Refrigerant Solutions Ltd

RS-24 COMMERICAL REFRIGERATION SYSTEM TRIAL

A series of controlled tests were carried out at the test site of Refrigerant Services Inc, Canada between June and November 1999 in a commercial refrigeration systems where R12 was replaced by RS-24. The exisitng mineral oil was replaced by a new charge of mineral oil which was used with RS-24 for the trial.

SYSTEM SPECIFICATIONS

Existing R12 refrigerant purge system, 0.37 kw type Danfoss model DA05H1AAN air-cooled hermetic compressor,

Design evap. temp range –6^{o}C +10 ^{o}C .

Capacity 967 watts to 1861 watts/hr @ 32^{o}c cond. temp. voltage 115/1/60, compressor RLA 11.2 amps

Operating refrigerant charge: 1.2 kg R12

The system consisted of the above cond. unit and a tube in tube evaporator, a standard TXV and approx. 3 ft. of suction and liquid piping. An oil sight-glass was fitted to the compressor and the system was charged with 3g oil (150 viscosity).

The system was operated as a condensing system to condense R12 vapours from the top of a heated cylinder and the condensate flowed by gravity from the evaporator/condenser to a second unheated cylinder.

System capacity was determined by the weight of R12 condensed during a fixed time period.

The flow of R12 vapour to the evaporator/condenser was restricted manually to provide various load conditions.

All pressure, temperature, capacity and amperage readings were taken hourly and averaged over a 6-8 hour period.

MODIFICATIONS TO SYSTEM

Installed oil sight-glass on hermetic compressor.
Installed connections on discharge line and evaporator inlet for vapour sampling and to facilitate the addition of graduated amounts of pentane to the system.

PROCEDURES

1. Recovered refrigerant and installed oil sight-glass on compressor to monitor oil level.

2. Installed test ports on suction and discharge lines.

3. Replaced existing mineral oil with 3g mineral oil (150 viscosity).

4. Recharged system to normal operating charge of R12 and oil and recorded weight of refrigerant charge.

5. Installed temperature sensors on suction and discharge lines 15 cm from compressor body.

6. Installed liquid line temperature sensor 15 cm from receiver.

7. Installed suction and discharge gauges.

STAGE 1 OF COMMERCIAL REFRIGERATION SYSTEM TRIAL

Operated the system with R12 and monitored & recorded baseline data including :

Voltage, amperage, suction pressure, suction temperature, discharge pressure, discharge temperature, liquid line temperature, evaporator temperature, ambient temperature, oil level, source and receiving cylinder temperatures and process rates in kgs/min.

Note: evaporator temperatures were controlled by restricting inlet of purge gas and were monitored over a range of temperatures between –34^{o}C and -6 ^{o}C (-0.2 bar to 1.4 bar).

STAGE 2 OF COMMERCIAL REFRIGERATION SYSTEM TRIAL

Removed all R12 from system leaving oil in place.

Recorded total weight of refrigerant charge.

Charged system with R134a at approx. 90% of original R12 charge by weight.

Recorded initial oil level.

Monitored and recorded baseline data over similar range of evaporator temperatures as stage 1.
Monitored oil level carefully during entire test.

COMMERCIAL REFRIGERATION SYSTEM FIELD TEST RESULTS

	RECORDED DATA	
	R12	**RS-24**
HIGH LOAD CONDITIONS		
Suction pressure	1.72	1.59
Suction temperature	6	14
Discharge pressure	8.4	8.7
Discharge temperature	59	59
Capacity	0.3	0.32
Ambient temperature	24	21
Amperage	9.96	9.58
MEDIUM LOAD CONDITIONS		
Suction pressure	0.69	0.83
Suction temperature	0	14
Discharge pressure	7.5	7.8
Dischage temperature	56	57
Capacity	0.14	0.15
Ambient temperature	25	22
Amperage	9.14	8.78
LOW LOAD CONDITIONS		
Suction pressure	-0.1	0
Suction temperature	-17	16
Discharge pressure	5.8	6
Discharge temperature	42	46
Capacity	0.05	0.05
Ambient temperature	21	21
Amperage	8.7	8.14

NOTES:

Pressures are in bars
Temperatures are in Celcius
Capacity is in kgs/min

OIL RETURN

The R12 was recovered from the system and the system was evacuated. R134a was charged into the system using 90% of the original weight of R12. After many days of operation at various load conditions the oil level in the compressor did not change.

15 meters of suction line was added to the system again with no change in oil level. The 2 meter suction riser was increased in size to inhibit oil return. After several days of operation the oil level dropped approx. 10 mm.

R134a was recovered from the system and replaced by RS-24.

After approx. 18 hours the oil level increased approx. 6 mm.

OPERATIONAL CONDIITONS

Base data was recorded under various load conditions using the original R12 charge and with RS-24.

SYSTEM OBSERVATIONS

1. Oil return was improved with the addition of RS-24.

2. Capacities were slightly higher under all load conditions.

3. Energy consumption was slightly lower under all load conditions.

4. Discharge pressures were slightly higher on average.

5. Suction pressures were similar on average.

6. Discharge temperatures were slightly higher on average.

7. Suction temperatures were considerably higher on average.

8. There was no apparent negative impact on the system operation or components.

CONCLUSION

RS-24 installed as a Drop-in replacement appears to provide oil return, and equal or better capacity and higher efficiency for a medium or high temperature R12 commercial system with no immediate negative effects on the equipment or operation.