RS-50 (R442A)

Low global warming replacement for R404A, R507 and R22 in refrigeration





EXCLUSIVE USA MANUFACTURER AND DISTRIBUTOR OF THE RS SERIES REFRIGERANTS

ComStar International Inc.

20-45 128 Street

College Point, NY 11356

Phone: (800) 328-0142

Fax: (718)353-5998

Email: <u>customerservice@comstarproducts.com</u>

Website: www.comstarproducts.com

REFRIGERANT SOLUTIONS LIMITED

The Refrigerant Specialists



RS-50 (R442A)

LOW GWP & HIGH EFFICIENCY DROP-IN REPLACEMENT FOR R404A & R507

Extensive independent tests conducted on 6 refrigerants, including RS-50 (R442A), under identical conditions show that RS-50 has the highest energy efficiency & cooling capacity at lower temperatures. The other refrigerants tested were R404A, R507, R407F, R22 & R407A & were carried out by the University of Catalonia in Barcelona, Spain under strictly controlled conditions.

At typical supermarket refrigeration conditions, **RS-50** (**R442A**) showed the following comparative performances compared to R404A, R407F & R407A:

	Coefficient of Performance	Cooling capacity
R404A	+42%	+49%
R407F	+10%	+18%
R407A	+21%	+58%

Tests were also conducted under dynamic conditions which clearly demonstrated that **RS-50** (**R442A**) shows a faster pull-down time than any of the other refrigerants, especially at low temperature.

A specially constructed calorimeter was used for all these tests so that the results in terms of energy efficiency & capacity could be legitimately compared. A summary of a series of tests taken at -35°C evaporating & +35°C condensing temperatures are shown in the table below:

	R407F REF 1	R407A REF 2	RS-50 REF 3	R507 REF 4	R404A REF 5	R22 REF 6
P evaporation [bar]	1.35	1.3	1.35	1.7	1.64	1.27
P condensation [bar]	16.1	14.8	16.2	17	16.05	12.68
P high / P low	11.93	11.33	12	10	9.78	9.98
Discharge temperature [°C]	85	82	83	79	78	85
Cooling capacity [W]	1252	935	1477	1090	992	1263
Power input [W]	711	583	760	717	720	669
СОР	1.76	1.6	1.94	1.52	1.37	1.89

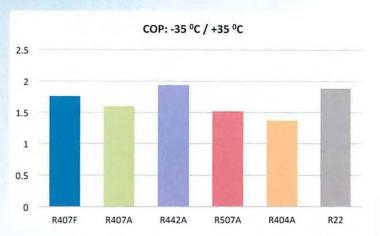
Cooling Capacity (W) at -35°C / 35°C

Cooling Capacity (W) -35 °C / +35 °C 1600 1400 1200 1000 800 400 200

R442A

R507A

COP at -35°C / 35°C



Further tests were undertaken to identify the pull-down times of these refrigerants, which showed that **RS-50** (R442A) also had a faster pull-down time than any of the other refrigerants, especially at low temperature:

R22

Comparison of Pull-down Times

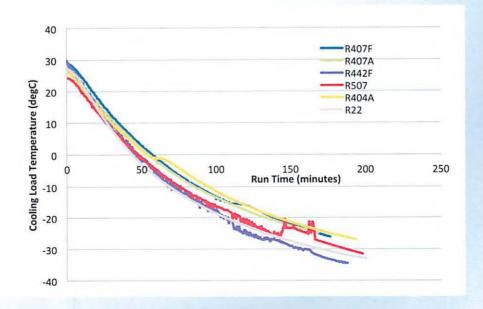
R407A

R407F

At -20°C evaporating temperature, the pull-down times were found to be as follows:

R404A

	Minutes	% R404A
R407F	140	0
R407A	135	96
RS-50 (R442A)	110	78
R507	115	82
R404A	140	0







RS-50 (R442A) A New Low Temperature Refrigerant

Performance Comparison with Five Existing Refrigerants

Summary

Independent tests were carried out on RS-50 (R442A) and five other refrigerants under identical conditions which show that R442A is superior to all the refrigerants tested under typical refrigeration condition:

- Under dynamic conditions R442A shows a faster pull-down time than any other low available temperature refrigerant.
- Under steady state conditions the COP of R442A is 44% higher than that of R404A and 10% better than that
 of R407F.
- Under steady state conditions the cooling capacity of R442A is 52% better than that of R404A and 16% better than that of R407F.

Abstract

Performance measurements on R442A (RS-50) in a calorimeter designed to emulate low temperature refrigeration conditions clearly demonstrate that its energy efficiency and cooling capacity are superior to those of R407F, R407A, R404A, R507, and R22.

1. Aim

The Technical University of Catalonia (UPC) was asked to test the comparative performances of six refrigerants for energy efficiency and other properties. The work was carried out in the University's Heat Engines Department where a suitable calorimeter was designed and built for these tests.

Two sets of trials were performed:

- Dynamic testing to compare the pull-down rates of the refrigerants.
- Steady state testing to compare the energy efficiencies and cooling capacities of selected refrigerants.

17 (2) (1)

2. Refrigerants

Six refrigerants were supplied to UPC of which five were provided as numbered samples only, and specifically not identified in any respect to those conducting the tests. Consequently, the first set of trials were in effect blind tests. The R404A sample was identified to enable the calorimeter to be commissioned.

3. Calorimeter circuit

The calorimeter circuit for conducting the tests was designed specifically to operate at temperatures down to -40°C.

Compressor

Model 1,5 HP K7.2X GELPHA reciprocating designed for R22

Condenser

Air-cooled

Model Tipo HRT/4-400-5PN

Expansion device

Danfoss TES2 valve designed for R404A or R507 with an external balance and fitted with a three port distributor.

Evaporator and Cooling Load

The cooling load was a mixture of 25 L of propylene glycol and 17.1 L of water, contained in a 50 L cylinder¹ and stirred magnetically to ensure good heat transfer and rapid approach to thermal equilibrium. The evaporator consisted of three serpentine coils each 15m long wrapped around the cooling load and contained within an outer cylinder. The narrow gap between inner and outer cylinders was filled with an ethylene glycol/water mixture containing 3.66 L of each to provide good heat transfer from the cooling load to the evaporator coils.

Measurements

All tests were carried out under the same conditions with the same refrigeration circuit and the same monitoring equipment. Pressures were recorded with a Testo 570-2 logger; temperatures with a Testo 177-T4 logger fitted with four probes; and power consumption with Landis Gyr electricity meters.

4. Dynamic Tests

These tests were carried out to assess the ability of the pull down abilities of the refrigerants and also to provide an initial assessment of their COPs. Each refrigerant was tested using the following method:

With the whole system initially at ambient temperature, the compressor was switched on and the system monitored by recording the following pressures and temperatures:

- Condensation and evaporation pressures.
- Propylene glycol/water temperature.
- Surface temperature of the outer cylinder at the bottom, middle and top.
- Power consumption for each line of the 3-phase supply.

Suction Superheat

Because the identities of the refrigerants were unknown, except for R404A, when the tests were made, the suction superheats could not be calculated using thermodynamic tables. Multiple temperature probes attached to the evaporator were employed to establish the point in the evaporator where no liquid was present and superheat started. The temperature difference between this point and the thermostatic expansion valve bulb was determined to be the evaporator superheat and the valve was set to maintain a superheat of 5°C to 7°C for all refrigerants tested.

After the tests had been completed the identities of the refrigerants were revealed, thus allowing the temperature measurements logged with the Testo instrument to be compared with the temperatures calculated from REFPROP using the recorded pressure data. The data collected was recorded and analyzed in Excel. The following key parameters, characterising the performance of the system, were calculated.

- The compressor power input (w) was obtained by summing the readings of the three meters.
- The refrigerant cooling power (h) was obtained from the enthalpy loss of the cooling load minus the heat gain from the surroundings.

5. Steady State Trial

RS-50, R404A, R407F, R407A, R507 and R22 were tested under steady state conditions with the evaporator operating at -35°C and the condenser at +35°C, again with suction superheats in the range 5 to 7 K. Since the identities of the refrigerants were known for these tests, the superheat condition for each refrigerant was determined using thermodynamic information from REFPROP.

The cooling capacities of the 6 refrigerants proved to be different so the heat flows into the heat load and out from the condenser were controlled to maintain the temperatures at -35°C and + 35°C respectively. For R404A the equipment proved capable of maintaining the desired evaporator temperature, but the condenser needed to be throttled by restricting the air flow with card-board strips. For R407F a 500W electric resistance heater was placed in the propylene-glycol/water heat load and less throttling applied to the condenser air flow. For RS-50 the full condenser air flow was used and two 500W heaters were placed in the load.

6. Results and Discussions

6.1 Dynamic Trial

The results for each refrigerant from the dynamic tests are summarised in the following tables. In this report, the term "Cooling Capacity" refers to the rate at which heat is removed from the load and is thus given in watts.² "Coefficient of Performance" (COP) is the ratio of the "Cooling Capacity" to the electrical "Power Input".

Table 6.1.1 COP

Temp ⁰C	R407F	R407A	R442A RS-50	R507	R404A	R22
-30	1.800	1.618	1.911	1.551	1.548	1.575
-20	2.385	2.144	2.533	2.056	2.052	2.087
-10	2.879	2.588	3.057	2.481	2.477	2.519

Table 6.1.2 Cooling Capacity (W)

Temp °C	R407F	R407A	R442A RS-50	R507	R404A	R22
-30	1384	1336	1552	1323	1308	1388
-20	2245	2168	2517	2147	2121	2252
-10	3353	3238	3761	3207	3169	3364

6.2 Steady State Trial

Table 6.2.1 summarises the results obtained under state conditions with the refrigerant nominally condensing at $+35^{\circ}$ C and evaporating at -35° C.

