Introducing

Cool50

a better alternative™

No oil change required

Compatible with all lubricants

Zero ODP Replacement for R22

ASHRAE Number (R424A)

Cool50

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THE ZERO ODP REPLACEMENT COMPATIBLE WITH ALL LUBRICANTS

HCFC 22 is a controlled substance under the Montreal Protocol and European Regulation and will be phased out on a global basis with all other HCFCs. HCFC 22 and all refrigerant blends containing HCFC 22 have been banned in Europe in new equipment and also for service work (reclaimed HCFC 22 is permitted but only until 2014). In many other countries, HCFC 22 is subject to a rapidly tightening cutback schedule. In all territories, therefore, it is now time to consider the options for replacing HCFC 22 which will become restricted in availability as these cutbacks come into effect.

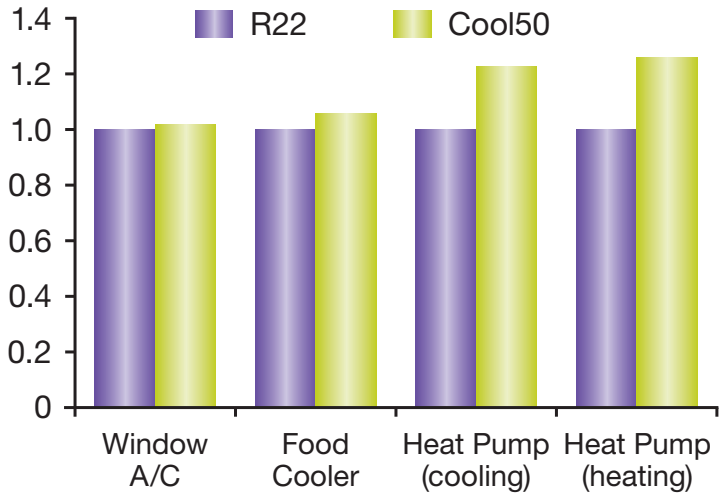
Cool50 provides a low cost and easy solution to replacing HCFC 22 by avoiding a costly and technically unsatisfactory retrofit situation. By definition, any replacement for HCFC 22 must have no ozone depleting ability so that, in contrast to replacing CFCs (e.g. R12, R502) where there were "interim" blends available (largely containing HCFC 22) enabling the existing lubricant in the system to be used, this is not an option when seeking to replace HCFC 22. **Cool50** has a zero Ozone Depletion Potential, a similar performance to HCFC 22, and can be used with all types of lubricants.

COMPARISON WITH HCFC 22

- Higher coefficient of performance
- Lower discharge temperature
- Zero ozone depletion potential
- Nonflammable
- Lower discharge pressure
- Similar capacity
- Compatible with existing oils
- No hardware changes needed

The lower head pressure obtained when using **Cool50** provides significant operational benefits, while the higher coefficient of performance reduces energy costs and has a beneficial effect on the total equivalent warming impact (TEWI) of the whole system. The significantly lower discharge temperatures and pressures of **Cool50** improve the reliability and extend the life of the compressor, and reduce the problem of oil decomposition.

Relative COPs of R22 and Cool50



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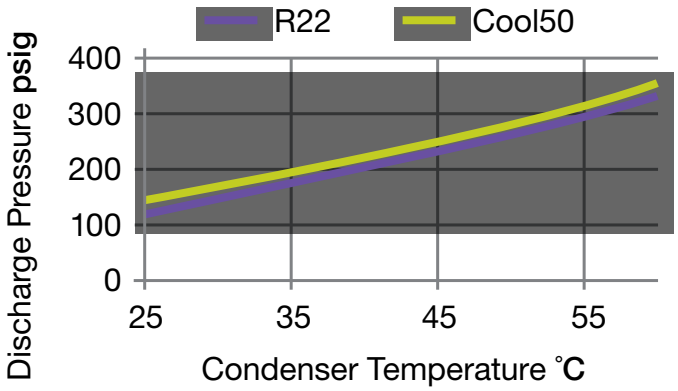
APPLICATIONS

Cool50 has been developed for use in all applications where HCFC 22 has traditionally been used including commercial air conditioning, commercial and industrial refrigeration, appliances, and others.

LUBRICANTS

Cool50 is compatible with both the traditional and new synthetic lubricants so that there is no need to change the oil when converting from HCFC 22 to **Cool50**. **Cool50** is suitable for use with mineral, alkylbenzene, and polyol ester lubricants.

