DWM COPELAND

# *SH DISCUS Compressors*

Application Guidelines

# Index

# Important Information

**Only qualified personnel should install and repair DWM COPELAND compressors. The electrical connection of the compressor and of its accessories is also to be done by authorized personnel only.**

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, Changeover Guidelines, Spare Parts Lists etc. accessible from our website at www.ecopeland.com and www.Prestcold.com

# General 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 stop valve has been fully opened before the compressor is started. If the discharge stop 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 gas and can explode due to the high temperature in the cylinder head, and thereby destroy the compressor.**
**Even when handling the compressor correctly high temperatures may develop and cause injuries when touching.**

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 which is under pressure, and therefore subject to the local safety regulations, (EN 378).

Please also pay attention to our Service Information “Instructions for the Running of Refrigeration Systems” which is based on CECOMAF No. GT1-001.

# General

## 1. 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.**

## 2. Delivery

Please check whether the delivery is complete and intact. Deficiencies should be immediately reported in writing.

**Standard Scope of Delivery:**
- suction and discharge shut-off valves
- oil charge, oil sight glass
- mounting kit
- cooling fan (low-temperature models only)
- motor protector
- holding charge

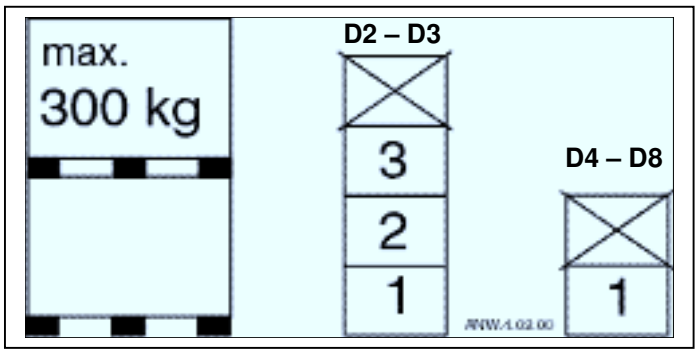
**Packaging**

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

**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 equipment appropriate for the weight involved.




**For safety reasons one or two lifting eyes should be fitted before moving a compressor (1/2" - 13 UNC)! Otherwise refer to the drawings on page 4 to see how to apply other lifting methods safely.**

In order to avoid refrigerant leaks or other damages the compressors should not be lifted by the service valves or other accessories.

**D3D compressors should not be lifted using a rope. The compressor shape can cause the rope to slip off. Therefore the use of the lifting eye is the only recommended handling method.**

## 3. 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 run cycle. Springs are selected in accordance with the table on page 4. Principally a compressor can be installed without spring mountings. To ensure proper lubrication of moving parts the compressor should be installed horizontally on both axes.

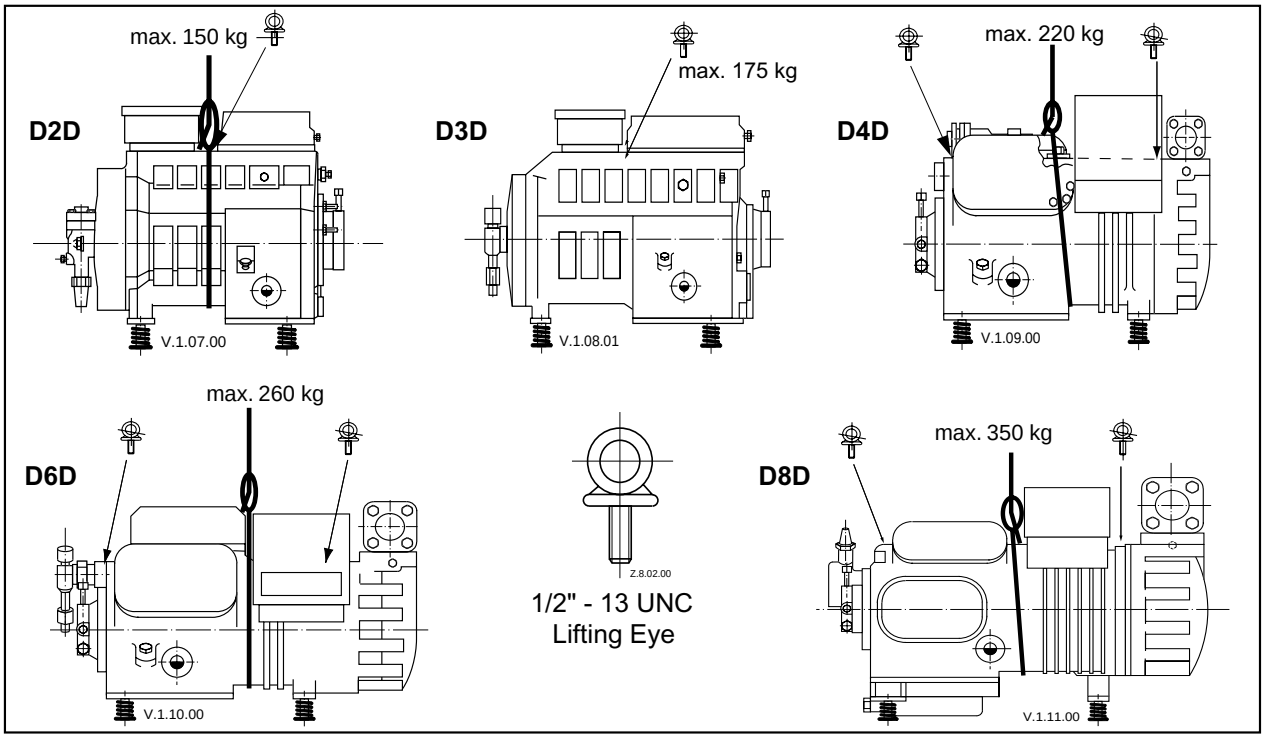
TWIN compressors are fitted to the mounting rails using rubber pads. If the installation requires a very high level of vibration absorbing additional vibration absorbers can be fitted between the rails and the foundation.

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.

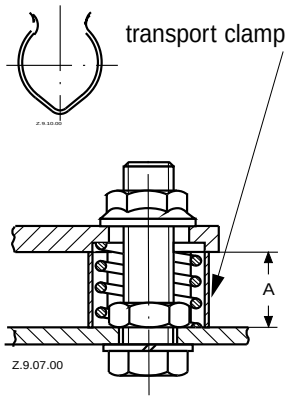
Each cylinder head has a plugged 1/8" - 27 NPTF tapped hole for connecting high-pressure switches.



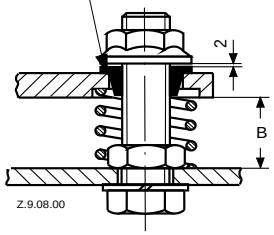

## Vibration Absorbers

| Motor-Compressor Type | Size A mm | Size B mm | Colour of Springs: motor end | Colour of Springs: compr. end |
|---|---|---|---|---|
| D2DC - 500 | 30 | 35 | 2 x maroon | 2 x maroon |
| D2DD - 500 | 30 | 35 | | |
| D2DL - 400 | 30 | 35 | | |
| D2DL - 750 | 30 | 35 | | |
| D2DB - 500 | 30 | 35 | | |
| D2DB - 750 | 30 | 35 | | |
| D3DA - 500 | 30 | 35 | | |
| D3DA - 750 | 30 | 35 | | |
| D3DC - 750 | 30 | 35 | | |
| D3DC - 1000 | 30 | 35 | | 2 x white |
| D3DS - 1000 | 30 | 35 | | |
| D3DS - 1500 | 34 | 44 | 2 x yellow | 2 x green |
| D4DA - 1000 | 34 | 44 | | |
| D4DF - 1000 | 34 | 44 | | |
| D4DA - 2000 | 34 | 44 | | |
| D4DH - 1500 | 34 | 44 | | |
| D4DL - 1500 | 34 | 44 | | |
| D4DH - 2500 | 34 | 44 | 2 x black | |
| D4DJ - 2000 | 34 | 44 | | |
| D4DT - 2200 | 34 | 44 | | |
| D4DJ - 3000 | 34 | 44 | | |
| D6DH - 2000 | 34 | 44 | | |
| D6DL - 2700 | 34 | 44 | | |
| D6DH - 3500 | 34 | 44 | 2 x blue | |
| D6DT - 3000 | 48 | 44 | | 2 x red |
| D6DJ - 3000 | 48 | 44 | | |
| D6DJ - 4000 | 48 | 44 | | |
| D8DL - 3700 | 48 | 51 | 2 x silver | 2 x black |
| D8DH - 5000 | 48 | 51 | | |
| D8DT - 4500 | 48 | 51 | | |
| D8DJ - 6000 | 48 | 51 | | |

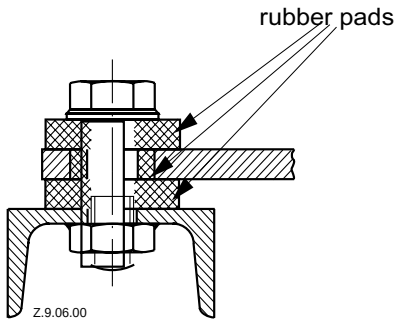
Transport Position




Running Position




Rubber Pads for TWIN Compressors

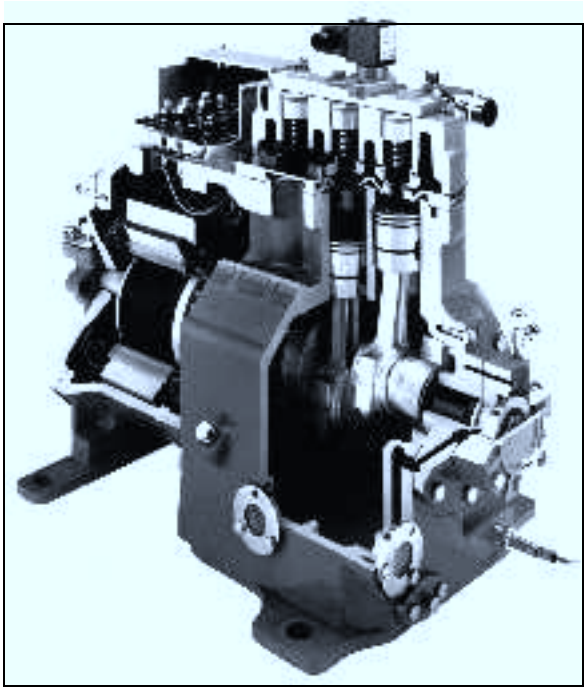


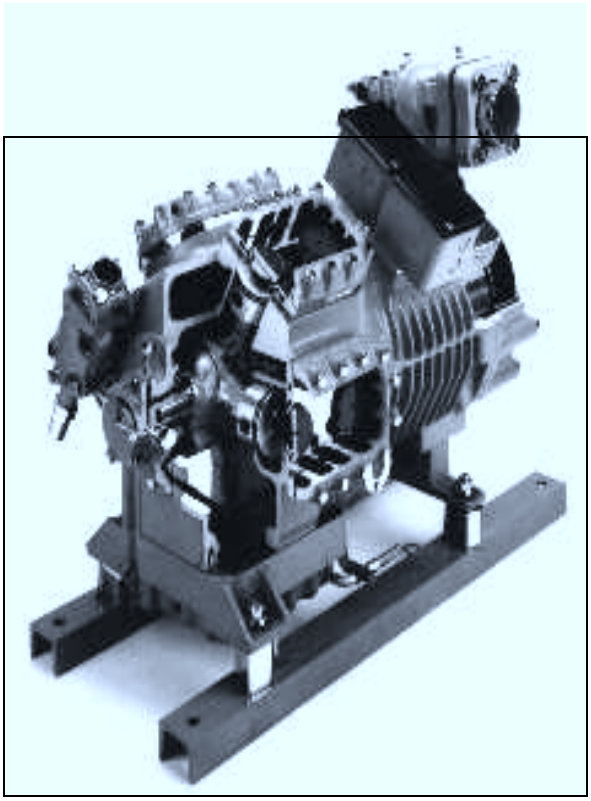
**These switches must be adjusted, functionally tested and properly wired before putting the compressor into service. They must stop the compressor if the allowable pressure is exceeded.**
**The complete cylinder head is under discharge pressure.**

A relief valve is installed in single-stage compressors with a displacement of over 50m$^3$/hr. The relief valve is dependant on counter 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 (standstill) |





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**
The following refrigeration oils are approved from Copeland:

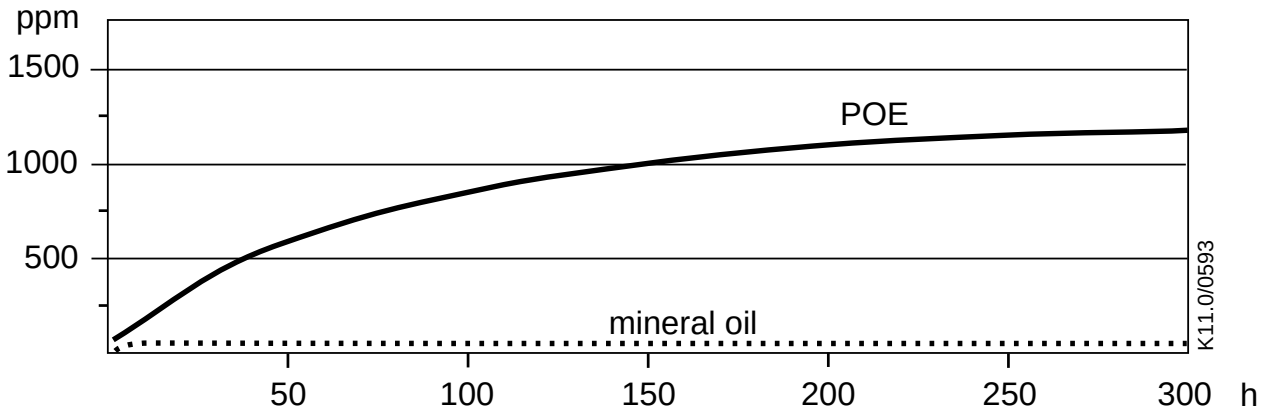
Ester Oils for R 134a, R407C and R404A / R507

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

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).
Ester oil is very hygroscopic and sensitive to moisture. This sensitivity influences the chemical stability of the oil. **It is essential to fit a filter drier which can reduce the moisture level to 50 ppm after several days running.**
This value has been recommended for refrigeration systems for many years and is nothing extraordinary. In general ester oil requires clean and careful handling.
In case existing installations operating with CFCs or HCFC’s are to be changed over to HFC’s refrigerants like R134a, R407C and R404A / R507 please request Technical Information 3.93, 95-14 or 1.94 for information on this topic.