Table 6.2.1

	Refrigerant 1 R407F	Refrigerant 2 R407A	Refrigerant 3 R442A (RS-50)	Refrigerant 4 R507	Refrigerant 5 R404A	Refrigerant 6 R22
P evaporation (bar)	1.35	1.3	1.35	1.7	1.64	1.27
P condensation (bar)	16.1	14.8	16.2	17	16.05	12.68
P high / P low	11.93	11.33	12.00	10.00	9.78	9.98
Discharge temperature (°C)	85	82	83	79	78	85
Cooling capacity (W)	1252	935	1477	1090	992	1263
Power input (W)	711	583	760	717	720	669
СОР	1.76	1.6	1.94	1.37	1.37	1.89

¹ Dimensions; 40 cm x 20 cm radius

²In RSL literature capacity is often quoted as the suction specific volume in kW/m3, which is dependent upon operating conditions but mainly independent of the equipment design. For calorimetric it is more convenient and direct to compare the cooling powers of the different refrigerants.





RS-50 (R442A)

Low global warming & higher efficiency replacement for R404A & R507

RS-50 has a Global Warming Potential (GWP) of less than one half of R404A together with a higher efficiency which delivers energy savings & a lower contribution to global warming.

RS-50 can be used to replace R404A in both new & existing equipment. Mass flow of RS-50 is lower than R404A and R507 so that reducing the opening of the expansion device may be required. No changes to other hardware are necessary. A significant increase in energy efficiency compared to R404A and R507 can be expected. Users will achieve a lower carbon footprint due to the lower direct GWP of the refrigerant & its inherent higher efficiency.

Replacement for R22 in refrigeration applications

RS-50 is a non ozone depleting and non flammable replacement for R22 in medium and low temperature refrigeration applications. The efficiency and cooling capacity of RS-50 provides a close match for R22 in overall system performance. Flow rate is identical to R22 which avoids the need to change or alter existing pipework.

Performance Characteristics

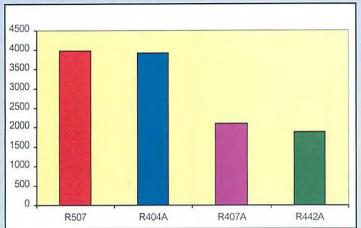
- Global Warming Potential less than half of R404A & R507
- Suitable in OEM & retrofit applications
- ASHRAE safety classification of A1
- Higher Coefficient of Performance than R404A & R507
- Higher capacity than R404A, R507 & R22

- Effective at medium and low temperatures
- Good match for R22 in refrigeration applications
- Mass flow equivalent to R22 and considerably lower than R404A & R507
- Zero Ozone Depletion Potential
- Non flammable & low toxicity

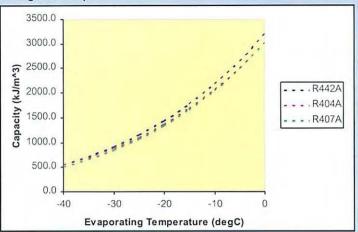
RS-50 (R442A)



Global Warming Potentials



Refrigerant Capacities



Applications

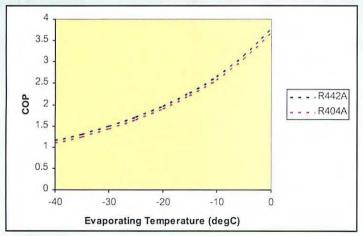
Because the properties of RS-50 are similar to R404A, it is suitable for use in many of the applications where R404A is commonly found including supermarket display cases, cold stores, freezers, refrigerated transport, ice machines, cold storage, transportation of foodstuffs, freezer cabinets, beer cellars, freeze dryers & environmental test chambers.

R22 is also used in many of these refrigeration applications where RS-50 can be a suitable replacement.

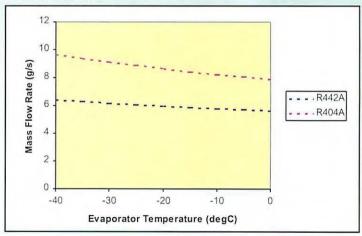
Lubricants

RS-50 is compatible with the same (POE) lubricants which are commonly used with R404A so that there is no need to change the oil when converting from R404A to RS-50. When replacing R22 with RS-50, the lubricant should be changed to a polyol ester oil.

COP



Mass Flow Rates



Safety

RS-50 is non flammable under all conditions of fractionation as per ASHRAE Standard 34. The components of RS-50 have been subjected to toxicity tests carried out by Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), and have been declared to be of low toxicity. RS-50 has been designated a refrigerant number of R442A by the ASHRAE with a safety classification of A1.

Servicing

Because RS-50 is a blend, it should be charged into the system in the liquid as opposed to vapour form. There is no need to make hardware changes when converting from R404A to RS-50 other than reducing the opening of the expansion device. Because RS-50 has a similar flow rate to R22, there is no need to adjust or change the expansion

RS-50 (R442A) PHYSICAL PROPERTIES (US)

PROPERTY		RS-50	R404A	R22
Molecular Weight		81.8	97.6	86.5
Boiling point (1 atm) (1)	°C °F	-46.5 ₍₁₎ -51.6 ₁₎	-46.2 ₍₁₎ -51.2 ₁₎	-40.8 -41.5
Temperature Glide	R	8.3	0.9	0
Critical Temperature	°C °F	82.4 180.3	72.1 161.7	96.1 205.1
Critical Pressure	bara psia	47.6 690	37.3 541	49.9 724
Liquid Density (77 ⁰ F) (1)	lb/cu.ft	69.15	65.18	74.33
Density of saturated vapour (77 °F) (1)	lb/cu.ft	2.978	4.075	2.761
Latent Heat of Vaporisation at boiling point	Btu/lb	114(1)	86 ₍₁₎	101
Cv (77 °F & 1 atm)	Btu(lb.R)	0.174	0.187	0.134
Cp (77 °F & 1 atm)	Btu(lb.R)	0.200	0.209	0.158
Cp/Cv (77 °F & 1 atm)		1.152	1.118	1.185
Vapour Pressure (77 °F) (1)	bara psia	13.3 ₍₁₎ 192 ₍₁₎	12.6 ₍₁₎ 182 ₍₁₎	10.4 151
Vapour Viscosity (77 ⁰ F & 1 atm)	lbm(ft.s)	0.00000844	0.00000807	0.00000849
Liquid Viscosity (77 °F) (1)	lbm(ft.s)	0.0000949	0.0000862	0.000110
Liquid Thermal Conductivity (77 °F) (1)	Btu(h.ft.R)	0.0495	0.0368	0.08266
Surface Tension (77 °F) (1)	lbf/ft	0.000453	0.000312	0.000553
Specific heat of liquid (77 °F) (1)	Btu(lb.R)	0.3728	0.3686	0.3004
Ozone Depletion Potential	ODP	0	0	0.055
Global Warming Potential	GWP	1888	3922	1810
Flammability limit in air (1 atm)	vol%	none	none	none
Inhalation exposure (8 hour day & 40 hour week)	ppm	1000	1000	1000

(1) Bubble Point

Refrigerant Solutions Ltd

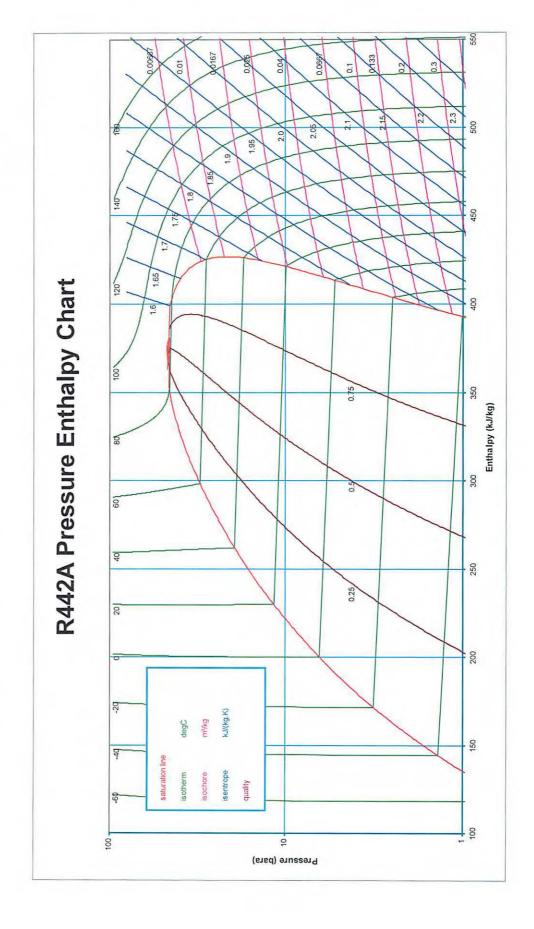
8 Murieston Road Hale Altrincham Cheshire WA15 9ST Tel: (+44)(0) 161 926 9876

Fax: (+44)(0) 161 926 9875 E-mail: rs@refsols.com



RS-50 (R442A) PRESSURE ENTHALPY DIAGRAM





BITZER & RS-50 (R442A)

Bitzer says that they do not expect any problems with regard to material compatibility & lubrication of the compressor when operated on RS-50 (R442A). Accordingly, Bitzer states that customers can use a Bitzer reciprocating compressor with RS-50 (R442A), & can provide the calculated performance data of the compressor. Bitzer does not see any particular risks from a technical point of view when operating their reciprocating compressors with RS-50 (R442A):

"The composition of RS-50 (R442A) is well-known and, therefore, no problems are expected when operating our compressors. From the Department of Application Engineering, we offer our customers the possibility to calculate the performance data of our compressors with special refrigerants e.g. in case of a retrofit of a R404A/R507A system.