Discharge Pressure vs. Condenser Temperature



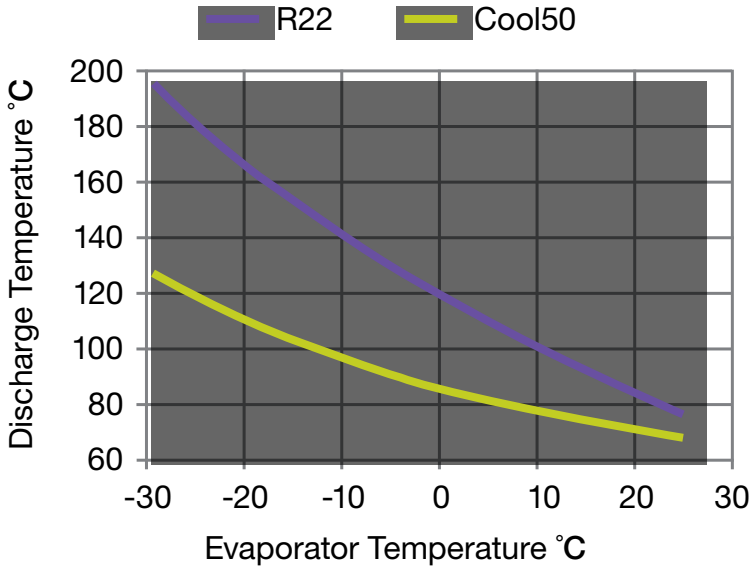
SAFETY

Cool50 (R424A) has been awarded a safety classification of A1, namely of low toxicity and nonflammable, by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

SERVICING

Because **Cool50** is a blend, it should be charged into the system in the liquid as opposed to vapor form. There is no need to make any hardware changes when converting from R22 to **Cool50**.

Discharge Temperature vs. Evaporator Temperature



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PHYSICAL PROPERTIES		Cool50	R22
Molecular weight		108.1	86.5
Boiling point (1 atm)	˚C	-38.7[1]	-40.8
	˚F	-37.6[1]	-41.4
Critical temperature	˚C	88.8	96.1
	˚F	191.8	204.8
Critical pressure	bara	40.4	49.9
	psia	586	724
Liquid density at 25˚C	kg/m^3	1169	1191
Density of saturated vapor at 25˚C	kg/m^3	43.6	44.2
Latent heat of vaporization @ boiling point	KJ/kg	196[1]	234
Cv at 25˚C and 1 bara	KJ/kg˚K	0.765	0.559
Cp at 25˚C and 1 bara	KJ/kg˚K	0.85	0.662
Cp/Cv at 25˚C and 1 bara		1.111	1.185
Vapor pressure at 25˚C	bara	9.67[1]	10.4
	psia	140.2[1]	151
Vapor viscosity at 25˚C and 1 bara	cP	0.0122	0.0126
Liquid viscosity at 25˚C	cP	0.167	0.166
Liquid thermal conductivity at 25˚C	W/m.K	0.072	0.0837
Surface tension at 25˚C	N/m	0.00656	0.00808
Specific heat of liquid at 25˚C	KJ/kg˚K	1.423	1.26
Ozone depletion potential	ODP	0	0.055
Flammability limit in air (1 atm)	vol%	none	none
Inhalation exposure (8 hr day and 40 hr week)	ppm	1000	1000

[1] *Bubble point*

Cool50 Data

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COMPOSITION

HFC 134a = 47%
HFC 125 = 50.5%
iso-pentane = 0.6%
n-butane = 1.0%
isobutane = 0.9%

TYPE

HFC blend

HCFC REPLACEMENT

R22

TEMPERATURE GLIDE

Approximately 3˚C

LUBRICANT

MO/AB/POE

ODP

Zero

CHEMICAL NAME

1,1,1,2-tetrafluoroethane/
pentafluoroethane/iso-pentane/
n-butane/isobutane

PHYSICAL PROPERTIES		Cool50	R22
Molecular weight		108.1	86.5
Boiling point (1 atm)	˚C	-38.7 (1)	-40.8
	˚F	-37.6 (1)	-41.4
Critical temperature	˚C	88.8	96.1
	˚F	191.8	204.8
Critical pressure	bara	40.4	49.9
	psia	586	724
Liquid density at 25˚C	kg/m^3	1169	1191
Density of saturated vapor at 25˚C	kg/m^3	43.6	44.2
Specific heat of liquid at 25˚C	KJ/kg˚K	1.42	1.26
Vapor pressure at 25˚C	bara	9.67 (1)	10.4
	psia	140.2 (1)	151
Latent heat of vaporization at boiling point	KJ/kg	196 (1)	234
Ozone depleting potential	ODP	0	0.055
Flammability limit in air (1 atm)	vol%	none	none
Inhalation exposure (8 hr day & 40 hr week)	ppm	1000	1000

(1) Bubble point

TYPE AND DESCRIPTION

Cool50 is a nonflammable blend of HFC 134a, HFC 125, iso-pentane, n-butane, and isobutane which has a zero ODP and is also compatible with both traditional and synthetic lubricants so that a retrofit is not required.