**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 page 45, 46 and 50.

**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 |

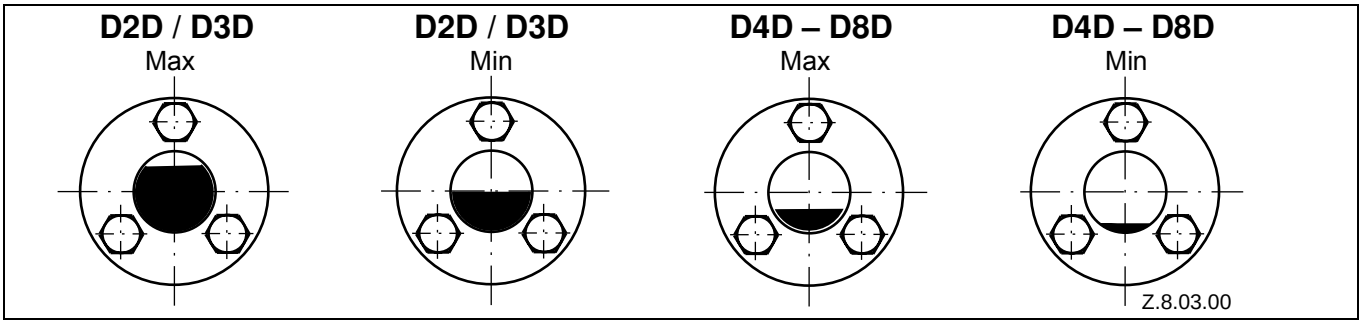
*Flare connection

**Oil Circulation**

Oil returned through a suction filter with the suction gases and separated in the motor chamber reaches the crankcase by way of a relief valve in the partition between motor and crankcase . This relief valve closes on compressor start-up due to the pressure difference arising between motor 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 pressure decreased rapidly. The valve does not reopen until the pressure has been equalized by means of a second relief 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 (see 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 shut-down. 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 connected to the oil pump (see page 6). The second gauge should be connected to the crankcase (T-fitting instead

of plug 3 or 5 on the compressor crankcase) or the suction service valve. (See Technical Bulletin No. 04 for details).
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.

## 4. 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.
With the exception of Wolverine all gaskets should be oiled before fitting, *O-rings should also be oiled.
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.
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 remain closed during pressure testing to prevent air and moisture from entering. 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 valves are closed and the system is evacuated down to 0.3 mbar. Then the compressor must be evacuated.
The factory holding charge - dry air - of the compressor is under pressure (about 1 to 2.5 bar) in order to indicate the compressor is leak-proof.
When plugs are removed from the compressor in order to connect a pressure gauge or to fill in oil, the plug may pop off and oil can spurt out.

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

**System Cleanliness**
Brazing only when using inert gas! Only materials and components approved by refrigeration engineering are suitable.
It is absolutely necessary that all impurities (dirt, brazing scale, flux, etc.) are removed from the system before operation in order to avoid 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. Other blockages can occur in the suction filter situated in the compressor, and a high pressure drop can even damage it. For this reason we strongly recommend the use of a large suction tube 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.

## 5. 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.

**Direct-on-Line Start**
All compressors can be started Direct-On-Line.

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

**Part-Winding Start (YY/Y) - Motorcode A**
PWS motors contain two parallel windings (2/3 + 1/3) which are connected in star. For Direct-On- Line starting both windings must be connected in parallel. The connection is made according to the wiring diagram in the terminal box using the jumpers provided. 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.**
This starting method is called part-winding start.
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).

**Part-winding motor for the 8-cylinder motor-compressors - Motorcode B**
From January 1994 onwards, accessible hermetic 8-cylinder motor-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 across the 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. Please refer to the existing data sheets for the according values.
If the motor is supplied with power by terminals 1–2–3 (without jumpers), a true part-winding start is put into effect. The starting current is 68% of the value for across the line starting. When the motor is started via terminals 7-8-9 (without jumpers), the starting current is 54%. (For details and limitations see Technical Information 2.93).
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**
Each motor-compressor has a motor protector. An overload relay for the electric motor is not required. Three thermistors are connected in series and embedded in the motor-windings. The sensor connections are brought out to a terminal board in the terminal box and connected to the built-in module (see page 56). All D4D-, D6D- and D8D-motors are equipped with two chains of three thermistors. The overload protector has a nominal voltage of 200 - 240 V / 1~ /40-60 Hz. Overload protectors for other voltages are available on request. The maximum test voltage for thermistors is 3 V. The resistance of the thermistor chain(s) on a cold compressor should be ≤ 750 Ω.

**Protection Class of Terminal Box according to IEC 34**

| 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 |

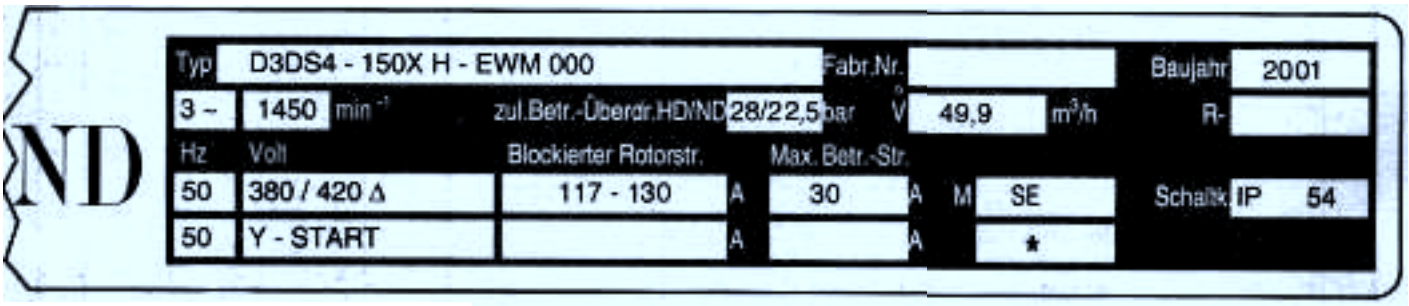
*external; overload protector

Cable glands can influence the protection class. Factory fitted cable glands reduce the protection class to IP 41.

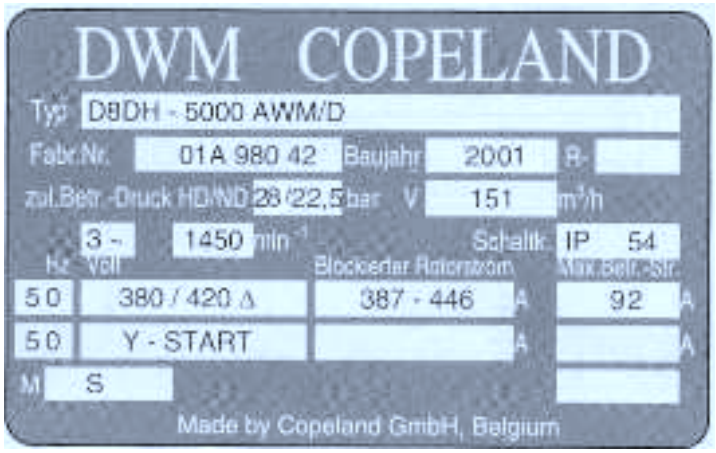
## 6. Nameplate Information
All important information for identification of the compressor is printed on the nameplate. The type of refrigerant used should be stamped on the nameplate by the installer. The date of production has been extended from showing merely the year. Now a letter is used to indicate 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.

