Unicla

General Service Information

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General Service Information

Table of contents:

General service information

The information contained herein is presented to assist service personnel in the selection of the correct compressor for specific applications and to ensure correct fitting procedures are adopted to maximise the life of both the compressor and associated components.

All Unicla compressors are manufactured to exacting standards using quality materials with test programs to ensure both reliability and durability are optimised. It is important to recognise poor fitment or servicing procedures and/or compressors mismatched to systems can seriously jeopardise both reliability and performance. This may result in premature compressor failure or unacceptable performance losses.

The following guidelines of fitment must be strictly adhered to. Unicla warranty against faulty product *(Materials and Workmanship)* - is subject to system compatibility and refrigerant and lubricant compatibility.

Principle causes of premature compressor failure

The broad categories of causes of premature compressor failure are:

- Excessive pressure loading
- Excessive thermal loading
- Liquid slugging of compressor
- Lack of oil/oil return
- Contamination
- Over speed
- Incorrect direction of rotation

Failure cause 1 - Pressure loading

Excessive pressure loadings are directly attributable to one or more of the following system design or servicing faults:

- Overcharge
- Inadequate condenser capability *(condenser too small)*
- Inadequate condenser efficiency due to either
- Poor airflow dynamics *(fans and/or ram air)*
- Poor condenser placement *(air damming and/or excessive external heat loading eg. oil coolers etc)*
- Oil flooding *(reduced thermal efficiency)*
- Flow restriction *(condenser internal fault)*
- Contaminated refrigerants – either non condensables *(air/nitrogen)*, flushing agent contamination or refrigerant mixtures *(cocktails)*

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

°C	°F	kPa	PSI
15	60	600 - 800	90 - 115
18	65	750 - 950	130 - 160
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

Alternatively:

Condensing temperatures can be used for high side evaluation. Refer to additional technical information regarding condensing to air differentials for specifications.

Cautionary notes

Liquid line access valves will not identify condenser internal restrictions, nor will liquid line line high pressure cut switches offer protection. Internal flow restrictions or blockages in the condenser rely on compressor mounted P.R.V's (pressure relief valves) or compressor/discharge line high pressure cut switches for protection.

Failure cause 2 - Thermal loadings

The enemy of the modern system. Thermal loadings are often misinterpreted as being directly attributable to excess pressures. This is not the case. Excess discharge temperatures may be pressure driven or maybe 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.

Note: Modern compressors generate superheat as a normal operating condition – this is referred to as superheat of compression.

Please refer to the chart below for normal superheat/discharge line temperatures
(factory test data)

Compressor	RPM	Discharge Temp °C	Condensing Pressure Kgf/cm²	Condensing Temp °C	Evaporator Pressure Kfg/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	23
	3500	98	15.5	58	1.86	8.9	40
UP200 (200cc)	1800	77	15.5	58	1.86	8.9	19
	2000	78	15.5	58	1.86	8.9	20
	3500	93	15.5	58	1.86	8.9	35
UP170 (172cc)	1800	75	15.5	58	1.86	8.9	17
	2500	78	15.5	58	1.86	8.9	20
	3500	83	15.5	58	1.86	8.9	25
UP150 (145cc)	1800	77	15.5	58	1.86	8.9	19
	2400	81	15.5	58	1.86	8.9	23
	3600	88	15.5	58	1.86	8.9	30

Interpreting the data:

1kgf / cm² = 100 kPa

A condensing pressure of 15.5 kgf/cm² gives a condenser temperature of 58°C
- *(Ambient temperature would be approximately 30°C - refer high side pressure chart page 2)*

Compressor inlet pressure of 1.86 kgf/cm² relates to a vaporisation temperature of - 1°C *(refer refrigerant pressure/temperature chart).*

A compressor inlet temperature of 8.9°C gives us a total low side superheat of +10°C under these *"normal"* operating conditions. *(-1°C vaporisation up to 8 .9°C = 9.9° superheat)*

The discharge line temperature related to the condensing pressure directly calculates the superheat of compression.

Example:

Discharge line temp = 73°C
Condensing temp = 58°C
Superheat = 15°C

} **Refer to top line of chart above**

From this chart we can readily identify normal superheat levels as opposed to excessive superheat *(superheating that may lead to premature compressor failure due to the thermal overload.)*

Causes of excessive superheat (discharge)

It is important to note that superheat levels increase as a normal condition:

- at higher compressor speeds
- at higher ambient temperature

Abnormal Superheat Generation may be caused by one or more of the following conditions - exaggerated under high heat loads.

