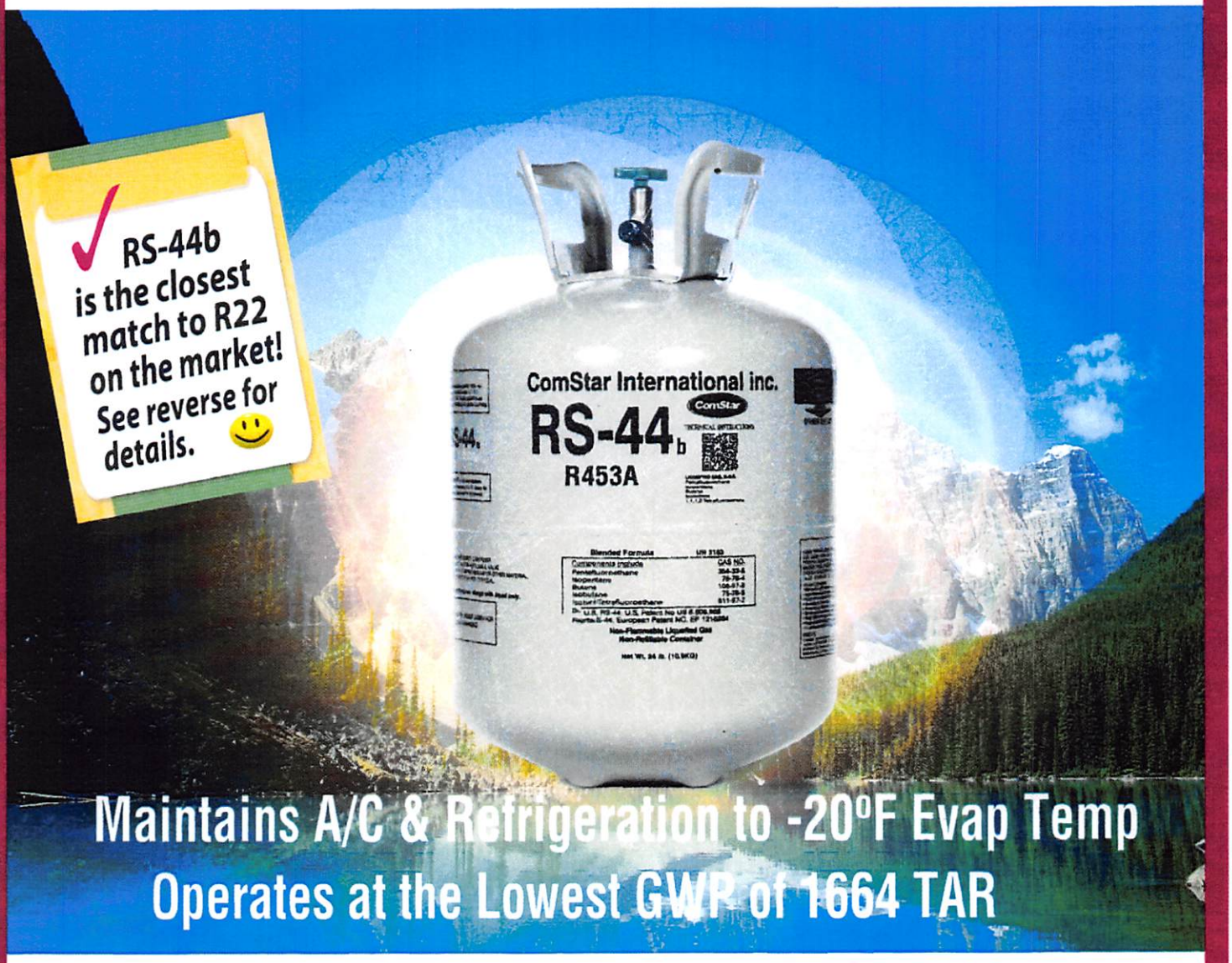
RS-44b

The *NEXT* Generation to replace R22!



Maintains A/C & Refrigeration to -20°F Evap Temp

Operates at the Lowest GWP of 1664 TAR

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

Made in the U.S.A.

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Refrigerant Comparison Checklist

R22

Phased out of production by 2020*

=

RS-44b

The only refrigerant for all R22 applications!

- ✓ Equal flow rate
- ✓ Similar discharge pressure
- ✓ Energy efficient
- ✓ Equal cooling capacity
- ✓ Non-flammable, non-toxic
- ✓ Ideal for A/C systems
- ✓ Maintains Refrigeration to -20°F Evap Temp
- ✓ Lowest GWP at 1664 TAR
- ✓ No oil change required
- ✓ Compatible with Mineral, AB & POE Oils
- ✓ Lower discharge temperature
- ✓ Zero ozone depleting
- ✓ Uses same service equipment
- ✓ No system or component changes necessary

Use RS44b for the closest match to R22!

ComStar — *Environmentally Safe, Industrial Strength Chemical Products*

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The Next Generation drop-in replacement for R22 in air conditioning & refrigeration has arrived!

REFRIGERANT SOLUTIONS LTD
RS44B
R22 DROP-IN
ZERO ODP

TRUE DROP-IN REPLACEMENT FOR FOR R-22. NO NEED TO REPLACE OIL OR COMPONENTS.

RS44B is the ANSWER to REPLACE R22!

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Made in the U.S.A.

All purpose, low GWP & zero OPDP Drop-in replacements for R22, & compatible with lubricants

RS44B is a new, non-flammable Drop-in replacement for R22 which has been designed to have the lowest possible Global Warming Potential (GWP) consistant with high thermodynamic performance having a similar cooling capacity & Coefficient of Performance (COP) as R22. Consequently, RS44B can be used to replace R22 in both air conditioning and refrigeration applications across the temperature range where R22 is commonly used.

RS44B is compatible both with the traditional mineral & alkylbenzene oils, and also the polyol ester lubricants so that there is no need to change the existing lubricant in the system when retrofitting to R22. With its high technical performance, compatibility with all lubricants and low GWP, RS44B is an excellent choice to replace R22 as the end of R22 approaches as mandated under the Montreal Protocol, the F Gas regulation in the European Union and other country based restrictions.

The GWP of RS44B is lower than all other Drop-in replacements for R22 available on the market including R438A, R417A, R422B, R422D, R4178B, and others. The GWD of RS44B is lower than R427A, R407A, R407F & R421A. However, this has not been achieved by sacrificing performance since RS44B is similar to R22 in terms of cooling capacity, COP, mass flow, compression ratio & discharge pressure while having a lower discharge temperature. Accordingly, RS44B is an excellent choice to replace R22 in the majority of applications where R22 is found.

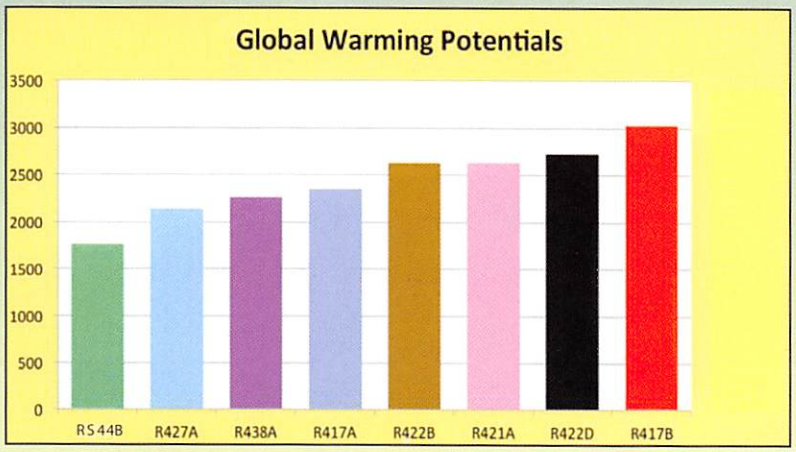
Performance Characteristics

- Lowest direct GWP Drop-in replacement for R22 on the market
- Similar energy efficiency to R22
- Close match for R22 in cooling capacity
- Similar discharge pressure to R22 & lower than R407C, R407A, R407F. R422D, R417B & R427A
- No changes to hardware required during retrofitting
- Compatible with MO, AB & POE lubricants
- Replaces R22 in air conditioning and refrigeration applications
- Similar flow rate to R22
- Application in systems with both fixed and variable expansion devices
- Lower discharge temperature than R22
- Zero Ozone Depletion Potential
- Non-flammable & low toxicity

REFRIGERANT SOLUTIONS LTD
RS44B
R22 DROP-IN
ZERO ODP

Low Global Warming Potential

The whole subject of global Warming and climatic change has become arguably one of the most important environmental issues of the day. Much research has been conducted on an international basis culminating in the recent report of the Inter Governmental Panel on Climate change, which concludes that there is overwhelming evidence of warming of the planet caused by man-made activities. Increasing quantities of carbon dioxide are considered as the prime cause of global warming taking place, and the Authorities are increasingly minded to restrict the emissions of materials with a GWP.