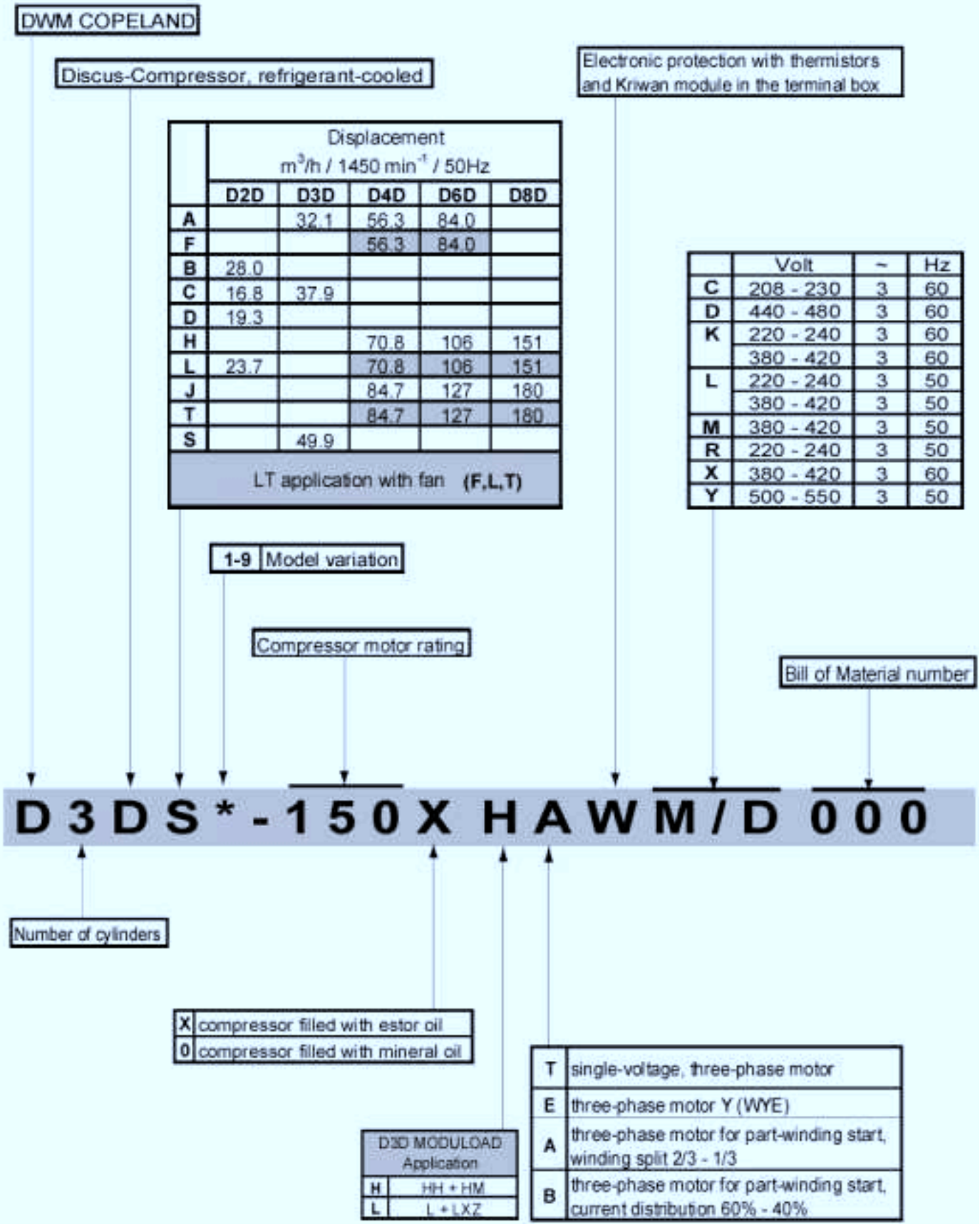
**Nameplate D2D, D3D**



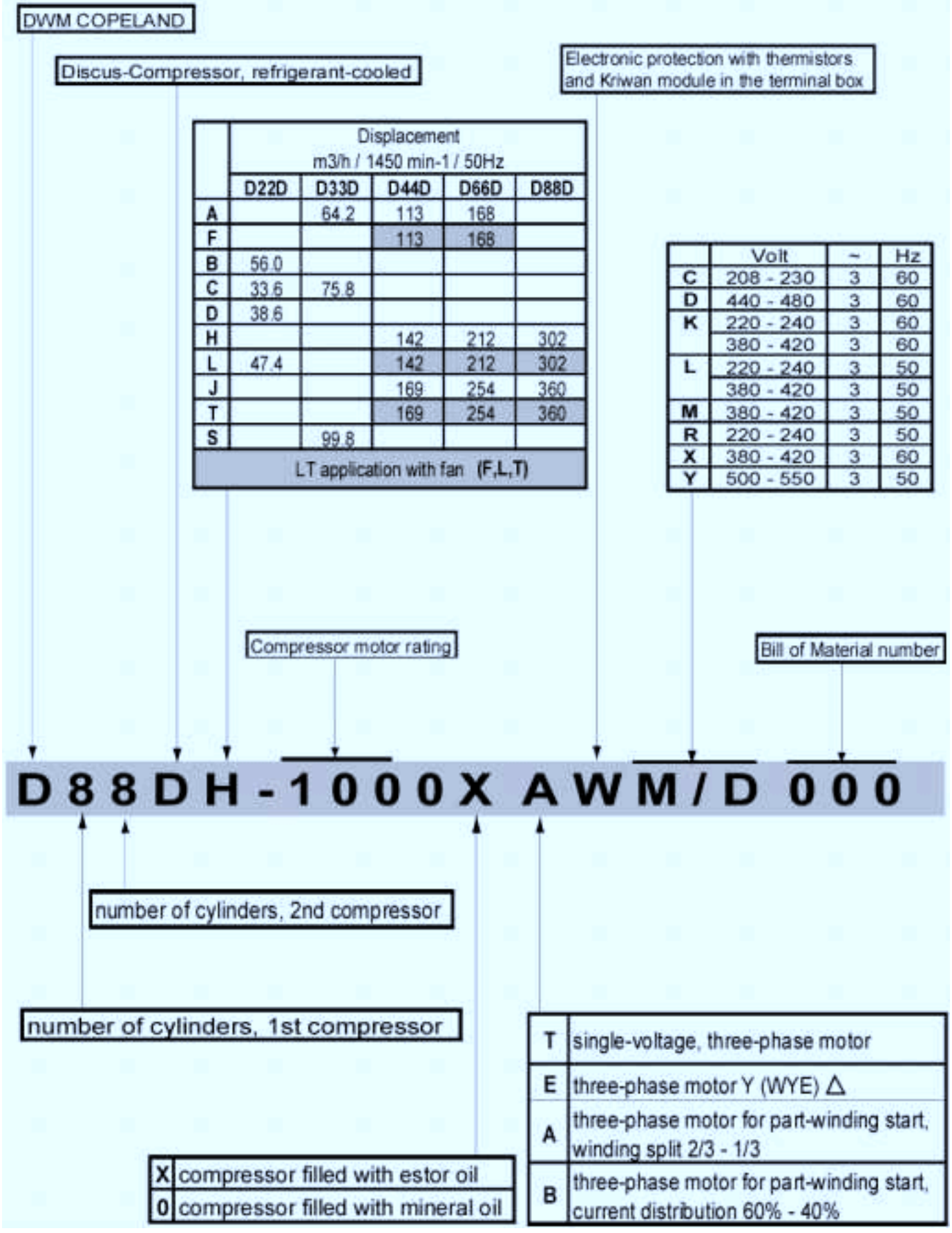

**Nameplate D4D - D8D**



# 7. Model Designation Discus Compressor



## 8. 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 |

| | |
|---|---|
| X | compressor filled with estor oil |
| 0 | compressor filled with mineral oil |

| | |
|---|---|
| T | single-voltage, three-phase motor |
| E | three-phase motor Y (WYE) Δ |
| A | three-phase motor for part-winding start, winding split 2/3 - 1/3 |
| B | three-phase motor for part-winding start, current distribution 60% - 40% |

## Technical Data on Accessories

| Motor-Compressor | Capacity Control | Unloaded Start | | | Heater Blade (Watt) | | | Oil Charge | Suction Line Size (sweat) | Discharge Line Size (sweat) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Solenoid Valve | Pilot Valve | Check Valve[1] | | | | | | |
| | optional | | | | | | | l | | |
| D2DC - 500 | - | EVR 15 | - | NRV 22S ∅ 22 | 70 | - | - | 2.3 | ∅ 1 3/8" | ∅ 7/8" |
| D2DD - 500 | - | EVR 15 | - | NRV 22S ∅ 22 | 70 | - | - | 2.3 | ∅ 1 3/8" | ∅ 7/8" |
| D2DL - 400 | - | EVR 15 | - | NRV 22S ∅ 22 | 70 | - | - | 2.3 | ∅ 1 3/8" | ∅ 7/8" |
| D2DL - 750 | - | EVR 15 | - | NRV 22S ∅ 22 | 70 | - | - | 2.3 | ∅ 1 3/8" | ∅ 1 1/8" |
| D2DB - 500 | - | EVR 15 | - | NRV 22S ∅ 22 | 70 | - | - | 2.3 | ∅ 1 3/8" | ∅ 7/8" |
| D2DB - 750 | - | EVR 15 | - | NRV 22S ∅ 22 | 70 | - | - | 2.3 | ∅ 1 3/8" | ∅ 1 1/8" |
| D3DA - 500 | MODULOAD | EVR 20 | - | NRV 22S ∅ 22 | 70 | - | - | 3.4 | ∅ 1 3/8" | ∅ 7/8" |
| D3DA - 750 | MODULOAD | EVR 20 | - | NRV 28S ∅ 28 | 70 | - | - | 3.4 | ∅ 1 3/8" | ∅ 1 1/8" |
| D3DC - 750 | MODULOAD | EVR 20 | - | NRV 28S ∅ 28 | 70 | - | - | 3.4 | ∅ 1 3/8" | ∅ 1 1/8" |
| D3DC - 1000 | MODULOAD | EVR 20 | - | NRV 28S ∅ 28 | 70 | - | - | 3.4 | ∅ 1 3/8" | ∅ 1 1/8" |
| D3DS - 1000 | MODULOAD | EVR 20 | - | NRV 28S ∅ 28 | 70 | - | - | 3.4 | ∅ 1 3/8" | ∅ 1 1/8" |
| D3DS - 1500 | MODULOAD | EVR 20 | - | NRV 28S ∅ 28 | 70 | - | - | 3.4 | ∅ 1 5/8" | ∅ 1 1/8" |
| D4DA - 1000 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.5 | ∅ 1 5/8" | ∅ 1 1/8" |
| D4DF - 1000 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.5 | ∅ 1 5/8" | ∅ 1 1/8" |
| D4DA - 2000 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.0 | ∅ 1 5/8" | ∅ 1 1/8" |
| D4DH - 1500 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 3.6 | ∅ 1 5/8" | ∅ 1 1/8" |
| D4DL - 1500 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 3.6 | ∅ 1 5/8" | ∅ 1 1/8" |
| D4DH - 2500 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.0 | ∅ 2 1/8" | ∅ 1 1/8" |
| D4DJ - 2000 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.0 | ∅ 2 1/8" | ∅ 1 3/8" |
| D4DT - 2200 | 50% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.0 | ∅ 2 1/8" | ∅ 1 3/8" |
| D4DJ - 3000 | 50% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | 100 | - | 4.0 | ∅ 2 1/8" | ∅ 1 3/8" |
| D6DH - 2000 | 33% + 66% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | 100 | - | 4.3 | ∅ 2 1/8" | ∅ 1 3/8" |
| D6DL - 2700 | 33% + 66% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100 | - | 4.3 | ∅ 2 1/8" | ∅ 1 3/8" |
| D6DH - 3500 | 33% + 66% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | 100 | - | 4.3 | ∅ 2 1/8" | ∅ 1 3/8" |
| D6DT - 3000 | 33% + 66% | - | 705 RA 001 VLC | NRV 22S ∅ 22 | - | 100[2] | 200 | 7.4 | ∅ 2 1/8" | ∅ 1 3/8" |
| D6DJ - 3000 | 33% + 66% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | 100[2] | 200 | 7.4 | ∅ 2 1/8" | ∅ 1 3/8" |
| D6DJ - 4000 | 33% + 66% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | 100[2] | 200 | 7.4 | ∅ 2 1/8" | ∅ 1 3/8" |
| D8DL - 3700 | 33% + 66% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | - | 200 | 7.7 | ∅ 2 5/8" | ∅ 1 5/8" |
| D8DH - 5000 | 33% + 66% | - | 705 RA 001 VLC | NRV 35S ∅ 42 | - | - | 200 | 7.7 | ∅ 2 5/8" | ∅ 1 5/8" |
| D8DT - 4500 | 33% + 66% | - | 705 RA 001 VLC | NRV 28S ∅ 28 | - | - | 200 | 7.7 | ∅ 3 1/8" | ∅ 1 5/8" |
| D8DJ - 6000 | 33% + 66% | - | 705 RA 001 VLC | NRV 35S ∅ 42 | - | - | 200 | 7.7 | ∅ 3 1/8" | ∅ 1 5/8" |

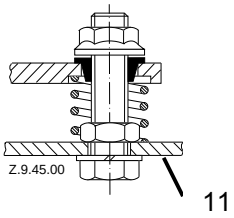
[1] for TWIN-compressors and in parallel compressor operation with enforced spring (Type NRV**H**…)

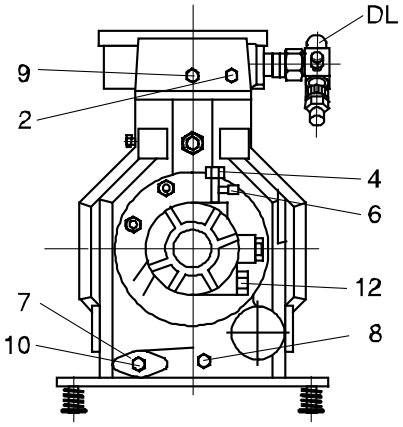
[2] possible as an addition, minimum is 200 W

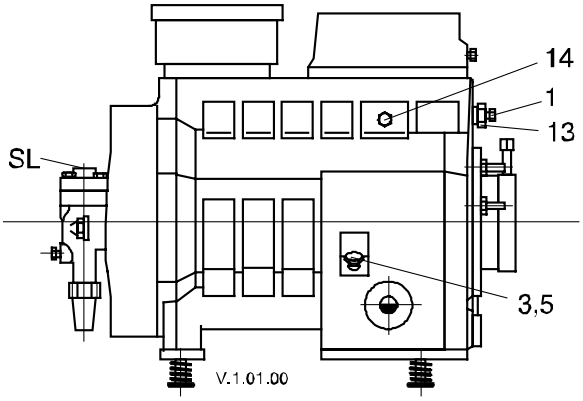
# Discus Compressor Connections

## D2D_3

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



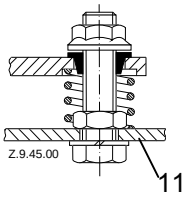



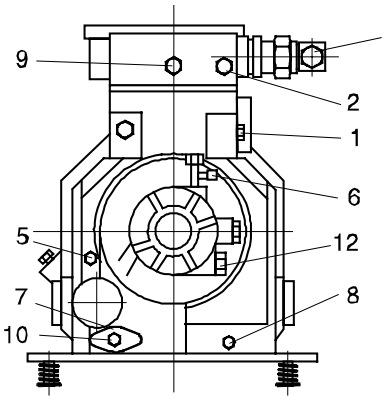



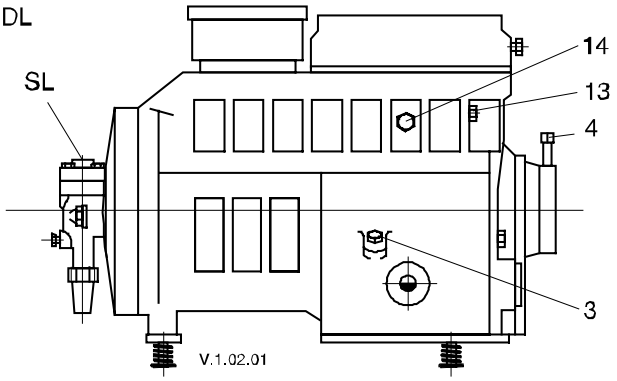

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SL | suction line size | (sweat) | | | 7 | oil screen built-in | X | |
| DL | discharge line size | (sweat) | | | 8 | sleeve (crankcase heater) | 3/8" | - 18 NPSL |
| 1 | plug low-pressure connection | 1/8" | - 27 | NPTF | 9 | plug high-pressure 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 | ∅ | 14 mm |
| 4 | oil-pressure control H.P. | 1/4" | ∅ 6 | mm | 12 | sensor connection / SENTRONIC | X | |
| 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



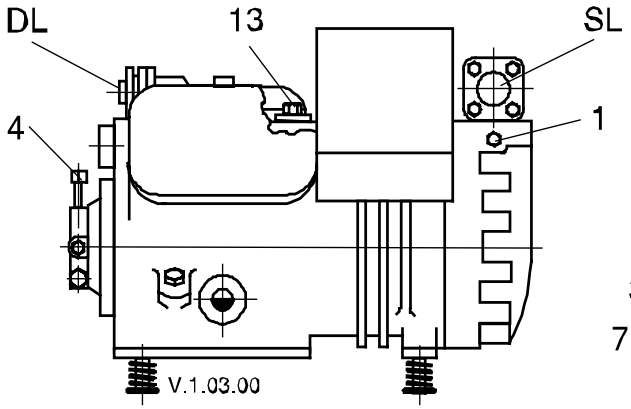



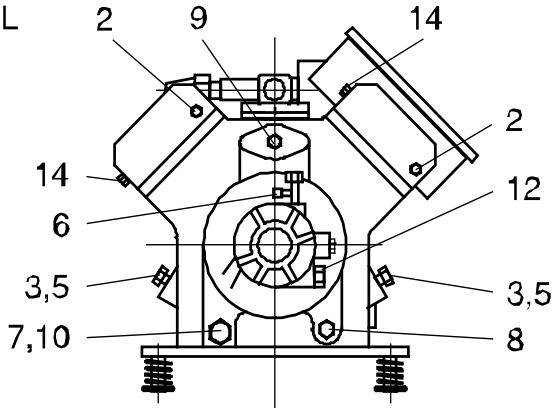



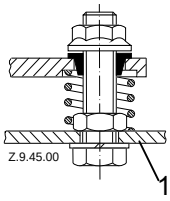

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SL | suction line size | (sweat) | | | 7 | oil screen built-in | X | |
| DL | discharge line size | (sweat) | | | 8 | sleeve (crankcase heater) | 3/8" | - 18 NPSL |
| 1 | plug low-pressure connection | 1/8" | - 27 | NPTF | 9 | plug high-pressure 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 | ∅ | 14 mm |
| 4 | oil-pressure control H.P. | 1/4" | ∅ 6 | mm | 12 | sensor connection / SENTRONIC | X | |
| 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



