

1 - INTRODUCTION

With the intention of moving away from refrigerants which are chemically noxious to the ozone layer, the refrigeration industry and the refrigeration technicians have been placed in a dilemma: What is the best R 12 alternative in reoperation services? After exhaustive research, Embraco advises the use of four refrigerant fluid blends to substitute the CFC's. These alternatives were developed with a view to obtaining a refrigerant whose pressures and temperatures were very close to those of the R 12, and furthermore, non toxic to the environment. However, the knowledge and the quality of the service the refrigeration technician offers are especially important in the application of the refrigerant blends.

It is important to remember that the compressor and the R 134a refrigerant fluid cannot be applied to systems which have already operated with the R 12. The impurities and, especially the lubricant oil residues which remain in the reoperated system, are definitely not compatible with the R 134a and the ester oil.

2 - DEVELOPMENT

In 1988, Embraco began an extensive alternative refrigerant fluid evaluation program for R 12 substitution in existing refrigeration systems, evaluating not only the methodology for changing a compressor but also a very strict evaluation of the compressor performance characteristics and the refrigeration system using the alternative refrigerant fluid.

For a refrigerant fluid to be used as an R 12 substitute in existing systems, all characteristics offered by the R 12 must be satisfied. The most important characteristic is the chemical stability with the refrigeration system components and materials. Besides this, the refrigerant fluid must meet the criteria in relation to toxicity and safety aspects. A great number of other characteristics of a more practical nature are also necessary or, at least, desirable. A good miscibility with the lubricant oil and a high dielectric rigidity are very important for hermetic compressors. Lastly, the compatibility with sealed unit constructive materials, the facility of leakage detection and low cost are obviously desirable.

3 - REFRIGERANT FLUID BLENDS

Embraco carried out an extensive testing program to evaluate different refrigerant fluid blend alternatives for substitution in R 12 systems. Among the available market options, the following refrigerant fluid blends were approved for use with the Embraco compressors:

REFRIGERANT (# ASHRAE)	MANUFACTURER	COMPOSITION	RECOMMENDED APPLICATION (ACCORDING TO MANUFACTURER)
SUVA MP66 (R 401b)	DuPont	61% R 22 11% R 152a 28% R 124	Evaporating temperature lower than -23°C
SUVA MP39 (R 401a)	DuPont	53% R 22 13% R 152a 34% R 124	Evaporating temperature lower than -23°C
FX 56 (R 409a)	Elf Atochem	60% R 22 15% R 142b 25% R 124	Medium and low evaporation applications
ISCEON - 49 (R 413a)	Rhône Poulenc	88% R 134a 9% R 218 3% R 600a	Medium and low evaporation applications

These blends are composed of two or three HCFCs, HFCs or HC type refrigerant fluids and possess the following important characteristics:

- Ozone layer destruction factor less than that of the CFC-12.
- Their components do not blend completely and for this reason are known as non azeotropic refrigerants.
- Due to the density difference between the blend components, eventual leakage in the gas phase can affect the performance of the refrigeration system. This occurs due to the fact that the higher pressure gases escape first, altering their composition.

4 - IMPACTS ON REFRIGERATION SYSTEMS

The refrigeration systems designed to run with a determined refrigerant fluid are manufactured according to the quality and safety specifications in such a way as to offer the final user an adequate level of performance. Obviously, this adequate level of performance varies from manufacturer to manufacturer. However, it must be maintained within certain limits, even after an eventual system repair.

When there is a need to repair one of the sealed unit components and, to do this the original fluid loaded at the factory has to be removed, the refrigeration technician must observe the following points:

4.1 – MISCIBILITY OF THE ALTERNATIVE REFRIGERANT WITH THE COMPRESSOR OIL

The lack of miscibility of the refrigerant fluid with the compressor oil can cause oil retention problems in the sealed unit components and lead to higher balancing pressures in the refrigeration system causing problems during compressor start and, occasionally, during the running. To counteract these problems, from September 1997 the Embraco compressors destined for replacement will be supplied with alkylbenzene added synthetic oil. In approval tests carried out at Embraco, the alkylbenzene synthetic lubricant oil combined with the additive, obtained satisfactory results when operating in systems supplied with the blends mentioned in the table in item 3.

NOTE: In the factory, Embraco compressors receive a special oil load which is completely degassed, moisture free and in specified quality and quantity.
It should not be removed or mixed.

4.2 – COMPATIBILITY WITH ELECTRIC MOTOR INSULATION

The materials used as electric motor insulation of a hermetic compressor must maintain their physical and chemical properties unaltered during the system's life span. The R 12 refrigerant fluid substitute and the lubricant oil will create a new chemical atmosphere within the compressor and, according to tests carried out at Embraco, it was shown that the chemical attack on the electric motor insulation, is more severe in the presence of R 22 + mineral oil than in the presence of R 22 + alkylbenzene oil. As the majority of the refrigerant fluid blends use the R 22 as one of their components, it becomes necessary that the compressor uses alkylbenzene added synthetic oil. **Refrigerant fluid blends must not be used with mineral oil.**

4.3 – COMPATIBILITY WITH THE DRYER FILTER

Due to problems of chemical compatibility, the dryer filter normally used for systems which operate with R 12, should be substituted for one compatible with the blend. Of the dryer filters found on the market with molecular sieves we could use the XH9 or the Universal (MS594).

4.4 – COMPRESSOR DISCHARGE TEMPERATURE

The presence of R 22 in refrigerant fluid blends increases the compressor discharge temperature. This increase can vary from 5 to 11% compared to the same system using R 12. Therefore, the refrigeration technician must evaluate the conditions in which he found the refrigeration system, and decide whether the blend being used is suitable or not.

4.5 – REFRIGERANT FLUID LOAD (BLEND)

Due to the difference in density of the blend components previously mentioned, the loading of the system's refrigerant fluid should only be done in the liquid phase. We advise the use of an auxiliary cylinder to carry out system loading. During the introduction of the refrigerant fluid in the liquid phase the compressor must remain disconnected.

For the majority of the systems, the optimized refrigerant fluid load should be 75 to 90% of the original R 12 weight.

5 - CONCLUSION

The performance of the refrigeration system can vary from case to case. Eventual efficiency losses associated with the use of these blends are expected, as it is not the original refrigerant fluid.

The quality of the service rendered by the refrigeration technician is fundamental for obtaining satisfactory results.

Important

The Embraco compressors for use with the blends mentioned in this information sheet, will be available from retailers only from the beginning of September 1997. Do not use compressors which were manufactured on previous dates as they do not have alkylbenzene added synthetic oil suitable for this use.

With the objective of facilitating future services, after concluding system maintenance, it is important to identify the refrigerant fluid and the load used.

Note: After replacement, the compressor and its accessories must have proper processing, and the components must be recycled according to the material group (ferrous, non-ferrous, polymers, oils, ...) directives. These recommendations are intended to minimize the adverse impacts that may be caused to the environment.



Embraco is participating in the United Nations Global Compact.