MITSUBISHI ELECTRIC
AIR CONDITIONING SYSTEMS

A guide to R410A

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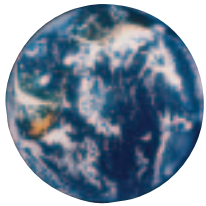
The facts



on R410A refrigerant

With more manufacturers introducing systems that use R410A refrigerant, we've produced this booklet to explain the hype that currently surrounds R410A and to present you with the facts.

Handled correctly, many installers have already realised that R410A refrigerant has some excellent benefits to offer. However, it's being portrayed within the industry as potentially dangerous to use or, it's being labelled as the only efficient refrigerant that's available - which simply isn't true.

Whilst R410A can provide some small advantages in efficiency, it is technology itself that is the largest contributor towards the steady increase in ever important COP's. A good comparison can be made with cars and fuel for example: The fact that a car can provide more miles per gallon today than say, fives years ago, is due to technological advances in the car rather than the fuel.

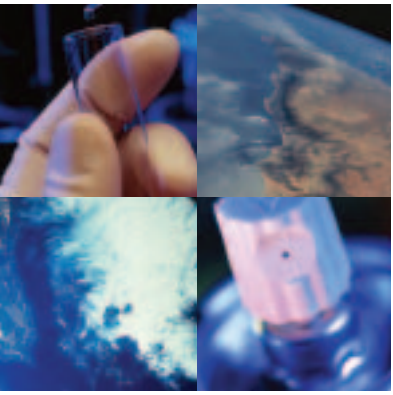
The same is true of direct expansion systems, with the need to focus on efficiency as a whole, not simply the type of refrigerant. How the refrigerant is used is of paramount importance and good system installation is crucial. The skills required today, are no different to those that have always been required and although the equipment and subsequent numbers may differ, the need for good practice remains the same.

R410A refrigerant has some **excellent benefits** to offer

This guide aims to provide you with a better understanding of R410A and to subsequently improve your effectiveness in today's air conditioning industry.

A brief history

Since 1985 it's been well documented that the ozone layer surrounding the earth has been diminishing. Scientific evidence suggests man-made chemicals are responsible for creating the hole in the ozone layer and that they're likely to add to global ozone depletion.



Ozone Depleting Substances (ODS) have been used in many products which take advantages of their physical properties. For example, Chloro Fluoro Carbons (CFC's), have commonly been used as aerosol propellants and refrigerants.

However, since highlighting that the chlorine in CFC's attributes to the demise of the ozone layer, the 'Montreal protocol on substances that deplete the ozone layer' was negotiated and signed by 24 countries and the European Union in 1987. The protocol calls for all parties to scale down the use of CFC's, halons and other man-made ODS.

# of refrigerant

R22 is a Hydrochlorofluorocarbon (HCFC)

As a result of legislation R22 refrigerant (an HCFC), has been virtually phased out in all new equipment. The air conditioning industry now uses (HFC) as it has no chlorine content and zero Ozone Depletion Potential (ODP).

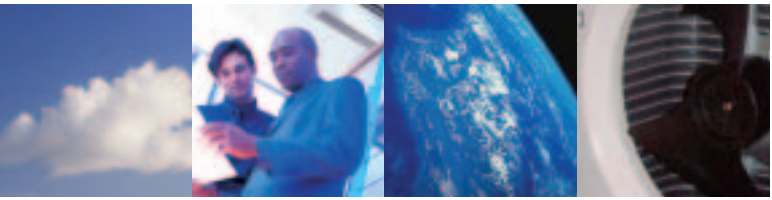
R410A is a Hydrofluorocarbon (HFC)

Systems using R410A refrigerant run at a pressure of approximately 1.6 times that of similar systems using R22 and the energy efficiency is comparable. The R410A refrigerant is a 50:50 mixture of R32 and R125. It has a higher direct Global Warming Potential (GWP) than R22 or R407c, but a much lower indirect GWP (CO2 production at power station).

R407c is a Hydrofluorocarbon (HFC)

R407c is a mix of three refrigerants: R32, R125 and R134a - all of which boil at a different temperature. R407c has a range or glide of approximately 5°C compared with R410A which has less than 0.17K. In R407c, R32 provides the capacity, R125 controls the flammability and R134a reduces the pressure.