Low charge rates - insufficient flow of refrigerant to the compressor to provide adequate cooling for 2 reasons:

1. The flow *(volume)* **is reduced giving less cooling medium**

2. Low flow relates to excessive low side superheating – the suction vapours are no longer cold

1 + 2 = low quantity of cooling vapours, plus they are no longer cold

With the compressor placed in environments of low external airflow *(ie - behind transverse mounted engines)* adequate charge rates must be maintained to ensure adequate compressor cooling by the refrigerant.

Restricted TX valves / Orifice tubes - will give the same conditions as above. It is strongly recommended the TX valve or Orifice *(Expansion)* tube be replaced at the time of compressor fitment. Partially blocked valves/tubes may provide adequate flow under moderate heat load conditions, but starve the compressor under high heat load conditions when pump cooling is most critical.

Poor condensing - in addition to excessive pressure generation poor condensing will result in vapour feed to the TX/Orifice tube causing excessive evaporator superheating under high heat loads.

Contaminated refrigerants - may result in loss of compressor cooling particularly if air or other non-condensables *(ie - nitrogen)* are present in the refrigerant stream.

Cautionary notes – superheat testing

Excessive discharge line temperatures may be either excessive vapour superheating *(as above)* or due to excessive discharge line pressures. *(as previously mentioned)* In the event of condenser internal restrictions or oil slugging a liquid line access valve will not identify excessive discharge line pressures. Dual high side test points may be required in cases where condenser restrictions need to be identified.

Compressor relief valve activation *(if fitted)* may be an indicator of condenser internal restrictions.

These photographs clearly show a high degree of discharge line superheat relative to the pressure – however if the pressure is being sampled from the liquid line to excessive discharge line temperature may be pressure generated.

Calculation:

121°C	**on the Discharge line**
68°C	**on the Gauge**
58°C	**Superheat**

Failure cause 3

Liquid slugging of compressor

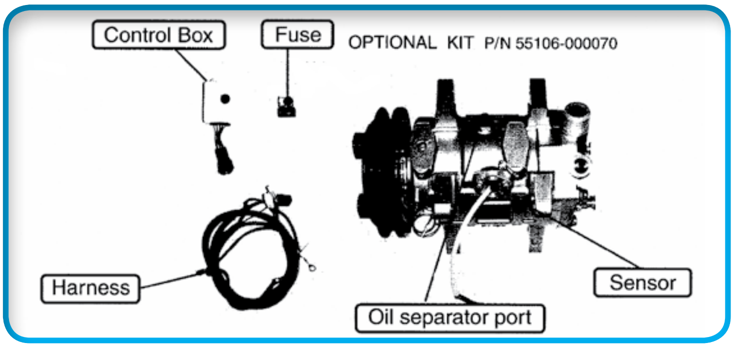
To prevent the risk of liquid slugging the following precautions must be observed when fitting **any** compressor from the Unicla range.

- **The TX Valve must be correctly sized and superheat set (if adjustable) to manufacturers specifications (TX Valves jammed open must be replaced).**
- **Refrigerants with positive glide characteristics are not to be used unless a TX superheat adjustment is made as glide compensation.**
- **Systems must not be overcharged**
- **Suction piping must be in accordance with accepted refrigeration standards particularly in applications where liquid migration is deemed a possibility.**
- **Suction line accumulators are the recommended alternative to piping design that may act as an oil trap, or where migration levels are high.**

In applications where suction line system design indicates a risk of either liquid migration or liquid slugging in operation a lock detection sensor *(optional kit P/N 55106 - 000070)* must be fitted.

This sensor is a protective device in case of adverse operating conditions allowing liquid to reach the pump. **It must not be used as a "Front line" defence against liquid slugging of the pump.** If it is deemed there is a significant risk of liquid reaching the pump the suction line must be redesigned, the TX adjusted and/or a suction line accumulator used. The lock detection sensor will disengage the clutch if the control box does not receive a signal from the sensor for 2 seconds.

Lock detection sensors can be considered on essential component where the compressor drive belt is a common drive for associated components *(ie water pump)*. Liquid entry into the pump may cause belt breakage *(on compressor engagement)* which obviously must be avoided **at all costs** in common belt drive systems.



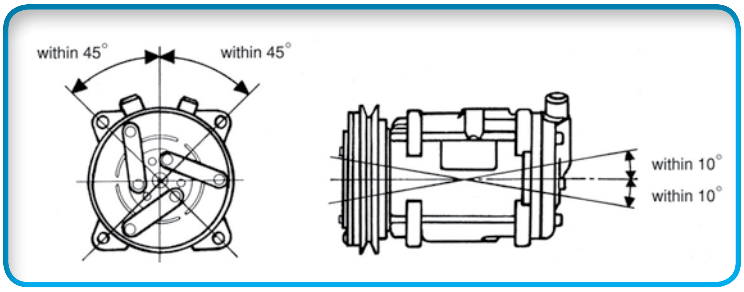
Failure cause 4

Lack of oil/oil return

There are 4 aspects to correct compressor lubrication:

Mounting angle

The compressor must be mounted in accordance with recommendations.
Maximum mount angles must not be exceeded.