The recent IPCC report indicates that HFCs would contribute less than 2% to global warming, far less than the effects of carbon dioxide emitted by fossil combustion and deforestation. HFC refrigerants under-pin present refrigeration and air-conditioning technologies giving customers an excelle combination of high efficiency with low hazard. Nevertheless, governments are minded to increasingly restrict HFC emissions by regulation and/or taxation, (eg. revision of the F Gas regulation in the European Union in December 2013).

RS44B has been specifically designed to mitigate these changes to the refrigerant user by reducing the direct GWP of the refrigerant while not compromising its energy efficiency and technical properties as a suitable Drop-in replacement for R22.

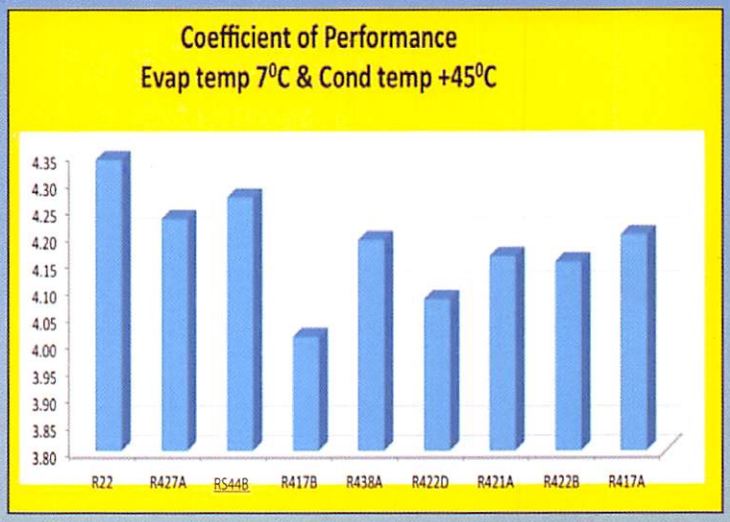
Applications

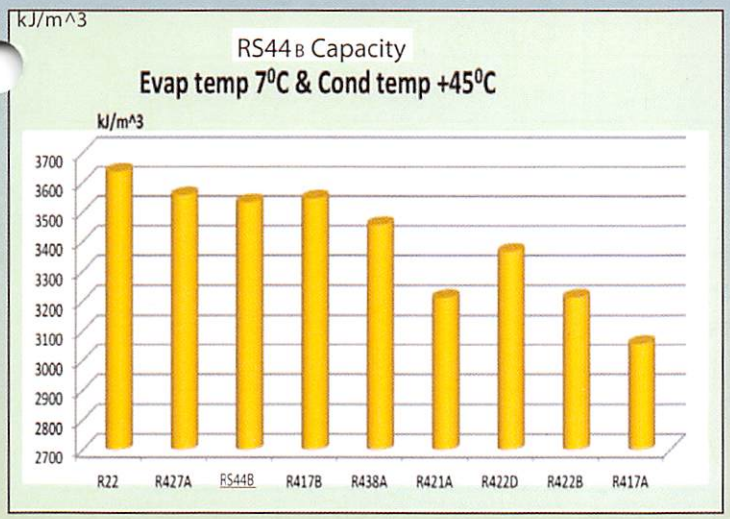
RS44B has similar energy efficiency, cooling capacity, mass flow rate, compression ratio & discharge pressure as R22. RS44B is therefore a single solution replacement for R22 across the range of applications where R22 is commonly found.

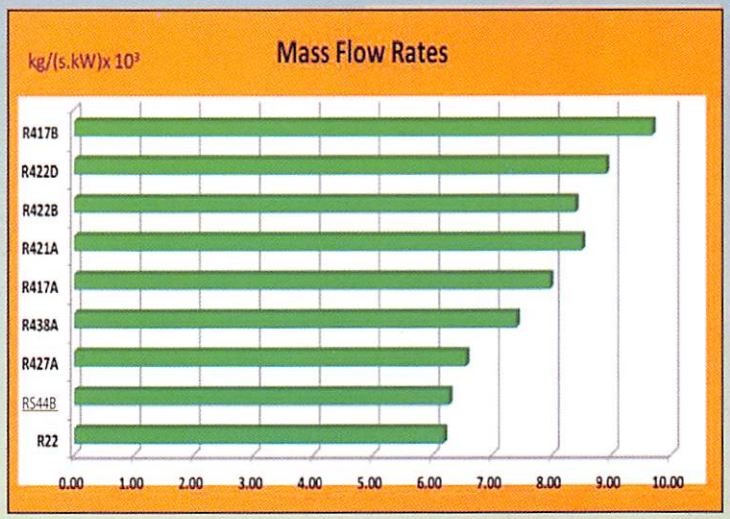
Because the mass flow of RS44B is similar to R22, RS44B can be freely used in systems both with a capillary, fixed orifice or variable expansion devices.

RS44B is compatible both with existing traditional lubricants, such as mineral & alkyl benzene oils, and also with polyol ester lubricants.

Applications for RS44B include but are not restricted to air conditioning, commercial & industrial refrigeration, chillers, beer cellars, cold stores, refrigerated transport, supermarkets, appliances, diary chillers, and others.







Lubricants

RS44B compatible with both the traditional & new synthetic lubricants so there is no need to change oil when converting from R22 to RS44B. RS44B is suitable for use with mineral, alkylbenzene and polyol ester oils.

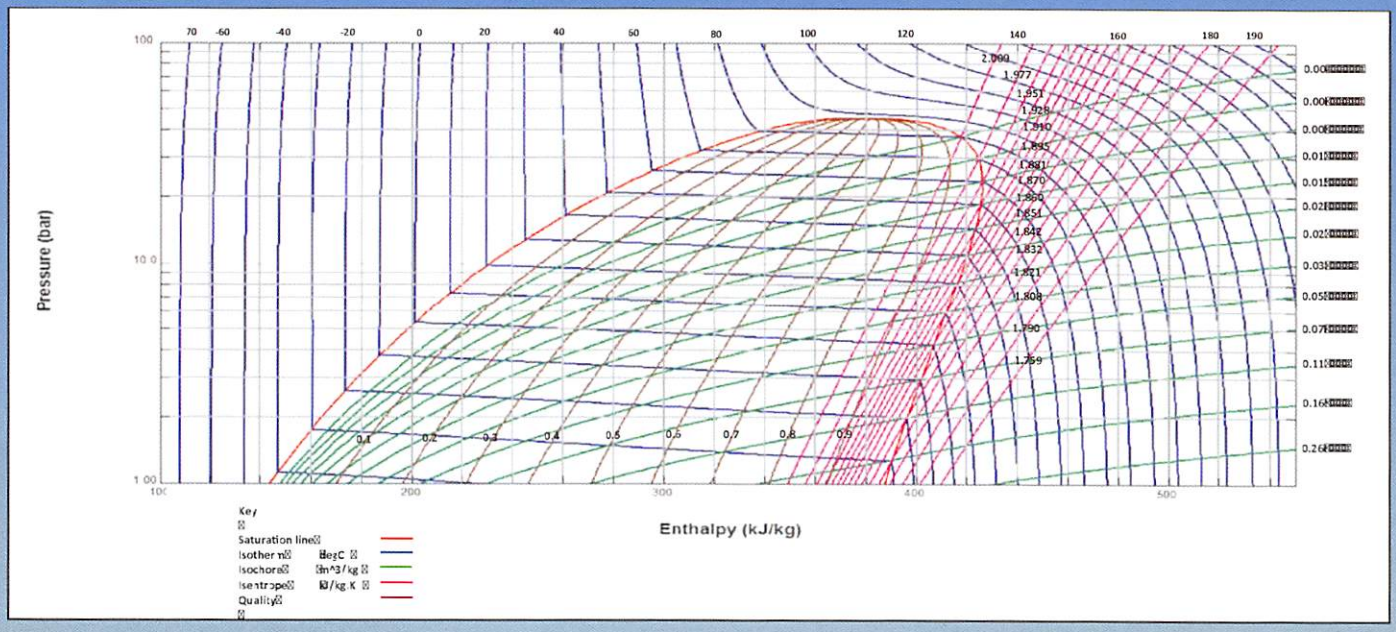
Safety

RS44B is non-flammable as per ASHRAE Standard 34. The components of RS44B have been subjected to toxicity tests carried out by the Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), and have benn declared to be low toxicity.

Servicing

Because RS44B is a blend, it should be charged into the system in the liquid as opposed to vapour form. There is no need to make any hardware changes when converting from R22 to RS44B and can be used with expansion devices having orifice or adjustable setting.