R410A in detail

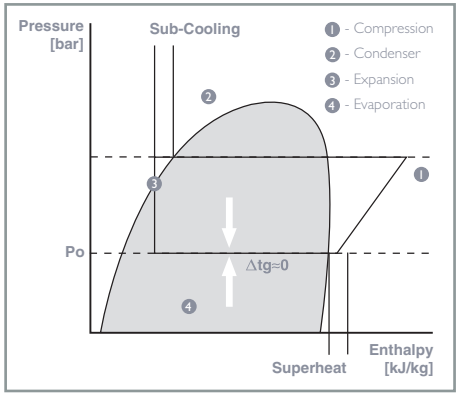


R410A is a Zeotropic blend of two refrigerants

R32 50% **R125** 50%

The phase change of R410A mixtures takes place at an almost constant temperature during the liquefaction or evaporation process.

The temperature glide for R410A is less than 0.17K.



Refrigerant	Volumic Refrigerating Effect KJ/m^3
R410A	6725
R407C	4688
R22	4358

R410A has zero Ozone Depletion Potential (ODP)

With the relatively high density and high efficiency of R410A , it is possible to reduce the size of system components such as condensers, compressors, evaporators and piping, etc. As operating pressures are higher compared to that of R22 and R407c, all system components must all be designed for suitability with R410A.

	R22	R410A
Suction	60psi (4 bar)	90 to 105 psi (6 to 7 bar)
Discharge	260psi (17 bar)	350 to 400 psi (23 to 28 bar)

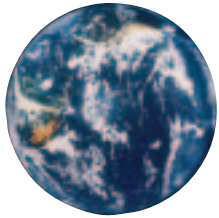
When installing equipment using R410A refrigerant, there are a number of standards that must be met:

- An ester oil is used for R410A (as with R407c)
- It's important to work with absolute cleanliness
- Brazing must be done with the use of Nitrogen (OFN)
- The system must be evacuated thoroughly (triple evacuation)
- A strength test in accordance with BS EN378 must be carried out
- The system must always be charged in the liquid phase

The **EN378** European Standard

EN378 is the European Standard which governs the design and installation of all air conditioning systems. Superceding BS4434, one element of EN378 is the practical limit of refrigerant leakage into an occupied space. For category A buildings such as schools, hotels and hospitals for example, the limit relating to R407c is 310g per m3 of occupied space, and 440g per m3 for R410A. The current standard for R407c does not preclude the use of VRF in any category A building.

Ensure **correct** system evacuation



To ensure problem-free operation of any air-conditioning system, it is crucial to carry out thorough evacuation of the system. During the evacuation any moisture is removed from all of the system components and the pipework.

The **importance** of thorough evacuation

It is vitally important to thoroughly evacuate any refrigeration system in order to prevent the following harmful effects:

- Any non-condensible product left in the system can cause the pressure in the condenser to increase and in turn, the compression temperature to rise.
- Moisture will result in adverse reactions in the refrigerant circuit.
- The polyester oils used in the R410A refrigeration systems are hydroscopic, which means that they absorb moisture from the air. To prevent chemical reactions in the system, any moisture must be removed at all costs.
- Oxygen (air) reacts with the refrigeration unit oil and can lead to faults such as compressor failure.

To be able to remove moisture from the system it must be evaporated. The pressure in the pipework must be reduced to such an extent that the ambient temperature is sufficient to evaporate the moisture.

Essential tips for good evacuation

Before evacuating a system, it is essential to check for any potential leaks. Such leaks may be discovered at brazed or flared joints. Evacuation can only start once the system has been properly pressure tested and found to be completely leakproof.

Leak Testing in 3 easy steps

Step 1 3.0 bar (N2) - Test for a minimum of 3 minutes

Step 2 15.0 bar (N2) - Test for a minimum of 3 minutes

Step 3 33.3 bar (N2) - Test for a minimum of 24 hours (if using R410A)

Triple evacuation in **6 easy steps**

Step 1 Evacuate the system to 10 'Torr' from both service valves. To measure the vacuum a 'Torr gauge' must be used at all times - do not use a system manifold gauge

Step 2 Break the vacuum with OFN to 1 bar

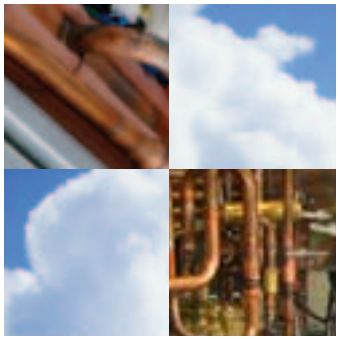
Step 3 Evacuate to 5 'Torr'