It is not expected from our side to have any problems regarding material compatibility and lubrication of the compressor, when operated on R442A. For this reason, customers can use a BITZER reciprocating compressor with R442A and we can provide them the calculated performance data of the compressor. In case of a compressor failure, the decision about the guarantee will always be taken after a compressor examination in our facilities. Since the R442A composition is very similar to the R407F one, mass flow and discharge gas temperatures from R442A and R407F will be quite similar. For this reason, the R407F application envelope for every retrofit with R442A has to be considered."

As above Bitzer says that since RS-50 (R442A) has a similar composition to R407F, the mass flow & discharge temperature will also be similar and, accordingly, RS-50 will occupy the same application retrofit envelope as R407F. A special calculation by Bitzer on RS-50 (R442A) follows.

BITZER is an independent compressor manufacturer & offers their customers the possibility of checking if a retrofit of a R404A system is possible from a technical point of view, & which different details of the system need to be checked for a retrofit. Bitzer will check the application & calculate the expected performance data based on the thermodynamic properties of the refrigerant & the performance of the compressor.

In event of a compressor failure, the decision about the guarantee will always be taken after the compressor has been examined by Bitzer in their facilities.

1March 2014

REFRIGERANT SOLUTIONS LTD
8 Murieston Road
Murieston Road
Hale
Altrincham
Cheshire WA15 9ST
Tel: (+44)(0) 161 926 9876

Fax:(+44)(0) 161 926 9875 E-mail: rs@refsols.com





Operating conditions / given value	es		
Type of system	Single stage		
Refrigerant	R442A*		(Dew point temp.)
Evaporating temperature		-33,0 °C	(1,4 bar(a))
Superheat evaporator	10,0 K		
Superheat suction line	0,0 K		
Superheat int. heat. exch.	0,0 K		
Superheat total		10,0 K	(-23 °C)
Condensing temperature		37,0 °C	(16 bar(a))
Subcooling condenser	0,0 K		
Subcooling int. heat. exch.	0,0 K		
Subcooling external	0,0 K		
Subcooling total		0,0 K	(32,2 °C)
Power supply frequency		50 Hz	
Performance data**			
Compressor type		2DC-2.2Y-40	os
Cooling capacity, compressor (4 -> 1)		1,9 kW	
Cooling capacity, evaporator		1,9 kW	
Power input		1,5 kW	
Current (400 V)		3,3 A	
COP / EER		1,30	

3,4 kW

44 kg/h

126 °C

Discharge gas temp. without cooling

Condenser capacity Refrigerant mass flow

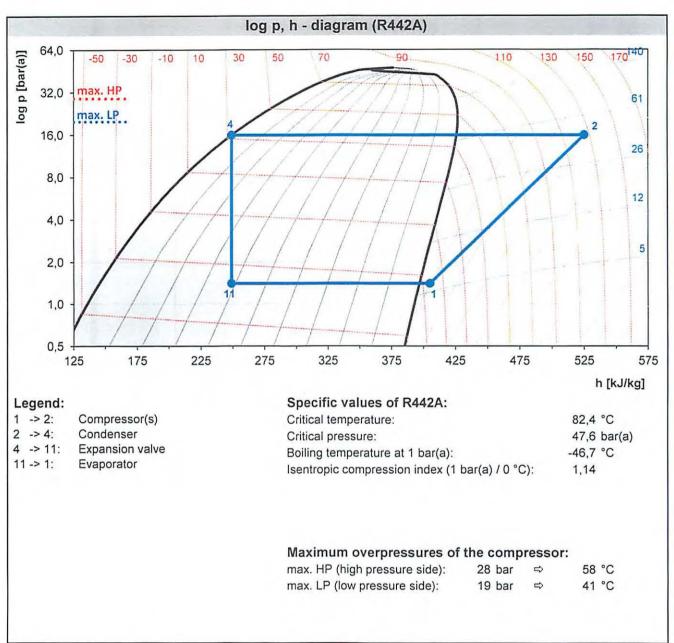
See additional application-related remarks on page 3.

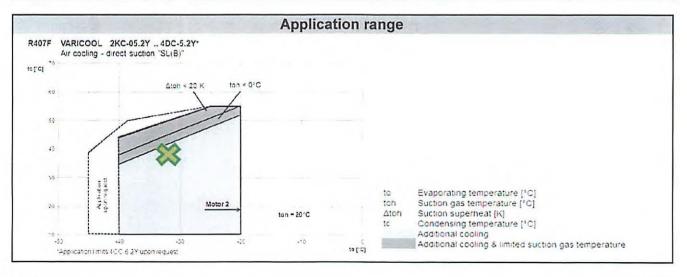
In case of a compressor failure, the decision on a potential warranty claim remains reserved to a diagnosis and examination of the compressor at the BITZER factory. Design, operation, and monitoring of the system is in the responsibility of the designer or executing company.

Refrigerant data calculated by Refprop library

Listed performance data are based on calculations and measured data. Under worst conditions given values might differ from common tolerances









Application related remarks:

The recommended oil for this application on R442A is our BSE32 (POE).

At the indicated operating point, the discharge gas temperature is 126°C. Therefore, additional cooling is required. Since typical suction gas superheat in supermarket applications is higher than 10 K and the condensing temperature during hot ambient conditions will be higher than 37°C, the "direct suction SL(B)" should be used to protect the compressor from high discharge gas temperatures (see further information on page 10 of the KB-100-6). Moreover, additional cooling and monitoring of the discharge gas temperature (max. 140°C) are required.

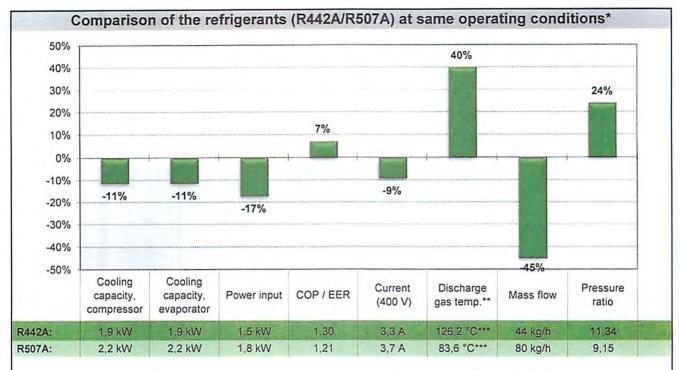
A comparison of the performance data with R442A and R507A can be found on page 4 of this document.

R442A has a similar composition to R407F. Therefore, the application limits for R407F must be considered for every R442A application.

The refrigerant R442A has a pronounced temperature glide. Detailed information with respect to the challenges and specific properties of zeotropic refrigerants can be found in the BITZER Refrigerant Report A-501-17.

18.02.2014 Page 3/4





The comparison calcuation is based on theoretical approach, respectively the same input parameters. Different pressure
drops and heat transfer properties of the refrigerants are not regarded

^{**} Ratio of the differences (Discharge gas temp. without cooling - Suction gas temp. at compressor inlet)

^{***} Absolut discharge gas temperature



EXCLUSIVE USA MANUFACTURER AND DISTRIBUTOR OF THE RS SERIES REFRIGERANTS

FOLLOWING ARE CASE STUDIES

ComStar International Inc.

20-45 128 Street

College Point, NY 11356 Phone: (800) 328-0142

Fax: (718)353-5998

 $\pmb{Email: \underline{customerservice@comstarproducts.com}}\\$

Website: www.comstarproducts.com





company and its aims

ian, a leader in retail distribution, tremely concerned about its CO₂ rint. The company is, therefore, proactive in optimising its ing facilities. To address the duction of the R404A regulation in Auchan wishes to pre-empt this line by replacing this fluid in its llations

equirements for the choice of fluids tested are:

VP under 2500

npatibility with the existing allations at a lower cost.

npatibility and a good performance the existing oils.

loss of refrigeration capacity.

rgy savings in order to reduce ual consumption.

r Pla, refrigeration facilities manager uchan Meriadeck has delegated the e of proposing the best solution to its be provider, the company MCI sented by Lionel Michot, manager of site. The analysis of the RS-50 fluid udes: non-flammable

more effective
a GWP of a half compared to that of 404A.

Vational Technical Department ⇒n to test this refrigerant on lation no 2 in this store

ription of the installation

IT PROFROID type CR55H6F50ZCA



- ✓ Rapid cooling unit converted from R404A to F
- √ 30% increase in energy performance
- ✓ Meets regulation in 2020
- ✓ Reduction in direct & indirect carbon footprint

Carrying out the conversion

L Michot supervised the conversion to RS-50 carrie in November 2014:

- ✓ recovery of the R404A charge,
- ✓ emptying the POE oil replaced by for the same tyl
- ✓ replacement of the desiccant cartridges and oil filt
- ✓ Charging the equivalent RS-50-mass to R404A.
- ✓ Closing systems expansion valves by 40
- ✓ Modification of the floating LP setting by resetting DIGITEL controllers using data from the RS-50 thermodynamic tables

1st FINDING:

CASE STUDY R442A (RS-50)



Overheating: 8 °C

Environmental temperature: +10 °C.





Proposed solution:

Oriol Martínez:

"We have proposed a refrigeration system for a plant that uses RS-50 refrigerant gas. The system is made up of the central unit, the condenser, the oil cooler, the tunnel and the new refrigeration piping network.

The new refrigerant allows an increase of approximately 30% in cooling capacity and with a GWP of 1888, the installation can be kept beyond 2020, as opposed to the R404A."

The tunnel was installed with RS-50 in January 2015, improving the following to date:

- R404A load recovery.
- Draining and changing of POE oil.
- Replacement of drying cartridges and oil filters.
 - RS-50 load equivalent to R404A.
- Closing the expansion valves by 40%.
- Modification of temperature set points, adapting them to the new gas

CASE STUDY R442A (RS-50)

Conversion result:

Oriol Martínez:



"This was a direct "drop-in" conversion with the previously used R404A refrigerant. The new central unit and the condenser were installed and combined with a network of pipes to the current evaporators, using the expansion system.

