Unicla

UX330 Compressor System Fitting Guidelines

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1. Introduction

The information contained in this booklet will assist technical personnel to ensure correct fitting procedures and system design parameters for the fitting of the compressor.

They are adopted to maximise the life of the compressor and associated air conditioning system components.

Unicla UX330 compressors are manufactured to exacting standards using quality materials and rigorous test programs to ensure reliability and durability are optimised.

It is important to recognise poor fitting or servicing procedures as well as any mismatch of the compressor to a system can seriously jeopardise reliability and performance, and result in premature compressor failure or unacceptable performance losses.

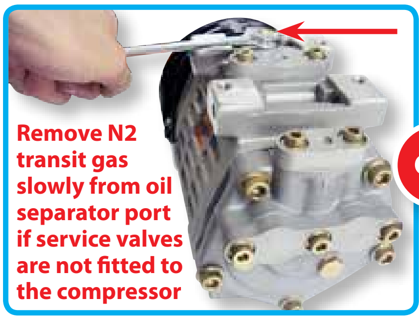
The following guidelines must be strictly adhered to. Unicla warranty against faulty product (materials and workmanship) and is subject to proper air conditioning system design combined with refrigerant and lubricant compatibility.

2. Initial handling

a) Removing transit gas

When handling the Unicla UX330 compressor for the first time, the transit gas must be removed before mounting and commissioning procedures commence. This can be done by slightly loosening one of the hose port caps to allow the Nitrogen (N2) gas to gently escape, or if service access fittings are installed, remove one of the dust caps and depress the valve as shown below.

Note: access ports are manufactured into the low and high side pressure sections in the rear cap of the compressor. These ports will be fitted with either blank plugs or service valves which can be used for transit gas venting, or removed at any time to allow for the installation of pressure switches or sensors. If the service valves remain in place, it must be noted these are for diagnostic purposes only, and must not be used for adding refrigerant to the system.



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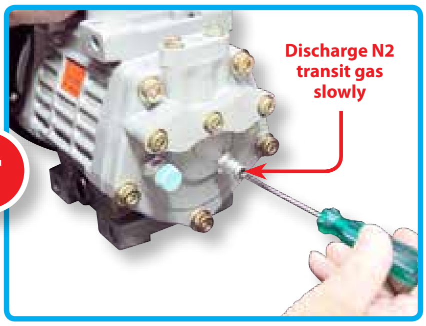
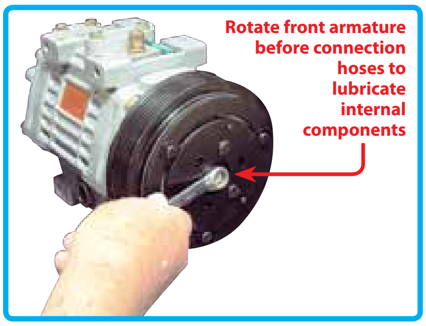




b) Initial lubrication

Rotate the compressor manually for 4-5 revolutions to ensure proper lubrication to the working assembly components. This will avoid damage during initial start up.

c) Service manual

If any disassembly of compressor components is required, the Unicla UX330 compressor service manual must be consulted and the relative procedures strictly adhered to.
This is available at **www.unicla.hk**

3. System cleanliness

a) Contamination

The system must be free of both solid particle and chemical contamination before connecting to the compressor. Solid particle contamination will cause direct compressor damage and starvation due to blocked system filters, screens and valves.

Chemical contamination can reduce solubility/miscibility of refrigerants and oils, reduce lubrication, and cause acid etching and sludge formation.

b) Flushing

Contaminated hose and pipe lines must be flushed before connection to the UX330 compressor, plus other individual component flushing is strongly recommended in systems where solid particle contamination has occurred during the system assembly process.

The compressor, TX valve, pressure control valves, receiver driers/accumulators, and mufflers/ pulsation dampers should have been kept clean at all times and must not be flushed. These components must be replaced if contaminated.

c) Cleanliness during hose and manifold connection

1. Assembly of all AC components including the manifold and hose connections to the Unicla UX330 compressor should be undertaken in an environment free of excessive dust and dirt, and normally suitable for standard vehicle engine compartment assembly and completion. This environment would normally meet standard occupational health and safety standards of containing $\leq 50\mu g/m^3$ concentrations of PM10 particles (particles 0.01mm in size).

2. The Unicla compressor hose ports should not be opened until the hose connection procedure is ready to complete and the system is ready for immediate evacuation.

This will ensure minimal ingress of moisture and dust particles into the compressor.

3. The oil in the compressor is hygroscopic and has the ability to absorb moisture from the air once exposed to ambient conditions. The contained moisture level in the oil should be kept at ≤ 50 ppm. (Note: in certain ambient conditions the oil moisture content can rise to levels ≥500 ppm within 15 minutes of exposure to ambient air.)

4. Once assembled, the complete system should have a liquid line filter drier installed capable of filtration to ≤ 75 microns, and moisture removal of ≤ 50 ppm.

d) Adding additional oil

Oil which is added to the system and compressor must be in accordance with section 8 of this manual, and must meet the relative Unicla recommendations and be free of any contaminants. Oil moisture levels must not exceed the manufacturers original specifications which is commonly recommended as < 50 ppm.

4. Hose manifold connection

Hose connection to the Unicla UX330 compressor fitted to the engine is available from the rear position only as follows.

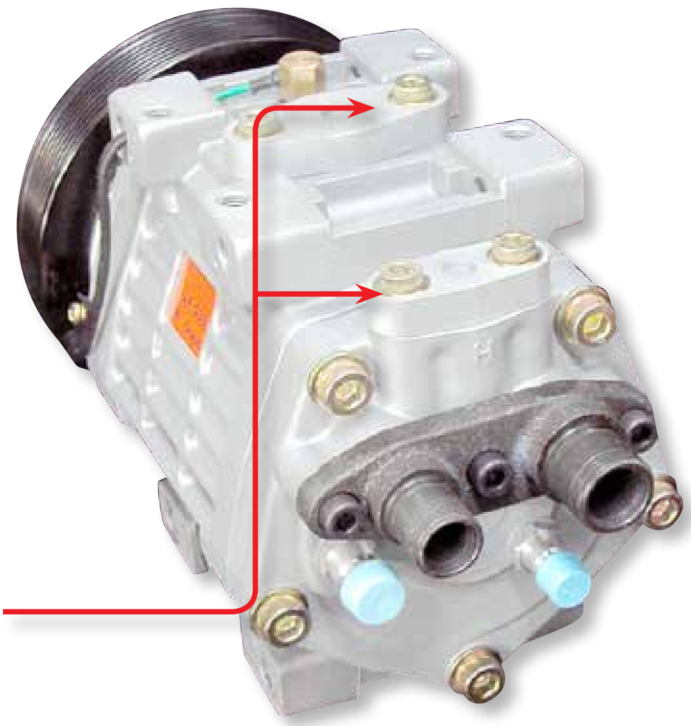
a) Rear manifold

Remove the rear shipping cap as shown in picture and then fit a Unicla recommended manifold as shown in picture below. The compressor is now ready for connection to hoses.

Remove rear shipping cap

b) Top shipping caps

If the top manifold option is not available in the engine application, the top shipping caps must stay in place at all times as shown.



Fit rear manifold.
Leave top shipping caps in place

5. Hose and pipe selection

a) Suction line

Correct sizing of the suction line is critical to ensure adequate flow of refrigerant to the Unicla UX330 compressor is maintained. Too often the nominated capacity of the evaporator and the compressor are ideally matched, only to be compromised by undersized piping in the suction line.

The following tables outline the required pipe or hose sizes for the compressor under common speed and capacity ratings.

Unicla 330 Series Compressors

		3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
RPM	Rated (kW)	Temp Diff (K)	Press Diff (kpa)	Pipe Size mm (inch)	Temp Diff (K)	Press Diff (kpa)	Pipe Size mm (inch)	Temp Diff (K)	Press Diff (kpa)	Pipe Size mm (inch)	Temp Diff (K)	Press Diff (kpa)	Pipe Size mm (inch)	Temp Diff (K)	Press Diff (kpa)	Pipe Size mm (inch)
1000	6.25	0.46	7.7	19 (3/4)	0.92	9.4	19 (3/4)	0.71	7.3	22 (7/8)	0.86	8.8	22 (7/8)	0.34	3.5	28 (1,1/8)
1500	9.25	0.94	9.6	19 (3/4)	0.87	8.9	22 (7/8)	0.38	3.9	28 (1,1/8)	0.45	4.6	28 (1,1/8)	0.68	7	28 (1,1/8)
2000	11.2	0.70	7.1	22 (7/8)	0.36	3.7	28 (1,1/8)	0.6	6.2	28 (1,1/8)	0.73	7.5	28 (1,1/8)	1.1	11.2	28 (1,1/8)
2500	12.9	0.89	9.1	22 (7/8)	0.46	4.7	28 (1,1/8)	0.77	7.9	28 (1,1/8)	0.93	9.5	28 (1,1/8)	0.48	5	35 (1,3/8)
3000	13.25	0.99	10.1	22 (7/8)	0.51	5.2	28 (1,1/8)	0.85	8.7	28 (1,1/8)	10.5	10.6	28 (1,1/8)	0.54	5.5	35 (1,3/8)

These suction line size recommendations are calculated so any pressure drop from friction is no greater than the equivalent of approximately 1 K change in saturation temperature.