Cool50 is a replacement for R22 providing an easy and at the same time a long-term solution. Because there is no need to use expensive and hygroscopic synthetic lubricants, the risk of moisture ingress into a refrigeration system is completely avoided. **Cool50** has significantly lower discharge temperatures and pressures than R22 which removes the problem of oil decomposition and also widens the applications for **Cool50**.

APPLICATIONS

Cool50 is suitable for use in the main applications normally occupied by R22 including commercial air conditioning, cold stores, supermarkets, dairy chillers, refrigerated transportation, cellar cooling, and others.

SERVICE WORK

Because it is a blend, it is recommended that **Cool50** be charged into systems in the ***liquid*** as opposed to the gaseous phase.

Since in most cases there is no need to change the existing lubricant, **Cool50** is straightforward to use as the procedure below outlines.

LUBRICANTS

Cool50 is compatible with both mineral and alkylbenzene oils found in R22 systems, and also with the polyol ester lubricants. Therefore, in most cases there is no need to change the lubricant although compressor manufacturers' recommendations regarding lubricity should be followed. However, in systems with extensive and complex piping configurations, or a large volume of liquid in the receiver, POE may need to be added.

MATERIALS COMPATIBILITY

Cool50 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 **Cool50**. It is recommended to check the 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 **Cool50** which contains HFCs.

ENVIRONMENTAL DATA

None of the components of **Cool50** contain chlorine so that it has no ability to deplete the ozone layer.

As with all hydrofluorocarbons (HFCs), **Cool50** does have a direct global warming potential (GWP), but this is counterbalanced by its lower Total Equivalent Warming Impact (TEWI). Tests have shown that **Cool50** has a higher Coefficient of Performance (COP) than R22 in a range of applications including window air conditioners, chilled food, and heat pumps both in the heating and cooling mode.

CONVERSION PROCEDURE FOR REPLACING R22 WITH COOL50

(1) Ensure the right equipment is available, e.g. recovery unit and cylinders, container for recovered lubricant, vacuum pump, weighing scale, replacement drier, etc.

(2) Record baseline data to establish the normal operating conditions for the equipment.

(3) Recover R22 charge and weigh recovered amount of R22 to determine amount of **Cool50** to be charged.

(4) **Cool50** is compatible with MO/AB and POE. If, however, the oil in the system is being changed to a different type, it is not necessary to remove all of the existing oil in the system.

(5) Replace the filter/drier.

(6) Evacuate the system and ***liquid charge*** with **Cool50**, an amount equal to the original charge of R22.

(7) Start the system and check baseline data, adjust the expansion device if required. If a low pressure control functions as a temperature control, check space temperature and adjust if necessary.

(8) If the system is fitted with a refrigerant sight glass and the sight glass is not indicating a full charge, additional **Cool50** may be added.

(9) 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 stabilize and is erratic, some of the oil should be removed from the system and replaced with POE. Adopt the procedure in (10) below.

(10) In systems where oil return could be an area of potential concern, e.g. containing a liquid receiver, flooded evaporators, or long and 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 stabilizes and returns to normal.

(11) Avoid overcharging the system.

(12) Check system thoroughly for leaks.

(13) Clearly label system as charged with **Cool50** and type of oil used.

(14) On larger systems with an oil sight glass check oil level after several hours of operation and add oil if necessary.

NOTE: SYSTEMS WITH INHERENT POOR OIL RETURN, OFTEN WITH UNUSUALLY LONG SUCTION LINES AND/OR LOW TEMPERATURE SYSTEMS, MAY HAVE IMPROVED **Cool50** OIL RETURN CAPABILITIES WITH ALKYLBENZENE OR POLYOL ESTER OILS.

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Zero ODP Replacement

KEY FEATURES OF Cool50 COMPARED TO R22

- Higher coefficient of performance
- Compatible with existing traditional and new synthetic lubricants
- Lower head pressures
- Lower discharge pressures
- Lower discharge temperatures
- Zero ozone depletion potential
- Nonflammable
- Similar capacity
- Wider range of applications
- No hardware changes needed
- Reduces problems of oil decomposition
- Nontoxic

Cool50 Q & A

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Q1: What is Cool50?