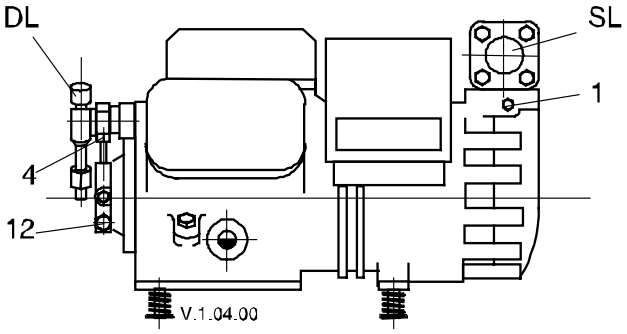



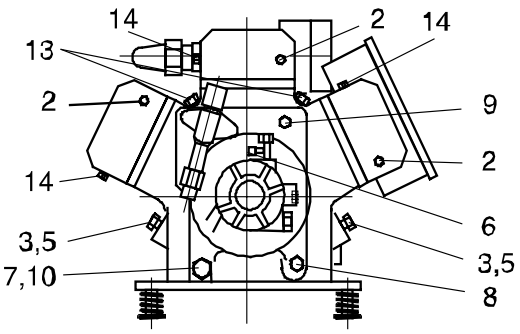



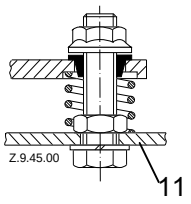

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SL | suction line size | (sweat) | 7 | oil screen built-in | X | | |
| DL | discharge line size | (sweat) | 8 | sleeve (crankcase heater) | 1/2" | - 14 | NPSL |
| 1 | plug low-pressure connection | 1/8" - 27 NPTF | 9 | plug high-pressure connection | 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 / SENTRONIC | 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



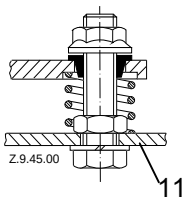



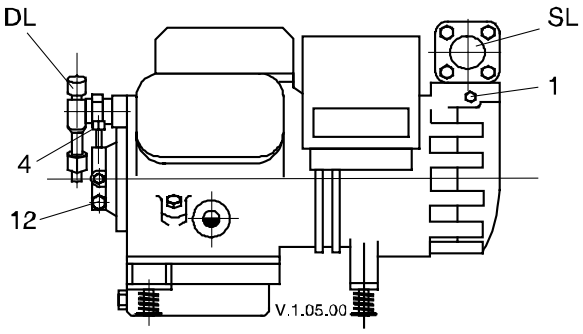

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SL | suction line size | (sweat) | 7 | oil screen built-in | X | | |
| DL | discharge line size | (sweat) | 8 | sleeve (crankcase heater) | 1/2" | - 14 | NPSL |
| 1 | plug low-pressure connection | 1/8" - 27 NPTF | 9 | plug high-pressure connection | 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 / SENTRONIC | 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 |

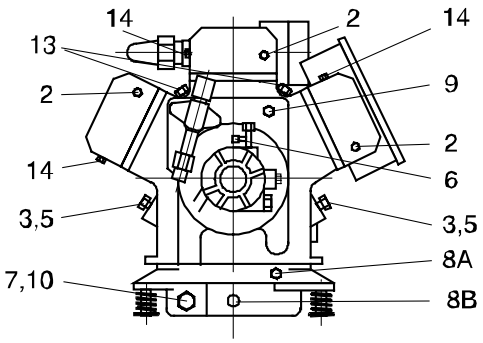
[1)] illustration without fan and oil cooler

## D6D_3 / 4

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



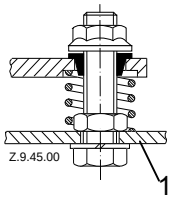



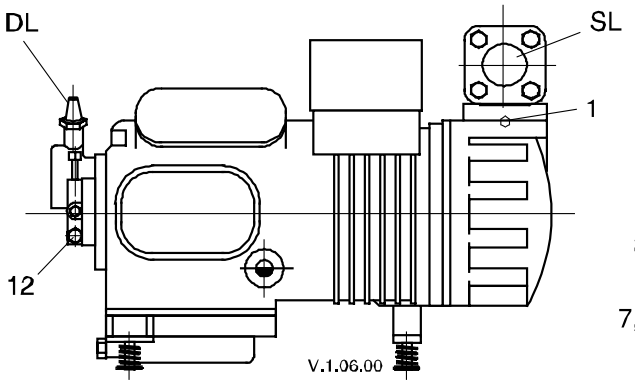



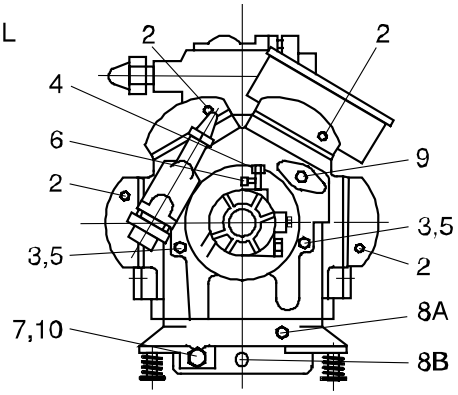

| | | | | | |
|---|---|---|---|---|---|
| SL | suction line size (sweat) | | 8A | plug crankcase heater | $^1/_2$" - 14 NPTF |
| DL | discharge line size (sweat) | | 8B | bore crankcase heater | ∅ $^1/_2$" |
| 1 | plug low-pressure connection | $^1/_8$" - 27 NPTF | 9 | plug high-pressure connection | $^1/_8$" - 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 / SENTRONIC | 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 |
| 7 | oil screen built-in | X | | | |

## D8D_1

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



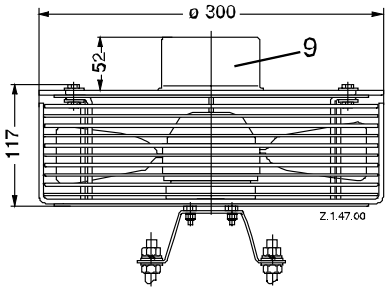

| | | | | | |
|---|---|---|---|---|---|
| SL | suction line size (sweat) | | 8 A | plug crankcase heater | $^1/_2$" - 14 NPTF |
| DL | discharge line size (sweat) | | 8 B | bore crankcase heater | ∅ $^1/_2$" |
| 1 | plug low-pressure connection | $^1/_8$" - 27 NPTF | 9 | plug high-pressure connection | $^1/_8$" - 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 / SENTRONIC | X |
| 5 | plug oil-pressure control L.P. | $^1/_4$" - 18 NPTF | | | |
| 6 | oil-pressure connection | $^7/_{16}$" - UNF Schrader V. | | | |
| 7 | oil screen built-in | X | | | |

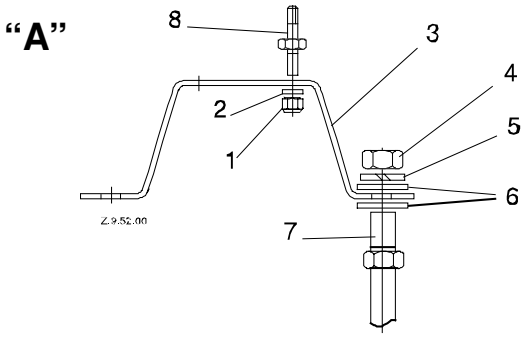
## Tightening Torque (Nm)


| | | | | |
|---|---|---|---|---|
| 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

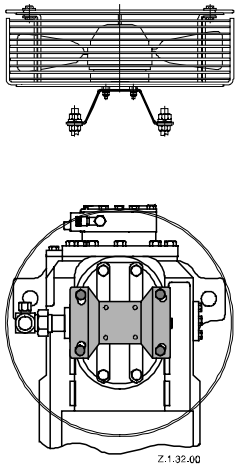
## Additional Fan Type 75 Z (D2 – D8)



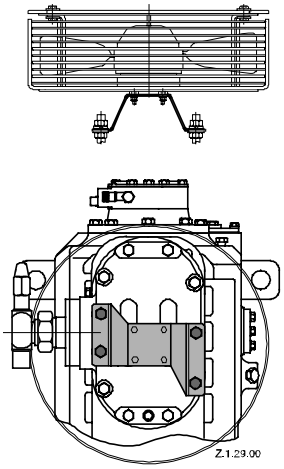




1 lock nut (1,2 – 2 Nm)
2 washer
3 bracket
4 nut (40 – 48 Nm)
5 spring washer
6 washer
7 stud
8 bolts for fan
9 terminal box (single-phase motors only)

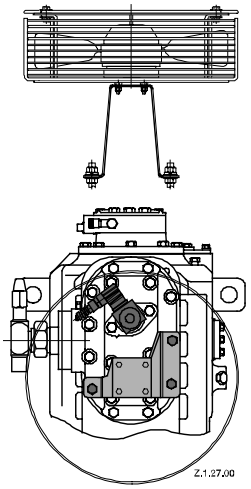
**D2D**




**D3D**

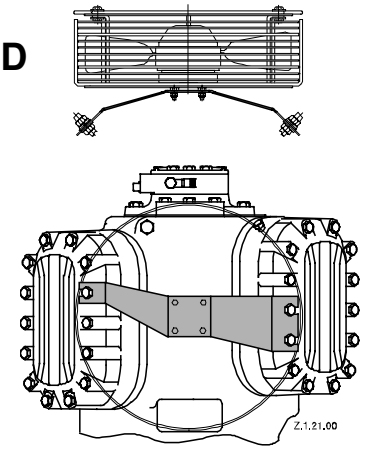



**D3D[1)]**

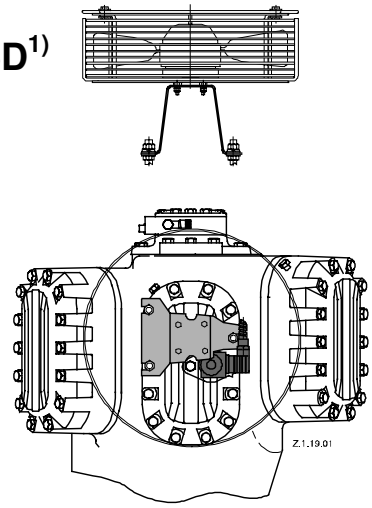



**1)** with capacity control

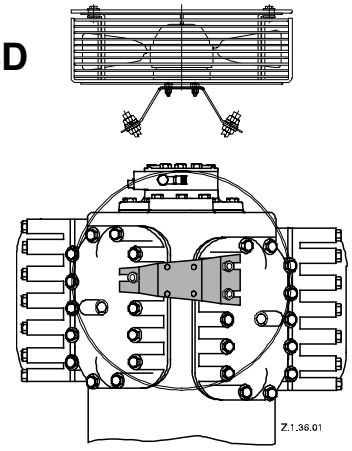
**D4D**




**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 70% of the voltage on the nameplate.
For further information as well as common starting techniques such as the part-winding start see Technical Bulletin No 09. **Unloaded start is not available for 2-stage compressors.**

## D2D and D3D Compressors

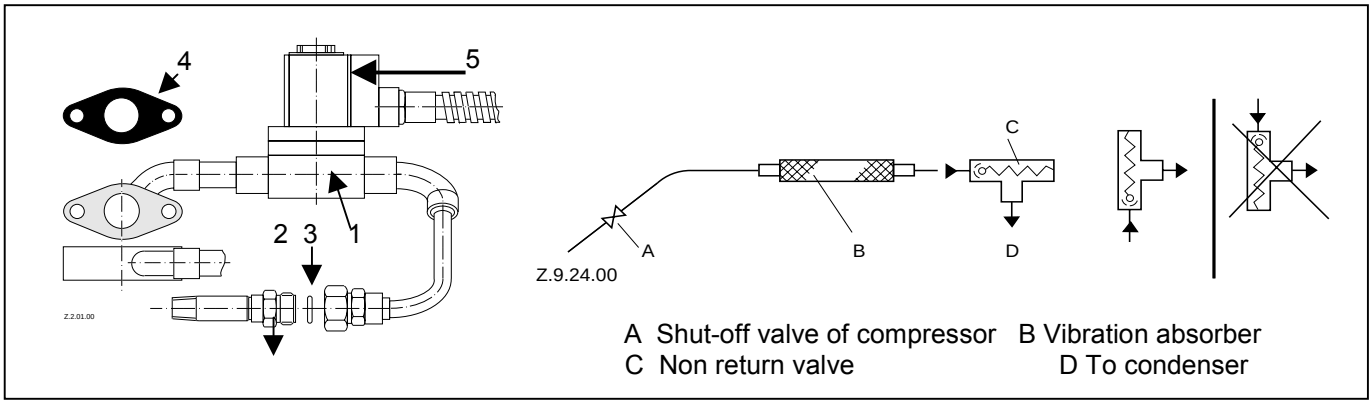
Unloaded start consists of a very short bypass line with a solenoid valve that connects the pressure side of the motor-compressor to the suction side.
When the motor-compressor is switched on, the solenoid valve opens the bypass line and holds it open during the starting phase. The refrigerant vapor 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 closes 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.

