HyChill Australia Pty. Ltd.

OKA Media Release Frequently Asked Questions (FAQ)

The recent announcement by HyChill that OKA Motor Company is the first motor vehicle OEM in the world to supply vehicles using hydrocarbon refrigerants has generated significant interest. Not surprisingly, HyChill has received further enquiries from many sources and many of the questions are similar. So HyChill decided to compile answers to the following set of Frequently Asked Questions (FAQs) as set out below.

Question: Is the use of hydrocarbons in OEM MACs approved by any Australian state or federal regulatory bodies?

Answer: The short answer is “business doesn’t work like this in Australia”.

Australia has a (more or less) free market approach, governed by a suite of laws requiring fairness and honesty in business and clearly defined legal liabilities ensuring products and services supplied are fit for the purpose intended (or else serious legal penalty will result).

Not surprisingly, given that general safety and responsibility laws are already in place, there is no Australian state or federal regulatory body charged with approving specific refrigerant alternatives.

As to why ‘gatekeeper’ bureaucratic roadblocks such as ‘safety’ approval components of the United States Environmental Protection Agency’s Significant New Alternatives (SNAP) regime exists when the USA already has very effective general safety, liability and consumer protection laws is a question we cannot answer, and we would encourage you to ask the US EPA directly. As we see it, motor vehicle companies have an excellent record of supplying safe products to market, and where design flaws have emerged general legal liability laws “kick in” to create the proper incentives to fix the problems. As we understand it, the US EPA SNAP program simply provides a mechanism to block certain refrigerant technologies it objects to. For those refrigerants (and applications) that are approved, the USEPA takes no further responsibility for the correctness (or otherwise) of it’s decisions. Despite any evidence that motor vehicle manufacturers have a track record of bad design or need “hand holding” with regard to choosing safe refrigerant alternatives, the US EPA exists as a gatekeeper above, beyond and distinct from its central mandate of environment protection. As far as we can tell it is, in a very practical sense, not much more than a tool for erecting trade barriers to certain refrigerant choices. The fact that the USA is more than 15 years behind the rest of the developed world in adopting hydrocarbons across a wide range of applications should make the point reasonably clear. Thankfully, in Australia such redundant schemes are not common.

HyChill (like any other Australian business) under Australian law becomes automatically legally responsible if it is found that the product is not suitably safe when used according to HyChill’s instructions, and the penalties are severe if it turns out that the product is not suitably safe.

HyChill explicitly states in it's product literature that "Minus 30" is suitable for use in automotive air conditioning systems, including as a drop-in-replacement for HFC-134a and R-12 in most vehicles. Therefore, under Australian law HyChill becomes legally responsible that Minus 30 is indeed safe for this purpose, and faces severe legal and financial penalties if it is not.

Neither HyChill nor any other hydrocarbon refrigerant supplier (to our knowledge) has ever been prosecuted for supplying a product that was not fit for the purpose(s) approved by the refrigerant manufacturer.

Of the very small number of mobile air-conditioning safety incidents over the last 20 years where hydrocarbon refrigerants have been involved, all have been servicing/workshop related and were the direct result of serious and basic design flaws and/or clear failures to abide by basic common sense and straightforward safety procedures.

We are not aware of any credible evidence whatsoever (since hydrocarbons were first applied commercially as a drop-in replacement for HFC-134a and CFC-12 in mobile AC around 20 years ago) that there is any trend of safety problems due to any kind of fundamental unsuitability of hydrocarbons in mobile AC whatsoever, either on-road or in workshops.

The only reason concerns about hydrocarbon suitability in mobile air conditioning persists today is that misinformation, misconceptions and flawed analysis that was widely publicised by competing interests in the early 1990's was spread widely enough to be mistaken as fact.

In the 17th and 18th centuries, the Spaniards enjoyed tomatoes as part of their diet. Even though some Britons were aware of this fact, the tomato was still widely regarded there as poisonous and not to be eaten. As the truth gradually became more widely known, tomatoes took up their deserved place in British (and North American) diets. But, just as sure as there still remains a "Flat Earth Society", we can be fairly certain that in 10 years from now there will still be a remnant of people opposed to hydrocarbons in motor vehicle AC regardless of reality. After all, if 20 years of evidence is not sufficient for them, why would an additional 10 or 20 of safe use shift their attitudes? As for the rest of us, the simple path forward is to accept the objective reality that hydrocarbons are safe in motor vehicle air conditioning.

