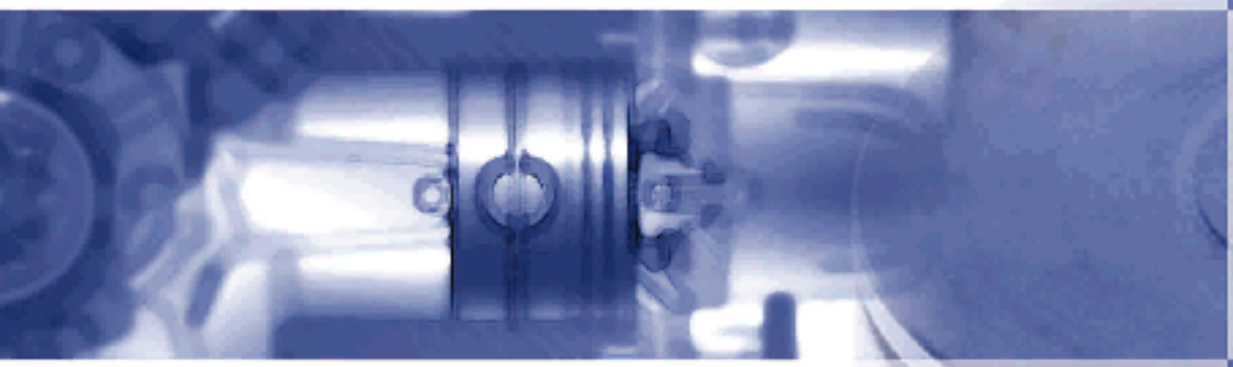
DWM COPELAND



Semi-Hermetic DISCUS compressors

Application Guidelines

EMERSON
Climate Technologies

Index

Important

Only authorised and qualified personnel should install, electrically connect and / or repair COPELAND compressors and their accessories.

This manual is intended to give the installer advice and technical information.

Further technical information can be found in our Selection Software and literature which includes Application Guidelines, Spare Parts Lists etc. accessible from our website at www.ecopeland.com

Safety Information

Refrigeration compressors must be used with Copeland approved refrigerants and refrigeration oils only.

It is not allowed to run a test without the compressor being connected to the system and without refrigerant.
It is of vital importance that the discharge shut-off valve has been fully opened before the compressor is started. If the discharge shut-off valve is closed or partly closed an unacceptable pressure with accordingly high temperatures may develop in the cylinder head.
When operating with air the so-called diesel effect may occur, i.e. the air sucked in is mixed with oil and gas and can explode due to the high temperature in the cylinder head, thereby destroying the compressor.
Care must be taken even when the compressor is running correctly, high temperatures may develop and the compressor may be very hot, anyone touching the compressor may be burned or injured.

The maximum operating pressures stamped on the nameplates are compulsory and should never be exceeded (see page 5).

The compressor is part of a system that is under pressure and therefore subject to the local safety regulations, (EN 378).

General

Validity of this Manual

This manual only covers Discus compressors built after 01 April 1991, i.e. serial numbers 91D and later. It is valid for all released refrigerants:

- D2D and D8D compressors were not modified.
- Some spare parts for D3D*4 and D3D*5 are not interchangeable, *4 was used on models from 91D to 99K and *5 used from 99L onwards.
- The fifth digit of the compressor designation identifies the generation of D4D and D6D compressors with 3 used on models produced between 91D to 99D and 4 used on models from 99E onwards.
- Accessories and spare parts for D4D and D6D are not interchangeable with earlier models. Unloaded start and capacity control mounting positions have changed. Suction chambers for older TWIN compressors cannot be used with models built in April 1991 or later.
  The compressor is only one component which must be combined with many others to build a functional and efficient refrigeration system.

Therefore the information in this manual relates to Discus compressors with standard equipment and accessories only.

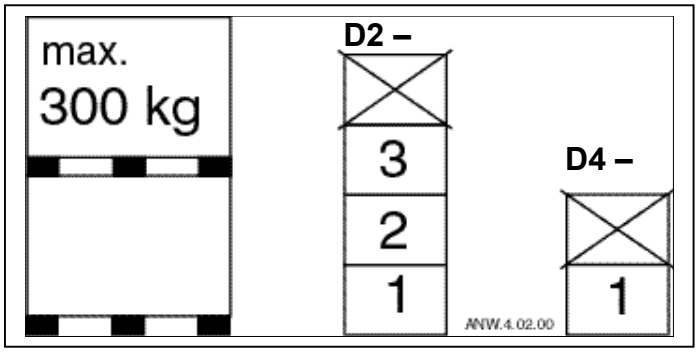
Delivery
Please check whether the delivery is correct and complete, deficiencies should be reported immediately in writing.

Standard Delivery:
- Suction and discharge shut-off valves
- Oil charge, oil sight glass
- Mounting kit
- Cooling fan (low-temperature models only)
- Motor protector
- Holding charge

Packaging
Compressors are individually packed and may be delivered on pallets depending on quantity and size. Cooling fans are delivered in separate cartons. Accessories may be mounted or delivered loose. Solenoid valves are never mounted.

Care must be taken when stacking, stacking higher than the recommended maximum can cause accidents. The packaging must be kept dry at all times!

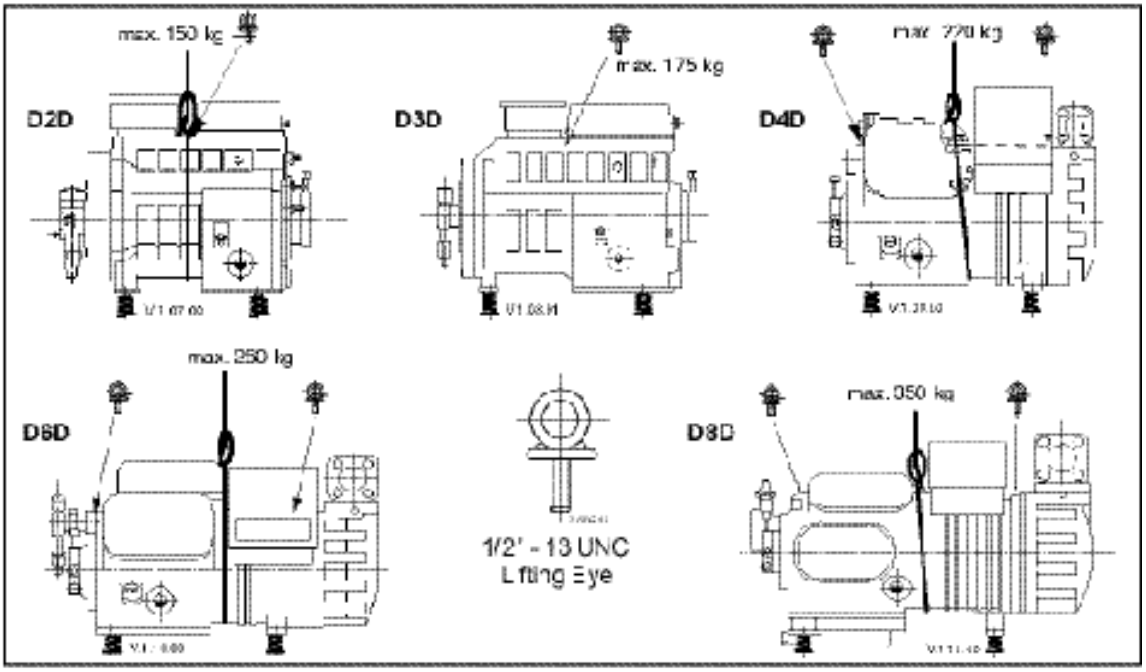
Transport
Compressors should only be moved with handling equipment suitable for use with the weight involved.



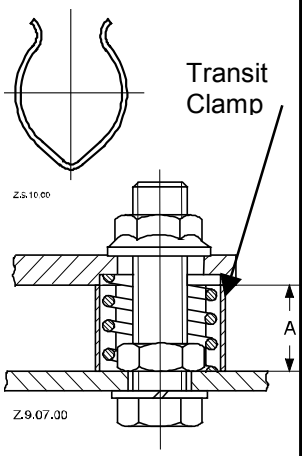
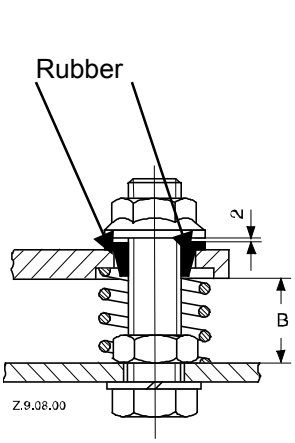
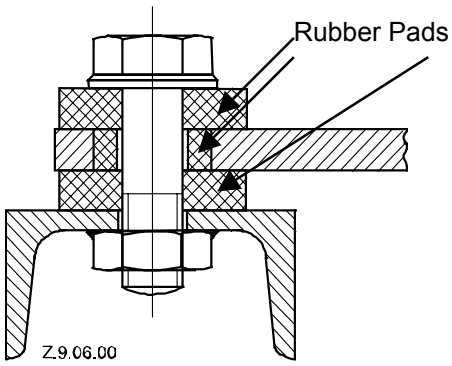
For safety reasons one or two lifting eyes should be fitted before moving a compressor (½" - 13 UNC)! Otherwise refer to the drawings on page 4 to see how to apply other lifting methods safely.
D3D compressors should not be lifted using a rope. The compressor shape can cause the rope to slip off.
In order to avoid refrigerant leaks or other damage the compressors should not be lifted by the service valves or other accessories.
Therefore using the lifting eye is the only recommended handling method.

Design Features
Each compressor is delivered with four coloured mounting springs. The springs allow compressor movement at start and stop and prevent vibration from being transferred into the compressor mounting frame during the running cycle. Springs are selected in accordance with the table on page 4.
Sometimes a compressor can be installed without using mounting springs it is a decision for the installer.
To ensure proper lubrication of moving parts the compressor should be installed horizontally on both axes.
TWIN compressors are fitted to the mounting rails using rubber pads. If the installation requires a very high level of vibration absorbing additional vibration absorbers can be fitted between the rails and the foundation.

Construction
Basic construction features can be seen in the pictures on page 5.
All compressors are fitted with Discus valve plates which cannot be dismantled. To maintain the high capacity of these compressors the correct valve-plate-to-body gasket must always be selected in case of exchange. The gasket thickness is marked on the gasket tab.
Each cylinder head has a plugged 1/8" - 27 NPTF tapped hole for connecting high-pressure switches.
These high-pressure switches must be calibrated and tested before putting the compressor into service, they must stop the compressor if the allowable pressure is exceeded.
The complete cylinder head is under discharge pressure.



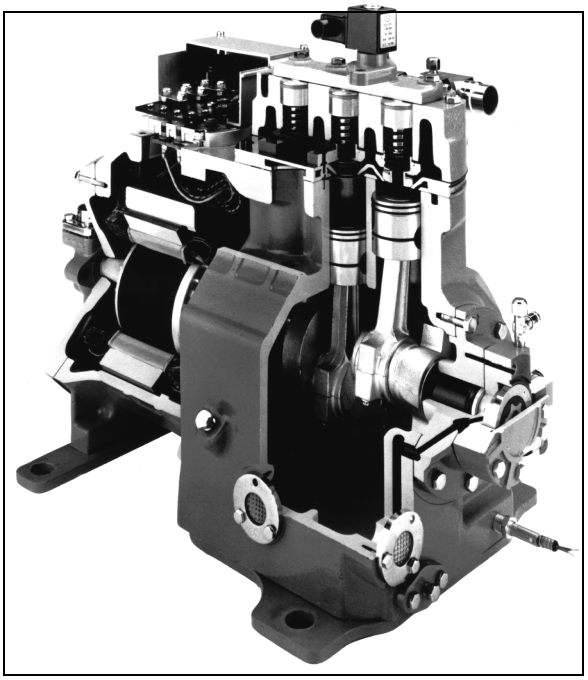
Mounting Springs

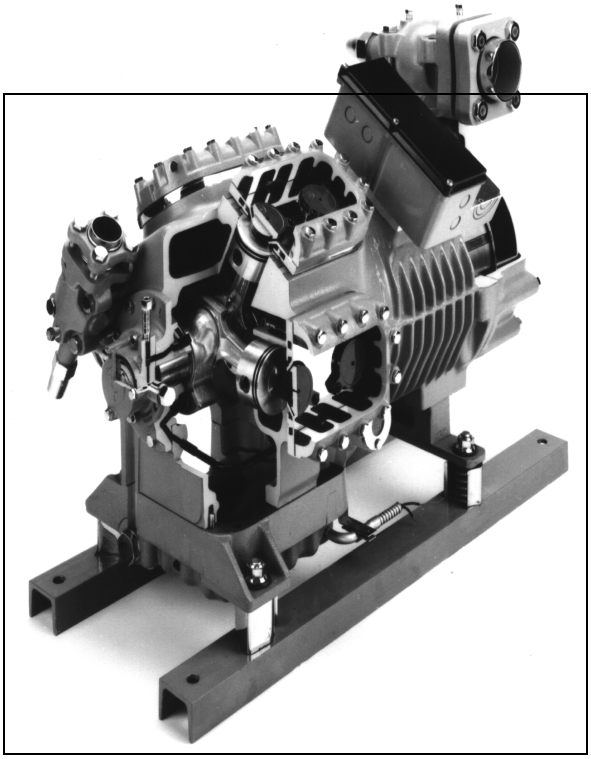
Motor-Compressor	Size	Size	Colour of Springs		Transport Position	Running Position
Type	A mm	B mm	motor end	compr. end		
D2DC-50X (500)	30	35	2 x maroon	2 x maroon		
D2DD-50X (500)	30	35				
D2DL-40X (400DC)	30	35				
D2DL-75X (750)	30	35				
D2DB-50X (500DC)	30	35				
D2DB-75X (750)	30	35				
D3DA-50X (500DC)	30	35				
D3DA-75X (750)	30	35				
D3DC-75X (750DC)	30	35				
D3DC-100X (1000)	30	35		2 x white		
D3DS-100X (1000DC)	30	35				
D3DS-150X (1500)	34	44	2 x yellow	2 x green		
D4DA-100X	34	44				
D4DF-100X (1000DC)	34	44				
D4DA-200X (2000)	34	44				
D4DH-150X	34	44				
D4DL-150X (1500DC)	34	44				
D4DH-250X(2500)	34	44	2 x black		Rubber Pads for TWIN Compressors	
D4DJ-200X	34	44				
D4DT-220X (2200DC)	34	44				
D4DJ-300X (3000)	34	44				
D6DH-200X	34	44				
D6DL-270X (2700DC)	34	44				
D6DH-350X (3500)	34	44	2 x blue			
D6DT-300X (3000DC)	48	44		2 x red		
D6DJ-300X	48	44				
D6DJ-400X (4000)	48	44				
D8DL-370X	48	51	2 x silver	2 x black		
D8DH-400X,500X (5000)	48	51				
D8DT-450X	48	51				
D8DJ-500X,600X (6000)	48	51				

A relief valve is installed in single-stage compressors with a displacement of over 50m^3/hr. The relief valve is dependant on differential pressure, it responds to a differential pressure of ~ 30.0 bar.

Maximum Operating Pressures

High pressure side	(HP)	28.0	bar
Low pressure side	(LP)	22.5	bar (static)





Cross-section view of D3D compressor with MODULOAD Cross-section view of D8D compressor

Internal Compressor Cooling
All Discus compressors are refrigerant-cooled with suction gas passing through and around the motor.

External Compressor Cooling
Depending on the application point some compressors need an additional fan, fan mounting instructions are given on page 18.
More specific application information can be found in the selection software.

DEMAND COOLING
"Demand Cooling" as the term implies means liquid refrigerant injection on demand. If a low-temperature R22 installation is required the following compressors can be equipped with a DEMAND COOLING accessory kit:

D2DL* - 400	D4DF * - 1000
D2DB* - 500	D4DL* - 1500
D3DA* - 500	D4DT* - 2200
D3DC* - 750	D6DL* - 2700
D3DS* - 1000	D6DT* - 3000

* The fifth digit of the model designation for D4D and D6D must be ≥ 3, for D3D ≥ 4.
Further detailed information about DEMAND COOLING can be found in brochures C6.4.1, C6.4.2 and C6.4.3.
Reminder: R22 is no longer allowed for new refrigeration systems in Europe.

Refrigeration Oils

All compressors using ester oil are marked with an “X”. Brand-new “X”-compressors can also operate using R22.

Copeland approve the following refrigeration oils:

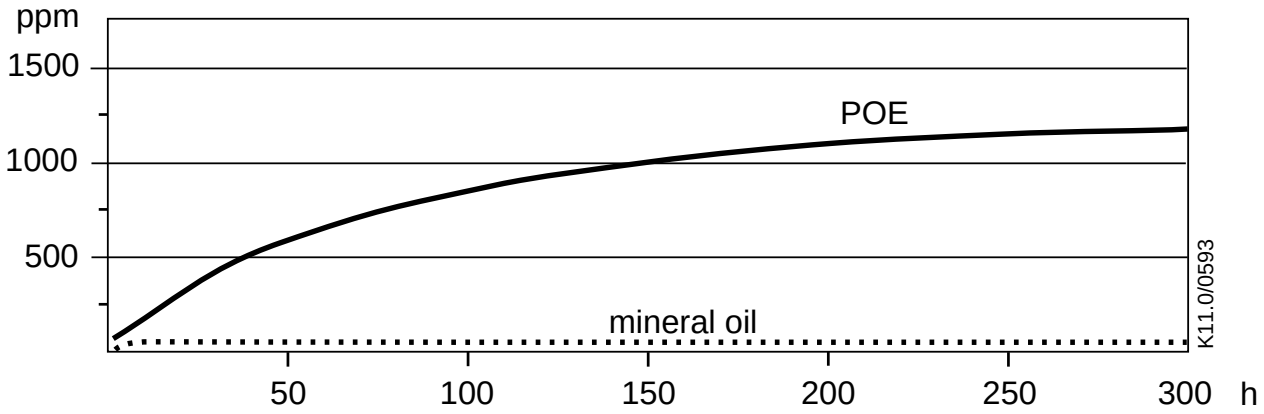
Ester Oils for R 134a, R407C and R404A / R507:

ICI	Emkarate RL 32 CF (original charge, also used for adjusting or recharging)
Mobil	EAL Arctic 22 CC (used for adjusting or recharging)

Limited refilling can be done with ICI Emkarate RL 32S.

Mineral Oils used for R 22

R. Fuchs	Fuchs Reniso KM 32
Sun Oil Co.	Suniso 3 GS
Texaco	Capella WF 32
Shell	Shell 22-12



The diagram compares the hygroscopic characteristics of Arctic 22 CC with mineral oil (moisture absorption in ppm at 25°C and 50% relative humidity).
HFC refrigerants shall only be used with polyolester oils, usually referred to as ester oils. Ester oil is sensitive to moisture and is hygroscopic. This sensitivity influences the chemical stability of the oil.
It is essential to fit a suitable filter drier which can reduce the residual moisture level to 50 ppm or less after several days running. Measured after a minimal operation of 48hours. In general ester oil requires clean and careful handling with minimum exposure to the atmosphere.

Oil Pumps

The oil pumps used for Discus compressors are independent of their rotating direction. They are designed to accommodate fittings for an OPS1, SENTRONIC oil safety system or a standard oil pressure switch.
For basic components and mounting instructions see pages 45 to 52.

Oil Pressure Switch

The oil pressure switch breaks the control circuit when the pressure difference between the oil pump outlet and the crankcase is too low. The switch must be properly adjusted and tamper proof. If the oil differential pressure drops below the minimum acceptable value the compressor will be stopped after a 120-sec. delay. After having solved the problem the control has to be reset manually.
Proper oil pressure safety control with an approved switch is a condition of warranty!

Specifications for electro-mechanical oil pressure switches are as follows:

Cut-out pressure:	0.63	±	0.14	bar
Cut-in pressure:	0.9	±	0.1	bar
Time delay:	120	±	15	sec.

The following oil pressure switches are approved:

Manufacturer	Type
ALCO CONTROLS	FD 113 ZU
Ranco	P 30-5845*
Ranco	P 30-5842*
Danfoss	MP 55
Penn	P 45 NCA-12
Penn	P 45 NCB-3
Penn	P 45 NAA-3
Penn	P 45 NCA-9104
Robertshaw	LG 21-2500
Robertshaw	PD 21-1006
Robertshaw	PD 21-7501
Robertshaw	PD 21-5001

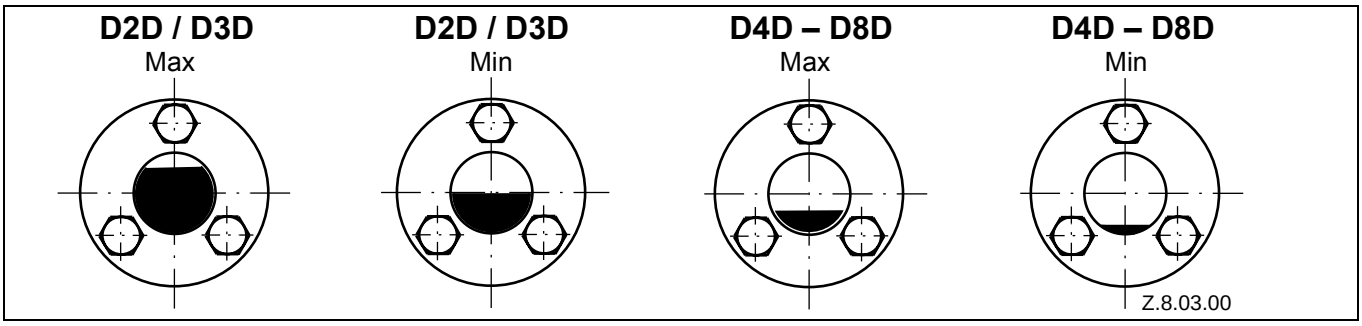
*Flare connection

Oil Circulation

Oil returns with the suction gases through a suction strainer and separates in the motor chamber reaching the crankcase by way of a pressure relief valve in the partition between motor housing and crankcase. This relief valve closes on compressor start-up due to the pressure difference arising between motor side and crankcase, thus slowing down pressure decrease in the crankcase over a certain period of time. It reduces the foaming of the oil/refrigerant mixture that would occur if the pressure decreased rapidly. The valve does not reopen until the pressure has been equalized by means of a crankcase ventilating valve. This second valve connects the crankcase and suction side cylinder head. It reduces the pressure difference by means of a very small bore in the plate of the valve so slowly that oil foams less and only limited oil/refrigerant foam is transferred to the oil pump.

Oil Level

All compressors are delivered with sufficient oil for normal operation (table on page 13). The optimum oil level should be checked by operating the compressor until the system is stable and then comparing the sight glass reading with the appropriate diagram below. The level can also be checked within 10 sec. of compressor shutdown. For D4D*...D8D*-compressors a higher oil level may be accepted when an oil regulator is in use because the oil separator will reduce excessive oil circulation.



Oil Pressure

Normal oil pressure is between 1.05 and 4.2 bar higher than crankcase pressure. Net oil pressure can be read by connecting two pressure gauges to the compressor and comparing the readings. One gauge should be con-

nected to the oil pump. The second gauge should be connected to the crankcase (T-fitting instead of plug on the compressor crankcase) or the suction service valve.
During irregular operating conditions (e.g. a blockage of the suction filter), the pressure measured at the suction shut-off valve of the compressor may differ widely from that measured at the crankcase therefore pressure drops have to be avoided.

Start-up

The compressor must be equipped according to our technical documentation considering the application intended, make sure of this before start-up. For information on accessories and other components see tables on pages 13, Bolt torque settings are listed on page 17. A compressor should never be operated beyond its approved application range, check by consulting the appropriate data sheet.
To avoid motor damage the compressor must neither be started, nor may high-potential testing be carried out under vacuum.
With the exception of Wolverine all gaskets should be oiled before fitting, *O-rings should also be oiled.

To achieve a long compressor service life the following conditions must be satisfied.

Leak Test

The suction shut-off valve and discharge shut-off valve on the compressor must remain closed during pressure testing to prevent air and moisture from entering the compressor. The test pressure (dried nitrogen) must not exceed 20.5 bar provided no other system component's pressure is lower, in this case the lower pressure is the test pressure.

Evacuation (Drying)

To achieve undisturbed operation the compressor shut-off valves are closed and the system is evacuated down to 0.3 mbar, then the compressor must be evacuated.
The factory holding charge is "dry air" and the compressor is under pressure (about 1 to 2.5 bar) in order to indicate the compressor is leak-proof.
Never open the compressor under excessive pressure and exert caution when plugs/caps are removed from the compressor in order to connect a pressure gauge or to fill with oil, the plug may explode off and oil can spurt out. Protective glasses and clothing should be worn.

Charging with Refrigerant

Charging the system with liquid refrigerant must be done through the charge fitting on the liquid receiver shut-off valve or through the liquid line. The use of a filter drier in the charging line is highly recommended.

System Cleanliness

During installation while brazing the system should be swept with an inert gas such as oxygen free nitrogen at a very low pressure to prevent the formation of oxidation within the pipe work and fittings. Only recommended brazing materials and components are suitable.
It is imperative that all impurities (dirt, oxidation, flux, etc.) are removed from the system before operation in order to avoid problems leading to breakdowns. Many of these impurities are so small that they can pass through a filter as fine as the one built into the suction side of the compressor. Blockages can occur in the suction filter and a high pressure drop can even cause damage. For this reason we strongly recommend the use of a large suction line filter (which causes only a minimal drop of pressure) for all installations which are to be assembled on site or in cases where the required cleanness cannot be guaranteed.

Electrical Information

Electrical Connection

Each compressor terminal box contains schematic and wiring diagrams. Before connecting the compressor make sure that the supply voltage, the phases and the frequency match the nameplate data.
Jumpers should be connected in accordance with the starting method used. See page 55 for details.

Three Phase Motors

All compressors can be started Direct-On-Line.

Star-Delta Start (Y/∆) - Motor Code E

If the supply voltage and the nominal voltage of the motor in ∆-connection are identical, the motor can also be started in star. In this case the jumpers must be removed. Trouble-free Y/∆-starting can only be guaranteed by fitting an unloaded start kit (see pages 13, 19 - 22).

Part-Winding Start (YY/Y) - Motor Code A

PWS motors contain two parallel windings (2/3 + 1/3) which are internally connected in star and operated in parallel. The windings can be brought on line separately using two contactors and a time delay (1 second ± 0.1). The 2/3 winding must be connected first (terminal studs 1-2-3). This reduces the mains loading by limiting the starting current..

It is imperative that both windings are connected in the same phase sequence.

Jumpers must be removed. Trouble-free operation of part-winding start can only be guaranteed by fitting an unloaded start kit (see pages 13, 19 - 22).

For DOL start the connection is made according to the wiring diagram in the terminal box using the jumpers provided.

Attention:

In order not to endanger the motor the connection of first part windings (terminals 1, 2 & 3) and second part windings (7, 8 & 9) to the mains (L1, L2 & L3) must be identical. The connection of the first and second part winding must be equiphase.

Part-Winding Motor (∆/∆) for the 8-cylinder motor-compressors - Motor Code B

From January 1994 onwards these compressors are equipped with a new part-winding motor. Compared with the Code A part-winding motor used before, the torque has been increased both for Direct-On-Line starting as well as for Part Winding Start. Additionally, in order to improve the starting characteristics, the entire motor winding has been subdivided in such a way that 3/5 of the entire motor current flows through terminals 1-2-3 and 2/5 through terminals 7-8-9.

In spite of the increased torque provided, the Locked Rotor Current (full winding) and the maximum operating current remain unchanged.

If the motor is supplied with power by terminals 1–2–3 (without bridges), a true part-winding start is put into effect. The starting current is 68% of the value for Direct-On-Line starting. When the motor is started via terminals 7-8-9 (without bridges), the starting current is 54%. The distribution of current to both windings is independent of the load:

Winding on terminals 1-2-3	60%
Winding on terminals 7-8-9	40%

Motor Protection - Motor Code "_W_"

All three-phase compressors with a "W" in the motor code have thermistor protection. The temperature dependant resistance of the thermistor (PTC resistance) is used to sense the winding temperature.

A chain of three thermistors (D2D & D3D) are connected in series and embedded in the motor-windings. The sensor connections are brought out to the terminal box and connected to an INT 69 release module. All D4D, D6D and D8D motors are equipped with two chains of three thermistors with a 5 minute time delay and connected to an INT 69TM. These electronic release modules switch a control relay depending upon the thermistor resistance.

The resistance of the thermistor chain(s) on a cold compressor should be ≤ 750 Ω.
The maximum test voltage for thermistors is 3 V.
The overload protector has a nominal voltage of 200 - 240 V / 1~ / 40-60 Hz.
Overload protectors for other voltages are available on request.

