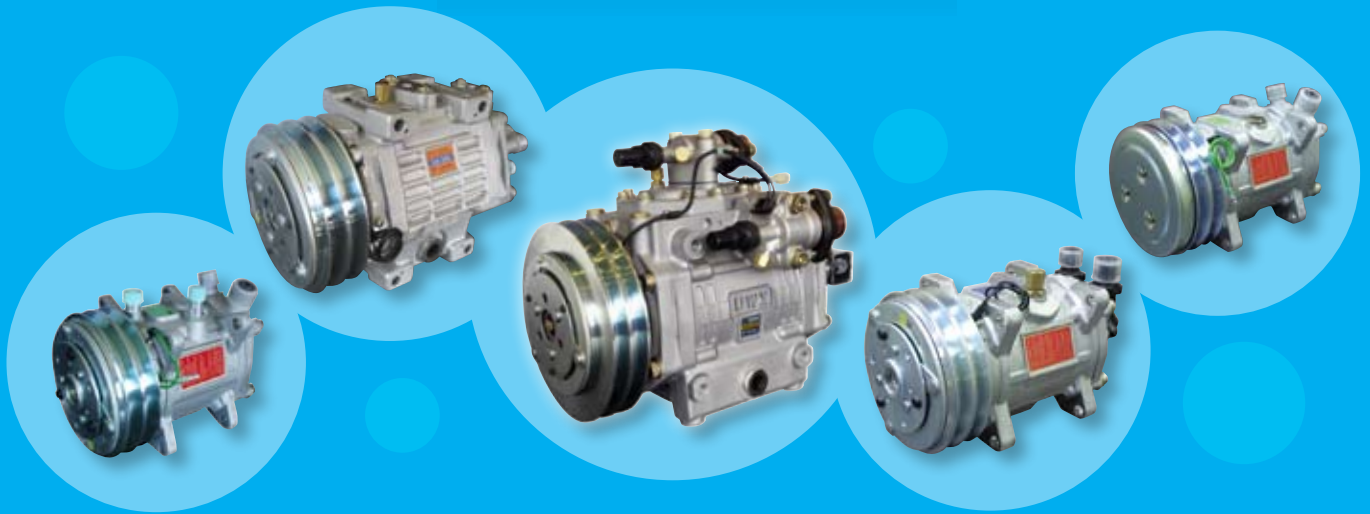




Unicla



**Compressor Fitting
Guidelines for
New Applications**



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Compressor fitting guidelines for new applications

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Note: This booklet is designed to assist the installing technician to ensure Unicla guidelines and procedures have been followed during the installation and initial commissioning of Unicla compressors.

Please read carefully and if further information is required please visit: www.unicla.hk
or contact the nearest Unicla dealer.

1. Compressor Fitting Information

This information will assist technical personnel to ensure correct fitting procedures are adopted to maximise the life of the compressor and associated components.

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

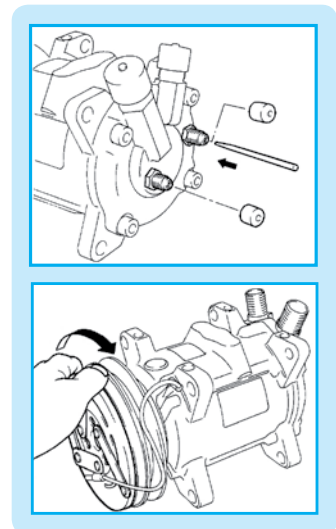
It is important to recognise poor fitting or servicing procedures as well as any mismatch of compressors to systems as these factors can seriously jeopardise reliability and performance and result in premature compressor failure or unacceptable performance losses.

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

a) Removing transit gas

Before mounting and when handling a new Unicla UWX compressor for the first time, remove the dust cap from the discharge service valve and gently release the N₂ gas as follows.

Take care to not let oil escape.



b) Initial lubrication

Rotate the compressor armature 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 specific Unicla compressor service manual must be consulted and the relative procedures strictly adhered to. UWX series compressors require fitting of the discharge line hose manifold to the appropriate left or right hand side of the compressor. A separate installation instruction booklet is attached to the compressor for this.