Selections are based on a R134a saturation temperature of 0 C° (Referenced from ASHRAE Hand Book, Refrigeration Volume, 2006 Edition.)

b) Discharge line

Discharge line pipe or hose sizes should be calculated in consideration of the nominated suction line sizes. In most applications this is set at one size under the suction line size.

Reference tables showing this are available from Unicla upon request.

6. Hose manifold and fitting recommendations

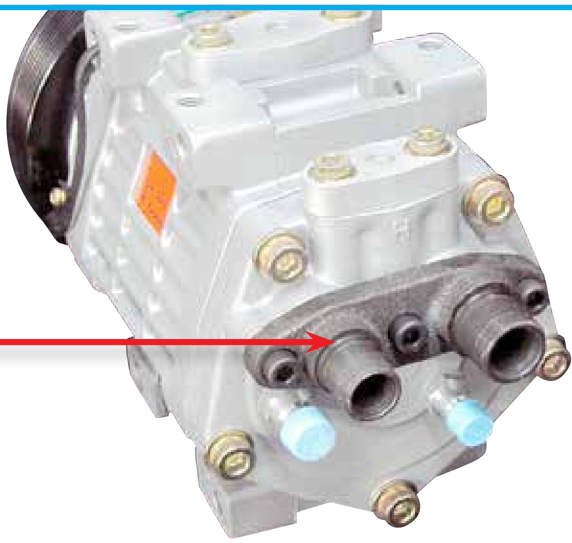
a) Unicla standard manifolds

Unicla can supply some standard hose manifolds for fitting to the rear ports of the UX330 compressor as shown in the photos below.

In addition to this system designers are able to design any appropriate hose manifold to suit the UX330 compressor which suits the relative hose connection requirement.

Rear hose manifold #12 and #16 straight (flare) hose fittings
32308-000760

Rear hose manifold #10 and #12 straight hose fittings
32308-000540



Unicla Manifold	Bolt type and diameter (mm)	Tightening torque (N.m)
32308-000540	M8 X 20 P1.25	25.5+/-1
32308-000760	M8 X 20 P1.25	25.5+/-1
	M8 X 25 P1.25	25.5+/-1

b) Hose fitting connections

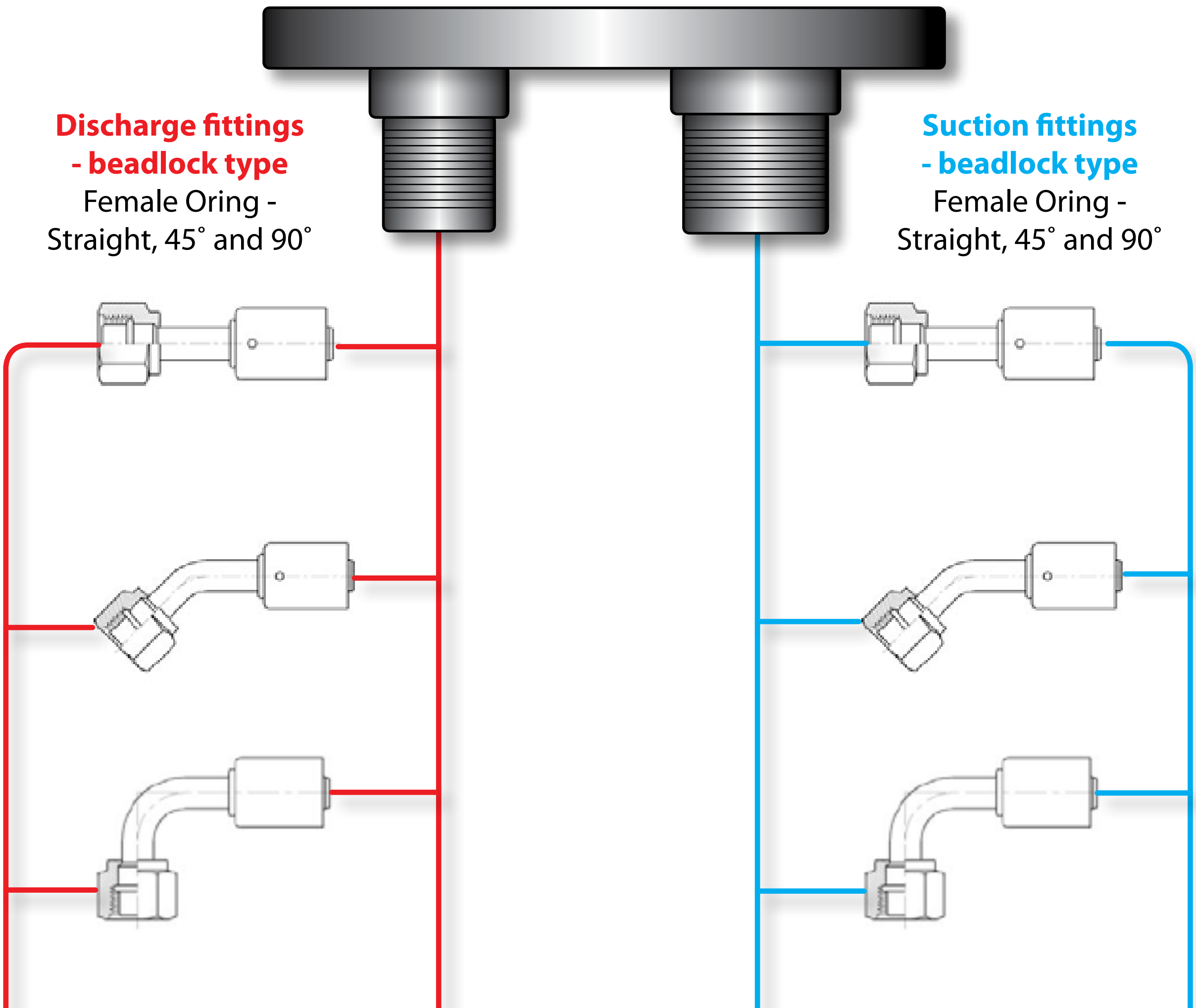
It is important to note the hose fitting sizes on any manifold fitted to the UX330 compressor must not determine the size of the suction and discharge lines running to the compressor.

The charts in part a) and b) of this section must be used for this calculation.

In the event of the fitting size being different to the required hose size, appropriate step up or step down hose fittings should be used.

The following chart shows some common examples and combinations of this when using standard Unicla Manifolds part numbers 32308-000540 and 32308-000760.

Unicla manifold - 32308-000540



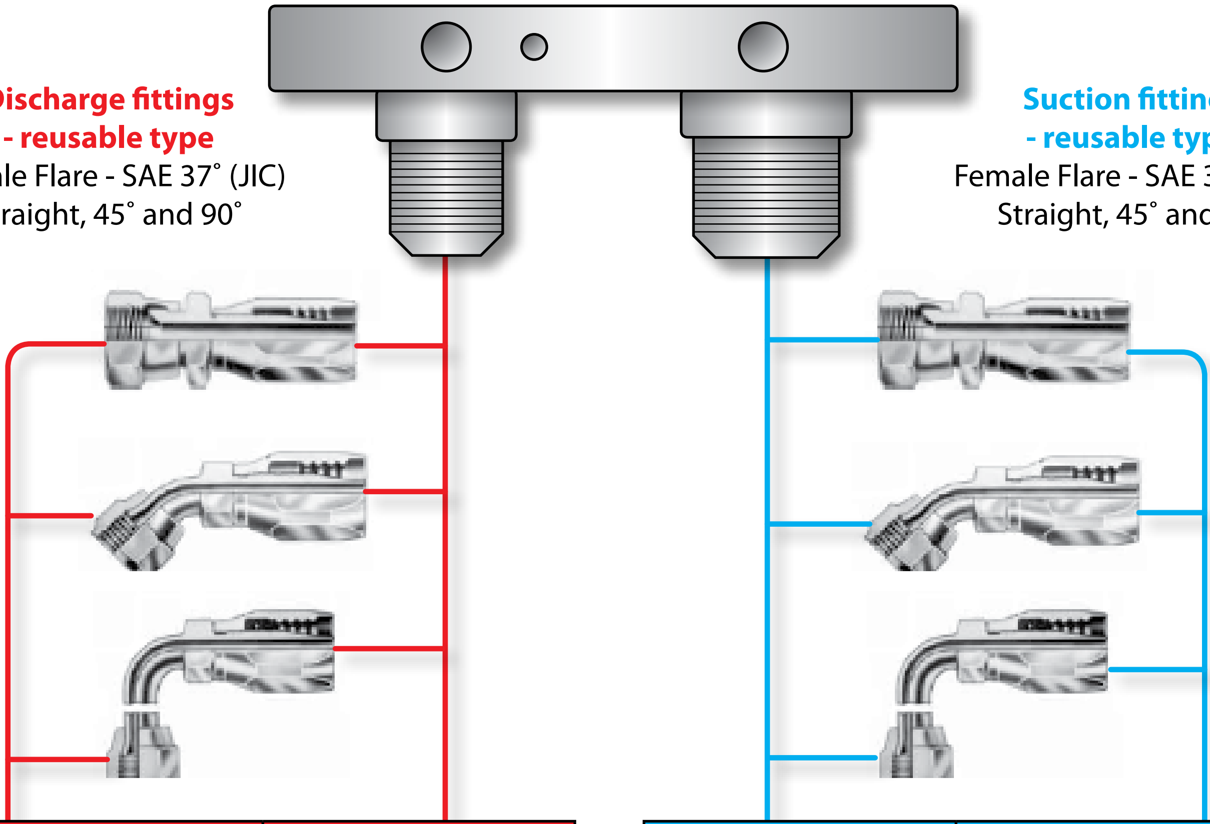
Hose size	Thread size
#10 (1/2”- 12mm)	7/8” - 14 UNF (#10)
#12 (5/8”- 16mm)	

