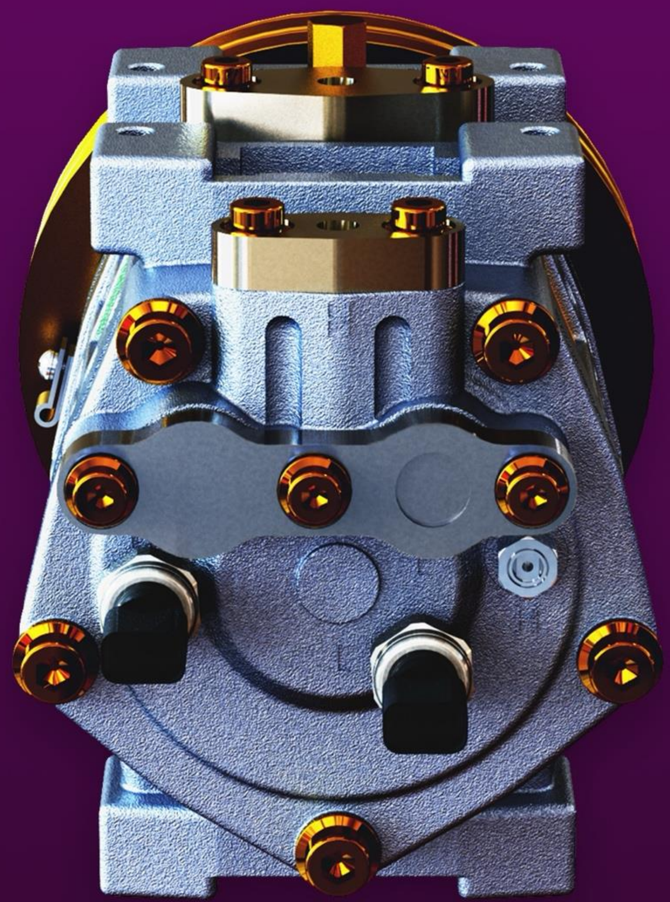
UX330 compressor
System fitting guidelines



Unicla Cat No.B2409

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Table of contents

1. Introduction

This booklet will assist technical personnel to ensure correct fitting procedures and system design parameters for UX330 compressors fitted to different engine applications . Adopting these procedures will maximise the life of the compressor and associated air conditioning system components.

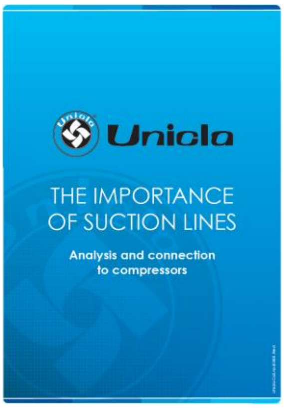
Unicla UX330 compressors are manufactured to exacting standards using quality materials and rigorous test programs to optimise reliability and durability.
It is important to recognise that poor fitting or servicing procedures as well as any mismatch of the compressor to a system can seriously jeopardise reliability and performance, and result in premature compressor failure or unacceptable loss of performance.

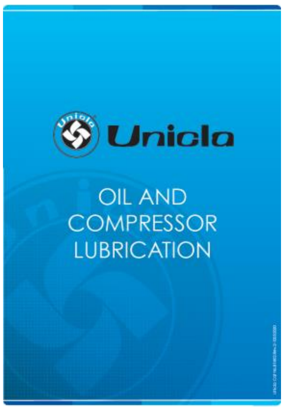
The Unicla warranty against faulty product (materials and workmanship) is subject to proper air conditioning system design combined with proper refrigerant and lubricant compatibility.

Therefore, the guidelines in this booklet must be strictly adhered to and must be considered in conjunction with Unicla instruction booklets:

B1801 The importance of suction lines – analysis and connection to compressors

B1802 Oil and compressor lubrication





2. Initial handling

2.1 Removing transit gas

When handling the Unicla UX330 compressor for the first time, the transit gas must be removed before mounting and commissioning procedures begin. This is 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.

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 they can be removed at any time to allow for the installation of pressure switches or sensors. Fitted service valves must remain in place because they are for diagnostic purposes only, and must not be used for adding refrigerant to the system.

Remove N2 transit gas slowly from oil separator port if service valves are not fitted to the compressor

OR

Discharge N2 transit gas slowly

Rotate front armature before connecting hoses to lubricate internal components

2.2 Initial lubrication

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

2.3 Service manual

If the compressor needs to be disassembled, the Unicla UX330 compressor service manual must be consulted and the relative procedures strictly adhered to. Find manuals at **www.unicla.hk.**

3. System cleanliness

3.1 Contamination

The system must be free of contamination from solid particles and chemicals 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.

3.2 Flushing

Contaminated hose and pipe lines must be flushed before connecting to the UX330 compressor. Flushing of individual components 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 all be kept clean at all times and must not be flushed. These components must be replaced if contaminated.

3.3 Cleanliness during hose and manifold connection

3.3.1

Assembly of all air conditioning components including the manifold and hose connections should be undertaken in an environment free of excessive dust and dirt and one that would normally be suitable for standard vehicle engine compartment assembly. Such an environment would meet standard occupational health and safety standards of ≤ 50 μg/m³ concentrations of PM10 particles (particles 0.01 mm in size).

3.3.2

The Unicla compressor hose ports should not be opened until the hose connection procedure is completed and the system is ready for immediate evacuation. This will ensure minimal ingress of moisture and dust particles into the compressor.

3.3.3

The oil in the compressor is hygroscopic and has the ability to absorb moisture from the air once exposed to ambient conditions. The moisture level contained 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.

3.3.4

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

3.4 Oil added to the system

Oil added to the system and compressor must be in accordance with Section 8 of this manual. It must also meet the relative Unicla recommendations and be free of any contaminants. Oil moisture levels must not exceed the manufacturers' original specifications, usually recommended as < 350 ppm.

4. Hose manifold connection

Hose connection to the Unicla UX330 compressor is available from the rear and top positions as described below.

4.1 Rear manifold

Remove the rear shipping cap as shown in Figure 4.1. Fit a Unicla-recommended manifold as shown in Figure 4.2. The compressor is now ready for connection to hoses.

Figure 4.1

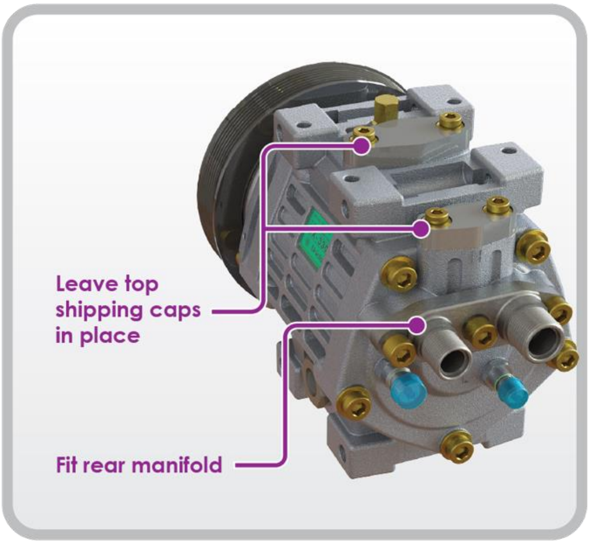


Figure 4.2

4.2 Top manifolds

Remove the top shipping caps as shown in Figure 4.3. Fit a Unicla-recommended manifolds as shown in Figure 4.4. The compressor is now ready for connection to hoses.
(refer to Figure 4.2 above).

