
- ✓ LOW glide equals performance
- ✓ BLENDS in seamlessly with R22 (See Note 2)
- ✓ OPERATES with all types of OILS including MINERAL OIL
- ✓ REQUIRES NO system changes

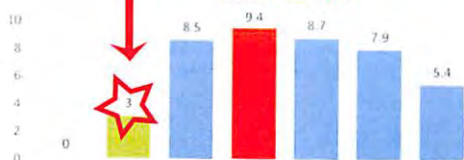
**TRUE DROP-IN REPLACEMENT FOR R-22.  
NO OIL OR SYSTEM CHANGES REQUIRED.**



Made in the USA



## RS-45 LOW GLIDE PERFORMANCE COMPARISON



Comparison of glide for common R22 alternatives at the same conditions. Flooded systems require ultra low glide refrigerants.



R22 to  
RS-45  
Conversion  
Data

Note 1: Use in liquid overfeed, flooded, recirc and DX systems.  
Note 2: The system will not be harmed if RS45 is inadvertently mixed in with existing R22.  
Note 3: Since RS45 has 40% greater mass flow than R22, the float expansion device will need to accommodate 40% greater mass flow.



for more info visit [www.comstarproducts.com](http://www.comstarproducts.com) or call 1-800-328-0142





## C A S E S T U D Y

# ComStar Conversion from R22 to RS-45 Refrigerants for a Direct Liquid Overfeed Ice Rink System



ComStar International Inc., the world's most comprehensive manufacturer of environmentally safe, industrial strength chemical products, successfully introduced a turnkey system for ice rink managers to comply with the government-mandated phase-out of R22 refrigerant.

This case study details a recent ice rink project in Michigan and shows how easy the transition can be. Brownstown Sports Center is a 40-year-old sports complex with two full size ice sheets. The rink had a direct liquid overfeed refrigeration system with approximately 11,000 pounds of R22 refrigerant operating with mineral oil.



### SPECIFICATIONS OF CONVERTED R22 FLOODED SYSTEM

- Direct liquid overfeed refrigeration system
- R22 refrigerant charge of approximately 11,000 lbs
- Two reciprocating compressors; York GI-12 and an Emerson Vilter 450 XL
- Coalescing oil separator with line to an oil still on low side with lines from still to the two compressors
- System operation on mineral oil (no change out required)
- System has a manual expansion valve

Since the United States Environmental Protection Agency declared that new production and import of most R22 will cease by 2020, conventional refrigerant costs have risen and also left ice rink managers facing the prospect of depleted supplies.

ComStar, a 47-year-old U.S. company, manufactures the only R22 replacement refrigerant for use in flooded, R22 liquid overfeed ice rink







BROWNSTOWN, MICHIGAN

systems without changing components or oil. ComStar's RS-45 (R434a) refrigerant is a true drop-in replacement for R22 and blends with any remaining R22, with low glide for high performance applications.

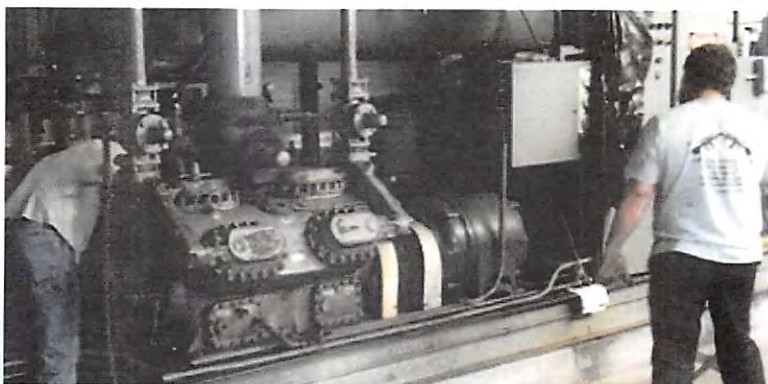
"We're proud to offer an affordable solution to ice rink managers who are stuck in a tough situation. Our RS-45 refrigerant has all the qualities to make the conversion seamless," said Steve Mella, CEO of ComStar.

Ron Zimmers, VP of Operations, said, "I did a fair amount of research and concluded the easiest and least expensive fix was to change out the R22 to ComStar's RS-45 (R434a) drop-in replacement refrigerant. I breathed a sigh of relief knowing I wouldn't be caught without any R22 options down the road."

ComStar supplied the new RS-45 along with empty cylinders for the R22 that was removed from the system and subsequently purchased by ComStar. Serv-Ice

Refrigeration of Northville, Michigan evacuated the R22 and recharged the system with RS-45 for the two rinks over a four-day period in August. The cost of the RS-45 was offset by the R22 buyback, resulting in a small net cost to Brownstown. There was no maintenance performed on the system before or during the replacement of refrigerant.