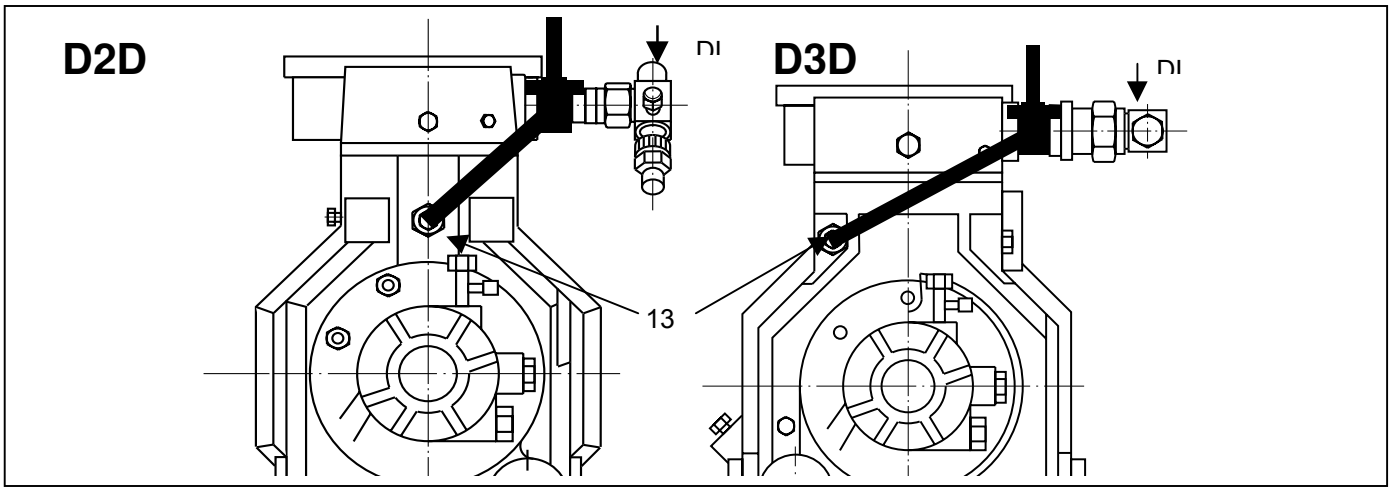
A retrofit kit is also available. This consists of the following parts:

| | |
|---|---|
| 1 x | pipe assembly and valve body (1) |
| 1 x | Rotalock stub (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 $^{1}/2$" 13 UNC X 2 $^{3}/4$" |




## Mounting

Remove plug (13) overpage and fit the Rotalock stub. 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 check thoroughly.
For further information please see tables on page 13 and Technical Bulletin no. 09.




### 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 p. 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 valve-plate-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 and Technical Bulletin no. 09.

## 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.

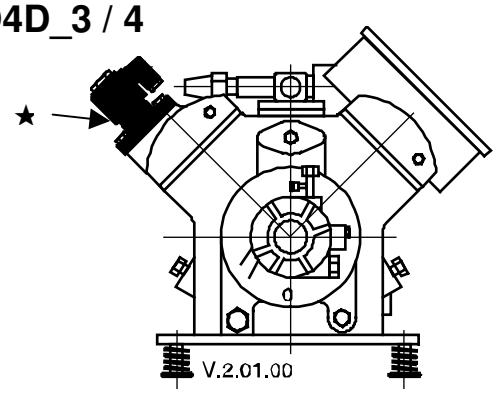
### Mounting Position Of Non-Return Valve

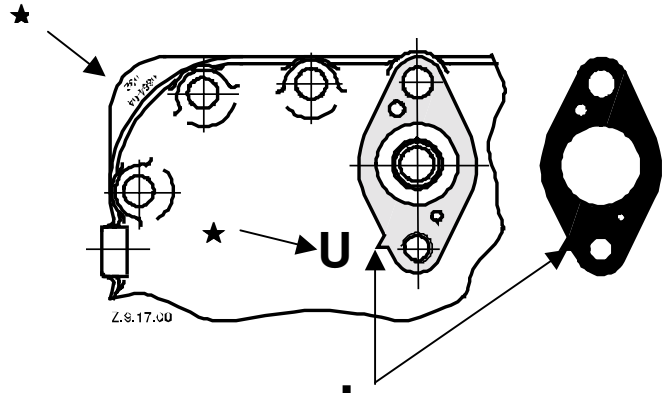
See drawing on previous page.

| Compressor | | Non-Return Valve | Compressor[1)] | | Non-Return Valve |
|---|---|---|---|---|---|
| | DLH | NRV 22S ∅ 22 | | | |
| D2D | | NRV 22S ∅ 22 | D22D | | 2 X NRVH 22S ∅ 22 |
| D3DA -500 / 50X | | NRV 22S ∅ 22 | D33DA - 1000 / 100X | | 2 X NRVH 22S ∅ 22 |
| D3D | | NRV 28S ∅ 28 | D33D | | 2 X NRVH 28S ∅ 28 |
| D4D | D4S | NRV 22S ∅ 22 | D44D | D44S | 2 X NRVH 22S ∅ 22 |
| D4DJ | D4SJ | NRV 28S ∅ 28 | D44DJ | D44SJ | 2 X NRVH 28S ∅ 28 |
| D6DL/ T | D6SF/ L/ T | NRV 22S ∅ 22 | D66DL/ T | D66SF/ L/ T | 2 X NRVH 22S ∅ 22 |
| D6DH/ J | D6SA/ H/ J | NRV 28S ∅ 28 | D66DH | D66SA/ H/ J | 2 X NRVH 28S ∅ 28 |
| D8DL | | NRV 28S ∅ 28 | D88DL | | 2 X NRVH 28S ∅ 28 |
| D8DT | | NRV 28S ∅ 28 | D88DT | | 2 X NRVH 28S ∅ 28 |
| D8DH | D8SH | NRV 35S ∅ 42 | D88DH | D88SH | 2 X NRVH 35S ∅ 22 |
| D8DJ | D8SJ | NRV 35S ∅ 42 | D88DJ | D88SJ | 2 X NRVH 35S ∅ 28 |