Figure 4.3

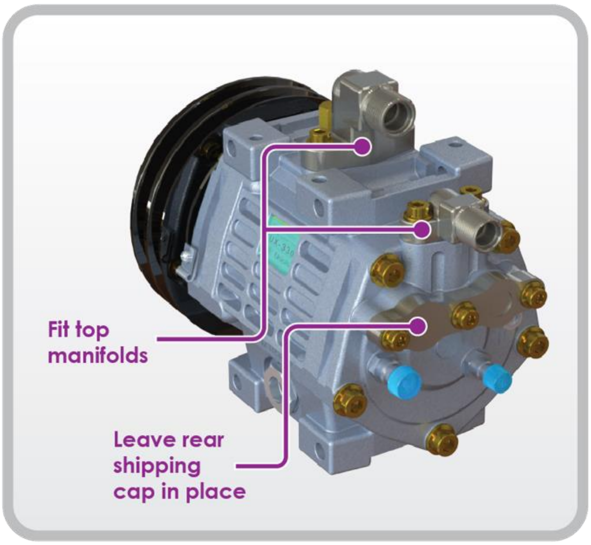


Figure 4.4

5. Hose and pipe selection

5.1 Suction line

Correct sizing of the suction line is critical to ensure adequate flow of refrigerant to the Unicla UX330 compressor. The nominated capacity of the evaporator and the compressor are often 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. Also refer to *Unicla Cat.No. B1801 (The importance of suction lines)* for more information and specifications for correct pipe or hose sizes.

Unicla 300 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 recommendations for suction line size are calculated to ensure that any pressure drop from friction is no greater than the equivalent of approximately 1 K change in saturation temperature.

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

5.2 Discharge line

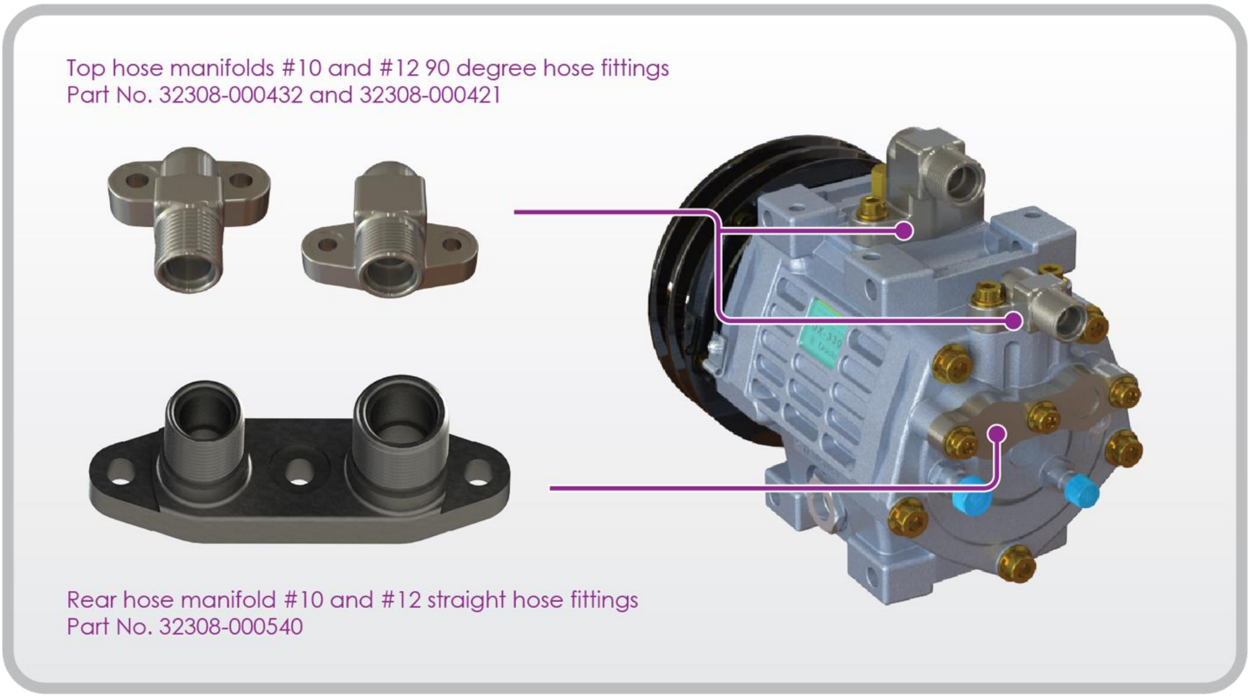
Discharge line pipe or hose sizes should be calculated in consideration of the nominated suction line sizes. In most applications this is set at one size under the suction line size.

Reference tables are available from Unicla.

6. Hose manifold and fitting recommendation

6.1 Unicla standard manifolds

Unicla can supply a standard hose manifold for fitting to the rear and top ports of the UX330 compressor as shown below.



System designers can also design any appropriate hose manifold to suit the UX330 compressor and the relevant hose connection requirement shown in the table below.

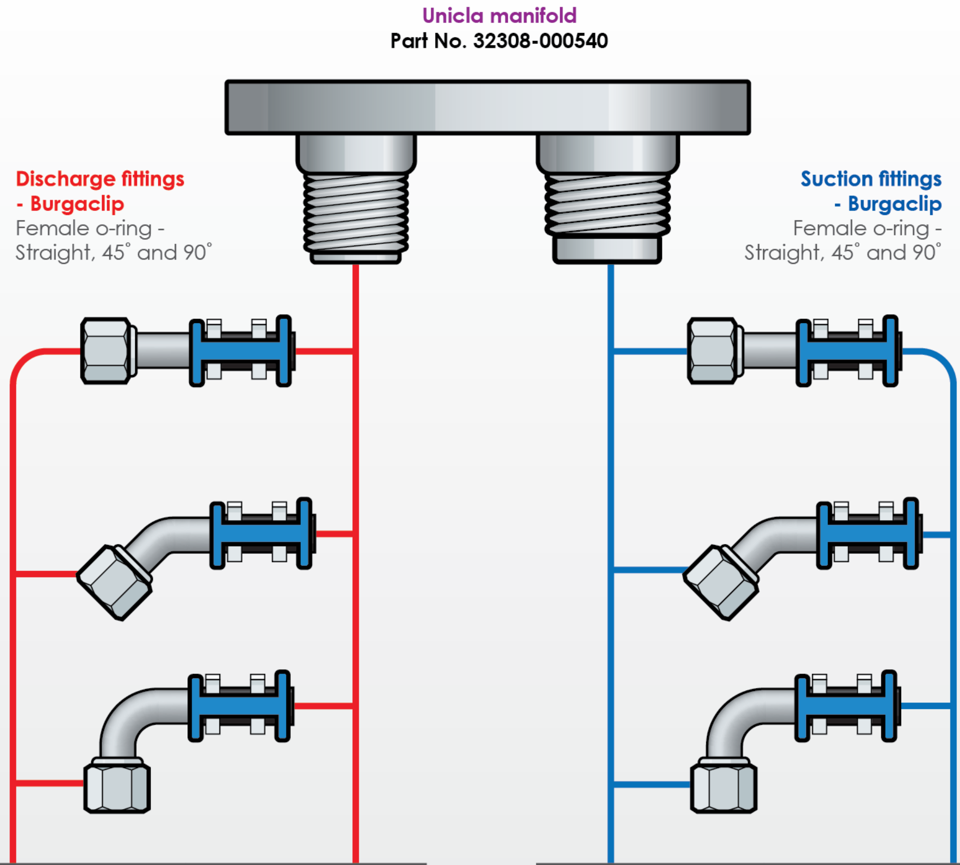
Unicla Manifold	Bolt type and diameter (mm)	Tightening torque (N.m)
Part No. 32308-000432	M8 X 20 P1.25	25.5 +/- 1
Part No. 32308-000421	M8 X 20 P1.25	25.5 +/- 1
Part No. 32308-000540	M8 X 20 P1.25	25.5 +/- 1