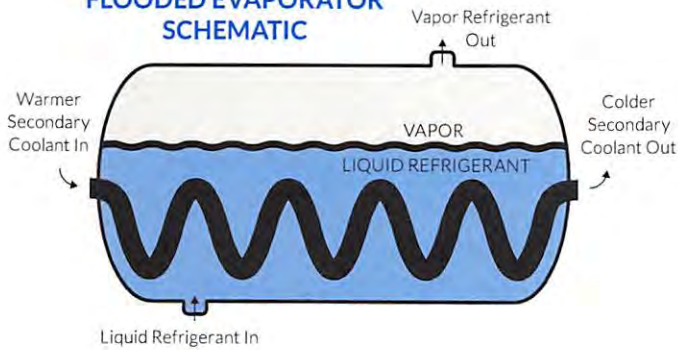
Zimmers monitored the sequence of events and said, "We charged the first ice sheet system with approximately 5,000 pounds of RS-45 and the ice was good to go the next morning. The results were much better than I imagined."



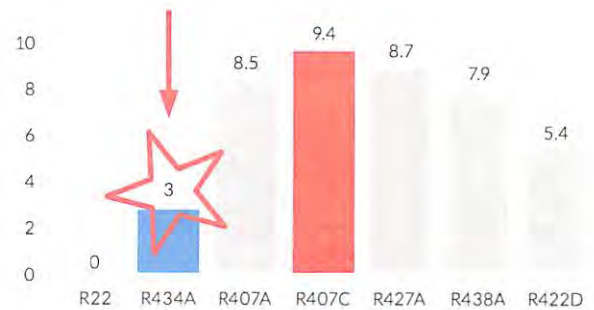


# C A S E S T U D Y

## FLOODED EVAPORATOR SCHEMATIC



## RS45 LOW GLIDE PERFORMANCE COMPARISON



Comparison of glide for common R22 alternatives at the same conditions. Flooded systems require ultra low glide refrigerants.

- Note 1: Use in liquid overfeed, flooded, recirc and DX systems.  
 Note 2: The system will not be harmed if RS45 is inadvertently mixed in with existing R22.  
 Note 3: Since RS45 has greater mass flow than R22, the expansion device will need to accommodate greater mass flow, equal to R404.

Remarkably, the second ice sheet conversion began with no ice, just concrete. After observing the performance of the first sheet for two days, the crew charged the second rink with RS-45 in the afternoon and flooded the rink with water during the night. The next morning the ice was solid, ready to be painted and then re-flooded. Hockey players were skating on it the next day — an amazing 36-hour turn around.

"I've never seen ice freeze that fast. The system actually runs a lot more efficient and smoother now," Zimmers said.

Mella added, "The Brownstown conversion to RS-45 proves, without a doubt, that a sheet of ice can be changed out and operating in 24 hours or less. We're excited to make this happen for rinks all around the country."

## PREPARATION OF FLOODED R22 SYSTEM

- Took baseline readings operating with R22.
- Removed approximately 10,000 lbs. of R22 refrigerant from both ice sheets.
- Checked compressors.
- Performed leak checks.
- Performed vacuum/dehydration process, pulled system to depth of 2mm HG until a depth of 1.5mm HG was achieved.
- Holding period of four hours at a minimal rise of 100 microns.
- Charged first ice sheet with 5,000 lbs. of RS-45.
- Observed first sheet ice and system operation for 48 hours.
- Charged second sheet with 5,500 lbs. of RS-45.





## SERV-ICE REFRIGERATION'S CONCLUSIONS

After charging the first ice sheet with RS-45, the system was exposed to normal load conditions upon start up. Daytime ambient temperatures during the 4 days, two ice sheet conversion ranged from a high of 91 to a low of 81. Under normal operation the compressor performed load demand easily. Discharge pressure with RS-45 was lower than R22. Suction pressure was easily achievable and oil pressure was normal. The system was running smooth and efficient.

The second ice sheet was down to concrete at the time we charged it with RS-45. Starting early evening we began flooding the rink with water and started the system with the RS-45. Overnight the ice sheet was re-flooded to the desired depth. When we came in the next morning the ice was hard and ready to be painted. Based on this experience, it appears that the retrofit of a R22 direct system to RS-45 is a great alternative to maintain the existing power plant for many years to come. The change out from R22 to RS-45 was easy, fast and provided good results to everyone's satisfaction.



