R410A THE REFRIGERANT OF THE FUTURE

Why Change?
In compliance with the requirements written in the Montreal Protocol the developed world has been preparing to move away from HCFC Refrigerants, the most commonly used being R22.

When reviewing the alternatives to R22 two different approaches were taken. The first was to develop a substitute product with similar characteristics to R22. R407c has been accepted worldwide as this replacement with overall attributes best resembling R22. The second approach was to develop a substitute refrigerant, which would give the best performance when applied to the redesigned equipment, which traditionally uses R22. R410A is this substitute with better thermodynamic performance.

Why 410A?
R410A has a higher volumetric cooling capacity compared to R22 and has better thermal exchange properties. This results in overall performance gains in terms of system efficiency. The greater density of the vapour in R410A permits higher system velocities, reduces pressure drop losses and allows smaller diameter tubing to be used. In laymen's terms a smaller unit can be developed using a smaller displacement compressor, less coil and less refrigerant while maintaining system efficiencies comparable to current day R22 equipment. Therefore OEM's have a low cost solution to meet specific equipment requirements.

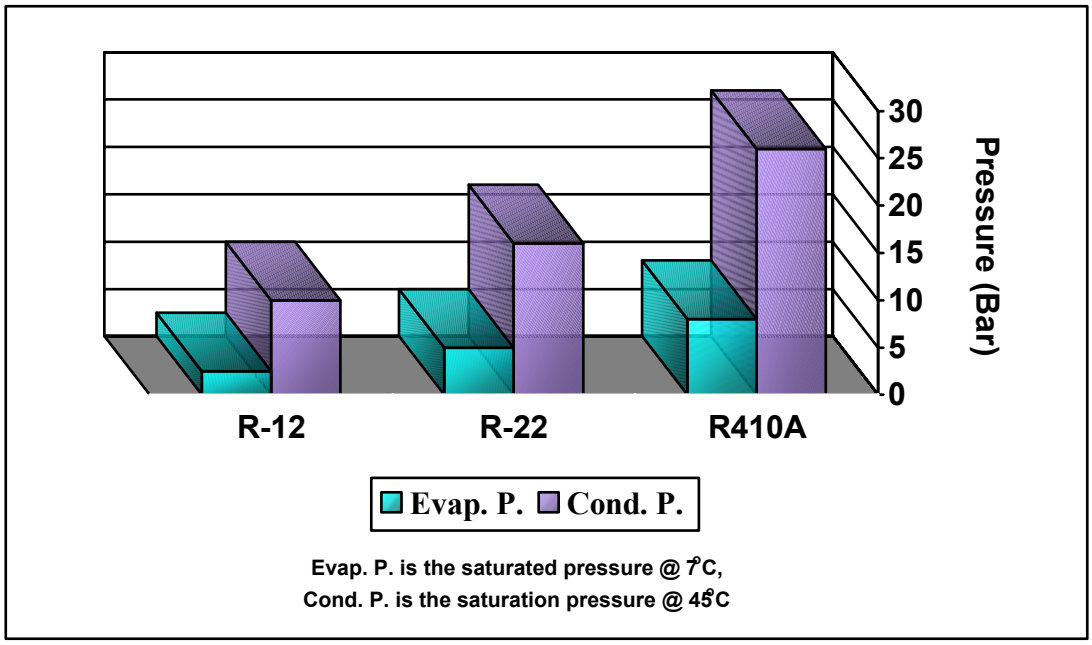
According to some major compressor manufacturers, R410A units can reach the industry's highest efficiency levels and, coupled with R410A's low global warming rating, result in an overall improved environmental choice for residential air conditioning applications.

R410A Properties
R410A is a blended refrigerant using HFC 32 and HFC 125 in an equal mix. It is a near azeotropic blend with a negligible glide (0.1%). As a HFC refrigerant, R410A requires the use of polyoester oils (POE). R410A is classified A1/A1 by ASHRAE Standard 34 meaning it is non flammable and non toxic. But the biggest difference to R22 is the pressure levels generated which are more than 50% higher. Although operating pressures of R410A are significantly higher than those of R22, the R410A system actually runs slightly cooler than a comparable R22 system due to the higher vapour heat capacity of the refrigerant.