Manifold specification for Unicla UX330

6.2 Hose fitting connections

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 diagram below 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 must be used. The following chart shows some common examples and combinations of this when using standard Unicla manifold *Part No. 32308-000540*



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

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

Common hose fitting examples for manifold Part No. 32308-000540

6.3 Recommended torque valves

The table below is a guide to recommended torque values to ensure correct sealing of hose connections to standard Unicla manifolds with *Part No. 32308-00540.*

Assembly torque values for steel and aluminium O-ring hose fittings are the same due to the common sealing properties of the O-ring. Lubrication is recommended on the rear of all nuts to prevent chafing between the nut and hose fitting tube.

Sealing lubrication must be applied to flare surfaces or O-rings when hoses are connected to the compressor manifold. The lubricant applied to any component during the hose assembly process must be the native oil used in the system – Unidap 7 or equivalent PAG56.

Unicla Manifolds	Tightening torque (N.m)		Tightening torque (Ft/lbs)	
	Steel	Aluminium	Steel	Aluminium
O-ring type - 7/8" - 14UNF (#10)	21-27	21-27	15-20	15-20
O-ring type - 1-1.16" - 14UNS (#12)	28-33	28-33	20-24	20-24

Recommended torque values for Part No. 32308-000540

7. Compressor speed

System integrators must ensure that system design and performance must operate within these rpm levels and the recommended Unicla operation envelope shown in Section 12 of this manual.

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

Rpm parameters for Unicla UX330 compressor

8. Oil selection

8.1 Recommended oil

Unicla UX330 compressors are available in a range of oil grades depending on the refrigerant used and the parameters of the system. The table below shows the range of Unicla Unidap oils. Other reputable oil types such as ND8, Fuchs and element.ac may also be used. Failure to comply with this specification 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.

Unicla oil	Type	Viscosity @ 40 °C	Viscosity @ 100 °C
Unicla Unidap 3	POE32	32.50	5.80
Unicla Unidap 6	POE68	65.50	9.30
Unicla Unidap 7	PAG56	56.00	10.85
Unicla Unidap 8	PAG46	48.01	10.51
Unicla Unidap 9	PAG46 HD	46.00	9.70
Unicla Unidap 10	PAG100	100.00	21.00

8.2 Oil quantity

The correct amount of oil must be maintained in the compressor and the system. Long hose runs and dual evaporator systems must have extra oil added to the system to prevent potential severe oil starvation problems. To determine total system oil quantity 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 the length of suction and discharge lines exceed six metres

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 600 cc of oil, then deduct the compressor oil charge to determine amount of system oil to be added. Therefore 800 – 600 = 200 cc oil to be added to system.

Oil can be added to the system by filling it into the suction line before final hose connection or by using a suitable oil injector during the evacuation or refrigerant charging process.

8.3 Matching oil

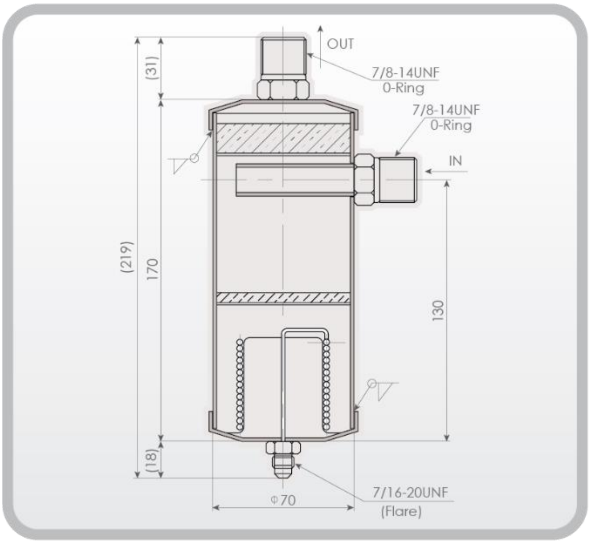
The oil added to the system must be Unidap which is the native oil already installed in the Unicla compressor as identified on the compressor label.

9. Oil separator

Unicla B Group oil separator (Part No. 35401-000030) is recommended for use in multiple evaporator systems connected to a UX330 compressor due to the potential oil circulation rate reduction (poor oil return to the compressor).

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

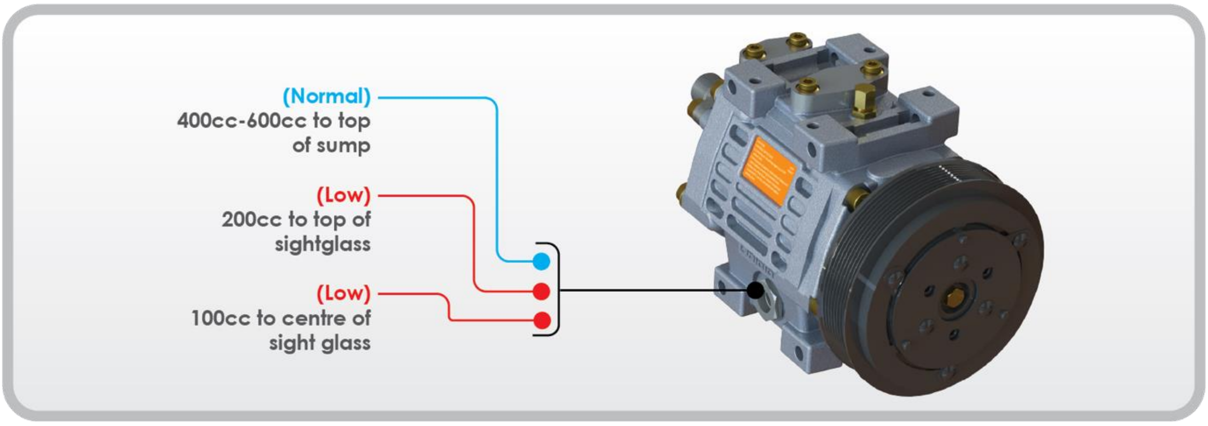
This oil separator has O-ring hose fittings (#10 – 7/8" 14 UNF) for easy connection into the discharge line, and a male flare (#4 – 7/16" 20 UNF) for connection to the oil return line. It has a rated capacity of 0.52 litres/minute at operating pressures of 0.2 ~ 0.3 MPa.



