TECHNICAL
DATA SHEET

# R-428A (RS-52)

## Features and uses of the R-428A (RS-52)

R-428A (RS-52) is a non flammable azeotropic blend, with zero ODP, compatible with traditional mineral lubricants, alkyl benzene and also with synthetic POE, thus not being necessary to make changes in the installation.

- "Drop-in" direct replacement for R-22 and R-502 and a replacement of R502 that are HCFC as R-408A, DI-44, etc. providing an easy and long term solution.
- The use of RS-52 avoids the need for expensive and technically unsatisfactory retrofits including oil changes, and changes in different parts of the installation.
- Low glide of about 0,8°C.

## Applications

R-428A (RS-52) can be used in most applications of R-502 and HCFC substitutes and they are not limited to supermarkets, ice machines, cold stores, refrigerated transport, ice rinks, etc.
RS-52 can replace R-22 in those installations set at the same pressure as R-502. RS-52 is a long-term economic solution, and solves the problem of replacing refrigerants that harm the ozone layer.

- Capacity and pressure similar to R-507.
- Flooded systems.
- Low temperature (-46.7°C).
- R22 replacement as long as the condenser has the right size.

See the application guide for more information RS.

Service and work terms
Since it is a blend, it should always be transferred in liquid phase or full loads if transferred in gas phase.

In most cases there is no need to change the existing lubricant, so RS-52 can be used directly as indicated in the conversion guidelines.

## Lubricants

RS-52 is compatible with mineral and alkyl benzene oils which are in R-502 and R-22 systems, and polyester lubricants.

While in most cases there is no need to change the lubricant, it is recommended to follow the directions in relation to the viscosity and lubrication qualities of compressor manufacturers. However, in systems configured with extensive and complex piping, or in large volume liquid containers or at very low operating temperatures, it may be necessary to add a part of POE.

## Environmental Information

None of RS-52 components contains chlorine, so the product has ODP = 0 (ability to deplete the ozone layer). As all hydro fluorocarbons (HFC), RS-52 has a direct warming potential (GWP), but this is compensate by its low TEWI-Total Equivalent Warming Impact-(greenhouse effect).

## Safety

R-428A (RS-52) is not toxic or flammable, high security.
It belongs to the security classification A1 / group L1.

## Compatibility with materials

R-428A (RS-52) is compatible with all materials commonly used in refrigeration systems that have previously worked with R-22 or R-502.
In general, the materials compatible with R-22 and R-502 can be used with RS-52. . It is recommended to check with the manufacturer the particularities of the equipment for its adaptation with regard to materials' compatibility. In existing installations with R-22, it may be necessary to replace some joints due to the different composition of RS-52, which contains HFC's

## Pressure and Temperature Tables

The tables of refrigerant pressure temperature and graphs indicate both bubble liquid point and pressure dew point.

**Bubble Temperature:** This is the temperature at which the liquid refrigerant begins to vaporize at the given pressure. Below this temperature the refrigerant is sub cooled liquid.

**Vapour dew point:** This is the temperature at which the refrigerant vapour begins to condense at the given pressure. Above this temperature, the refrigerant vapour is considered in superheated state.

**Superheated steam:** To determine the superheat of evaporator, measure temperature and pressure line suction in evaporator outlet piping. Using P/T tables you can determine pressure dew point, with pressure measured in suction. Subtract to the dew point current temperature and this difference is the evaporator superheat.

**Sub cooling in cooling liquid:** To determine sub-cooling in condenser, measure temperature condenser outlet pipe and measure pressure condenser outlet of the same pipe.
Using table Pressure / Temperature to determine bubble point of fluid from condenser. Subtract measured temperature from boiling point determined and the difference is sub cooling of condenser refrigerant liquid.

Note: The range of refrigerants RS, the average of evaporating and condensing temperatures will be the midpoint between bubble and dew temperature.

Note: with the RS range of refrigerants, the average of the evaporation and condensation temperatures is the half way point between the temperatures of the bubble point and the dew point.