Pressure-Enthalpy Chart



		RS44B (2)	R22
Molecular Mass		88.8	86.5
Boiling point (1 atm) (1)	°C °F	- 42.2 - 44.0	- 40.8 - 41.5
Temperature Glide (4)	K	4.2	0.0
Critical Temperature	°C °F	87.9 109.3	96.1 205.1
Critical Pressure	bara psia	45.3 656.5	49.90 724
Liquid Density (25 °C) (1)	kg/m³	1136	1191
Density of saturated vapour (25 °C) (1)	kg/m3	41.69	44.23
Latent Heat of Vaporisation at boiling point (3)	kJ/kg	243.3	233.8
Heat capacity constant volume Cv (25 °C & 1bara)	kJ/kg.K	0.7458	0.5587
Heat capacity constant pressure Cp (25 °C & 1bara)	kJ/kg.K	0.8453	0.6619
Cp/Cv (25 °C & 1 bara)		1.137	1.185
Vapour Pressure (25 °C) (1)	bara psia	11.22 162.7	10.439 151.4
Vapour Viscosity (25 °C & 1 bara)	cP	0.0122	0.0126
Liquid Viscosity (25 °C) (1)	cP	0.1572	0.164
Liquid Thermal Conductivity (25 °C)	W/m.K	0.0833	0.0835
Surface Tension (25 °C) (1)	N/m	0.0072	0.00808
Specific heat of liquid (25 °C) (1)	kJ/kg.K	1.5209	1.2568
Ozone Depletion Potential	ODP	0	0.06
Flammability limit in air (1 atm)	vol%	none	none
Inhalation exposure (8 hour day & 40 hour week)	ppm	1000	1000
GWP AR4		1765	1810

Notes:
(1) Bubble Point
(2) RS44B refrigerant properties obtained from NIST's REFPROP program.
(3) Difference between bubble point liquid enthalpy and dew point vapour enthalpy at 1 atm.
(4) Evaporator temperature guide calculated using NIST CYCLE D in accordance with high evaporating condition specified in Standard EN 12900-2005 Section 7 Table 2 assuming 100% compressor and motor efficiencies.

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R22 DROP-IN REPLACEMENT ADVANTAGES OF RS-44b (R453A)

1. Same flow rate as R22
2. Similar discharge pressure as R22
3. Similar energy efficiency as R22
4. Matches R22 cooling capacity
5. No system component changes required
6. Replaces R22 in both A/C and Refrigeration down to -20°F evap. temp.
7. Lowest GWP HFC R22 replacement on the market at 1664 TAR
8. No oil change required
9. Compatible with mineral, AB and POE oils
10. Lower discharge temperature than R22
11. Zero Ozone Depletion
12. Use same service equipment as R22
13. Non-flammable & toxicity

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RS-44B

{R-453A)

COMPOSITION

HFC-134a	1,1,1,2-tetraflouroethane (HFC134A)
HF -125	Pentafluoroethane (HFC 125)
HFC-32	Difluoromethane (HFC 32)
HFC-227ea	1,1,1,2,3,3,3,-heptafluoropropane (HFC227)
R-600 n-butane	Butane (HC600)
R-601a isopentane Chemical name	Isopentane (HC601a)

Type	
HCFC Replacement	R22
Temperature glide	Approximately 4 C
Drop-in or long term	Both
Lubricant	MO/AB/POE
ODP	Zero
Atmospheric lifetime	16 years
GWP 100 year 1TH	1761
500 year 1TH	545

RS-44B(R-453A) PHYSICAL PROPERTIES		RS-44B	R22
Molecular weight		105.3	86.5
Boiling point (1 atm)	°C	-42.5 (1)	-40.8
	°F	-44.5 (1)	-41.4
Temperature glide	°C	4	0
Critical temperature	°C	87.5	96.1
	°F	189.6	204.8
Critical pressure	bara	45.7	49.9
	psia	663	724
Liquid density at 25°C	kg/m³	1132	1191
Density of saturated vapour at 25°C	kg/m³	42.1	44.2
Heat capacity of liquid at 25°C	kjkg°C	1.52	1.26
Ratio of gas heat capacities c_p/c_v, k)		1.137	1.185
Vapour pressure at 25°C	bara	11.3(1)	10.4
	psia	164(1)	151
Latent heat of vaporisation at Boiling point	kj/kg	256(1)	234
Ozone depletion potential	ODP	0	0.6
Flammability limit in air (1 atm)	vol%	None	None
Inhalation exposure (8 hr day & 40 hr week)	ppm	1000	1000

(1) Bubble point

TYPE and DESCRIPTION

RS-44B is a non flammable blend which has a zero ODP and is also compatible with both traditional and synthetic lubricants. RS-44B is a suitable replacement in both refrigeration and air conditioning applications, at low and high temperatures. With its low GWP relative to other refrigerants, RS-44B is an excellent replacement for R22 use in a wide range of applications. RS-44B can be used as a "Drop-in" replacement. R22 in systems which contain both a fixed orifice or an expansion device. Because there is no need to use expensive and hygroscopic synthetic lubricants, the risk of moisture ingress into a refrigerant system is completely avoided.

APPLICATIONS

RS-44B is suitable for use in the main applications normally occupied by R22 including commercial air conditioning, cold stores, supermarkets, dairy chillers, refrigerated transport, cellar cooling and others. RS-44B is equally suitable to replace R22 in low & high temperature applications.

LUBRICANTS

RS-44B 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-44B 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-44B. It is recommended to check equipment manufacturer's retrofit literature and obtain recommendations from equipment manufacturers with regard to materials' compatibility.

ENVIRONMENTAL DATA

None of the components of RS-44B contains chlorine so that it has no ability to deplete the ozone layer. As with all hydrofluorocarbons (HFCs), RS-44B does have a direct global warming potential (GWP), but this is counterbalanced by its lower Total Equivalent Warning Impact (TEWI).

EVAPORATOR SUPER HEAT

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

CONDENSER SUB-COOLING

To determine condenser sub-cooling, measure the temperature and the 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 actual temperature measured from the determined bubble point this difference is the condenser sub-cooling.

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RETROFIT PROCEDURE

The retrofit procedure for replacing R22 with RS-44B is as follows:

(1) If possible collect baseline data before conversion. Suction and discharge pressures can be converted to temperature using an R-22 pressure temperature conversion chart. Once the average evaporating and condensing temperatures have been deteremined they can be compared to the same temperatures after conversion

(2) Compressor oil levels and refrigerant charge should be recorded.

(3) Recover the R-22

(4) RS-44B (R-453A) is compatible with MO, AB and POE oils.
NOTE: If POE oil is used to replace MO or AB oils in the system, it is recommended that o-ring seals be replaced before starting the system.

(5) Evacuate the system and charge with RS-44B (R-453A) to 90% of the original R-22 charge.
NOTE: Remove RS-44B refrigerant from the cylinder in liquid form to prevent fractionation.

(6) Start the system and check and compare the baseline data, adjust thermostatic expansion valves as needed to the manufacturers recommended settings. Adjust all pressure controls to equivalent RS-44B (R453A) values. If fitted, adjust evaporator and/or condensor pressure regulator valves to maintain desired temperatures.

(7) Check system charge and add refrigerant if needed to match original charge levels. If the system is fitted with a liquid line sight-glass, charge to a full glass (small amounts of bubbles in the glass may be normal with refrigerant blends). If the equipment manufacturer recommends charging R22 by evaporator superheat or liquid sub-cooling, use the same amount of superheat or sub-cooling for RS-44B. Avoid overcharging.

(8) Compare new data with baseline data and confirm that evaporating and condensing temperatures are similar to the original R-22 temperatures. Carefully monitor the oil level in the compressor and add more oil if required to maintain the correct level. If the oil level does not stabilise and is erratic, some of the oil should be removed from the system and replaced with POE. Adopt the procedure in (9) below.

(9) In systems where oil return could be an area of potential concern, e.g. containing a liquid receiver, long & complex pipelines, the replacement of up to 25% of the oil charge with a POE is recommended starting with an initial 10% followed by increments of 5% until the oil level stabilises and returns to normal.

(10) Check system thoroughly for leaks.

(11) Clearly label the system as charged with RS-44B (R-453A).

NOTE: Systems with inherent poor oil return, often with unusually long suction lines and/or low temperature systems, may have improved RS-44 oil return capabilities with Alkylbenzene or polyol ester oils.