Step 4 Repeat Step 2

Step 5 Evacuate to the lowest pressure that the pump will achieve (2 'Torr' for 1 hour minimum)

Step 6 The rise test must then be carried out for a minimum of 30 minutes

When using **copper pipework**



- Use only copper pipes with the correct wall thickness - please refer to your usual copper pipe supplier for detail
- Make sure you cut the copper pipe with a proper pipe cutter only
- Remove any burrs with the utmost care
- Make sure that no swarf or other impurities get into the piping
- When brazing make sure that Nitrogen (OFN) is used at all times
- Brazed joints must be bare and clean

The importance of correct **brazing**

Brazed joints should only be made using Nitrogen (OFN) as without it carbon deposits are left on the pipe surface. The carbon deposits are then washed off of the surface of the pipe when the refrigerant is circulated and it then travels with the refrigerant.

Carbon deposits can cause the refrigerant and refrigeration unit oil to decompose. This is likely to result in operation defects and warranty will become null and void.

The right tools

The right tools are required in to enable the refrigeration system to be properly evacuated and dried.

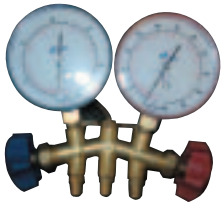
These include:

- R410A Manifold Gauges
- Flaring Tool
- Torque Wrench
- Vacuum Pump
- Refrigerant Weighing Scales

R410A Refrigerant Manifold

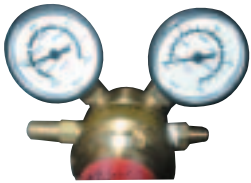
A solid manifold gauge specifically used for R410A.

Manifold gauges with sight gauges should never be used due to the higher operating pressures, unless specified for use on R410A.



Nitrogen Pressure Gauge (up to 160 bar)

A higher range Nitrogen Regulator must be used due to the higher pressure testing requirements when strength testing to conform with BS EN378.



Torr Gauge

A Torr gauge to be used to provide an accurate evacuation level required.

Vacuum Pump

A Vacuum pump of sufficient quality and working order to be used to pull the correct vacuum to negate any moisture being present in the system (pump oil needs to be regularly changed).

The pressure gauge

*The refrigerant manifold gauges are not suitable for measuring vacuum.

Flaring Tool

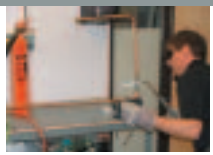
A suitable Flaring tool to be used so as not to compromise the integrity of the copper when flared.

Torque Spanners

Torque spanners must be used at all times to tighten flares in accordance with manufacturers guidelines.

Oxygen free nitrogen for brazing

OFN to be used at all times during brazing to prevent oxidation within the copper pipework.

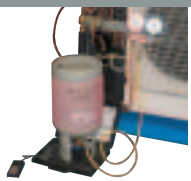


Oxygen free nitrogen for strength and leak test

OFN to be used for strength and leak testing with the higher pressure regulator.

Refrigerant charging weighing scales

Any additional refrigerant required for the installed system must be weighed in the liquid phase using charging scales.



Suitable vacuum measuring gauges

To determine accurately the pressure in the system and whether the desired vacuum has been attained, a vacuum or torr meter is indispensable. A professional evacuation requires such an instrument.

Summary >>

To get the best from R410A

- Use the correct tools
- Adhering to BS EN378
- Strength test to 1.3 x Ps (43 bar)
- Leak test to 1.0 x Ps (33 bar)
- Observe regulations (Health & Safety at work, pressure equipment etc.)
- Use correct copper pipework with appropriate wall thickness
- Follow good working practice at all times (Nitrogen brazing, proper evacuation, etc.)

The benefits of working with R410A

- Higher pressures
- More efficient
- Smaller pipe diameters
- Lower refrigerant charge
- Small system size per kW
- Higher heat transfer coefficient
- Very small temperature glide <0.17k
- HFC zeotropic mixture of HFC-32 and HFC-125
- High pressure - narrow glide
- Hydrofluorocarbon blend with zero ODP
- Lower indirect global warming potential (CO_2 production at power station) than R22 and R407c

If you follow the guidelines contained within and carry out good refrigeration practices at all times, then working with R410A will be no different from working with previous refrigerants.

Know it and use it!

All text, illustrations, diagrams and examples in this guide are only intended to help with the handling and proper use of the refrigerant R410A. The information contained in this brochure has been carefully researched and checked and is considered correct at time of going to press.

Should you have any further queries regarding installation and operation of the equipment described in this guide, please contact us at:

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