## Components

| Chemical name | % by weight | CAS Nº | EC No. |
|---|---|---|---|
| 1,1,1,2,2-Pentafluoroethane (HFC 125) | 77,5 | 354-33-6 | 206-557-8 |
| 1,1,1- Trifluoroethane (HFC 143a) | 20,0 | 420-46-2 | 206-996-5 |
| Isobutane (R-600a) | 1,9 | 75-28-5 | 200-857-2 |
| Propane (R290) | 0,6 | 74-98-6 | 200-827-9 |

## Physical properties

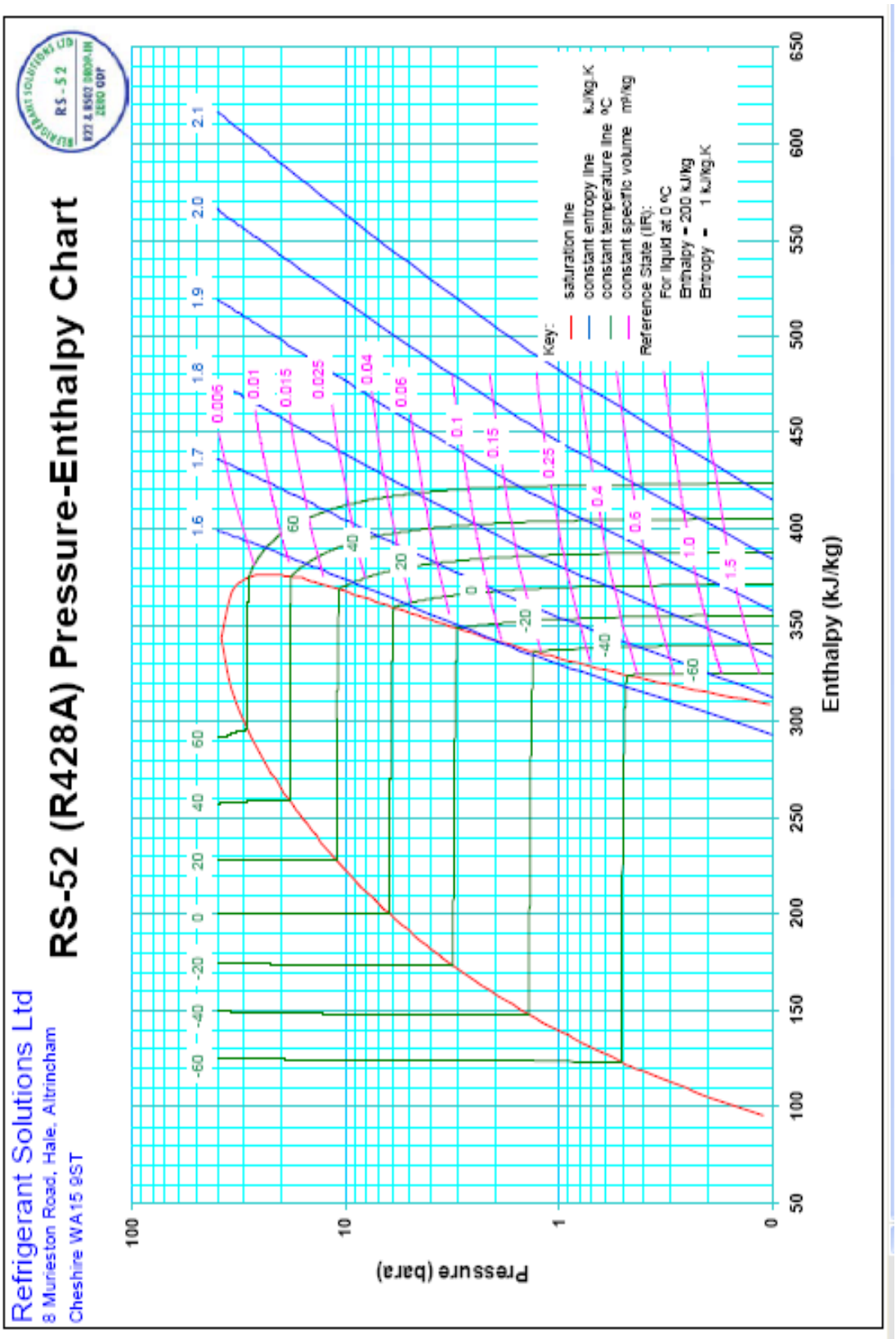
| PHYSICAL PROPERTIES | UNITS | R-428A (RS-52) | R-502 | R-22 |
|---|---|---|---|---|
| Molecular weight | (kg/kmol) | 107.5 | 111.6 | 86.5 |
| Boiling point (1 atm.) | (ºC) | -46.7 (1) | -45.4 | -40.8 |
| Critical temperature | (ºC) | 73 | 82.2 | 96.1 |
| Critical pressure | (bar a) | 38.1 | 40.7 | 49.9 |
| Liquid Density at 25 ° C | ($kg/m^3$) | 1053 | 1217 | 1191 |
| Saturated vapour density at 25 ° C | ($kg/m^3$) | 70.2 | 62.2 | 44.2 |
| Specific heat of liquid at 25 ° C | (kJ/kgºC) | 1.52 | 1.25 | 1.26 |
| Specific heat steam at 25 ° C and 1 atm | (kJ/kgºC) | 0.87 | 0.706 | 1.18 |
| Steam Pressure 25 ° C | (bar a) | 12.68 (1) | 11.5 | 10.44 |
| Latent heat of vaporization | (kJ/kgºC) | 189.2 (1) | 173 | 234 |
| Slip temp. | (ºC) | Aprox. 0.8 | 0.2 (1) | 0 |
| Flammability in air at 1 atm | %vol | No | No | No |
| ODP | | 0 | 0.33 | 0.055 |
| GWP | | 3607* | 4657* | 1810* |
| Inhalation exposure (8h/day and 40 h / week | (ppm) | 1000 | 1000 | 1000 |