Protection Class of Terminal Box according to IEC 529. Cable glands can influence the protection class. Factory fitted cable glands reduce the protection class to IP 41.

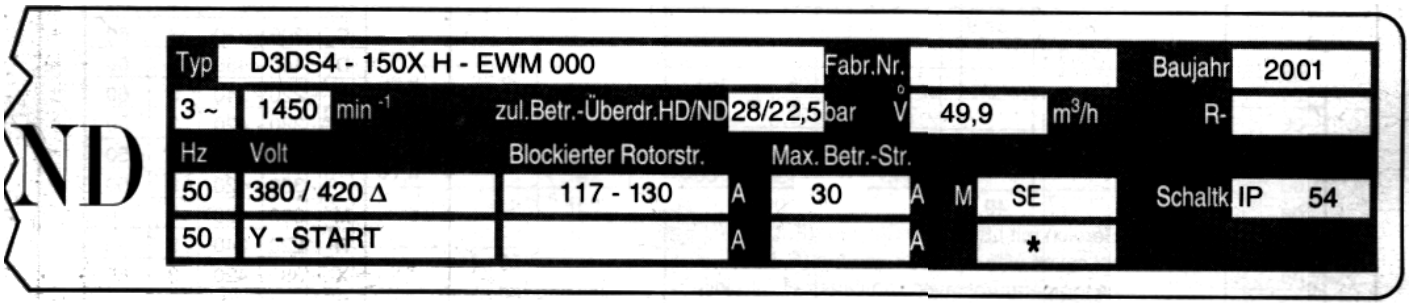
Model	Class	Option
D2D	IP 54	IP 56*
D3D	IP 54	IP 56*
D4D	IP 54	IP 56
D6D	IP 54	IP 56
D8D	IP 54	IP 56

*external; overload protection

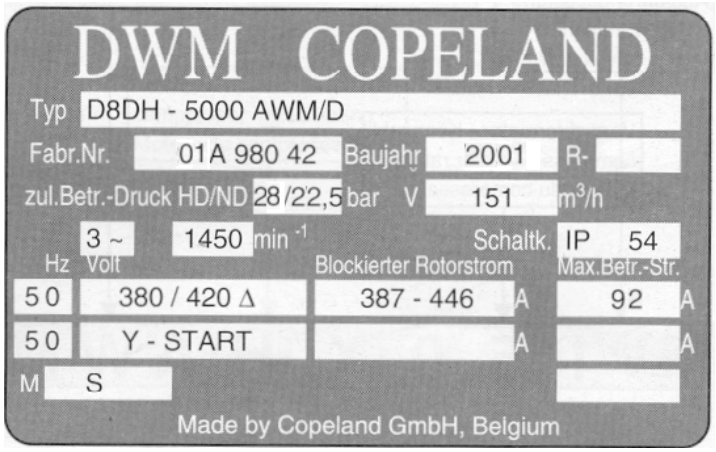
Nameplate Information

All important information for identification of the compressor is printed on the nameplate. The type of refrigerant used should be stamped on the nameplate by the installer. The date of production has been extended from showing merely the year. Now a letter is used to indicate the month as well: Jan. = A, Feb. = B, ...Dec. = L.
D2D and D3D compressors have a field marked with an * which is used to indicate the month of manufacturing.
The indication of the month is included in the serial numbers of the D4D - D8D compressors.
The mutual nameplate on TWIN compressors only indicates the model and the year of manufacturing. All other details should be taken from the individual compressor nameplates.

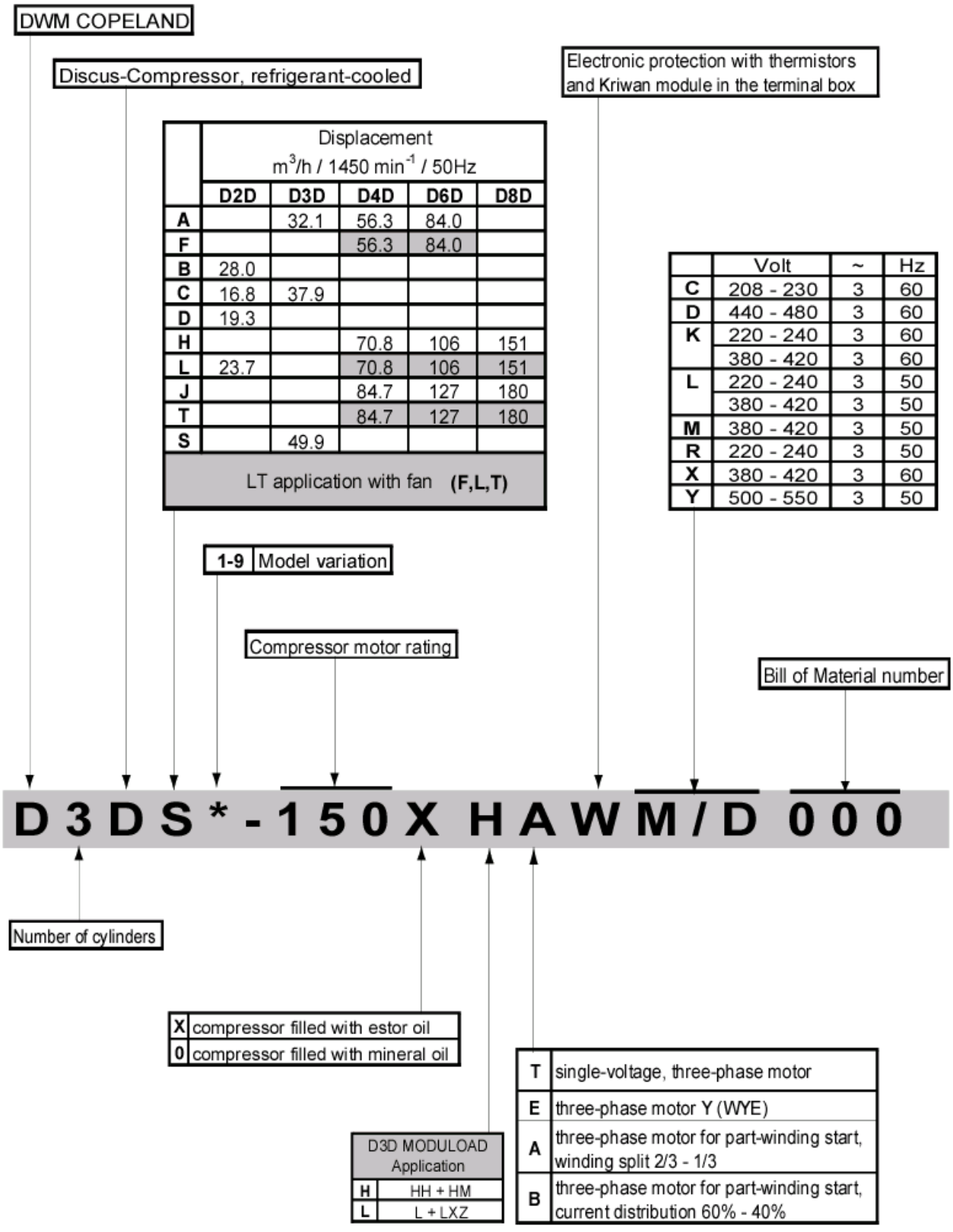
Nameplate D2D, D3D



Nameplate D4D - D8D



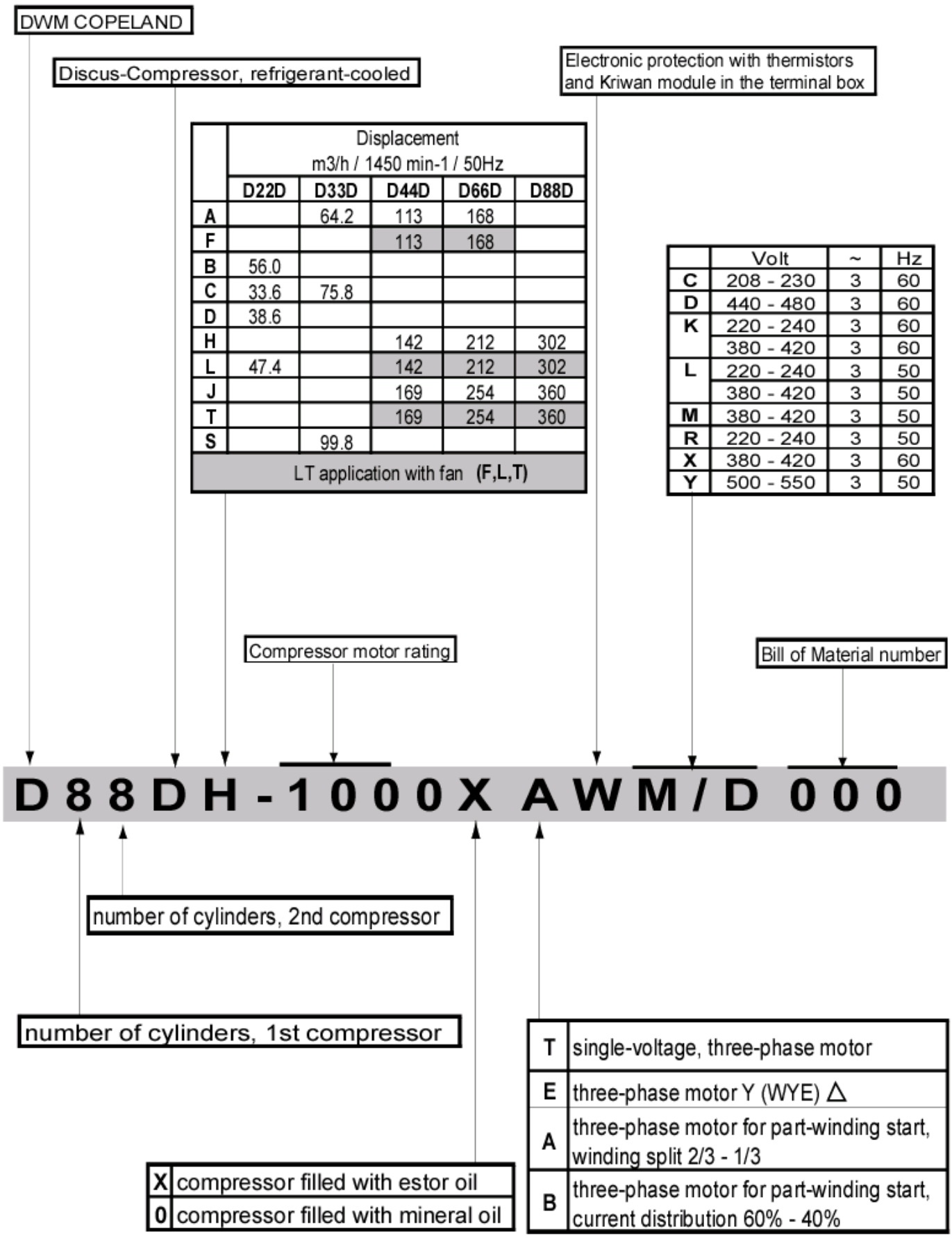
Model Designation Discus Compressor



	Displacement m^3/h / 1450 min^{-1} / 50Hz				
	D2D	D3D	D4D	D6D	D8D
A		32.1	56.3	84.0	
F			56.3	84.0	
B	28.0				
C	16.8	37.9			
D	19.3				
H			70.8	106	151
L	23.7		70.8	106	151
J			84.7	127	180
T			84.7	127	180
S		49.9			

	Volt	~	Hz
C	208 - 230	3	60
D	440 - 480	3	60
K	220 - 240	3	60
	380 - 420	3	60
L	220 - 240	3	50
	380 - 420	3	50
M	380 - 420	3	50
R	220 - 240	3	50
X	380 - 420	3	60
Y	500 - 550	3	50

Model Designation Discus Compressor TWIN



	Displacement m3/h / 1450 min-1 / 50Hz				
	D22D	D33D	D44D	D66D	D88D
A		64.2	113	168	
F			113	168	
B	56.0				
C	33.6	75.8			
D	38.6				
H			142	212	302
L	47.4		142	212	302
J			169	254	360
T			169	254	360
S		99.8			
LT application with fan (F,L,T)					

	Volt	~	Hz
C	208 - 230	3	60
D	440 - 480	3	60
K	220 - 240	3	60
	380 - 420	3	60
L	220 - 240	3	50
	380 - 420	3	50
M	380 - 420	3	50
R	220 - 240	3	50
X	380 - 420	3	60
Y	500 - 550	3	50

Technical Data on Accessories

Motor-Compressor	Capacity Control	Unloaded Start			Crank-case Heater (Watts)		Oil Charge	Suction Line Size (sweat)	Discharge Line Size (sweat)
		Solenoid Valve	Pilot Valve	Check Valve[1]					
	Optional						l		
D2DC-50X (500)	-	EVR 15	-	NRV 22S E 22	70	-	2.3	E 1 3/8"	E 7/8"
D2DD-50X (500)	-	EVR 15	-	NRV 22S E 22	70	-	2.3	E 1 3/8"	E 7/8"
D2DL-40X (400 DC)	-	EVR 15	-	NRV 22S E 22	70	-	2.3	E 1 3/8"	E 7/8"
D2DL-75X (750)	-	EVR 15	-	NRV 22S E 22	70	-	2.3	E 1 3/8"	E 1 1/8"
D2DB-50X (500 DC)	-	EVR 15	-	NRV 22S E 22	70	-	2.3	E 1 3/8"	E 7/8"
D2DB-75X (750)	-	EVR 15	-	NRV 22S E 22	70	-	2.3	E 1 3/8"	E 1 1/8"
D3DA-50X (500 DC)	MODULOAD	EVR 20	-	NRV 22S E 22	70	-	3.4	E 1 3/8"	E 7/8"
D3DA-75X (750)	MODULOAD	EVR 20	-	NRV 28S E 28	70	-	3.4	E 1 3/8"	E 1 1/8"
D3DC-75X (750 DC)	MODULOAD	EVR 20	-	NRV 28S E 28	70	-	3.4	E 1 3/8"	E 1 1/8"
D3DC-100X (1000)	MODULOAD	EVR 20	-	NRV 28S E 28	70	-	3.4	E 1 3/8"	E 1 1/8"
D3DS-100X (1000 DC	MODULOAD	EVR 20	-	NRV 28S E 28	70	-	3.4	E 1 3/8"	E 1 1/8"
D3DS-150X (1500)	MODULOAD	EVR 20	-	NRV 28S E 28	70	-	3.4	E 1 5/8"	E 1 1/8"
D4DA-100X	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.5	E 1 5/8"	E 1 1/8"
D4DF-100X (1000 DC	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.5	E 1 5/8"	E 1 1/8"
D4DA-200X (2000)	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.0	E 1 5/8"	E 1 1/8"
D4DH-150X	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	3.6	E 1 5/8"	E 1 1/8"
D4DL-150X (1500 DC)	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	3.6	E 1 5/8"	E 1 1/8"
D4DH-250X (2500)	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.0	E 2 1/8"	E 1 1/8"
D4DJ-200X	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.0	E 2 1/8"	E 1 3/8"
D4DT-220X (2200 DC	50%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.0	E 2 1/8"	E 1 3/8"
D4DJ-300X (3000)	50%	-	705 RA 001 VLC	NRV 28S E 28	100	-	4.0	E 2 1/8"	E 1 3/8"
D6DH-200X	33% + 66%	-	705 RA 001 VLC	NRV 28S E 28	100	-	4.3	E 2 1/8"	E 1 3/8"
D6DL-270X (2700 DC)	33% + 66%	-	705 RA 001 VLC	NRV 22S E 22	100	-	4.3	E 2 1/8"	E 1 3/8"
D6DH-350X (3500)	33% + 66%	-	705 RA 001 VLC	NRV 28S E 28	100	-	4.3	E 2 1/8"	E 1 3/8"
D6DT-300X (3000 DC	33% + 66%	-	705 RA 001 VLC	NRV 22S E 22	100[2]	200	7.4	E 2 1/8"	E 1 3/8"
D6DJ-300X	33% + 66%	-	705 RA 001 VLC	NRV 28S E 28	100[2]	200	7.4	E 2 1/8"	E 1 3/8"
D6DJ-400X (4000)	33% + 66%	-	705 RA 001 VLC	NRV 28S E 28	100[2]	200	7.4	E 2 1/8"	E 1 3/8"
D8DL-370X	33% + 66%	-	705 RA 001 VLC	NRV 28S E 28	-	200	7.7	E 2 5/8"	E 1 5/8"
D8DH-400X	33% + 66%	-	705 RA 001 VLC	NRV 35S E 42	-	200	7.7	E 2 5/8"	E 1 5/8"
D8DH-500X (5000)	33% + 66%	-	705 RA 001 VLC	NRV 35S E 42	-	200	7.7	E 2 5/8"	E 1 5/8"
D8DT-450X	33% + 66%	-	705 RA 001 VLC	NRV 28S E 28	-	200	7.7	E 3 1/8"	E 1 5/8"
D8DJ-500X	33% + 66%	-	705 RA 001 VLC	NRV 35S E 42	-	200	7.7	E 3 1/8"	E 1 5/8"
D8DJ-600X (6000)	33% + 66%	-	705 RA 001 VLC	NRV 35S E 42	-	200	7.7	E 3 1/8"	E 1 5/8"

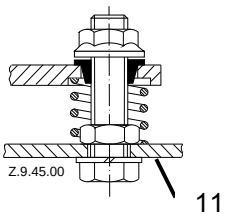
[1] for TWIN-compressors and in parallel compressor operation with enforced spring (Type NRV**H**…)

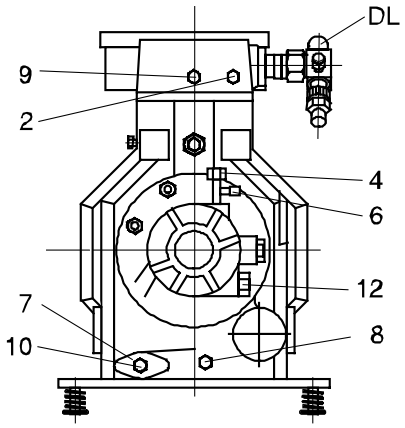
[2] possible as an addition, minimum is 200 W

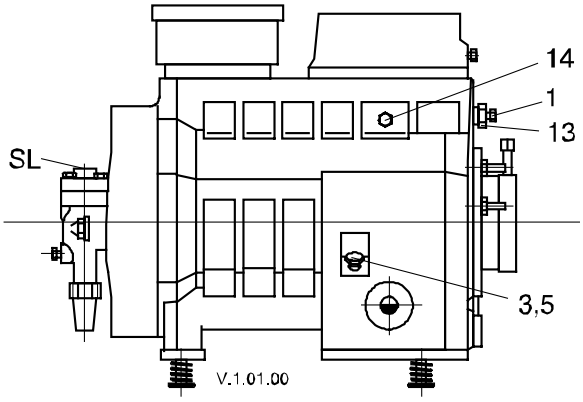
Discus Compressor Connections

D2D_3

D2DC3 - 500
D2DD3 - 500
D2DL3 - 400
D2DL3 - 750
D2DB3 - 500
D2DB3 - 750



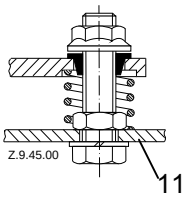


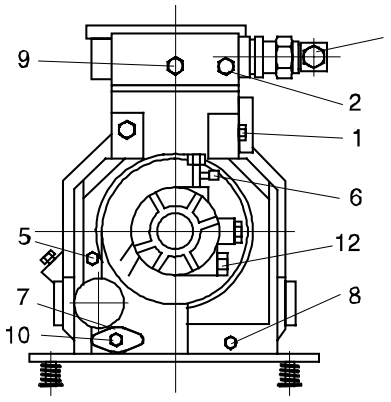


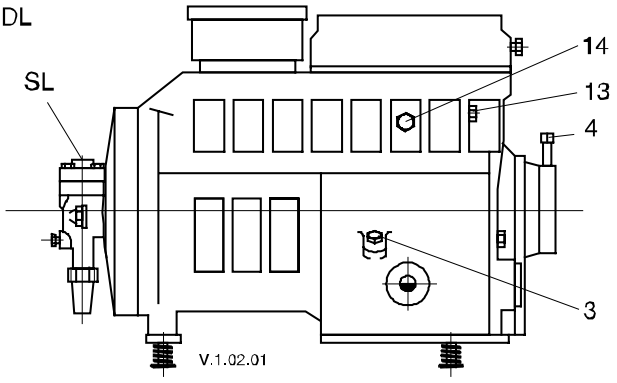
SL	suction line size	(sweat)	E	1⅜"	7	oil screen built-in			
DL	discharge line size	(sweat)	E See Page 13		8	sleeve (crankcase heater)	$^{3}/_{8}$"	- 18	NPSL
1	plug low-pressure connection		$^{1}/_{8}$"	- 27 NPTF	9	plug high-pressure connection	$^{1}/_{8}$"	- 27	NPTF
2	plug high-pressure connection		$^{1}/_{8}$"	- 27 NPTF	10	magnetic plug	$^{1}/_{8}$"	- 27	NPTF
3	plug oil charge		$^{1}/_{4}$"	- 18 NPTF	11	base mountings	E	14	mm
4	oil-pressure control H.P.		$^{1}/_{4}$"	6 mm	12	sensor connection / OPS1			
5	plug oil-pressure control L.P.		$^{1}/_{4}$"	- 18 NPTF	13	plug low-pressure connection	$^{3}/_{4}$"	- 14	NPTF
6	oil-pressure connection		$^{7}/_{16}$"	- UNF Schrader V.	14	plug low-pressure connection	$^{1}/_{8}$"	- 27	NPTF

D3D_4 / 5

D3DA4 - 500
D3DA4 - 750
D3DC4 - 750
D3DC4 - 1000
D3DS4 - 1000
D3DS4 - 1500



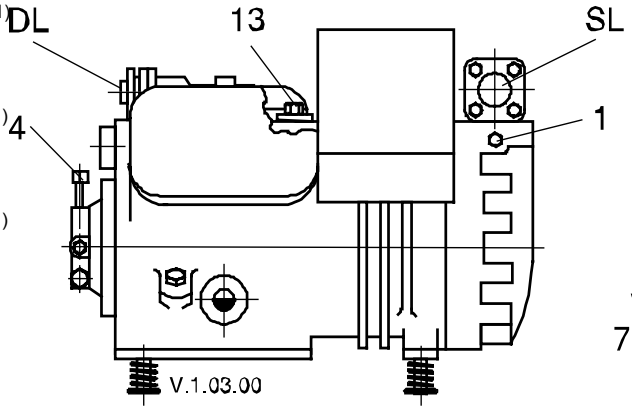


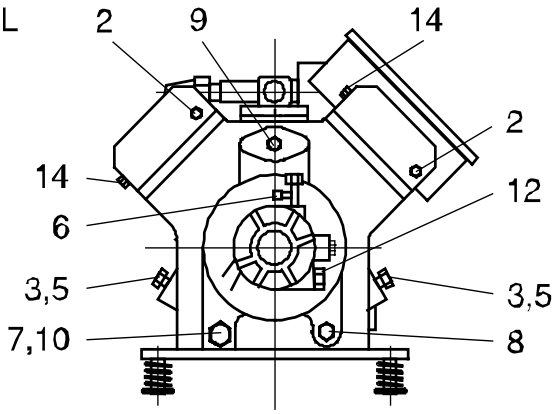


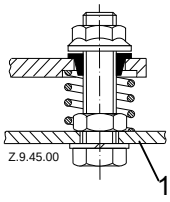
SL	suction line size	(sweat)	E See Page 13		7	oil screen built-in			
DL	discharge line size	(sweat)	E See Page 13		8	sleeve (crankcase heater)	$^{3}/_{8}$"	- 18	NPSL
1	plug low-pressure connection		$^{1}/_{8}$"	- 27 NPTF	9	plug high-pressure connection	$^{1}/_{8}$"	- 27	NPTF
2	plug high-pressure connection		$^{1}/_{8}$"	- 27 NPTF	10	magnetic plug	$^{1}/_{8}$"	- 27	NPTF
3	plug oil charge		$^{1}/_{4}$"	- 18 NPTF	11	base mountings	E	14	mm
4	oil-pressure control H.P.		$^{1}/_{4}$"	6 mm	12	sensor connection / OPS1			
5	plug oil-pressure control L.P.		$^{1}/_{4}$"	- 18 NPTF	13	plug low-pressure connection	$^{1}/_{2}$"	- 14	NPTF
6	oil-pressure connection		$^{7}/_{16}$"	- UNF Schrader V.	14	plug low-pressure connection	$^{1}/_{8}$"	- 27	NPTF

D4D_3 / 4

D4DA3 - 1000
D4DF3 - 1000 [1]
D4DA3 - 2000
D4DH3 - 1500
D4DL3 - 1500 [1]
D4DH3 - 2500
D4DJ3 - 2000
D4DT3 - 2200 [1]
D4DJ3 - 3000



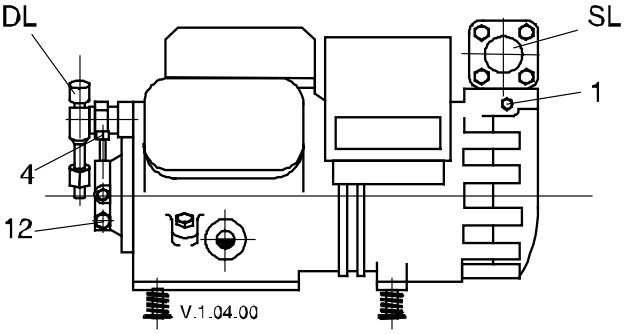


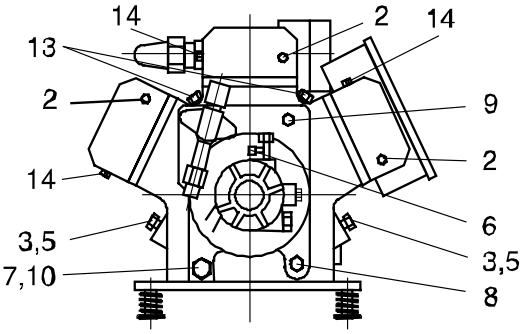


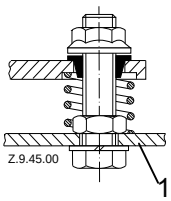
SL	suction line size	(sweat)	E	See Page 13	7	oil screen built-in			
DL	discharge line size	(sweat)	E	See Page 13	8	sleeve (crankcase heater)	1/2"	- 14	NPSL
1	plug low-pressure connection		1/8"	- 27 NPTF	9	plug high-pressure connection	1/8"	- 27	NPTF
2	plug high-pressure connection		1/8"	- 27 NPTF	10	magnetic plug	1"	- 16	UN
3	plug oil charge		1/4"	- 18 NPTF	11	base mountings		18	mm
4	oil-pressure control H.P.		1/4"	6 mm	12	sensor connection / OPS1	E X		
5	plug oil-pressure control L.P.		1/4"	- 18 NPTF	13	plug low-pressure connection	3/8"	- 18	NPTF
6	oil-pressure connection		7/16"	- UNF Schrader V.	14	plug high-pressure connection	1/8"	- 27	NPTF

D6D_3 / 4

D6DH3 - 2000
D6DL3 - 2700 [1]
D6DH3 - 3500





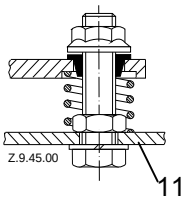


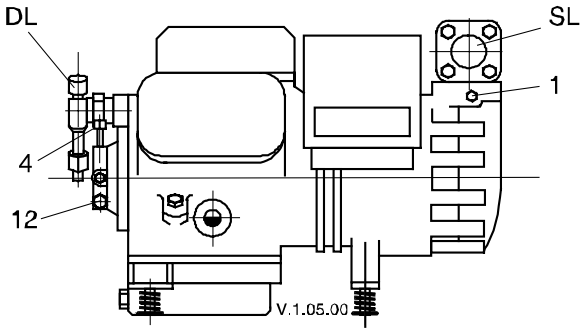
SL	suction line size	(sweat)	E	2⅛"	7	oil screen built-in			
DL	discharge line size	(sweat)	E	1⅜"	8	sleeve (crankcase heater)	1/2"	- 14	NPSL
1	plug low-pressure connection		1/8"	- 27 NPTF	9	plug high-pressure connection	1/8"	- 27	NPTF
2	plug high-pressure connection		1/8"	- 27 NPTF	10	magnetic plug	1"	- 16	UN
3	plug oil charge		1/4"	- 18 NPTF	11	base mountings		18	mm
4	oil-pressure control H.P.		1/4"	6 mm	12	sensor connection / OPS1	E X		
5	plug oil-pressure control L.P.		1/4"	- 18 NPTF	13	plug low-pressure connection	3/8"	- 18	NPTF
6	oil-pressure connection		7/16"	- UNF Schrader V.	14	plug high-pressure connection	1/8"	- 27	NPTF