Thread size	Hose size options
1 1/16” - 14 UNS (#12)	#10 (1/2”- 12mm)
	#12 (5/8”- 16mm)
	#14 (3/4”- 28mm)

Unicla manifold - 32308-000760

Discharge fittings - reusable type
Female Flare - SAE 37˚ (JIC)
Straight, 45˚ and 90˚

Suction fittings - reusable type
Female Flare - SAE 37˚ (JIC)
Straight, 45˚ and 90˚



Hose size	Thread size
#8 (13/32”- 10mm)	7/8” - 14 UNF (#10)
#10 (1/2”- 12mm)	
#12 (5/8”- 16mm)	

Thread size	Hose size
1 5/16” - 12 UNS (#16)	#12 (5/8”- 16mm)
	#16 (11/8”- 28mm)

c) Recommended torque values

The following recommended torque values are provided as a guide to ensure correct sealing of hose connections to standard Unicla manifolds part numbers 32308-00540 and 32308-000760.

Assembly torque values for steel and aluminium O ring hose fittings are the same due to the common sealing properties of the O ring, and lubrication is recommended on the backside of all nuts to prevent chaffing between the nut and hose fitting tube.

Sealing lubrication must be applied to flare surfaces or O rings at the time of hose connection to the compressor manifold. The lubricant applied to any component during hose assembly process must be the native oil used in the system. Unidap 7 or equivalent PAG46.

Unicla Manifolds	Tightening torque N•m		Tightening torque Ft/lbs	
	Steel	Aluminium	Steel	Aluminium
32308-000540				
Oring type - 7/8” - 14UNF (#10)	21 - 27	21 - 27	15 - 20	15 - 20
Oring type - 1-1/16” - 14UNS (#12)	28 - 33	28 - 33	20 - 24	20 - 24
32308-000760				
Flare type - 7/8” - 14UNF (#10)	70 - 77	70 - 77	52 - 57	52 - 57
Flare type - 1-15/16” - 14UNS (#16)	79 - 95	79 - 95	58 - 70	58 - 70

7. Compressor speed

The operational speed of this Unicla UX330 compressor can be specifically set and optimised within the mounting and drive design of the engine. The following chart shows the compressor rpm parameters.

Compressor	Ideal operation speed rpm	Maximum continuous rpm	Maximum momentary rpm
UX330	1500 - 2500	3000	4500

8. Oil selection

a) Recommended oil

The Unicla UX330 compressor fitted to the engine is installed with specific Unicla Unidap 7 (or ND-8 or equivalent high grade PAG 46b grade oil) for use with refrigerant R134a. Only this recommended refrigerant and oil should be used. Failure to comply with this may result in dramatically reduced oil circulation rates with subsequent starvation of the compressor.
Warranty is void if non-approved oils and refrigerants are used.

Compressor model	Refrigerant	Oil type	Viscosity @40˚C	Viscosity @100˚C	Application	Low side saturation	Oil separator
UX330	R134a	Unidap 7	48.01	10.51	Airconditioning	≥ 0˚C	Optional

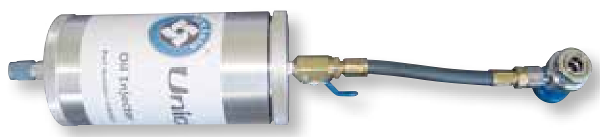
b) Oil quantity

The correct amount of oil must be maintained in the compressor and the system. Long hose run and dual evaporator systems must have additional oil added to the system to prevent potential severe oil starvation problems resulting from insufficient system oil being allowed. To determine total system oil quantity required Unicla recommends a calculation as a percentage of refrigerant charge as follows:

20 % **for Unicla UX330 compressor connected to a standard system application**
30 % **for Unicla UX330 compressor connected to a system application where suction and discharge lines exceed 6m in length**

Example: Calculate oil charge as 20% of refrigerant charge, 4 kg charge = 4000 g x 20% = 800 ml (cc) of oil. UX330 is supplied with 600cc of oil, then deduct the compressor oil charge to determine amount of system oil to be added. Therefore 800 – 600 = 200cc oil to be added to system.

Oil can be added to the system by filling oil into the suction line before final hose connection or by using Unicla oil injector part no OI00001 during the evacuation or refrigerant charging process. Alternatively any similar injection device can be used.



Unicla oil injector **OI000001**

c) Matching oil

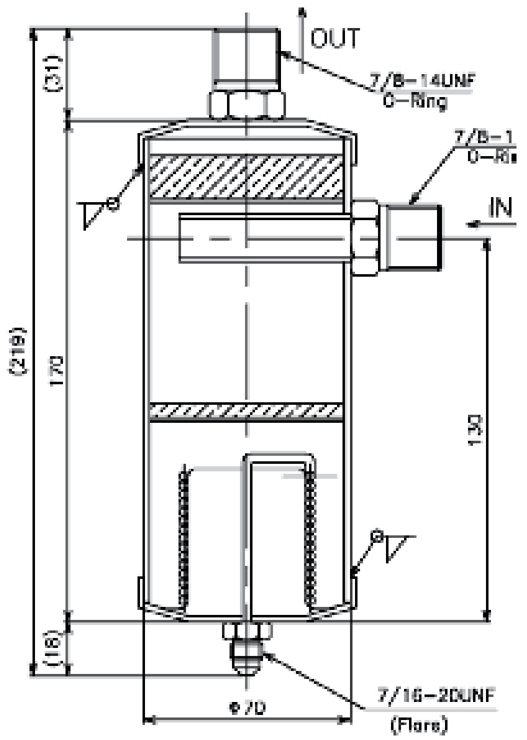
The oil added to the system must be Unidap which is the native oil already installed to the Unicla compressor fitted to the engine, and as identified on the compressor label.

9. Oil separator

Unicla compressor oil separator **part number 35401-000030** is recommended for use in multiple evaporator systems connected to this UX330 compressor due to the potential oil circulation rate reduction (poor oil return to the compressor).

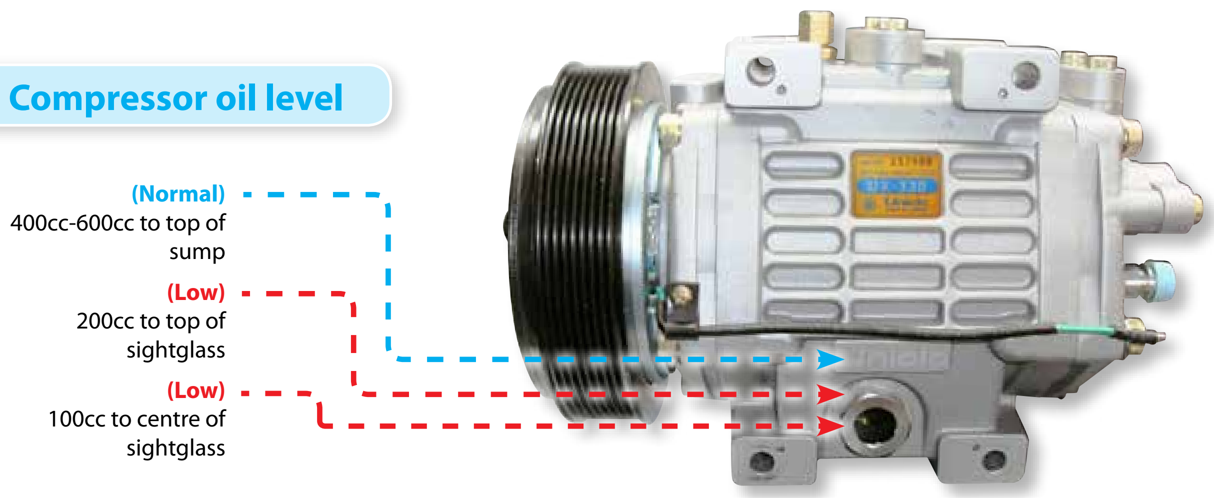
Also systems where it is deemed the suction may go below zero, such as in high speed operation or any system where discharge line temperatures are likely to be in the higher range, the use of the correct oil separator is highly recommended.

This oil separator has oring hose fittings (#10 – 7/8" 14UNF) for easy connection into the discharge line, and a make flare (#4 7/16" 20UNF) for connection to the oil return line. It has a rated capacity of 0.52 litres/minute at operating pressures of 0.2 ~ 0.3 MPa.