Since the mass flow of the RS-50 is 40% less than that of R404A, the expansion valves were adjusted and their openings were changed.

The condenser has four stages for regulating the operation of its ventilators, to optimise operation according to the condensation pressure.

Our customer is very satisfied:

- The intervention time is minimal.
- The end of R404A is anticipated.
- There is a great benefit from energy savings every day since the installation generates more cold without increasing electric consumption, and thus without increasing your electricity bill."

Why choose RS-50?



Lluís Giralt Jr., managing director of GAS SERVEI S.A.:

With the future increase of the cost of energy and the arrival of the new F-GAS, it is extremely important to create installations for the future with the lowest impact from emissions produced by the carbon footprint of refrigeration installations.



The installations made with RS-50 (R442A) are installations for the future that can be maintained without ban dates thanks to the GWP of 1888. Being a low GWP solution, in case of leakage, we will reduce direct CO₂ emissions (direct impact).

In addition, thanks to its high energy efficiency even at low temperatures,

we can improve its energy efficiency by 20%-30%, depending on the application, compared to installations that will use R404A. In reducing electricity consumption, we will reduce indirect CO₂ emissions (indirect impact).

With RS-50 we move forward to the next ban in 2020 of R404A, a product normally used in this type of application until now.

We have also been able to reduce the installation cost by using lower compressor power, thanks to the high cooling power of RS-50.

CONCLUSION

THE TEWI IS CRUCIAL IN CHOOSING AN ALTERNATIVE REFRIGERANT TO R404A, SINCE WE ARE NOT ONLY DECREASING THE ENVIRONMENTAL IMPACT OF THE INSTALLATIONS, BUT ALSO THEIR RESULTING COSTS.

R442A IS THE MOST ECO-FRIENDLY FLUORINATED REFRIGERANT FOR THESE APPLICATIONS, SINCE IT HAS THE BEST TEWI ON THE MARKET AND THEREFORE A LOWER ECONOMIC IMPACT AS WELL.



RS-50 (R442A)

REPLACES R404A AT S K FOODS MIDDLESBROUGH



Blast chiller operating on RS-50 (R442A) which shows an increased energy efficiency of 22% and a higher capacity of 14% compared to R404A.

S K Foods Ltd, a food manufacturer and a leader in the world of chilled snack food and ready meals, made a major capital investment in 2010 at the company's largest manufacturing site in Middlesbrough. This development was completed in 2012 doubling the capacity of the plant and included a range of new refrigeration equipment essential to the manufacturing process. The company decided that they would not use the refrigerant R404A due to its high direct Global Warming Potential (GWP) and were looking for an alternative product which would not only have a lower global warming potential but also a greater energy efficiency.

Paul Jackson, Senior Engineering Manager, approached Refrigerant Solutions Ltd (RSL) to test out the new refrigerant RS-50 (R442A) which is non flammable, more efficient and less than half the GWP of R404A. RS-50 is additionally an effective Drop-in replacement for R404A since little if any changes are required to the existing equipment to use this new refrigerant. The deployment of RS-50 is entirely consistent with the policy of S K Foods which is to reduce their carbon footprint and minimising any effect on the environment.

Conversions of a blast chiller, cold store and freezer were carried out during 2012 with RS-50 replacing R404A and R507. Evaporating temperatures ranged from -8°C to -38°C. All installations are operating satisfactorily & there have been no problems using RS-50 which is performing well.

Retrofitting R404A with RS-50 proved to be straightforward. The systems were operating under standard operating conditions before R404A was replaced by RS-50. No change of lubricant was required since the systems already contained POE oil with which RS-50 is fully miscible. Because RS-50 has a lower liquid flow rate than R404A, the expansion device was adjusted accordingly which was the only change needed during the retrofit procedure.

from

RS-50 has been operating successfully at this site since May 2012. Two blast chillers operating side by side with one operating on R404A and the other on RS-50 showed the following results:

	Direct comparison between ic	dentical syst	ems		
	System 2A & 2B (R404A) and 5	System 3A & 2A	3 B (R442A) 3A	2B	3B
1	Refrigerant Type	R-404A	RS-50	R-404A	RS-50
2	Date	19/02/2013	19/02/2013	19/02/2013	19/02/2013
3	Time	14.00	15.00	16.00	17.00
4	Suction Pressure (psig)	42 psig	39 psig	40 psig	37 psig
5	Discharge Pressure(psig)	220 psig	220 psig	225 psig	220 psig
6	Cooling Capacity(btu)	62.0	70.9	62.0	70.9
7	Compressor amperage	42.5A	39.9A	43.5A	40.5A
8	Energy Consumption(watts)	24277.5	23032.5	24277.5	23032.5
9	COP	3.51	4.28	3.43	4.22
10	Evap entering temperature	+4°C	+4°C	+4°C	+4°C
11	Evap leaving temperature	-3°C	-4°C	-3°C	-4°C
15	Evaporator Superheat C	8°C	6°C	8°C	7°C
16	Discharge Temperature C	66°C	64.5°C	67.5°C	62°C
17	Suction Temperature C	-6°C	-4°C	-7°C	-5°C
18	TXV setting (turns open)	22MM	N/K	22MM	N/K
19	Oil Level	CORRECT	CORRECT	CORRECT	CORRECT
20	Refrigerant Charge (kg)	80 kgs	N/K	80 kgs	N/K
21	Compressor consumption (watts)	17637.5	16558.5	18052.5	16807.5

Section #8 is energy consumption for entire unit Section #21 is energy consumption for compressor only Evaporators FRIGA BOHN 2x6DB3L rated @ 44.62 kW @ 7°C Evaporator air volume = 25200 3hr @ 1000 RPM

Compressor used is a Copeland 6 cylinder semi hermetic reciprocating type.

These results show that the energy efficiency and cooling capacity of RS-50 are 22% and 14% respectively greater than R404A, which supports the extensive trials carried out on RS-50 by the Technical University of Barcelona.

Paul Jackson of S K Foods said: "Investment in this new production facility is an important part of our overall strategy to deliver high quality products and a good service to our customers. It is also important and company policy to be aware of and minimise any effect on the environment. R404A is well known and the dominant low temperature refrigerant used in the industry today, but it does have a high direct GWP so that we were anxious to explore the possibility of using an alternative refrigerant which has a lower GWP and higher energy efficiency. RSL explained that RS-50 is just such a refrigerant and so it has proved. The conversion process was simple and the results have been impressive as demonstrated by the initial results shown above. Our plan is to convert the remaining systems in the factory to RS-50."









The new high-efficiency refrigerant with low GWP: RS-50 (R442A)

CASE STUDY OF A SYSTEM WITH RS-50 (R442A) IN A SUPERMARKET UNDERTAKEN BY FRIGORÍFICOS DEL PENEDÈS S.A.



GAS SERVEI S.A. would like to thank the owners of the supermarket **SORLI DISCAU** and the installation company **FRIGORIFICOS DEL PENEDES S.A**. for their invaluable cooperation in installing the new refrigerant gases with low global warming potential (GWP) and high energy efficiency. This supermarket has always demonstrated a keen interest in adopting the most environmentally-friendly solutions.

Location: Sant Vicenc de Montalt (Barcelona).

Installation company: Frigorificos del Penedes S.A.

Date: Official opening ceremony on 26 April by Felip Puig, Minister for Enterprise and

Employment of the Catalan Government.

Note: Information supplied by Gas-Servei S.A. www.gas-servei.com

from:



curoretrigerants



SYSTEM SPECIFICATIONS

The system has an automated DANFLOSS cold store with remote control, frequency converters and capacity regulators.

Compressors: 4 BITZER compressors

1 x 2HP for freezing. MODEL 2DC-2.2Y-40S; 1.9 kW.

2 x 25HP for commercial chilling. MODEL 4H-25.2Y; 80 kW.

1 x 30HP for climatization. MODEL 4G30.2; 66 kW.

Condenser: LU-VE. **Evaporators:** ECO.

Expansion valves: DANFOSS type TES2.

Area to be air-conditioned: 870 m².

Condensation and evaporation float and the heat from the condensation is used for climate control in the store.

Refrigerant Load: 200 kg R-442 (RS-50).

Oil: POE SUNISO SL-32 (ISO-32).

Installation date: 2013.



The system was originally designed for the refrigerant R-507 and in the end the only modification made for using R-442A (RS-50) was to slightly close the expansion valves due to its molecular structure being smaller than that of R-404A/R-507.









AUTOMATED FEATURES AND REMOTE CONTROL OF THE SYSTEM





We can see through the compressor's viewers that the oil level is correct and has not changed, meaning that it offers a good return due to the composition of the R-442A (RS-50).







curoretrigerants



Data taken on 26/11/2013

	Frozen	Fresn
Room Temperature (^O C):	-20	3
Evaporating temperature (OC):	-33	-12
Condensing temperature (°C):	+37	+37
Discharge temperature (°C):	+80	+65

COMMENTS: The R-442A gives much more cooling capacity with much shorter time reaching the desired evaporation temperature and therefore the compressor runs less time. Thus we also reduce energy demand.

CONCLUSIONS

A system ready to face the immediate future:

R-442A (RS-50) is a refrigerant that is compliant with the new European regulations due to its low global warming potential (GWP), less than 50% compared to R-404A and R-507.

Big savings in terms of both energy and money:

The working temperature was reached much faster than if R-507 had been used.

Additionally, the big advantage compared to R-507, R-404A and the other HFC solutions currently on the market is that it offers a much better coefficient of performance (COP) at low temperatures. The system's owner is already seeing energy savings of approximately 25%, thereby easing the economic situation.

The installer is considering doing future installations with less reliance on the compressor thanks to the high capacity and efficiency of the refrigerant.