A1: **Cool50** is a non-ozone depleting replacement for R22 in most applications.

Q2: What does Cool50 contain?

A2: **Cool50** is a blend of HFC134a, HFC125, iso-pentane, n-butane, and isobutane.

Q3: Does Cool50 have an ASHRAE number and what is its classification?

A3: Yes. It has been designated an ASHRAE number of R424A with a classification of A1, which is low toxicity and nonflammable under all conditions of fractionation.

Q4: Is Cool50 subject to a phase-out program under any regulations as is the case with CFCs and HCFCs?

A4: No. None of the components of **Cool50** are subject to a phase-out schedule under the Montreal protocol or any regulations.

Q5: How is Cool50 different from ISCEON 59/MO59 (R417A)?

A5: **Cool50** is a different blend from R417A with a higher capacity and additionally contains a combination of iso-pentane, n-butane, and isobutane which provides optimum oil return to the compressor while remaining nonflammable as formulated.

Q6: Can Cool50 be used with mineral and alkylbenzene lubricants?

A6: Yes. There is no need to change to a synthetic polyol ester (POE) oil with **Cool50** which operates satisfactorily with traditional lubricants.

Q7: Is Cool50 approved by compressor manufacturers?

A7: The individual components which comprise **Cool50** are widely used in compressors produced by major manufacturers.

Q8: Can Cool50 be used to top up a system containing R22?

A8: The standard recommendation is not to mix refrigerants. **Cool50** does not form an azeotropic mixture with R22 so that adding **Cool50** to R22 in a system will not generate any higher pressures. In strictly technical terms, work has shown that **Cool50** may be added to R22 without any adverse effects.

Q9: Can Cool50 be added to ISCEON 59/MO59 (R417A)?

A9: There is not sufficient experience in the field to be able to comment. It is recommended that MO59 is recovered from the system and replaced with **Cool50**.

Q10: Can Cool50 be used in refrigeration as well as air conditioning?

A10: **Cool50** was designed as a replacement for R22 in existing air conditioning equipment without replacing the mineral oil lubricant. At lower temperatures Cool50 is the preferred alternative to R22.

Q11: Is Cool50 as efficient as R22?

A11: Tests show that **Cool50** has a higher coefficient of performance than R22 and hence is considered to be more energy efficient than R22.

Q12: What trials have been carried out on Cool50 and what are the results?

A12: Case studies on **Cool50** have been carried out in a range of applications commonly occupied by R22 including window air conditioning, chilled food, and commercial heat pumps in both heating and cooling modes. The results show good oil return to the compressor in all cases and a high COP.

Q13: What is the glide of Cool50?

A13: A calculation based on a typical air conditioning cycle gives evaporator and condenser glides of approximately 3˚C. It has been demonstrated in tests that **Cool50** is an excellent replacement for R22 in a variety of air conditioning equipment and that the refrigerant glide does not adversely affect its performance. It is considered that glide values, calculated from the properties of a zeotropic refrigerant, do not necessarily reflect the glides observed in a real unit. For example, for R22 a pressure drop of 0.5 bar in a DX evaporator will induce a glide of 2.8˚C. In contrast a similar pressure will induce a glide of only 0.8˚C with **Cool50**. This apparently paradoxical result occurs because the glide resulting from the composition change of **Cool50** works opposite to the glide due to the pressure drop tending to cancel it out.

Q14: Does Cool50 need to be charged in the liquid or gaseous form?

A14: Because **Cool50** is a blend, the recommendation is to charge it into the system in the liquid form.

Q15: Does the Cool50 disposable cylinder have a dip tube?

A15: No. The disposable should be inverted to discharge **Cool50** in the liquid form.

Q16: Is Cool50 on the SNAP (Significant New Alternative Policy Program) list in the USA?

A16: Yes. R424A is approved by the US Environmental Protection Agency as a replacement for R22 and is on the SNAP list.

Q17: How does the pressure rating of Cool50 compare with R22?

A17: The discharge pressure of **Cool50** is lower than R22.

Q18: How does the capacity of Cool50 compare to R22?

A18: Tests have been carried out with **Cool50** in a variety of air conditioning units under realistic operating conditions. In all cases the cooling performance of **Cool50** was indistinguishable from that of R22 working in the same equipment under comparable conditions. Preliminary calculations based on a simplified cycle suggested that the refrigeration capacity of **Cool50** might be lower than that of R22 under similar conditions. In practice this is not supported by the results from real equipment confirming that cooling capacity is determined by a number of factors which cannot be readily included in simple calculations.