Question: What (if any) design changes were made to the OKA air conditioning systems (compared to a R134a design) in order to safely use hydrocarbons?

Answer: None.

A large number of vehicle repair workshops in Australia, USA, Canada, Philippines, China, North Africa and many mining sites from all over the globe have been using hydrocarbons as a drop-in replacement for HFC-134a and CFC-12 (without additional

modifications) for up to 20 years. If you're from one of those workshops, then the news that OKA's vehicles use "standard" designs will not surprise you at all.

If you are not one of those people, however, it is highly likely that you have encountered misinformation that still propagates around the industry. Alternatively, you may just have a "healthy" fear of flammable fluids in general and don't quite understand how an air conditioner designed for "non-flammble" HFC-134a could be safe when used with flammable hydrocarbons instead. If either of these cases is you, read on.

Naturally, this document does not have the scope for a completely thorough examination of the subject, but we hope we can provide enough thinking points for you to gain a better perspective on this issue.

In dot points, these are the issues you need to (re)consider:

- Despite the fact that HFC-134a (and CFC-12) are marked as non-flammable, leaks of these gases from air conditioning systems ARE flammable because of the lubricant that is in the AC system that is being released at the same time. Even the large fluoro-chemical manufacturers are willing to go more public about this fact because it now suits their purposes for promoting HFO-1234yf as the successor to HFC-134a (see slide 16 in this presentation). You simply cannot move forward in your understanding of this issue until you grasp and accept this fact. Please contact us if you would like more information on this topic. Furthermore, the autoignition temperature of the lubricant is typically lower than the refrigerant.

- Despite the fact that ALL HFC-134a (and CFC-12) systems pose flammability risks in various failure situations, actual real-world ignition incidents are extremely rare. This is because of many factors, not least of which are:

    - The relatively small charge sizes.

    - The design of the AC systems and the vehicle itself (which contains fluids which are orders of magnitude more hazardous and present in much larger quantities).

    - Overly conservative modelling and unrealistic assumptions about risk scenarios that are orders of magnitude different from reality.

- Although hydrocarbons are more flammable than HFC-134a and CFC-12 based AC systems, the net increase in risk is not significant. This can be explained technically, but is best evidenced by the public record of 20+ years of successful and safe commercial use in the automotive sector. Furthermore, the slightly increased flammability risks are offset by:

    - the significantly reduced toxicity risks associated with hydrocarbons compared to HFC-134a (or HFO-1234yf) - hydrocarbons do not form extremely toxic substances (such as hydrogen fluoride) when heated or combusted, and

- the fact that hydrocarbons do not become corrosive in the presence of moisture (reducing the incidence of leaks caused by corrosion, or eliminating corrosion altogether if used with a non-corrosive lubricant).

Side note: OEM's that find themselves considering hydrocarbons in future are, of course, free to elect one or more of the many available safety mitigation techniques if they want to add extra (albeit redundant) layers of safety to their designs. If this is the route by which they can accept hydrocarbons whilst preserving in their own minds some justification for their concerns about hydrocarbons, then so be it.

Question: What theoretical, laboratory and/or field testing have you conducted in order to demonstrate the safety of hydrocarbon-based MACs?

Answer: Over the past 20 years there have been a number of risk assessments, laboratory tests and field trials conducted.

However, as any competent analyst would acknowledge, all controlled and contrived theoretical and practical assessments and tests (however well intentioned) are inferior to the results of widespread real-world usage in the target application(s).

As already mentioned numerous times, hydrocarbons are in widespread use and have been used commercially in automotive applications as a drop-in (without modification) replacement for HFC-134a and CFC-12, and the total usage exceeds 20 years duration. Usage exceeds the equivalent of 20 million car-user-years equivalent (as at 2004 – these figures would be considerably larger now). This was all documented by Maclaine-cross, peer-reviewed and published in the International Journal of Refrigeration[1]. We are not aware of any subsequent literature that in any way rebuts or challenges the findings of this paper.