Big reductions in CO₂ emissions = more environmentally-friendly:

As a result of the combination of the reduction in both direct CO₂ emissions from refrigerant leakage and indirect emissions caused by electricity consumption, Sorli Discau will be able to significantly reduce its TEWI (Total Environmental Warming Impact), demonstrating its support for and responsibility towards the environment.

The project was carried out by the technical departments of FRIGORÍFICOS DEL PENEDÈS S.A. and GAS-SERVEI, S.A.

Note: Information supplied by Gas-Servei S.A. www.gas-servei.com



REFRIGERANT SOLUTIONS LIMITED



New refrigerant RS50 proves a successful replacement for R22 at McVitie's



Refrigeration system at McVitie's Glasgow North Chill Store

McVitie's is a masterbrand for United Biscuits (UK) Limited and produces many famous sweet biscuit lines including Digestives, Hobnobs and Medley Bars at its manufacturing site in Glasgow.

The Glasgow site uses refrigeration in many parts of its production processes and efficient operation is a key to their business success. Since the EU phase-out of HCFC refrigerants began in the late 1990s, the search has been on for a replacement for the R22 refrigerant that could be used in existing equipment and would provide the same cooling capacity.

The recent development and introduction of RS50 (R442A) has provided a refrigerant that has achieved this for McVitie's. RS50 is an HFC with a Global Warming Potential (GWP) of 1888, which is below the 2500 GWP threshold in the revised F-gas legislation.

Danny Watson of Glasgow-based HRP, a leading wholesaler of refrigeration and air conditioning equipment, suggested to C&M Environmental Ltd, which has retrofitted many R22 systems that it was worth considering RS50. They identified the additional cooling capacity of RS50 was a possible solution to McVitie's concern that R22 retrofit gases would result in a loss of capacity that would not be acceptable for their production.. This lead to a trial of RS50 at McVitie's Glasgow in the North Chill Store that is used for holding ingredients at 4degC. Commenting on the outcome of the trial, Norrie Fraser, Director of C&M Environmental, said: "We are delighted, the RS50 was a straight-forward retrofit and the energy saving is even better than we expected".

The performance of the system was measured when operating on the R22, and also after replacement with the RS50. The performance with RS50 met the cooling requirements and further provided an average power saving of 16% over R22.

The successful outcome of the trial enables McVitie's Glasgow to withdraw from using R22 before the complete ban on HCFCs at the end of 2014.

The trial

The compressor is a Bitzer 4T-12.2 semi-hermetic unit. Retro-fitting the R22 with RS50 was a straight-forward procedure. The R22 was recovered from the system and the mineral oil drained before filling with polyol ester oil (POE) Mobil EAL Arctic 68 and then recharging with RS50.

The system was then recommissioned and adjustments made to the expansion valve superheat. Key performance results are highlighted in the table below.

Table: Comparison of plant operating on R22 and RS50

	R22 average*	RS50 average*
Refrigerant charge	11.2kg	8kg
Running time per 24hrs	8.4hrs	7.1hrs
Compressor starts per 24hrs	30	51
Amps (maximum) (design max operating current 24.0A)	5.4	8.2
Discharge Temp deg C	95	90
Discharge Pressure barg	12	14
Condenser Outlet Temp deg C	25	20
kWhr over 24hr period	19.15	16:0

^{*} average of the 24hr run periods

Over the 24hour periods evaluated the required duty for the Chill Store was achieved with 15.5% fewer compressor running hours and a resultant energy (kWhr) saving of 16.4%. This performance is in line with the findings of both the independent blind testing and other field trials carried out in 2013.

Andrew Wilson, Engineering Projects Manager for McVitie's, said "RS50 has come along at just the right time. We have been looking to retrofit away from R22 but we could not risk the potential loss of capacity that was expected with other retrofit gases. We are delighted that RS50 has meant no loss of cooling capacity but also has delivered double digit energy savings.

An extra bonus is that the we have not only got solution to the R22 issue but will be using a refrigerant that puts McVitie's Glasgow on a gas that is below the 2500 GWP threshold that F-Gas part 2 will introduce".

BOC would like to thank the following companies for their co-operation and support:











RS-50 (R442A)

RETROFIT PROCEDURE TO REPLACE R404A OR R507

Replacing R404A or R507 with RS-50 essentially will follow the procedure specified by the equipment manufacturer for a refrigerant change. Since RS-50 is zeotropic it is very important that liquid refrigerant, not vapour, be removed from the container and added to the system.

- 1. Ensure the right equipment is available, eg recovery unit and cylinders, container for recovered lubricant, vacuum pump, weighing scales, replacement drier etc.
- 2. Before removing the R404A or R507A, operate the unit under standard operating conditions and record the pressures, temperatures and any other relevant measurable data to establish unit performance. Typically, the appropriate standard conditions for setting up the unit will have already been specified by the equipment supplier.
- 3. Recover and weigh the R404A or R507A from the unit. The weight should be within the range specified by equipment manufacturer.
- 4. Replace the filter/drier and evacuate the system.
- 5. As in the case of R404A and R507, RS-50 should be used with a polyol ester lubricant.
- 6. Before operating the unit, charge the unit with **liquid** RS-50. The weight added at this stage should be approximately 10% lower than the R404A or R507 charge specified by the equipment manufacturer.
- 7. Operate the unit under conditions similar to those used in Step 2, closely watching the liquid line sight glass, the compressor oil level sight glass and the suction superheat.
- 8. RS-50 has a lower liquid flow rate than R404A and R507, so that it may be necessary to replace the expansion device with a valve approximately 40% smaller.
- 9. The evaporator superheat should be checked and changed as necessary by adjusting the TX valve.

- 10. If the equipment manufacturer recommends charging R404A or R507 by evaporator superheat or liquid sub-cooling, use the same amount of superheat or sub-cooling for RS-50
- 11. If a liquid line sight-glass is fitted, charge to a full glass gradually adding more liquid RS-50 until only liquid is passing through the expansion valve. **Do not overcharge the system.**
- 12. Adjust the expansion device superheat setting as required.
- 13. Check system thoroughly for leaks.
- 14. Remove all R404A or R507A labels and clearly label system RS-50.

Warning: It is highly recommended that the thermostatic expansion valve be checked and adjusted to compensate for small differences in the pressure temperature relationship of the replacement refrigerant when compared to the original refrigerant. Failure to check and adjust the valve could allow liquid refrigerant to enter the compressor and damage bearings and other compressor components.

RS SERIES OF REFRIGERANTS PRESSURE/TEMPERATURE CHARTS

RS Series Pressure/Temperature charts indicate both liquid bubble point and vapour dew point of the RS Series Refrigerant.

Liquid Bubble Point: this is the temperature which the liquid refrigerant will begin to vaporize at the given pressure. Below this temperature the liquid refrigerant will be subcooled.

Vapour Dew Point: this is the temperature at which refrigerant vapour will begin to condense at the given pressure. Above this temperature the refrigerant vapour will be superheated.

EvaporatorVapour Superheat:

To determine evaporator superheat, measure the suction line temperature at the outlet pipe of the evaporator and measure the suction pressure at the outlet pipe of the evaporator. Using the Pressure/Temperature chart, determine the vapour dew point for the measured suction pressure. Subtract the determined dew point from the actual temperature and this difference is the evaporator superheat.

Condenser Liquid Sub-Cooling:

To determine condenser sub-cooling, measure the temperature of the outlet pipe of the condenser and measure the condenser pressure at the outlet pipe of the condenser. Using the Pressure/Temperature chart, determine the liquid bubble point for the measured condenser pressure. Subtract the measured temperature from the determined bubble point and this difference is the condenser liquid sub-cooling.

RS-50 (R442A)



RETROFIT PROCEDURE TO REPLACE R22

Replacing R22 with RS-50 essentially will follow the procedure specified by the equipment manufacturer for a refrigerant change. Since RS-50 is zeotropic it is very important that liquid refrigerant, not vapour, be removed from the container and added to the system.

- 1. Ensure the right equipment is available, eg recovery unit and cylinders, container for recovered lubricant, vacuum pump, weighing scales, replacement drier etc.
- 2. Before removing the R22, operate the unit under standard operating conditions and record the pressures, temperatures and any other relevant measurable data to establish unit performance. Typically, the appropriate standard conditions for setting up the unit will have already been specified by the equipment supplier.
- 3. Recover and weigh the R22 from the unit. The weight should be within the range specified by equipment manufacturer.
- 4. If mineral oil or alkylbenzene are being used in the system, which is common in the case of R22, it is necessary to change the lubricant to a miscible lubricant such as a polyol ester. It is advisable to check with the compressor manufacturer which type and viscosity of lubricant to use. The remaining amount of mineral oil or alkylbenzene left in the system should be less than 5%.
- 5. Record the quantity of oil removed from the system, and compare with the amount recommended by the compressor manufacturer, since this is the quantity of lubricant that will need to be replaced.
- 6. Recharge the same quantity as in 5 above with a suitable miscible lubricant.
- Since the mass flow of R442A is similar to R22, it should not be necessary to replace
 the expansion device, but superheat should be checked and the TXV adjusted as
 necessary.
- 8. Replace the filter/drier and evacuate the system.
- 9. Before operating the unit, charge the unit with **liquid** RS-50. The weight added at this stage should be approximately 10% lower than the R22 charge specified by the equipment manufacturer.

- 10. Operate the unit under conditions similar to those used in Step 2. Although compressor suction pressures will be similar to those experienced using R22, discharge pressures will be approximately 20% higher which may require the higher pressure cut out to be reset and controls to be adjusted accordingly. It is important that the operating limits of the compressor etc are not exceeded.
- 11. Check superheat to ensure the system is operating satisfactorily.
- 12. Check system thoroughly for leaks.
- 13. Remove all R22 labels and clearly label system RS-50.