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RS-44b Pressure/Temperature Comparison

VALUES SHOWN: PSIG * DENOTES HG"

TEMPERATURE		RS-44b LIQUID BUBBLE PT.	RS-44b VAPOR DEW PT.	R-22
C	F	PSIG	PSIG	PSIG
-50	-58	9.1*	15.8*	11.4*
-48	-54.4	6.9*	14.1*	9.4*
-46	-50.8	4.6*	12.4*	7.2*
-44	-47.2	2.1*	10.5*	4.8*
-42	-43.6	0.3	8.4*	2.2*
-40	-40	1.8	6.1	0.3
-38	-36.4	3.4	3.6*	1.8
-36	-32.8	5.1	1*	3.4
-34	-29.2	6.9	0.9	5.1
-32	-25.6	8.9	2.5	6.9
-30	-22	11	4.2	8.9
-28	-18.4	13.2	6	11
-26	-14.8	15.6	7.9	13.2
-24	-11.2	18.2	10	15.6
-22	-7.6	20.9	12.2	18.1
-20	-4	23.8	14.6	20.8
-18	0.4	26.8	17.1	24.3
-16	3.2	30	19.8	26.7
-14	6.8	33.5	22.7	29.9
-12	10.4	37.1	25.7	33.3
-10	14	40.9	29	36.8
-8	17.6	45	32.4	40.6
-6	21.2	49.2	36	44.6
-4	24.8	53.7	39.9	48.7
-2	28.4	58.4	44	53.1
0	32	63.4	48.2	57.7
2	35.6	68.6	52.8	62.5
4	39.2	74.1	57.6	67.6
6	42.8	79.8	62.6	72.9
8	46.4	85.8	67.9	78.4
10	50	92.2	73.5	84.2
12	53.6	98.7	79.4	90.3
14	57.2	105.6	85.5	96.6
16	60.8	112.8	92	103.3
18	64.4	120.3	98.7	110.2
20	68	128.2	105.8	117.4
22	71.6	136.3	113.2	124.9
24	75.2	144.8	121	132.7
26	78.8	153.7	129.1	140.8
28	82.4	162.9	137.6	149.3
30	86	172.5	146.4	158.1
32	89.6	182.4	155.6	167.2
34	93.2	192.8	165.2	176.7
36	96.8	203.5	175.3	186.6
38	100.4	214.7	185.7	196.8
40	104	226.3	196.6	207.4
42	107.6	238.2	207.9	218.4
44	111.2	250.7	219.7	229.8
46	114.8	263.6	232	241.7
48	118.4	276.9	244.7	253.9
50	122	290.7	258	266.6
52	125.6	304.9	271.7	279.7
54	129.2	319.7	286	293.3
56	132.8	335	301	307.4
58	136.4	350.7	316.2	321.9
60	140	381.7	332.2	337

1/08/16

RS-44b (R453A) Q & A

1.Q: What is RS-44b?

A: RS-70 is a non ozone depleting Drop-in replacement for R22 in most applications.

2 Q: Yes, but what does RS-44b contain?

A: RS-44b is a blend of R125, R32, R134a, R227ea, butane, & isopentane.

3.Q: Is RS-44b 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-44b is subject to a phase out schedule under the Montreal protocol or any regulations.

4 Q: Can RS-44b be used with mineral and alkylbenzene lubricants?

A: Yes. There is no need to change to a synthetic polyol ester (POE) oil with RS-44b which operates satisfactorily with traditional lubricants.

5 Q: What is the temperature glide of RS-44b?

A: 4.2°C

6.Q: Is RS-44b non flammable and non toxic?

A; RS-44b is both non flammable and non toxic.

7 Q: Is RS-44b70 approved by compressor manufacturers?

A: The individual components which comprise RS-44b are widely used in compressors produced by major manufacturers.

8 Q: What is the compression ratio of RS-44b?

A: High compression ratios can result in increased energy expenditure and the potential for compressor damage. RS-44b has a compression ratio which matches R22 across the range of applications where R22 is commonly found

9 Q: Can RS-44b be used to top up a system containing R22?

A: it is not recommended that RS-44b is mixed with R22.No azeotropic mixtures are formed so that there will not be higher pressures by topping up a R22 system with R22.

10 Q: Is RS-44b as efficient as R22?

A: Tests show that RS-44b has a higher Coefficient of Performance than R22 and hence is considered to be more energy efficient than R22.

11 Q: What trials have been carried out on RS-44b and what are the results?

A: RS-44b has shown comparable results to R22 in systems where an expansion device is present. RS-44b is particularly effective at low temperatures. The results show good oil return to the compressor.

12 Q: Does RS-44b need to be charged in the liquid or gaseous form?

A: Because RS-44b 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.

13 Q: Does the RS-44b disposable cylinder have a dip tube?

A: No. The disposable should be inverted to discharge RS-44b in the liquid form.

14 Q: Is RS-44b on the SNAP (Significant New Alternative Policy) list in the USA?

A: Yes, RS-44b is on EPA's SNAP list for sale in the USA.

15 Q: Has RS-44b got an ASHRAE number?

A: Yes. RS-44b has been designated a refrigerant number of R453A by the ASHRAE & a safety classification of A1, namely low toxicity & non flammable under all conditions of fractionation.

16 Q: How does the pressure rating of RS-44b compare with R22?

A: The discharge pressure of RS-44b is about half a bar higher than R22.

17 Q: How does the capacity of RS-44b compare to R22?

A: The capacity of RS-44b matches R22 from high to low temperatures across the temperature range where R22 is commonly found.

18 Q: How does the temperature rating of RS-44b compare to R22?

A: The discharge temperatures of RS-44b are lower than R22.

19 Q: What are the flammability characteristics of RS-44b?

A: RS-44b is non flammable as formulated.

20 Q: What are the decomposition products resulting from the combustion of RS-44b?

A: The decomposition products resulting from subjecting RS-44b to a high temperature source are similar to those when R22 is 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.

21 Q: Are there any special precautions with RS-44b?

A: There are no specific precautions which must be taken with RS-44b. As with all refrigerants, common sense and good housekeeping is always recommended. Because the use of hygroscopic synthetic POE lubricants are avoided with RS-44b, scrupulous attention to preventing moisture contamination is not necessary, although the ingress of moisture should be avoided at all times.

22 Q: Is RS-44b compatible with refrigeration and air conditioning systems designed for R22?

A: Yes. RS-44b is compatible with all materials commonly used in systems that were designed and charged with R22. As in the case of R22, magnesium and zinc alloys should be avoided.

23 Q: Can RS-44b be recovered and recycled?

A: Yes. RS-44b can be recovered and re-used after a cleaning process such as reclamation.

24 Q: What technical guidance do you advise when changing from R22 to RS-44b?

A: The procedure for converting from R22 to RS-44b is straightforward. Use the same type of lubricant, replace the filter/drier and charge the same quantity of RS-44b as the original R22 charge after fully evacuating.

25 Q: How does RS-44b compare in price with other R22 alternatives?

A: RS-44b is competitive in price with other R22 alternatives.

26 Q: What is the main advantage of RS-44b?

A: RS-70 has a lower GWP than most replacements for R22. RS-44b is a suitable replacement for R22 across the range of temperatures where R22 is commonly found at high and low temperatures. RS-44b can be used to replace R22 without the need to change the original mineral oil in the system. There is, therefore, no necessity to retrofit to a synthetic lubricant such as POE.

27 Q: Is RS-44b compatible with hoses, seals, gaskets and O-rings commonly used with R22?

A: Yes. Because the original mineral oil is being used and not a synthetic lubricant, elastomers and plastics used with R22 are compatible with RS-44b.

28 Q: How does the Coefficient of Performance (COP) of RS-44b compare with R22?
A: Tests show that RS-44b provides a higher COP than R22 depending upon the application, equipment and system design...all these are factors.

29 Q: What is the specification for RS-44b?

A: RS-44b complies with the refrigerant specification AHRI 700 – 2004 for fluorocarbon refrigerants.

30 Q: What is the effect of high exposure by inhalation of RS-44b?

A: As is the case with all CFC, HCFC and HFC based refrigerants, high exposure to RS-44b 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.

31 Q: What is the flash point, flammability explosion limits and auto-ignition temperature for RS-44b?

A: RS-44b is non flammable as formulated and does not have a flash point or explosion limits. The auto-ignition temperature of RS-44b has not been determined but is expected to be greater than 750°C.

32: What types of leak detectors should be used with RS-44b?

A: Leak detectors used with HFCs are suitable for use with RS-44b.

33: What would be the effect of a large release of RS-44b?

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.

34 Q: Is RS-44b available in both returnable and disposable cylinders:

A: Yes.

35: Can RS-44b be used in systems designed to replace R22 and initially charged with a hydrocarbon?

A: Although no development work has been carried out on hydrocarbon systems designed to replace R22, we believe that RS-44b would be suitable but an increased refrigerant charge would be required.

36: Can RS-44b be added to systems containing R22 or RS-44 (R424a) without materially affecting the performance of the whole system?

A: First and foremost, the EPA does not condone, recommend or approve of mixing any refrigerants. However, RS-44b does not form an azeotropic mixture with R22 or RS-44 (R424a). Therefore, if a technician inadvertently or unknowingly adds RS-44b to R22 or a system containing RS-44 (R424a) the system will not generate any higher pressures and should operate as normal without any harm to system components..