(1) Bubble point

* According to IPPCC-AR4/CIE (Fourth Assessment Report of the Intergovernmental Panel on Climate Change) -2007.

*Remember to consult the guidelines for the reconversion of R428A (RS-52)*

## Mollier Diagram



## R-428A (RS-52) Saturation Properties Absolute

| T [°C] | Pressure Liquid [bar] | Pressure Vapour [bar] | Density Liquid [kg/m3] | Density Vapour [kg/m3] | Volume Liquid litre/kg | Volume Vapour litre/kg | Enthalpy Liquid [kJ/kg] | Enthalpy Vapour [kJ/kg] | Entropy Liquid [kJ/K·kg] | Entropy Vapour [kJ/K·kg] |
|---|---|---|---|---|---|---|---|---|---|---|
| -60 | -0.448 | -0.480 | 1417.500 | 3.246 | 0.705 | 0.308 | 125.790 | 314.070 | 0.696 | 1.581 |
| -58 | -0.385 | -0.420 | 1411.200 | 3.597 | 0.709 | 0.278 | 128.110 | 315.280 | 0.707 | 1.578 |
| -56 | -0.317 | -0.354 | 1404.900 | 3.977 | 0.712 | 0.251 | 130.440 | 316.490 | 0.718 | 1.576 |
| -54 | -0.243 | -0.282 | 1398.600 | 4.388 | 0.715 | 0.228 | 132.790 | 317.700 | 0.728 | 1.574 |
| -52 | -0.162 | -0.205 | 1392.200 | 4.832 | 0.718 | 0.207 | 135.130 | 318.910 | 0.739 | 1.571 |
| -50 | -0.075 | -0.120 | 1385.800 | 5.311 | 0.722 | 0.188 | 137.490 | 320.110 | 0.749 | 1.569 |
| -48 | 0.020 | -0.029 | 1379.300 | 5.826 | 0.725 | 0.172 | 139.860 | 321.310 | 0.760 | 1.567 |
| -46 | 0.121 | 0.069 | 1372.800 | 6.380 | 0.728 | 0.157 | 142.240 | 322.510 | 0.770 | 1.566 |
| -44 | 0.231 | 0.175 | 1366.300 | 6.974 | 0.732 | 0.143 | 144.620 | 323.700 | 0.781 | 1.564 |
| -42 | 0.348 | 0.289 | 1359.700 | 7.611 | 0.735 | 0.131 | 147.020 | 324.900 | 0.791 | 1.562 |
| -40 | 0.475 | 0.412 | 1353.000 | 8.293 | 0.739 | 0.121 | 149.420 | 326.080 | 0.802 | 1.561 |
| -38 | 0.610 | 0.543 | 1346.300 | 9.021 | 0.743 | 0.111 | 151.840 | 327.270 | 0.812 | 1.559 |
| -36 | 0.755 | 0.684 | 1339.600 | 9.799 | 0.746 | 0.102 | 154.260 | 328.440 | 0.822 | 1.558 |
| -34 | 0.910 | 0.835 | 1332.800 | 10.628 | 0.750 | 0.094 | 156.700 | 329.620 | 0.832 | 1.557 |
| -32 | 1.075 | 0.996 | 1325.900 | 11.512 | 0.754 | 0.087 | 159.150 | 330.780 | 0.842 | 1.555 |
| -30 | 1.251 | 1.167 | 1319.000 | 12.452 | 0.758 | 0.080 | 161.600 | 331.950 | 0.853 | 1.554 |