## COMPARATIVE RESULTS & COMMENTS

Table shows results of R22 prior to conversion and RS-45 post conversion

R22 to RS-45 (R434a) Comparison		
	R22	RS-45 (R434a)
Suction pressure	32 PSIG @ 80° F	40 PSIG @ 90° F
Discharge	210 PSIG @ 80° F	250~60 PSIG @ 90° F
Evap Refrigerant temp	15° F	150° F
Oil pressure compressor #1	80 PSIG	same
Oil pressure compressor #2	80 PSIG	same
Oil type	Mineral	Mineral

**SPEED**

**PERFORMANCE**

**LOW INVESTMENT**

**SUSTAINABILITY**

## BENEFITS OF RS-45 (R434A) OVER OTHER ALTERNATIVES

As the working pressures of RS-45 (R434A) are lower than 24 bar, there was no need to change the safety valves and other parts rated to 24 bar (348 PSI) which would be necessary with a conversion to R507.

Since RS-45 (R434A) is compatible with all refrigeration oils, including mineral oils, installations using this lubricant do not need to move to a POE, which would be necessary with R507, thereby reducing the conversion time, cost of oil, emergence of new leaks and the constraints imposed by the use of very hygroscopic lubricants.

The RS-45 (R434A) low temperature glide of 3°F enables the system to be directly charged with RS45. From a technical standpoint, if all R22 cannot be evacuated from a system, no fractionation of the mixture would occur. However, the EPA guidelines call for refrigerants not to be knowingly mixed.

RS-45 (R434A) achieves good condensation and it is therefore unnecessary to change the condensers or make any changes in this regard as would be the case with R507.

Owners can continue to use an A1 safety classification product, thus avoiding toxic or flammable chemicals like ammonia and hydrocarbons, respectively, which, amongst other things, also requires a major overhaul of facilities.

RS45 (R434A) does not involve any significant loss of cooling power compared to R22.

Unlike R22, there is no phase-out plan for RS-45.





## P R E S S   R E L E A S E

*October 19, 2016 // for immediate release*

MUSKEGON, MI \_ ComStar International Inc, the world's most comprehensive manufacturer of environmentally safe, industrial strength chemical products, has successfully replaced another direct liquid overfeed ice rink refrigeration system.

Lakeshore Sports Centre is a 41-year-old sports complex with two full-size ice sheets cooled by a system with approximately 10,000 pounds of R22 refrigerant operating with mineral oil. Due to a unfortunate leak in one of the ice sheets, Sean Rekeny, the Lakeshore manager, conferred with the rinks' decision-makers and determined they needed a second option to restore function rather than merely add more R22 refrigerant.

Since the United States Environmental Protection Agency declared that new production and import of most R22 will cease by 2020, conventional refrigerant costs have risen and also left ice rink managers facing depleted supplies.

After weighing the options, the Lakeshore team decided to convert over to the RS-45 (R434a) drop-in R22 replacement refrigerant from ComStar. Worries of problems associated with installing a different refrigerant other than R22 proved to be unfounded.

Rekeny said, "Surprisingly, we have no detectable issues with oil return after a week of operating, which was our concern running mineral oil with a HFC blend. In fact, the only modifications we did were adjusting a few liquid valves. Nothing else was needed."

ComStar, a 47-year-old U.S. company, manufactures the only R22 replacement refrigerant for use in flooded, liquid overfeed ice rink systems without changing components or oil. ComStar's RS-45 (R434a) refrigerant is a true drop-in replacement for R22 and blends with any remaining R22, with low glide for high performance applications.

"As a father of two hockey-playing sons, I am very pleased that we at ComStar can offer ice rinks an affordable and sustainable alternative to R22 during the phase-out," said Steve Mella, CEO of ComStar.

The compressor system, built in 1997, has two Vilter 440 reciprocating compressors with 75-horsepower belt-driven electric motors. Initially, a full charge of R22 was 5,000 pounds for each ice sheet. Lakeshore evacuated the R22, transferred it to the other sheet, and recharged the sheet with 4,000 pounds of RS-45.

In similar conversions, ComStar offers buy back the R22 removed from the system, thereby offsetting the ice rinks' cost of buying the RS-45 refrigerant. However, Lakeshore decided to transfer the small amount of R22 pulled from the first ice sheet into the second ice sheet which will continue to operate with R22 until next spring when they will change over the second ice sheet to RS-45.

"At the end of the day, we are very satisfied with the changover and excited for the future," said Rekeny, who deemed the project a great success.





P R E S S   R E L E A S E

## ComStar Introduces Easy Conversions from R22 to RS-45 Refrigerants for Liquid Overfeed Ice Rink Systems

*August 25, 2016 // for immediate release*

COLLEGE POINT, NY \_ ComStar International Inc., the world's most comprehensive manufacturer of environmentally safe, industrial strength chemical products, announces a turnkey system for ice rink managers to comply with the government-mandated phase-out of R22 refrigerant.

Since the United States Environmental Protection Agency declared that new production and import of most R22 will cease by 2020, conventional refrigerant costs have risen and also left ice rink managers facing depleted supplies.