RS44B (R453A)

Safety Data Sheet

06/01/2015

SECTION 1: IDENTIFICATION

Product identifier

Product Form: Mixture

Product Name: In USA as RS44B (R453A)

Alternate Names: Blended Formula**Intended Use of the Product**

Refrigerant

Name, Address, and Telephone of the Responsible Party

Company

ComStar International Inc.
20-45 128th Street,
College Point, NY 11356
Emergency Telephone Number
Emergency number :(800) 328-0142, (718) 445-7900

SECTION 2: HAZARDS IDENTIFICATION

Classification of the Substance or Mixture
Classification (GHS-US)
Simple Asphyxiant
Liquefied gas H280

Label Elements

GHS-US Labeling

Hazard Pictograms (GHS-US) :

Signal Word (GHS-US) : Warning

Hazard Statements (GHS-US) : H280 - Contains gas under pressure; may explode if heated
May displace oxygen and cause rapid suffocation

Precautionary Statements (GHS-US) : P410+P403 - Protect from sunlight. Store in a well-ventilated place

Other Hazardsx

Other Hazards Not Contributing to the Classification: Exposure may aggravate those with pre-existing eye, skin, or respiratory conditions. Liquid contact with eyes or skin may cause frostbite.

Unknown Acute Toxicity (GHS-US) Not available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Substances-Name	Product identifier	% (w/W)	Classification (GHS-US)
1,1,1,2,3,3,3 Heptafluoropropane (HFC 227)	(CAS No) 431-89-0	5	Simple Asphyxiant Liquefied gas, H280
Pentafluoroethane (HFC125)	(CAS No) 354-33-6	20	Simple Asphyxiant Liquefied gas, H280
1,1,1,2-Tetrafluoroethane (HFC-134a)	(CAS No) 811-97-2	53.8	Simple Asphyxiant Liquefied gas, H280
Difluoromethane (HFC-32)	(CAS No) 75-10-5	20	Simple Asphyxiant Flam. Gas 1, H220 Liquefied gas, H280
Butane (HC-R600)	(CAS No) 106-97-8	0.6	Simple Asphyxiant Flam. Gas 1, H220 Liquefied gas, H280
Isopentane (HC-R601a)	(CAS No) 78-78-4	0.6	Simple Asphyxiant Flam. Gas 1, H220 Liquefied gas, H280

Full text of H-phrases: see section 16

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label if possible).

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Obtain medical attention if breathing difficulty persists.
Skin Contact: Rinse immediately with plenty of water. Obtain medical attention if irritation develops or persists.
Eye Contact: Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention.
Ingestion: Do NOT induce vomiting. Rinse mouth. Immediately call a POISON CENTER or doctor/physician.

Most Important Symptoms and Effects Both Acute and Delayed

General: Vapors are heavier than air and may cause asphyxia by reduction of the oxygen content.
Inhalation: May cause respiratory irritation.
Skin Contact: May cause skin irritation. Liquid contact may cause frostbite.
Eye Contact: May cause eye irritation.
Ingestion: Ingestion is likely to be harmful or have adverse effects.
Chronic Symptoms: None expected under normal conditions of use.

Indication of Any Immediate Medical Attention and Special Treatment Needed

If you feel unwell, seek medical advice (show the label where possible).

SECTION 5: FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media: Use extinguishing media appropriate for surrounding fire.
Unsuitable Extinguishing Media: None known.

Special Hazards Arising From the Substance or Mixture

Fire Hazard: RS - 44 is not flammable at atmospheric pressure and in air at temperatures up to 100 °C (212 °F). RS - 44 should not exist with air/excess oxygen at elevated pressures and high temperatures. RS - 44 Can become combustible with high concentrations of air at elevated pressure and/or temperature and in the presence of an ignition source. These substance can also become combustible in an oxygen enriched environment (oxygen concentrations greater than that in air). For example, do not mix RS - 44 with air under pressure for leak detection purposes.
Explosion Hazard: Product is not explosive. Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries.
Reactivity: Hazardous reactions will not occur under normal conditions.

Advice for Firefighters

Precautionary Measures Fire: Exercise caution when fighting any chemical fire.
Firefighting Instructions: Use water spray or fog for cooling exposed containers.
Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.
Hazardous Combustion Products: Carbon oxides (CO, CO2). Halogenated hydrocarbons. Hydrogen Fluoride (HF).

Reference to Other Sections

Refer to section 9 for flammability properties.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Avoid all contact with skin, eyes, or clothing. Avoid breathing vapors.

For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protection equipment (PPE).
Emergency Procedures: Evacuate unnecessary personnel.

For Emergency Personnel

Protective Equipment: Equip cleanup crew with proper protection.
Emergency Procedures: Stop leak if safe to do so. Ventilate area.

Environmental Precautions

Avoid release to the environment.

Methods and Material for Containment and Cleaning Up

For Containment: Ventilate area.
Methods for Cleaning Up: Isolate area until gas has dispersed.

Reference to Other Sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: HANDLING AND STORAGE

Precautions for Safe Handling

Additional Hazards When Processed: Ruptured cylinders may rocket.
Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work.

Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Comply with applicable regulations.
Storage Conditions: Store in a dry, cool and well-ventilated place. Keep container closed when not in use. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials.
Incompatible Materials: Strong acids. Strong bases. Strong oxidizers. Chlorine.
Storage Area: Store in a well-ventilated place.

Specific End Use(s)
Refrigerant.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters

Butane (HC-R600) (106-97-8) / Isopentane (HC-R601a) (78-78-4) / Difluoromethane (HFC-32) (75-10-5)		
USA ACGIH	ACGIH STEL (ppm)	1000 ppm
USA NIOSH	NIOSH REL (TWA) (mg/m3)	1900 mg/m3
USA NIOSH	NIOSH REL (TWA) (ppm)	800 ppm
Manitoba	OEL STEL (ppm)	1000 ppm
Newfoundland & Labrador	OEL STEL (ppm)	1000 ppm
Nova Scotia	OEL STEL (ppm)	1000 ppm
Ontario	OEL TWA (ppm)	800 ppm
Prince Edward Island	OEL STEL (ppm)	1000 ppm
Saskatchewan	OEL STEL (ppm)	1250 ppm
Saskatchewan	OEL TWA (ppm)	1000 ppm
Pentafluoroethane (HFC125 (354-33-6) / 1,1,1,2,3,3,3 Heptafluoropropane (HFC 227) (431-89-0)		
AEL*	OEL 8 & 12 hr TWA (ppm)	1000 ppm
AIHA WEEL	OEL 8 hr TWA	1000 ppm, 4900 mg/m3
1,1,1,2-Tetrafluoroethane (HFC-134a) (811-97-2)		
AEL*	OEL 8 & 12 hr TWA (ppm)	1000 ppm
AIHA WEEL	OEL 8 hr TWA	1000 ppm, 4900 mg/m3

Exposure Controls

Appropriate Engineering Controls: Ensure adequate ventilation, especially in confined areas. Ensure all national/local regulations are observed.

Personal Protective Equipment: Protective goggles. Gloves. Protective clothing.

Materials for Protective Clothing: Chemically resistant materials and fabrics.

Hand Protection: Impervious butyl rubber gloves.

Eye Protection: Chemical goggles or safety glasses.

Skin and Body Protection: Wear suitable protective clothing.

Respiratory Protection: Use a NIOSH-approved respirator or self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limits.

Environmental Exposure Controls: Do not allow the product to be released into the environment.

Consumer Exposure Controls: Do not eat, drink or smoke during use

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State	: Liquefied Gas
Appearance	: Colorless
Odor	: Slightly ethereal
Odor Threshold	: Not available
pH	: Neutral
Relative Evaporation Rate (butylacetate=1)	: Not available
Melting Point	: Not available
Freezing Point	: Not available
Boiling Point	: Dew @ 1 atm. -35.9 °C (-32.6 °F) Bubble @ 1 atm. -41.3 °C (-42.4 °F)
Flash Point	: Not available
Auto-ignition Temperature	: > 550 °C (1022 °F)
Decomposition Temperature	: Not available
Flammability (solid, gas)	: Not available
Lower Flammable Limit	: Not available
Upper Flammable Limit	: Not available
Vapor Pressure	: @ 20 °C (68 °F) 120.6 psia @ 60 °C (140 °F) 340.3psia

Relative Vapor Density at 20 °C	: Not available
Relative Density	: Not available
Density	: Liquid @ 1 atm. 87.25 lb/ft3 Vapor @ 1 atm. .3633 lb/ft3
Specific Gravity	: Not available
Solubility	: Not available
Partition coefficient	: n-octanol/water Not available
Viscosity	: Not available
Explosion Data - Sensitivity to Mechanical Impact	: Not expected to present an explosion hazard due to mechanical impact.
Explosion Data - Sensitivity to Static Discharge	: Not expected to present an explosion hazard due to static discharge.