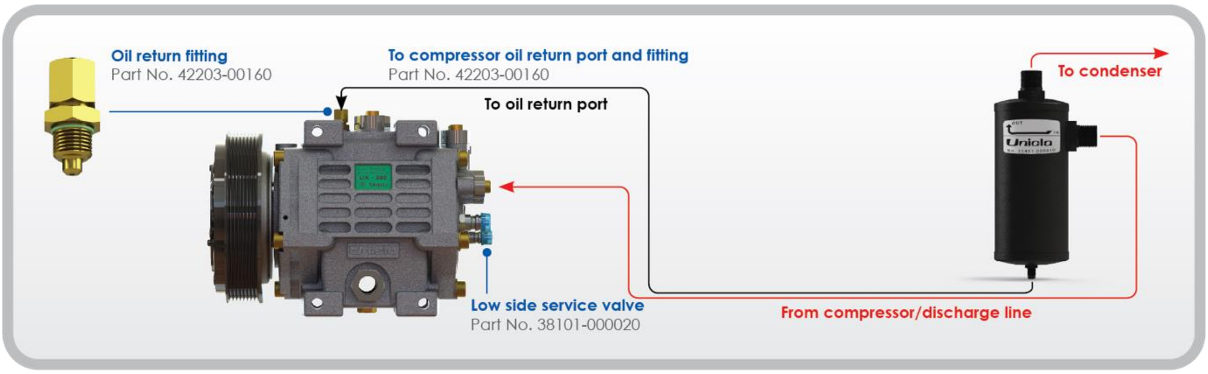
Unicla oil separator Part No. 35401-000030

10. Compressor oil level

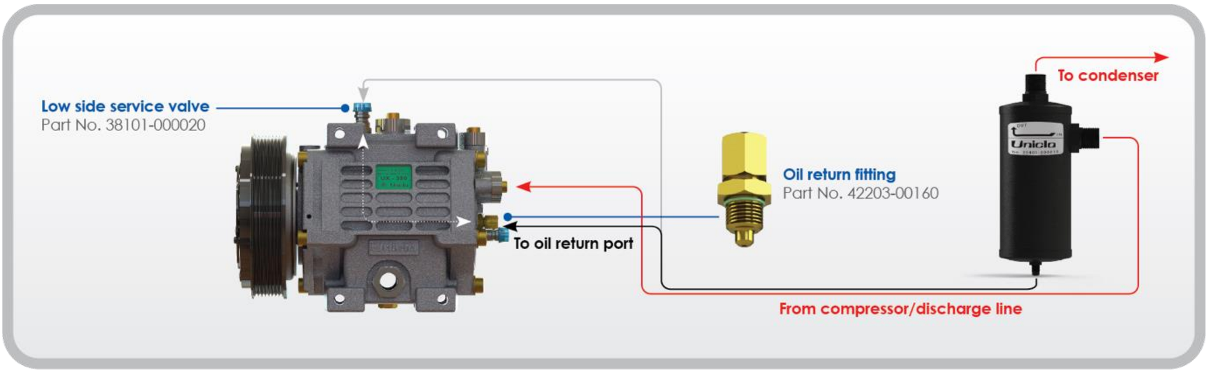
The oil sight glass on each side of the UX330 is designed to be a low-level indicator only. Under no circumstances should the oil level line be seen through the sight glass during compressor operation. If it does occur, the system should be immediately switched off and the oil level in the system rectified.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



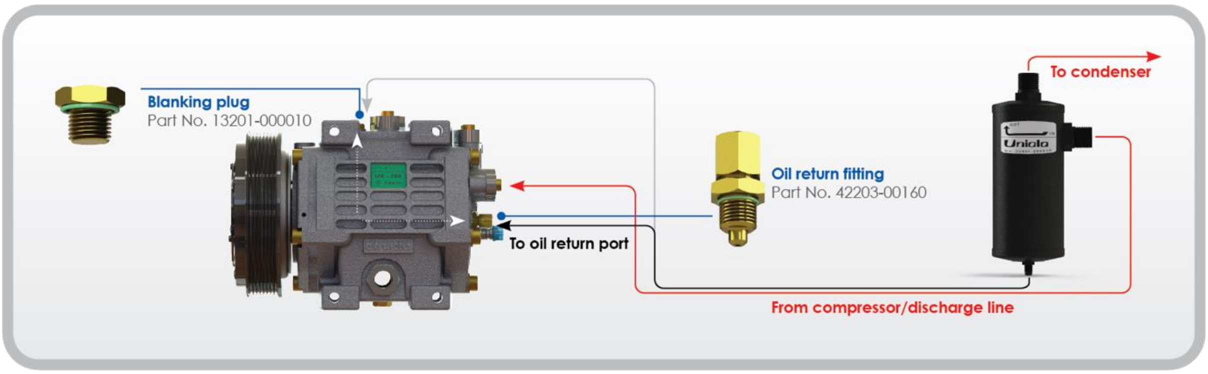
11. Connection circuit for Unicla oil separator



The oil return fitting (Unicla Part No. 42203-00160) can be placed on the top or rear of the compressor 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). These parts can be purchased separately and placed in either the top or bottom port of the compressor after removal of the blanking plug.



Refer to *Unicla booklet Cat.No.B1802 (Oil and compressor lubrication)* for more information and correct oil specifications, quantities and use in Unicla compressors.

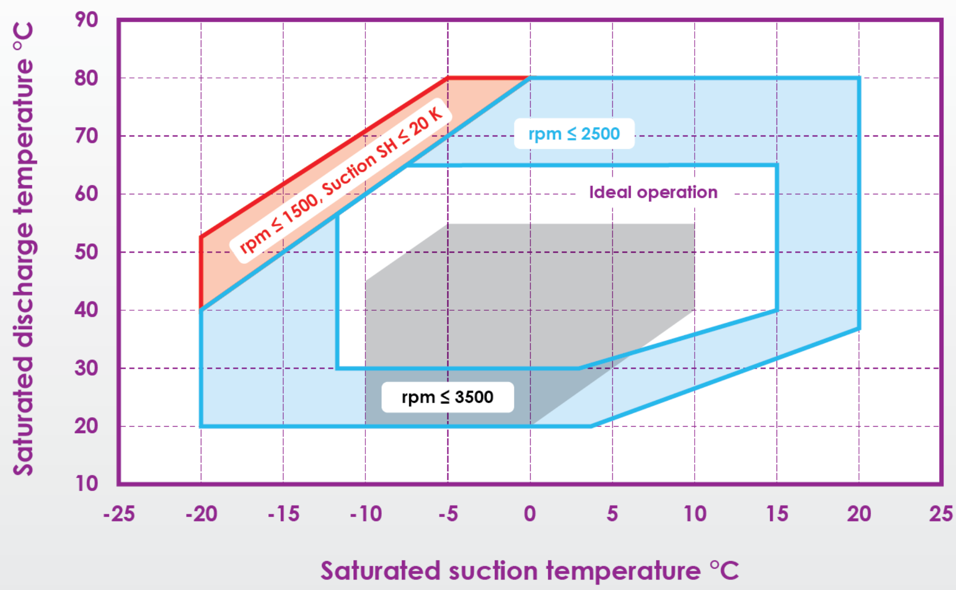
12. Compressor operating parameters

The diagram below shows the upper and lower limits of the operational envelope and use of the Unicla UX330 compressor. This will assist air conditioning designers to understand the compressor's thermal parameters and relative rpm parameters.