ComStar, a 47-year-old U.S. company, manufactures the only R22 replacement refrigerant for use in flooded, R22 liquid overfeed ice rink systems without changing components or oil. ComStar's RS-45 (R434a) refrigerant is a true drop-in replacement for R22 and blends with any remaining R22, with low glide for high performance applications.

"We're proud to offer an affordable solution to ice rink managers who are stuck in a tough situation. Our RS-45 refrigerant has all the qualities to make the conversion seamless," said Steve Mella, CEO of ComStar.

A recent ice rink project in Michigan showed how easy the transition can be. Brownstown Sports Center is a 40-year-old sports complex with two full size ice sheets. The rink had a direct liquid overfeed refrigeration system with approximately 11,000 lbs of R22 refrigerant operating with mineral oil.

Ron Zimmers, VP of Operations, said, "I did a fair amount of research and concluded the easiest and least expensive fix was to change out the R22 to ComStar's RS-45 (R434a) drop-in replacement refrigerant. I breathed a sigh of relief knowing I wouldn't be caught without any R22 options down the road."

ComStar supplied the new RS-45 along with empty cylinders for the R22 that was removed from the system and subsequently purchased by ComStar. Serv-Ice Refrigeration of Northville, Michigan evacuated the R22 and recharged the system with RS-45 for the two rinks over a four-day period in August. The cost of the RS-45 was offset by the R22 buyback, resulting in a small net cost to Brownstown. There was no maintenance performed on the system before or during the replacement of refrigerant.

Zimmers monitored the sequence of events and said, "We charged the first ice sheet system with approximately 5,000 pounds of RS-45 and the ice was good to go the next morning. The results were much better than I imagined."

Remarkably, the second ice sheet conversion began with no ice, just concrete. After observing the performance of the first sheet for two days, the crew charged the second rink with RS-45 in the afternoon and flooded the rink with water during the night. The next morning the ice was solid, ready to be painted and then re-flooded. Hockey players were skating on it the next day — an amazing 36-hour turn around.

"I've never seen ice freeze that fast. The system actually runs a lot more efficient and smoother now," Zimmers said.

Mella added, "The Brownstown conversion to RS-45 proves, without a doubt, that a sheet of ice can be changed out and operating in 24 hours or less. We're excited to make this happen for rinks all around the country."



**Conversion  
from R22 to  
RS45**



## Direct replacement (Drop-in) From R22 to RS45 with Flooded evaporator system

FRAMACOLD, official distributor of GAS SERVEI in France, would like to thank LABEYRIE, manufacturer of frozen food, from Castelsarrasin, for their agreement to the conversion of their facility. We also want to thank QUERCY REFRIGERATION for their professionalism in the conversion and management of this CO<sub>2</sub> / RS-45 cascade installation, with holding tank and flooded evaporator.

Factory in Castelsarrasin  
230 people

Production of frozen food:

- Desserts and Pastries
- Aperitif Snacks
- and the famous macaroons

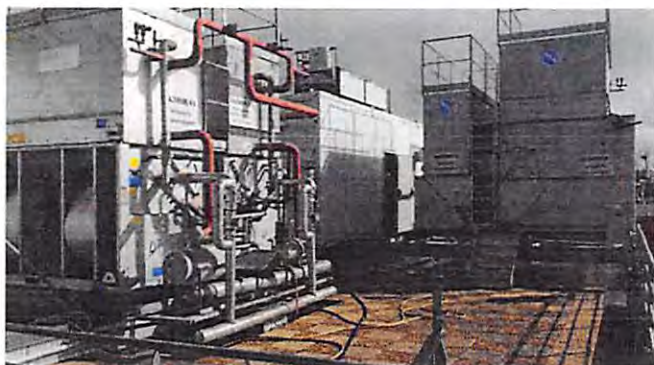


### INSTALLATION

#### Description:

Operates five major freezers in the factory:  
Low-pressure stage in CO<sub>2</sub> with 564kW capacity for temperatures -42°C / -10°C.  
High-pressure stage on R22, to be converted to R434A (RS45), with the following characteristics:

- Central "IMEF" with BP holding tank and pump for flooded evaporator VAHTERUS between CO<sub>2</sub> and RS45
- Cooling capacity: 689kW
- 1 screw compressor SABROE SAB128HF MK2, 110kW
- 1 screw compressor SABROE SAB163HF MK2, 200kW
- BP holding tank
- 1 pump brand Hermetic-Pumpen GmbH
- Original refrigerant R22: 990kg
- Oil: ZERICE S68 (Alkylbenzene)
- Temperature: 35°C / -15°C



HP IMET unit and roof mounted condensers

### PROBLEMS & SOLUTIONS

#### Problems encountered:

Because recycled R22 was banned on 31/12/2014, and the main installation operates in two cascade systems, HP in R22 and BP in CO<sub>2</sub>, a choice had to be made.