SECTION 10: STABILITY AND REACTIVITY

Reactivity: Hazardous reactions will not occur under normal conditions.
Chemical Stability: Stable under recommended handling and storage conditions (see section 7).
Possibility of Hazardous Reactions: Hazardous polymerization will not occur.
Conditions to Avoid: Direct sunlight. Extremely high or low temperatures. Ignition sources. Incompatible materials.
Incompatible Materials: Strong acids. Strong bases. Strong oxidizers.
Hazardous Decomposition Products: Halogenated hydrocarbons. Hydrogen Fluoride (HF).

SECTION 11: TOXICOLOGICAL INFORMATION

Information on Toxicological Effects - Product
Acute Toxicity: Not classified
LD50 and LC50 Data: Not available
Skin Corrosion/Irritation: Not classified
Serious Eye Damage/Irritation: Not classified
Respiratory or Skin Sensitization: Not classified
Germ Cell Mutagenicity: Not classified
Teratogenicity: Not available
Carcinogenicity: Not classified
Specific Target Organ Toxicity (Repeated Exposure): Not classified
Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Single Exposure): Not classified
Aspiration Hazard: Not classified
Symptoms/Injuries After Inhalation: May cause respiratory irritation.
Symptoms/Injuries After Skin Contact: May cause skin irritation. Liquid contact may cause frostbite.
Symptoms/Injuries After Eye Contact: May cause eye irritation.
Symptoms/Injuries After Ingestion: Ingestion is likely to be harmful or have adverse effects.
Chronic Symptoms: None expected under normal conditions of use.
Information on Toxicological Effects - Ingredient(s)
LD50 and LC50 Data:

Pentafluoroethane (HFC125) (354-33-6) / Difluoromethane (HFC-32) (75-10-5)	
LC50 Inhalation Rat	2910 g/m3 (Exposure time: 4 h)
ATE US (vapors)	2,910.00 mg/l/4h
ATE US (dust, mist)	2,910.00 mg/l/4h
Butane (HC-R600) (106-97-8) / Isopentane (HC-R601a) (78-78-4) / 1,1,1,2,3,3,3 Heptafluoropropane (HFC 227) (431-89-0)	
LC50 Inhalation Rat	658 mg/l/4h
ATE US (vapors)	658.00 mg/l/4h
ATE US (dust, mist)	658.00 mg/l/4h
1,1,1,2-Tetrafluoroethane (HFC-134a) (811-97-2)	
LC50 Inhalation Rat	1500 g/m3 (Exposure time: 4 h)
ATE US (vapors)	1,500.00 mg/l/4h
ATE US (dust, mist)	1,500.00 mg/l/4h

SECTION 12: ECOLOGICAL INFORMATION

Toxicity Not classified
Persistence and Degradability Not available
Bioaccumulative Potential

Butane (HC-R600) (106-97-8) / Isopentane (HC-R601a) (78-78-4)	
BCF fish 1	1.57 - 1.97
Log Pow	2.88 (at 20 °C)

Mobility in Soil Not available
Other Adverse Effects
Other Information: Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Recommendations: Recover, reclaim or recycle when practical. Dispose of waste material in accordance with all local, regional, national, and international regulations. This product is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling. Contact a certified reclaimer for recovery/reclaimtion of this product.
Ecology - Waste Materials: Avoid release to the environment.

SECTION 14: TRANSPORT INFORMATION

14.1 In Accordance with DOT
Proper Shipping Name : LIQUEFIED GAS, N.O.S.(Pentafluoroethane, 1,1,1,2-Tetrafluoroethane)
Hazard Class : 2.2
Identification Number : UN3163
Label Codes : 2.2
ERG Number : 126

14.2 In Accordance with IMDG
Proper Shipping Name : LIQUEFIED GAS, N.O.S.(Pentafluoroethane, 1,1,1,2- Tetrafluoroethane)
Hazard Class : 2.2
Identification Number : UN3163
Label Codes : 2.2
EmS-No. (Fire) : F-C
EmS-No. (Spillage) : S-V

14.3 In Accordance with IATA
Proper Shipping Name : LIQUEFIED GAS, N.O.S.(Pentafluoroethane, 1,1,1,2-Tetrafluoroethane)
Identification Number : UN3163
Hazard Class : 2.2
Label Codes : 2.2
ERG Code (IATA) : 2L

14.4 In Accordance with TDG
Proper Shipping Name : LIQUEFIED GAS, N.O.S.(Pentafluoroethane, 1,1,1,2- Tetrafluoroethane)
Hazard Class : 2.2
Identification Number : UN3163
Label Codes : 2.2

SECTION 15: REGULATORY INFORMATION

US Federal Regulations

RS44B (R453A)	
SARA Section 311/312 Hazard Classes	Sudden release of pressure hazard
RS44B (R453A)	
EPA Clean Air Act	This product is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82

Pentafluoroethane (HFC125) (354-33-6) / Difluoromethane (HFC-32) (75-10-5)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

Butane (HC-R600) (106-97-8) / Isopentane (HC-R601a) (78-78-4)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

1,1,1,2-Tetrafluoroethane (HFC-134a) (811-97-2) / 1,1,1,2,3,3,3 Heptafluoropropane (HFC 227) (431-89-0)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

US State Regulations

Difluoromethane (HFC-32) (75-10-5)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List

Canadian Regulations

RS44B (R453A)	
WHMIS Classification	Class A - Compressed Gas

Pentafluoroethane (HFC125) (354-33-6) / Difluoromethane (HFC-32) (75-10-5)	
Listed on the Canadian DSL (Domestic Substances List) inventory.	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

Butane (HC-R600) (106-97-8) / Isopentane (HC-R601a) (78-78-4)	
Listed on the Canadian DSL (Domestic Substances List) inventory.	
WHMIS Classification	Class A - Compressed Gas Class B Division 1 - Flammable Gas

1,1,1,2,3,3,3 Heptafluoropropane (HFC 227) (431-89-0)	
Listed on the Canadian DSL (Domestic Substances List) inventory.	
WHMIS Classification	Class A - Compressed Gas

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all of the information required by CPR.

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Revision date : 05/01/2015

Other Information : This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200.

GHS Full Text Phrases:

Compressed gas	Gases under pressure Compressed gas
Flam. Gas 1	Flammable gases Category 1
Liquefied gas	Gases under pressure Liquefied gas
Simple Asphyxiant	Simple Asphyxiantxiant
H220	Extremely flammable gas
H280	Contains gas under pressure; may explode if heated

Party Responsible for the Preparation of This Document

ComStar International Inc.
20-45 128th Street,
College Point, NY 11356
(800) 328-0142
www.comstarproducts.com

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

North America GHS US 2012 & WHMIS

NOTE

RS-44B (R453A) IS THE USA DESIGNATION FOR RS-70 (R453A)

THE FOLLOWING PAGES WILL REFER TO RS-70

ComStar is the exclusive manufacturer and distributor for the RS refrigerants in the USA

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Website: www.comstarproducts.com

REFRIGERANT SOLUTIONS LTD
RS-70
R22 DROP-IN
ZERO ODP

RS-70

NEW LOW GWP DROP-IN REPLACMENT FOR R22

PERFORMANCE COMPARISON WITH SIX EXISTING REFRIGERANTS

Summary

Independent tests were conducted on RS-70 and six other refrigerants under the same conditions. The results demonstrate that RS-70 has good energy efficiency providing a high cooling capacity with a lower power input and so can be used satisfactorily as a replacement for R22.

1 Refrigerants

Gases, Research, Innovation & Technology S.L (GRIT), a Barcelona based refrigeration company, provided 6 unnamed samples of refrigerants to DIRA S.L. (Desenvolupament, Investigació i Recerca Aplicada S.L.) for testing in a suitable calorimeter. Only the identity of R22 was known to DIRA before the trials started. The identities of the other refrigerants were declared at the end of the tests:

Sample 1 - RS-70
Sample 2 - R22
Sample 3 - R438A (MO99)
Sample 4 - R422D (MO29)
Sample 5 - R417A (MO59)
Sample 6 - R424A (RS-44)
Sample 7 - R434A (RS-45)

2. Calorimeter cycle

Calorimeter cycle used to carry out the different tests was specifically designed to measure refrigerants' performance.

Compressor
GELPHA 1,5 HP K7.2X model
Wide range of working temperatures

from

REFRIGERANT SOLUTIONS LIMITED

Condenser
Air-cooled
HRT/4-400-5PN model

Expansion valve
Danfoss TES2 model

Evaporator and Cooling load
The cooling load consisted of a mixture of 25 litres of propylene glycol and 25 litres of water, contained in a cylinder of 50 litres and was stirred in order to ensure good heat transfer and rapid approach to thermal equilibrium. The evaporator was formed of three copper coils (15 metres each coil), wound around the cooling load cylinder and contained within an outer cylinder. The narrow space between the inner outer cylinders was filled with a mixture of ethylene glycol and water (5 litres of each) which provided good heat transfer from the thermal cooling load to the evaporator coils.

