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Field Study

UPF170 compressor

March 2010

Cat. No. T1702

Introduction

The purpose of this field test is to examine the performance and durability of a Unicla UPF170 compressor operating in a real life application, and to demonstrate the capabilities of Unicla F series compressors in direct drive applications operating with refrigerant R404a.

Description

The vehicle is a new Mitsubishi truck installed with a Transfridge unit operating in Sydney Australia, and delivering frozen goods around the CBD district and greater Sydney region. The installation was completed in March 2003 by Transfridge Australia. Details as follows:

Vehicle make and model	Mitsubishi FM 10.0
Body type	Full fibreglass body 5.3 metres in length, polyurethane insulation
Refrigeration system	Transfridge OED-14 with R404a refrigerant - 3kW capacity
Compressor type	Unicla UPF170 with 132mm AA clutch - serial no: 240560

Summary

The final evaluation of this compressor is it has performed well, and has shown excellent durability despite the lack of service and maintenance carried out on the refrigeration system. The vehicle was presented to the original service agent Transfridge, only when a problem or fault occurred. Transfridge was able to keep the complete system and compressor operating between extended and infrequent service intervals by replacing any suspect or worn components, such as the shaft seal and clutch pulley on this compressor.

This report reveals the high temperature levels in the system caused from the low refrigerant conditions and how it impacted on the compressor. The main components affected are the shaft seal, rear cap housing and the rear oring. The final leakage at the heat fatigued oring resulted in the replacement of the compressor after six and a half years of service and 355,000km.

Compressor mounted to engine.

Actual UPF170 compressor.

Vehicle and refrigeration unit history

The vehicle delivered frozen goods in Sydney and the immediate country areas, mostly completing shorter country runs of 100-200 km at a time. Operating conditions were typically as follows:

Hot day / Hot cargo area
Suction pressure 420 kPa/Discharge pressure 2100 kPa.

Cool day or when cargo area is at -18.0°C
Suction pressure 150 kPa/Discharge pressure 1100 kPa.

Average temperature requirements in the cargo area during deliveries range from -10.0°C to -18.0°C.

Rear view with horizontal refrigerant hose connections, plus oil return line fitted in place of suction service fitting to rear cap.

The following services and repairs were undertaken:

November 2006
Service and repair minor leaks including shaft seal at compressor.

October 2008
At 293,000 km, service and replace idler pulley bearing, compressor clutch and fan motor brushes. (all showing normal wear and tear conditions)

August 2009
At 340,000 km service and repair minor leaks, replace receiver drier.

November 2009
At 355,000 km, service and repair leaking discharge hose, locate leaking oring at compressor rear cap. Replace compressor. The compressor was removed and returned to the factory for inspection.

Compressor evaluation report

Date	5th February 2010
Completed	Engineering and design department at Unicla factory – senior engineers Mr Yano and Mr Kato
Purpose	To verify condition and conduct pull down evaluation of UPF170 compressor serial no: 240560 manufactured in 2003

Results

Swashplate

Clearance: 0.150 mm (Standard: 0.020 - 0.022). This enlarged clearance (endplay) is due to normal wear on the contacting surfaces between cylinder and thrust washer. No damage was found on these surfaces or the thrust washers. This would not affect the running operation and durability of the compressor, however may cause a slight noise.

Front and rear surfaces of swashplate

Shoe discs

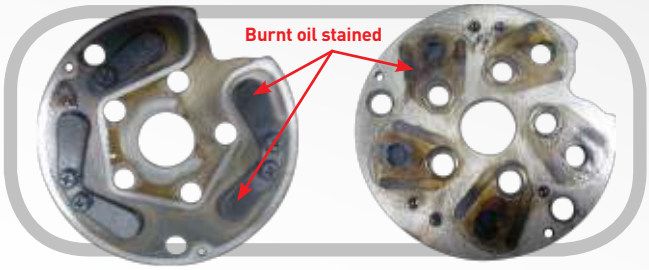
Clearance: (Standard: 0.020 - 0.022). The sliding sides of the shoe discs are in good condition and within specification for their age. No damage to other parts of the discs and they could continue to function normally.