2. System Cleanliness

a) Contamination

The system must be free of both solid particle and chemical contamination before compressor fitting. Solid particle contamination will cause direct compressor damage and starvation due to blocked system filters and screens (see section 10). Chemical contamination can reduce solubility/miscibility of refrigerants and oils, reduce oil viscosity, and cause acid etching and sludge formation.

b) Flushing

Contaminated systems must be flushed before fitting the new compressor. 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 - **must not be flushed.**

3. Mounting

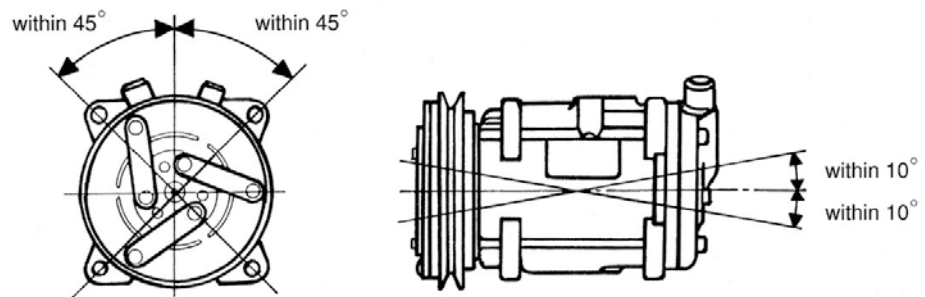
a) Mounting points

All compressors should be mounted firmly and securely to the engine bracket using manufacturers' standard specifications. The following chart outlines the minimum mounting point utilisation for each Unicla model.

Compressor type	Mounting description	Minimum mounting requirement
UC	Alternator or swing type	Three lugs
UP	Lug type	Four lugs
UX	Direct or bolt through type	Four points
UWX	Multiple direct mounting	Six points

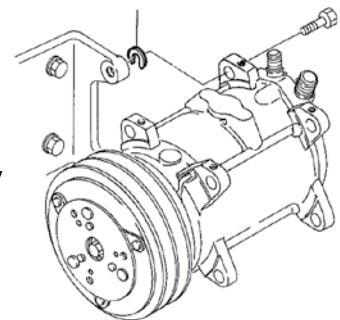
b) Mounting angle

The mounting angle for each model must be as follows:



c) Lug type mounting

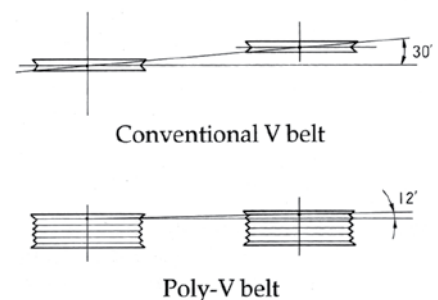
When mounting Unicla UP series compressors (lug mount type) there must be no gap between the bracket and the lug. This will ensure additional stress is not placed on the compressor and noise transmission is kept to a minimum. Universal sliding bushes or shims, or Unicla shim kit part no 2900-000010 must be used as follows:



4. Belt alignment and tension

a) Alignment

The compressor clutch pulley must be in perfect alignment with the drive pulley on the engine and any auxiliary idler or adjusting system. Unacceptable alignment is shown in the following diagram



b) Tension

Belt tension adjustment should be made so the belt is taut, but not to excess to cause excessive bearing loads. Due to the pulsating load created by compressors, the belt tension must be greater than for a normal steady load. The tension must be within the manufacturers' guidelines for the specific belt used to drive the compressor, or in the absence of this information, Unicla recommends belt deflection of 10 - 20 mm /meter after tensioning, or 50kg of tension for most applications. This tension must be checked again and tighten back to specification after 36-48 hours of initial operation.