Measurements
All the tests were carried out under the same conditions with the same refrigeration circuit and equipment. Pressures were recorded with a Testo 570-2 device, while temperatures were measured using three other Testo devices. Power input was measured with Landis Gyr counters.

With these instruments it was possible to record:

- Condensation and evaporation pressures.
- Temperature at the end of the condenser.
- Temperature in the middle of the condenser.
- Discharge temperature.
- Liquid temperature condenser outlet.
- Temperature of the top of the outside cylinder.
- Temperature in the middle point of the outside cylinder.
- Temperature of the bottom of the outside cylinder.
- Evaporator outlet temperature.
- Temperature at the inlet of the expansion valve.
- Temperature of the thermal inertia load.
- Power input.

Suction superheat
During the different tests, refrigerant identities were unknown (except R22), so it was not possible to calculate suction superheat using thermodynamic tables. As a consequence, it was necessary to use temperature probes at different evaporator levels.

Average evaporation temperature was estimated according to R22 data. The bubble point temperature was obtained adding half of the glide to the average evaporation temperature. From this last temperature, the aim was to reach an evaporator outlet superheat of about 5°C.

3. Test results - graphs

3.1 Cooling capacity

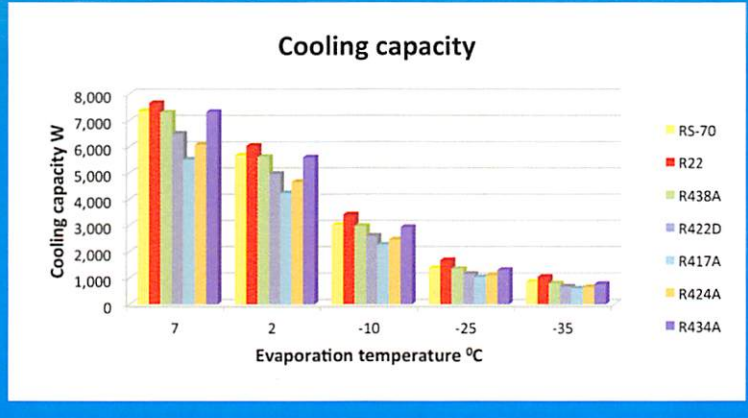

Figure 1 - Cooling capacity as a function of evaporation temperature

The cooling capacity of RS-70 is shown to be only slightly lower than R22 and higher than all the other refrigerants

3.2 Power input

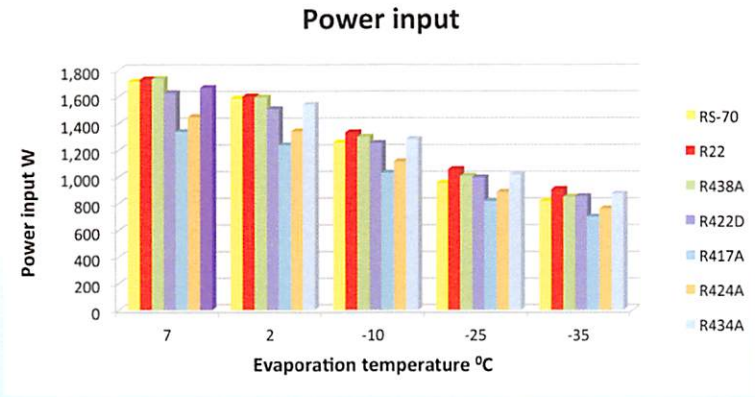

Figure 2 - Power input as a function of evaporation temperature

3.3 Coefficient of Performance

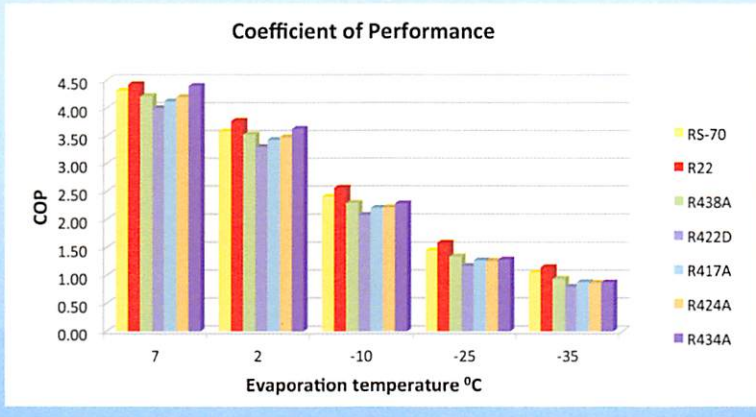

Figure 3 - COP as a function of evaporation temperature

This graph shows that the COP of RS-70 (sample 1) is comparable to R22 COP (sample 2). In other words, RS-70 reaches a high cooling capacity with a low power input.

3.4. Suction pressure, discharge pressure and discharge temperature

3.4.1 Suction pressure

Pressures shown in the graph were obtained through experimental measurement.

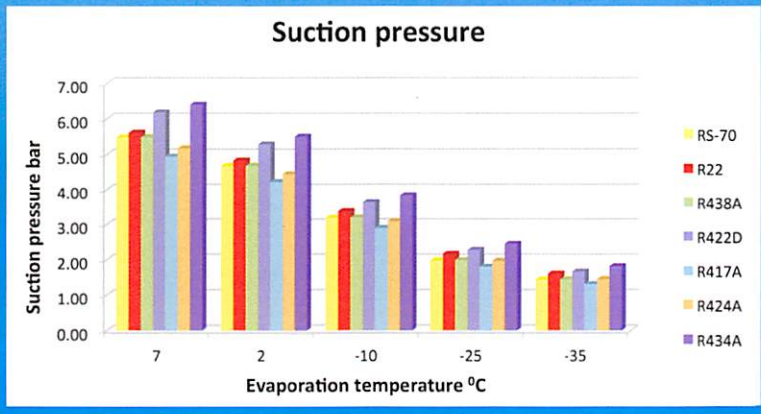

Figure 4 - Suction pressure as a function of evaporation temperature

From this graph, it can be seen that RS-70 suction pressure is a little lower than R22, and similar to sample 3 (MO99).

3.4.2 Discharge pressure

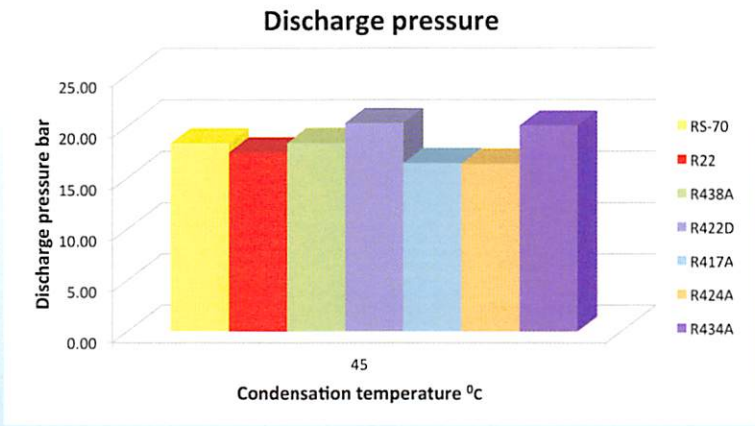

Figure 5 - Discharge pressure as a function of condensation temperature

This graph shows that RS-70 discharge pressure is lower than R22, similar to sample 3 (MO99) and lower than sample 4 (MO29).

3.4.3 Discharge temperature

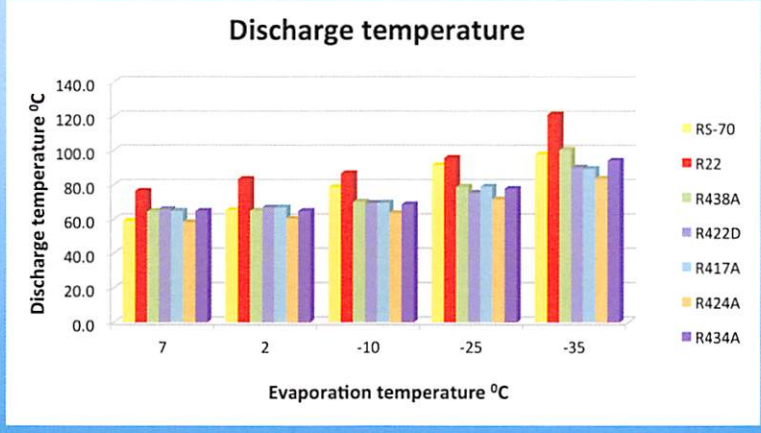

Figure 6 - Discharge temperature as a function of evaporation temperature

This graph shows that RS-70 discharge temperature is lower than R22 and all the other refrigerants with the exception of sample (RS-44).