Clearance	1	2	3	4	5
	0.056	0.050	0.045	0.057	0.057

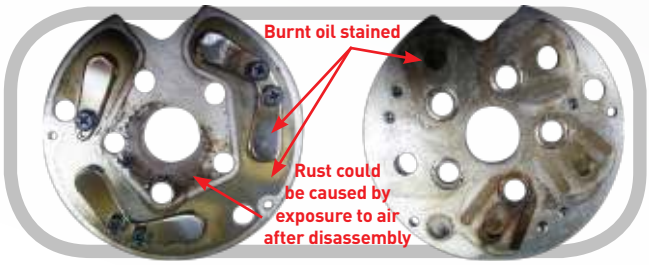
Shoe discs

Valve plates

All valve plates are in normal working order. Burnt oil stains are evident which is most likely caused from excessive temperatures during operation with low gas. Rust is evident on the rear discharge plate, however this has appeared from exposure to air and moisture after removal from the system.

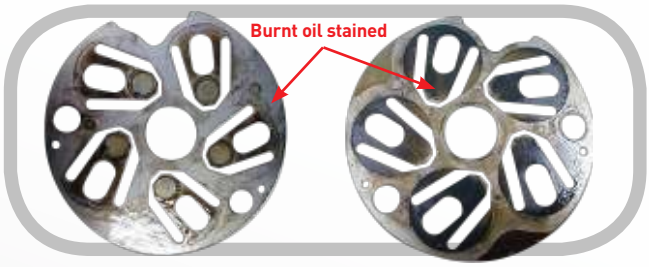


Front discharge valve plate assembly (front & rear)



Rear discharge valve plate assembly (front & rear)

Front suction valve plate (front & rear)



Rear suction valve plate assembly (front & rear)

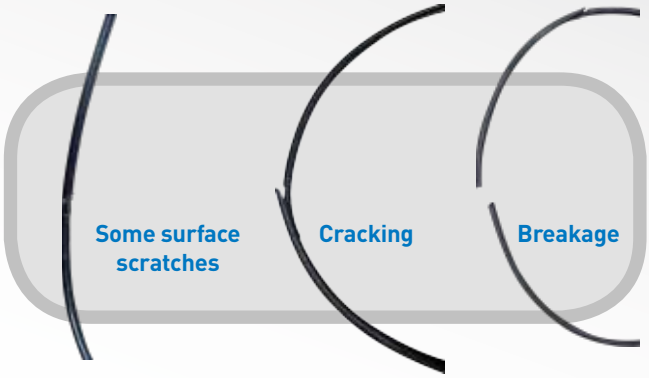
Rear cap

The rear cap is still in good condition, however the inside section had black and burnt oil stain on both high pressure and low pressure chambers. The high temperatures causing this condition have also contributed to the oring stress on rear cap, causing the oring to break its seal (see photos on this page).

Oring groove is dirty

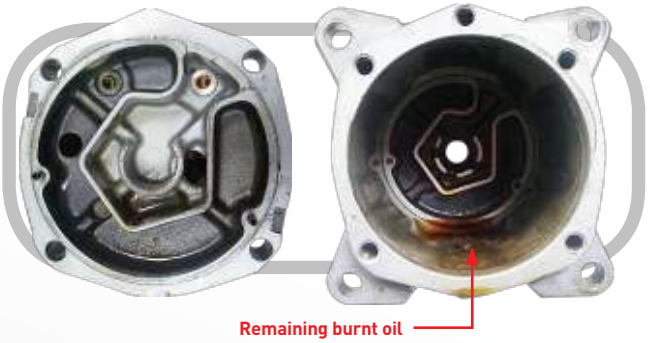
Rear cap oring

Inspection on rear cap oring. The oring groove on the rear cap is dirty with burnt oil and oring deposits turning to carbon from excessive heat. Sections of the oring have hair line cracks caused from the removal and inspection process (oring is slightly brittle).



Shaft seal

In good condition with no abnormalities. Installed in November 2006.



Shaft seal - no abnormalities

Clutch

This clutch was fitted at 293,000 km, therefore has travelled 52,000 km. Armature and pulley surfaces are showing normal wear and tear.

Armature gap and abrasion
The wear and tear of the armature is uniform and pulley is showing very little wear.

Armature wear and tear
0.14mm (outside surface)
0.11mm (inside surface)

Pulley bearing
Bearing is operational with slight roughness.

Small deformation from impact with another object, possibly during servicing or removal.

Pistons

All in good condition, showing slight chaffing.

Thrust bearings and washers

Front and rear cylinder

Front and rear gaskets

Ball bearings

Clutch coil

Clutch pulley

Conclusion

The major components of the compressor are still in excellent condition for this duration of operation. In particular the pistons, thrust bearings, shoes discs and swashplate are showing low to medium wear factors, and it is concluded the combination of these components as the working assembly of the compressor are capable of further operation in the field.

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For further information visit www.unicla.hk
Other references:
Unicla General Service Information (Cat.No.B0901)
Unicla Compressor Selection Criteria (Cat.No.B0902)