Oil quantities

The correct amount of oil must be maintained in the system. Long hose runs and dual evaporator systems must have additional oil added to the system. Severe oil starvation problems may result from insufficient system oil being allowed. There are two methods of determining oil charge rates for systems – compressor specific and generic calculation.

Compressor specific calculation

The following chart is a sample *(UP/UX200 – Bus application)*. Compressor and/or system manufacturers charts similar to the one shown below may be referred to for oil calculation.

Passenger vehicles only

Cooling capacity	Passengers	Oil quantity in system
14,000 kcal/h	60	Approx. 1600 cc
10,000 kcal/h	40	Approx. 1100 cc
7,500 kcal/h	30	Approx. 850 cc
5,000 kcal/h	20	Approx. 650 cc

Generic calculation:

Calculate oil charge as 20% of refrigerant charge ie - 3 kg charge = 3000g x 20% = 600 ml *(cc)* of oil.

Oil separators

Oil separators are strongly recommended in multiple evaporator systems due to oil circulation rate reduction and in systems where it is deemed the suction may go below zero. *(ie - high speed operation).*

Oil separator

Oil separators provide protection in long hose run multi evaporator systems particularly if there is a change of sub zero refrigerant temperatures in high speed operation.

Accumulator

Accumulators hold large quantities of oil. 60ml must be allowed if they are incorporated into the system.

Miscibility/solubility

Only recommended refrigerants and oils are to 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.

In low temperature applications *(ie - freezer vans)* oil quantity and selection must be in accordance with system manufacturer's recommendations.

Failure cause 5

System cleanliness *(contamination)*

The system must be maintained free of both solid particle and chemical contamination. Solid particle contamination will cause direct compressor damage and starvation of the pump due to Blocked system filters and screens.

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

System flushing prior to compressor fitment

Contaminated systems must be flushed prior to fitting of the new compressor.

Individual component flushing is strongly recommended in systems where solid particle contamination is present *(ie - previous compressor failure.)*

Compressors, TX valves, pressure control valves, receiver driers/accumulators and mufflers/ pulsation dampers must not be flushed.

Additional information - flushing

For full details of flushing options/procedures refer to VASA Training Booklet *"flushing of automotive air conditioning systems"* - policies, procedures and recommendations.

Additional procedures - flushing

In systems where residual contamination is suspected a post fitment inspection service *(including a filter/drier replacement)* must be conducted to reduce the risk of premature compressor failure.

Additionally a *"catch all"* filter may be used for further protection - refer to commercial refrigeration suppliers for more information.

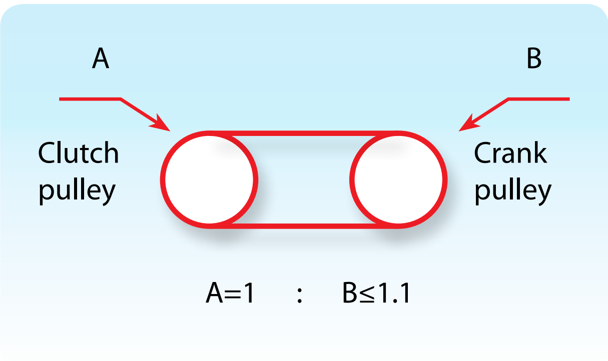
Failure cause 6

Overspeed

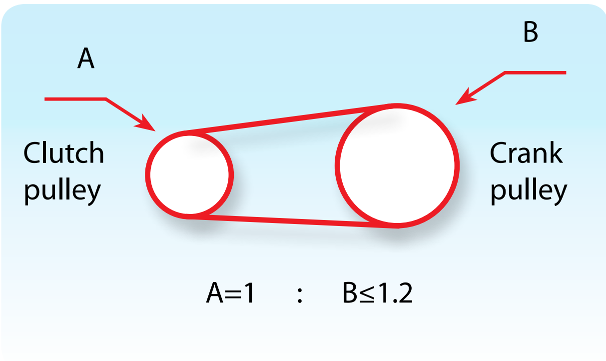
When fitting any compressor from the Unicla range ensure the compressor driven speed does not exceed the specified limit. This includes both continuous speed and momentary speed as applicable.

Crank to compressor drive ratios must not exceed **1.2:1** in normal applications. In low speed governed applications the gearing ratio may exceed **1.2:1** to provide maximum performance providing the rated compressor speed is not exceeded.