4. Conclusions

RS-70 compares favourably with the other five alternatives to R22, but with the lowest Global Warming Potential (GWP) thereby providing the optimum combination of good thermodynamic properties with environmental performance.

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RS-70 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

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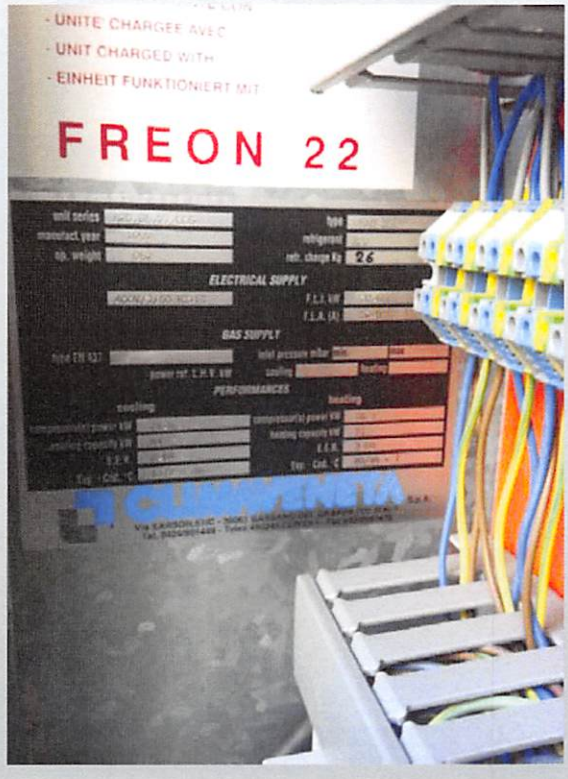
RS-70

REPLACES R22 AT THE POLYTECHNIC UNIVERSITY OF CATALONIA (UPC)

PERIOD: DECEMBER 2013-JANUARY 2014

Cooling unit with network analyser



Features panel

Alberto Lapuente
Head of Maintenance, Nord Campus
Infrastructures & Maintenance Unit

January 2014

from

REFRIGERANT SOLUTIONS LIMITED

1. EQUIPMENT STUDIED

To carry out the present study, the equipment on which the performance analysis was run was a heat-fired boiler in operation at the archive of the Rector Gabriel Ferraté Library at the Nord Campus of the Polytechnic University of Catalonia (UPC).

Located on basement floor 1, the unit has a cooling thermal power of 64kW, a heating thermal power of 71kW, an electric power of 30.65kW, a 2.69 EER and a 3.09 COP.

The chiller, from the year 1997, with R22 refrigerant and with a charge of 26 kg, is a circuit with a semi-hermetic Copeland-brand compressor. The oil is mineral 3GS and is in good condition.

The chiller is used to produce cold and hot air during winter, in accordance with the requirements of the area served, and that is the mode in which the study was performed, both the initial one with the old refrigerant and the one carried out following the replacement, at a time when the working conditions were considered to be similar.

Semi-hermetic compressor with heat exchangers

2. BACKGROUND FIGURES

Monitoring of the equipment began on 26 November 2013, using an HT-brand network analyser (portable equipment) and ended on 16 December 2013. Figures were obtained on consumption, power, energy, voltage and intensities.

Other data were also recorded when the equipment was running, such as suction and discharge pressure and discharge temperature.

Operation was also analysed at the start, checking that the circuit was in optimal cooling charge conditions.
A superheat level of 8°C was obtained, along with a subcooling level of 11°C

R22				
DATE	DISCHARGE PRESSURE (bar)	SUCTION PRESSURE (bar)	DISCHARGE TEMP (°C)	MODE OF OPERATION
26/11/2013	19	3.3	75	HEATING
27/11/2013	17.7	3.1	73	HEATING
28/11/2013	14.3	3.7	63	COOLING
29/11/2013	18.2	3.2	69.5	HEATING
02/12/2013	18.5	3	72	HEATING
03/12/2013	18.8	4.7	79	HEATING

R22				
DATE	DISCHARGE PRESSURE (bar)	SUCTION PRESSURE (bar)	DISCHARGE TEMP (°C)	MODE OF OPERATION
04/12/2013	19.6	3.4	82.7	HEATING
05/12/2013	19.1	3.7	80.2	HEATING
09/12/2013	16.5	3.2	65.3	COOLING
10/12/2013	19	3.6	78.2	HEATING
11/12/2013	18.6	3.5	69.6	HEATING
12/12/2013	19.2	3.3	75	HEATING
13/12/2013	12.4	2.6	69	COOLING

5. CONCLUSIONS

The first point to note with regard to the refrigerant replacement process was the absence of incidences.

The refrigerant has a temperature glide that must be considered when recharging, but the equipment may also be charged by weight, so the error margin is slight; with the same weight the chiller presented similar superheat and subcooling levels.

No changes could be seen with regard to the oil and the different oil pressure readings for the equipment were the same.

With regard to discharge and suction pressures, these were very similar to those of R22.

In terms of performance, it must be noted that the discharge temperature was slightly lower, a positive feature as it means slightly less wear and tear of the internal parts of the compressor, among other factors.

As we can see on the Power consumption chart above, the results were fairly similar to those obtained for R22, and there was no noticeable rise in cooling power consumption. We therefore understand that there was no difference in terms of energy consumption, but there was a clear benefit in the GWP index, the lowest on the market.

In short, the replacement of the R22 refrigerant with the RS-70 is considered strategic, both for current units with R22 and other units already replaced with gases such as R424A or R434A.

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3. REFRIGERANT REPLACEMENT PROCESS

The refrigerant was replaced on 23 December 2013. All of the existing refrigerant (R22) was recovered and stored in recovery bottles. The unit was kept under vacuum for 48 hours and the mineral oil conserved.

The unit was charged with the new refrigerant gas RS-70 on 27 December. It was charged by weight, approximately the same amount, i.e. 26.8 kg, and kept at a superheat level of 5°C and a subcooling level of 11°C

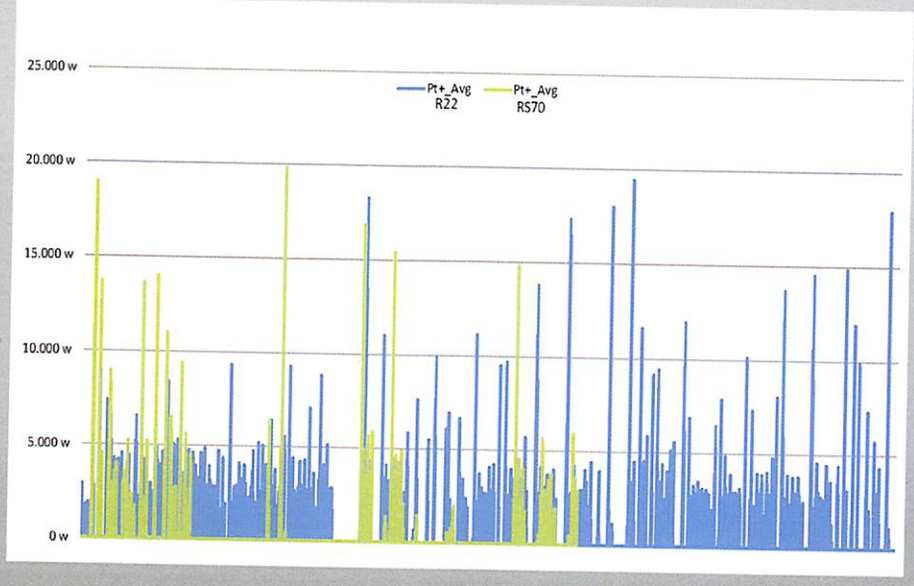
4. DATA OBTAINED

Data began to be recorded on 27 December after the refrigerant was charged, with the RS-70 refrigerant installed. The unit was kept under observation for approximately two weeks and the same variables were recorded both relating to the refrigeration cycle and the power and energy consumed.

RS-70				
DATE	DISCHARGE PRESSURE (bar)	SUCTION PRESSURE (bar)	DISCHARGE TEMP (°C)	MODE OF OPERATION
27/12/2013	21	4.3	60.8	HEATING
30/12/2013	12	2.6	50	COOLING
02/01/2014	14.4	3.3	53.8	COOLING
03/01/2014	16.7	3.1	60	COOLING
07/01/2014	12.9	2.6	58.7	COOLING

RS-70				
DATE	DISCHARGE PRESSURE (bar)	SUCTION PRESSURE (bar)	DISCHARGE TEMP (°C)	MODE OF OPERATION
08/01/2014	20	3.2	62.6	HEATING
09/01/2014	19.7	3.1	60.6	HEATING

**All readings are gauge pressure*



AVERAGE POWER CONSUMPTION CHART