The solution should fulfil the following requirements:

- To preserve the process without any loss of capacity.
- To minimise production stoppage time (max. 48h).
- To comply with the legislation.
- Not to penalize the company's profitability.

#### Solutions proposed:

The customer has two solutions:

- To completely change the IMEF High-Pressure installation working on R22, which represents an estimated investment of more than 500,000€.
- To keep the existing installation replacing only the R22 refrigerant with RS45 (R434A).

The second solution is around **10 times less expensive**.

Given the state of the installation, its complex operation with holding tank and flooded evaporator, LABEYRIE has wisely decided to maintain the existing installation and to replace R22 with RS45.



## REPLACEMENT PROCESS OF R22 WITH RS-45 (R434A)

QUERCY REFRIGERATION, represented by Benoît Duparc, having significant experience with this refrigerant in this application, carried out the conversion.

### How did the refrigerant replacement go?

**Benoît Duparc:** after some arrangements on the previous days, the conversion took place on Friday 28<sup>th</sup> of February:

6H: we start reclaiming R22 from the system

9H: once this process was finished, we charged the system with RS45

14H: we started the system, checked tightness, oil return, pressures...

16H: gradual start-up of the CO2 unit and freezers. However, a previous problem, prior to the conversion (malfunction of the compressor's Solenoid valves during heat increase) did not allow completing any meaningful tests.

On Saturday 1<sup>st</sup> of March, we found the cause of the problem and carried out the necessary repairs. Full tests were organised for Monday 3<sup>rd</sup> of March.

### Validation of tests:

**B.D.:** on Monday, at 8:00h, we gradually started up the IMEF HP system on R434A, then the CO2 unit and the freezers. After some minutes, the freezers reached a temperature of -42°C, the tests were validated without any question.



Getting ready for RS45 conversion

## PRODUCTION STARTS...

**Mr. Gilles Dupeyroux (responsible for energy management at the factory):**

On Tuesday, March 4, at 1 am, automatic start of the R434A / CO2 cascade system with five production freezers.

Freezing temperatures were reached in the required time.

### Have you noticed any changes with the RS-45?

**G.D.:** yes, during the tests I realized immediately that the Sabroe compressors' sound level was lower than with R22. Now, after several days working, I have noticed that:

- IMEF HP regulation is optimized.
- The COP has further improved.
- Suction temperature to the Sabroe compressors has gone from -14°C (in R22) to -19°C with RS45.
- Flooded evaporator for CO2 condensation and for RS evaporation has also improved.

## RS45: MANDATORY TRANSITION?

**Mr. Franck Krier, General Manager of Framacold:**

Yes, RS45 (R434A) is the only temporary solution that allows the continuity of industrial installations with flooded evaporators on R22, without any changes and maintaining the same performances.

Europe must find solutions to increase productivity. The use of RS refrigerants is an extraordinary tool for our industry!

RS-45 meets the need to find an alternative to R22. In fact, it was formulated for this purpose. Now, with the new F-GAS regulation forbidding HFC with a GWP higher than 2500, RS-45 becomes a solution, surely temporary until 2020 -2024 in the event of a derogation- and in all cases until 2030 if used as regenerated gas. We are thus preparing for the following stage and we will certainly propose solutions to replace the refrigerants that will be reliable, efficient and complying with the legislations in force.



QUERCY REFRIRATION in action!





# FRAMACOLD

Solutions for increasing your productivity

## KIWI CONTAINERS

### Conversion from R22 to RS45 (R434A) Flooded evaporators with a pumped recirculation system

FRAMACOLD would particularly like to thank QUERCY REFRIGERATION and especially their director **Benoît Duparc** for their professionalism in managing the installation of this thermosyphon with an HFC RS-45 recirculation pump.

#### Installation:

- Cold storage with a recirculation pump dating from 1986
- Refrigerating capacity: 450 kW
- 2 SAMIFI BABCOCK compressors with 37 kW motors
- 3 SAMIFI BABCOCK compressors with 55 kW motors
- 3 m<sup>3</sup> BP recirculation tank
- 3 Hermetic-Pumpen GmbH pumps dating from 1986
- 16 PROFOID flooded evaporators - type ADM779
- Original fluid R22: from 1,500 kg to 3,000 kg
- Oil: ZERICE S 100 (alkylbenzene)
- Liquid line: more than 800 m
- Suction/discharge temperature: +28°C/-13°C

#### What was your client's problem?

Benoît Duparc: My client's concern was to get a number of his kiwi storage containers back into operation quickly to cope with the forecast of a large harvest. He was looking for an efficient and cost-effective solution.

