

# R22 retrofit with R422D in German Supermarkets

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## Abstract

In commercial refrigeration systems in Europe, R22 is still widely used, although the most common refrigerant for new systems is R404A. Since R22 has a non-zero ozone-depletion potential (ODP), European legislation requires a phase-out of R22. One important element of this legislation is a phase-out of virgin R22 for use in maintenance and service by 2010, and a phase-out of recycled/reclaimed R22 by 2015. Consequently, owners of supermarkets where systems are still operating on R22 may face shortages of refrigerant supply and consequently endanger operation of their system after this date.

In close cooperation with DuPont Germany, EPTA has developed a retrofit scheme using MO29 (R422D) which allows a quick change of refrigerant in existing R22 systems without interrupting activities on the shop floor and without impacting system performance. This case study presents the retrofit procedure and summarizes operation conditions before and after the retrofit with R422D.

## Background

Since the introduction of HFCs in commercial refrigeration systems in the mid 1990s, many efforts were done to find a drop-in refrigerant to replace R22 in existing systems. The main difficulties in finding a suitable drop-in substitute were related to the following:

- The drop-in must be environmentally friendly
- The drop-in should be compatible with mineral oil used in R22 systems
- Performance properties of the drop-in should be close to R22 performance properties in order to avoid major changes in the system design and allow continuous usage of main components, like compressors, condensers and evaporators
- The drop-in must be readily available in sufficient quantities

Recently, DuPont has introduced ISCEON MO29 (R422D) on the market which is a mixture of 31.5 % R134a, 65.1% R125 and 3.4% Isobutane claiming to fulfill all of the above requirements. EPTA group, one of the major commercial refrigeration suppliers for display cabinets and system solutions in Europe, has chosen this HFC blend and started to develop an easy and time-efficient retrofit scheme in 2006 which will subsequently be outlined.

## Thermodynamic properties

Compared to R22, MO29 (R422D) shows similar properties as summarized for some characteristic properties in the table below:

	R22	R422D (ISCEON MO29)
Vapor pressure at 0°C	498,2 kPa	482..543 kPa
Normal boiling point	-41,0 °C	-41,5..-46,2 °C
Discharge temp. (43°C cond., 4°C evap.)	96 °C	71 °C
Cooling capacity	100%	95..97%

Important to note is that saturation properties and cooling capacity are very similar. Another advantage is the lower discharge temperature which indicates an improvement of compressor performance. Since R422D is a non-azeotropic mixture, it has a temperature glide of about 4,5 K. A small temperature glide generally improves area usage in heat exchangers, indicating also a potential improvement of system performance.

## Retrofit procedure

As a first test, a supermarket was selected for a retrofit with the following parameters:

- Low temperature (LT) system supplying 10 m of frozen food islands and 1 cold room with a total refrigerant charge of 55 kg.
- Normal temperature (NT) system supplying 25 m of multideck, 10 m of serve-over and 3 cold rooms. Total refrigerant charge was also 55 kg.

In preparation, EPTA Service technicians carried out a leak inspection to ensure that no major leaks existed in the system. On the day of the retrofit, the following schedule was followed:

- Forced cooling of all cooling points in NT 8.00 am
- Switch off and extraction of R22 from NT system 9.00 am
- Check of sealings, change of solenoid sealings 9.00-11:30 am
- Change of filter driers 11.30 am
- Evacuation of entire system 12.00 am
- Refill of NT system with R422D and re-start 1.00 am

In summary, the entire duration of the retrofit took 5 hours and the system was without cooling for 4 hours. The same process and time table was applied to retrofit the LT system immediately after. One day after the retrofit, an inspection visit was carried out to check temperatures and double check for leakages which took approximately 1 hour.

All these activities were carried out during times of normal store trading hours. No emptying of display cases or cold rooms was necessary, and the selling activities on the sales floors were not interrupted, which is a very important element for the customer. As noted above, no oil change was carried out and the expansion valves and nozzles were not exchanged.

## Performance comparison

System performance parameters of the above supermarket were measured before and after the retrofit. Of course, since measurements took place on different days, different ambient conditions apply. The following table gives a summary:

Built in 1995	NT-system (t0 = -10 °C)		LT-system (t0 = -35 °C)	
	R22	R422D	R22	R422D
Ambient temp.	11 °C	16 °C	11 °C	16 °C
Condensing pressure	1490 kPa	1500 kPa	1270 kPa	1330 kPa
Condensing temp.	41,5 °C	38,5...41,0 °C	35,5 °C	34,2...36,8 °C
Discharge temp.	76 °C	63 °C	81 °C	71 °C
Compressor pack current	17,5 A	16,4 A	16,2 A	15,8 A

It should be noted that subcooling of liquid was about the same at about 11 K, while vapor superheat was at about 4 K in both cases.

As expected, the discharge temperature has dropped significantly by about 10 K to 13 K when operating with R422D. This will impact positively on compressor life considering that this plant was already in operation by more than 10 years. In addition, a reduction in compressor current is observed which will reduce energy consumption of this system by 3% to 6%. Similar observations were made when monitoring other systems where retrofit was carried out as outlined above. In total, EPTA has now retrofitted about 50 stores in Germany and about 10 stores in the UK. The largest system contained about 700 kg R22, however,

the same retrofit procedures applied. Given that the system was virtually leak-free before the retrofit, no major disturbances were encountered.

### **Conclusion**

With ISCEON MO29, DuPont has developed a suitable R22 drop-in substitute which allows easy and quick retrofit in existing R22 commercial refrigeration systems. The key advantage of the retrofit method described here is that there is no disturbance of shop floor activities impacting on customers business. Furthermore, activities and investments for retrofit can be reduced to a minimum.

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