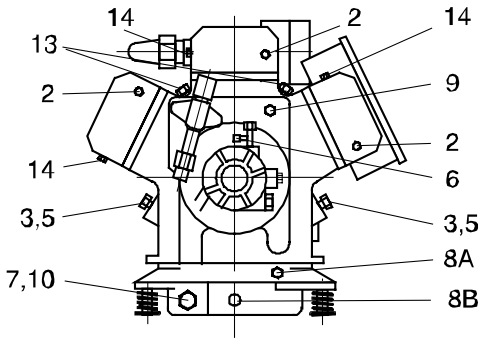
[1] illustration without fan and oil cooler

D6D_3 / 4

D6DT3 - 3000 [1)]
D6DJ3 - 3000
D6DJ3 - 4000



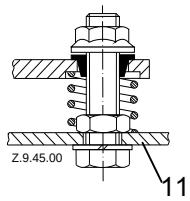


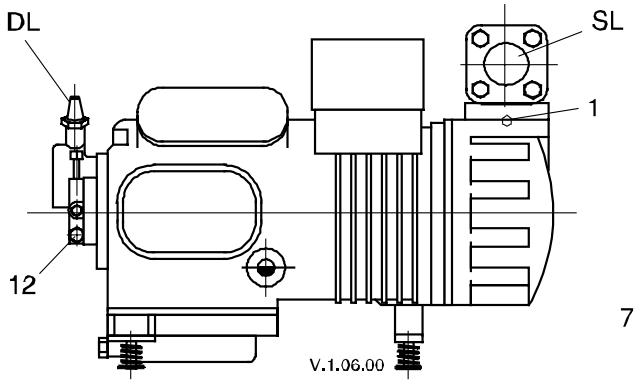


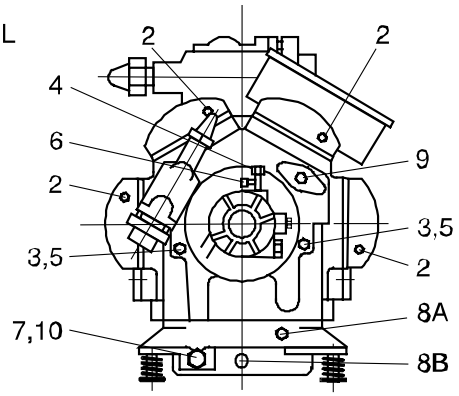
SL suction line size	(sweat) E 2⅛"	8A plug crankcase heater	½" – 14 NPTF
DL discharge line size	(sweat) E 1⅜"	8B bore crankcase heater	E ½"
1 plug low-pressure connection	⅛" - 27 NPTF	9 plug high-pressure connection	⅛" - 27 NPTF
2 plug high-pressure connection	⅛" - 27 NPTF	10 magnetic plug	1" - 16 UN
3 plug oil charge	¼" - 18 NPTF	11 base mountings	E - 18 mm
4 oil pressure control H.P.	¼" 6 mm	12 sensor connection / OPS1	
5 plug oil-pressure control L.P.	¼" - 18 NPTF	13 plug low-pressure connection	⅜" - 18 NPTF
6 oil-pressure connection	7/16" - UNF Schrader Valve	14 plug high-pressure connection	⅛" - 27 NPTF
7 oil screen built-in			

D8D_1

D8DL1.- 3700
D8DH1- 5000
D8DT1- 4500
D8DJ1- 6000







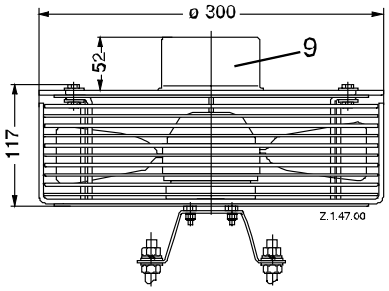
SL suction line size	(sweat) See Page 13	7 oil screen built-in	
DL discharge line size	(sweat) E 1⅝"	8A plug crankcase heater	½" - 14
1 plug low-pressure connection	⅛" - 27 NPTF	8B bore crankcase heater	E ½"
2 plug high-pressure connection	⅛" - 27 NPTF	9 plug high-pressure connection	⅛" - 27
3 plug oil charge	¼" - 18 NPTF	10 magnetic plug	1" - 16
4 oil-pressure control H.P.	¼" 6 mm	11 base mountings	E 18 mm
5 plug oil-pressure control L.P.	¼" - 18 NPTF	12 sensor connection / OPS1	
6 oil-pressure connection	7/16" - UNF Schrader Valve		

Tightening Torque (Nm)

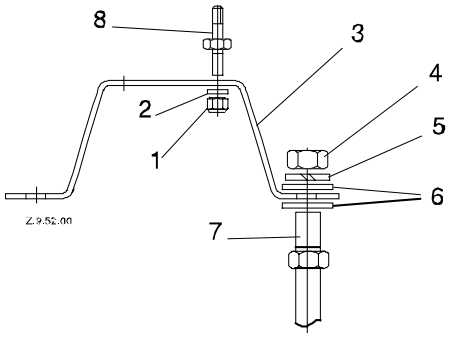
Suction shut-off valve	2D / 3D	1/2" - 13 UNC	63 - 76	19.0
Suction shut-off valve	4D / 6D	1/2" - 13 UNC	72 - 81	19.0
Suction shut-off valve	4D - 8D	5/8" - 11 UNC	122 - 149	23.8
Discharge shut-off valve	2D / 3D	5/16" - 18 UNC	29 - 30	12.7
Discharge shut-off valve	3D	1/2" - 13 UNC	63 - 76	19.0
Discharge shut-off valve	4D - 8D	1/2" - 13 UNC	72 - 81	19.0
Plug 1, 2, 9, 14	2D - 8D	1/8" - 27 NPTF	22 - 25	12.7
Plug 3, 5	2D / 3D	1/4" - 18 NPTF	45 - 50	17.5
Plug 3, 5	4D - 8D	1/4" - 18 NPTF	27 - 34	17.5
Plug 8 (crankcase heater)	2D / 3D	3/8" - 18 NPTF	55 - 60	22.0
Plug 13	2D	3/4" - 14 NPTF	60 - 70	26.6
Plug 13	3D	1/2" - 14 NPTF	45 - 55	27.0
Plug 13	4D / 6D	3/8" - 18 NPTF	55 - 60	27.0
Oil sight glass	2D / 3D	1/4" - 20 UNC	7 - 8	11.1
Oil sight glass	4D - 8D	1/4" - 20 UNC	4 - 5	11.1
Blind flange for oil sight glass	2D / 3D	1/4" - 20 UNC	14 - 17	11.1
Blind flange for oil screen	2D / 3D	5/16" - 18 UNC	27 - 30	12.7
Oil pump	2D - 8D	5/16" - 18 UNC	35 - 39	12.7
Magnetic plug	2D / 3D	1/8" - 27 NPTF	22 - 25	12.7
Magnetic plug	4D - 8D	1" - 16 UNC	136 - 203	25.4
Cylinder head	2D	3/8" - 16 UNC	55 - 60	14.2
Cylinder head	3D - 8D	3/8" - 16 UNC	58 - 69	14.2
Bottom plate	2D	3/8" - 16 UNC	50 - 54	14.2
Bottom plate	3D - 8D	3/8" - 16 UNC	58 - 69	14.2
Mounting foot	2D	3/8" - 16 UNC	50 - 54	14.2
Mounting foot	3D	3/8" - 16 UNC	58 - 69	14.2
Mounting foot	4D - 8D	3/8" - 16 UNC	40 - 45	14.2
Stator cover	2D	3/8" - 16 UNC	50 - 54	14.2
Stator cover	3D	3/8" - 16 UNC	58 - 69	14.2
Stator cover	4D - 6D	1/2" - 13 UNC	72 - 81	19.0
Stator cover	8D	1/2" - 13 UNC	122 - 149	19.0
Housing cover	2D	3/8" - 16 UNC	50 - 54	14.2
Housing cover	3D - 8D	3/8" - 16 UNC	58 - 69	14.2
Terminal stud	2D - 8D	10 - 32 UNF	3 - 4	9.0
Terminal stud	2D - 8D	1/4" - 28 UNF	5 - 6.5	11.0

Fan Installation

Additional Fan Type 75 Z (D2 – D8)

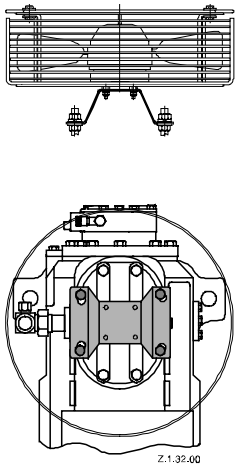


“A”

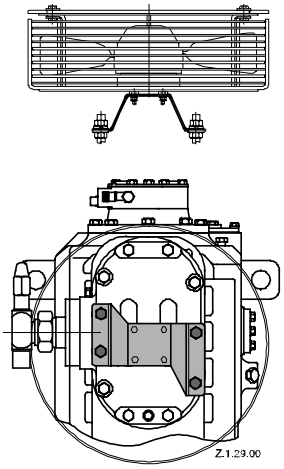


1 lock nut (1,2 – 2 Nm)
2 washer
3 bracket
4 nut (40 – 48 Nm)
5 spring washer
6 washer
7 stud
8 bolts for fan
9 terminal box (single-phase motors only)

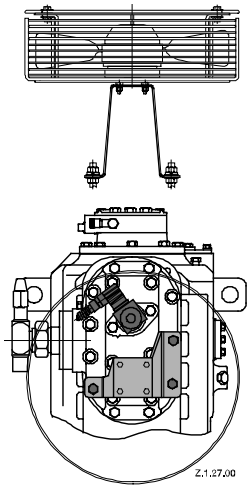
D2D



D3D

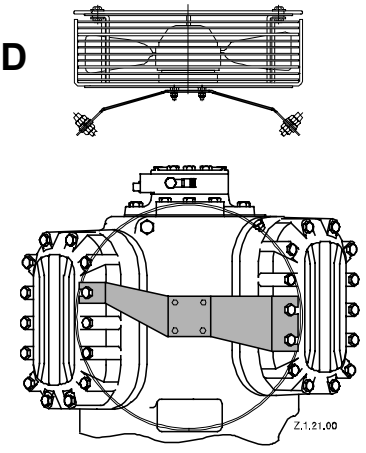


D3D[1)]

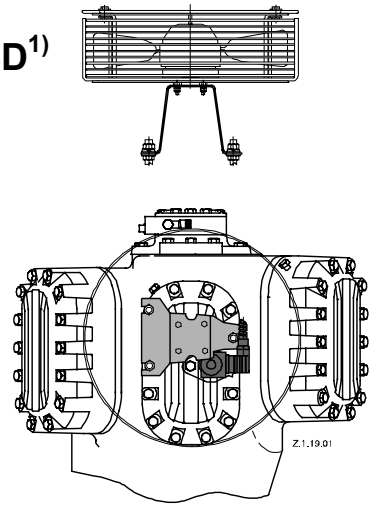


[1)] with capacity control

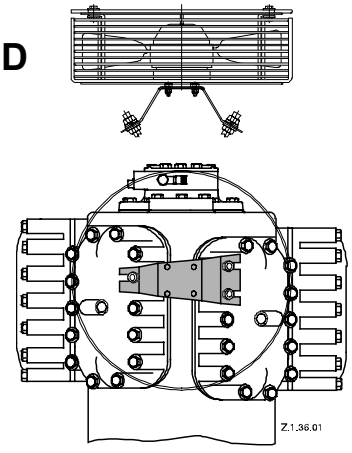
D4D



D6D[1)]



D8D



Unloaded Start

With direct starting the motor of a compressor is switched directly into the mains by means of a switch. The resulting breakaway starting current amounts to multiple times the rated motor current, without consideration being given to transient phenomena. In the case of high-powered motors the breakaway starting currents become so large that they lead to disruptive voltage dips in the mains. The compressors that are subject to current limitation must therefore by all means be equipped with starting load reduction to guarantee perfect starting even when the voltages amount to less than approximately 85% of the voltage on the nameplate.

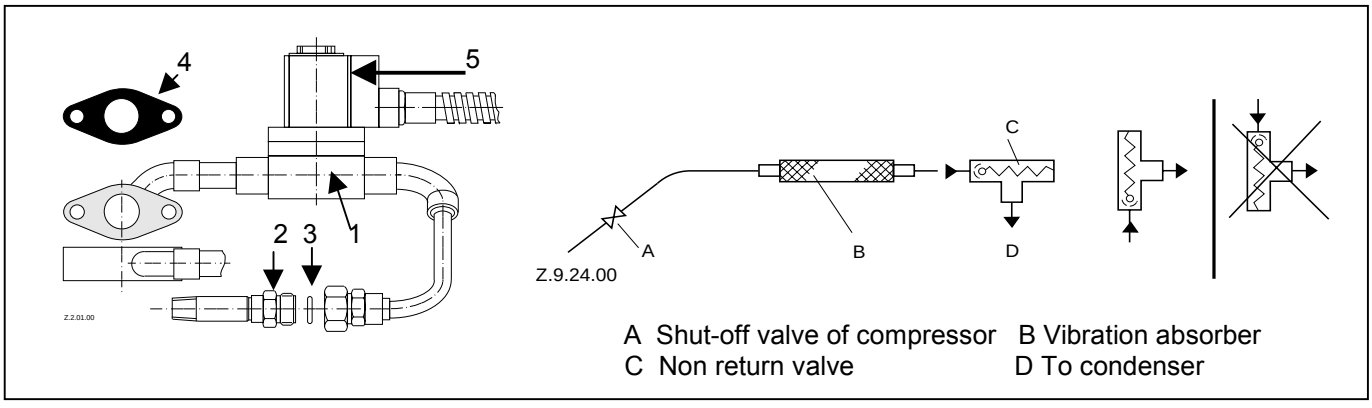
D2D and D3D Compressors

Unloaded start consists of a very short bypass line that connects the high-pressure side of the compressor to the suction side. A solenoid valve is installed in this by-pass line. When the compressor is switched on, the solenoid valve opens the bypass line and holds it open during the starting phase. The refrigerant vapour is short-circuited without any significant increase in pressure, and the motor is unloaded. After completion of the starting procedure, i.e. After : energizing of the second part-winding or changeover from star to delta or short-circuiting of starting resistors the solenoid valve is de-energised closing off the bypass line.

A non-return valve must be installed in the discharge line to prevent the refrigerant from flowing back from the condenser to the suction side using the bypass line as shown in the drawings below.

A retrofit kit is also available. This consists of the following parts:

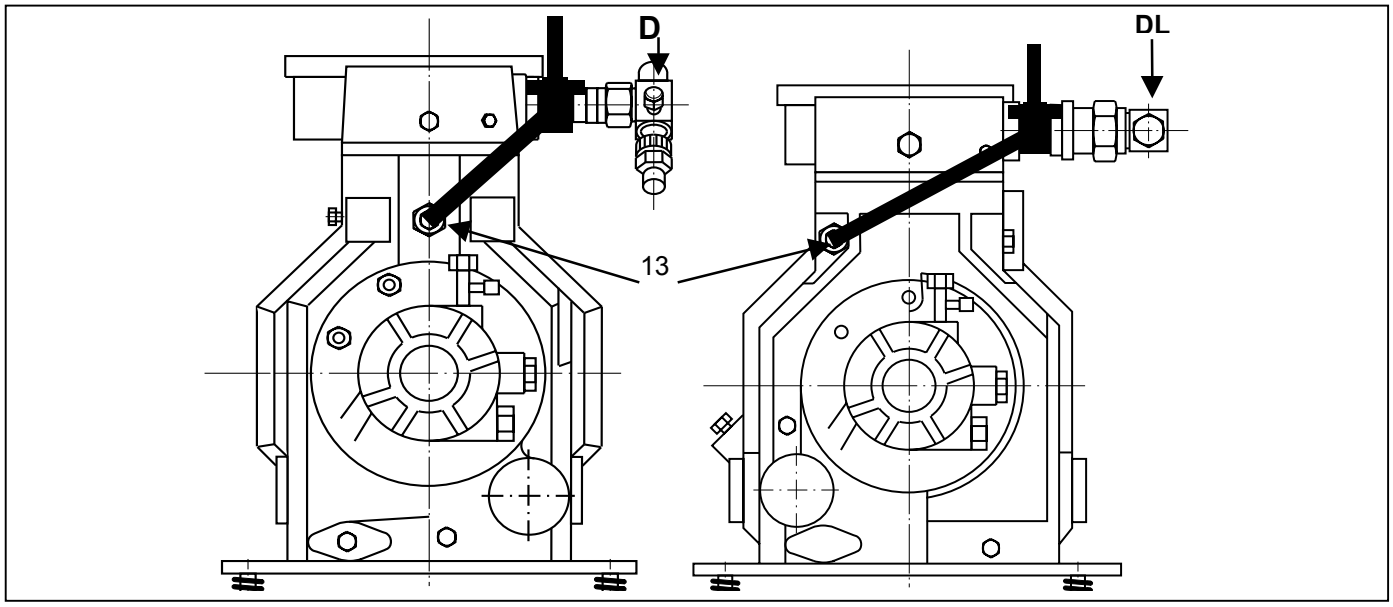
1 x	pipe assembly and valve body (1)
1 x	Rotalock connection (2)
1 x	Rotalock seal (3)
1 x	gasket - flange to cylinder head (4)
1 x	gasket - flange to Rotalock valve (4)
1 x	solenoid valve coil (5)
1 x	check valve
2 x	screws ½ " 13 UNC X 2 ¾"



Mounting

Remove plug (Item 13 over page) and fit the Rotalock connection. Remove the Rotalock flange (DL) adapter from the cylinder head, discard the gasket and clean the gasket surfaces. Fit the pipe and valve assembly using the gaskets and mounting hardware supplied in the kit. Fit the discharge line check valve as shown in the drawing. Leak test thoroughly.

For further information please see tables on page 13.



D4D – D8D Compressors

When a compressor is ordered with unloaded start, it is supplied with the special cylinder head and control piston fitted. The control valve and coil are supplied loose, and must be fitted before the compressor is put into operation. The unloaded start is factory fitted as shown in the illustrations on page 21.

Coils with the following voltage variants (± 10% DC, +10% - 15% AC) are available for the solenoid:

Voltage	50 Hz	60 Hz	DC
220V	X	X	-
110V	X	X	-
24V	X	X	X

A retrofit kit is also available. The kit consists of

1 x cylinder head for unloaded start **"U"**
1 x valve plate and gasket kit
1 x solenoid valve assembly (No 705 RA 001)
2 x mounting screws

The kit does not contain the valveplate to body gasket, this must be ordered separately. The gasket size is marked on the gasket itself.

Mounting

In principle unloaded start can be fitted on any cylinder bank. However, the options available are more limited when the compressor is fitted with capacity control and/or oil cooler. Capacity control must be fitted on specified cylinder banks only. Remove the shipping plate and fit the gasket and solenoid valve assembly. Fit the discharge line check valve as shown in the drawing. A non-return valve must be installed in the discharge line to prevent the refrigerant from flowing back from the condenser to the suction side using the bypass line.
For further information please see page 13.

D2D – D8D

Non-Return Valve

The check valves are to be selected in accordance with the table overpage and mounted as shown in the illustration.

This selection facilitates quiet operation over a wide application range without chattering noises caused by gas pulsation. If noise should occur during normal or partial load operation, it is necessary to match the check valve to the operating conditions.

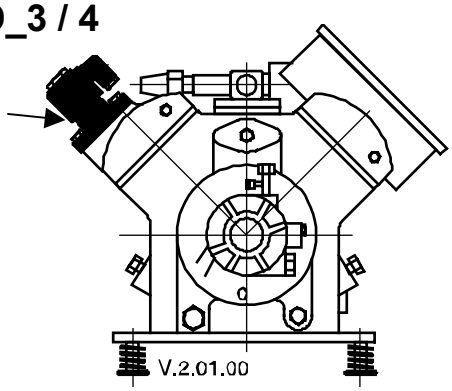
Mounting Position Of Non-Return Valve

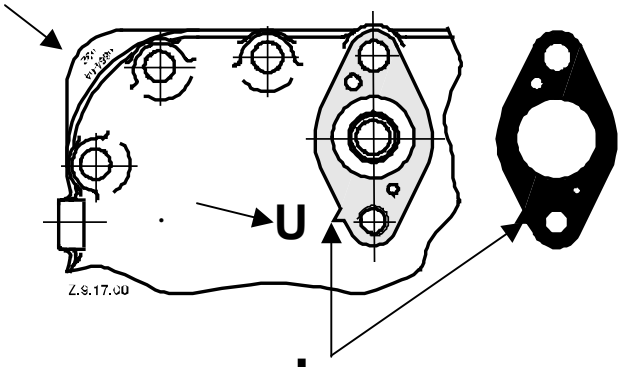
See drawing on previous page.

Compressor	Non-Return Valve	Compressor[1)]	Non-Return Valve
D2D	NRV 22S $_{E}$ 22	D22D	2 X NRVH 22S $_{E}$ 22
D3DA - 500 / 50X	NRV 22S $_{E}$ 22	D33DA - 1000 / 100X	2 X NRVH 22S $_{E}$ 22
D3D	NRV 28S $_{E}$ 28	D33D	2 X NRVH 28S $_{E}$ 28
D4D	NRV 22S $_{E}$ 22	D44D	2 X NRVH 22S $_{E}$ 22
D4DJ	NRV 28S $_{E}$ 28	D44DJ	2 X NRVH 28S $_{E}$ 28
D6DL / T	NRV 22S $_{E}$ 22	D66DL / T	2 X NRVH 22S $_{E}$ 22
D6DH / J	NRV 28S $_{E}$ 28	D66DH	2 X NRVH 28S $_{E}$ 28
D8DL	NRV 28S $_{E}$ 28	D88DL	2 X NRVH 28S $_{E}$ 28
D8DT	NRV 28S $_{E}$ 28	D88DT	2 X NRVH 28S $_{E}$ 28
D8DH	NRV 35S $_{E}$ 42	D88DH	2 X NRVH 35S $_{E}$ 22
D8DJ	NRV 35S $_{E}$ 42	D88DJ	2 X NRVH 35S $_{E}$ 28

1) also for parallel compressor operation

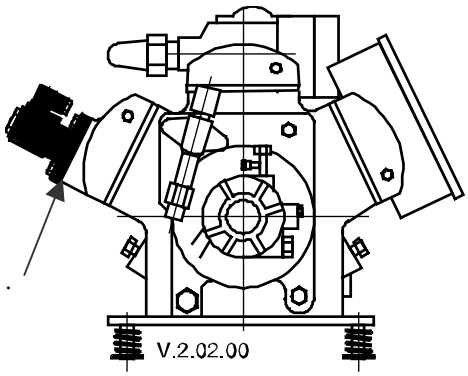
D4D_3 / 4



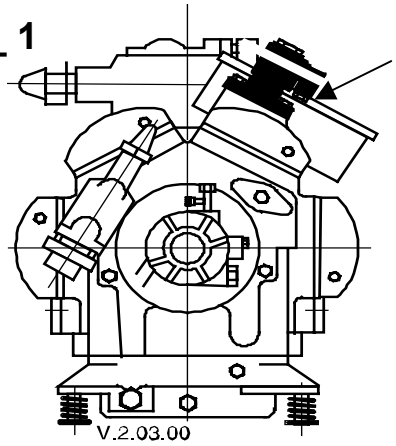


. written “U” for unloaded start **!**

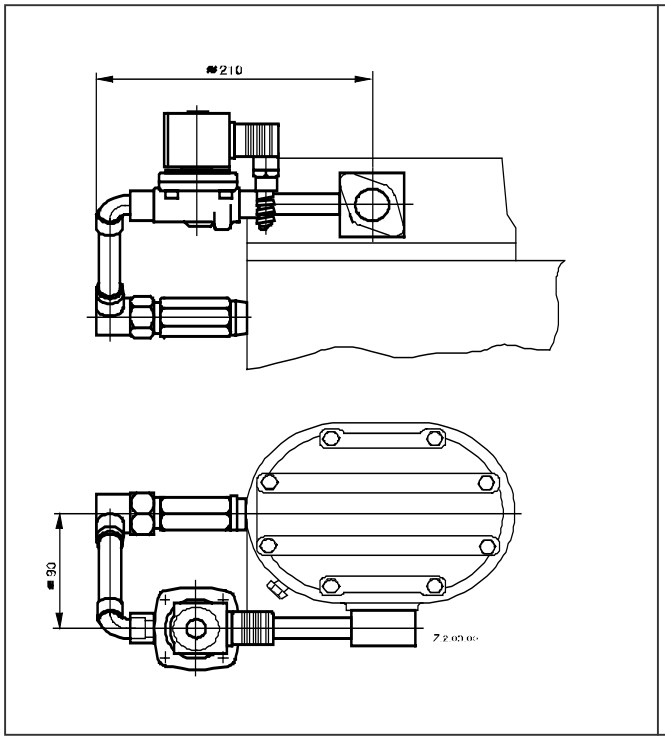
D6D_ 3 / 4

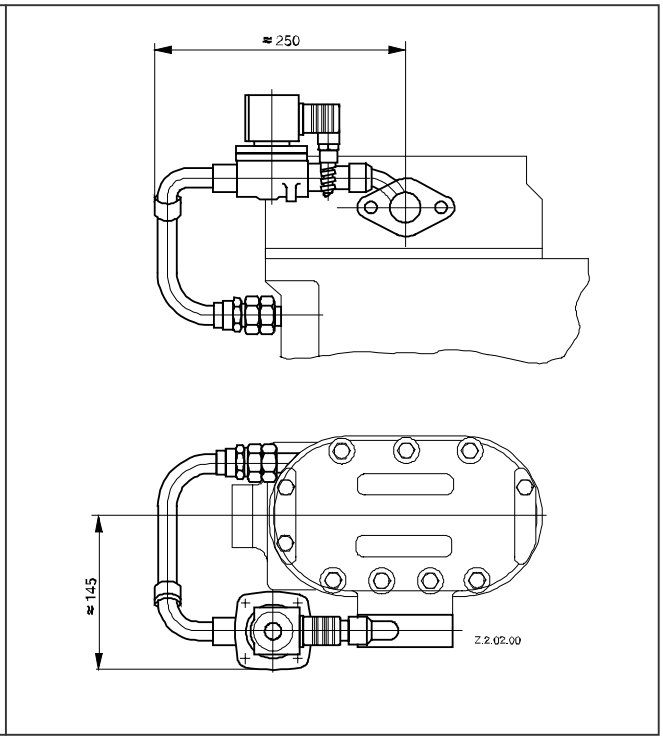


D8D_ 1

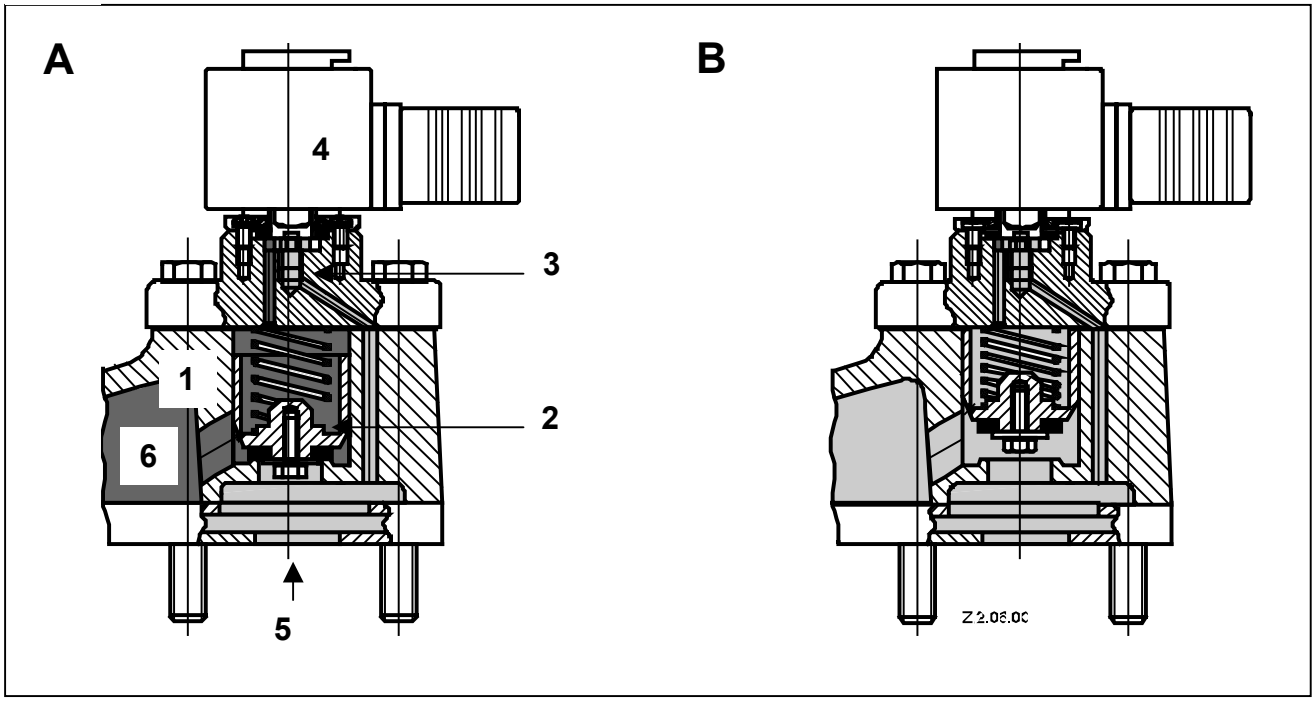


D2D **D3D**





D4D*, D6D*, D8D*



A standard operation
B unloaded start operation

1 special cylinder head
2 spring loaded control piston
3 valve

4 solenoid
5 low side in the cylinder head
6 high side in the cylinder head

Capacity Control

All Discus model compressors can be equipped with capacity control. When the compressor is operated using capacity control the application range changes.