RS SERIES OF REFRIGERANTS PRESSURE/TEMPERATURE CHARTS

RS Series Pressure/Temperature charts indicate both liquid bubble point and vapour dew point of the RS Series Refrigerant.

Liquid Bubble Point: this is the temperature which the liquid refrigerant will begin to vaporize at the given pressure. Below this temperature the liquid refrigerant will be subcooled.

Vapour Dew Point: this is the temperature at which refrigerant vapour will begin to condense at the given pressure. Above this temperature the refrigerant vapour will be superheated.

EvaporatorVapour Superheat:

To determine evaporator superheat, measure the suction line temperature at the outlet pipe of the evaporator and measure the suction pressure at the outlet pipe of the evaporator. Using the Pressure/Temperature chart, determine the vapour dew point for the measured suction pressure. Subtract the determined dew point from the actual temperature and this difference is the evaporator superheat.

Condenser Liquid Sub-Cooling:

To determine condenser sub-cooling, measure the temperature of the outlet pipe of the condenser and measure the condenser pressure at the outlet pipe of the condenser. Using the Pressure/Temperature chart, determine the liquid bubble point for the measured condenser pressure. Subtract the measured temperature from the determined bubble point and this difference is the condenser liquid sub-cooling.

RS-50 (R442A): Q & A



1.Q: What is RS-50?

A: RS-50 is a non ozone depleting low GWP replacement for R404A and R507, and also for R22 in refrigeration.

2 Q: Yes, but what does RS-50 contain?

A: RS-50 is a blend of R32a, R125, R134a, R227ea and R152a.

3.Q: Is RS-50 subject to a phase out programme under any regulations as is the case with CFCs and HCFCs?

A: No. None of the components of RS-50 is subject to a phase out schedule under the Montreal Protocol or any regulations.

4 Q: Can RS-50 be used with the same lubricant when replacing R404A and R507?

A: Yes. RS-50 is fully compatible with synthetic lubricants such as polyol ester (POE) which are commonly used with R404A and R507.

5 Q: Can RS-50 be used with the same lubricant when replacing R22?

A: No. RS-50 is not compatible with mineral and alkylbenzene oils, lubricants commonly found in use with R22. A complete change of lubricant to POE is required when replacing R22 with RS-50

6.Q: Is RS-50 non flammable and non toxic?

A; RS-50 is both non flammable and non toxic. RS-50 is non flammable under all conditions of fractionation under ASTM 681-09.

7 Q: Is RS-50 approved by compressor manufacturers?

A: The individual components which comprise RS-50 are widely used in compressors produced by major manufacturers.

8: How efficient is RS-50?

A: Tests show that RS-50 has a considerably higher Coefficient of Performance than R404A and R507 which provides a significant energy saving for users.

9 Q: What trials have been carried out on RS-50 and what are the results?

A: Extensive independent testing has been carried out which clearly demonstrates that RS-50 has higher energy efficiency than R404A, R507, R407A and R407F at low temperature.

10 Q: Does RS-50 need to be charged in the liquid or gaseous form?

A: Because RS-50 is a blend, the recommendation is to charge it into the system in the liquid form. However, if the entire contents of the cylinder are being charged, then vapour charging is acceptable.

11 Q: Does the RS-50 disposable cylinder have a dip tube?

A: No. The disposable should be inverted to discharge RS-50 in the liquid form.

12 Q: Is RS-50 on the SNAP (Significant New Alternative Policy programme) list in the USA?

A: Yes, RS-50 is approved for use by the US Environmental Protection Agency..

13 Q: Does RS-50 have an ASHRAE number & what is its classification?

A: Yes. RS-50 has been designated an ASHRAE number of R442A with a classification of A1, which is low toxicity & non flammable under all conditions of fractionation.

14 Q: How does the pressure rating of RS-50 compare with R22, R404Aand R507?

A: The discharge pressure of RS-50 is similar to R404A and R507, and higher than R22.

15 Q: How does the capacity of RS-50 compare to R404A and R507?

A: The capacity of RS-50 is higher than R404A and R507, with a quicker pulldown time.

16 Q: How does the temperature rating of RS-50 compare to R22, R404A and R507?

A: The discharge temperature of RS-50 is lower than R22 and higher than R404A and R507.

17 Q: What are the flammability characteristics of RS-50?

A: RS-50 is non flammable at room temperature and atmospheric pressure, and has the same classification as R12, R134a, R404A, R409A (FX56), R507 (AZ-50) etc.

18 Q: What are the decomposition products resulting from the combustion of RS-45?

A: The decomposition products resulting from subjecting RS-50 to a high temperature source are similar to those when R404A and R507 are exposed to fire conditions. The decomposition products in each case are irritating and toxic, and breathing apparatus should be worn where a possibility to exposure exists.



19 Q: Are there any special precautions with RS-50?

A: There are no specific precautions which must be taken with RS-50. As with all refrigerants, common sense and good housekeeping is always recommended.



20 Q: Is RS-50 compatible with refrigeration and air conditioning systems designed for R404A, R507 and R22?

A: Yes. RS-50 is compatible with all materials commonly used in systems that were designed and charged with R404A, R507 and R22. Magnesium and zinc alloys should be avoided.

21 Q: Can RS-50 be recovered and recycled?

A: Yes. RS-50 can be recovered and re-used after a cleaning process such as reclamation.

22 Q: What technical guidance do you advise when changing from R404A or R507 to RS-50?

A: Use the same type of lubricant which will be polyolester, replace the filter/drier and charge 10% less quantity of RS-50 as the original charge for R404A or R507 after fully evacuating. RS-50 has a lower liquid flow rate than R404A and R507, so that it may be necessary to replace the expansion device with a valve approximately 40% smaller.

23 Q: In systems operating with R404A or R507, what if any adjustments need to be made to electronic expansion valves when using RS-50 (R442A)

A: Electronic expansive valves that operate on temperature difference only will have to be adjusted to allow for the evaporator glide. The estimated glide must be added to the recommended evaporator superheat setting for the equipment and the valve adjusted accordingly. Electronic expansive valves that operate on evaporator pressure converted to temperature will have to be re-programmed for the pressure temperature relationship of RS-50 (R442A).

24 Q: What technical guidance do you advise when changing from R22 to RS-50?

A: If mineral oil or alkylbenzene are being used in the system, which is common in the case of R22, it is necessary to change the lubricant to a miscible lubricant such as a polyol ester. It is advisable to check with the compressor manufacturer which type and viscosity of lubricant to use. The remaining amount of mineral oil or alkylbenzene left in the system should be less than 5%. Charge 10% less quantity of RS-50 as the original charge for R22 after fully evacuating. Since the mass flow of R442A is similar to R22, it should not be necessary to replace the expansion device, but superheat should be checked and the TXV adjusted as necessary.

25 Q: In systems operating with R22, what if any adjustments need to be made to electronic expansion valves when using RS-50 (R442A)

A: Electronic expansive valves that operate on temperature difference only will have to be adjusted to allow for the evaporator glide. The estimated glide must be added to the recommended evaporator superheat setting for the equipment and the valve adjusted accordingly. Electronic expansive valves that operate on evaporator pressure converted to temperature will have to be re-programmed for the pressure temperature relationship of RS-50 (R442A). The capacity rating of a R22 valve will be similar when operating on RS-50 (R442A).

26 Q: How does RS-50 compare in price with R404A and R507?

A: RS-50 is competitive in price with R404A and R507.

27 Q: What is the main advantage of RS-50?

A: RS-50 has a considerably higher Coefficient of Performance than R404A and R507 at low temperature which can realise serious energy savings for users. In addition, RS-50 has a Global Warming Potential which is less than half that of R404A and R507 which results in a lower carbon footprint.

28 Q: Is RS-50 compatible with hoses, seals, gaskets and O-rings commonly used with R404A and R507?

A: Yes, there is no necessity change any seals, hoses etc when replacing R404A and R507 with RS-50.

29 Q: Is RS-50 compatible with hoses, seals, gaskets and O-rings commonly used with R22?

A: RS-50 (R442A) is compatible with materials commonly used in refrigeration systems previously charged with R22. In general, materials which are compatible with R22 can be used with RS-50 (R442A). It is recommended to check equipment manufacturer's retrofit literature and obtain recommendations from equipment manufacturers with regard to materials' compatibility. In older systems which have been operating on R22 for many years, replacement of some seals may be required due to the different composition of RS-50 (R442A) which contains HFCs.

30 Q: How does the Coefficient of Performance (COP) of RS-50 compare with R404A and R507?

A: Independent tests show that RS-50 provides a considerably higher COP than R404A and R507 at l,ow temperature.

31 Q: What is the specification for RS-50?

A: RS-50 complies with the refrigerant specification AHI 700 for fluorocarbon refrigerants.

32 Q: What is the effect of high exposure by inhalation of RS-50?

A: As is the case with all CFC, HCFC and HFC based refrigerants, high exposure to RS-50 may produce anaesthetic effects. Very high exposures may cause an abnormal heart rhythm and prove suddenly fatal as is the case with all CFC, HCFC and HFC based refrigerants.

33 Q: What is the flash point, flammability explosion limits and auto-ignition temperature for RS-50?

A: RS-50 is non flammable as defined in the ASHRAE EN 681-09 test, and hence does not have a flash point or explosion limits. The auto-ignition temperature of RS-50 has not been determined but is expected to be greater than 750°C.

34: What types of leak detectors should be used with RS-50?

A: Leak detectors used with HFCs are suitable for use with RS-50.

35: What would be the effect of a large release of RS-50?

A: In common with other refrigerants of this type, the area should be immediately evacuated. The vapour may concentrate at floor level and in poorly ventilated areas may be slow to disperse. Forced ventilation should be provided before entering such areas.



36 Q: Is RS-50 available in both returnable and disposable cylinders?

A: Yes.