Properties R22 vs. R410A

Properties	Units	R22	R410A
Components	-	$CHCIF_2$	HFC-32 HFC-125
Composition	% weight	-	50/50
Molecular Weight	g/mol	86.5	72.6
Bubble Temperature (at 1.013 bar)	°C	-40.7	-52.2
Temperature Glide (at 1.013 bar)	K	0	0.1
Liquid Density (at 25°c)	Kg/dm³	1.194	1.0615
Density of Saturated Vapour (at boiling point)	Kg/m³	4.70	4.12
Vapour Pressure at: .25°c .50°c	 bar* bar*	 10.4 19.4	 16.4 30.5
Critical Temperature	°C	96	72.2
Critical Pressure	bar*	49.8	49.5
Critical Density	Kg/dm³	0.525	0.491
Latent Heat of Vaporisation (at 1.013 bar)	KJ/kg	233.7	271.5
Specific Heat at 25c Liquid Vapour (at 1.013 bar)	 KJ/(kg.K) KJ/(kg.K)	 1.26 0.66	 1.855 0.819
Ratio of Specific Heat Cp/Cv (at 25°c and 1.013 bar)	-	1.185	1.172
Flammability Limits in Air	-	None	None
ODP	-	0.055	0

Table 1. Comparison of R22 and R410A properties.



Graph 1. Pressure Comparison: R12 vs. R22 vs. R410A

Higher Pressures Mean What?

The system pressures of R410A make is necessary for all equipment to be specifically made to work at these levels. R410A was **never** designed for retrofitting existing R22 systems. Newly designed R410A equipment generally employ thicker walled tubing, newly developed compressors, and use componentry capable of withstanding these high pressures.

Oils Ain't Oils

R410A is a blend of HFC refrigerants. The great majority of systems using HFC refrigerants contain polyoester oils (POE). POE oils are required because other oils, like mineral oil, are not miscible with HFC refrigerants. Miscibility is a measure of the ability of a liquid refrigerant to mix with the oil.

When replacing oil in any system always check the manufacturers recommendations. Care should be taken to avoid exposure of the POE oil to air as it readily absorbs moisture (often referred to as being highly hydroscopic). Preference is always to use a fresh unopened tin of oil and perform the task with minimum exposure to air.

Controlling Moisture

The use of hydroscopic POE oils increases the chances of introducing water to the refrigeration system. POE oils hydrolyse to form acids at 75ppm. It is therefore essential that a good drier developed for use with HFC refrigerants and POE oils is used. Moisture indicators should therefore also have a sensitivity level below 75ppm when used.

What About Glide

Glide is best described as follows: During the boiling process for a refrigerant, the temperature at which a liquid refrigerant begins to boil is the saturated liquid temperature (bubble point). The temperature at which the last drop of liquid has boiled is the saturated vapour temperature (dew point). During the condensing process the dew point is the temperature when the vapour first starts to condense, the bubble point when all has condensed. At constant pressure the difference between the dew point and bubble point is referred to as temperature glide. Single component refrigerants like R22 have no glide but blended refrigerants generally have some measurable glide. Put in simple terms, in a blended refrigerant one component begins to boil before the other. The glide for R410A is around 0.1°C which is very small. For field service purposes this glide can be neglected and the refrigerant treated as you would a single component refrigerant. In line with good practice, it is suggested you still liquid charge systems, as you should for any blended refrigerant.

R410A Applications

R410A is ideal for residential and light commercial unitary air conditioning systems. Most world renown manufacturers (see table 2) are now producing or have planned production of air conditioning units using R410A as suitable componentry is now widely available.

Some of the Many Manufacturers Using R410A

• Airewell	• Hyundai	• Sharp
• Carrier	• LG	• Tatung
• Corona	• Matsushita	• Toshiba
• Daewoo	• McQuay	• Toyotomi
• Daikin	• Mitsubishi	• Trane
• Frigidaire	• Panasonic	• York
• Fujitsu	• Samsung	
• Hitachi	• Sanyo	

Table 2.

What's in a Name?

Typical of many refrigerants, a number of brand names exist for R410A. These include AZ20, Puron and Suva® 9100. Using the ASHRAE name (e.g. R410A) assigned to any refrigerant will always ensure you are using the same refrigerant regardless of the brand name.

Price of R410A

Current costs for the manufacture of R410A are significantly higher than R22 due to higher raw material costs, lower production yields and smaller volume demand. As a result today's R410A price is significantly higher than R22. R22 price is expected to rise in future years when usage volumes decrease as a result of compliance with the phase out of HCFC's. Conversely R410A pricing may change as demand continues to increase.