5. Compressor speed

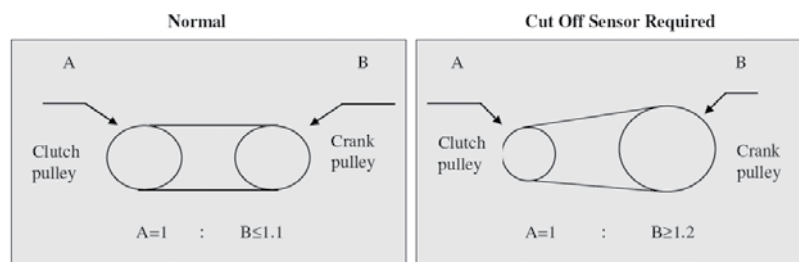
a) Speed limit

When fitting any compressor from the Unicla range, ensure that the compressor speed does not exceed the specified limit. This includes both continuous speed and momentary speed. Crank to compressor drive ratios are recommended to not exceed 1.2:1 to ensure maximisation of compressor clutch and pulley durability. 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. The following chart gives the Unicla speed recommendation for each model.

Compressor series	Ideal operation speed rpm	Maximum continuous rpm	Maximum momentary rpm
90	1800-2400	3000	4500
120/150/170	1800-2400	3000	6000
200/330	1500/2500	3000	4500
440/550	1200/2500	3000	4500

b) Pulley ratios

If excessive pulley ratio is unavoidable, then consideration should be given to fitment of a cut – off sensor for over speed.



c) Compressor rotation

The direction of rotation of the compressor must match the application in which it is being placed. Unicla compressors are designed to operate in both clockwise and counterclockwise directions. However, the clutch design varies depending on direction of rotation. 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 direction of rotation may result in premature clutch failure, especially in applications of high torque engagement spike (high head pressure) and/or constant high speed cycling.

6. Oil selection

a) Recommended oil

Each Unicla compressor is fitted with specific oil. The following chart outlines the recommended selection of oil and refrigerant to common applications, however each compressor is labelled separately with the refrigerant and oil type to be used.

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
UC	R134a	Unicla Unidap7	48.01	10.51	Airconditioning	≥ 0°C	Optional
UP & UX	R134a	Unicla Unidap7	48.01	10.51	Airconditioning	≥ 0°C	Optional
UP & UX	R134a	Emkarate RL68H	65.5	9.3	Airconditioning	≥ 0°C	Optional
UP & UX	R134a	Emkarate RL68H	65.5	9.3	Airconditioning	≥ -10°C	Required
UP & UX	R404a	Emkarate RL32H	32.5	5.8	Refrigeration	≥ -15°C	Required
UPF	R404a	Emkarate RL32H	32.5	5.8	Refrigeration	≥ -35°C	Required
UPF	R404a	Emkarate RL32H	32.5	5.8	Refrigeration	≥ -15°C	Required
UWX	R134a	Unicla Unidap7	48.01	10.51	Airconditioning	≥ 0°C	Optional
UWX	R134a	Emkarate RL68H	65.5	9.3	Airconditioning	≥ 0°C	Optional

b) Oil quantity

The correct amount of oil must be maintained in the compressor and 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.

To determine oil quantity required Unicla recommends a calculation as a percentage of refrigerant charge as follows:

- 20 % for Unicla A group compressors (90,120,150,170 series) in standard applications
- 30 % for Unicla B group compressors (200,330,440,550 series) in applications where suction and discharge lines exceed 6m in length

Example: Calculate oil charge as 20% of refrigerant charge, 3 kg charge = 3000 g x 20% = 600 ml (cc) of oil. If fitting a UP200 compressor, then deduct the compressor initial oil charge to determine amount of oil to be added.
Therefore 600 – 180 = 420cc oil to be added to system.

c) Matching oil

The oil added to the system must be identical to the native oil already installed to the specific Unicla compressor as identified on the compressor label.

d) 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, such as in high speed operation or as per the system applications mentioned in the chart above.

7. Compressor selection

a) Selection criteria

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

Compressor selection must be done using the following basic guidelines:

- **What is the operational speed of the compressor?
This varies dramatically in highway to city cycle.**
- **What is the total net refrigerating capacity of the system? Evaporator rating.**
- **What refrigerant is being used in the system?**

Taking into consideration these three factors and if the evaporator capacity is adequate for the application, the correct compressor can be selected.

Note: Graphs will often incorporate three plots onto one grid – power consumption, refrigerating capacity, and coefficient of performance. Coefficient of performance relates to input (*power consumption*) versus output (*refrigerating capacity*). If interpreting single plot graphs, ensure you have selected the Refrigerating Capacity Graph. A complete range of graphs for each model is available from Unicla upon request.