The Unicla Compressor Operation Analysis Tool is available to system designers to evaluate system performance and capacity, and to map the envelope position of the compressor in various conditions as determined by the air conditioning system. The tool is available at **www.unicla/hub**.

For further information to maximise the performance, efficiency and durability of a Unicla UX330 compressor in a specific system, refer to *Section 17: System validation* on pages 17 and 18 of this booklet or visit **www.unicla.hk**.

300 Series operational envelope with refrigerants R134a, R513a and R1234yf



13. System design and selection

13.1 Selection criteria

- Ensure that the compressor capacity matches the system type.
- 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 and must fall within rpm recommendations in the Unicla operational envelope. Therefore, it is important to know the most common use and engine speed range of the vehicle 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.

13.2 Capacity Calculation

The following graph and chart show the Unicla UX330 compressor capacity under condensing temperatures of 58°C and evaporative condition of zero degrees over the complete revolution range. Air conditioning system designers must ensure the evaporator and condenser sizes chosen for the system are within the specified capacity range of the UX330 compressor.

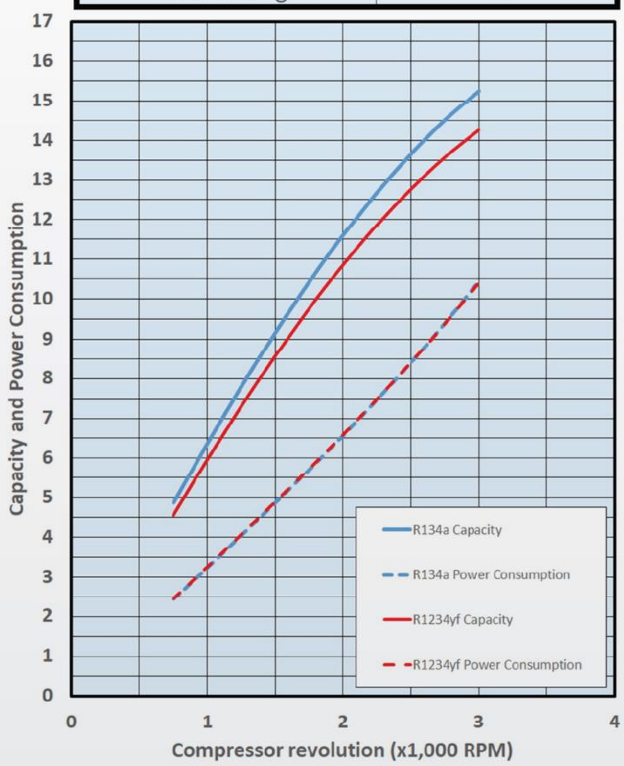
UX330 compressor performance for R134a and R1234yf

Specifications

Model	Displacement	Number of cylinders
UX330	330 cc/rev	10

Conditions

Suction pressure	1.82 bar
Discharge pressure	15.20 bar
Suction temperature °C	-1°C
Discharge temperature °C	58.4°C
Superheat	9
Subcooling	5



14. Suction line accumulators

Suction line accumulators are recommended if the refrigerant flow settings or layout of the system components and connecting lines present a risk of liquid refrigerant flooding back to the compressor. Incoming liquid at the suction inlet of the compressor can damage the valve plates and the compressor's internal working assembly.

There are many scenarios where this can occur, but the risk can be reduced by following the specifications below.

14.1 Evaporator usage and performance

The system design is likely to demand high capacity and performance particularly when used in high ambient temperatures and high humidity under full engine power.

Maximum evaporator cooling capacity will depend on efficient use of space, and the location of the heat exchangers.

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

Alternatively, by decreasing the superheat run in the evaporator to a 'flooded' condition of only 1 K–2 K, the heat exchanger space in the evaporator is fully used, the temperature of the returning refrigerant at the compressor suction inlet is reduced, and the CDT is lowered. Lower CDT conditions reduces the overall temperature of the compressor body, improves lubrication due to lower oil temperature, and means less heat strain on the compressor seals and O-rings. The result will be longer life and durability for the compressor. In this situation the use of a suction accumulator is recommended.

14.2 Accumulator types and characteristics

The suction line accumulator is basically a storage vessel with an incoming liquid port to direct 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

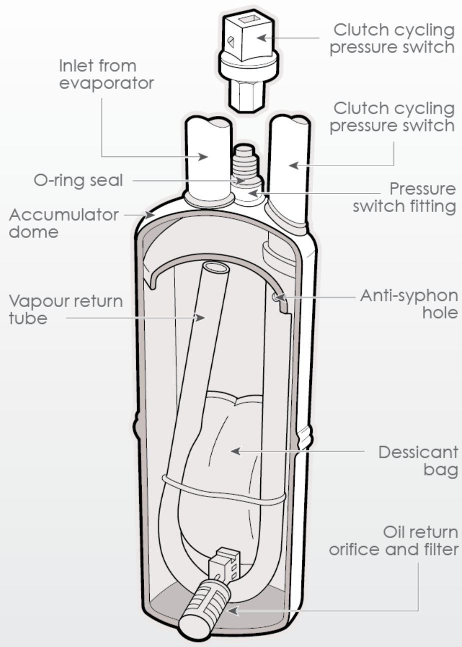
Pressure switch
The setting will vary depending on the purpose of the switch. This circuit may switch on the clutch relay direct or form part of the request signal circuit for the ECU or another secondary controller.

Oil return orifice
Ensures oil (with some refrigerant) will return to the compressor. 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.

Anti-syphon hole
Only used in some accumulators to stop liquid migration.



14.3 Accumulator size

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

- Design and type of system (orifice tube or expansion valve)
- Capacity of the system (volume of refrigerant)
- Operating conditions (heat load – temperature and humidity)

In an orifice tube system operating under low heat loads, very little heat is 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 of 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 has to cater only 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 to have an accumulator capacity of 50% of the total refrigerant capacity of the system.

While 50% may seem excessive, note that during system start-up, the expansion valve bulb is warm. This causes the valve to open wide with flooding of the evaporator which brings the accumulator into play – 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.

Also, when the system is shut down, liquid migration will occur as the valve opens during system equalisation, and this brings the accumulator into play. If multiple evaporators are used with split suction lines, the options are to use a single accumulator in the common suction (after they have joined) or to use two accumulators for each parallel run. 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 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 completed in the system design to ensure optimum performance and protection and a minimal dilution of oil on the suction return.