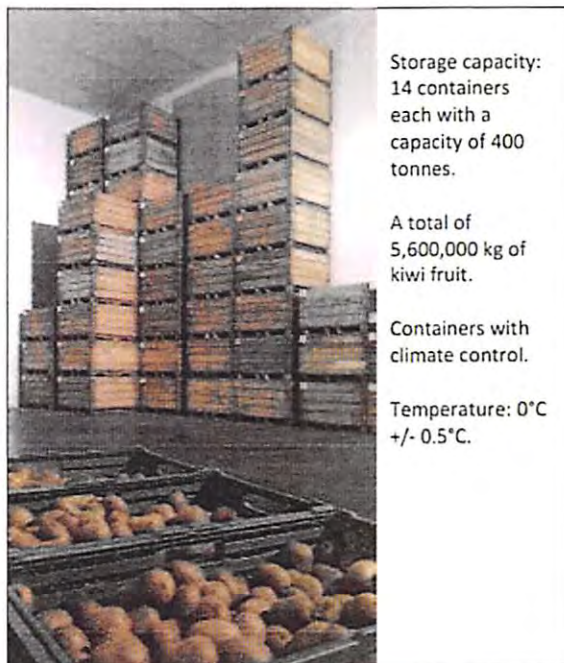
Although the installations themselves are impressive because of their size, our clients cannot allow superfluous costs to be incurred in this tense economic climate.

#### What solution was offered?

BD: After having studied various possibilities for this facility over a number of years, I put forward the most economical solution to my client: simply substituting an HFC fluid miscible in R22, without modifications, for the existing AB oil and without any loss of performance features. RS-45 (R434A) fluid covers all of these prerequisites. This is backed up by my experience over four years working with this fluid. Thus, after extracting the R22, 3,000 kg were introduced into the circuits.



*Benoît Duparc in front of the BP tank and recirculation pump*



Storage capacity:  
14 containers  
each with a  
capacity of 400  
tonnes.

A total of  
5,600,000 kg of  
kiwi fruit.

Containers with  
climate control.

Temperature: 0°C  
+/- 0.5°C.

### Implementing the conversion R22+RS-45

#### What precautions did you take?

BD: In the primary circuit (compressor/BP tank), we monitored the correct discharge of oil to the compressors, the discharge temperatures and, obviously, any leaks. In the secondary circuit (BP tank/pump/flooded evaporators), due to the length of the pipes, the leaks were monitored. Given that there are automatic compensations for the evaporation phase settings, the only thing I did was check that it was working properly.

#### Did any technical problems arise?

BD: To be honest, no, neither in this case nor with any other conversion to RS-45 of this type. It really is the ideal solution:

- Technically, R22 systems, which are often antiquated, are sorted out with this gradual transition.
- At a chemical level, RS-45 behaves very uniformly due to its low level of glide (1.5).

The fact that the mineral oil is retained also helps to protect the joints and I've had no cause to complain of leaks for that reason.



# KIWI CONTAINERS (47)

## Conversion from R22 to RS45 (R434A)

### Feedback

#### What do you think about this solution?

BD: I've been able to test RS-45 as a substitute for R22 over the last four years. I was surprised at first at how simple it was to implement this update and in low temperature systems with direct expansion.

It was my supplier who suggested it, and its use as a simple substitute for R22 paved the way to profits for my clients. On that level, I immediately saw the great advantages of RS-45 fluid.

#### How have you formalized this solution?

BD: As a cold storage professional and a member of SNEFCCA (National Union of Refrigeration Companies, Professional Kitchen Equipment and Air-Conditioning), I am obliged to adhere to environmental legislation.

So, the indelible label on the system (in line with article R. 543-77 of the French environmental code) states:

TYPE OF GAS: R434A (RS45)

TOTAL WEIGHT: 3,000 kg

The installation's log book details all the interventions, the material added, quantities, dates, any sign of leaks, etc.

#### What does your client think of the RS45 solution?

BD: As you know, my clients have complete confidence in my work based on the fact that I offer honest, straightforward, dependable solutions that work and that are, above all, economical.

My client puts a particular emphasis on this last point, given that he was able to get his old containers back into operation quickly and simply and hence increase his seasonal production. All of this was achieved, most importantly, without potentially very high levels of investment such as changing the whole installation (which works perfectly well) for an ammonia-based system.

Other cold storage companies, often much bigger than mine, find it more difficult to put themselves in the position of the user as they have ulterior interests. They don't put forward simple solutions like I do.

Right now, many clients are suffering as they can't invest in new installations before the current ones have been amortized. Environmental legislation is developing more rapidly than the industry and I have to find honest and pragmatic industrial solutions to be able to keep working in this sector.

#### F-GAS: What is the shelf life of RS-45?

The European Council and Parliament is currently working on HFC legislation with a GWP > 2,500. As it stands today, the negotiations have still not finished. Whatever happens, what we do know is that HCFCs, including recycled ones, will be banned from 31/12/2014.