37: Is RS-50 suitable for use with new equipment?

A: RS-50 is targeted to replace R404A and R507 in new equipment in order to take advantage of its high energy efficiency and lower global warming than R404A and R507.

RS-50 (R442A) MATERIALS COMPATIBILITY

MATERIALS RANKING

Ethylene-Propylene Diene Terpolumer	S
Ethylene-Propylene copolymer	S
Chlorosulfonated Polyethylene	S
Polyisoprene	Su
Chlorinated Polyethylene	Su
Neoprene (Chloroprene)	S
Epychlorohydrin	Su
Polyinylidene fluorine and copolymer of	
Vinylidene fluoride & hexofluoropropylene	U
Silicone	Us
Polyurethane	Su
Nitrile	Su
H-NBR	Su
Butyl rubber	Su
Natural rubber	Su
Polysulfide	S
Nylon	S
Polytetrofluoroethylene (PTFE)	S
PEEK	S
ABS	Su
Polypropylene	Su
Polyphenylene sulfide	S
Polyethylene terepthalate	S
Polysulfone	S
Polyimide	S
Polyetherimide	S
Polyphthalamide	Su
Polyamideimide	Su
Polyamiderimide	Su
Acetal	S
Phenolic	S
Eopxyresin	S

Note:

S - Suitable Su - Suitable with some exceptions

U - Unsuitable

Us - unsuitable with some exceptions Rankingss should be used with caution

Refrigerant Solutions Ltd

8 Murieston Road

Hale

Altrincham

Cheshire WA15 9ST

Tel: (+44)(0) 161 926 9876 Fax: (+44)(0) 161 926 9875 E-mail: rs@refsols.com





RS-50 (R442A) PRESSURE & TEMPERATURE TABLE : ABSOLUTE

TEMPERATURE	BUBBLE PRESSURE (LIQUID)	DEW PRESSURE (VAPOUR)	BUBBLE PRESSURE (LIQUID)	DEW PRESSURE (VAPOUR)	BUBBLE PRESSURE (LIQUID)	DEW PRESSUR (VAPOUR)
(oC)	(kPa)	(kPa)	(bara)	(bara)	(psia)	(psia
-60	49.76	33.15	0.50	0.33	7.22	4.81
-58	55.63	37.47	0.56	0.37	8.07	5.43
-56 -54	62.05 69.05	42.24 47.48	0.62	0.42	9.00	6.12
-52	76.66	53.24	0.77	0.53	11,12	7.72
-50	84.93	59.54	0.85	0.60	12.31	8.63
-48	93.90	66.43	0.94	0.66	13.62	9.63
-46	103.60	73.95	1.04	0.74	15.02	10.72
-44	114.08	82.13	1.14	0.82	16.54 18.18	11.91 13.20
-42 -40	125.37 137.53	91.01 100.64	1.38	1.01	19.94	14.59
-38	150.60	111,06	1.51	1,11	21.84	16.10
-36	164.62	122.32	1.65	1.22	23.87	17.74
-34	179.65	134.46	1.80	1.34	26.05	19.50
-32	195.72	147.52	1.96	1.48	28.38	21.39
-30	212.88	161.57 176.64	2.13	1.62	30.87	23.43
-28 -26	231.20 250.70	192.78	2.51	1.93	33.52 36.35	25.61 27.95
-24	271.46	210.06	2.71	2.10	39.36	30.46
-22	293.52	228.51	2.94	2.29	42.56	33.13
-20	316.93	248.21	3.17	2,48	45.95	35.99
-18	341.75	269.19	3.42	2.69	49.55	39.03
-16 -14	368.03 395.83	291.52 315.25	3.68	2.92 3.15	53.36 57.40	42.27 45.71
-12	425.20	340.45	4.25	3.40	61.65	49.37
-10	456.19	367.17	4.56	3.67	66.15	53.24
-8	488.88	395.48	4.89	3.95	70.89	57.34
-6	523.31	425.42	5.23	4.25	75.88	61.69
-4	559.55	457.08	5.60	4.57	81.13	66.28
-2 0	597.65 637.67	490.51 525.77	5.98	4.91	86.66	71.12
2	679.68	562.93	6.38	5.26 5.63	92.46 98.55	76.24 81.62
4	723.74	602.07	7.24	6.02	104.94	87.30
6	769,91	643.24	7.70	6.43	111.64	93.27
8	818.24	686.52	8.18	6.87	118.64	99.55
10	868.82	731.98	8.69	7.32	125.98	106.14
12	921.69 976.93	779.69 829.73	9.22 9.77	7.80 8.30	133.65 150.02	113.06
16	1034.60	882.16	10.35	8.82	150.02	127.91
18	1094.80	937.07	10.95	9.37	158.75	135.88
20	1157.50	994.54	11.58	9,95	167.84	144.21
22	1222.80	1054.60	12.23	10.55	177.31	152.92
24 26	1290.90 1361.70	1117.50	12.91	11.18	187.18	162.04
28	1435.40	1183.10 1251.60	13.62 14.35	11.83 12.52	197.45 208.13	171.55 181.48
30	1512.00	1323.00	15.12	13.23	219.24	191.84
32	1591.50	1397.60	15.92	13.98	230.77	202.65
34	1674.10	1475.30	16.74	14.75	242.74	213.92
36	1759.80	1556.20	17.60	15.56	255.17	225.65
38 40	1848.80 1941.00	1640.50 1728.20	18.49 19.41	16.41 17.28	268.08 281.45	237.87 250.59
42	2036.60	1819.50	20.37	18.20	295.31	263.83
44	2135.50	1914.50	21.36	19.15	309.65	277.60
46	2238.10	2013.20	22.38	20.13	324.52	291.91
48	2344.10	2115.90	23.44	21.16	339.89	306.81
50 52	2453.90 2567.40	2222.60	24.54	22.23	355.82	322.28
54	2684.80	2333.50 2448.60	25.67 26.85	23.34	372.27 389.30	338.36 355.05
56	2806.10	2568.30	28.06	25.68	406.88	372.40
58	2931.50	2692.60	29.32	26.93	425.07	390,43
60	3060,90	2821.70	30.61	28.22	443.83	409.15
62	3194.60	2955.90	31.95	29.56	463.22	428.61
64 66	3332.50 3474.80	3095.30 3240.30	33.33 34.75	30.95 32.40	483.21	448.82
68	3621.50	3391.10	36.22	33.91	503.85 525.12	469.84 491.71
70	3772.80	3548.10	37.73	35.48	547.06	514.47
72	3928.50	3711.90	39.29	37.12	569.63	538.23
74	4088.80	3883.00	40.89	38.83	592.88	563.04



RS-50 (R442A) PRESSURE & TEMPERATURE TABLE : GAUGE

MPERATURE	BUBBLE PRESSURE (LIQUID)	DEW PRESSURE (VAPOUR)	BUBBLE PRESSURE (LIQUID)	DEW PRESSURE (VAPOUR)	BUBBLE PRESSURE (LIQUID)	DEW PRESSURI (VAPOUR)
(oC)	(kPag)	(kPag)	(barg)	(barg)	(psig)	(psig
-60	-51.54	-68.15	-0.52	-0.68	-7.47	-9.88
-58	-45.67	-63.83	-0.46	-0.64	-6.62	-9.26
-56 -54	-39.25 -32.25	-59.06 -53.82	-0.39 -0.32	-0.59 -0.54	-5.69 -4.68	-8.56 -7.80
-52	-24.64	-48.06	-0.25	-0.48	-3.57	-6.97
-50	-16.37	-41.76	-0.16	-0.42	-2.37	-6.06
-48	-7.40	-34.87	-0.07	-0.35	-1.07	-5.06
-46	2.30	-27.35	0.02	-0.27	0.33	-3.97
-44 -42	12.78 24.07	-19.17 -10.29	0.13 0.24	-0.19 -0.10	1.85 3.49	-2.78 -1.49
-42	36.23	-0.66	0.36	-0.01	5.25	-0.10
-38	49.30	9.76	0.49	0.10	7.15	1.42
-36	63.32	21,02	0.63	0.21	9.18	3.05
-34	78.35	33.16	0.78	0.33	11.36	4.81
-32	94.42	46.22	0.94	0.46	13.69	6.70
-30 -28	111.58 129.90	60.27 75.34	1.12 1.30	0.60 0.75	16.18 18.84	8.74 10.92
-26	149.40	91.48	1.49	0.73	21.66	13.26
-24	170.16	108.76	1.70	1.09	24.67	15.77
-22	192.22	127.21	1.92	1.27	27.87	18.45
-20	215.63	146.91	2.16	1.47	31.27	21.30
-18	240.45	167.89	2.40	1.68	34.87	24.34
-16 -14	266.73 294.53	190.22 213.95	2.67 2.95	1.90 2,14	38.68 42.71	27.58 31.02
-12	323.90	239.15	3.24	2.39	46.97	34.68
-10	354.89	265.87	3.55	2.66	51.46	38.55
-8	387.58	294.18	3.88	2.94	56.20	42.66
-6	422.01	324.12	4.22	3.24	61.19	47.00
-4	458.25	355.78	4.58	3.56	66.45	51.59
-2 0	496.35	389.21 424.47	4.96	3.89	71.97	56.44
2	536.37 578.38	461.63	5.36 5.78	4.24 4.62	77.77 83.87	61.55 66.94
4	622.44	500.77	6.22	5.01	90.25	72.61
6	668.61	541.94	6.69	5.42	96.95	78.58
8	716.94	585.22	7.17	5.85	103.96	84.86
10	767.52	630.68	7.68	6.31	111.29	91.45
12	820.39 875.63	678.39 728.43	8.20 8.76	6.78 7.28	118.96 126.97	98.37 105.62
16	933.30	780.86	9.33	7.81	135.33	113,22
18	993.50	835.77	9.94	8.36	144.06	121.19
20	1056.20	893.24	10.56	8.93	153.15	129.52
22	1121.50	953.30	11.22	9.53	162.62	138.23
24 26	1189.60 1260.40	1016.20 1081.80	11.90	10.16	172.49	147.35
28	1334.10	1150.30	12.60 13.34	10.82 11.50	182.76 193.44	156.86 166.79
30	1410.70	1221.70	14.11	12.22	204.55	177.15
32	1490.20	1296.30	14.90	12.96	216.08	187.96
34	1572.80	1374.00	15.73	13.74	228.06	199.23
36	1658.50	1454.90	16.59	14.55	240.48	210.96
38 40	1747.50 1839.70	1539,20 1626.90	17.48 18.40	15.39 16.27	253.39	223.18
42	1935.30	1718.20	19.35	17.18	266.76 280.62	235.90 249.14
44	2034.20	1813.20	20.34	18.13	294.96	262.91
46	2136.80	1911,90	21.37	19.12	309.84	277.23
48	2242.80	2014.60	22.43	20.15	325.21	292.12
50	2352.60	2121.30	23.53	21.21	341.13	307.59
52 54	2466.10 2583.50	2232.20 2347.30	24.66 25.84	22.32 23.47	357.58 374.61	323.67 340.36
56	2704.80	2467.00	27.05	24.67	392.20	357.72
58	2830.20	2591.30	28.30	25.91	410.38	375.74
60	2959.60	2720.40	29.60	27.20	429.14	394.46
62	3093.30	2854.60	30.93	28.55	448.53	413.92
64	3231.20	2994.00	32.31	29.94	468.52	434.13
66 68	3373.50 3520.20	3139.00 3289.80	33.74	31.39	489.16	455.16
70	3671.50	3446.80	35.20 36.72	32.90 34.47	510.43 532.37	477.02 499.79
72	3827.20	3610.60	38.27	36.11	554.94	523.54
74	3987.50	3781.70	39.88	37.82	578.19	548.35