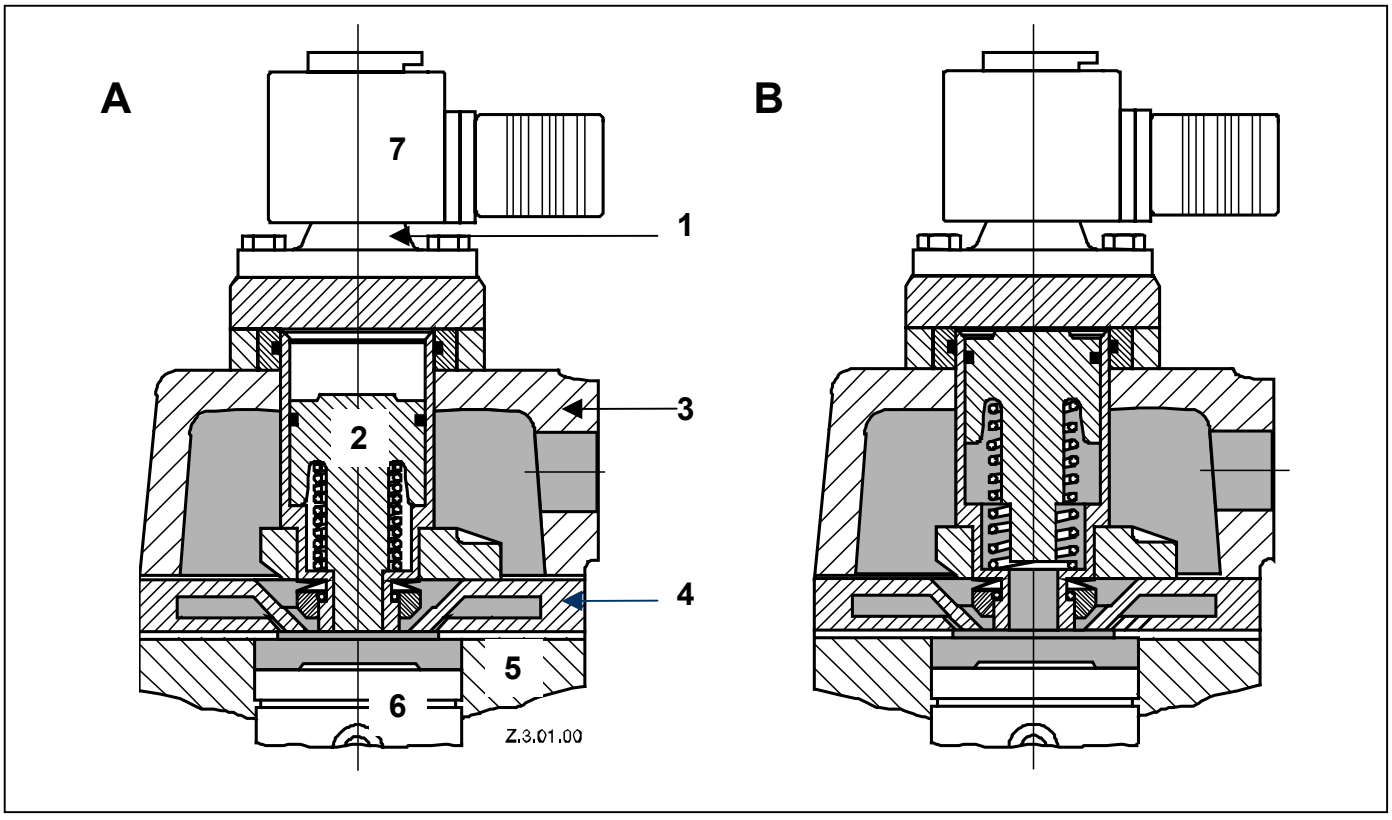
To prevent transport damage the solenoid valves are supplied loose with the compressor, and the cylinder head is fitted with a shipping plate. The shipping plate and the gasket must be removed. Then the solenoid valve must be mounted using the gasket supplied. Torque to 58-69 Nm.
A retrofit kit is available. The kit does not contain the valve-plate-to- body gasket. This must be ordered separately. The gasket thickness is marked on the gasket itself ("X"). When ordering please state refrigerant.
For conversion kits see spare parts list, the kit contains mounting instructions and a complete bill of material.

Moduload for D3D Compressor

Moduload is an efficient capacity control based on the principle of adjustable clearance volume. The capacity control kit will reduce both the refrigeration capacity and the power input in almost the same proportion, which ensures optimum performance even in part load.
The solenoid valve may be energized by a thermostat, a pressure control switch or a multiple contact switch. When the solenoid valve is energized the three control pistons are loaded with the evaporator pressure via the opened connection to the suction side. The spring power pushes the three control pistons upwards, thus increasing the clearance volume.

There are two different versions of Moduload:
1. Suitable for HFC refrigerants R134a, R407C and R404A / R 507 and the according refrigerant oils approved by COPELAND.;
2. Suitable for R22 and for the approved refrigerant oils

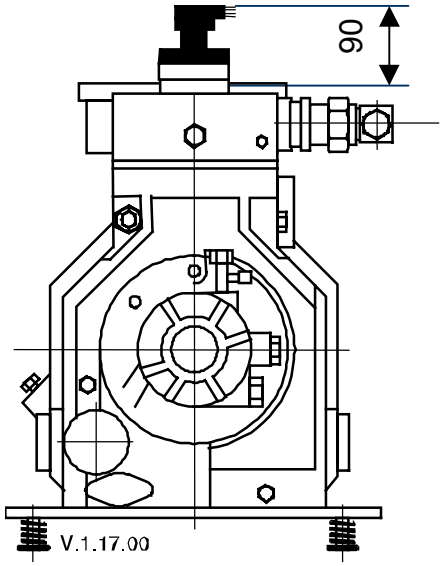
MODULOAD should not be fitted on compressors with DEMAND COOLING.



A full-load operation
B part load operation
1 control valve
2 control piston
3 cylinder head
4 valve plate
5 compressor body
6 piston
7 solenoid coil

Selection of Capacity Control

Compressor with MODULOAD	Refrigerant	Range	Diagram	Compressor with MODULOAD	Refrigerant	Range	Diagram
D3DA*-50XH D3DC*-75XH D3DS*-100XH	R 134a	HM	1	D3DA*-50X L D3DC*-75X L D3DS*-100X L	R404A	LXZ	4
D3DA*-75XH D3DC*-100XH D3DS*-150XH	R 134a	HH	2	D3DA*-750H D3DC*-1000H D3DS*-1500H	R 22	HM	5
D3DA*-75XH D3DC*-100XH D3DS*-150XH	R 404A	HM	3	***DISCUS***			



Voltages of the solenoid valve coil:
24 V D.C.
24 V / 1~ / 50 Hz
120 V / 1~ / 50 / 60 Hz
208-240 V / 1~ / 50 / 60 Hz
protection class: IP 55 (evaluation according to IEC 34)

The diagrams show the application range while operating with capacity control, remaining refrigerant capacity and power input at 25°C suction gas temperature.

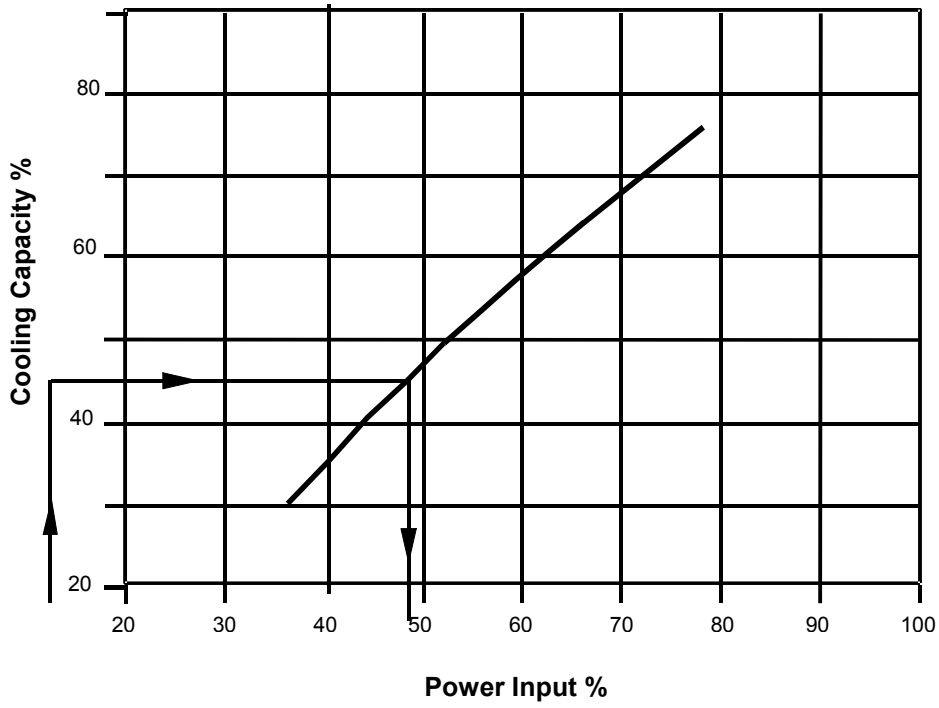
Cooling capacity (part load) = cooling capacity (full load) x factor

Power input (part load) = power input (full load) x factor

Tentative Data

The diagrams show the application range while operating with capacity control, remaining refrigerant capacity and power input at 25°C suction gas temperature.

Diagram 1



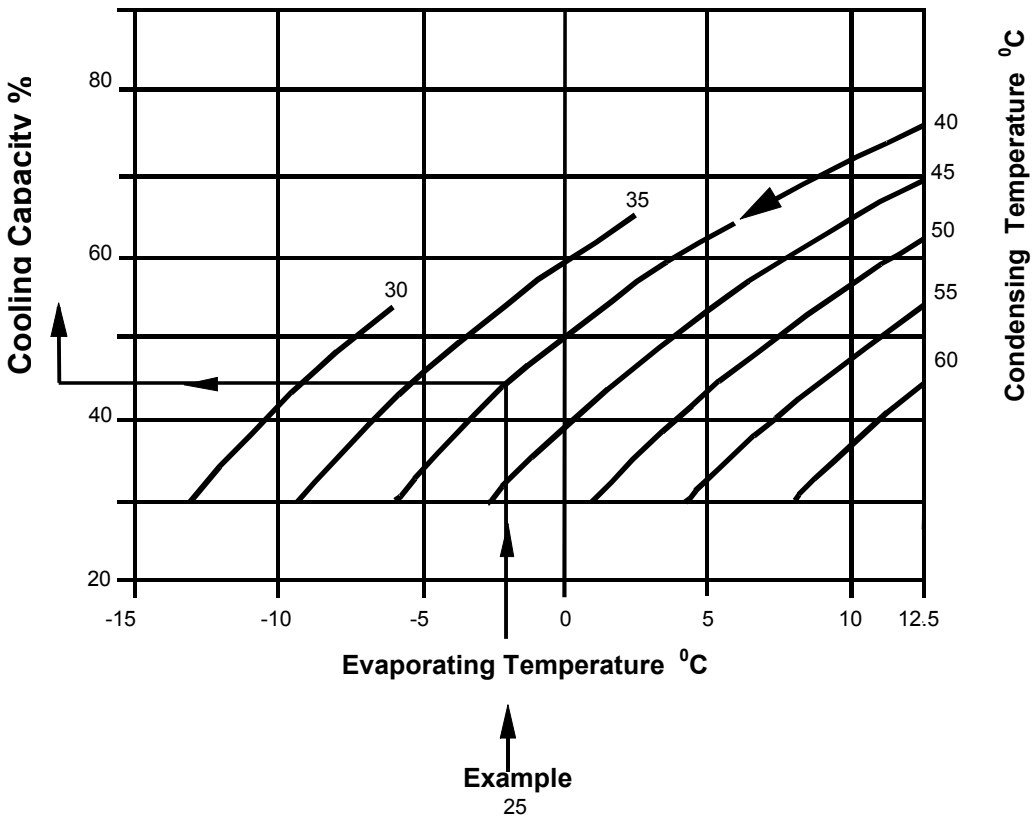
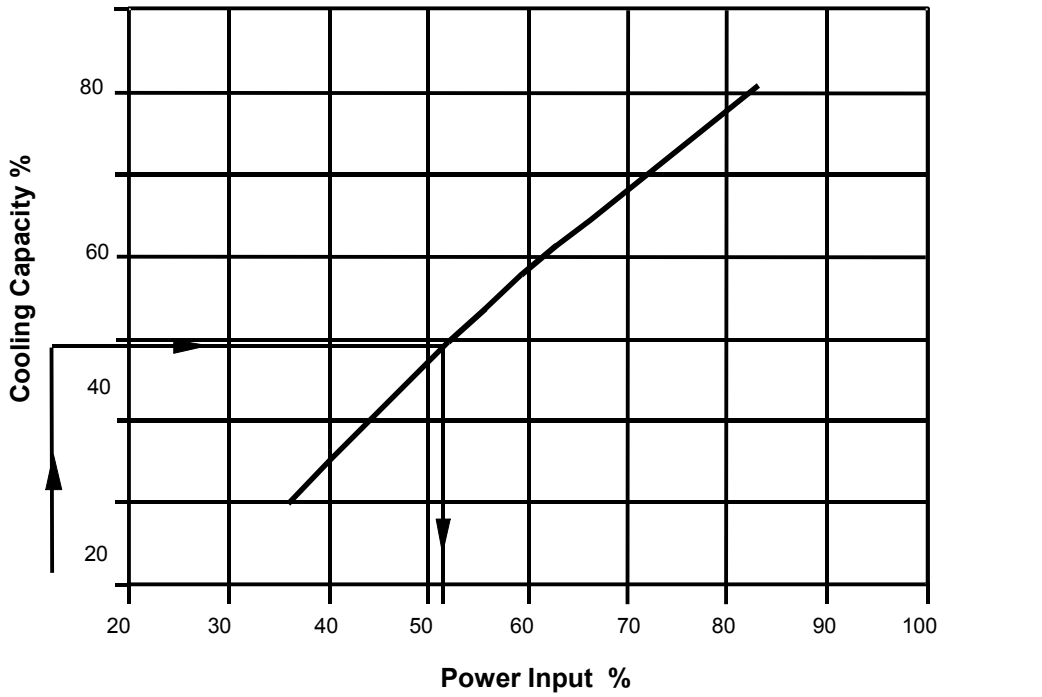


Diagram 2


Cooling Capacity %
80
60
40
20
20
30
40
50
60
70
80
90
100
Power Input %

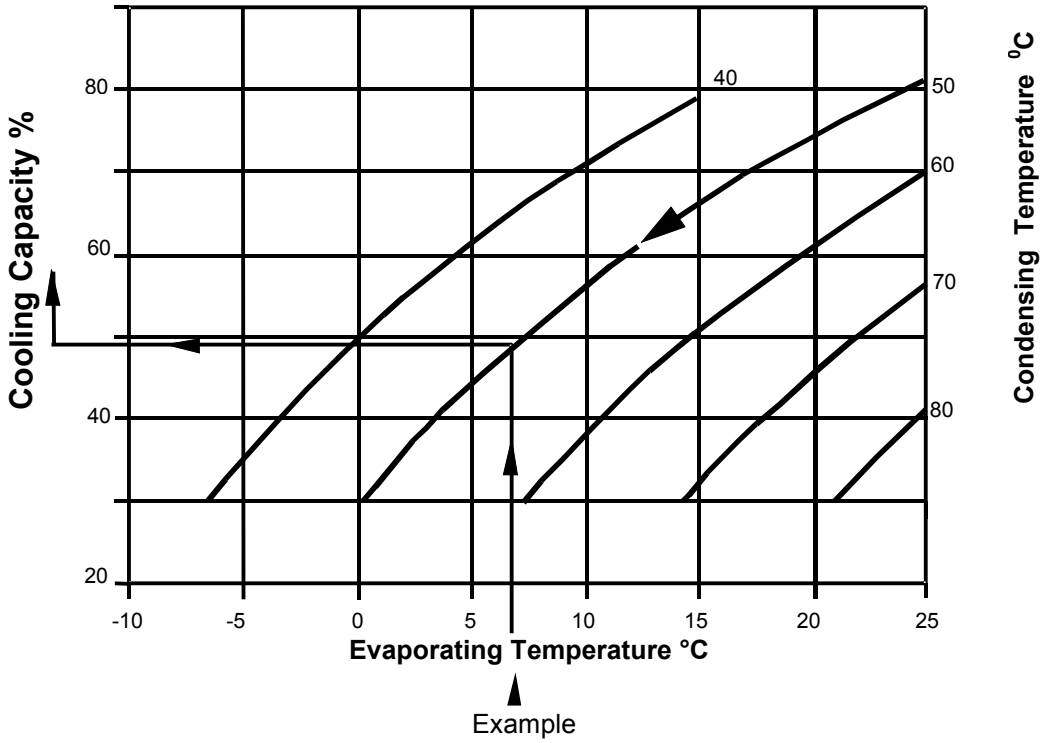
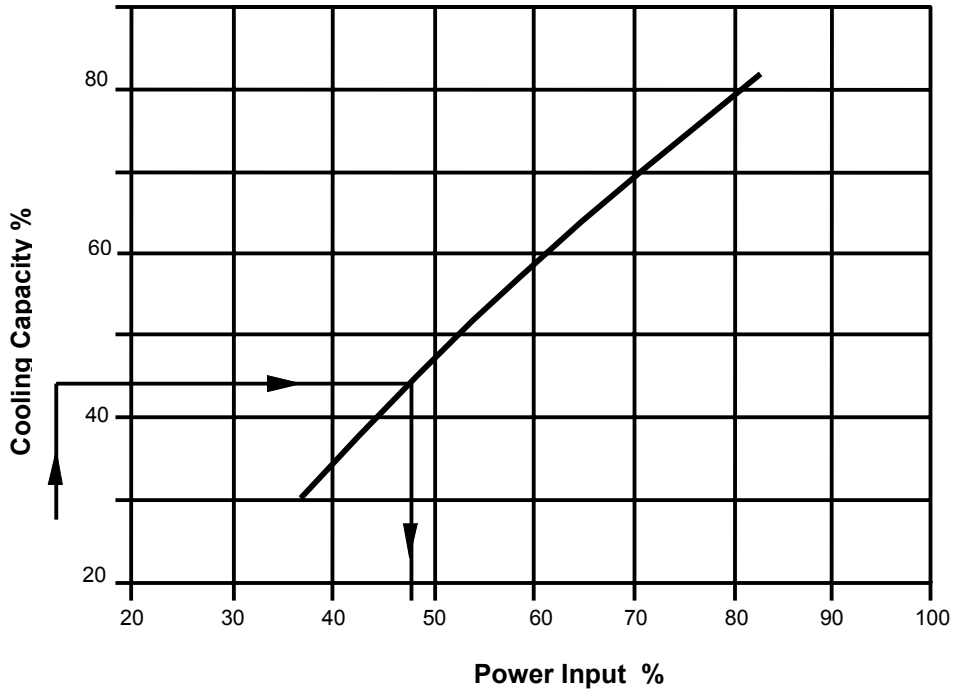

Cooling Capacity %
80
60
40
20
-10
-5
0
5
10
15
20
25
Evaporating Temperature °C
40
50
60
70
80
Condensing Temperature °C
Example

Diagram 3


Cooling Capacity %
80
60
40
20
20
30
40
50
60
70
80
90
100
Power Input %

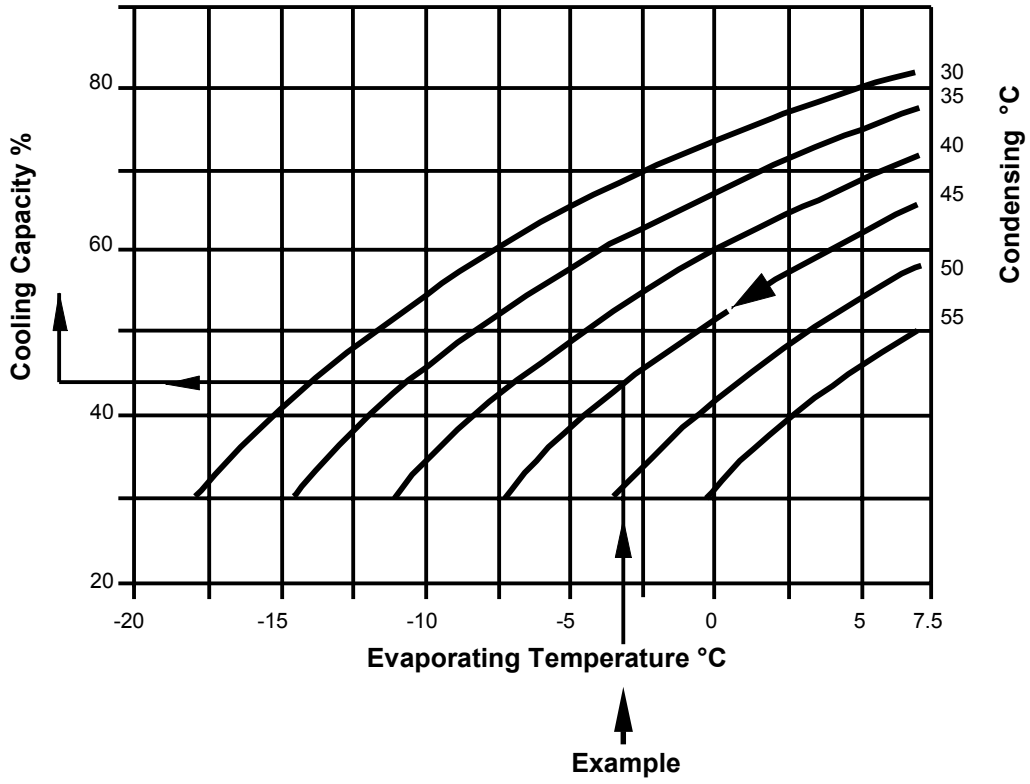
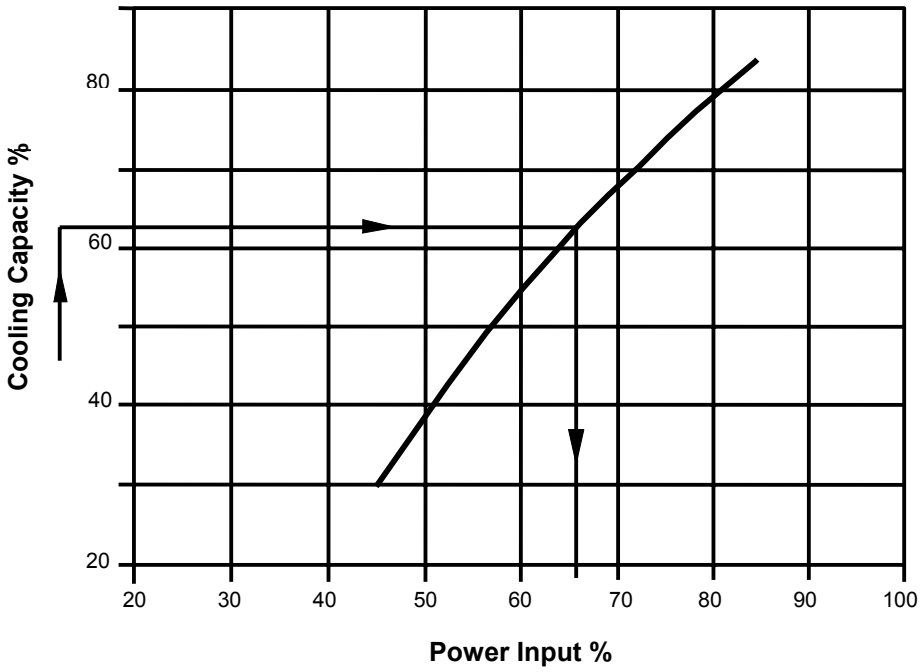

Cooling Capacity %
80
60
40
20
-20
-15
-10
-5
0
5
7.5
Evaporating Temperature °C
30
35
40
45
50
55
Condensing °C
Example