The latest European Council negotiations propose a complete exemption in respect of GWP for fluids that substitute HCFCs up until 2022 or 2030 (if they are recycled). R434A (RS45) would fall directly into this category.

<http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A7-2013-0240+0+DOC+XML+V0//EN> (article 11 paragraph 3).



3 Hermetic-Pumpen GmbH pumps



5 SAMIFI BABCOCK compressors 1986



## Conversion from R22 to RS45



# Direct replacement (Drop-in) From R22 to RS45 with Flooded evaporator system

FRAMACOLD, official distributor of GAS SERVEI in France, would like to thank Mr. Guibert, owner of the Ice-skating rink in Vannes (France), for entrusting us with the adaptation of his installation. We also want to acknowledge CESBRON for their competence and skills in dealing with the management and replacement process of the flooded evaporator installation.



### Private Ice-Skating Rink In Vannes (France)

Construction 1992

More than 50.000 persons per  
year

Skating rink of 45m x 20m

Open 365 days a year

## INSTALLATION

### Description:

The York system cools directly the ice from the rink by means of a flooded network of refrigerant:

- Refrigeration unit YORK, La Chevrolière, 1992
- 2 reciprocating compressors YORK 4VF
- 2 electric motors 37 kW 1500v/min
- Liquid tank BP
- Original refrigerant R22 : 990kg
- Oil : HAFA S 46 FRIGEX (Alkylbenzene)
- Evaporating temperature: -20°C



## PROBLEMS & SOLUTIONS

### Encountered problems:

Considering that the availability of reclaimed R22 ends on the 31/12/2014, and that the cost of building a new installation is not reasonable, CESBRON -branch from Vannes- proposed a simple and quick conversion which would allow the continuity of the installation at the lowest possible cost.

The solution should fulfil the following requirements:

- To preserve the existing installation without any loss of capacity.
- To minimise the stop time (max. 24h).
- To comply with the legislation.
- To avoid a decrease in the company's profitability due to a higher electricity bill.

### Alternatives suggested:

-Adapt the installation to a compatible refrigerant like R404A, which would entail a complete change of oil (from mineral to synthetic oil, POE). This is a long and annoying process, given the complexity of the flooded network under the ice-rink.  
-Preserve the existing installation and change only the refrigerant, from R22 to RS45 (R434A), since this one is compatible both with mineral and alkylbenzene oils.  
This is the most economic solution.

Due to the conditions of the installation, the complicated system with LP tank and the flooded evaporator under the rink, PATINIUM chose to preserve the installation and to replace R22 with RS-45.



## DROP-IN FROM R22 TO RS45



### REPLACEMENT PROCESS OF R22 WITH RS-45 (R434A)

The company CESBRON, through its branch in Vannes (France), and its responsible Julien MICHEL, has supervised the process:

#### How did the refrigerant replacement go?

**Julien Michel:** after some works carried out during the previous days, the replacement took place on the morning of Tuesday 3 June:

1. Reclaim R22 into cylinders supplied by FRAMACOLD.
2. Maintenance procedure and substitution of Solenoid valve connections.
3. Filling with RS45.
4. Start-up and parameters control.
5. Oil return correct (without any addition).
6. Leakage monitoring.

Twelve hours after having stopped the installation, we were able to start it up again. Not a single problem occurred during this stage of the process.

#### Validation of tests:

**J.M.:** We restarted the installation in the afternoon, twelve hours after the stoppage. The following day the ice had already reached its original state, with temperature close to -5°C nominal. No leakage was observed. The tests were validated unequivocally.



### MAKE THE ICE!

#### Mr. Guibert (responsible and owner of the ice-rink):

In order to anticipate the replacement works, we had lightly thickened the ice-layer, foreseeing a long stop in our installations.

#### Have you noticed any changes with the RS-45?

**M.G.:** yes, during the start-up I realized immediately that the York compressors' sound level was lower than with R22. And now, after several days working, I've noticed that:

- The ice reaches temperature (-5°C) more easily.
  - The amperage of motors is lower and the COP improves.
  - The recovery exchanger during discharge is less demanded (lower discharge temperature), which results in lesser losses in the refrigeration system.
  - One week after the works, there were high temperatures in Vannes. It's true that with R22, the condenser could have been « not enough », but now with RS45 there was no problem. I am confident about the future.
- I want to thank the professionals that have provided a common sense solution!

### RS45: MANDATORY TRANSITION?

#### Mr. Franck Krier, General Manager of Framacold:

Yes, RS45 (R434A) is the only temporary solution that allows the continuity of industrial installations with flooded evaporator in R22, without any changes and maintaining the same performances.

Europe must find solutions to increase productivity. The use of RS refrigerants is an extraordinary tool for our industry!