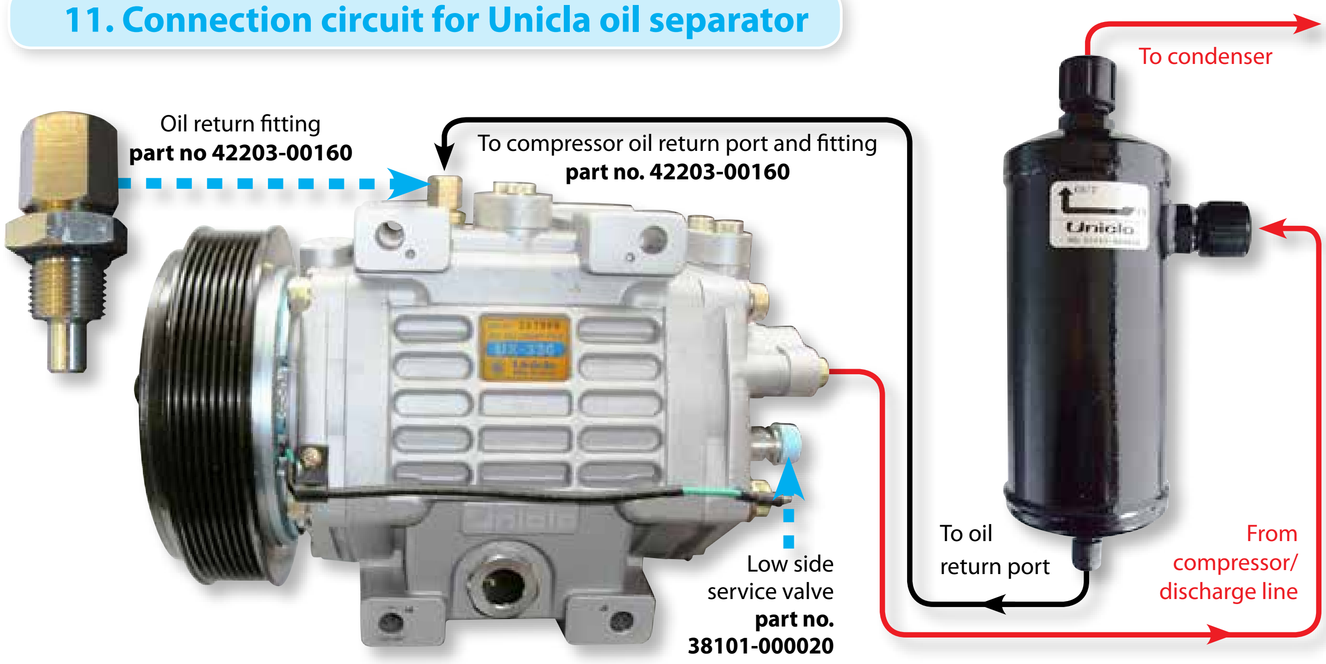
Unicla oil separator
35401-000030

10. Compressor oil level

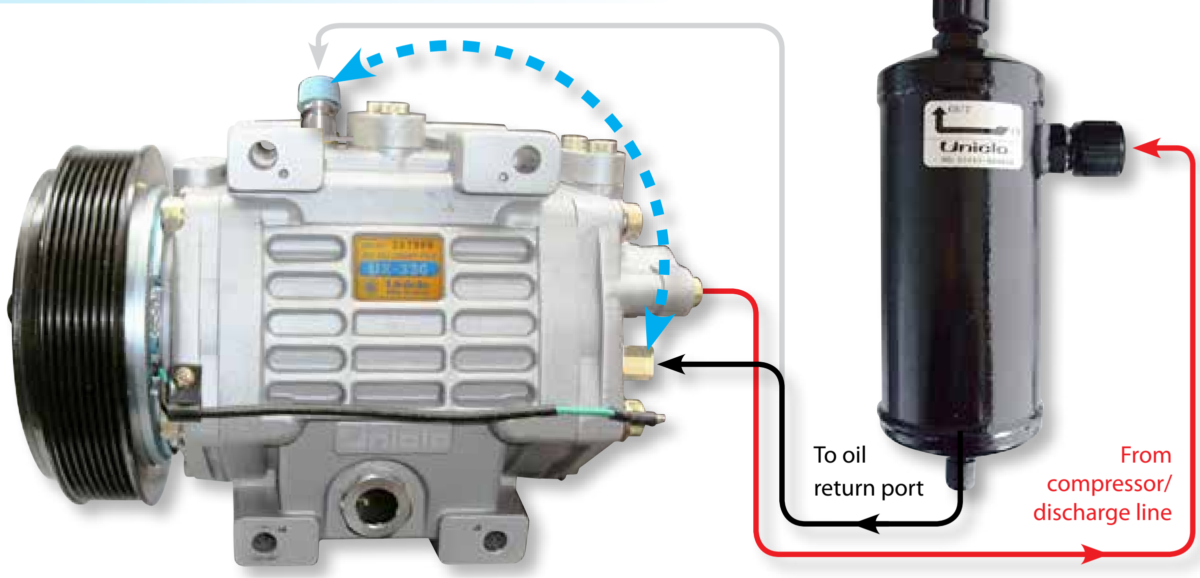


The oil sight glass on each side of the UX330 is designed to be a low level indicator only, as shown in picture. Under no circumstances should the oil level line be seen through the sight glass during compressor operation. If this occurs the system should be immediately switched off and oil level in the system rectified. (The sight glass must be entirely covered with oil in operation).

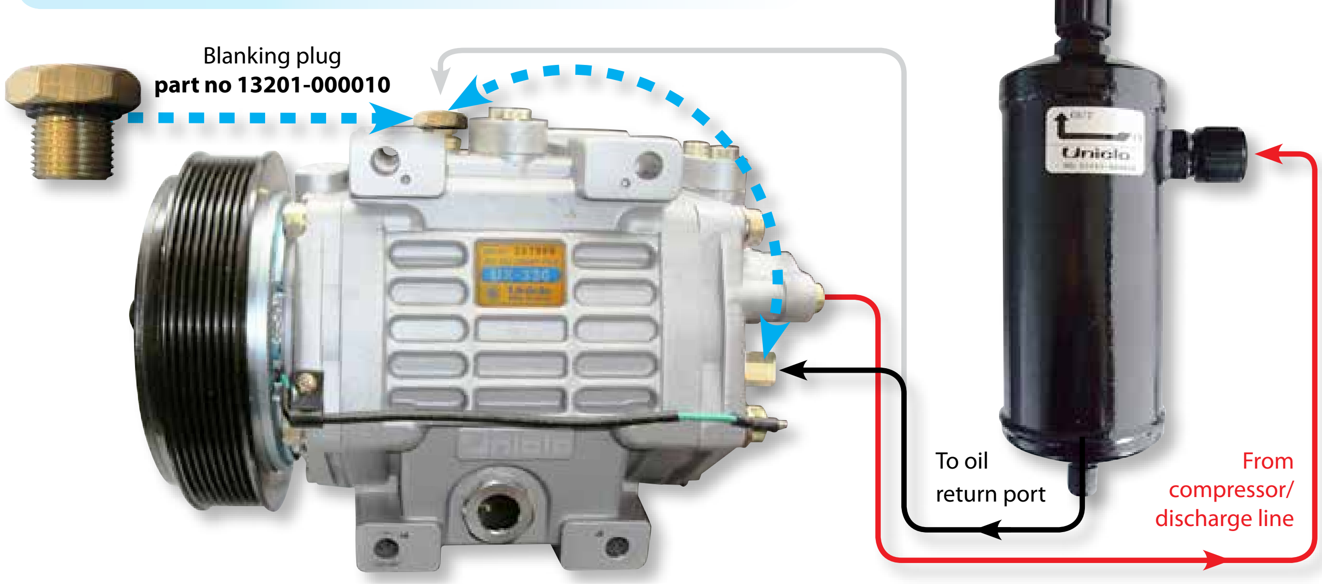
11. Connection circuit for Unicla oil separator



The oil return fitting on the compressor **(Unicla part no 42203-00160)** can be placed on the top **or** rear by switching positions with the low side service valve **(Unicla part no. 38101-000020)** which allows the oil return line from the oil separator to be placed in either position.



Compressors with the blanking plug on the top **(Unicla part no 13201-000010)** also have the option of using this position for the oil return fitting **(Unicla part no 42203-00160)** or the low side service valve **(Unicla part no. 38101-000020)** which can be purchased separately and placed in either of top or bottom port of the compressor after removal of the blanking plug.



12. Compressor operating parameters

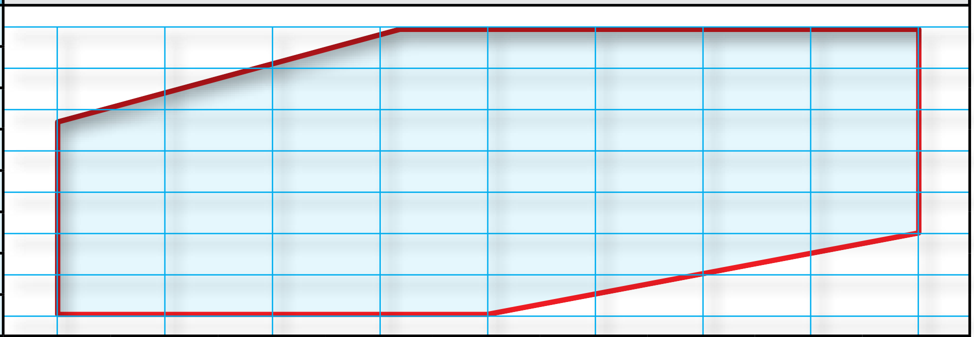
The following chart represents the upper and lower limits of operation and use of the Unicla UX330 compressor fitted to the engine. This information is to assist air conditioning designers to know the total parameters of this compressor and its capabilities from original design.