What Happens when the System Leaks?
System leaks have always raised concern when the refrigerant used is a blend as the composition of the remaining refrigerant may have altered due to the difference in the volatility of the components in the blend (glide). As stated earlier the glide of R410A is only around 0.1°C and results in no meaningful change in composition during a leak or when charging a system

Servicing a R410A System
In general R410A is handled the same as R22. You will require some specific tools that are rated for the higher pressures. These include gauges and manifolds, reclaimers, and correct rated gas bottles with appropriate valves. As well as this it is recommended that flaring and swaging tools with an eccentric action be used as they provide a smoother flare surface.

Replacement parts must also be chosen bearing in mind that the system works under higher pressure. Items like driers, valves and even copper tube **must** be approved for use with R410A (refer to table 3).

R410A Copper Tube Wall Thickness Recommendations

Copper Size (Inches)	Recommended Wall Thickness (mm)	Safe Working Pressure 75°C to 125°C (kPa)
1/4	0.91	9787
3/8	0.91	6221
1/2	0.91	4556
5/8	1.02	4059
3/4	1.22	4045

Table 3. Based on AS1677.2-1998 “Refrigerating Systems”, page 20.

Leak Detection
Any electronic detector capable of detecting HFC refrigerants can be used. Halide torches are not capable. Soap solutions will detect larger leaks. UV sensitive dyes can also be used effectively.

Safety and Handling
As said above, R410A generally is handled the same as R22. Always minimise personal exposure to refrigerant gas. All refrigerants are heavier than air and will displace oxygen which can lead to asphyxiation.

Mixtures of refrigerants and air can become combustible under pressure. Never use mixtures of refrigerant to leak test. Always use dry nitrogen or other inert gas instead of air. Never braze on a system containing refrigerant.

All refrigerant cylinders can become over pressurised in high temperature conditions. Never allow refrigerant cylinders to exceed 60°C. Never store cylinders unprotected in direct sunlight. Always use cylinders with the correct pressure rating and frequently check the condition of the cylinder you are using. Minimum rating for R410A cylinders is 5.8MPa. Never over-fill the cylinder with refrigerant.

Only use R410A in equipment specifically designed and constructed for R410A. Do not retrofit R22 units with R410A.

Ensure that correct replacement parts are used when servicing an R410A system and always use equipment and tools designed for R410A service work.

For further safety information obtain a Material Safety Data Sheet available wherever the refrigerant is sold.

In Summary
R410A is a HFC refrigerant for use in specifically designed air conditioning systems. It is not designed to retrofit existing R22 systems. Although running at much higher pressures R410A is a far more economical refrigerant allowing equipment manufacturers to design smaller yet highly efficient air conditioning systems. R410A is proven to be safe and reliable providing the correct tools and equipment are used.

	R22		R410A	
°C	kPa	psig	kPa	psig
-30	63	9.1	173	25
-28	80	12	196	28
-26	91	13	220	32
-24	108	16	245	35
-22	126	18	272	39
-20	145	21	301	44
-18	165	24	331	48
-16	185	27	364	53
-14	207	30	398	58
-12	231	33	434	63
-10	254	37	472	68
-8	284	41	512	74
-6	310	45	554	80
-4	334	48	599	87
-2	361	52	646	94
0	398	58	695	101
2	430	62	747	108
4	465	67	801	116
6	504	73	858	124
8	542	79	918	133
10	584	85	980	142
12	622	90	1046	152
14	668	97	1114	161

	R22		R410A	
°C	kPa	psig	kPa	psig
16	716	104	1186	172
18	769	112	1260	183
20	814	118	1338	194
22	866	126	1419	206
24	917	133	1504	218
26	975	141	1592	231
28	1040	151	1684	244
30	1107	161	1779	258
32	1165	169	1878	272
34	1230	178	1981	287
36	1300	189	2088	303
38	1378	200	2199	319
40	1448	210	2315	336
42	1525	221	2434	353
44	1610	233	2558	371
46	1688	245	2686	389
48	1770	257	2819	409
50	1855	269	2956	429
52	1950	283	3099	449
54	2050	297	3245	470
56	2140	310	3397	492
58	2245	326	3554	515
60	2345	340	3716	539

Note: R410A pressures shown at Saturated Vapour Temperature (dew point).

Table 4. Temperature – Pressure Data for R22 and R410A.

For further information contact your local Actrol Parts Branch.

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