14.4 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.

14.5 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 while using 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 that the expansion valve maintains.

A short superheat run would have only 1–2 K of superheat, whereas an 8 K superheat value would keep the evaporator well short of 'full'.

In systems where a short superheat run is used and the margin to a fully flooded evaporator is close, the use of a suction line is recommended.

14.6 Expansion valve hunting

In principle, the expansion valve should control flow to an exact predetermined value. In reality, 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 underfill the evaporator around the predetermined value.

Expansion valve hunting varies from system to system and is dependent on three main factors:

- charge rate
- adjustment of the valve (superheat setting)
- system size and design.

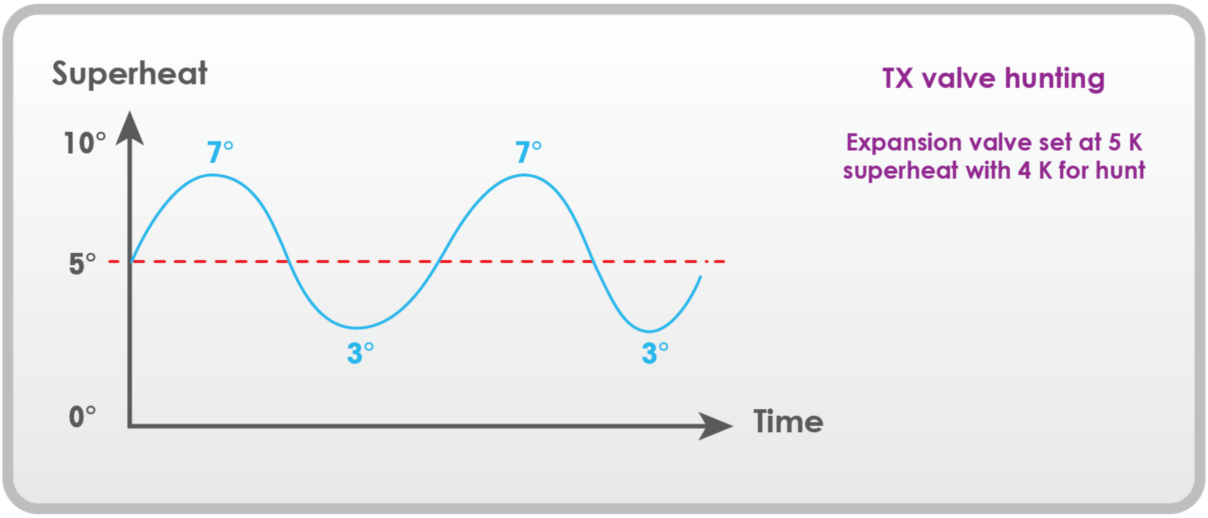
Many valves can be adjusted to minimise or eliminate hunting and the manufacturer's valve literature relating to this adjustment should be consulted. A cycling of below 1 K is not considered hunting.

There are two key issues with excessive expansion valve hunting:

- underuse of the coil when the TX valve shuts down and starves the evaporator
- 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 for the compressor. The use of a suction line accumulator is recommended in any system where the expansion valve is set to a superheat margin, or where the expansion valve hunting characteristics increase the possibility of liquid entering the suction line and compressor.

The alternative action of setting the expansion valve super setting higher (to compensate for risk of liquid migration caused by hunting and full evaporator use) when the installation of a suction line accumulator will suffice, is not recommended. The downsides of high superheat levels in the evaporator are lower system capacity and performance, and higher CDTs.



Example: A 5 K expansion valve in operation opens too wide and fills the evaporator to a level where it has only 3 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 K. The valve then responds to the starved evaporator, opens and once again overfills to 3 K of superheat and the cycle continues. This would be referred to as 4 K of expansion valve hunting.

14.7 Accumulators versus P traps

A P trap occurs 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 it has 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 of having a much larger capacity and therefore greater protection against liquid flood back. The suction line accumulator also has an internal oil bleed hole to ensure oil returns to the pump at a normal rate.

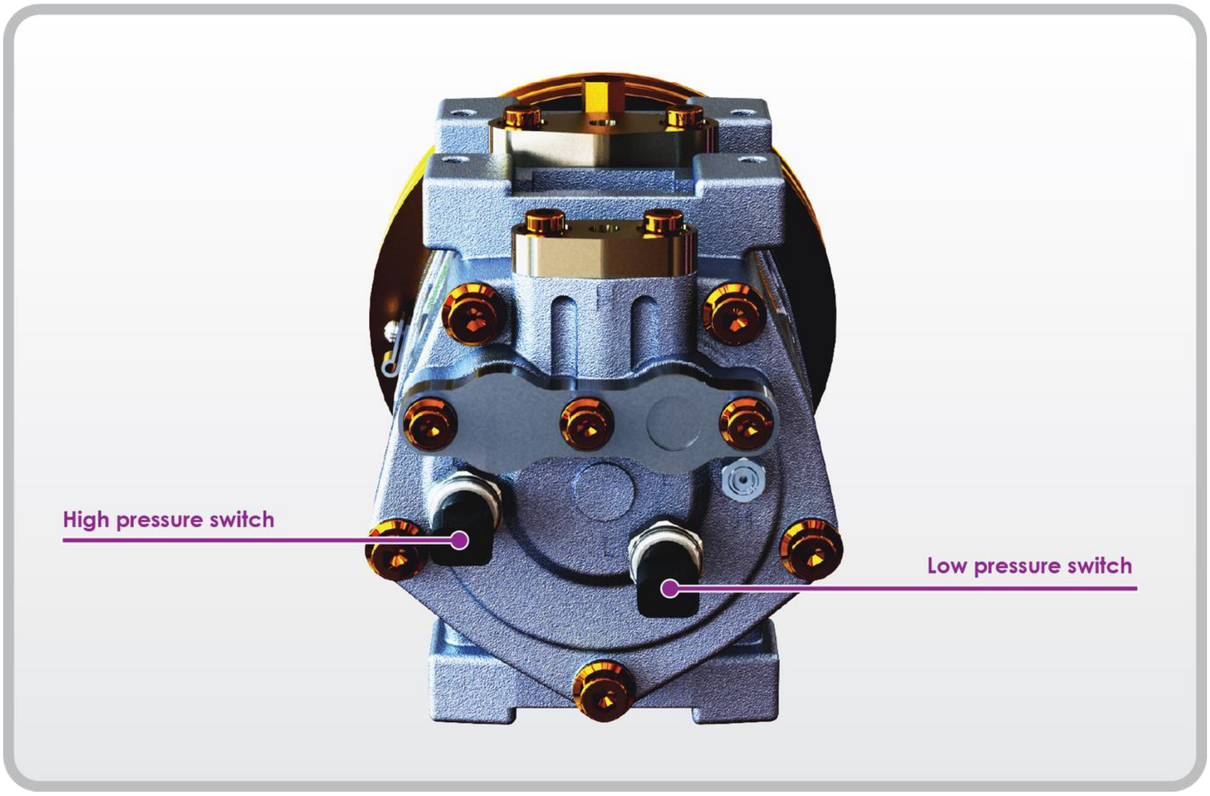
15. Pressure switches

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

There are several ports in the compressor body where different high and low pressure switches can be installed. However, for typical engine applications, it is recommended that the space on a suitable hose manifold fitted to the rear of the compressor is used for this purpose, or at points on the suction and discharge lines of the system.