1) also for parallel compressor operation

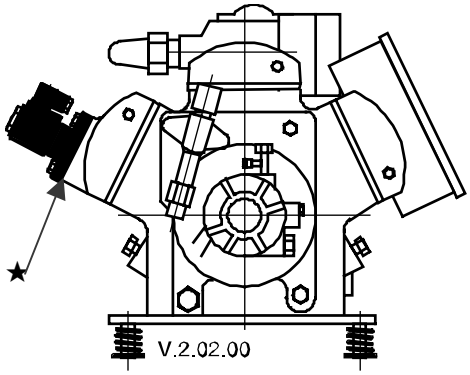
**D4D_3 / 4**



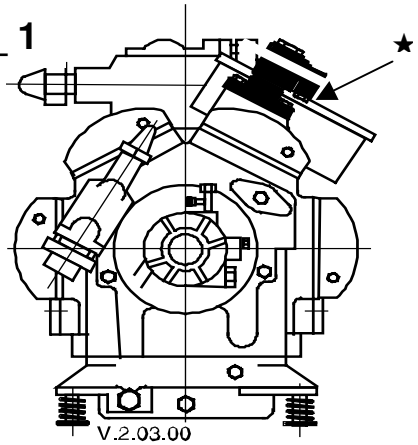




★ **written "U" for unloaded start** **!**

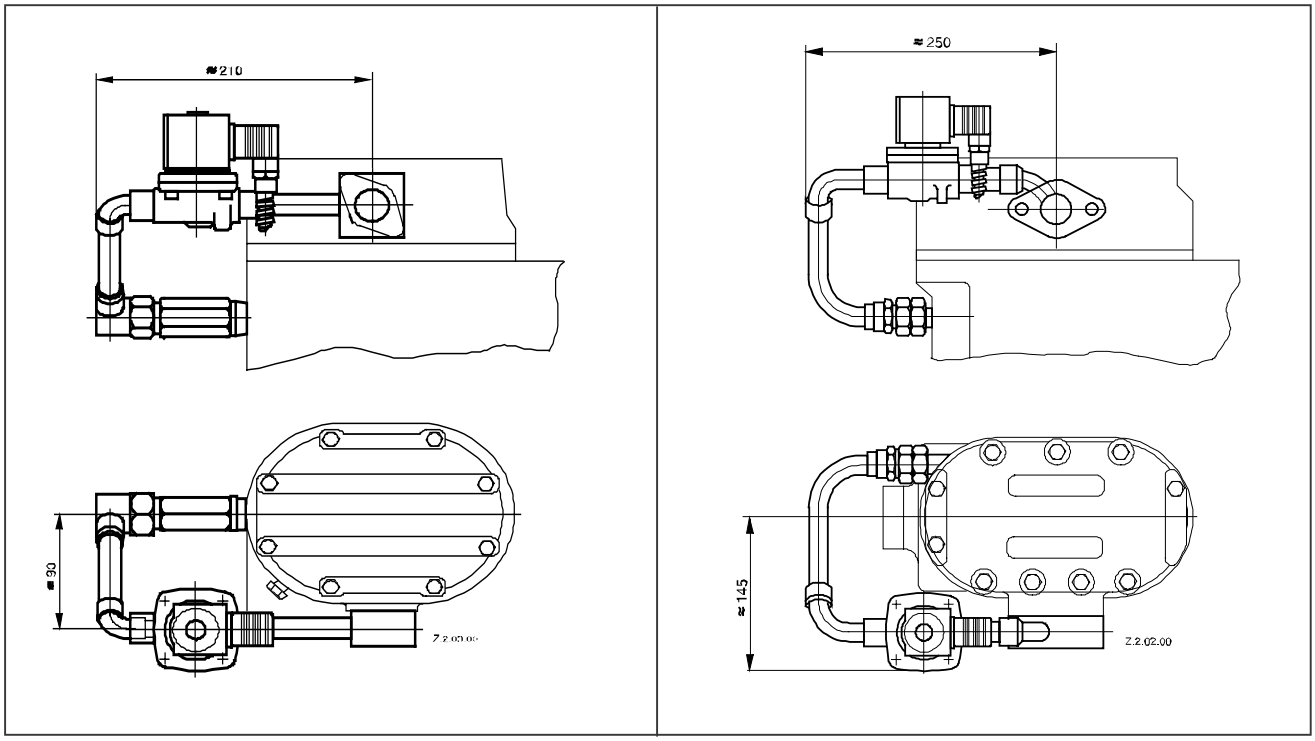
**D6D_ 3 / 4**



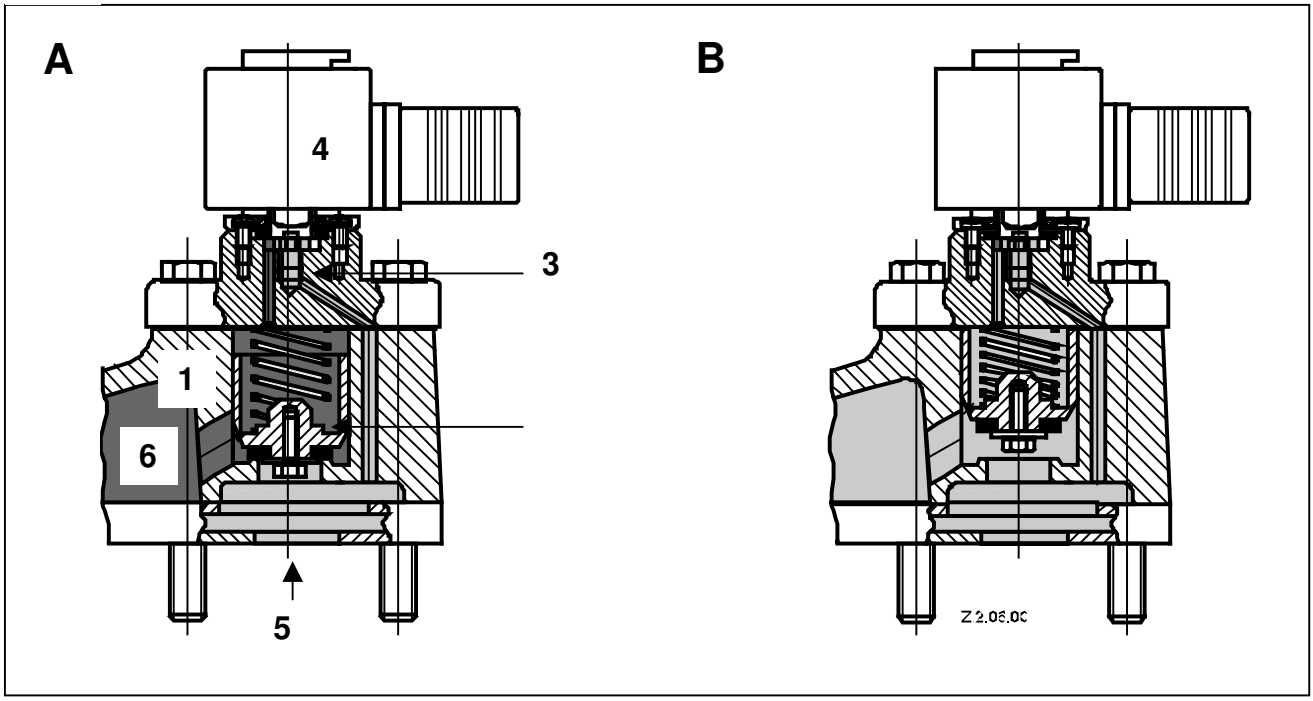

**D8D_ 1**



**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

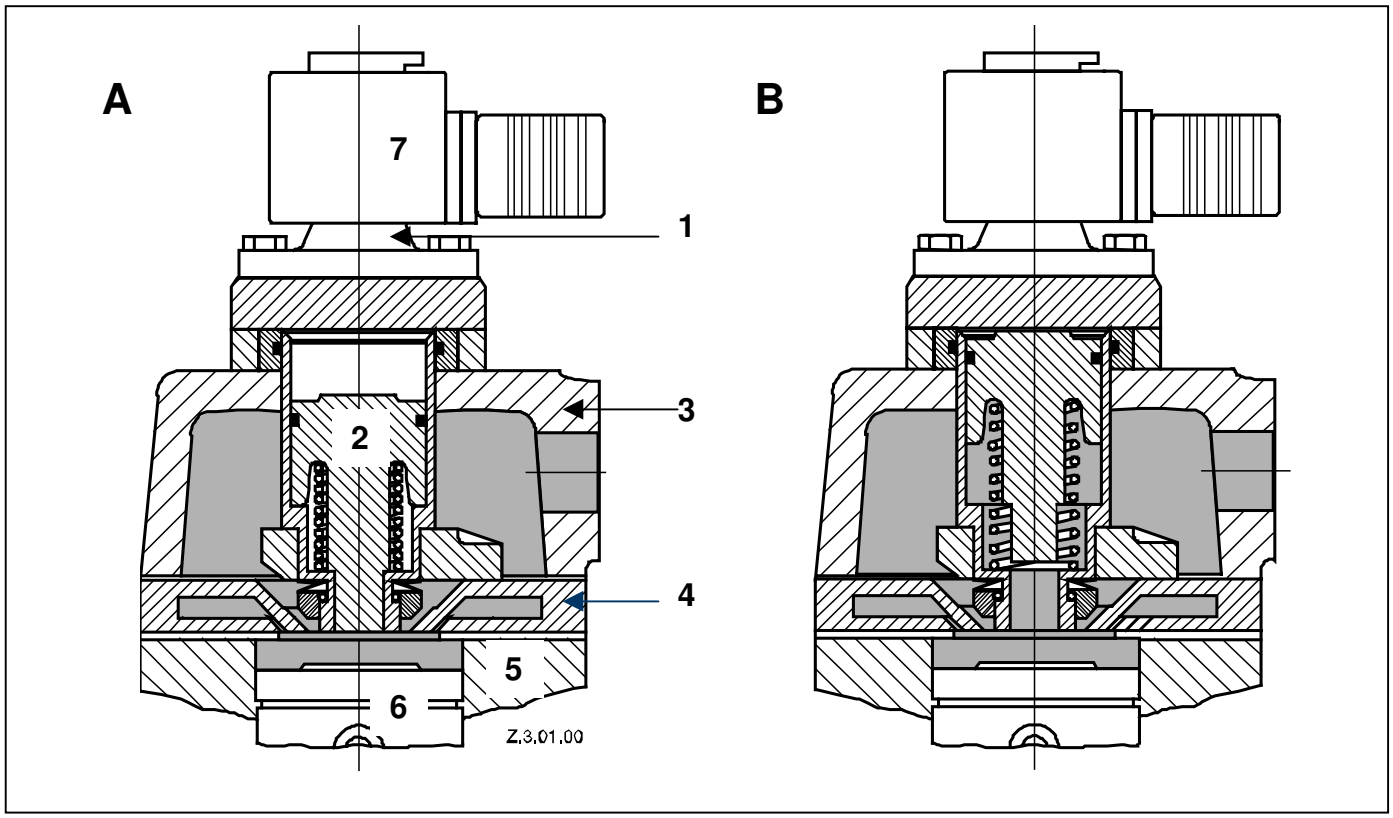
**All Discus model compressors can be equipped with capacity control. When the compressor is operated using capacity control the application range changes.**

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 R22 and for the approved refrigerant oils;
2. Suitable for HFC refrigerants R134a, R407C and R404A / R 507 and the according refrigerant oils approved by COPELAND.

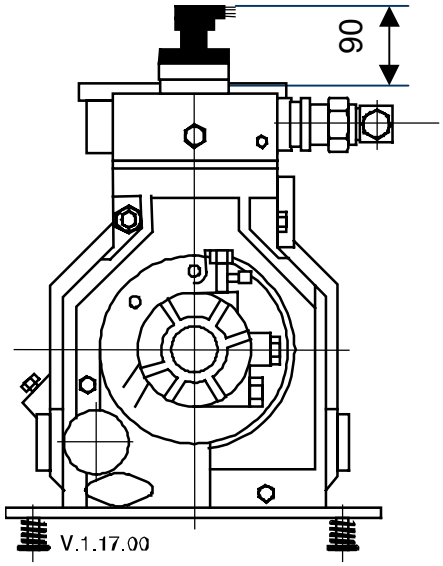
**MODULOAD should not be fitted on compressors with DEMAND COOLING.**




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<br>D3DC*-75XH<br>D3DS*-100XH | R 134a | HM | 1 | D3DA*-50X L<br>D3DC*-75X L<br>D3DS*-100X L | R404A | LXZ | 4 |
| D3DA*-75XH<br>D3DC*-100XH<br>D3DS*-150XH | R 134a | HH | 2 | D3DA*-750H<br>D3DC*-1000H<br>D3DS*-1500H | R 22 | HM | 5 |
| D3DA*-75XH<br>D3DC*-100XH<br>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)

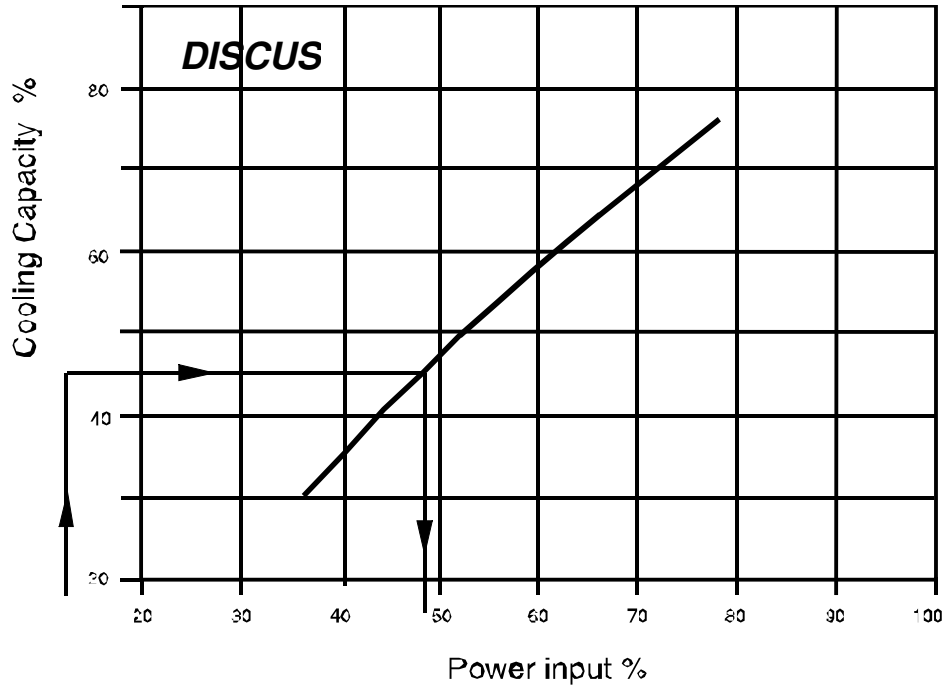
The diagram shows the application range while operating with capacity control, remaining refrigerant capacity and power input at 25°C suction gas temperature.

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

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

Tentative Data

Diagram 1


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

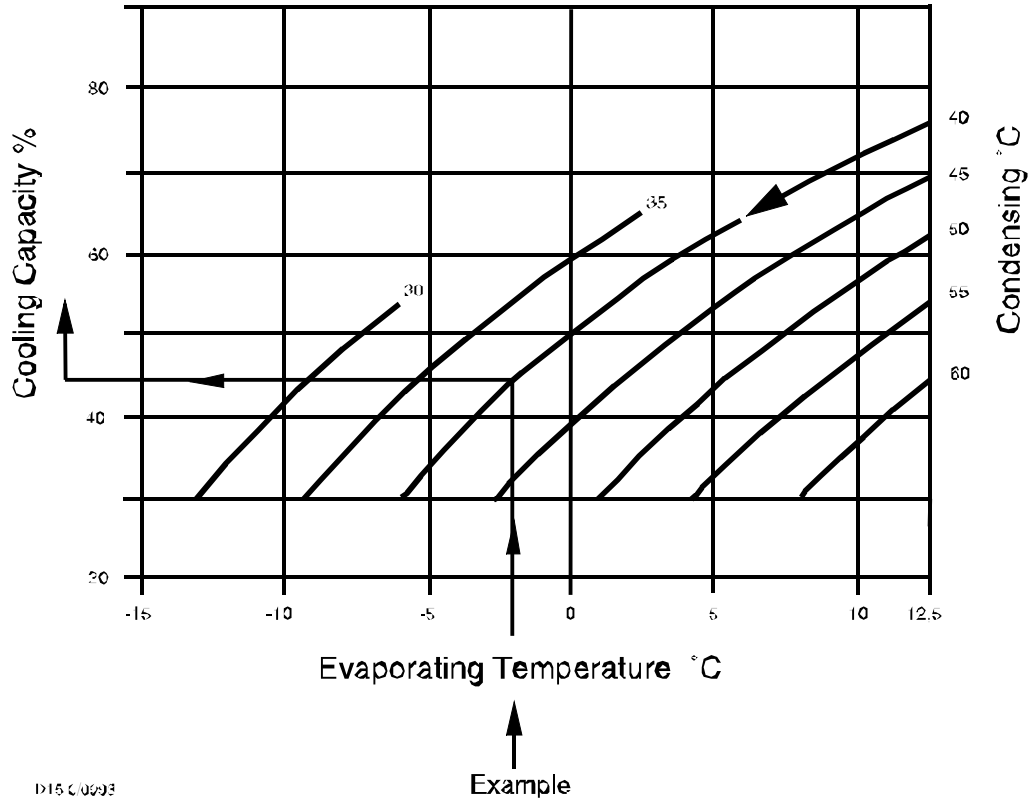
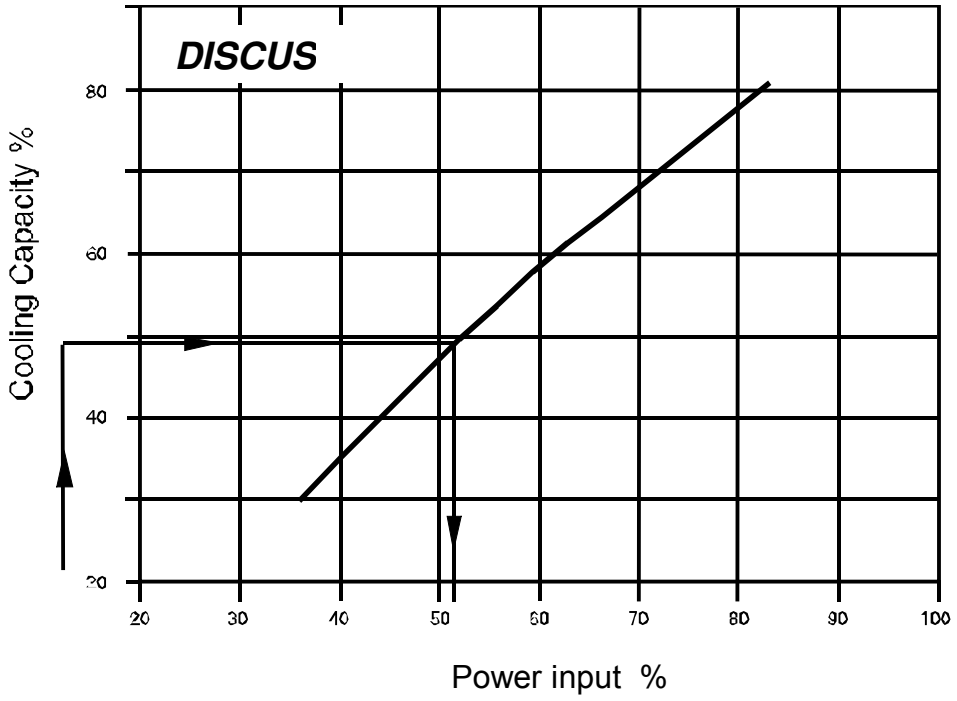

Cooling Capacity %
80
60
40
20
-15
-10
-5
0
5
10
12.5
35
30
40
45
50
55
60
Condensing °C
Evaporating Temperature °C
Example