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.

8. Hose and pipe selection

a) Suction Line

Correct sizing of the suction line is critical to ensure adequate flow of refrigerant 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 each Unicla compressor model under common speed and capacity ratings.

The suction lines are sized to have pressure drop from friction no greater than the equivalent of approximately 1 K change in saturation temperature. Selections are based on R134a saturation temperature of 08C (*Referenced from ASHRAE Hand Book, Refrigeration Volume, 2006 Edition.*)

9. Recommended suction line pipe size

The following charts give the suction pipe size recommendations for Unicla compressors.

Unicla 150 Series Compressors

RPM	Rated (kW)	3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
		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	2.4	0.95	9.7	12 (1/2)	0.58	6	16 (5/8)	0.98	10	16 (5/8)	0.43	4.5	19 (3/4)	0.65	6.7	19 (3/4)
1500	3.6	0.59	6	16 (5/8)	0.43	4.5	19 (3/4)	0.72	7.4	19 (3/4)	0.87	8.9	19 (3/4)	0.61	6.2	22 (7/8)
2000	4.9	0.95	9.7	16 (5/8)	0.70	7.2	19 (3/4)	0.54	5.6	22 (7/8)	0.65	6.7	22 (7/8)	0.98	10	22 (7/8)
2500	6	0.45	4.6	19 (3/4)	0.91	9.3	19 (3/4)	0.7	7.2	22 (7/8)	0.84	8.6	22 (7/8)	0.33	3.5	28 (1,1/8)
3000	7.2	0.56	5.8	19 (3/4)	0.52	5.3	22 (7/8)	0.87	8.9	22 (7/8)	1.05	10.7	22 (7/8)	0.41	4.2	28 (1,1/8)

Unicla 170 Series Compressors

RPM	Rated (kW)	3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
		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	3	0.37	3.8	16 (5/8)	0.74	7.6	16 (5/8)	0.45	4.7	19 (3/4)	0.55	5.6	19 (3/4)	0.82	8.4	19 (3/4)
1500	4.9	0.74	7.5	16 (5/8)	0.54	5.6	19 (3/4)	0.91	9.3	19 (3/4)	1.09	11.2	19 (3/4)	0.76	7.8	22 (7/8)
2000	6.5	0.44	4.5	19 (3/4)	0.88	9	19 (3/4)	0.68	7	22 (7/8)	0.82	8.4	22 (7/8)	0.32	3.3	28 (1,1/8)
2500	7.9	0.58	5.9	19 (3/4)	0.53	5.5	22 (7/8)	0.89	9.2	22 (7/8)	1.08	11	22 (7/8)	0.42	4.3	28 (1,1/8)
3000	8.8	0.71	7.2	19 (3/4)	0.65	6.7	22 (7/8)	1.1	11.2	22 (7/8)	0.34	3.5	28 (1,1/8)	0.51	5.3	28 (1,1/8)

Unicla 200 Series Compressors

RPM	Rated (kW)	3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
		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	3.5	0.49	5.1	16 (5/8)	0.99	10.2	16 (5/8)	0.61	6.3	19 (3/4)	0.74	7.5	19 (3/4)	1.1	11.3	19 (3/4)
1500	5.8	1.01	10.3	16 (5/8)	0.74	7.6	19 (3/4)	0.57	5.9	22 (7/8)	0.69	7.1	22 (7/8)	1.04	10.6	22 (7/8)
2000	7.8	0.59	6	19 (3/4)	0.55	5.6	22 (7/8)	0.91	9.3	22 (7/8)	1.1	11.2	22 (7/8)	0.43	4.4	28 (1,1/8)
2500	9.3	0.78	8	19 (3/4)	0.72	7.4	22 (7/8)	0.31	3.2	28 (1,1/8)	0.38	3.9	28 (1,1/8)	0.57	5.8	28 (1,1/8)
3000	10.5	0.96	9.8	19 (3/4)	0.89	9.1	22 (7/8)	0.38	4	28 (1,1/8)	0.46	4.8	28 (1,1/8)	0.7	7.1	28 (1,1/8)