Diagram 4


Cooling Capacity %
80
60
40
20
20
30
40
50
60
70
80
90
100
Power Input %

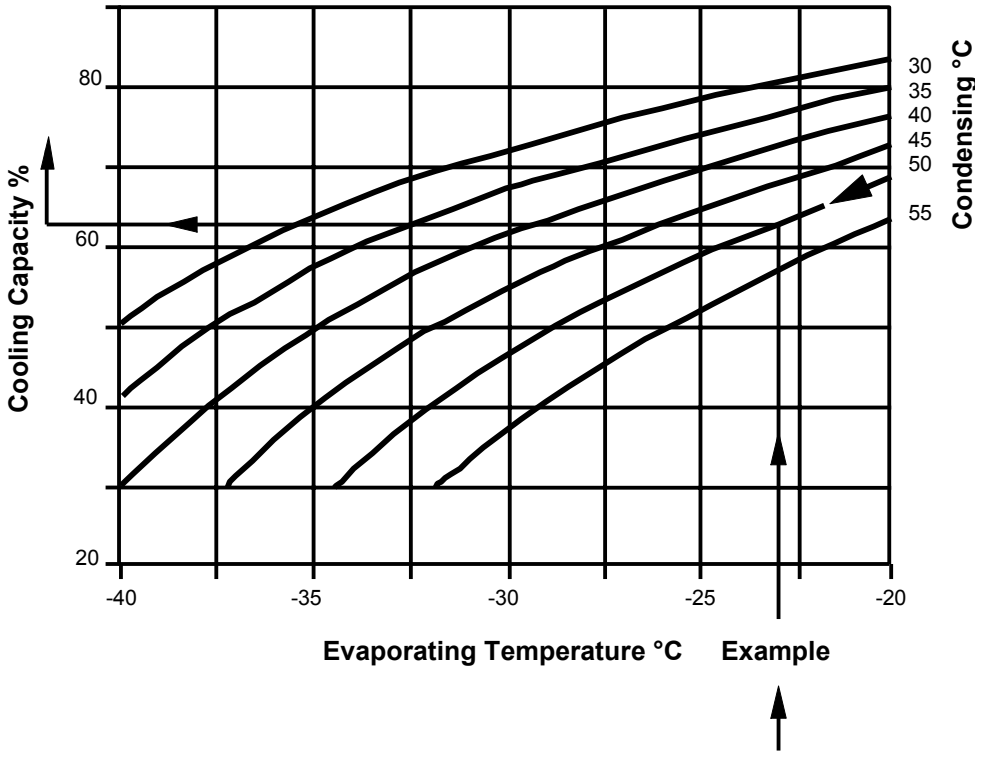
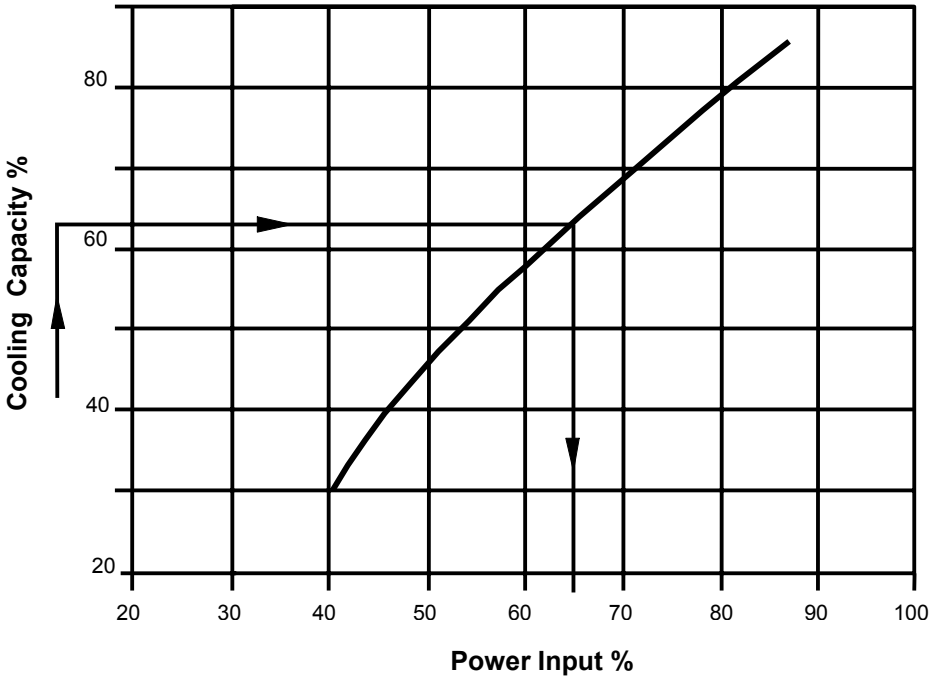
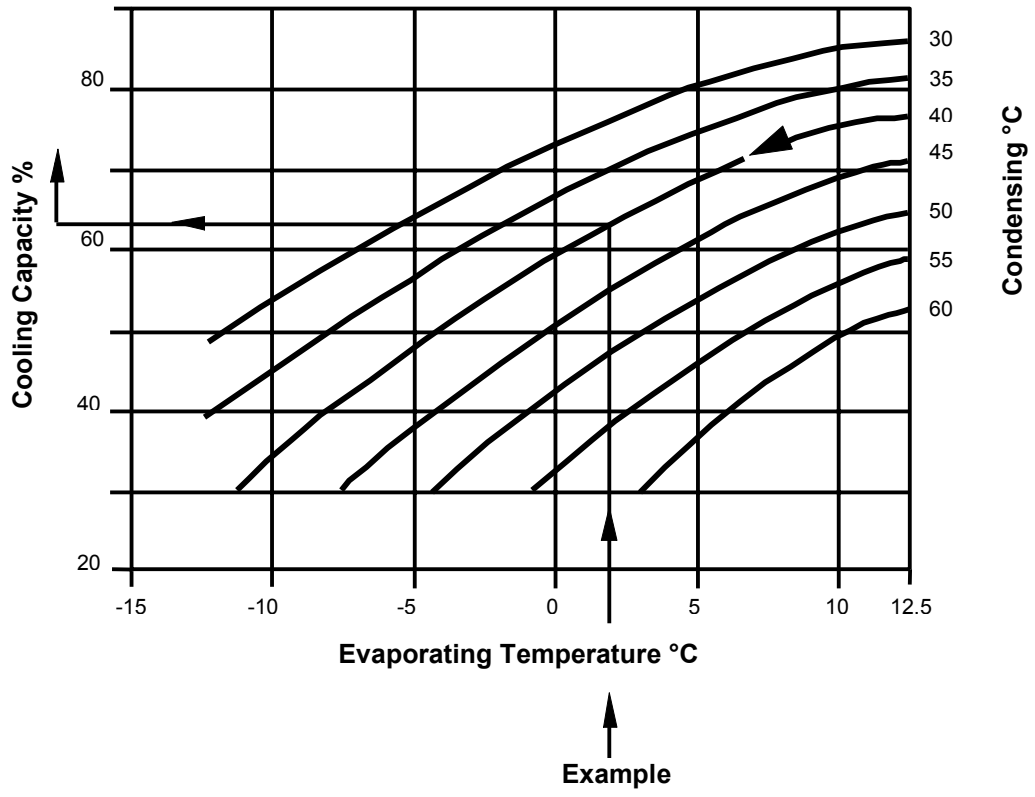

Cooling Capacity %
80
60
40
20
-40
-35
-30
-25
-20
Evaporating Temperature °C
Example
Condensing °C
30
35
40
45
50
55

Diagram 5


Cooling Capacity %
80
60
40
20
20
30
40
50
60
70
80
90
100
Power Input %


Cooling Capacity %
80
60
40
20
-15
-10
-5
0
5
10
12.5
Evaporating Temperature °C
30
35
40
45
50
55
60
Condensing °C
Example

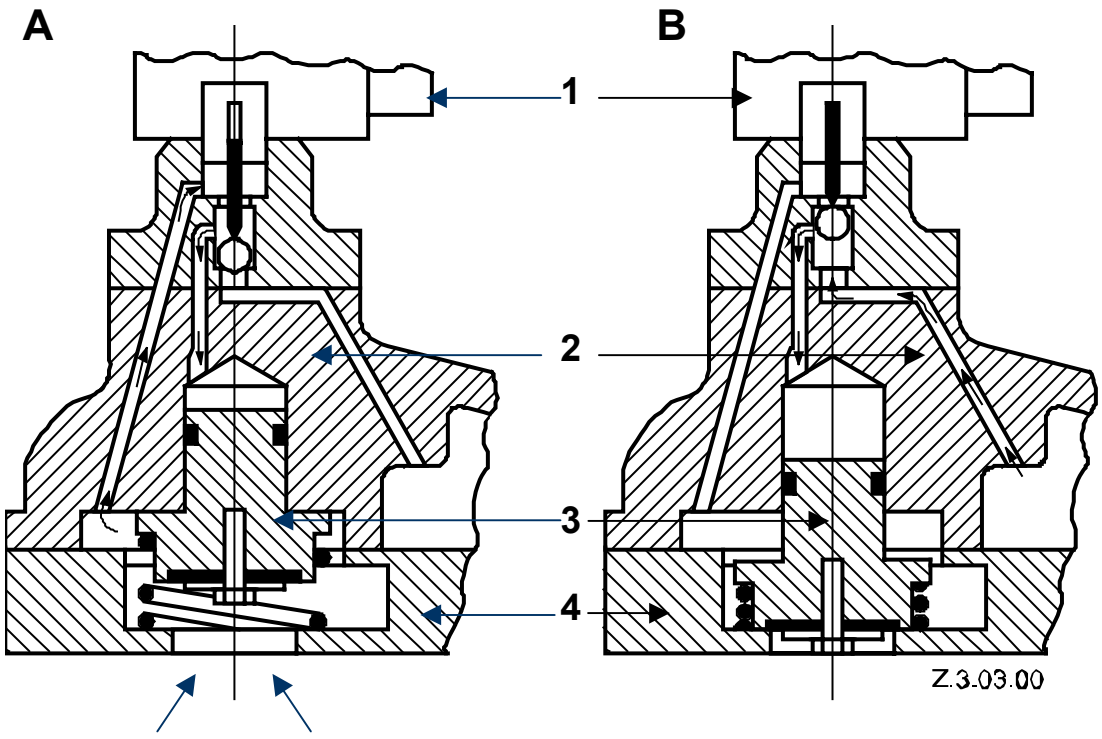
D4D, D6D and D8D Compressors

Capacity-controlled D4D, D6D, and D8D compressors work on the principle of blocking the suction gas passage to two or more cylinders. They require the use of a special cylinder head, a control valve with solenoid coil, and in the case of Discus a special valve plate, too. These items may be ordered installed at the factory or in kit form for later installation.

Normal Operation (full load)
When the solenoid coil **is not** energized, the top of the unloader piston is vented to suction pressure allowing the piston to be lifted by means of a spring. The compressor draws gas from all cylinders and reaches full cooling capacity.

Capacity-Controlled Operation (part load)
When the solenoid coil **is** energized, the top of the unloader piston is forced down with discharge gas pressure thereby blocking the suction gas passage into the cylinders, thus enabling the compressor to run with reduced capacity.

Voltages of the solenoid valve coil:
24 V D.C.
24 V / 1~ / 50 Hz
120 V / 1~ / 50 / 60 Hz
208-240 V / 1~ / 50 / 60 Hz
protection class: IP 55 (evaluation according to IEC 34)



A = full load operation
B = part load operation

1 = solenoid valve
2 = cylinder head

3 = control piston
4 = valve plate

Capacity Controlled Cylinder Head Gaskets for 4, 6 & 8 Semi-Hermetic Compressors

All capacity control prepared cylinder heads on 4, 6 and 8 cylinder semi-hermetic compressors are delivered with the mounted inactive gasket for the capacity controlled port, this will ensure full capacity operation of the compressor if the solenoid control valve is not installed for any reason. To activate the capacity control, the blind flange and the inactive gasket have to be removed and to be replaced by the solenoid control valve and the active gasket which is provided with the conversion kit.

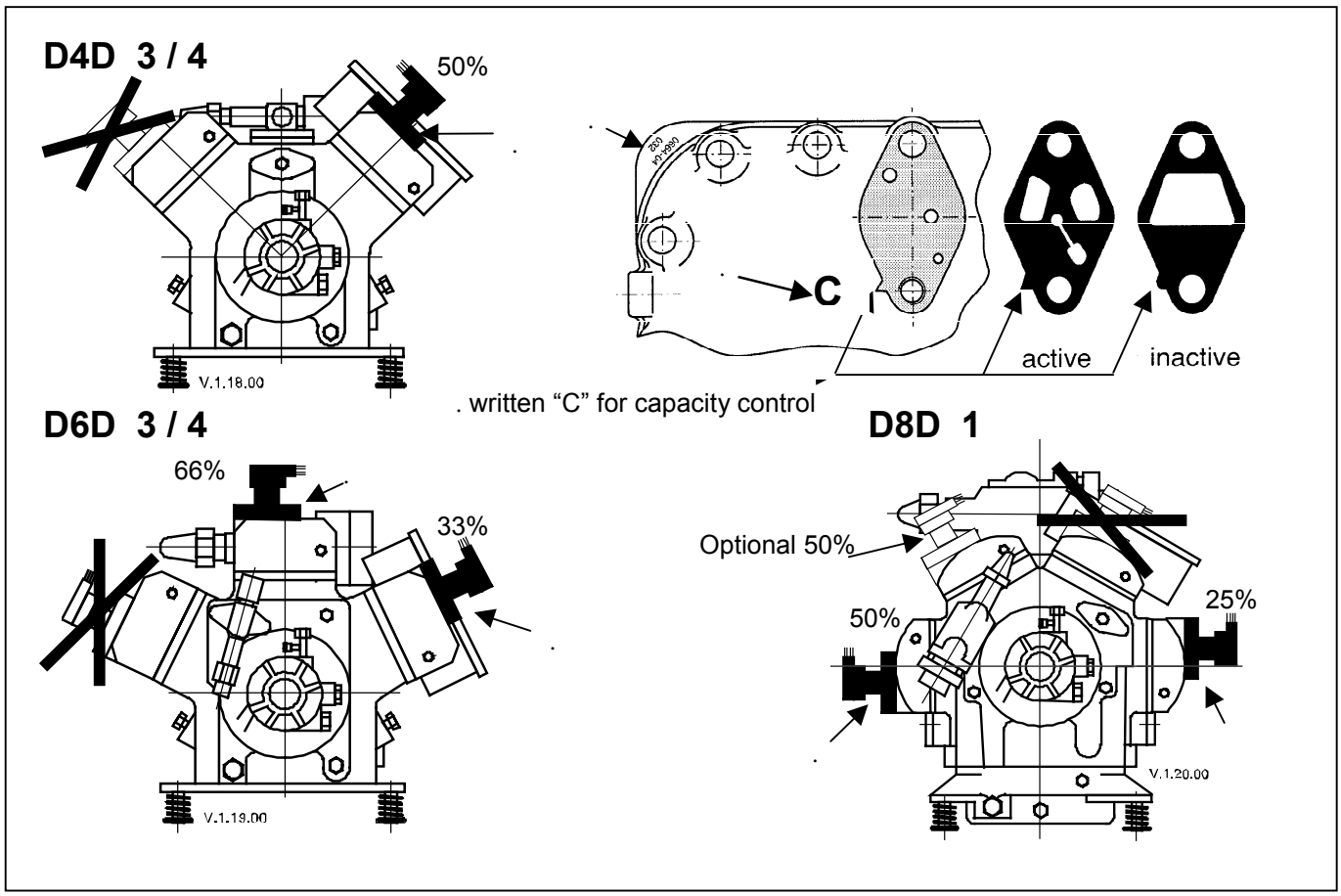
The gasket change was effective with compressors shipped from our Welkenraedt, Belgium plant from August 17,1999

Conversion kit includes;

1 x	cylinder head for capacity control “C”
1 x	valve plate and gasket kit
1 x	solenoid valve assembly
2 x	mounting screws

Capacity control must be fitted in the following positions:

D4D		50%	terminal box side
D6D	1st step	33%	terminal box side
D6D	2nd step	66%	upper cylinder head
D8D	1st step	25%	lower cylinder head on terminal box side
D8D	2nd step	50%	lower cylinder head on discharge valve side



Selection of Capacity Control

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Step			Remaining Refrigeration Capacity / Power Input (average values) %								Diagram No
		0	1	2	Application Range								
					HH	H	M	L	HH	H	M	L	
D4DA-100X	2	100%	50%			51	52			53	59		8
D4DH-150X	2	100%	50%			51	52			53	59		8
D4DA-200X	2	100%	50%		51				53				9
D4DJ-200X	2	100%	50%			51	52			53	59		8
D4DH-250X	2	100%	50%		51				53				9
D4DJ-300X	2	100%	50%		51				53				9
D6DH-200X	2 / 4	100%	66%	33%		67/34	68/34			68/36	70/41		8
D6DJ-300X	2 / 4	100%	66%	33%		67/34	68/34			68/36	70/41		8
D6DH-350X	2 / 4	100%	66%	33%	67/34				68/36				9
D6DJ-400X	2 / 4	100%	66%	33%	67/34				68/36				9
D8DH-500X	2 / 4	100%	75%	50%	75/51	75/51	75/52		77/53	77/53	78/59		8(HM) /10(HH)
D8DJ-600X	2 / 4	100%	75%	50%	75/51	75/51	75/52		77/53	77/53	78/59		8(HM) /10(HH)

Application limit see data sheets and application diagrams

HH = heat pump
H = high
M = medium
L = low temperature

Diagram 8
Suction gas temperature 25°C

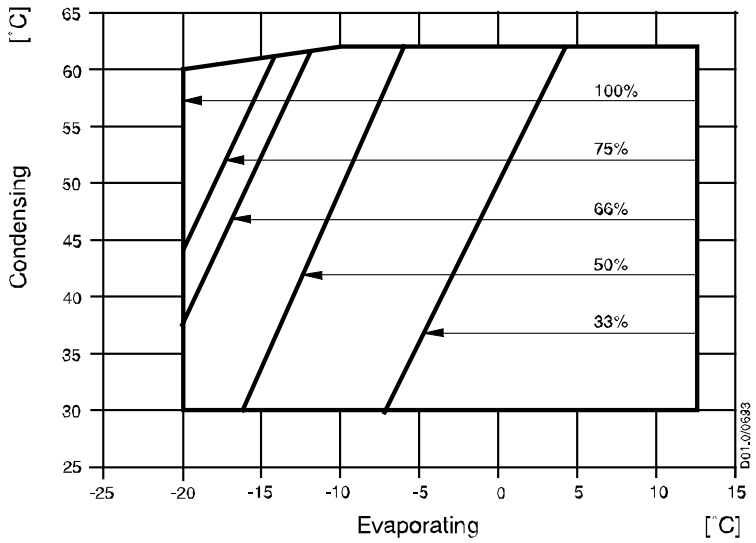


Diagram 9
Superheat 20 K

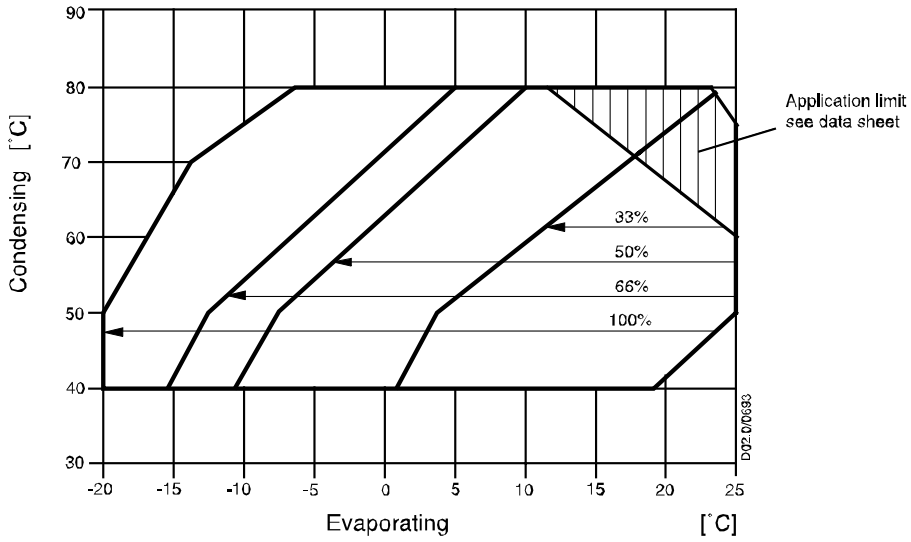
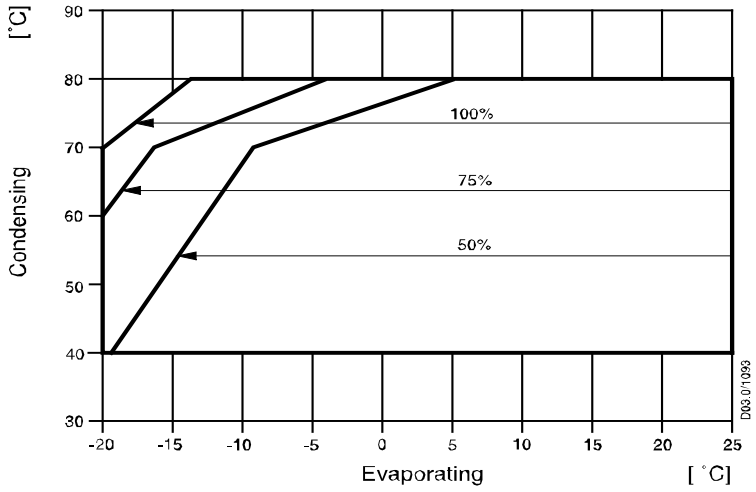


Diagram 10
Superheat 20 K



Selection of Capacity Control

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Step			Remaining Refrigeration Capacity / Power Input (average values) %		Diagram No
		0	1	2	Application Range		
					H	H	
D4DA-2000	2	100%	50%		51	53	11
D4DH-2500	2	100%	50%		51	53	
D4DJ-3000	2	100%	50%		51	53	
D6DH-3500	2 / 4	100%	66%	33%	67/34	68/34	
D6DJ-4000	2 / 4	100%	66%	33%	67/34	68/34	
D8DH-5000	2 / 4	100%	75%	50%	76/52	80/58	12
D8DJ-6000	2 / 4	100%	75%	50%	76/52	79/57	

Application limit see data sheets and application diagrams

H = high

Diagram 11
Suction gas temperature 25°C

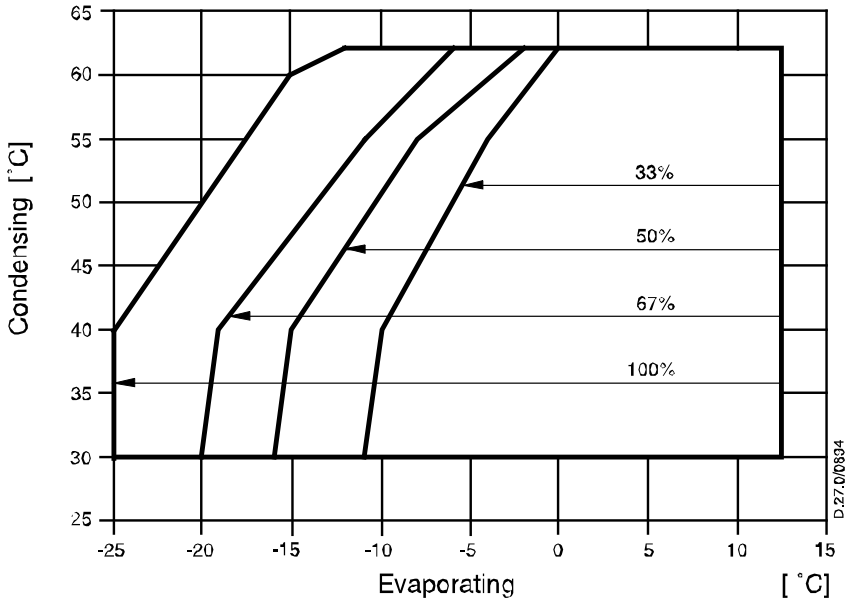
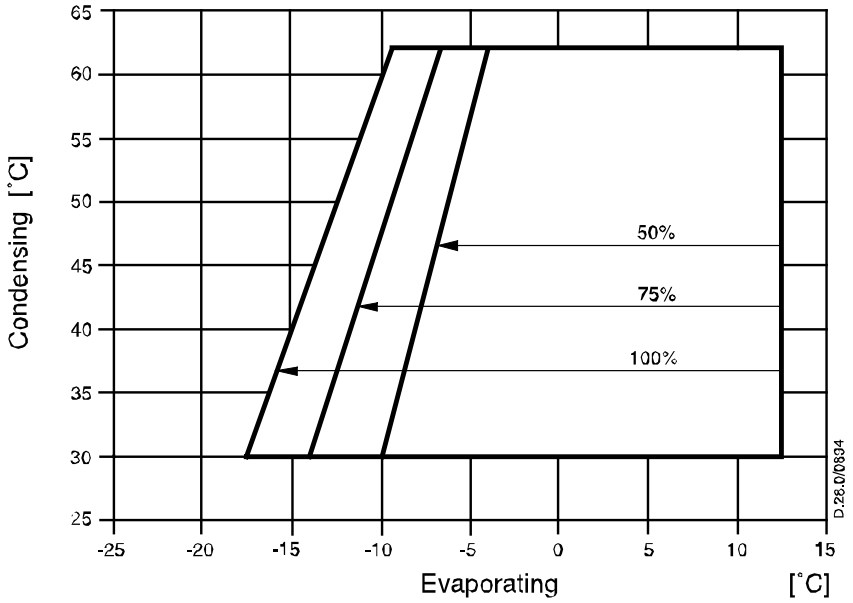


Diagram 12
Suction gas temperature 25°C



Selection of Capacity Control

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Steps			Remaining Refrigeration Capacity / Power Input								Diagram No
		0	1	2	Application Range								
					HH	H	M	L	HH	H	M	L	
D4DF-100X	2	100%	50%					52				59	13
D4DL-150X	2	100%	50%					52				59	13
D4DA-200X	2	100%	50%			51	52			53	59		15
D4DT-220X	2	100%	50%					52				59	13
D4DH-250X	2	100%	50%			51	52			53	59		15
D4DJ-300X	2	100%	50%			51	52			53	59		15
D6DL-270X	2	100%	66%					68				70	13
D6DT-300X	2	100%	66%					68				70	13
D6DH-350X	2 / 4	100%	66%	33%		67/34	68/34			68/36	70/41		16
D6DJ-400X	2 / 4	100%	66%	33%		67/34	68/34			68/36	70/41		16
D8DL-370X	2	100%	75%					77				78	14
D8DT-450X	2	100%	75%					77				78	14
D8DH-500X	2 / 4	100%	75%	50%		76/52	76/52			79/56	80/58		17
D8DJ-600X	2 / 4	100%	75%	50%		76/53	76/53			79/56	80/58		17

Application limit see data sheets and application diagrams

HH = heat pump
H = high
M = medium
L = low temperature

Diagram 13
Suction gas temperature

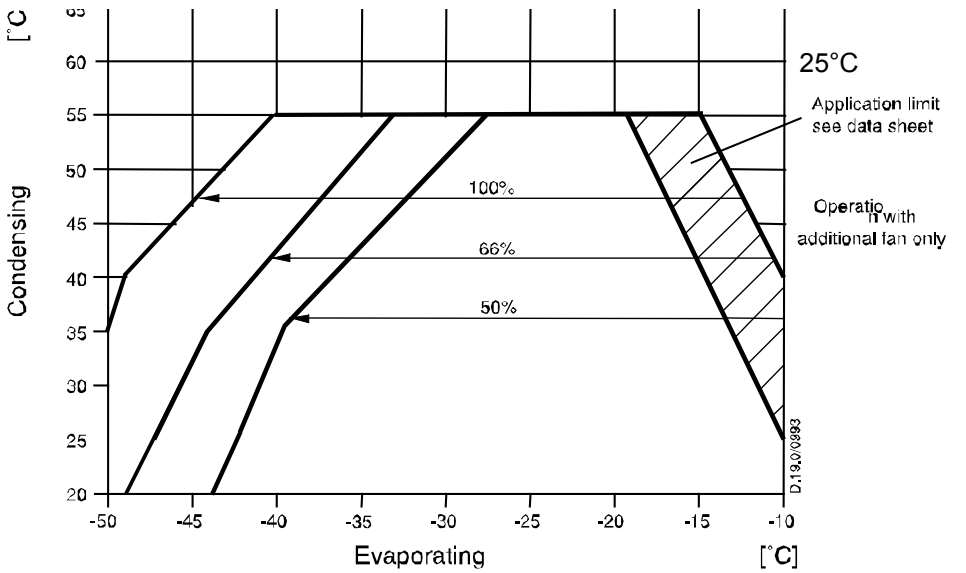


Diagram 14
Suction gas temperature 25°C

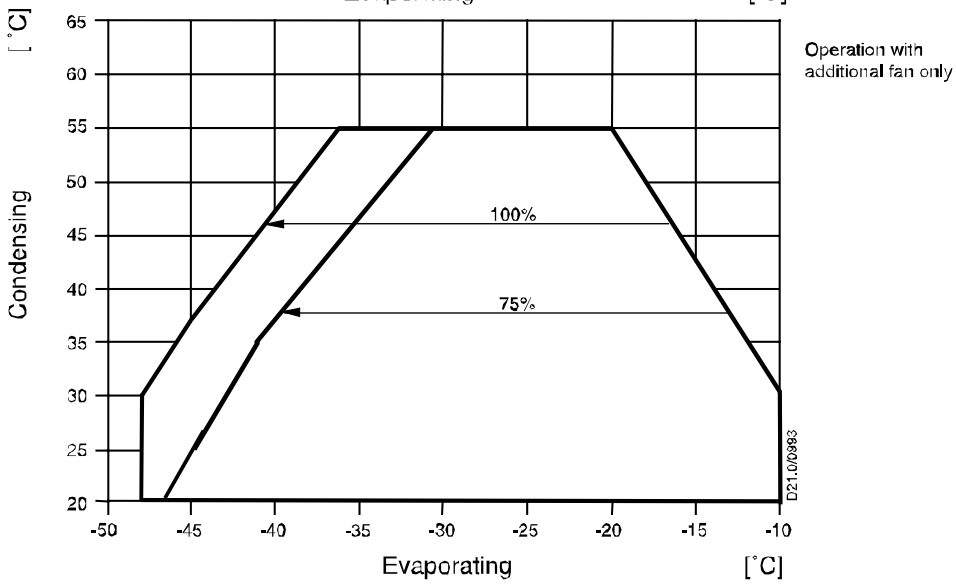


Diagram 15
Suction gas temperature 25°C

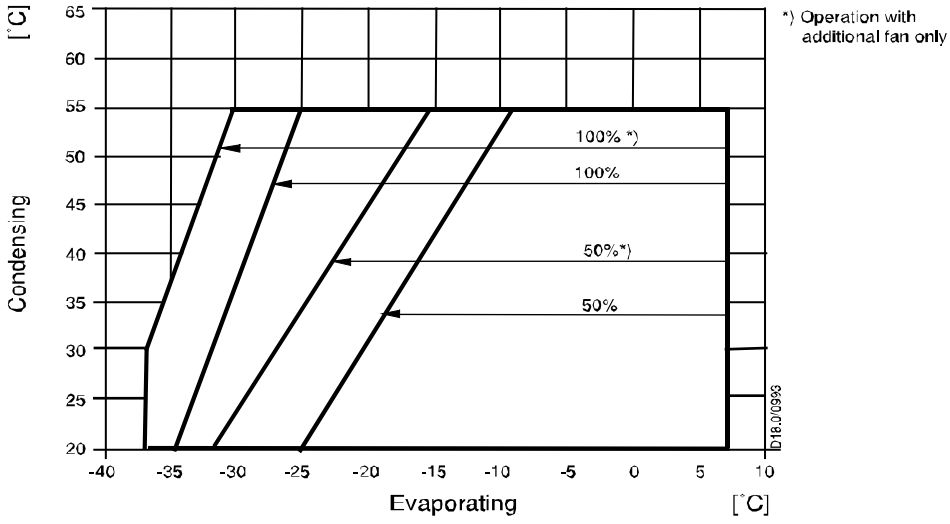


Diagram 16
Suction gas temperature 25°C Reduction to 33% with standard additional Ventilation not possible due to lack of space