Diagram 2


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

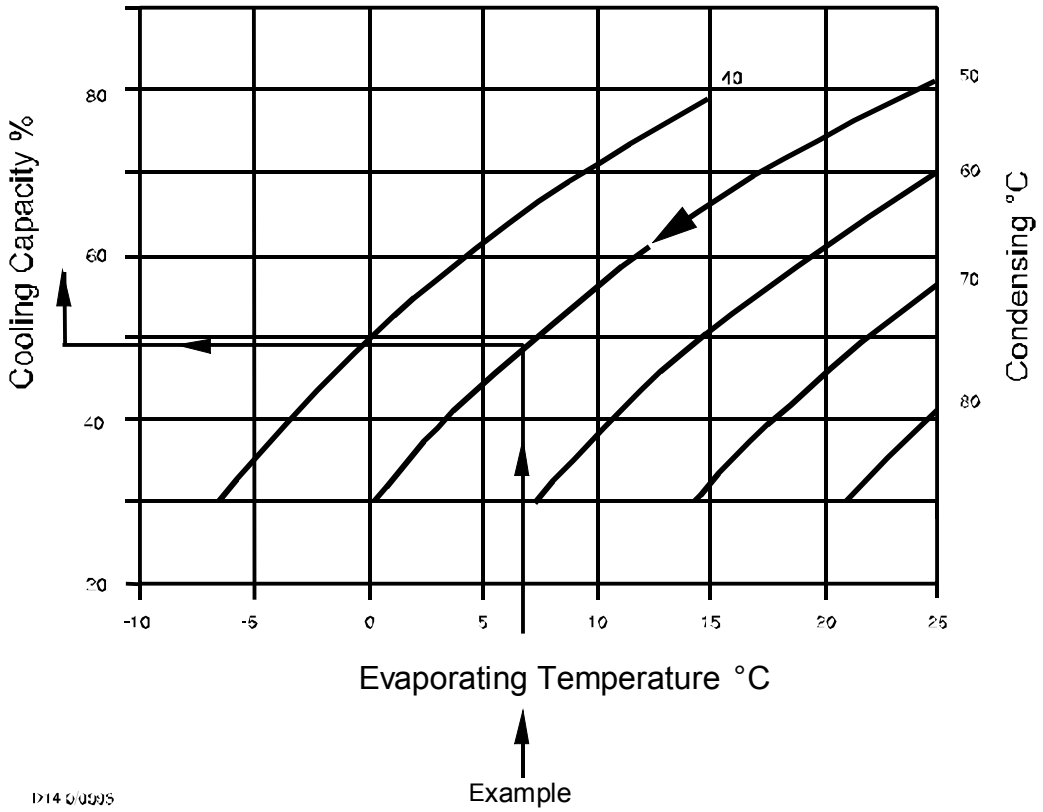
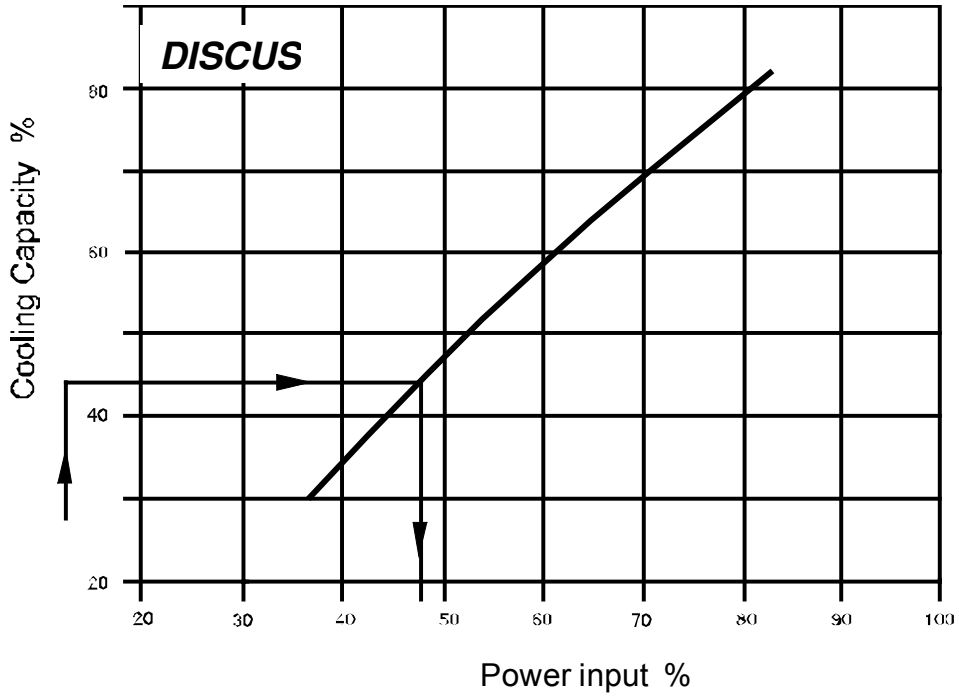

Cooling Capacity %
80
60
40
20
-10
-5
0
5
10
15
20
25
10
50
60
70
80
Condensing °C
Evaporating Temperature °C
Example

Diagram 3


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

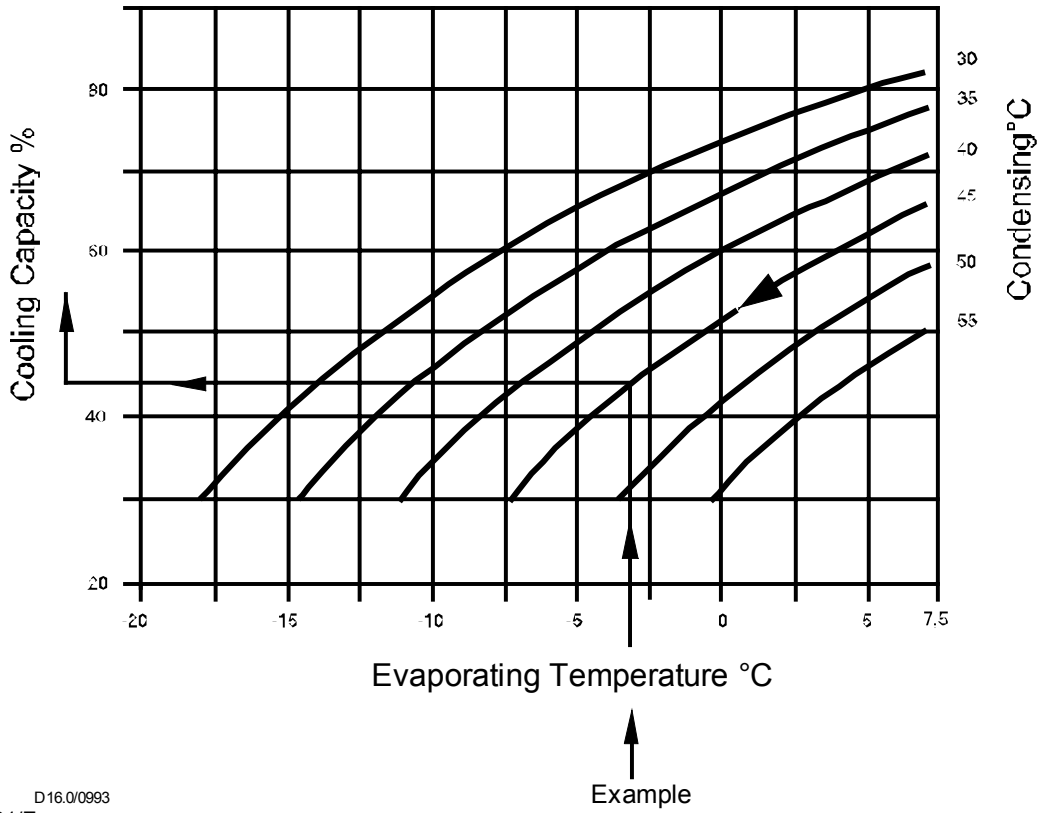
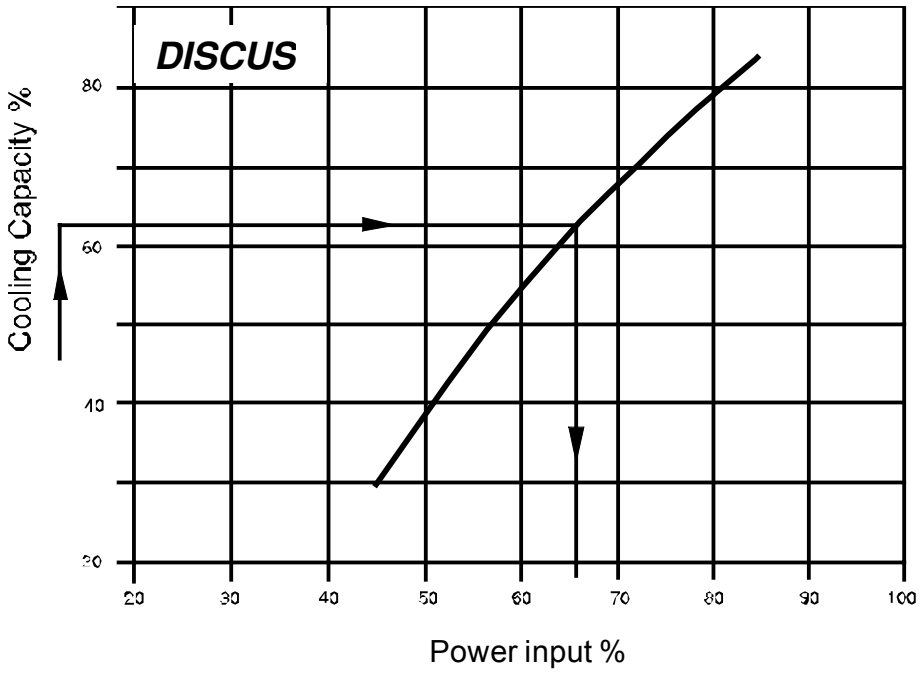
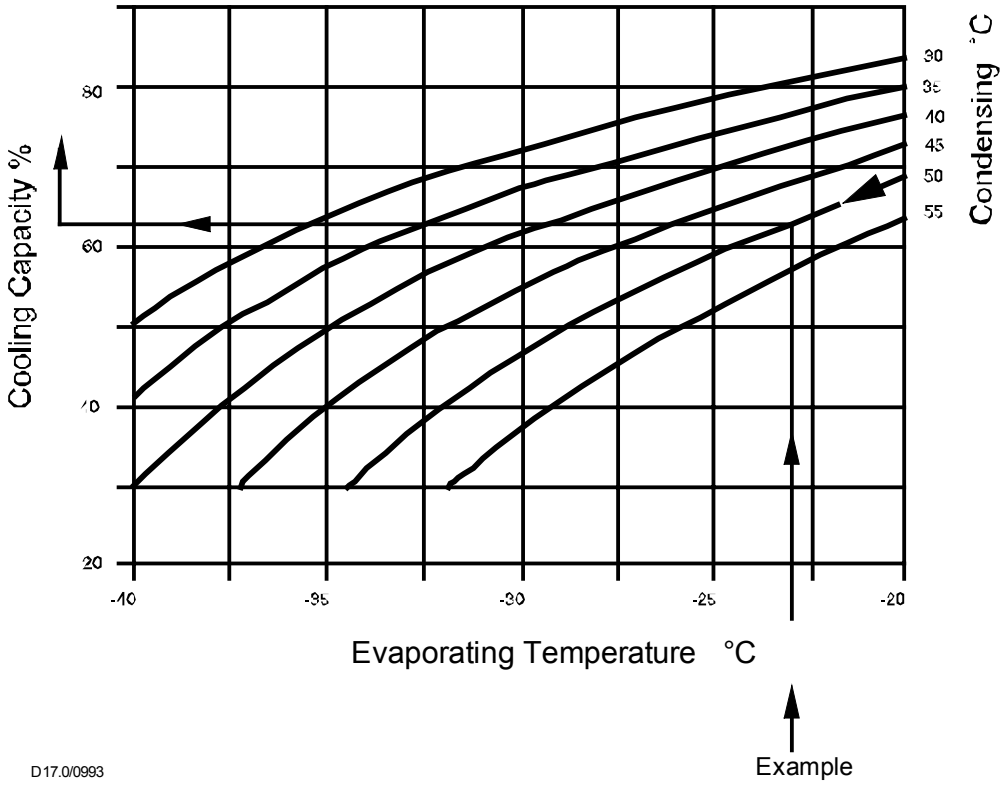

Cooling Capacity %
80
60
40
20
20
15
10
5
0
5
7.5
30
35
40
45
50
55
Condensing °C
Evaporating Temperature °C
Example