System designers may choose to design a specific manifold to suit the relative suction and discharge hose layout in the engine bay, in which case the features of the Unicla manifold *Part No. 32308-000540* could be adopted.

Switches fitted to the compressor rear cap are shown below.



Note: The switches shown are unconnected to the wiring circuit. Unicla accepts there are a number of choices for plugs and connectors in the market and the system designer must make this final choice. Unicla 7/16' male flare fitting (Part No. 42203-000150) can be fitted to all 12 mm 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 600 mm from the compressor. This will ensure oil is not pushed or washed away from the compressor sump causing immediate damage to the compressor's internal assembly during initial 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 procedure for adding refrigerant 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 there is no sudden removal or loss of oil in the compressor.

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.

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

During the charging process the sight glass should appear clear to pale in colour.

17. System validation

17.1 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 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.

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

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

17.2 Thermal loading

It is important the Unicla UX330 compressor is operated within its recommended heat range, and the system 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°C. It is a guideline of what to expect on the discharge line for the Unicla UX330 compressor and a target to aim for in relation to the discharge line superheat component.

rpm	Discharge temp °C	Condensing pressure Kfg/cm²	Condensing temp °C	Evaporator pressure Kfg/cm²	Compressor inlet temp °C	Superheat (discharge line)
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

Normal superheat/discharge line temperatures for Unicla UX330 compressor

17.3 Compressor durability

Compressor durability and service life are 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°C–6°C, and it is recommended this type of setting level should be considered by system designers where the vehicle is predominately used in high ambient conditions requiring maximum performance from the air conditioning system.

Reduced discharge line temperatures also result in lower compressor body temperatures causing far less thermal strain on seals and O-rings. In addition, oil temperatures are lowered and are not pushed to their limit thereby assisting with increased compressor lubrication and durability.

17.4 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 deliver the same results as described in 'Low charge rates'. 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 5, Hose and pipe 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.

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.

17.5 Compressor operation analysis report

The operation report T2113 shown on page 31 of this booklet should be completed when commissioning a new air conditioning system and Unicla UX330 compressor for the first time. An online analysis tool is also available at **www.unicla.hk** to assist engineers with capacity and envelope position calculations for the system and compressor operating in different conditions.

The relevant data will help validate both the operational parameters of the compressor and complete system, and it will highlight any discrepancies in system performance affecting the compressor operation.

The compressor operation must reflect a match to system capacity in conjunction with achieving durability and long service life, and it must be remembered that the operational parameters shown in *Section 9* outline only 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. Some items may be required by system designers at the point of initial installation and others to meet service and repair requests after extended mileage and service in the field.

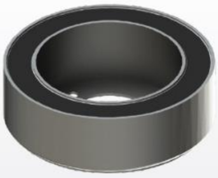
Clutch armature
Part No. 27206-000070
Note: may require placement in conjunction with pulley. Surface condition of pulley and armature must be smooth and consistent.

Clutch fitting kit
Part No. CK330

Clutch pulley and armature set
168mm 8 PG type
Part No. CL330-8

O-ring
Part No. 92501-000190

Gasket kit
Part No. 93204-000030



Clutch field coil
12v (black wire)
Part No. 27204-000080
24v (green wire)
Part No. 27204-000010

Shaft seal kit
Part No. 92503-000050

Suction valve assembly - front and rear
Part No. 22602-000010

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

Front cap
Part No. 21510-000012

Rear cap - all models
Part No. 21505-000260

Rear hose manifold #10 and #16
straight (flare) hose fittings
Part No. 32308-000760

Rear hose manifold #10 and #16
straight hose fittings
Part No. 32308-000540

Thermal switch to
suit rear manifold
(Part No. 32308-
000760)

setting cut out
85°C - cut in 65°C
Part No. 53101-000110

Service valve -
low side
Part No.
38101-000020

Service valve -
high side
Part No.
38101-000030

Male flare fitting
pressure switch
access
Part No.
42203-000150

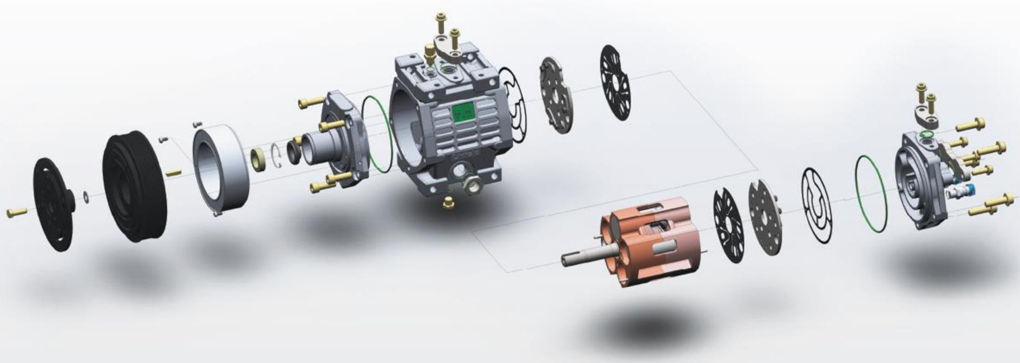
Male flare fitting
oil separator port
Part No.
42203-000161