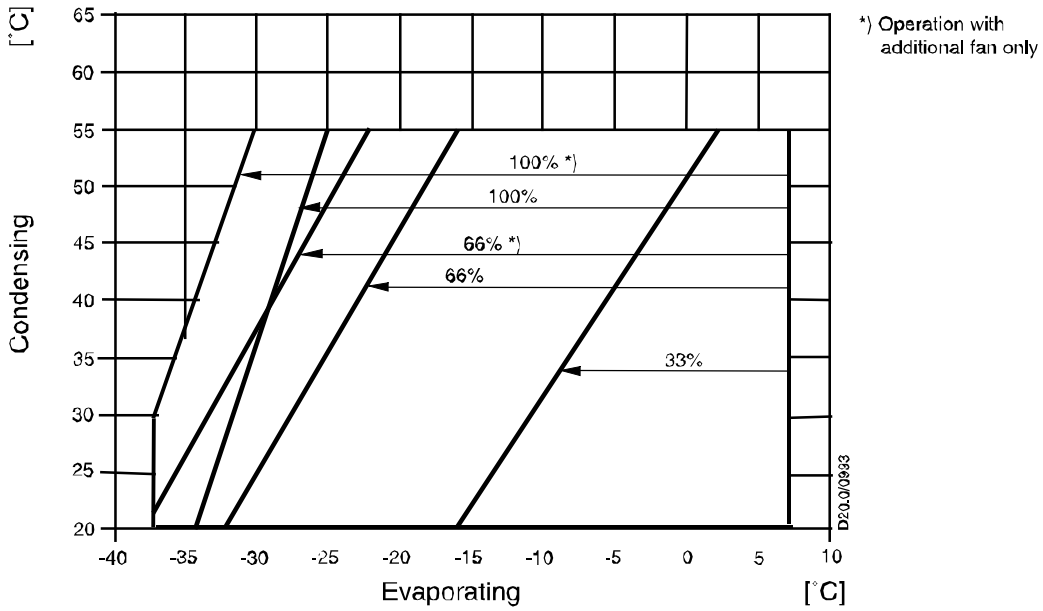
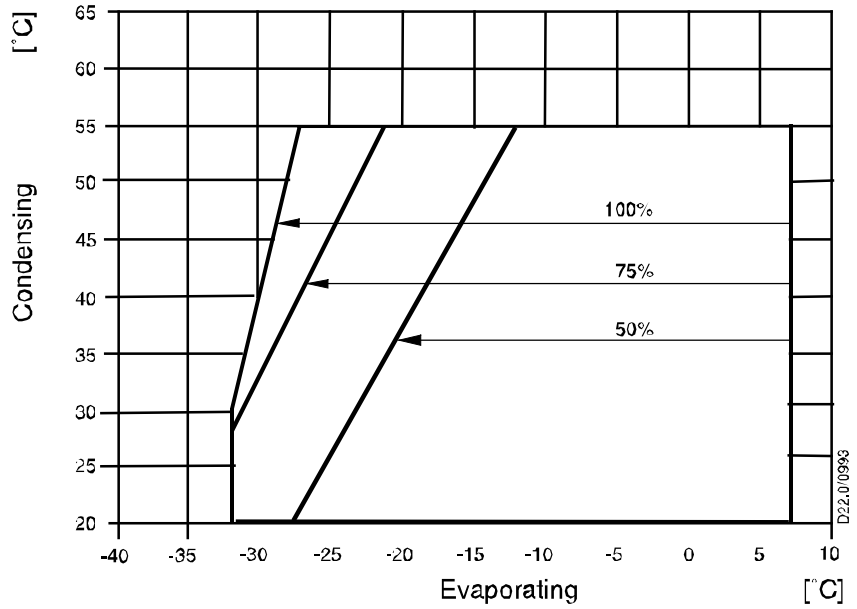


Diagram 17
Suction gas temperature 25°C



Selection of Capacity Control (mid-point)

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Step			Remaining Refrigeration Capacity / Power Input (average values) %		Diagram No
		0	1	2	Application Range		
					H	H	
D4DA-200X	2	100%	50%		51	53	18
D4DH-250X	2	100%	50%		51	53	
D4DJ-300X	2	100%	50%		51	53	
D6DH-350X	2 / 4	100%	66%	33%	67/34	68/34	
D6DJ-400X	2 / 4	100%	66%	33%	67/34	68/34	
D8DH-500X	2 / 4	100%	75%	50%	76/52	80/58	19
D8DJ-600X	2 / 4	100%	75%	50%	76/53	79/57	

Application limit see data sheets and application diagrams

H = high

Diagram 18 D4D – D6D
Suction gas temperature 25° C

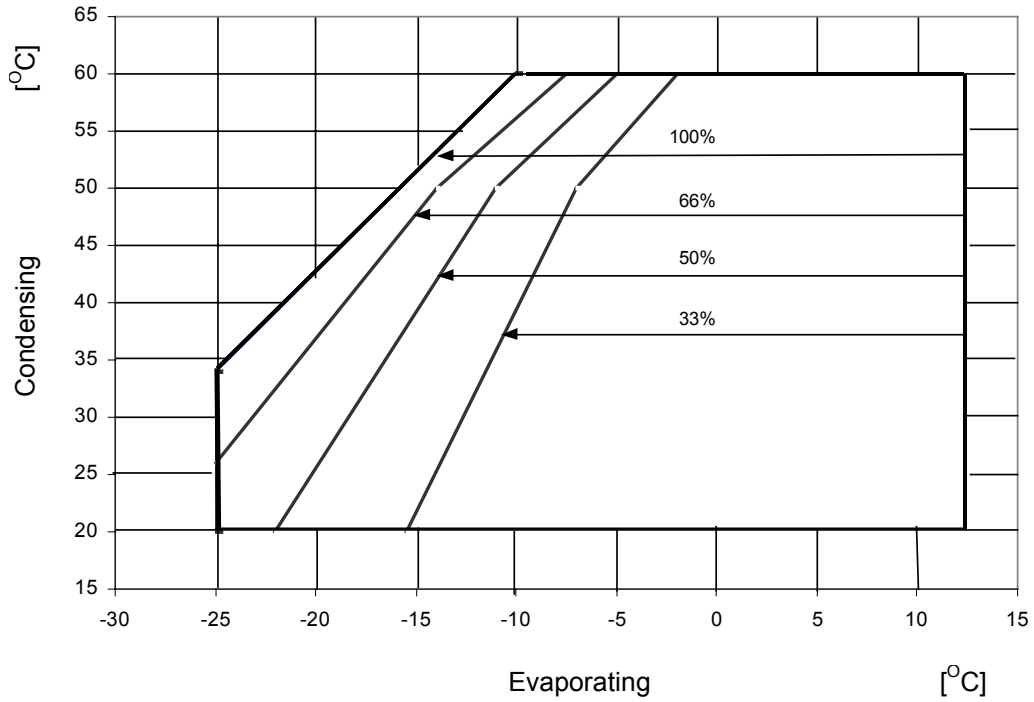
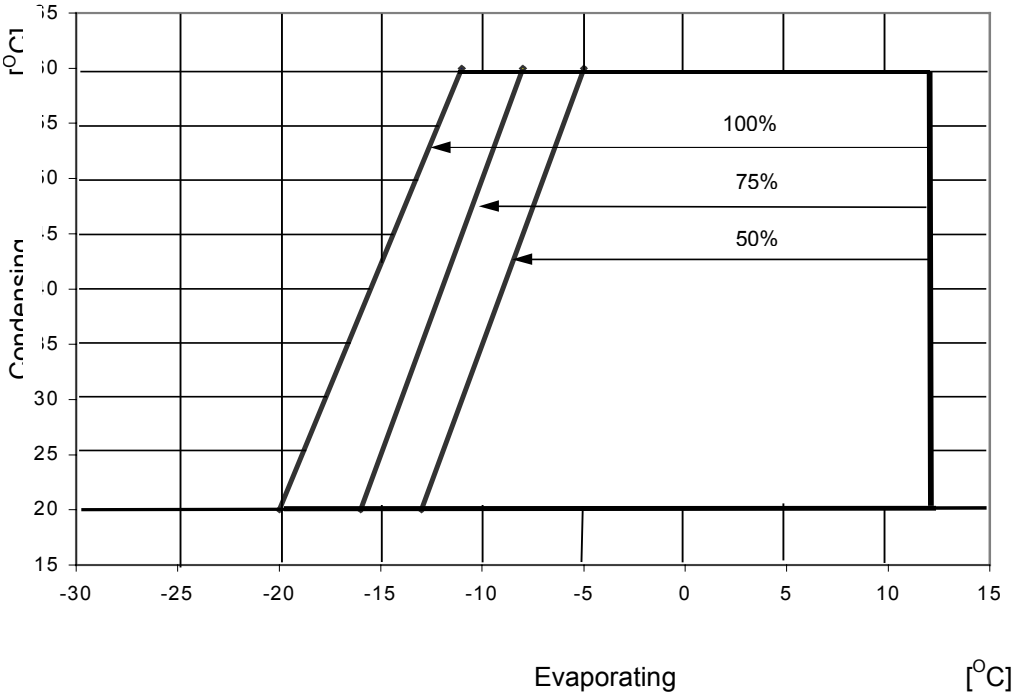
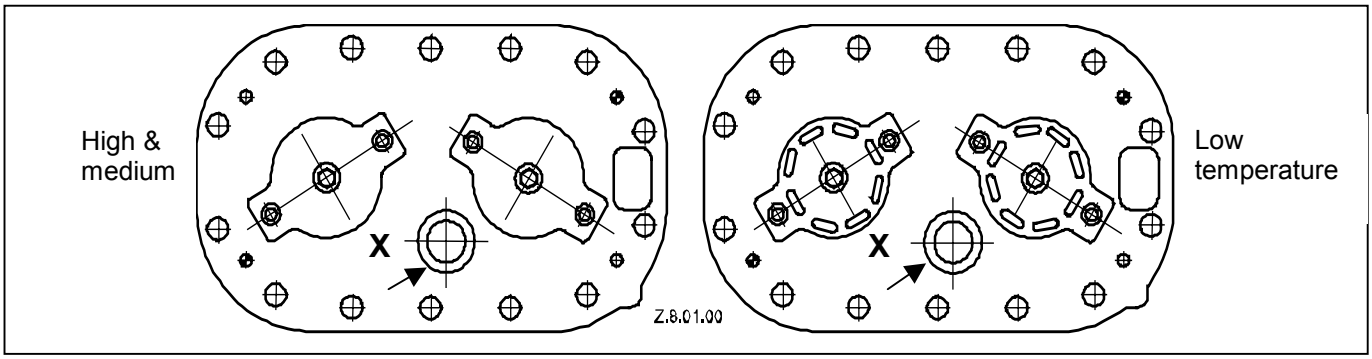


Diagram 19 - D8D
Suction gas temperature 25° C



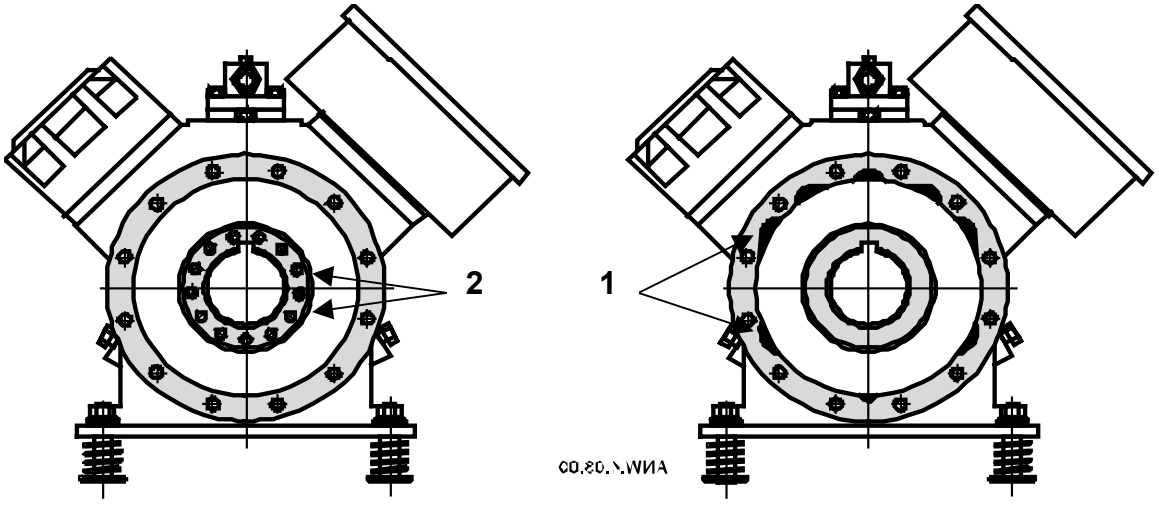
Discus Valve Plates D4D - D6D

For optimum performance Discus valve plates differ depending on the application range and the compressor features. Valve plates used on compressors with capacity control and unloaded start have an additional port “X”. So there are four different types.



TWIN Compressors D44D - D66D

In previous compressors the gas flowed through holes in the rotor (2). Now the D4D and D6D-compressors are manufactured using by-pass bodies. The suction gas flows through passages around the stator (1). This reduces losses and thereby increases efficiency.



View of compressor after removal of the suction chamber

TWIN compressors therefore require new suction chambers which have by-pass slots.

When exchanging a compressor in the field the serial numbers should be noted as it may be necessary to exchange the suction chamber. The necessary kits are available.

New Suction Chamber

Using new suction chambers with compressors that pre date this publication should be trouble free. The following table will help to identify the old and new suction chamber castings. These numbers are not to be used for ordering spares.

TWIN - Compressor	Old Casting No.	New Casting No.
D44DF - 2000	019-0042-99	019-0050-99
D44DH - 3000		
D44DA - 2000		
D44DA - 4000		
D44DL - 3000	019-0004-99	019-0049-99
D44DH - 5000		
D44DJ - 4000		
D44DJ - 6000		
D66D . -		

Crankcase Heater

The oil in the crankcase absorbs varying amounts of refrigerant according to the pressure and temperature. When the compressor is out of service, the amount of refrigerant absorbed may be so high that the oil level in the compressor rises creating the impression that the quantity of oil is large. When starting the compressor, the pressure in the crankcase decreases and the oil foams due to the evaporating refrigerant. The foam is drawn up by the pistons and liquid slugging as well as an increased discharge of oil into the refrigerant circuit will occur.

Absorption of refrigerant by the oil is easily possible if:

a) The compressor through its' location is colder than other parts of the system. When the system is not in service refrigerant may condense in the coolest part of the system in this situation in the compressor.
b) An automatic operating device for clearing the low-pressure part of the system was not mounted, and the low-pressure side is subjected to a relatively high pressure during standstill.

The knowledge that the possible refrigerant content in the oils is lower at higher temperatures and at lower pressures was the reason for developing heaters for the crankcase.

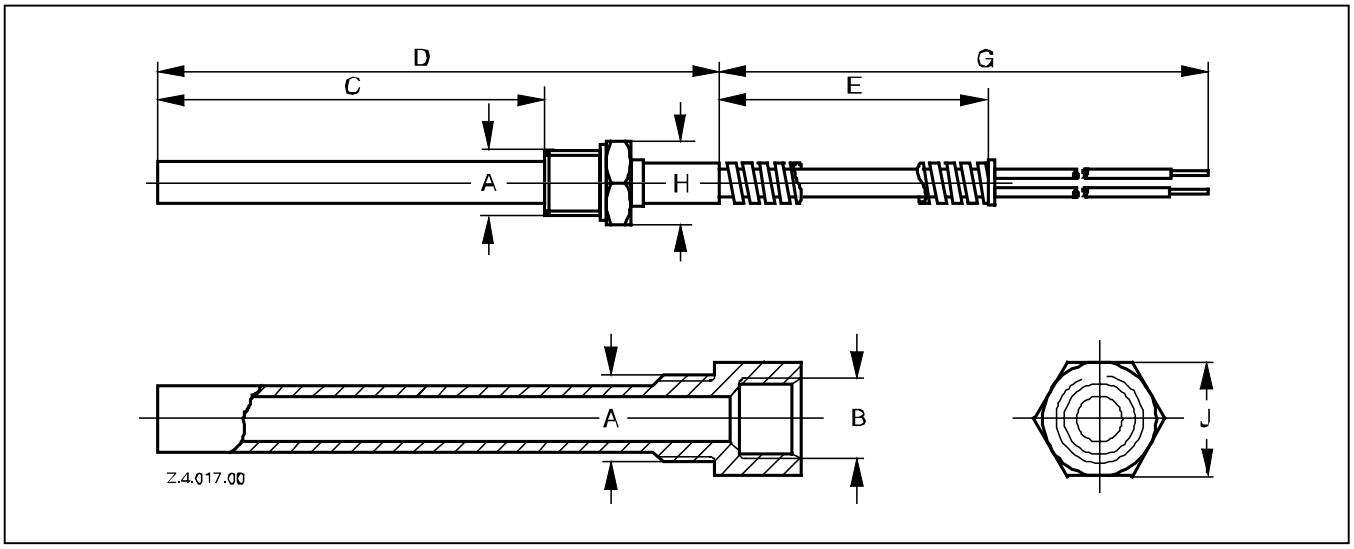
It is the object of the crankcase heater to maintain the oil in the crankcase at a temperature that is higher than that of the coolest point of the system during compressor standstill. The heating output has been rated as to make impossible a thermal over-heating of the oil provided the heaters are applied correctly. However, at low ambient temperatures the heating capacity may not be sufficient for preventing refrigerant accumulating in the oil. In these cases, a pump-down cycle becomes necessary.
The heater helps to prevent liquid slugging that is due to oil foaming with increased oil discharge during the starting phase of the compressor. However, problems resulting from the fact that the suction line was installed incorrectly cannot be prevented by the heater.

The individual "Discus Compressor Connection" sheets pages 14, 15 & 16 show the crankcase heater mounting position.

Standard D2D and D3D compressors are fitted with a crankcase heater sleeve which take a 70W heater, D4D and D6D compressors a 100W heater. D6DJ, D6DT, and D8D have a separate bore in the deep oil sump for a 200W heater.

The space between the heater and the sleeve should be filled with special heat sink paste to improve the heat transfer. Due to this improvement a fast and easy exchange of the heater or its retrofitting is possible without opening the refrigeration system to atmosphere.

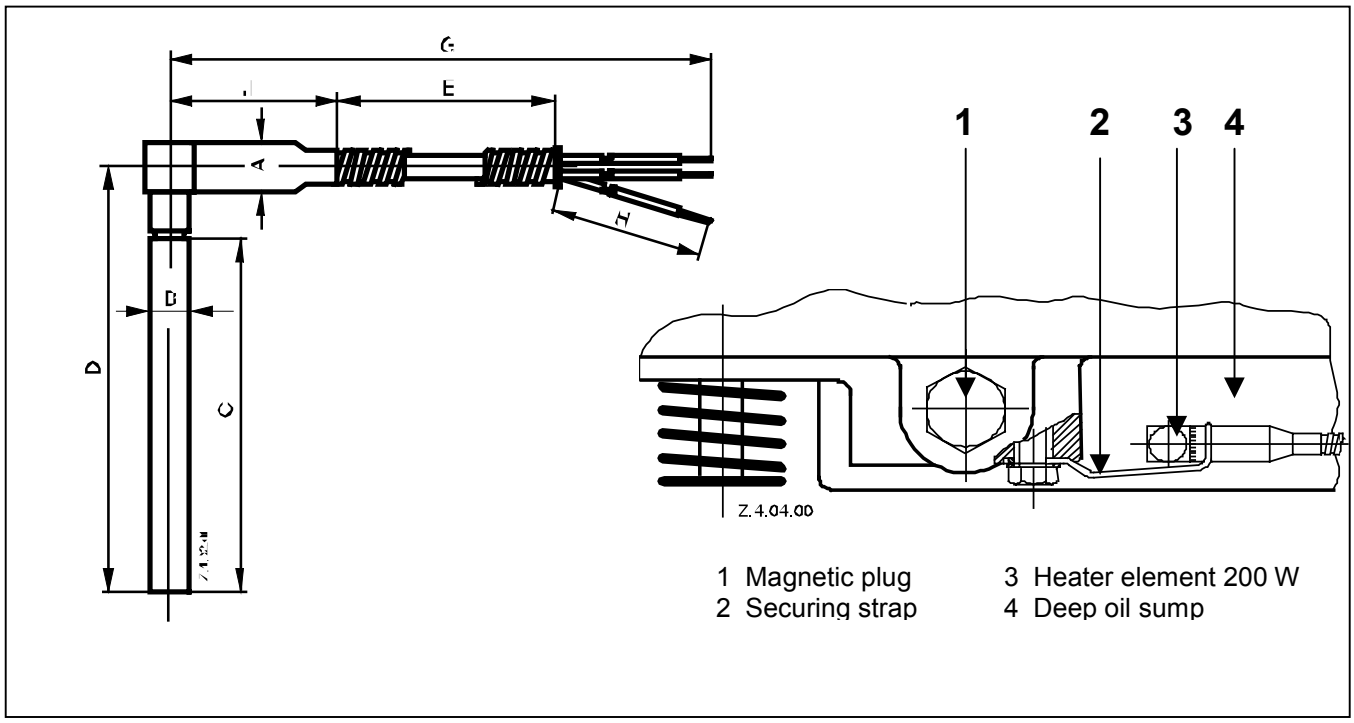
Internal Heater Element 70 Watt / 100 Watt and Heater Sleeve



Compressor	Heater	Power Supply	Dimensions							
	Watt	Voltage	A	B	C mm	D mm	E mm	G mm	H mm	J mm
D2D, D3D	70	230 ± 10 %	3/8" -18 NPTF	3/8" -18 NPSL	112	163	710	900	19	22
D4D, D6D	100	220 +20 / -10%	1/2" -14 NPTF	1/2" -14 NPSL	125	190	600	750	22	27
D4DJ*,D6DJ/T*,D8D	200	240 +10 / -15%	-	-	103	126	700	900	200	50

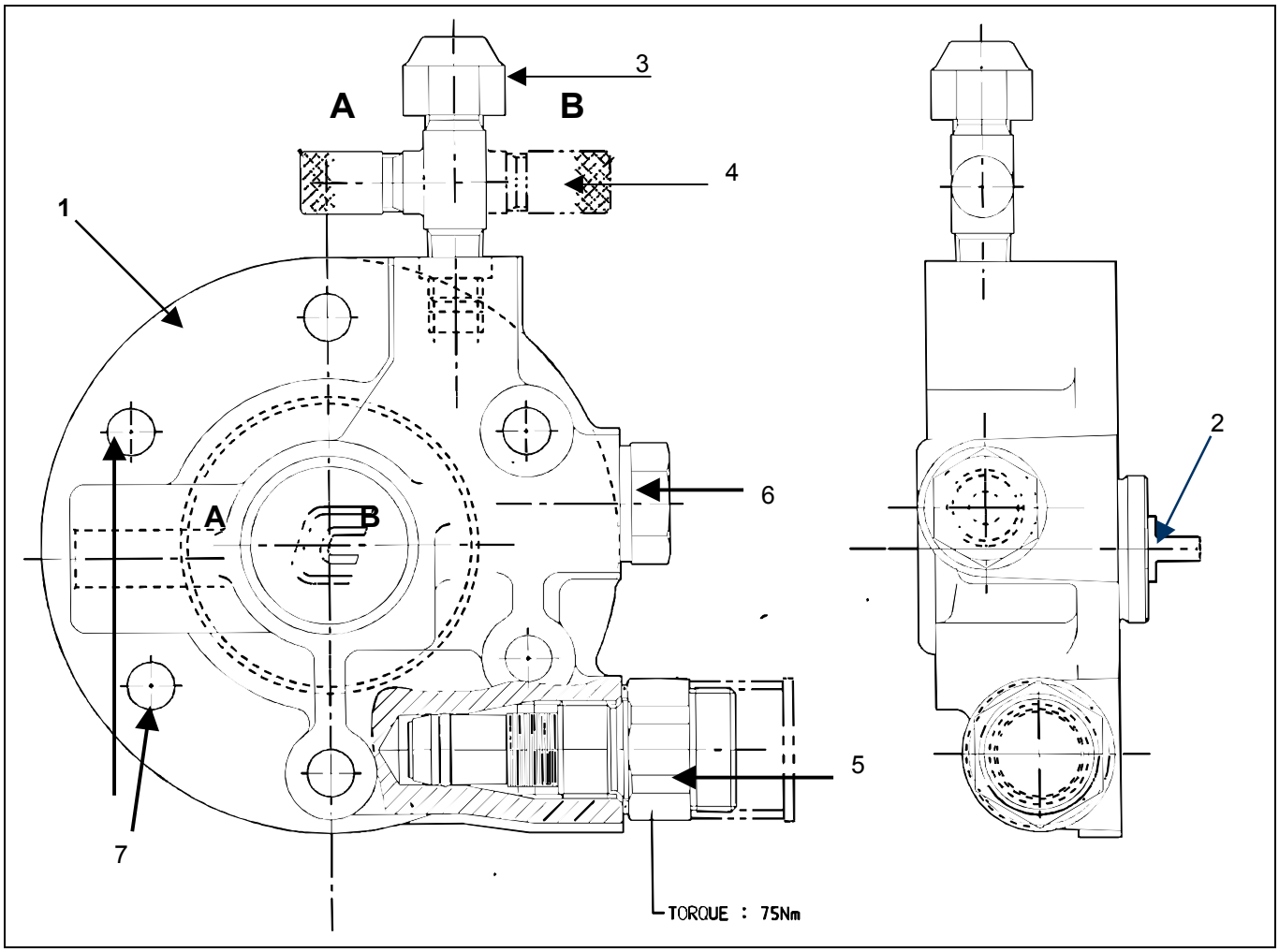
* with deep oil sump

Heater Element 200 Watt



Oil Pump

All Discus oil pumps have an OPS1 sensor fitted. There is an option of using the connection for the electronic oil pressure safety system SENTRONIC or also the pump can be connected to the capillaries of an approved oil pressure switch e.g. ALCO FD 113 ZU (A22-156) see page 52.



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A position D4, D6, D8
B position D2, D3

1 Oil pump housing
2 Oil pump rotor
3 Flare connection for high pressure side capillary tube from approved oil pressure control
4 $^{7}/_{16}$" - UNF Schrader valve
5 OPS1 sensor fitted or connection for the electronic sensor of the Sentronic oil protection system
6 Overflow valve limiting oil pressure to about 4.2 bar (not adjustable)
7 Fixing bolts (3 + 3 pieces)

Adapter

As the new oil pump is used for all refrigerant-cooled compressors an adjustment to the different shaft diameters of the compressors is necessary. It is achieved by using an adapter ring centering the pump (see Fig. 1).
The adapter ring is fixed to the pump case on the side of the cam pin (see Fig. 2). For fixing the ring there is a bead (see Fig. 1, section A) which snaps in into the cavity of the pump case (see Fig. 2 section B).
The oil pump shaft cam pin and the slot of the crankshaft must be properly aligned (see Fig. 2 - C).