| -28 | 1.438 | 1.350 | 1312.000 | 13.452 | 0.762 | 0.074 | 164.070 | 333.100 | 0.863 | 1.553 |
| -26 | 1.637 | 1.544 | 1305.000 | 14.514 | 0.766 | 0.069 | 166.550 | 334.250 | 0.873 | 1.552 |
| -24 | 1.848 | 1.750 | 1297.900 | 15.641 | 0.770 | 0.064 | 169.040 | 335.400 | 0.883 | 1.551 |
| -22 | 2.072 | 1.969 | 1290.700 | 16.837 | 0.775 | 0.059 | 171.550 | 336.530 | 0.893 | 1.551 |
| -20 | 2.309 | 2.201 | 1283.500 | 18.104 | 0.779 | 0.055 | 174.070 | 337.660 | 0.902 | 1.550 |
| -18 | 2.559 | 2.446 | 1276.200 | 19.445 | 0.784 | 0.051 | 176.600 | 338.780 | 0.912 | 1.549 |
| -16 | 2.824 | 2.705 | 1268.800 | 20.866 | 0.788 | 0.048 | 179.140 | 339.890 | 0.922 | 1.548 |
| -14 | 3.104 | 2.979 | 1261.300 | 22.368 | 0.793 | 0.045 | 181.690 | 340.990 | 0.932 | 1.548 |
| -12 | 3.399 | 3.268 | 1253.700 | 23.955 | 0.798 | 0.042 | 184.260 | 342.080 | 0.942 | 1.547 |
| -10 | 3.709 | 3.573 | 1246.000 | 25.633 | 0.803 | 0.039 | 186.850 | 343.160 | 0.952 | 1.547 |
| -8 | 4.036 | 3.894 | 1238.300 | 27.405 | 0.808 | 0.036 | 189.450 | 344.230 | 0.961 | 1.546 |
| -6 | 4.379 | 4.231 | 1230.400 | 29.276 | 0.813 | 0.034 | 192.060 | 345.290 | 0.971 | 1.546 |
| -4 | 4.740 | 4.586 | 1222.500 | 31.251 | 0.818 | 0.032 | 194.690 | 346.340 | 0.981 | 1.545 |
| -2 | 5.119 | 4.958 | 1214.400 | 33.335 | 0.823 | 0.030 | 197.340 | 347.370 | 0.990 | 1.545 |
| 0 | 5.516 | 5.349 | 1206.200 | 35.533 | 0.829 | 0.028 | 200.000 | 348.390 | 1.000 | 1.544 |
| 2 | 5.932 | 5.759 | 1197.900 | 37.851 | 0.835 | 0.026 | 202.680 | 349.400 | 1.010 | 1.544 |
| 4 | 6.368 | 6.188 | 1189.500 | 40.296 | 0.841 | 0.025 | 205.380 | 350.390 | 1.019 | 1.543 |
| 6 | 6.824 | 6.637 | 1180.900 | 42.874 | 0.847 | 0.023 | 208.090 | 351.360 | 1.029 | 1.543 |
| 8 | 7.300 | 7.107 | 1172.200 | 45.593 | 0.853 | 0.022 | 210.830 | 352.320 | 1.039 | 1.543 |
| 10 | 7.798 | 7.599 | 1163.300 | 48.460 | 0.860 | 0.021 | 213.580 | 353.250 | 1.048 | 1.542 |
| 12 | 8.318 | 8.112 | 1154.300 | 51.485 | 0.866 | 0.019 | 216.360 | 354.170 | 1.058 | 1.542 |
| 14 | 8.861 | 8.648 | 1145.100 | 54.676 | 0.873 | 0.018 | 219.160 | 355.070 | 1.067 | 1.541 |