Q19: How does the temperature rating of Cool50 compare to R22?

A19: The discharge temperatures of **Cool50** are considerably lower than R22.

Q20: What are the flammability characteristics of Cool50?

A20: **Cool50** is nonflammable at room temperature and atmospheric pressure, and has the same classification as R22, R134a, R404A, R409A (FX56), R507 (AZ-50), etc.

Q21: What are the decomposition products resulting from the combustion of Cool50?

A21: The decomposition products resulting from subjecting **Cool50** 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 of exposure exists.

Q22: Are there any special precautions with Cool50?

A22: There are no specific precautions which must be taken with **Cool50**. As with all refrigerants, common sense and good housekeeping are always recommended. Because the use of hygroscopic synthetic POE lubricants is avoided with **Cool50**, scrupulous attention to preventing moisture contamination is not necessary, although the ingress of moisture should be avoided at all times.

Q23: Is Cool50 compatible with refrigeration and air conditioning systems designed for R22?

A23: Yes. **Cool50** 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.

Q24: Can Cool50 be recovered and recycled?

A24: Yes. **Cool50** can be recovered in the same way as other refrigerants.

Q25: What technical guidance do you advise when changing from R22 to Cool50?

A25: The procedure for converting from R22 to **Cool50** is straightforward. Use the same type of lubricant, replace the filter/drier with an HFC-compatible one, and charge approximately the same amount of **Cool50** as the original R22 charge after fully evacuating.

Q26: How does Cool50 compare in price with R407C and other alternatives?

A26: **Cool50** is competitive in price with other R22 alternatives.

Q27: What is the main advantage of Cool50?

A27: **Cool50** is a long-term alternative for R22, and its main advantage is that it 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.

Q28: Is Cool50 compatible with hoses, seals, gaskets, and O-rings commonly used with R22?

A28: Yes. Because the original mineral oil is being used and not a synthetic lubricant, elastomers and plastics used with R22 are compatible with **Cool50**.

Q29: How does the coefficient of performance (COP) of Cool50 compare with R22?

A29: Tests show that **Cool50** provides a higher COP than R22 depending upon the application and equipment.

Q30: What is the specification for Cool50?

A30: **Cool50** complies with the refrigerant specification AHRI 700–2012 for fluorocarbon refrigerants.

Q31: What is the effect of high exposure by inhalation of Cool50?

A31: As is the case with all CFC-, HCFC- and HFC-based refrigerants, high exposure to **Cool50** 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.

Q32: What is the flash point, flammability explosion limits, and autoignition temperature for Cool50?

A32: **Cool50** is nonflammable as defined in the ASHRAE EN 681-98 test, and hence does not have a flash point or explosion limits. The autoignition temperature of **Cool50** has not been determined but is expected to be greater than 750˚C.

Q33: How does Cool50 compare with ISCEON/MO59 (R417A) in terms of efficiency?

A33: **Cool50** has a higher capacity than ISCEON/MO59 (R417A) and a similar coefficient of performance.

Q34: Can Cool50 be used in flooded evaporators, in systems with liquid receivers, and in centrifugal compressors?

A34: **Cool50** is suitable for use in flooded evaporators and should be used in this application.

Q35: What types of leak detectors should be used with Cool50?

A35: Leak detectors used with HFCs are suitable for use with **Cool50**.

Q36: What would be the effect of a large release of Cool50?

A36: In common with other refrigerants of this type, the area should be immediately evacuated. The vapor may concentrate at floor level and in poorly ventilated areas may be slow to disperse. Forced ventilation should be provided before entering such areas.

Q37: How does Cool50 compare to ISCEON/MO59 (R417A) in terms of GWP?

A37: **Cool50** has a similar GWP to ISCEON/MO59 (R417A).

Q38: Is Cool50 available in returnable cylinders?

A38: Yes. We offer **Cool50** in 110 lb., 850 lb. and 1,450 lb. returnable cylinders.

Q39: Can Cool50 be used in systems designed to replace R22 and initially charged with a hydrocarbon?

A39: Although no development work has been carried out on hydrocarbon systems designed to replace R22, we believe that **Cool50** would be suitable but an increased refrigerant charge would be required.

Q40: Is Cool50 suitable for use with new equipment?

A40: **Cool50** has a zero ODP, a relatively low GWP, a higher coefficient of performance, significantly lower discharge temperatures and pressures than R22, and a lower temperature glide and pressure than R407C. **Cool50** is a candidate for use by original equipment manufacturers but consideration should also be given to the use of **Cool50** and/or R428A in new equipment.