However this information is not a recommendation for maximising the performance, efficiency and durability of the Unicla UX330 compressor. Refer to other relative section 8(c) in this guideline booklet or visit **www.unicla.hk**

R134a (HFC-134a)

t = Condensing temperature (outlet)
to = Evaporating temperature (outlet)

HP Kg/cm²	HP MPa	t ˚C
26	2.548	80
20.6	2.019	70
16.1	1.578	60
12.4	1.215	50
9.3	0.911	40
6.8	0.666	30
4.8	0.47	20
3.2	0.314	10



to	**˚C**	-20	-15	-10	-5	0	+5	+10	+15	+20
Lp	**MPa**	0.029	0.058	0.098	0.147	0.196	0.245	0.314	0.329	0.47
	Kg/cm²	0.3	0.6	1	1.5	2	2.5	3.2	4	4.8

13. System design and selection

a) Selection criteria

- When selecting a system type and design to connect to the UX330 compressor, some basic considerations need to me made beforehand to ensure the compressor sizing (capacity) matches the system.
- The total net refrigerating capacity of the system (evaporator rating) must match the compressor.
- The nominated operational speed of the compressor must achieve this matching capacity. Therefore it is important to know the most common use and engine speed range of the engine.
- For single evaporator applications the compressor must cater for the net refrigerating capacity of the evaporator at these nominated operating speeds.
- For dual evaporator units the compressor must cater for the total net refrigerating capacity of all evaporators.
- Condensing capacity must be a minimum of 1.33 x total evaporator capacity. Therefore 1.5 x total evaporator capacity is commonly used by system designers.

b) Capacity calculation

The following graph and chart shows the Unicla UX330 compressor capacity under different condensing temperatures of 65 and 75 degrees and evaporative condition at zero degrees over the complete revolution range. Air conditioning system designers for the chassis and engine must ensure the evaporator and condenser sizes chosen for the system are within the specified capacity range of the UX330 compressor.

UX330 Compressor performance for HFC134a

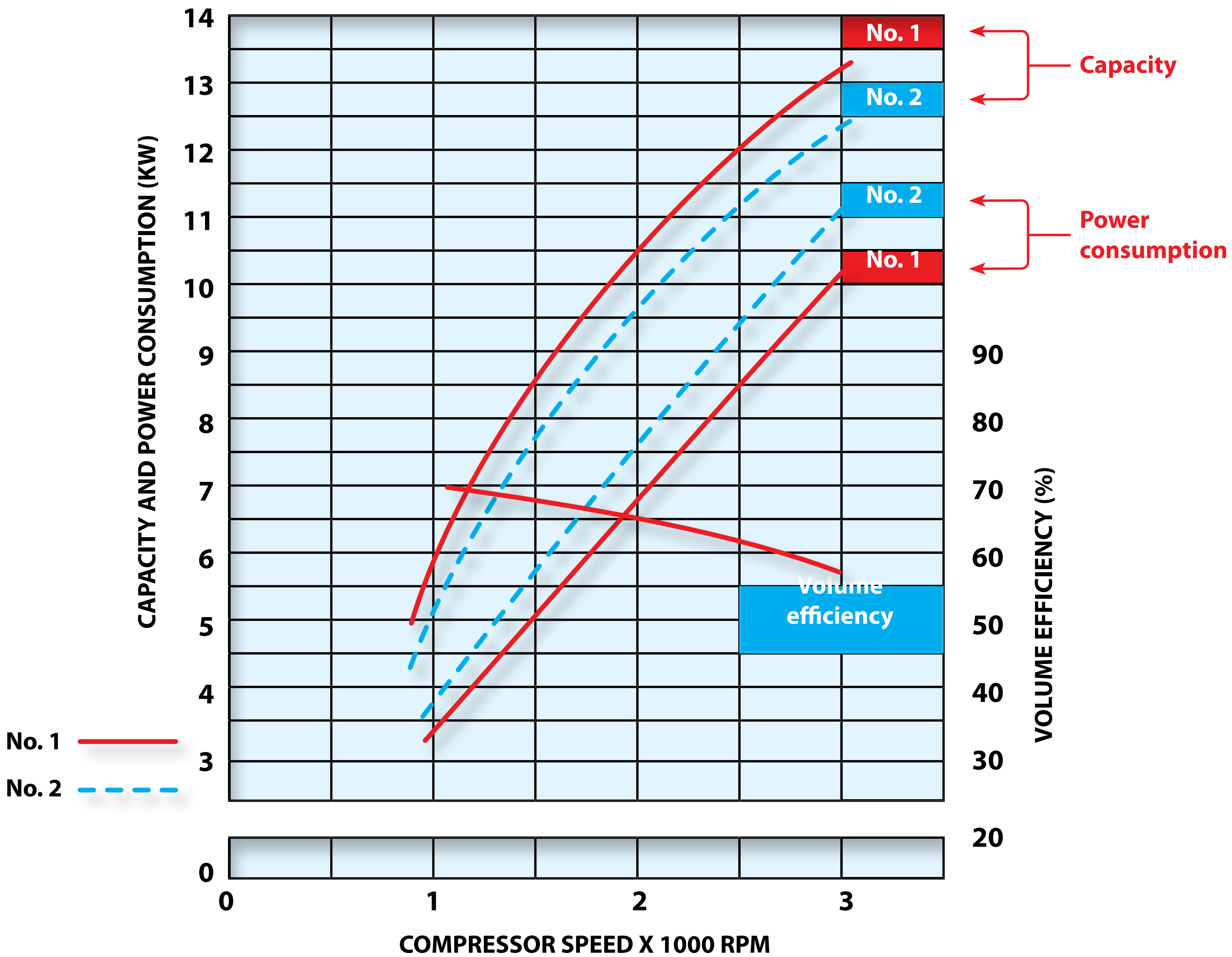
SPECIFICATIONS:

Model	Displacement	Number of cylinders
UX330	330 cc/rev	10

CONDITIONS:

TEST No.	No. 1		No. 2	
te (˚C)	0			
tc (˚C)	65		75	
rpm	Q (kW)	L (kW)	Q (kW)	L (kW)
1000	5.8	3.4	5.15	3.8
2000	10.77	6.7	9.57	7.7
3000	13.17	10.1	12.15	11.1

te = Evaporation temp
tc = Condensing temp
Q = Capacity
L = Power consumption
S.H. = 10 deg
S.C. = 5 deg



14. Suction line accumulators

Suction line accumulators are recommended for use in the system where the refrigerant flow settings or layout of the system component and connecting lines provide a risk of liquid refrigerant flooding back to the Unicla UX330 compressor. Incoming liquid at the suction inlet of the compressor can cause damage to the valve plates and internal working assembly of the compressor.

There are a number of situations where these conditions can occur, however the main points relating to system design and settings for the engines and Unicla UX330 compressor are as follows;

a) Evaporator utilisation and performance

When designing the system for a vehicle most suited to the engine, the Unicla UX330 compressor, high capacity and performance criteria are likely requirements where the design is centred on the vehicle operating in high ambient temperature and humidity conditions under full engine power. Efficient use of space and location of the heat exchangers will also be required, and therefore maximum use of the evaporator cooling capacity should be considered.

As a general rule, evaporators used in mobile air-conditioning applications where the compressor speed and outside conditions are quite variable, designers normally take a cautionary approach and the set the evaporator superheat values between 8 to 10 degrees K (8K-10K). This ensures all the refrigerant has boiled off in the evaporator and the compressor has good protection against liquid making its way into the suction line during system operation. However this condition also leads to underutilisation of the evaporator, which reduces capacity and creates the secondary issue of higher compressor discharge temperatures (CDT's) which can rise to excessive limits in high engine revving and ambient conditions.

As an alternative design, by decreasing the superheat run in the evaporator to a 'flooded' condition of only 1K-2K, full utilisation of the heat exchanger space in the evaporator is made and the temperature of the returning refrigerant at the compressor suction inlet is reduced which in turn reduces the CDT. Lower CDT conditions produce lower overall temperature of the compressor body, better lubrication due to lower oil temperature, and less heat strain on the compressor seals and orings, which in turn delivers longer life and durability of the compressor. In this situation the use of a suction accumulator for use with the Unicla UX330 compressor is recommended.

b) Accumulator types and characteristics

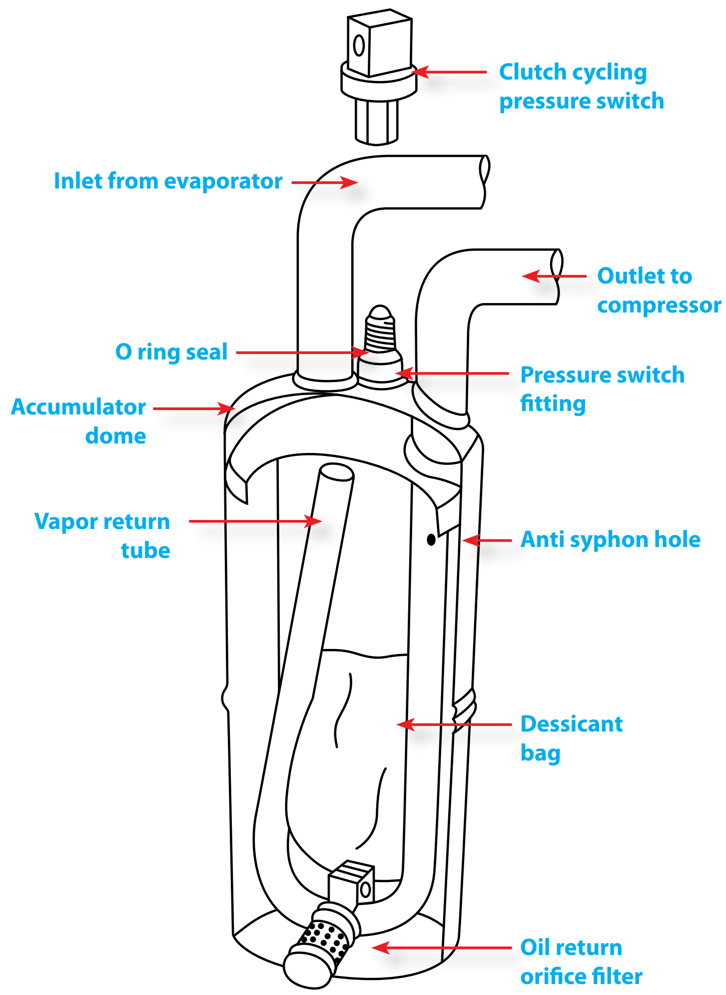
The basic design of a suction line accumulator is a storage vessel consisting of an incoming liquid port to direct incoming liquid to accumulate at the bottom, with another stand pipe and exit port taking refrigerant vapour from the top of the vessel.