Normal



Cut Off Sensor Required



Failure cause 7

Incorrect direction of rotation

Ensure the direction of rotation of the compressor matches the application in which it is being placed. Unicla compressors are designed to operate in both clockwise *(CW)* and counterclockwise *(CCW)* directions however the clutch design varies dependant upon direction of rotation *(D.O.R.)*

Later generation rubber clutches are designed to operate in both directions making the compressor and clutch assembly multi directional.

Failure to match the clutch with its D.O.R. may result in premature clutch failure especially in applications of high torque engagement spike *(high head pressure)* and/or constant high speed cycling.

Compressor selection

Three major factors to take into account:

- **Direction of rotation** ***(CW or CCW)***
- **Maximum speed of compressor – calculated by maximum engine speed x drive ratio.** *(as previously discussed - use an overspeed cut sensor if required).*
- **Capacity either shown in graph or table form aligning rpm with compressor capacity.**

Interpreting capacity data

When selecting compressors or upgrading systems to larger capacity or dual evaporators the compressor sizing *(capacity)* must match the system.

- **Compressor selection must be done on the following basis.** *(Basic guidelines only)*
- **What is the operational speed of the compressor?** *(Varies dramatically highway to city cycle)*
- **What is the total net refrigerating capacity of the system?** *(Evaporator rating)*
- **What refrigerant is being used in the system?**

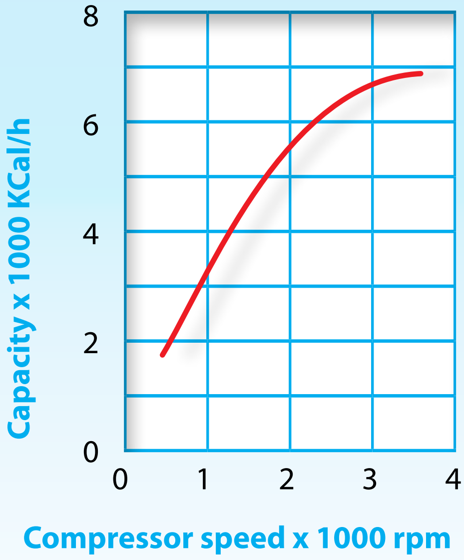
From these basic questions a compressor selection can be made – presuming that the evaporator capacity is adequate for the application the correct compressor can be selected.

Note: Graphs will often incorporate 3 plots onto one grid - power consumption, refrigerating capacity and coefficient of performance *(COP)* which relates to input *(power consumption)* verses output *(refrigerating capacity)*.

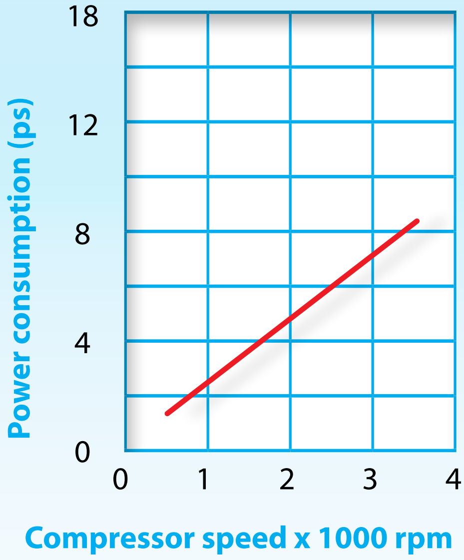
If interpreting single plot graphs ensure you have selected the Refrigerating capacity graph. *(see sample on next page)*

For single evaporator applications the compressor must cater for the net refrigerating capacity of the evaporator at nominated operating speeds.

For dual evaporator units the compressor must cater for the net refrigerating capacity of all evaporators.



This is the refrigerating capacity graph - must match system capacity.



The power consumption graph shown here relates to input *(drive)* power - not capacity.

Service checks

If the system has been upgraded *(ie - dual evaporators)* with the compressor undersized for the evaporator loads, the technician will often recognise a higher than normal low side pressure. *(The inability to pull down the low side).*

The undersized compressor *(with its high suction pressure)* is producing an inadequate flow of refrigerant with a high saturation temperature *(poor "chilling off" of the evaporator).*

Both factors place serious limitations on the evaporator performance. An inadequate flow to absorb maximum heat from the environment and an evaporator operating at a higher temperature.

Driving conditions

Customer complaints often indicate adequate highway performance but poor city cycle performance. This condition clearly indicates a compressor with inadequate performance at low speed *(see above)*.

A higher capacity compressor is required if the normal driving condition is city cycle. Alternatively a higher compressor speed may be used *(drive ratio changed)* providing the compressor maximum speed is not exceeded under any driving conditions.

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