## R-428A (RS-52) Saturation Properties Absolute

| T [°C] | Pressure Liquid [bar] | Pressure Vapour [bar] | Density Liquid [kg/m3] | Density Vapour [kg/m3] | Volume Liquid litre/kg | Volume Vapour litre/kg | Enthalpy Liquid [kJ/kg] | Enthalpy Vapour [kJ/kg] | Entropy Liquid [kJ/K·kg] | Entropy Vapour [kJ/K·kg] |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 9.426 | 9.207 | 1135.700 | 58.044 | 0.881 | 0.017 | 221.970 | 355.940 | 1.077 | 1.541 |
| 18 | 10.016 | 9.789 | 1126.200 | 61.599 | 0.888 | 0.016 | 224.820 | 356.790 | 1.087 | 1.541 |
| 20 | 10.629 | 10.397 | 1116.400 | 65.354 | 0.896 | 0.015 | 227.690 | 357.610 | 1.096 | 1.540 |
| 22 | 11.269 | 11.029 | 1106.400 | 69.323 | 0.904 | 0.014 | 230.580 | 358.410 | 1.106 | 1.540 |
| 24 | 11.933 | 11.688 | 1096.200 | 73.520 | 0.912 | 0.014 | 233.500 | 359.180 | 1.116 | 1.539 |
| 26 | 12.625 | 12.373 | 1085.700 | 77.962 | 0.921 | 0.013 | 236.450 | 359.910 | 1.125 | 1.539 |
| 28 | 13.344 | 13.086 | 1075.000 | 82.667 | 0.930 | 0.012 | 239.430 | 360.610 | 1.135 | 1.538 |
| 30 | 14.090 | 13.827 | 1064.000 | 87.657 | 0.940 | 0.011 | 242.440 | 361.270 | 1.145 | 1.537 |
| 32 | 14.866 | 14.597 | 1052.600 | 92.956 | 0.950 | 0.011 | 245.490 | 361.890 | 1.154 | 1.536 |
| 34 | 15.670 | 15.396 | 1040.900 | 98.590 | 0.961 | 0.010 | 248.580 | 362.460 | 1.164 | 1.536 |
| 36 | 16.506 | 16.227 | 1028.900 | 104.590 | 0.972 | 0.010 | 251.700 | 362.990 | 1.174 | 1.535 |
| 38 | 17.372 | 17.089 | 1016.400 | 110.990 | 0.984 | 0.009 | 254.870 | 363.460 | 1.184 | 1.534 |
| 40 | 18.270 | 17.983 | 1003.500 | 117.840 | 0.996 | 0.008 | 258.080 | 363.870 | 1.194 | 1.532 |
| 42 | 19.202 | 18.911 | 990.090 | 125.180 | 1.010 | 0.008 | 261.340 | 364.210 | 1.204 | 1.531 |
| 44 | 20.167 | 19.874 | 976.110 | 133.080 | 1.024 | 0.008 | 264.670 | 364.480 | 1.214 | 1.530 |
| 46 | 21.167 | 20.872 | 961.490 | 141.610 | 1.040 | 0.007 | 268.050 | 364.660 | 1.225 | 1.528 |
| 48 | 22.204 | 21.907 | 946.130 | 150.850 | 1.057 | 0.007 | 271.500 | 364.740 | 1.235 | 1.526 |
| 50 | 23.277 | 22.981 | 929.930 | 160.920 | 1.075 | 0.006 | 275.040 | 364.710 | 1.246 | 1.524 |
| 52 | 24.389 | 24.094 | 912.730 | 171.960 | 1.096 | 0.006 | 278.670 | 364.540 | 1.257 | 1.521 |
| 54 | 25.541 | 25.248 | 894.340 | 184.160 | 1.118 | 0.005 | 282.410 | 364.220 | 1.268 | 1.518 |
| 56 | 26.733 | 26.446 | 874.480 | 197.790 | 1.144 | 0.005 | 286.290 | 363.700 | 1.279 | 1.515 |
| 58 | 27.969 | 27.689 | 852.760 | 213.220 | 1.173 | 0.005 | 290.330 | 362.940 | 1.291 | 1.510 |
| 60 | 29.250 | 28.980 | 828.570 | 231.010 | 1.207 | 0.004 | 294.590 | 361.860 | 1.303 | 1.505 |
| 62 | 30.578 | 30.322 | 800.930 | 252.110 | 1.249 | 0.004 | 299.160 | 360.340 | 1.316 | 1.499 |
| 64 | 31.955 | 31.720 | 768.000 | 278.230 | 1.302 | 0.004 | 304.200 | 358.170 | 1.331 | 1.491 |
| 66 | 33.385 | 33.182 | 725.580 | 313.320 | 1.378 | 0.003 | 310.080 | 354.850 | 1.348 | 1.480 |