In addition to this basic function an accumulator must have the following design characteristics:

- Its capacity must be large enough to ensure that under minimal heat load it cannot fill completely and risk liquid exit

• It must incorporate an oil return bleed hole internally to ensure that oil is returned to the suction side of the compressor – even when an oil separator is used

• It may have an anti-syphon hole to ensure that liquid refrigerant and oil are not syphoned back to the compressor on off cycle



Typical suction line accumulator

Pressure switch - the setting will vary depending on the purpose of the switch. This circuit may switch on the clutch relay direct or form part of the request signal circuit for the ECU or another secondary controller.

Oil return orifice - ensures oil (with some refrigerant) will return to the pump. This orifice is critically sized for each system - a mismatched orifice will cause either liquid flood-back/migration or oil starvation.

Oil return orifice filter – provides particle filtration to the suction side of the compressor.

Vapour return tube - picks up vapour only from the top of the accumulator.

Antisyphon hole - only used in some accumulators to stop liquid migration.

c) Accumulator size

The size of the accumulator is largely dependent on 3 factors:

1. **Design and type of system** (orifice tube or expansion valve)
2. **Capacity of the system** (volume of refrigerant)
3. **Operating conditions** (heat load – temperature and humidity)

In an orifice tube system operating under low heat loads, there is very little heat being absorbed into the evaporator. Under these conditions extreme 'flooding' of the evaporator occurs. For this reason it is common practice for system designers to determine the size the accumulator with capacity or volume size equal to 70% of the total refrigerant capacity of the system.

In an expansion valve system the accumulator only has to cater for minor liquid flood-back to the compressor as a result of expansion valve hunting, minor overcharging or liquid present on initial start-up. For this reason the general recommendation is have an accumulator capacity of 50% of the total refrigerant capacity of the system.

Whilst 50% may seem excessive, it must be pointed out that during system start up, the bulb of the expansion valve is warm. This causes the valve to open wide with flooding of the evaporator which brings the accumulator into play (i.e. it will now be required to hold liquid.) This condition exists until the expansion valve regains control of the evaporator. It is therefore necessary to ensure the accumulator size is sufficient in this phase.

In addition, when the system is shut down, liquid migration will also occur as the valve opens during system equalisation, and this bring the accumulator into play. If multiple evaporators are used with split suction lines, the options to use a single accumulator in the common suction (after they have joined) or to use two accumulators for each parallel run should be considered. If dual accumulators are used, the accumulator size can be calculated from the proportional capacity of each evaporator run.

Either is acceptable for connection to the Unicla UX330 compressor provided the final selection of accumulator size works properly in the suction line as intended. Fine tuning of accumulator size and oil return rates should be done in the system design to ensure optimum performance and protection and a minimal dilution of oil on the suction return.

d) Orifice (expansion) tube systems

Accumulators are essential in an orifice tube system since the system is designed around having a fully flooded evaporator in operation in most conditions, or at least marginally fully flooded under very high heat load conditions. An orifice tube can be likened to an expansion valve that is in its fully open position at all times. If a system was fitted with a 'fully open' expansion valve the evaporator would obviously overfill (flood) and hydraulic damage to the compressor would result if left unprotected without a suction line accumulator fitted.

e) Thermostatic expansion (TX) valve systems

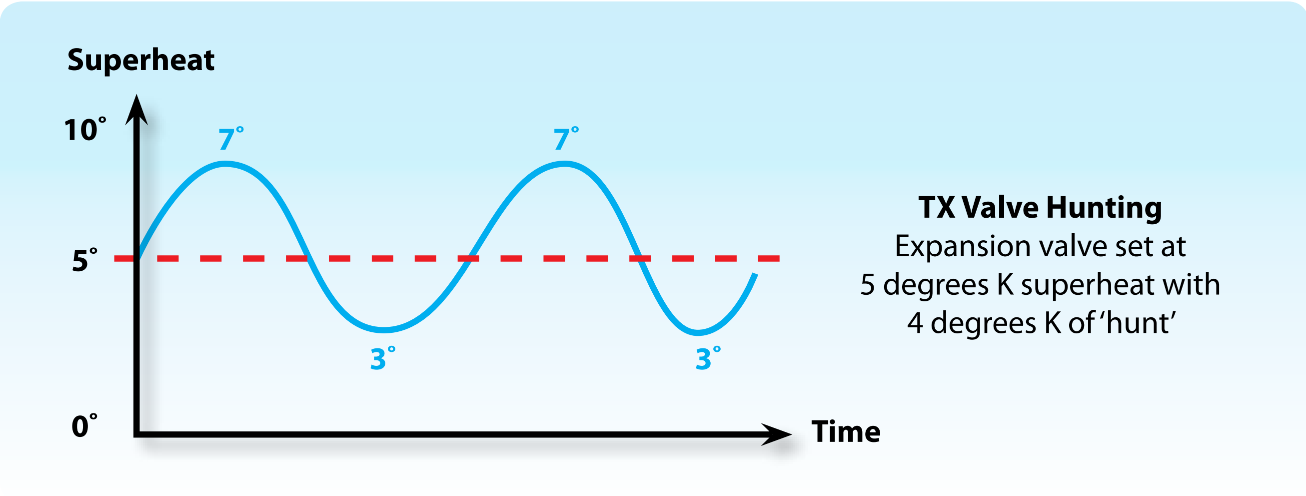
An expansion valve is in principle a very accurate metering device with the main aim of ensuring liquid doesn't exit the evaporator whilst utilizing as much of the evaporator as possible. In operation it meters flow around a predetermined superheat value. In simple terms the superheat value is the amount short of a flooded evaporator the expansion valve maintains. A short superheat run would only have 1 to 2 degrees K of superheat, whereas an 8 degree K superheat value would keep the evaporator well short of 'full'.

In systems where a short super heat run is used and the margin to a fully flooded evaporator is close, the use of a suction line is recommended as mentioned earlier.

f) Expansion valve hunting

Whilst in principle the expansion valve should control flow to an exact predetermined value, the reality is a majority of valves in service 'hunt'. Hunting is the term given to the cycling of the valve in operation where it opens and closes to overfill and under fill the evaporator around the predetermined value.

Example:
A 5 degree K expansion valve in operation opens too wide and fills the evaporator to a level where it only has 3 degrees K of superheat. It then responds, shuts the valve but in operation it "overreacts" and actually shuts down too far and superheat rises to 7 degrees K. The valve then responds to the starved evaporator, opens and once again overfills to 3 degrees K of superheat and the cycle continues. This would be referred to as 4 degrees K of expansion valve 'hunting'.



Expansion valve hunting varies from system to system and is dependent on the following 3 main factors:

- **Charge rate**
- **Adjustment of the valve** (superheat setting)
- **System size and design**

Many valves have an adjustment procedure for minimising or eliminating hunting and it is recommended to refer to the relevant valve literature from the manufacturer for adjustment procedures. A cycling of below 1 degree K is not considered "hunting".

There are two principle key issues with excessive expansion valve hunting:

1. **Under utilisation of the coil when the TX valve shuts down and starves the evaporator**
2. **A risk of liquid slugging of the compressor when the TX valve opens and floods the coil**

Of these items liquid slugging is obviously the most dangerous to the compressor, and the use of a suction line accumulator is recommended in any system where the expansion valve is set to a super heat margin, or the expansion valve hunting characteristics will provide the possibility of liquid entering the suction line and compressor.

It is not recommended to take the alternative action of setting the expansion valve super setting higher (to compensate for risk of liquid migration caused by hunting and full evaporator utilisation) when the installation of a suction line accumulator will suffice. As mentioned earlier high super heat levels in the evaporator produce the down side of lower system capacity and performance, and higher CDT's.

g) Accumulators versus P Traps

A P trap is when the suction line is designed to drop below the level of the compressor with a 'riser' in the final part of the hose. This effectively reduces the risk of minor issues with liquid flooding or liquid migration, however they do have the disadvantage of potentially holding oil in the lower part of the loop and reducing refrigerant flow and possibly causing an oil flood to be pulled back to the compressor from time to time.