element.ac
PAG 46 oil
(Polyalkylene
glycol), 250ml

Top rear manifold #10 90 degree
hose fitting
Part No. 32308-000421

Top manifold #12 90 degree
hose fitting
Part No. 32308-000432

19. Exploded view



20. Form – compressor operation/commissioning report

Unicla® Compressor operation analysis report

New applications validation for open drive compressors 45cc to 680cc

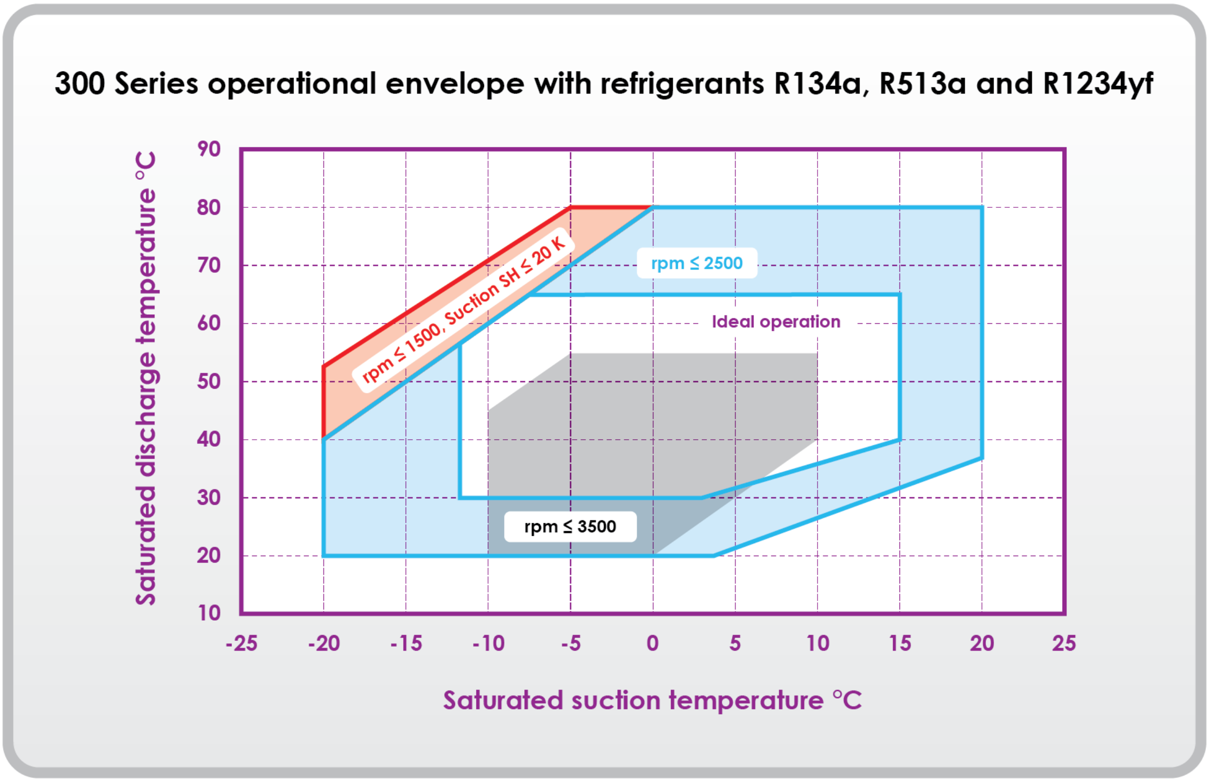
Vehicle Details			
Date		**Ref**	
Owner Name			
Contact Details			
Phone			
AC System Type			

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.					
					Unicla Cat.No.T2113

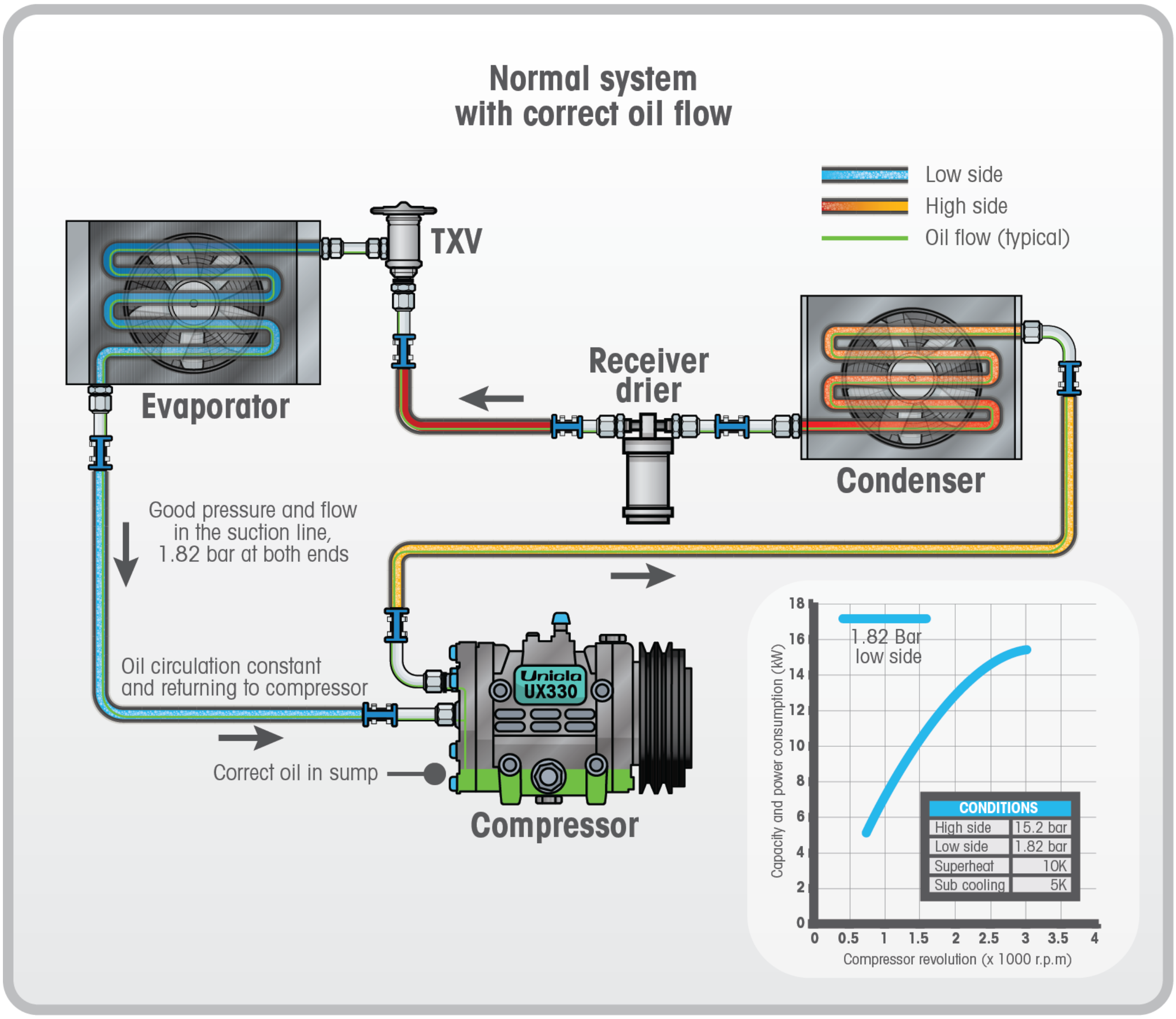


Compressor operation analysis is validated by marking each operational position in the envelope map as shown above. This can be done manually from the data recorded at each rpm interval, or calculated online by implementing the same data into the Unicla analysis tool (available at **www.unicla/hub**).

For assistance on other parameters measured during the validation process such as excessive suction or discharge vapour temperatures, or inadequate oil return to the compressor, refer to the following Unicla publications available at **www.unicla.hk**.

B1801_Unicla_SuctionLineBooklet_Rev1

B1802_Unicla_OilBooklet_Rev.2-12052020


Normal system
with correct oil flow
Low side
High side
Oil flow (typical)
TXV
Evaporator
Receiver
drier
Condenser
Good pressure and flow
in the suction line,
1.82 bar at both ends
Oil circulation constant
and returning to compressor
Correct oil in sump
Uniclo
UX330
Compressor
1.82 Bar
low side
CONDITIONS
High side 15.2 bar
Low side 1.82 bar
Superheat 10K
Sub cooling 5K
Capacity and power consumption (kW)
Compressor revolution (x 1000 r.p.m)

21. Notes

The compressor only Unicla makes.

For over 5 decades.

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