9. Recommended suction line pipe size

... continued

Unicla 330 Series Compressors

RPM	Rated (kW)	3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
		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)

Unicla 440 Series Compressors

RPM	Rated (kW)	3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
		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	9.9	0.79	8.1	19 (3/4)	0.73	7.5	22 (7/8)	0.32	3.3	28 (1,1/8)	0.55	4	28 (1,1/8)	0.58	5.9	28 (1,1/8)
1500	15.4	0.74	7.5	22 (7/8)	0.38	3.9	28 (1,1/8)	0.64	6.6	28 (1,1/8)	1.09	7.9	28 (1,1/8)	0.4	4.1	35 (1,3/8)
2000	20.1	0.31	3.2	28 (1,1/8)	0.62	6.4	28 (1,1/8)	1.04	10.6	28 (1,1/8)	0.82	4.4	35 (1,3/8)	0.65	6.7	35 (1,3/8)
2500	24.1	0.43	4.4	28 (1,1/8)	0.87	8.9	28 (1,1/8)	0.5	5.2	35 (1,3/8)	1.08	6.2	35 (1,3/8)	0.91	9.3	35 (1,3/8)

Unicla 550 Series Compressors

RPM	Rated (kW)	3 m Pipe Length			6 m Pipe Length			10 m Pipe Length			12 m Pipe Length			18 m Pipe Length		
		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	12.1	0.55	5.7	22 (7/8)	0.29	3	28 (1,1/8)	0.48	5	28 (1,1/8)	0.58	6	28 (1,1/8)	0.87	8.9	28 (1,1/8)
1500	18	0.29	3	28 (1,1/8)	0.58	6	28 (1,1/8)	0.98	10	28 (1,1/8)	0.41	4.2	35 (1,3/8)	0.61	6.3	35 (1,3/8)
2000	23	0.47	4.8	28 (1,1/8)	0.94	9.6	28 (1,1/8)	0.54	5.6	35 (1,3/8)	6.7	6.7	35 (1,3/8)	0.99	10.1	35 (1,3/8)
2500	26.7	0.64	6.5	28 (1,1/8)	0.44	4.5	35 (1,3/8)	0.74	7.6	35 (1,3/8)	0.89	9.1	35 (1,3/8)	0.56	5.7	41 (1,5/8)

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.

10. System validation

a) Discharge pressures

After commissioning a Unicla 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 . Allow 20% tolerance for humidity above 60% relative humidity.

High side pressure chart

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

b) Thermal loading

Excessive thermal loading is the enemy of the modern system, and is often misinterpreted as being directly attributable to excess pressures. This is not the case.

Excess 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.

It is important that all Unicla compressors are operated within a recommend heat range, and all new applications must be physically tested to ensure this is adhered to.

The following chart shows normal superheat/discharge line temperatures taken from factory test data. This gives a guideline of what to expect on the discharge line for each Unicla compressor, and a 'target' to aim for (*marked in red*) in relation to the superheat component for each compressor.

To determine the performance of a Unicla UWX compressor in a specific application, the following Compressor Operation Analysis Report will assist in the collection of the necessary data.

Normal Superheat/Discharge Line Temperature Chart

RPM	Discharge Temp °C	Condensing Pressure Kgf/cm ²	Condensing Temp °C	Evaporator Pressure Kgf/cm ²	Compressor Inlet Temp °C	Superheat (discharge line)
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330, 440 and 550 series compressors

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

200 series compressors

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

170 series compressors

1800	75	15.5	58	1.86	8.9	17
2200	78	15.5	58	1.86	8.9	20
3500	83	15.5	58	1.86	8.9	25

150 series compressors

1800	77	15.5	58	1.86	8.9	19
2200	81	15.5	58	1.86	8.9	23
3600	88	15.5	58	1.86	8.9	30

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 conditions described below and exaggerated under high heat loads.

Low charge rates

There are two reasons for insufficient flow of refrigerant to the compressor to provide adequate cooling:

- the 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.

11. Other features & performance information

With the compressor placed in environments of low external airflow, such as 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.

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 pump 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)

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.

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.



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