Suction line accumulators have the advantage over P traps by having a much larger capacity and therefore greater protection against liquid flood back, plus have an internal oil bleed hole to ensure oil returns to the pump at a normal rate.

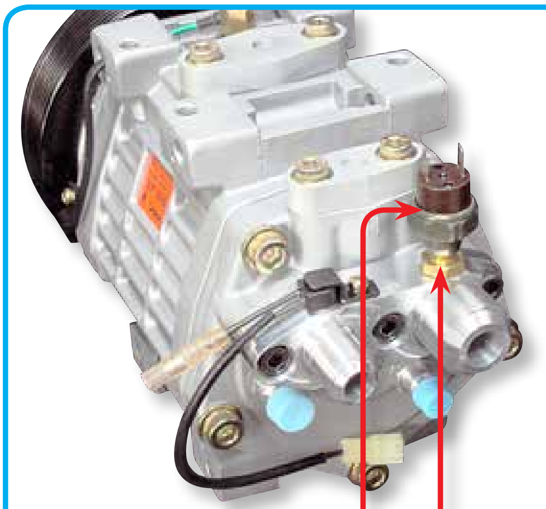
15. Pressure and thermal switches

To provide maximum protection for the compressor against overheating and low refrigerant flow Unicla recommends the installation of the appropriate protection switches on the UX330 compressor itself.

There several ports in the compressor body where different switches can be installed, for some engines it is recommended the space for a suitable hose manifold fitted to the rear of compressor is utilised for this purpose.

Different air-conditioning system designers may choose to design a specific manifold to suit the relative suction and discharge hose layout in the engine bay, however Unicla recommends some simple principles and standards for installation of these switches should be followed. In particular **Unicla hose manifold part number 32308-000760** can be used for this purpose, or alternatively system designers may use the features of this manifold for use in their own manifold design.

The following pictures show some common variations regarding protection switch recommendations and installation.



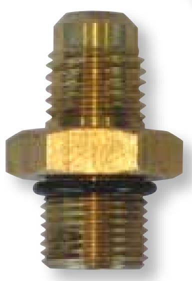
Unicla rear manifold and thermal switch is shown fitted with a universal type low pressure switch.

This switch has typical settings as recommended by Unicla to cut-out at 40 kPa (0.04Mpa, 6psi) and cut in at 180 kPa (0.18Mpa, 25psi). When connected in series to the UX330 compressor clutch circuit, it will protect the compressor against low system refrigerant level, or insufficient refrigerant flow in the suction line.

It is fitted to the manifold by using **Unicla fitting part no. 42203-000150** which is a 7/16" male flare fitting to allow any pressure switch with a female flare of this size to be easily fitted to the manifold.

Unicla manifold part no. 32308-000760 fitted with **Unicla thermal switch part number no. 53101-000110.**

This switch is wired in series to the compressor clutch supply and is normally closed. It is set to open circuit when the compressor discharge line temperature reaches 100°C, thereby interrupting the compressor clutch power and disengaging the compressor operation. Re-set point is at 80°C.



Note: The switches shown are un-connected to the wiring circuit. Unicla accept there are a number of choices for plugs and connectors in the market and it is up to the AC system designer to make this final choice. Unicla 7/16' male flare fitting **(part no 42203-000150)** can be fitted to all 12mm access holes available on the UX330 compressor and relative manifolds. It is a multi-purpose fitting which allows system designers to place both high and low side pressure switches in a number of different positions if required.

16. Refrigerant charging

When charging and commissioning the system for the first time, connection to the low and high side lines must be through service valves located at least 600mm distance from the compressor. This will ensure oil is not pushed or washed away from the compressor sup causing immediated damage to the compressor internal assembly during intial start-up.

Also, excessive liquid added to the system at any one time or 'bomb' charging may cause damage to the suction reed valves and piston assembly in the compressor.

It is therefore recommended that any refrigerant adding procedure should allow adequate vaporisation of the refrigerant during the process. This is commonly achieved by vapour charging only or by adding liquid very gradually to ensure no sudden removal or loss of oil in the compressor occurs.

Note: Service valves that remain fitted to the rear cap of the compressor are for diagnostic purposes only, and must not be used for adding refrigerant to the system.

During the charging process the sight glass should appear as shown.

Sight glass	Normal > high point
Oil	Normal - clean and transparent
Operation	OK

17. System validation

a) Discharge pressures

After commissioning the Unicla UX330 compressor for the first time, some basic pressure and thermal loading checks will determine if the operating environment for the compressor is within Unicla specifications, and whether compressor durability is being maximised.

The following chart should be used as a guide for analysing normally acceptable high side (head pressures) for given ambient conditions. Allow 20% tolerance for humidity above 60% relative humidity.

High side pressure chart

°C	°F	kPa	PSI
15	60	600-800	90-115
18	65	750-950	110-135
21	70	900-1100	130-160
24	75	1050-1300	155-190
27	80	1200-1550	185-220
30	85	1400-1750	200-250
33	90	1500-1900	215-275
35	95	1700-2100	245-300
38	100	1850-2250	265-325
41	105	2000-2400	290-350
44	110	2250-2650	325-385
47	115	2500-2900	370-420

If the system high side pressure is not within these parameters, reference to the Unicla Service Manual is required, or reference to additional technical information for specifications and faults regarding condensing to air differentials.

b) Thermal loading

It is important the Unicla UX330 compressor is operated within its recommended heat range, and all new systems designed and fitted to the chassis must be physically tested to ensure this is adhered to.

Excessive discharge temperatures may be pressure driven or may be superheated vapours generated due to inadequate cooling vapour return to the compressor or excessive external thermal loads on the suction line and/or the compressor.

The following chart shows normal superheat/discharge line temperatures taken when the suction inlet temperature is at 8.9 degrees. This gives a guideline of what to expect on the discharge line for the Unicla UX330 compressor and a target to aim for (marked in red) in relation to the discharge line superheat component for the compressor.

Compressor	RPM	Discharge temp °C	Condensing pressure Kgf/cm²	Condensing temp °C	Evaporator pressure Kgf/cm²	Compressor inlet temp °C	Superheat (discharge line)
UX330 (330cc)	1800	73	15.5	58	1.86	8.9	**15**
	2200	81	15.5	58	1.86	8.9	**22**
	3500	98	15.5	58	1.86	8.9	**40**

c) Compressor durability

Compressor durability and service life is dramatically increased when discharge line temperatures are kept to the minimum by allowing the correct flow of refrigerant into the suction inlet of the compressor. The discharge line temperatures shown in the previous chart can be further lowered by reducing the suction inlet temperature even lower to 4 to 6 degrees, and it is recommended this type of setting level should be considered by system designers for some engines and chassis where the prevailing use of the vehicle is in high ambient conditions and maximum performance from the air conditioning system is regularly required.

Reduced discharge line temperatures also result in lower compressor body temperatures which deliver far less thermal strain on seals and orings. Plus oil temperatures are lowered and are not pushed to their limit thereby further assisting with increased compressor lubrication and durability.

d) Causes of excessive superheat (discharge)

It is important to note that discharge line superheat levels increase as a normal condition at higher compressor speeds and at higher ambient temperature However abnormal superheat generation may be caused by one or more of the conditions described below and exaggerated under high heat loads.

Low charge rates: When the system has an inadequate level of refrigerant, the resulting insufficient flow of refrigerant to the compressor fails to provide compressor cooling. This occurs in two ways:

- **The poor flow (volume) is reduced giving less cooling medium**
- **Excessive low side superheating means the suction vapours are no longer cold**

The result is not only a low quantity of cooling vapours, but they are no longer cold. Net cooling is dramatically reduced.

Restricted TX valves/orifice tubes: Will give the same conditions as previous. Inoperable or partially blocked valves/tubes may provide adequate flow under moderate heat load conditions, but will starve the compressor under high heat load conditions when compressor cooling is most critical.

Poor condensing: In addition to excessive pressure generation, poor condensing will result in vapour feed to the TX valve/orifice tube, causing excessive evaporator superheating under high heat loads.

Undersized suction line: Creates inadequate flow of refrigerant back to the compressor and valuable cooling is not given to the compressor under high heat load conditions. This can be diagnosed by determining if a pressure drop is evident in the line. (Refer to section 7 for correct pipe size selection)

Note: Excessive discharge line temperatures may be due to either excessive vapour superheating (as described above) or to excessive discharge line pressures. Refer to the Unicla Service Manual for further information to assist in diagnosis and rectification if required.

All the above conditions also result in reduced oil return exaggerating heat generation within the pump.

Contaminated refrigerants: May result in loss of compressor cooling, particularly if air or other non condensables, such as nitrogen, are present in the refrigerant stream.

e) Compressor operation analysis report

The operation report shown on the back page of this booklet should be completed when commissioning a new air-conditioning system and Unicla UX330 compressor for the first time. The relevant data will assist the system designer to validate both the operational parameters of the compressor and complete system fitted to the engine and chassis, and it must highlight any discrepancies in system performance effecting the compressor operation. Unicla recommends compressor operation must reflect a match to system capacity in conjunction with achieving durability and long service life, and it must be remembered the operational parameters shown in section 9. only outline the upper limits of the compressor operation and capability. To achieve adequate conditions for extended compressor durability, the system design and final performance must reflect the settings as outlined in section 15.

18. Spare parts

The following chart shows the range of specific spare parts available for the UX330 compressor that can be fitted to the engine and chassis. Some items may be required by system designers at the point of initial installation and others are made available to meet service and repair requests after extended mileage and service in the field.