Fig. 1

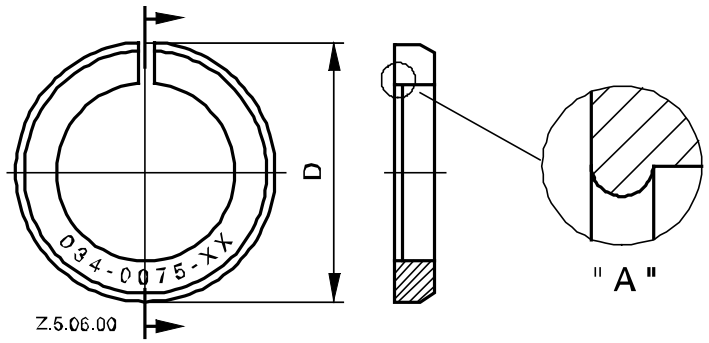
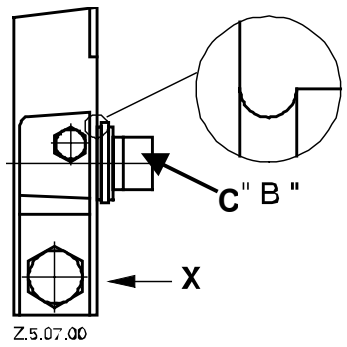


Fig. 2

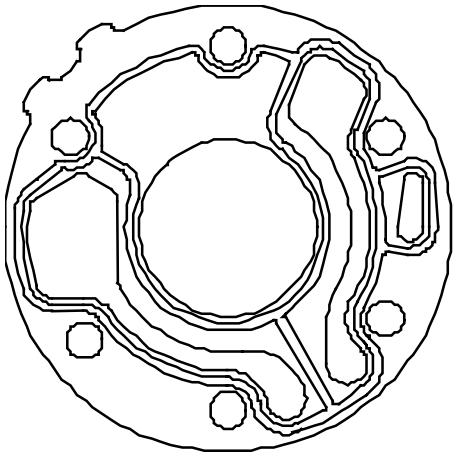


Compressor	Adapter	Gasket Material
D2D & D3D	D = 40.4 mm	Wolverine
D4D, D6D, D8D	D = 49.2 mm	Wolverine

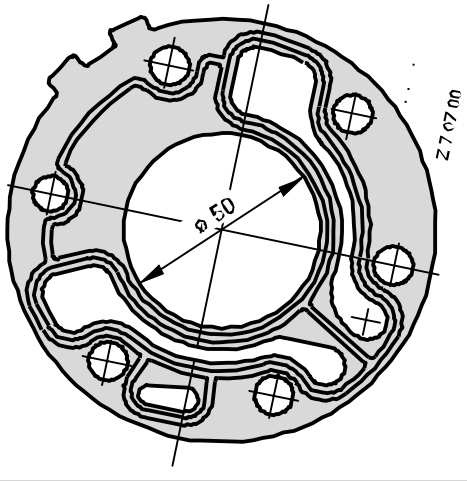
Oil Pump Gasket

The current oil pump gasket can be used on all of the oil pumps used by Discus compressors, however the old Concentric-pump gasket does not fit onto the newer oil pumps.

D2D, D3D



D4D, D6D & D8D

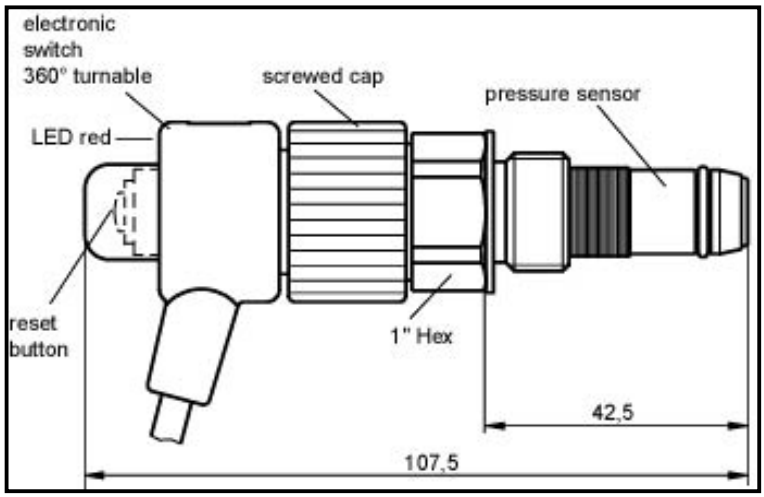


OPS1 Oil Differential Pressure Switch

Application

Monitoring the oil differential pressures in refrigeration compressors. OPS1 consists of two parts: a pressure sensor and an electronic switch. It is easy to apply and due to the pre-assembled sensor environmentally friendly, the risks of refrigerant leakage are minimized.

The pressure sensor of the oil differential switch is directly screwed into the pump housing of the compressor. Internal channels link the switch to the suction and discharge ports of the oil pump. No capillary connections are necessary. The electronic switch can be fitted or removed without opening the refrigeration circuit.



Functional description:

The differential pressure monitor is activated when the supply voltage is applied via an auxiliary contact of the motor contactor K1. A red LED signals insufficient differential oil pressure immediately. Once the pre-set value has been reached, the LED is extinguished. The output contact remains closed when the set value is reached or exceeded. If the oil differential pressure remains or drops below the set value for longer than the time delay time, the output contact opens and locks out mechanically. Depressing the reset button can reactivate the switch. Shorter periods of insufficient differential pressure are also recognised by the internal microprocessor circuitry and lead to a trip and lockout after correspondingly extended delay time (integration).

Trained electrical personnel must connect the unit. All valid standards for connecting electrical and refrigeration equipment must be observed. Limit values for the supply voltage of the unit may not be exceeded. The oil differential switch needs no maintenance.

Technical data:

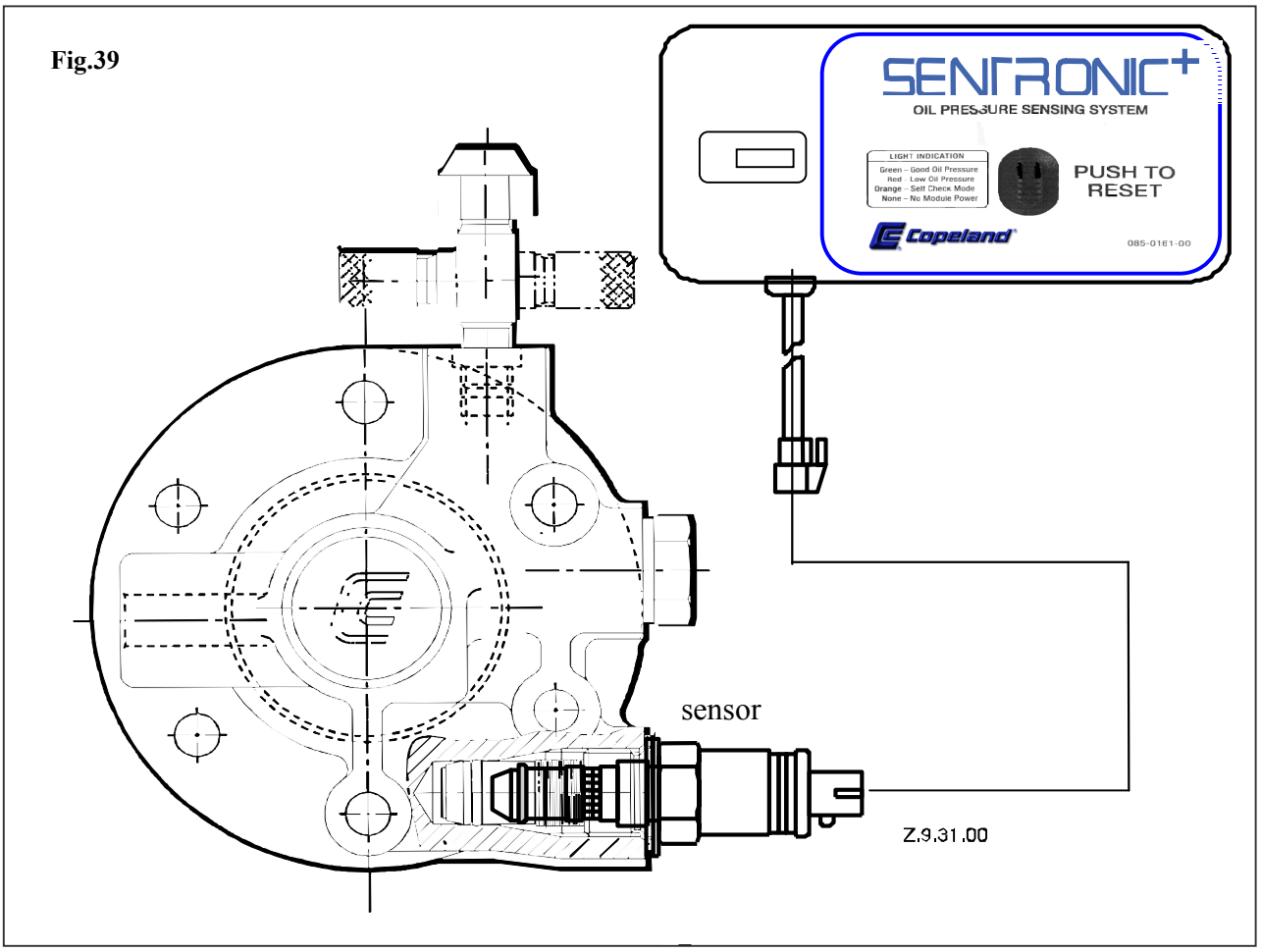
Supply voltage	AC 50/60 Hz 230V +/– 10% 10VA
Ambient temperature range	-30…..+60°C
Time delay	120 s
Cut-in pressure (fixed)	0,95 bar +/- 0,15 bar
Cut-out pressure (fixed)	0,63 bar +/- 0,15 bar
Switching capacity	AC 250 V, max. 2,5A, 720 VA ind.
Refrigerant compatibility	yes (brass)
Protection class according EN 60529	IP54
Reset	manual
Connection cable	4xAWG20 (0,5 mm^2), L=1m colour coded cores
Weight	ca. 200 g

NEW SENTRONIC^{+TM} Oil Pressure Safety System

All Discus compressors have an oil pump that is compatible with the electronic oil pressure safety system - SENTRONIC. This can be delivered as an option. It consists of:

1x	module (1)	2x	bolts
1x	sensor (2)	2x	lock washers
1x	mounting bracket	1x	O-ring (3)
2x	self locking nuts	1x	gasket (4)

Fig.39



Technical Data

Cut-out pressure:	0.55	±	0.1 bar
Cut-in pressure:	0.90	±	0.1 bar
Time delay:	120	±	15 s
Maximum switching current:			720 VA 120/240 V
Maximum ambient temperature:			66°C
Manual reset			
Built-in alarm connection			

Operation

The differential pressure between the pump outlet and the crankcase is measured by the sensor and converted to an electronic signal. If the net oil pressure of a running compressor drops to 0.55 ± 0.1 bar the compressor will be shut down after a time delay of 120 ±15 sec. During periods of erratic oil pressure the module will monitor

the pressure and add the periods of time when it is under the cut-in point of 0.9 ± 0.1 bar. When these periods of inadequate oil pressure total 2 min the module will shut down the compressor. When 4 minutes of adequate pressure are measured the timer resets to zero. In case of interruption of the power supply the SENTRONIC module holds stored information for one min.

Note: Proper oil-pressure safety control with an approved switch is a condition of warranty.

Mounting

The module is fitted to the bracket using two screws and lock washers (2.5 Nm torque).
The assembly is then mounted on the bearing housing cover studs using self-locking nuts (25 Nm torque).
When not under pressure remove the lower oil pump plug, the “O” ring, the gasket and discard.
Fit the sensor using a new “O” ring and gasket and torque to 105 Nm. Connect the sensor to the module.

Electrical Connection

See wiring diagram on page 58.
Power is supplied to the module on terminals “240V” or “120V” and “2”. Neutral must be connected to terminal 2.
The control circuit is to be connected on terminal “L” and “M”. The “A” terminal can be used to power an external alarm. An earth connection is also provided.
The module operation is powered by an internal transformer which is connected across terminal “2” and “120” or “240” depending on voltage.

Operation Test

The SENTRONIC module can be tested as follows:

1. Turn off the power supply.
2. Remove the sensor connection.
3. Turn on power supply.
4. After 2 min ± 15 s (time delay) the contact between “L” and “M” should be open and the contact between “L” and “A” closed (shutdown test).
5. While power is off connect the sensor connections in the module in a short circuit. Put the module back in operation using the reset button. On restart the module should not switch after the allowed time has elapsed.

The sensor can be checked with an ohmmeter. Disconnect the cable. Measure the sensor resistance at the sensor connections. This should show infinity when the compressor is stopped and 0 Ω when the compressor is running with sufficient oil pressure. The oil pressure can be checked by measuring the differential pressure between the Schrader valve and the compressor crankcase. This is approximately the same as the pressure measured by the SENTRONIC sensor.

The Sentronic^{+TM} features Copeland’s new LED diagnostics to allow for easier evaluation of oil pressure conditions. The system also features improvements to several component parts to reduce the frequency of nuisance trips caused by electromagnetic noise sensitivity. These improvements also eliminate the requirement for shielded cable and allow for splicing of the sensor cable up to a total length of 6 m. It also provides the same reliable oil flow pressure differential monitoring capability of the previous Sentronic™; however, there are a few new features worth noting as shown in the following list.

i) The Sentronic+ module features a “new look” plastic cover that will allow it to be distinguishable from the previous model.
ii) It will have a new sensor and module which includes a standard 60cm cable. An optional 3m cable extension is available.
iii) The terminal strip will accommodate bare wire connections and does not use a “spade” type terminal.
iv) The reset button must be pressed and released to activate the control. The oil pressure control will be momentarily by-passed while the reset button is pressed and the compressor could be running during this brief period without adequate oil pressure. It is recommended that the reset button be held at full depression for no longer than 2 seconds during the reset procedure.
v) Since the control system is by-passed when the Sentronic+ reset button is pressed and will continue to run, the reset button cannot be used to “jog” the compressor to clear liquid during start-up. The system control on/off must be used to clear liquid during start-up.
vi) The new Sentronic+ module cable is not compatible with the previous used (“old style”) sensor. Use of the new module with the old style sensor requires adapting the old style cable to the new module (as described in the Interchangeability document attached).
vii) The cable on the old style module will not connect properly to the new sensor. Copeland recommends upgrading to the complete Sentronic+ system if the old Sentronic™ sensor must be replaced.

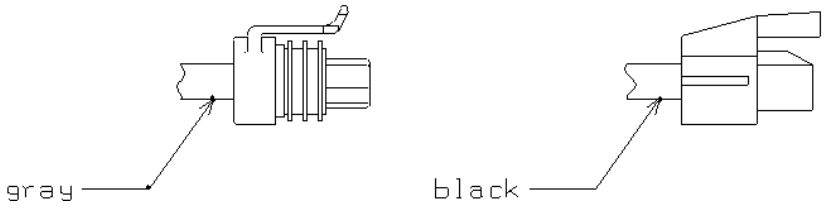
Interchangeability of Sentronic™ & Sentronic+™ Modules & Sensors

The new Sentronic+ ™ oil pressure control uses both a new module and a new sensor. The sensors and module can be made compatible with older generation components if the following steps are taken:

To use a Sentronic+ module with an older Sentronic™ sensor, the original Sentronic sensor cable must be wired to the new Sentronic+ module.

To use an older Sentronic module with a Sentronic+ sensor the new Sentronic+ cable must be wired to the Sentronic module.

There is an older generation Sentronic module that is fully compatible with the new Sentronic+ sensor. It is supplied with the new (Sentronic+) cable which is gray for identification purposes, see illustration below.



New Sentronic+ Old Sentronic

Connecting the Sentronic+ module to an older Sentronic sensor

Removing the cable from the old Sentronic module:

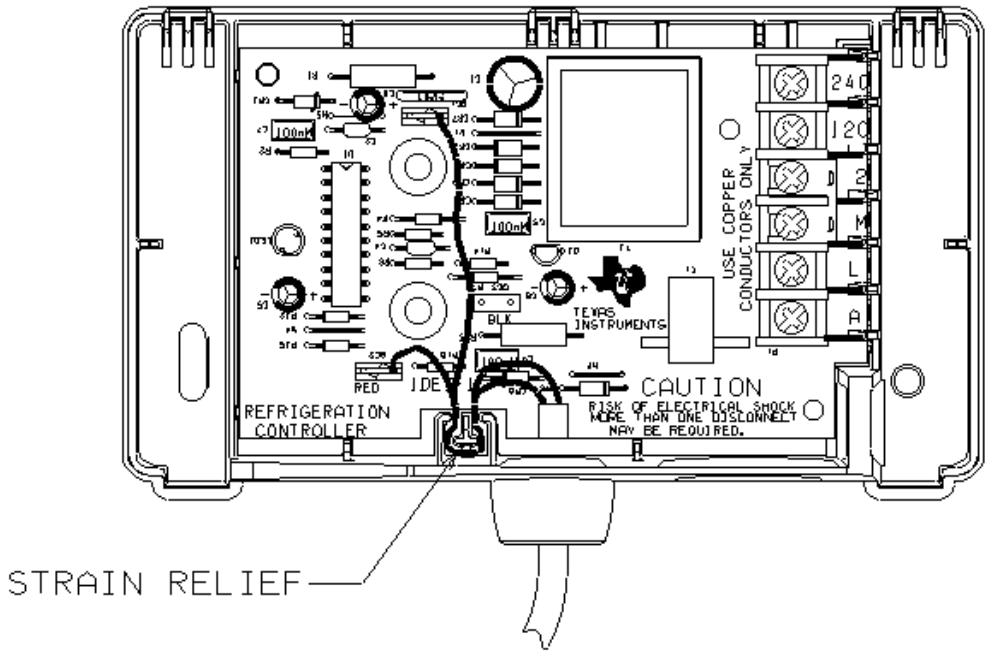
- Disconnect power to the old module
- Disconnect the cable from the sensor
- Remove the cover from the old module
- Remove the two cable quick connections from the circuit board
- Using pliers, squeeze the strain relief slots and pull to remove the cable from the module
- Remove the old module from the compressor

Removing the cable from the new Sentronic+ module:

- Remove the cover from the Sentronic+ module
- Pull the 2 cable quick connects from the circuit board (these are labeled “Org” and “Red”)
- Remove the wires from the strain relief (note the routing of the wires for future reference) and lift the wires out
- Remove the wire cable from the module by twisting the conduit counterclockwise and gently pulling

Connecting the old cable to the Sentronic+ module:

- Trim approximately 2” of cable sheathing from the module end of the old cable, taking care not to nick the wire insulation
- Feed the wires into the module through the hole in the bottom of the case
- Leaving enough lead length to reach the quick connects, push the wires into the strain relief.
- Connect the 2 quick-connects to the “ORG” and “RED” spades. (Note: the connections may be interchanged; there is no polarity on these wires). Refer to the figure below.
- Install the module to the compressor and make wiring and sensor connections per the general instructions.



Connecting the old Sentronic module to a newer Sentronic+ sensor

Removing the cable from the new Sentronic+ module:

- Disconnect power to the module
- Disconnect the cable from the sensor
- Remove the cover from the Sentronic+ module
- Pull the 2 cable quick connects from the circuit board (these are labeled “Org” and “Red”)
- Remove the wires from the strain relief by lifting the wires out
- Remove the wire cable from the module by twisting the conduit counterclockwise and gently pulling

Removing the cable from the old Sentronic module:

- Remove the cover from the old module
- Remove the two cable quick connections from the circuit board
- Using pliers, squeeze the strain relief slots and pull to remove the cable from the module
- Retain the strain relief from the cable for use on the Sentronic+ cable

Connecting the new cable to the old Sentronic module:

- Position the strain relief on the new cable at the termination of the conduit
- Feed the wires into the module through the hole in the bottom of the case
- Push the strain relief into position to lock it
- Connect the two quick connects to the circuit board. There is no polarity on the leads.
- Install the module on the compressor and make wiring and sensor connections per the general instructions

Sentronic+ Terminal Strip

- The Sentronic+ module terminal strip is designed to accept a bare wire end instead of a spade terminal
- If a Sentronic+ module is being retrofitted to a system with spade connections, the spade may be clipped off and ¼” of the wire end stripped or one leg of the spade may be clipped off for insertion into the terminal strip

Oil-Pressure Differential Switch

The oil-pressure difference between the oil pump outlet and the crankcase is too low. The switch must be properly adjusted and tamper proof. If the oil differential pressure falls below the minimum acceptable value the compressor will be stopped after a 120-sec. delay. After having eliminated the cause of the malfunction, a manual reset is required.

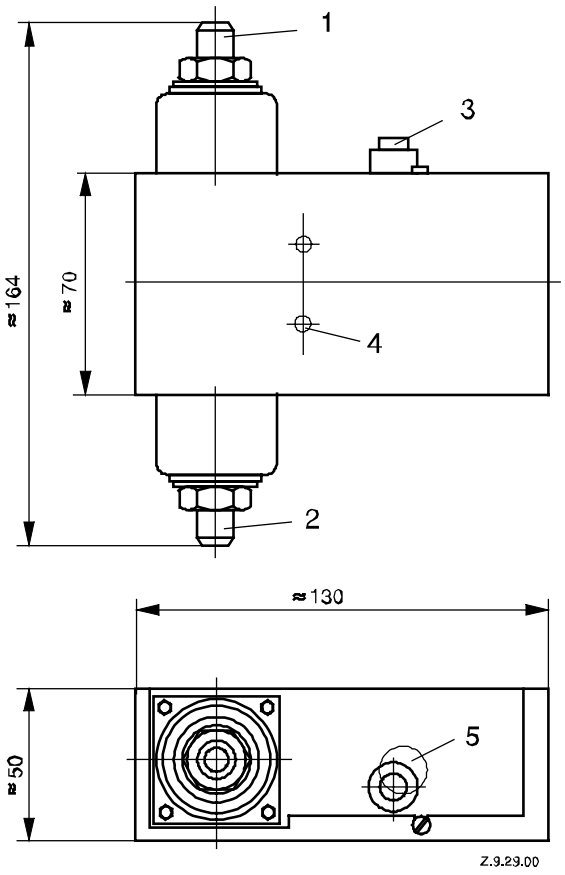
Note: Proper oil-pressure safety control with an approved switch is a condition of warranty!

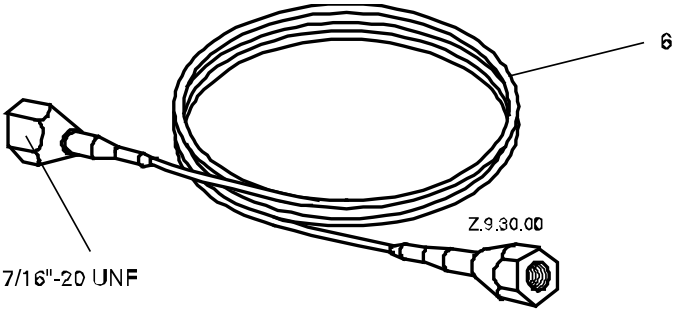
Specifications for electro-mechanical oil –pressure switches follow:
cut-out pressure: 0.63 ± 0.14 bar
cut-on pressure: 0.90 ± 0.1 bar
time delay: 120 ± 15 sec

Approved oil-pressure switched can be taken from the following table.

Supplier	Model No.	for Compressor	Voltage	Alarm Contact	Protection Class [1]
Alco Controls	**FD 113 ZU (A22-057)**	**D2 - D8**	**24..240 V AC/DC**	**yes**	**IP 30**
Ranco	P 30 - 5842	D2 - D8	120/240 V	yes	IP 20
Danfoss	MP 55	D2 - D8	110/220 V	yes	
	P 45 NCA - 12	D2 - D8	120/240 V	no	IP 30
Penn	P 45 NCB - 3	D2 - D8	120/240 V	yes	
	P 45 NAA - 3	D2 - D8	24 V	no	
	P 45 NCA - 9104	D2 - D8	110/220 V	yes	
1) Evaluation according to IEC 34					

Oil Pressure Differential Switch Alco FD 113 ZU **D2D – D8D**





1	Crankcase connection	7/16" - 20 UNF
2	Connection for oil pump	7/16" - 20 UNF
3	Manual reset button	
4	Mounting bracket holes	10 - 32 UNF B2
5	Cable bushing	
6	Capillary tube Cu	1000 mm

Technical Data FD 113 ZU	**(A22-057)**
Cut-out oil	0.63 ± 0.14 bar
Cut-in oil	0.90 ± 0.1 bar
Time delay	120 ± 15 s
Inductive load (AC 11)	3 A / 230 V AC
Inductive load (DC 11)	0.1 A / 230 V DC
Max. ambient temperature	70° C
Manual reset	
Built-in alarm connection	

[1] tentative data

Electrical Installation

The electric motors were specially developed for use in refrigeration compressors. High quality insulation materials are used because the motors are subjected to varying loads and are in contact with refrigerant and refrigeration oil.
Compressor motor and fan motor windings have class B insulation as per VDE 0530. In normal operation motors will never approach the temperature limit of 130°C.
Technical documentation and the compressor nameplate show the nominal voltage range. An additional tolerance of ±10% can be considered.

Example: Compressor model D2DL*-750 EWL
Nominal voltage range as per compressor nameplate:

Volts: 220 - 240 Δ / 380 - 420 Y
Power supply tolerance ± 10%
Motor can be connected in Δ or Y
Actual voltage range:

a)	from	220 V	-	10 %	=	198 V
	to	240 V	+	10 %	=	264 V in Δ
b)	from	380 V	-	10 %	=	342 V
	to	420 V	+	10 %	=	462 V in Y

Discus compressors are available for 50 and/or 60 Hz operation.
Application of a 50 Hz motor on 60 Hz and vice versa is possible provided that the voltage changes in proportion to the frequency.

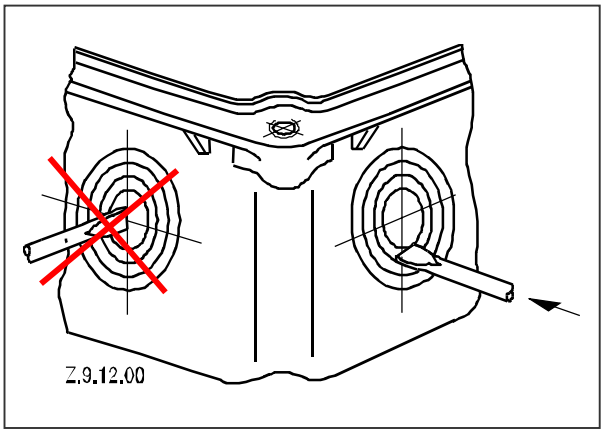
50 Hz = 380 V ==> 60 Hz = 456 V
60 Hz = 420 V ==> 50 Hz = 350 V

When the compressor is shipped the motor protector is mounted in the terminal box. The thermistors are connected, the power supply and the control circuit must be wired (see wiring diagram on the inside of the terminal box lid).

Due to European Standard EN50262, which replaced the former applied Standard DIN, the holes for the cable bushings in the terminal box have been changed. Changes for D4D, D6D , D8D etc have been implemented.

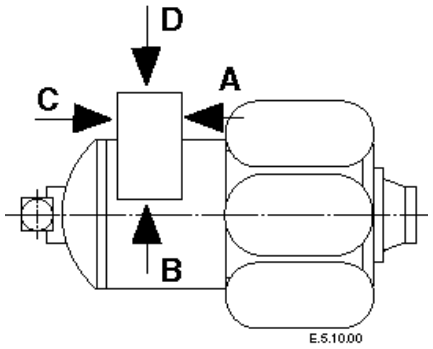
Terminal boxes with IP 56 protection class have no connection strips for reasons of space. D2D and D3D terminal boxes with IP 56 (according to IEC 529) protection class do not contain motor protectors. The modules must be mounted separately. In such cases the wires to the module should be kept well away from heavy cables. The influence of heavy power cables could cause incorrect motor temperature monitoring. The resistance of the connecting cables should not total more than 2.5Ω.