## Questions and answers about R-428A (RS-52)

**1 Q: What is R-428A (RS-52)?**
A: R-428A (RS-52) is a direct replacement (drop-in) of R-502, R-502 and R-22 replacement at low temperatures and also without effect on the ozone layer (ODP = 0).

**2 Q: What has R-428A (RS-52)?**
A: R-428A (RS-52) is a blend of HFC 143a, HFC 125, iso-butane and propane.

**3 Q: Does RS-52 an ASHRAE number and what is its classification?**
A: Yes, RS-52 has been assigned an ASHRAE number, R-428A, it is rated A1, nontoxic and non flammable in all conditions of fractionation.

**4 Q: Is R-428A (RS-52) subject to a phase-out according to the regulations, such as CFC and HCFC?**
A: No, none of the components of R-428A (RS-52) is subject to a gradual phase-out schedule under the Montreal Protocol or the European regulations.

**5 Q: Is R-428A (RS-52) can be used with mineral and alkyl benzene lubricants?**
A: Yes, there is no need to change to synthetic polyester oil (POE), since it operates satisfactorily with traditional lubricants.
Oil return depends on certain design and operating conditions. In some configurations of systems with extensive and complex piping, in flooded evaporators or in systems in which the accumulator of the suction line acts as a low pressure receiver, it is recommended the replacement of all or part (approximately 25%) of the compressor oil load with POE. See guidelines for conversion.

**6 Q: Is R-428A (RS-52) approved by the manufacturers of compressors?**
A: The individual elements that compose RS-52 are widely used in compressors produced by major manufacturers.

**7 Q: Is R-428A (RS-52) as efficient as R-22?**
A: Tests show that RS-52 is so efficient as R-502.

**8 Q: What is the Glide of R-428A (RS-52)?**
A: Less than 1°C.

**9 Q: Should R-428A (RS-52) be charged in liquid or gas phase?**
A: Because RS-52 is almost an azeotropic blend, the recommendation is to load the system in liquid phase. However, if the entire contents of the bottle must be introduced, it can be performed in gas phase.

**10 Q: Have containers of R-428A (RS-52) dip tube?**
A: It depends on the type of container. All blue containers of Servei Gas S.A. have it. In case of not having it, the recommendation is to reverse the container.

**11 Q: Is R-428A (RS-52) included in the SNAP (Significant New Alternatives Project)**
A: Yes, R-428A (RS-52) is approved in the U.S. by the Environmental Protection Agency as a replacement for R-22 and is on the SNAP list.

**12 Q: How are R-428A (RS-52) pressures compared to R-502?**
A: The discharge pressure of RS-52 is 1 bar higher than R-502 and similar to R-507.