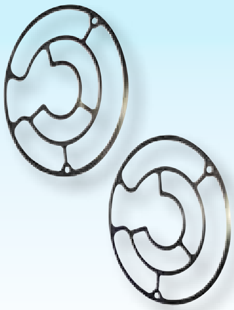
Clutch armature 27206-000070
Note: may require replacement in conjuction with pulley. Surface condition of pulley and armature must be smooth and consistent.

Clutch fitting kit CK330

Clutch pulley and armature set 168mm 8PG type CL330-8PG

Oring
92501-000190

Gasket kit
93204-000030



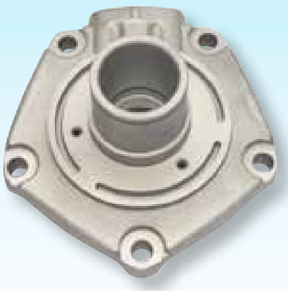
Clutch field coil
12v (Black Wire)
27204-000080
24v (Green Wire)
27204-000010

Shaft seal kit
92503-000050

Valve plate assembly - front and rear
Part no. 22601-000010

Suction valve assembly - front and rear
Part no 22602-000010

Front cap
21510-000012

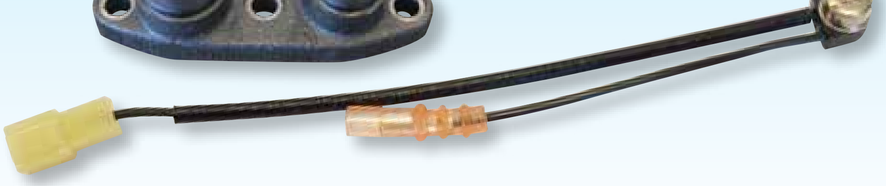


Rear cap - all models
21505-000260

Rear hose manifold #10 and #16 straight (flare) hose fittings
32308-000760

Rear hose manifold #10 and #12 straight hose fittings
32308-000540

Thermal switch to suit rear manifold (32308-000760) setting cut out 85˚C - cut in 65˚C
53101-000110



Service valve - low side
38101-000020

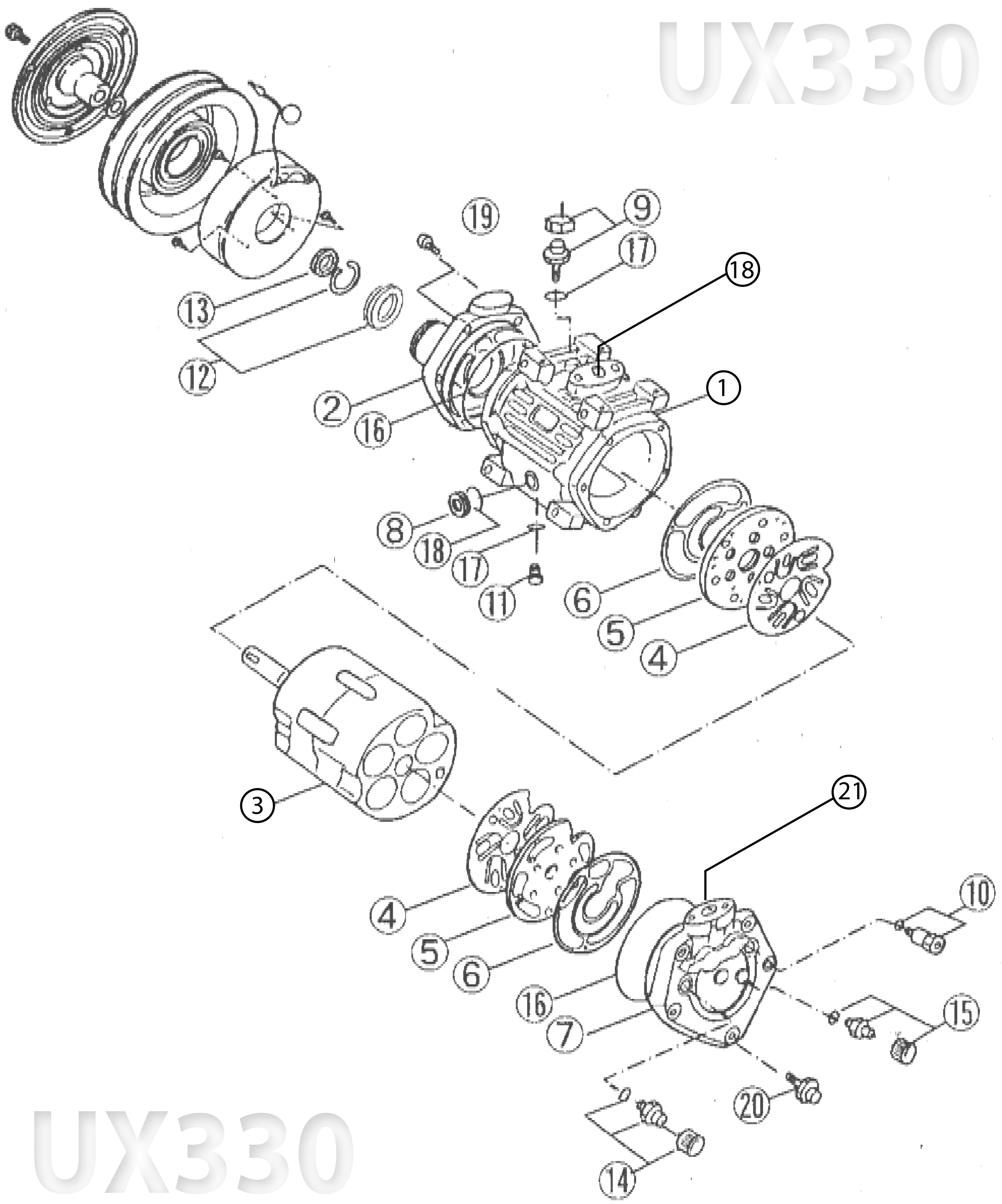
Service valve - high side
38101-000030

Male flare fitting pressure switch access
42203-000150

Male flare fitting oil separator port
42203-000161

Unidap 7 PAG oil 1 litre
Unidap 7-1

19. Exploded view



20. Form (compressor operation/commissioning report)

Vehicle Details			
Date		**Ref**	
Owner Name			
Contact Details			
Phone			
AC System Type			

Compressor Details			
Compressor Model		*Date Purchased*	
Clutch Type		*Invoice Number*	
Clutch Voltage		*Date Installed*	
		Vehicle Type	

System Information			
Refrigerant	***R12 / R134a / Other***	*UV Dye Added*	*Yes / No*
Purity	*%*	*Oil Separator Fitted*	*Yes / No*
Oil Type		*Accumulator Fitted*	*Yes / No*

Discharge		Suction		Other	
Operation Analysis at 1200 / 1500 / 1800 RPM (Indicate which)					
Discharge Pressure		*Suct.Pressure at Evap*		*Duct Temp - In*	*oC*
Condensor Temp	*oC*	*Suct.Pressure at Comp*		*Duct Temp - Out*	*oC*
Discharge Temp	*oC*	*Pressure Drop*		*Temp Difference*	*oC*
Liquid Line Temp	*oC*	*Suct.LineTemp at Comp*	*oC*	**Airflows**	
Discharge Superheat	*oC*	*Evap Temp*	*oC*	*Condensor*	*m/s*
Subcooling	*oC*	*Suct.LineTemp at Evap*	*oC*	*Evap Duct - Front*	*m/s*
		Suct.Line Superheat	*oC*	*Evap Duct - Rear*	*m/s*
Operation Analysis at 2000 / 2200 / 2400 RPM (Indicate which)					
Discharge Pressure		*Suct.Pressure at Evap*		*Duct Temp - In*	*oC*
Condensor Temp	*oC*	*Suct.Pressure at Comp*		*Duct Temp - Out*	*oC*
Discharge Temp	*oC*	*Pressure Drop*		*Temp Difference*	*oC*
Liquid Line Temp	*oC*	*Suct.LineTemp at Comp*	*oC*	**Airflows**	
Discharge Superheat	*oC*	*Evap Temp*	*oC*	*Condensor*	*m/s*
Subcooling	*oC*	*Suct.LineTemp at Evap*	*oC*	*Evap Duct - Front*	*m/s*
		Suct.Line Superheat	*oC*	*Evap Duct - Rear*	*m/s*
Operation Analysis at 2500 / 3000 / 3600 RPM (Indicate which)					
Discharge Pressure		*Suct.Pressure at Evap*		*Duct Temp - In*	*oC*
Condensor Temp	*oC*	*Suct.Pressure at Comp*		*Duct Temp - Out*	*oC*
Discharge Temp	*oC*	*Pressure Drop*		*Temp Difference*	*oC*
Liquid Line Temp	*oC*	*Suct.LineTemp at Comp*	*oC*	**Airflows**	
Discharge Superheat	*oC*	*Evap Temp*	*oC*	*Condensor*	*m/s*
Subcooling	*oC*	*Suct.LineTemp at Evap*	*oC*	*Evap Duct - Front*	*m/s*
		Suct.Line Superheat	*oC*	*Evap Duct - Rear*	*m/s*

Other Information					
Ambient Temp	oC	Clutch Cycle (set point)	oC	Comp oil Level	cc
Note: measure compressor oil level by sight glass for models 330, 440 & 550.					

Notes:

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