TEMPERATURE GLIDE: APPROXIMATELY 1.5 DEG C

Refrigerant Solutions Limited

8 Murieston Road Hale, Altrincham Cheshire WA15 9ST

Tel: +44 (0) 161 926 9875 Fax: +44 (0) 161 926 9875 E-mail: rs@refsols.com

www.refsols.com

1 July 2011



PRODUCT SAFETY DATA SHEET

PRODUCT: RS-50 (R442A)

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

- 1.1 Identification of the preparation: RS-50
- 1.2 Company

Refrigerant Solutions Limited 8 Murieston Road Hale, Altrincham Cheshire WA15 9ST Tel: +44 (0) 161 926 9875

Fax: +44 (0) 161 926 9875

- 1.3 Emergency telephone number: +44 (0)161 926 9876
- 1.4 E-mail: rs@refsols.com Web site: www.ref-sols.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No
Pentafluoroethane	354-33-6
1,1,1,2-tetrafluoroethane	811-97-2
Difluoromethane	75-10-5
1,1,1,2,3,3,3-heptafluoropropane	431-89-0
1,1-Difluoroethane	75-37-6

PRODUCT: RS-50 (R442A)

3. HAZARDS IDENTIFICATION

Liquefied gas: May cause frostbite to skin and eyes.

4. FIRST-AID MEASURES

Eyes: If substance has got into the eyes immediately wash

out with plenty of water for at least 15 minutes.

Keep eye wide open while rinsing.

Skin: May cause frostbite. Wash frost-bitten area immediately with plenty of water.

Do not remove clothing. Wash affected skin with warm water. If skin irritation

persists, call a physician.

Inhalation: Move to fresh air in case of accidental inhalation of vapours. Oxygen or

artificial respiration if needed. Do not apply artificial respiration if patient is breathing. Consult a physician after significant exposure. Do not give

adrenaline or similar drugs.

Ingestion: Do not induce vomiting without medical advice.

Call a physician immediately. Do not give drugs from adrenaline-ephedrine group.

General advice: Consult a physician for severe cases.

5. FIRE-FIGHTING MEASURES

5.1 Suitable extinguishing media:

The product itself does not burn. Extinguish with carbon dioxide, dry chemical, foam or water spray, as appropriate for surrounding area.

PRODUCT: RS-50 (R442A)

Cont.

5.2 Extinguishing media which must not be used for safety reasons:

None

5.3 Specific hazards:

Possibility of generating hazardous reactions during a fire due to the presence of F groups. Fire or intense heat may cause violent rupture of packages.

5.4 Special protection equipment for fire fighters:

In the event of fire, wear self-contained breathing apparatus. Suitable protective clothing.

5.5 Specific methods:

Standard procedure for chemical fires. In the event of fire, cool exposed containers with water spray.

6 ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions:

Use Personal protective equipment. Evacuate personnel to safe areas. Ensure adequate ventilation. Avoid contact with skin, eyes and inhalation of vapour.

6.2 Methods for cleaning up:

Shut off leaks if without risk. Let the liquid evaporate. Ensure adequate ventilation.

HANDLING AND STORAGE

7.1 Handling: Provide sufficient air exchange and/or exhaust in work rooms. Do not

puncture or drop container.

7.2 Storage: Keep containers tightly closed in a cool, dry well-ventilated place away

from direct sunlight. Keep away from heat and sources of ignition.

PRODUCT: RS-50 (R442A)

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Engineering measures: Ensure adequate ventilation, especially in confined areas.

8.2 Personal protection equipment:

- Respiratory protection: In case of insufficient ventilation wear suitable respiratory equipment,

preferably a compressed airline breathing apparatus.

- Hand protection: Impervious gloves (butyl rubber).

- Eye protection: Wear as appropriate: safety glasses, goggles. Wear face-shield and

protective suit for abnormal processing problems.

- Skin and body protection: Chemical resistant apron, long sleeved clothing, safety shoes.

8.3 Exposure limit: Occupational Exposure Limit 1000 ppm (TWA).

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Appearance: Compressed liquefied gas

9.2 Colour: Colourless

9.3 Odour: Very faint ether-like

9.4 Boiling point/range: -46.5°C

9.5 Critical temperature: 82.4°C

9.6 Critical pressure: 690 psia

PRODUCT: RS-50 (R442A)

Cont.

9.7 Vapour pressure: (25°C) 192 psia

9.8 Liquid density: 1108 kg/m³ at 25°C

9.9 Water solubility: Insoluble

9.10 Flash point: Not applicable

9.11 Flammability: Not applicable

9.12 Explosion limit: Not applicable

9.13 Auto-ignition temperature: Not determined

10. STABILITY AND REACTIVITY

10.1 Stability: Stable at normal conditions. No decomposition if stored

and applied as directed.

10.2 Conditions to avoid: Fire/sources of heat.

10.3 Materials to avoid: Strong oxidising agents, alkali metals, alkaline earth metals,

finely divided aluminium.

10.4 Hazardous decomposition products: Hydrogen fluoride by thermal decomposition and hydrolysis.

11. TOXICOLOGICAL INFORMATION

11.1 Acute toxicity: HFC 125: LC 50 inhalation

(Rat)/4h:>800,000 ppm
HFC 134a: LC 50 inhalation
(Rat)/4h:>500,000 ppm
HFC32: LC50 inhalation
(Rat) 520,000 ppm
HFC227ea: LC50 inhalation
(Rat)4h, 800.000 ppm
HFC152a: LC50 inhalation
(Rat)4h, 500.000 ppm

PRODUCT: RS-50 (R442A)

Cont.

11.2 Irritation:

- Skin: slightly irritating, may cause frostbite

- Eyes: slightly irritating

12 ECOLOGICAL INFORMATION

Behaviour in the environment:

Mobility: Product is volatile when not under pressure.

Persistence/degradability: All the components decompose comparatively rapidly in

the lower atmosphere and all have relatively short

atmospheric lifetimes demonstrated below:

 HFC 134a
 14 years

 HFC 125
 29 years

 HFC32
 4.9 years

 HFC227ea
 34.2 years

 HFC152a
 1.4 years

Bioaccumulation: Not bioaccumulable.

Destination of the product:

Effects on the aquatic environment:

Discharge of the product will enter the atmosphere. No long term aqueous contamination due to low solubility.

PRODUCT: RS-50 (R442A)

13. DISPOSAL CONSIDERATIONS

Waste treatment: Refrigerant Solutions Limited will take back product for reclamation provided

RS-50 has not been mixed with any other products. If RS-50 is mixed with other refrigerants, the mixture can be destroyed by high temperature incineration in an approved facility capable of absorbing and neutralising

the by-products.

14. TRANSPORT INFORMATION

14.1 International regulations: UN number: 1078

- Rail/road (RID/ADR): Class: 2

Item number: 2°A

Hazard identification number: 20

Labelling: 2

- Sea (IMO/IMDG): Class: 2.2

Labelling: Gaz comprime flammable Not classified as a marine pollutant

- Air (ICAO-IATA): Class: 2.2

Labelling: Non-flammable gas

14.2 United Kingdom: Rail/road: Substance Identification number: 1078

14.3 Note: Given the possible evolution of transport regulations for hazardous materials.

it is recommended to check their validity

15 REGULATORY INFORMATION

Classification according to European Directive on classification of hazardous preparations 88/379/EEC. Not classified as dangerous. The product does not need to be labelled in accordance with EC directives.

PRODUCT: RS-50 (R442A)

Cont.

R-phrase(s): No R-phrases

S-phrase(s): S7/9 - Keep container tightly closed in a well-ventilated place

S24/25 – Avoid contact with skin and eyes

S47 – Keep at temperature not exceeding 50°C
 S51 – Use only in well ventilated areas
 S61 – Avoid release to the environment.

16. OTHER INFORMATION

The information provided in this Product Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process unless specified in the text.