The following fact should be obvious to you if you read it aloud: there is no benefit to contriving tests designed to predict the real world safety of something when that very something has already been used widely in the real world itself. With such extensive real-world experience with hydrocarbons in automotive AC, field trials, laboratory tests and risk assessments attempting to determine whether or not hydrocarbons are sufficiently safe in a MAC context is pointless. If you would still like a list of theoretical and laboratory studies regarding hydrocarbon safety (regardless of the findings), we would be happy to supply you with a comprehensive list. However, the only significant information still contained in those is reports is that they highlight the level of skill and bias in the persons involved conducting the research, because one can now retrospectively compare and contrast the real world safety of hydrocarbons in MACs against their theoretical conclusions.

1Maclaine-cross, I. L., *Usage and Risk of Hydrocarbon Refrigerants in Motor Cars for Australia and the United States,* International Journal of Refrigeration, Vol. 27 No. 4, pp. 339-345, June 2004.

If you still have lingering concerns, we suggest that turning the question around is the only way forward - what precisely has not already been revealed in the real-world usage of hydrocarbons that you feel needs to be revealed in order to resolve your lingering concerns?

- If you can identify the specific requirement, then please let us know and we'll do our best to assist, or
- If you cannot identify the specific requirement, then you may be exhibiting the classic symptoms of cognitive dissonance, or
- You may be confused over the difference between *objective reality* and and *truth by consensus* (e.g. deciding that *black* is *white*, on the basis that enough of your peers agree with you, is an example of *truth by consensus* thinking).

Question: What testing have you conducted in order to demonstrate the performance improvement of hydrocarbon-based MACs vs. R134a?

Answer: The fact that (correctly selected) hydrocarbons are superior to HFC-134a is a fairly non-controversial fact these days. Even many prominent persons from amongst our competitors in the f-gas industry publicly acknowledge this fact now.

Due to it's use as a fuel for more than 100 years, the thermodynamic performance of hydrocarbons has been very accurately known since well before hydrocarbons were being used in automotive air-conditioning.

The only occasions where doubt about the superior cooling characteristics of hydrocarbons has arisen is when occasional comparison tests are conducted where (either through ignorance or intent) the comparison is not fair. The most common occurrence is testing a certain f-gas against a particular hydrocarbon with very different thermodynamic characteristics.

In practice the most common mistake we come across is attempts to compare HFC-134a against HC-290 (propane). This is a flawed comparison. The proper comparison against HFC-134a is the correct blend of propane (HC-290) and isobutane (HC-600a) such as HyChill Minus 30 - this comparison will indeed show superior performance - and the hydrocarbon will further outperform HFC-134a as the ambient temperature rises, due in no small part to the higher effective critical temperature of HyChill Minus 30 compared to HFC-134a (and HFO-1234yf).

If you would like copies/references of specific literature that details the reasons why hydrocarbons have superior performance, please contact us. Please note that most of the literature was written a decade or more ago, as the issue has been settled in scientific circles for some time now.

Glossary of terms

GWP - Global Warming Potential (a measure of the level of impact on the environment according to the Global Warming theory)

MAC - Mobile Air Conditioning

OEM - Original Equipment Manufacturer

CFC-12 (or R-12) - A synthetic fluorinated refrigerant gas, now phased out in most countries due to it's impact on the 'ozone layer'.

HFC-134a (or R-134a) - A synthetic fluorinated refrigerant gas, currently used extensively in motor vehicle air conditioning. It was the main successor of CFC-12.

HFO-1234yf - The proposed successor to HFC-134a. The gas was first synthesized in the 1930's, but is being brought back on to the table because it is one of the few fluorocarbon refrigerants with similar characteristics to HFC-134a that has a GWP low enough to meet the requirements of some jurisdictions. According to the USA Dept of Transport (DOT) and International Maritime Dangerous Goods (IMDG) Codes, HFO-1234yf is in the same hazard classification as hydrocarbons HC-290 and HC-600a – class 2.1

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doc rev 01, dated 10 Feb 2010

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