Terminal box preparation diagram for cable gland fitting: **Note position of the screw driver !**

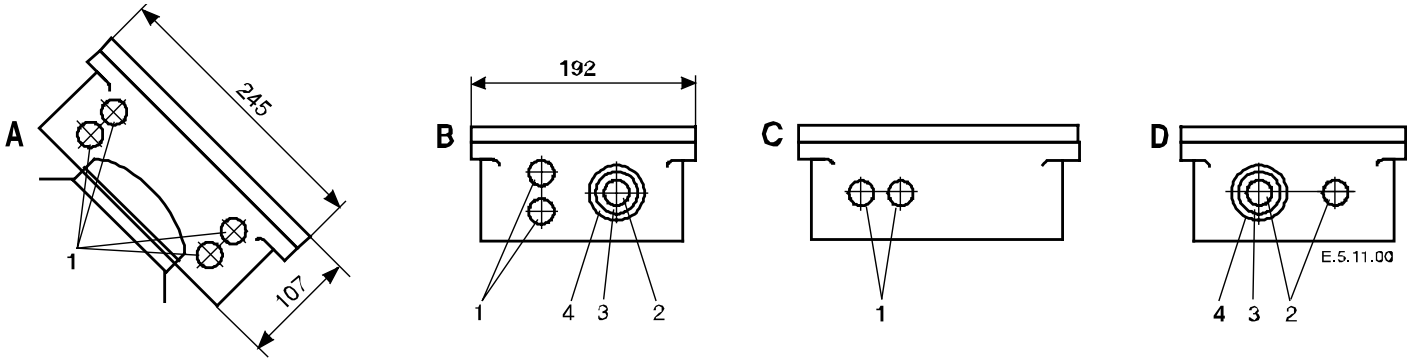


Position at terminal box	Previous terminal box			New terminal box		
	Hole at terminal box diameter mm	Cable bushing Pg	Outside diameter mm	Hole at terminal box diameter mm	Cable bushing metric	Outside diameter mm
1	21.5	13.5	20.4	20.6	M20 x 1.5	20
2	29.5	21	28.3	32.5	M32 x 1.5	32
3	48	36	47	50.5	M50 x 1.5	50
4	60.5	48	59.3	63.5	M63 x 1.5	63

Position of the different holes for cable bushings (e.g. top view of a 6-cylinder compressor)

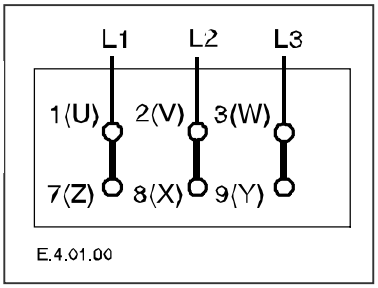
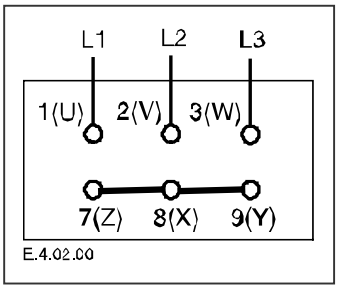
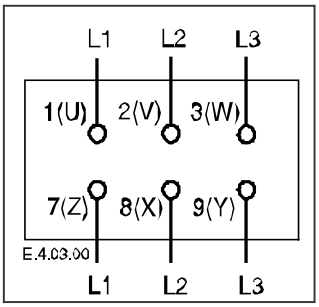
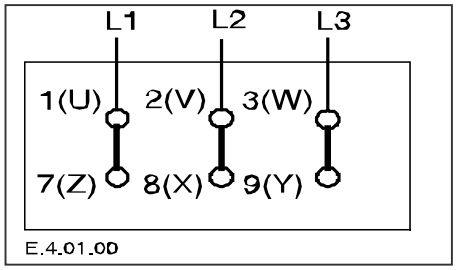
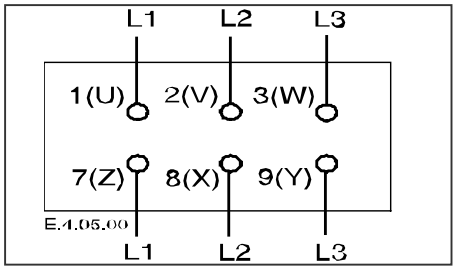
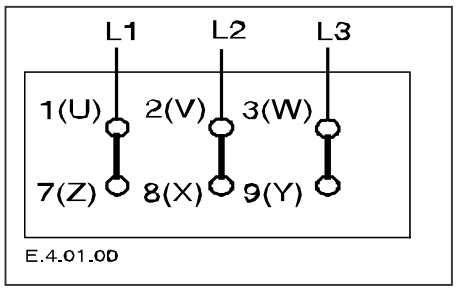
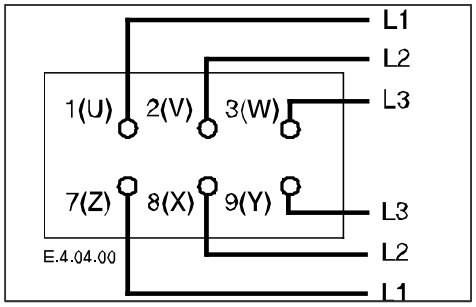


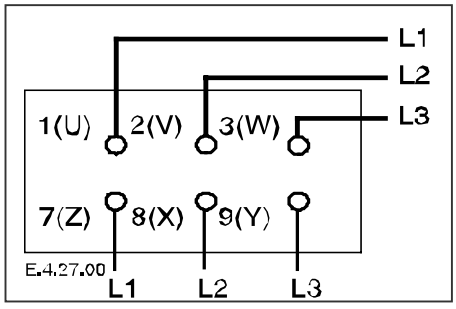
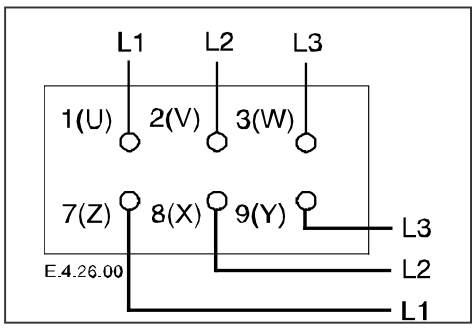
Standard terminal box with enclosure class according IEC 34: IP 54



Principal Wiring Diagrams

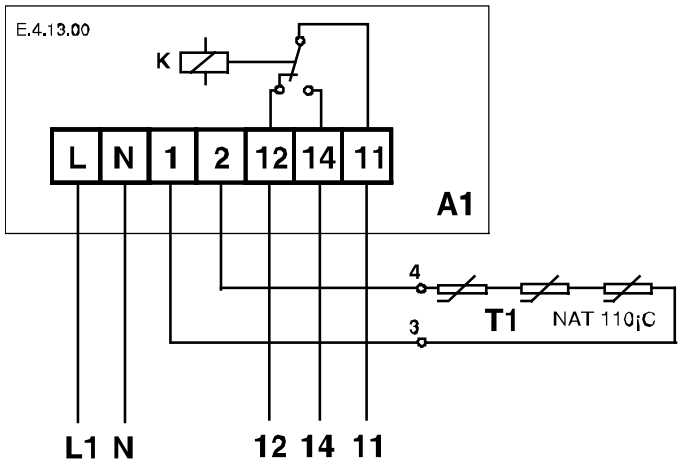
1. Compressor Motor Jumper Position

<table>
<tr><td rowspan="2">Star-Delta-Motor
Y - Δ
Code E</td><td>Direct-On-Line Start
Δ</td><td>Direct-On-Line Start
Y</td><td>Star-Delta-Start
Y - Δ</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td rowspan="2">Part-Winding
motor:
Y – Y
Code A</td><td colspan="2">Direct-On-Line Start
Y - Y</td><td>Part-Winding Start, first Start Step 1–2-3
Y - Y</td></tr>
<tr><td colspan="2"> 
</td><td> 
</td></tr>
<tr><td rowspan="2">Part-Winding
motor:
Δ - Δ
Code B</td><td colspan="2">Direct-On-Line Start
Δ - Δ</td><td>Direct-On-Line Start
Δ - Δ</td></tr>
<tr><td colspan="2"> 
</td><td> 

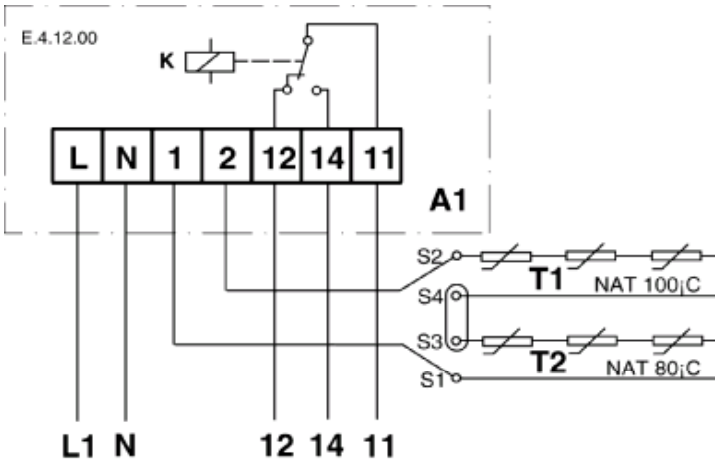
D8DH* - 5000 BWC, D8DJ* - 6000</td></tr>
<tr><td rowspan="2">Part-
Winding
motor:
Δ - Δ
Code B</td><td colspan="2">Part-Winding Start, Starting Wiring
via Terminals 1–2-3</td><td>Part-Winding Start, Starting Wiring
via Terminals 7-8-9</td></tr>
<tr><td colspan="2"> 
</td><td> 
</td></tr>
</table>

2. Release Module INT69 and INT69 TM

INT 69 (D2D, D3D)

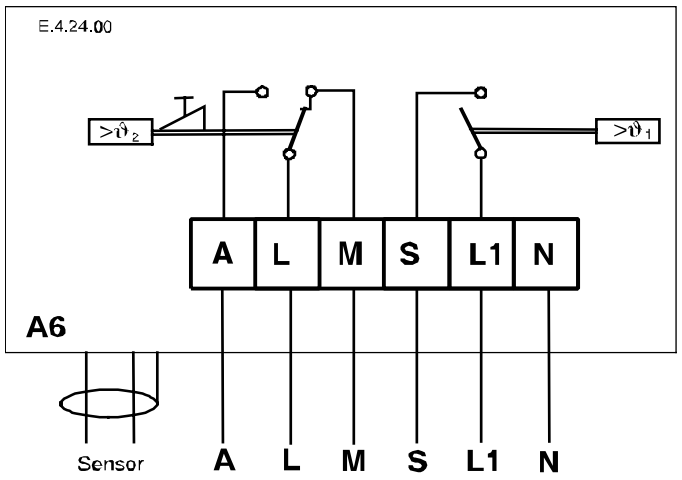


INT 69 TM (D4D – D8D)



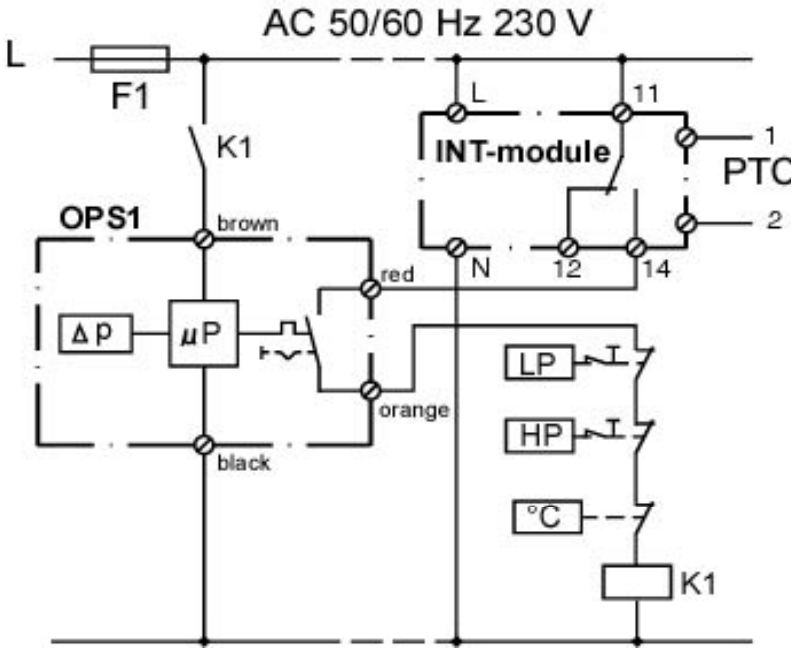
L	Voltage connection
N	Neutral connection
1+2	Thermistor chain connection
12	Alarm connection
14	Control circuit
11	Control Voltage connection
3+4	Cable bushings of thermistor connections in terminal box D2D, D3D
S1-S4	Cable bushings of thermistor connections in terminal box D4D - D8D
T1+T2	Thermistor chain (about 90Ω - 750Ω per chain at +20°C)
A1	Release module
NAT	National response temperature
	Protection class IP 20

3. Demand Cooling

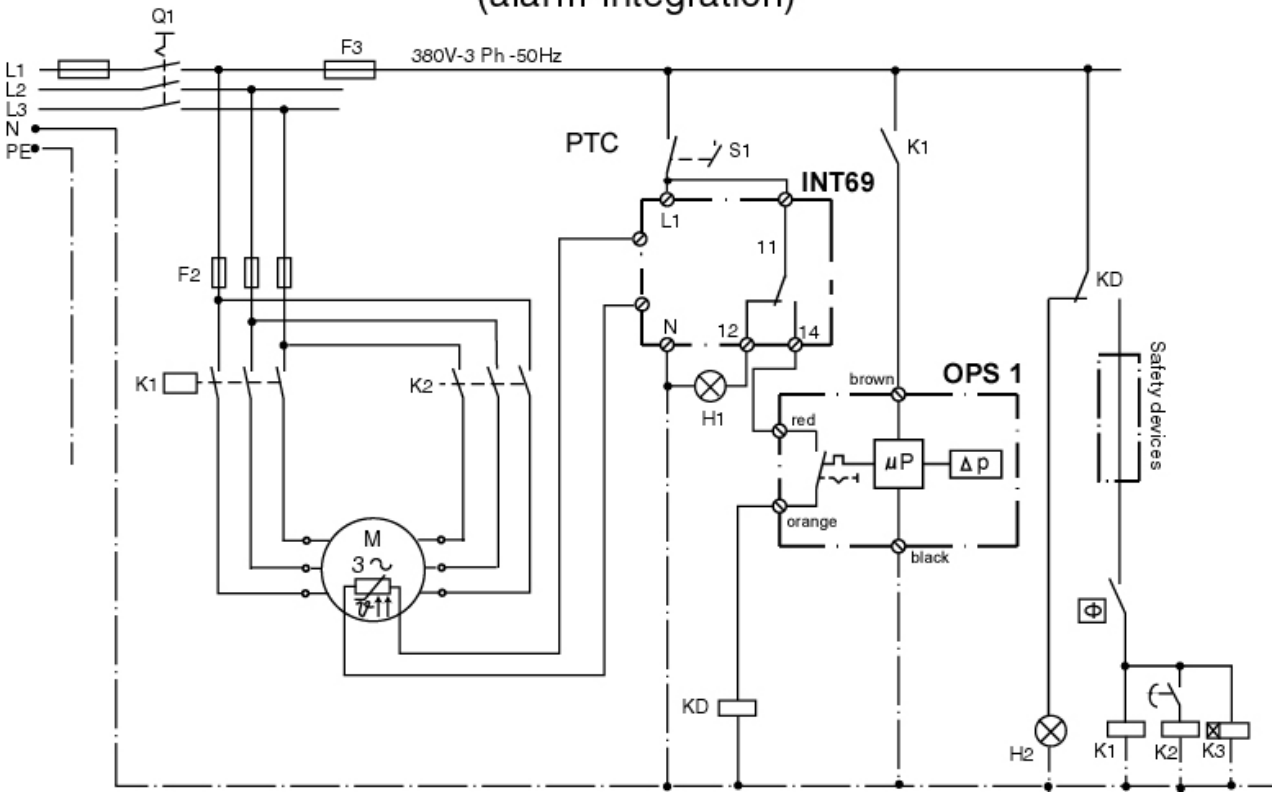


A	Alarm connection
L	Control voltage connection
M	Control circuit
S	Injection valve connection
L1	Voltage connection
N	Neutral connection
θ1	Temperature control device for energising the injection valve
θ2	Temperature control device for switch -ing off the compressor
A6	DEMAND COOLING Module

4. Oil Pressure Switch 1 (OPS1)

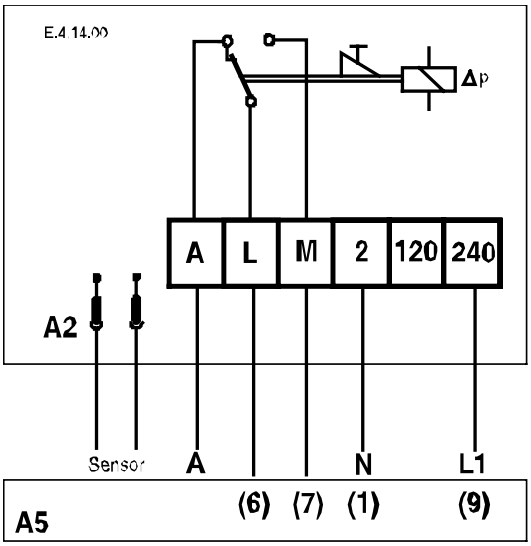


Wiring diagram OPS 1 with aux. relay KD
(alarm-integration)

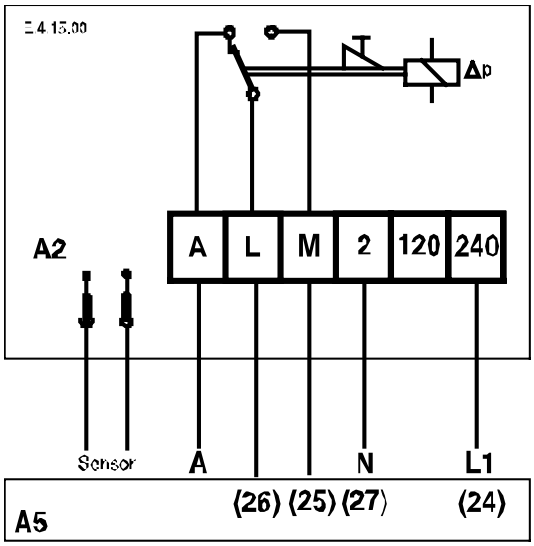


5. SENTRONIC Oil Pressure Control

D2D, D3D



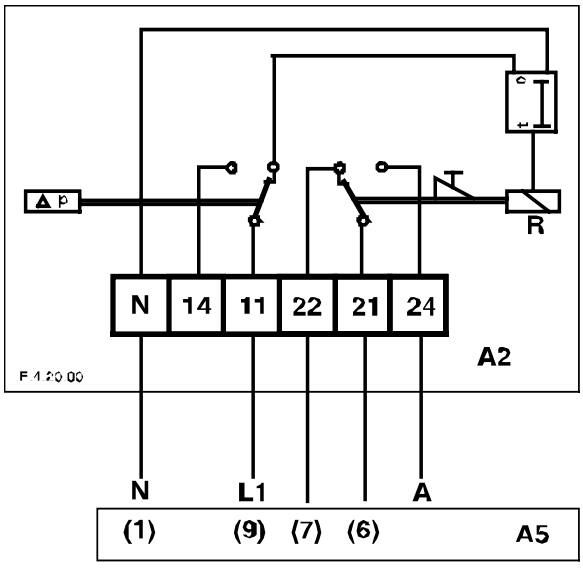
D4D – D8D



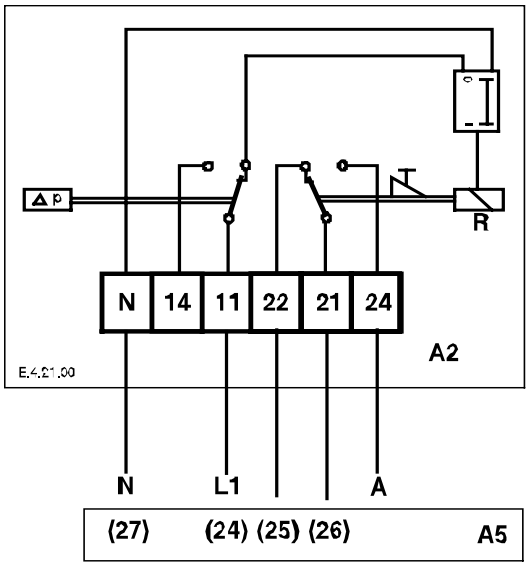
A alarm connection
L control voltage connection
M control circuit
2 neutral connection
L1 voltage connection
A2 oil pressure switch
A5 compressor terminal box
Protection class IP 31

6. Oil Pressure Switch - ALCO FD 113 ZU

D2D, D3D

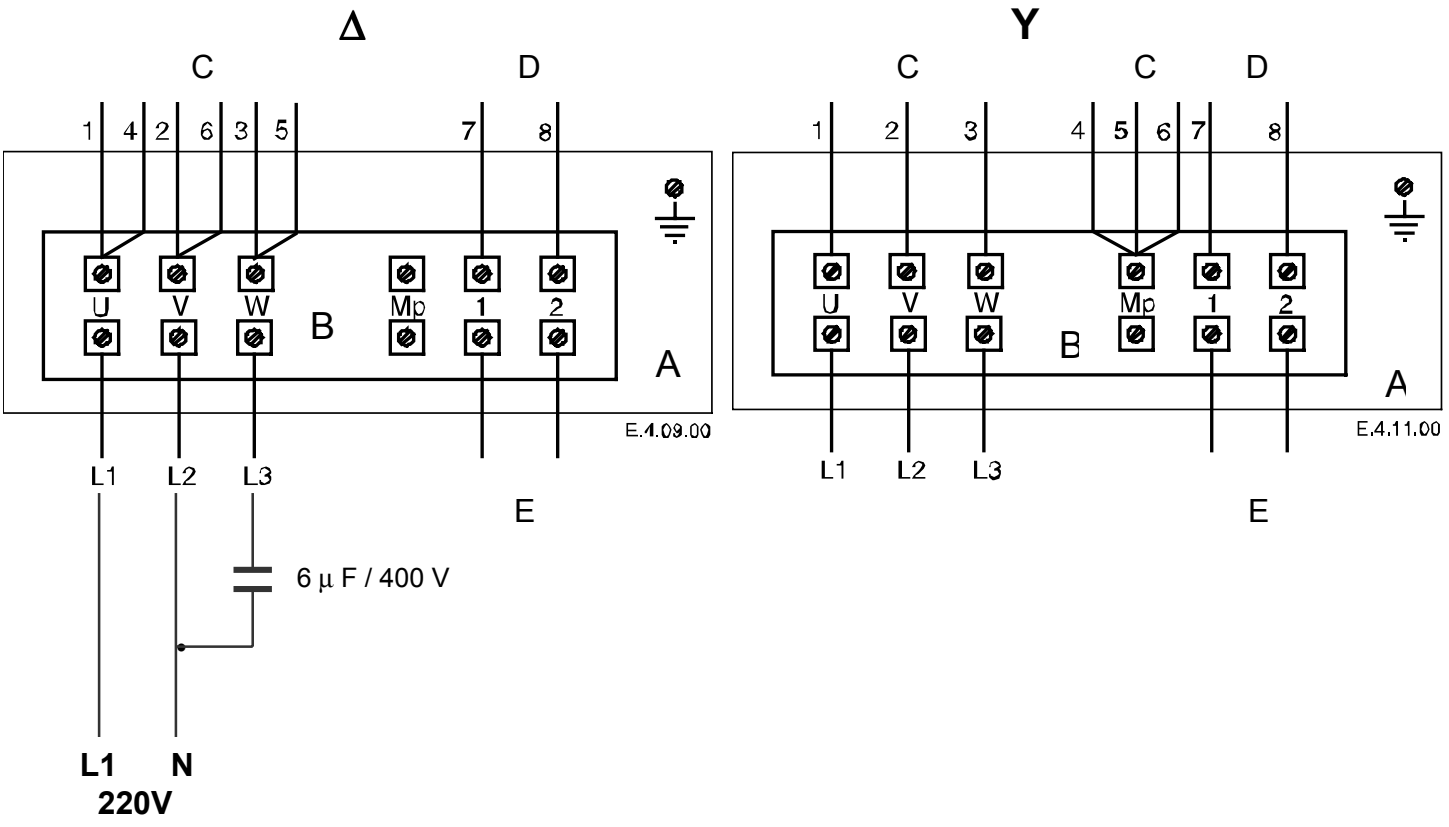


D4D – D8D



N Neutral connection
11 Voltage connection
22 Control circuit
21 Control voltage connection
24 Alarm connection
A2 Oil pressure switch
A5 Compressor terminal box
R Relay
t Time delay
Protection class IP 30

7. Additional Fans 60 Watt



A	B	C	D	E
terminal box	connecting block	motor winding	motor protection into C	control circuit

Connection	Voltages				Motor Current Ampere	Power Input Watt
	Volt	~	Hz	0		
△	220 - 240	1	50	+20% / -10%	0.50	105
△	220 - 240	3	50	+20% / -10%	0.50	100
Y	380 - 420	3	50	+20% / -10%	0.30	100
△	220 - 240	3	60	+20% / -10%	0.45	120
Y	380 - 420	3	60	+20% / -10%	0.25	120
Y	500 - 550	3	50	+20% / -10%	0.24	100

Causes of Failure

The prevention of failures is one of the primary responsibilities of the installer. Otherwise the user will not get the benefit of factory guaranteed quality.

1. Lubrication Problems

Compressors are delivered with an oil charge. The correct oil level is shown on page 7.
Some, but not all lubrication problems are listed below:

a) Oil pump out due to high on/off cycling rate.
The number of cycles should be limited to 10 - 12 per hour. A high cycling rate will pump oil into the sys -tem and lead to lubrication failure. Oil leaves the compressor at start-up and the short running time is in -sufficient to return the oil to the compressor via the suction side. Result: Lubrication damage.

b) Incorrect calculation of pipe sizes.
It should be remembered that the entire system will be coated in oil to some extent. Oil viscosity changes with temperature. More oil stays in the system than was originally expected.

c) Low gas velocity.
System gas velocity changes depending on temperature and load (capacity control). In low load conditions gas velocity may not be high enough to return oil to the compressor.

d) Faulty or badly designed oil return system.

e) Incorrect pipework.
For more information see special technical literature and the Technical Information 1.87.

f) Leaks.

In time, lubrication problems lead to failure of the main moving parts. A standard oil pressure switch protects the compressor against low oil pressure if the problem lasts for some considerable time. The best protection is the SENTRONIC system which records all abnormal oil pressure conditions.
The typical breakdown symptom of a compressor with inadequate lubrication is failure of the bearing furthest away from the oil supply the nearest having just enough oil to be properly lubricated.

2. Oil Dilution

During the off-cycle a certain refrigerant concentration is always present in the compressor oil. This depends on the compressor temperature and crankcase pressure.
Example: With a crankcase pressure of 8.03 bar corresponding to a saturation temperature of 22°C for R 22, the crankcase would contain a mixture of 35% R 22 and 65% oil. The rapid reduction of pressure on start-up causes the refrigerant to evaporate from the oil. This causes oil foaming which can be seen in the compressor oil sight glass. The oil pump draws in very diluted oil and foam and cannot build up oil pressure. If this cycle is repeated often enough bearing failure will eventually occur.
To prevent this type of failure a crankcase heater and/or a pump down system should be fitted.

3. Refrigerant Migration

When the compressor is switched off for a long period refrigerant can condense in the crankcase. If the compressor body is colder than the evaporator refrigerant will move from the evaporator to the compressor crankcase. Refrigerant migration normally occurs when the compressor is installed in a cold area. A crankcase heater and/or a pump down cycle provide good protection against refrigerant migration.

4. Inadequate Suction Superheat

The suction superheat should never be allowed to fall below 10 K.
Low superheat will cause valve plate, piston, cylinder wall and connecting rod damage. Low superheat can be caused by a defective or badly adjusted expansion valve, incorrect sensor bulb mounting or by very short refrigeration lines.
If refrigeration lines are very short the installation of a heat exchanger or an accumulator would be recommended.

5. Acid Formation
Acid forms in the presence of moisture, oxygen, metal, salts, metal oxides and / or high discharge temperatures. The chemical reactions are accelerated at higher temperatures. Oil and acid react with each other.
Acid formation leads to damage of the moving parts and in extreme cases to motor burnout.
Several different test methods can be used to test for acid formation.
If acid is present a complete oil change (including the oil in the oil separator) will help. A suction filter which removes acid should also be fitted. Check filter-drier condition.

6. Inadequate Compressor Cooling
Cooling fans must be fitted on certain compressor models. If the fan does not provide sufficient cooling high discharge temperatures can result. The only solution is to fit an appropriate cooling fan.

7. High Discharge Temperatures
The limit is 120°C measured on the discharge line a few centimeters from the service valve.
Symptoms of high discharge temperatures are cutting out on the high pressure switch (dirty condenser), oil carbonisation, black oil and acid formation. Inadequate lubrication is the result.
The condenser should be cleaned regularly.
The evaporating temperature should not be allowed to fall below the application limit of the compressor.

8. Motor Burn-out due to Undersize Contactors
If contactors are undersized the contacts can weld. Complete motor burnout on all three phases despite the presence of a functioning protection system can be the result.
Information for sizing contactors can be taken from the appropriate data sheets. If the application point of a compressor is changed the contactor sizing should be rechecked.

9. Motor Burnout due to By-passed or Disconnected Protectors.
If large sections of the windings are burned out it must be assumed that the protector was either not connected or by-passed.

Technical Application Questions
Questions relating to application or technical assistance on Discus compressors should be addressed to your local sales office.