RS-45 meets the need to find an alternative to R22. It was conceived for this. With the new F-GAS regulation forbidding HFC with a GWP higher than 2500, RS-45 becomes a solution, surely temporary until 2020 or until 2030 if used as regenerated gas. We are preparing for the following stage and we will certainly propose solutions to replace the refrigerants which will be reliable, efficient and complying with the legislations in force.

For any application with direct expansion in R22 or in any of its substitutes, we propose a refrigerant with a GWP of 1664: RS70. It's compatible with mineral oils AB and synthetic oils POE. RS70 has the same mass flow as R22 and almost the same pressures.

*From left to right: Mr Guibert, Manager of the Ice-skating rink and Mr. Michel, CESBRON branch responsible in Vannes*



# BRITISH ENERGY REPLACES R22 WITH **RS-45 (R434A) IN FLOODED CHILLER**

British Energy PLC, the largest electricity generator in the UK by volume with its HQ at Gloucester, has successfully replaced R22 in a large flooded chiller. Performance of the chiller after conversion from R22 to RS-45 matches the original design parameters for the unit so that, in terms of a comparison with R22, in the key areas of capacity and energy usage the machine is working equally effective as it was on R22.



The HQ site at Barnwood, Gloucester operates the data centres for the eight nuclear power stations in the UK. As part of their environmental strategy, British Energy has already converted all of the site's systems from R22 to non ozone depleting replacements, but has until recently been unable to find a suitable alternative to R22 for their flooded chillers. This has been of considerable concern in view of the imminent phase-out of the use of virgin R22 for service work, and the fact that replacement of a chiller of this size would cost over £500,000.

British Energy has experimented with R22 alternatives, such as R422D, but found that the chiller could not achieve the temperature difference across the evaporator that is an essential requirement. Consequently, in May 2009, one of their flooded chillers was converted to RS-45 (from R422D) with details as follows:

## REFRIGERANT SOLUTIONS LIMITED

8 Murieston Road, Hale, Altrincham, Cheshire WA15

**Tel:** (+44)(0)161 926 9876 **Fax:** (+44)(0)161 926 9875

**E-mail:** [rs@refsol.com](mailto:rs@refsol.com) **Web:** [www.refsols.com](http://www.refsols.com)





Dunham Bush Chiller Model PCX 700  
Condenser number SEPX790  
Dunham Bush Screw Compressor Model 2515DHFIL00  
Age 30 Years  
Flooded Evaporator  
Pilot Operated Thermostatic Expansion Valve + Partial Hand Expansion Valve  
Heat Recovery circuit on Condenser  
Recommended Charge 1,200 kgs R22  
Charged with 1,200 kgs RS-45  
Original oil Mineral Viscosity 170  
Charged with POE Viscosity 170

The control system operates compressor un-loader system based on a number of inputs which include but are not limited to chilled water leaving temperature, suction pressure, discharge pressure, motor loading percentage. The following readings were taken on 6 October:

Suction Pressure	74.32 psig
Discharge Pressure	188.30 psig
Motor amps	50 (Maximum setting 80, FLA 120)
Entering chilled water temperature	10.6°C
Leaving chilled water temperature	8.01°C (set point 8°C)
Suction Temperature	5.5°C
Evaporator Superheat	2.1°C
Motor load %	55.62 %
Outside air Temperature	17°C

Energy usage would appear to be lower with RS-45 with 5°C achieved at 65 amps, against design of 5.5°C at 108 amp. The system was operating up to 5.5° temperature difference on chilled water which was equal to design capacity. Before the initial conversion from R22 to R422D, the lubricant in the chiller had been changed from mineral oil to polyol ester.

The superheat was very consistent and did respond to adjustments to the expansion devices. Overall the customer is very happy with the performance of the chiller as it appears to be very similar to the R22 performance.

John Bravery of engineering contractor Balfour Beatty oversaw the conversion of the chiller to RS-45 with John Ormerod of refrigerant supplier A-Gas UK in attendance. The changeover process was quite straightforward, and no problems with this chiller have since been encountered since the machine has been achieving the duty previously obtained when operating on R22.

Geoff Benton, British Energy's Site Engineer, said:

"We have been planning to phase out R22 on this site before the cut-off date for using new R22 for service work kicks in at the end of 2009, but finding a refrigerant which can match the performance of R22 in the flooded chillers here had not been possible until the arrival of RS-45 (R434A). The fact that using RS-45 to replace R22 in one of our flooded chillers has resulted in an identical performance to using R22 in this unit means that we will be converting the remaining flooded chiller on site, and thereby achieving our overall objective to be free of ozone depleting substances prior to the phase out date in Europe. Overall, we are very pleased with the performance of RS-45 in what I understand is one of the most difficult applications for R22 replacements."

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