**13 Q: What is R-428A (RS-52) capacity compared to R-502?**
A: The capacity of RS-52 is the same as R-502.

**14 Q: What is R-428A (RS-52) capacity compared to R-22?**
A: RS-52 capacity is 17% higher than R-22.

**15 Q: How are the R-428A (RS-52) operating temperatures compared to R-22?**

A: R-428A (RS-52) discharge temperatures are slightly superior to those of R-502 and lower than R-22

**16 Q: What are R-428A (RS-52) flammability characteristics?**

A: R-428A (RS-52) is not flammable at room temperature and atmospheric pressure, and has the same classification as R-410A, R-134a, R-404A, R-409A (FX56), R-507, etc.

**17 Q: What are the decomposition products resulting from R-428A (RS-52) combustion?**

A: The decomposition products resulting from R-428A (RS-52) exposure to a high temperature source are similar to those formed by R-22 when they are exposed to fire. Decomposition products are in each case irritating and toxic, and breathing apparatus should be used if such possibility exists.

**18 Q: Must any special precaution be taken when using R-428A (RS-52)?**

A: No special precautions should be taken with RS-52. As with all refrigerants, common sense and good practices are always recommended. The use of hygroscopic synthetic lubricants (POE) can be avoided with the use of RS-52, so there is no need to take special care with humidity. However, humidity has to be always controlled.

**19 Q: Is R-428A (RS-52) compatible with refrigeration and air conditioning systems designed for R- 502?**

A: Yes, R-428A (RS-52) is compatible with all materials commonly used in systems that were designed and loaded with R-502. As in the case of R-502, magnesium and zinc alloys should be avoided.

**20 Q: Is R-428A (RS-52) recovered and recycled?**

A: Yes, R-428A (RS-52) can be recovered and reused after a cleaning process, and delivered to an authorized waste manager for further regeneration.

**21 Q: What is the technical guide for changing R-502 to R-428A (RS-52)?**

A: The procedure for the conversion of R-502 to RS-52 is simple. After recovering the R-502 and evacuating the system, use the same type of lubricant, replace the filter/drier and introduce about 15% less than the original charge of R-502. See guidelines for conversion.

**22 Q: What is R-428A (RS-52) main advantage?**

A: R-428A (RS-52) is a long-term solution for R-22, R-502 and R-502, and its main advantage is that can be used to replace R-502, without changing the original mineral oil in the system. Therefore, there is no need to adapt to a synthetic lubricant such as POE.

**23 Q: What is the R-428A (RS-52) coefficient of performance (COP) compared to R-22?**

A: Tests show that RS-52 provides a COP similar to R-502.

**24 Q: What is R-428A (RS-52) specification?**

A: R-428A (RS-52) complies with the specification of refrigerants ARI 700-95 for fluorocarbon refrigerants.

**25 Q: What are the effects of high exposure to R-428A (RS-52) by inhalation?**

A: All CFC, HCFC and HFC are the base of the refrigerants. High exposure to RS-52 can produce anaesthetic effects. Very high exposures may cause an abnormal heart rhythm and be fatal as happens with all CFC, HCFC and HFC

**26 Q: What is R-428A (RS-52) flash point, explosive and ignition temperature?**

A: R-428A (RS-52) is listed as a non-flammable as defined in ASHRAE test EN 681-98, and therefore has no flash point or explosion limits. RS-52 ignition temperature has not been determined, but it is expected to exceed 750°C.

**27 Q: Can R-428A (RS-52) be used in flooded evaporators?**

A: Tests continue in this field and the results are encouraging.

**28 Q: What types of leak detectors should be used with R-428A (RS-52)?**

A: You can use the same leak detectors used with HFC.

**29 Q: What would be the effect of a large emission of R-428A (RS-52)?**

A: As with other refrigerants, the area should be immediately evacuated. Vapour can be concentrated at ground level and at low poorly ventilated areas so the dispersion can be slow. You must proceed to ventilate the area before entering it.

**30 Q: Is R-428A (RS-52) available in disposable bottles?**

A: Not to be used in the European Union.

**31 Q: Is R-428A (RS-52) appropriate to be used with new equipment?**

A: R-428A (RS-52) is able to replace R-22 and R-502 due to its similar or greater capacity, lower discharge temperature than R-22, it has no (ODP), support traditional lubricants, low slip and energy efficient.