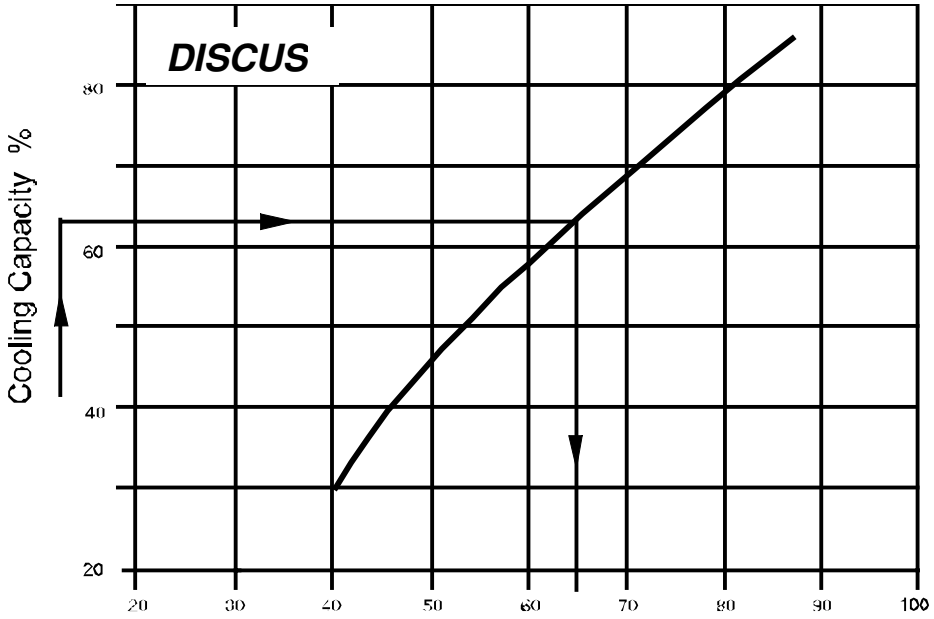
Diagram 4

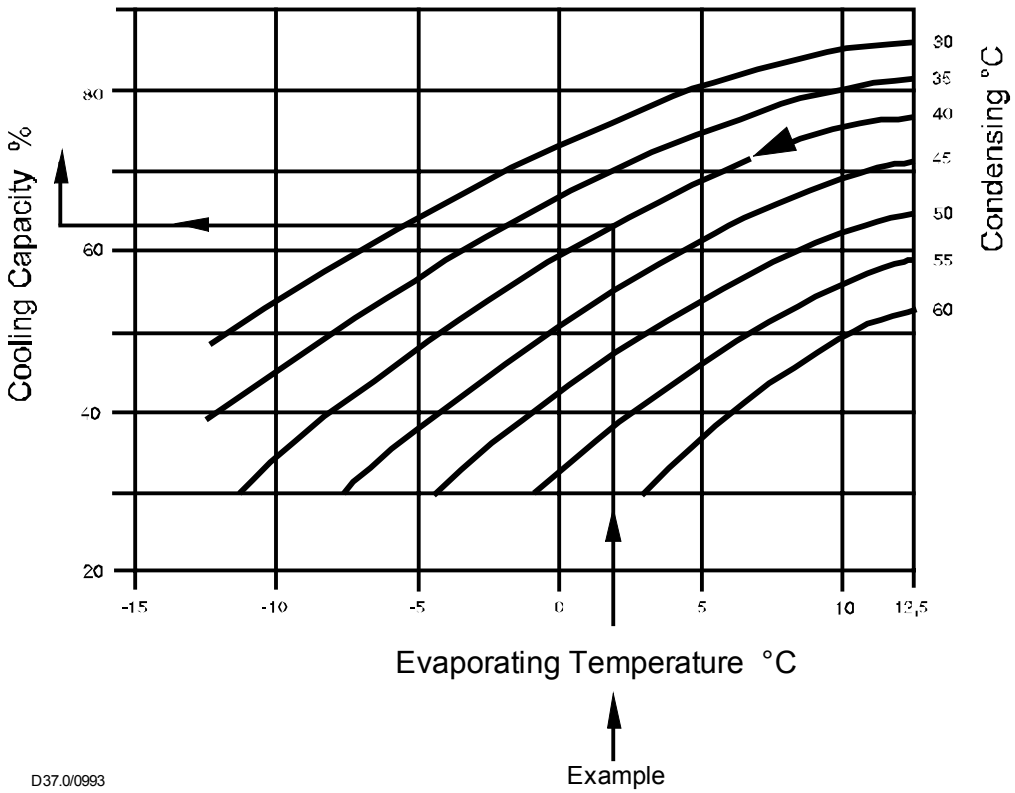



D17.0/0993

Diagram 5


DISCUS
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
30
35
40
45
50
55
60
Condensing °C
Evaporating Temperature °C
Example

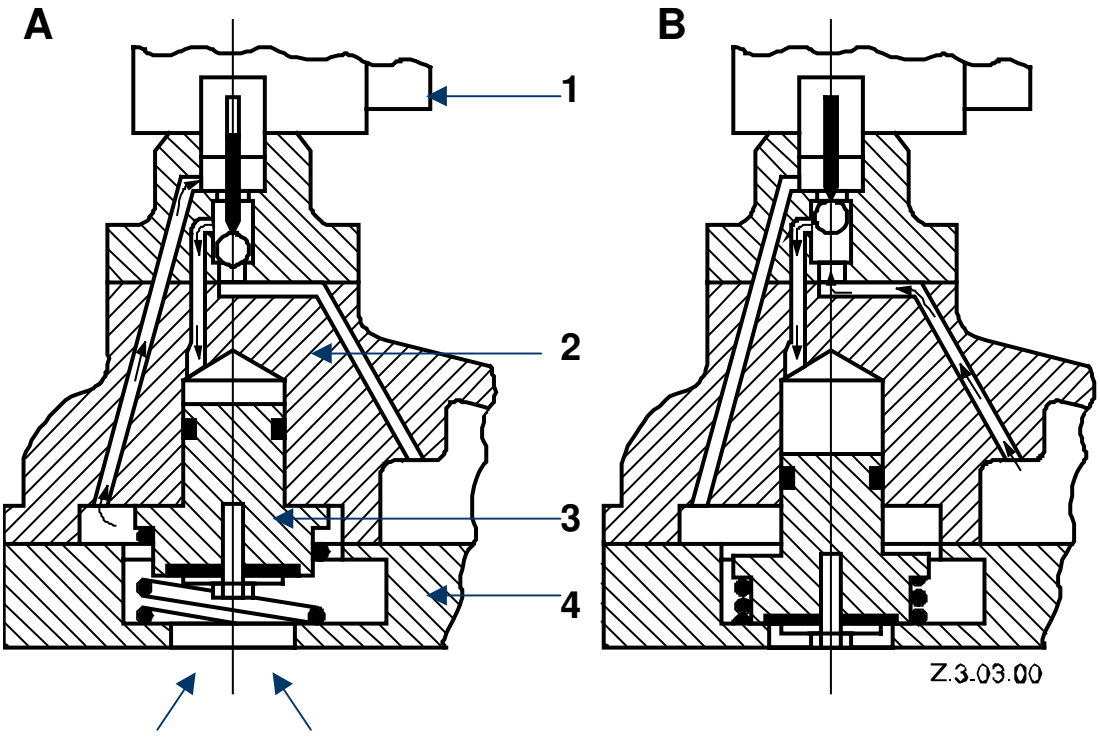
## D4D, D6D and D8D Compressors

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

**Gaskets on all capacity controlled cylinder heads 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 cap control 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.

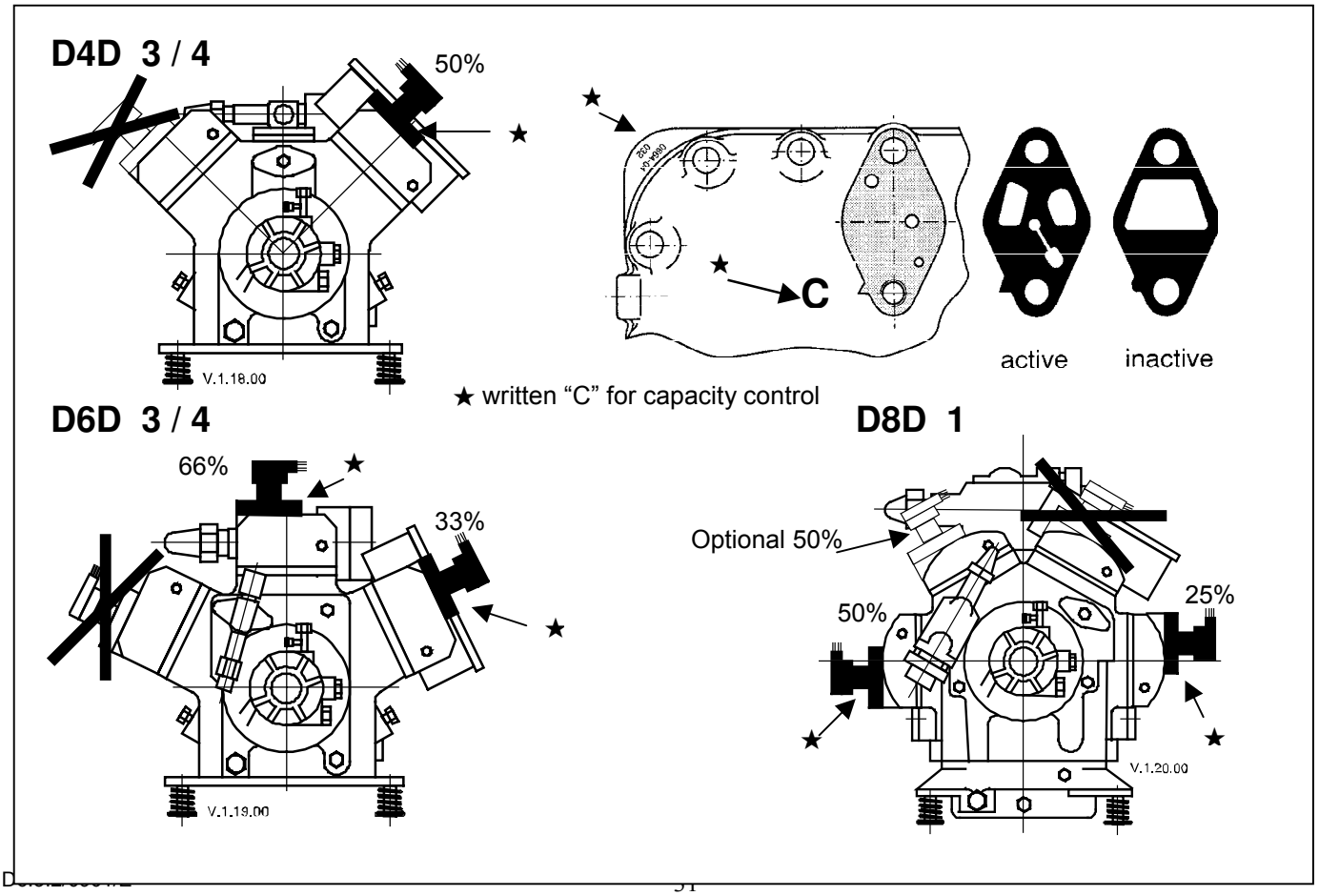
The gasket change was effective with compressors shipped from our Welkenraedt, Belgium plant from August 17,1999

Conversion kit includes;

| | |
|---|---|
| 1 x | cylinder head for capacity control "C" |
| 1 x | valve plate and gasket kit |
| 1 x | solenoid valve assembly (No 703 RB 001) |
| 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

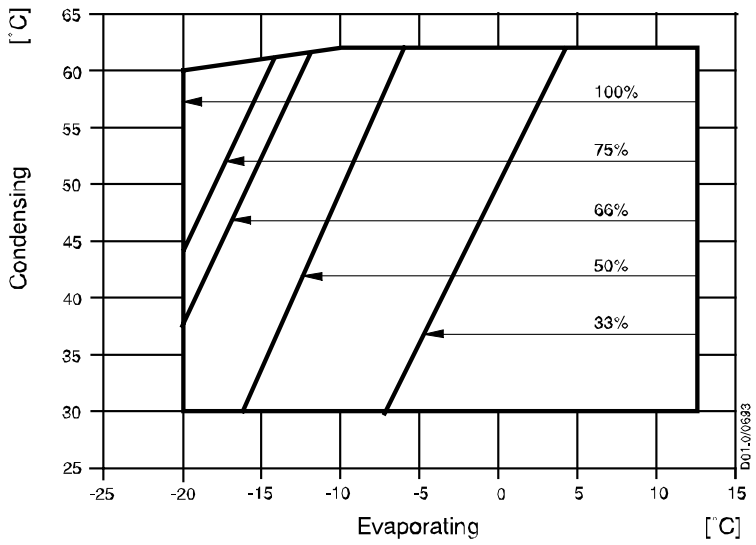



**Diagram 9**
Superheat 20 K

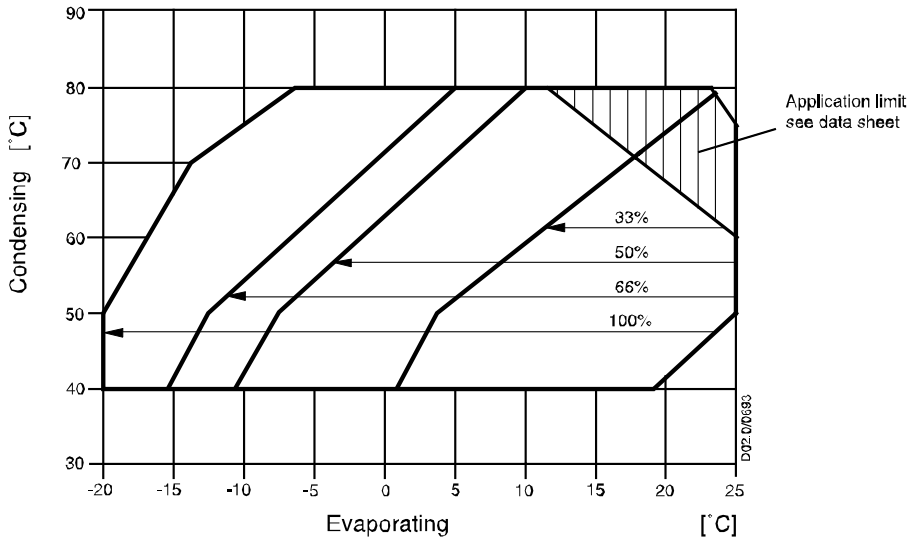
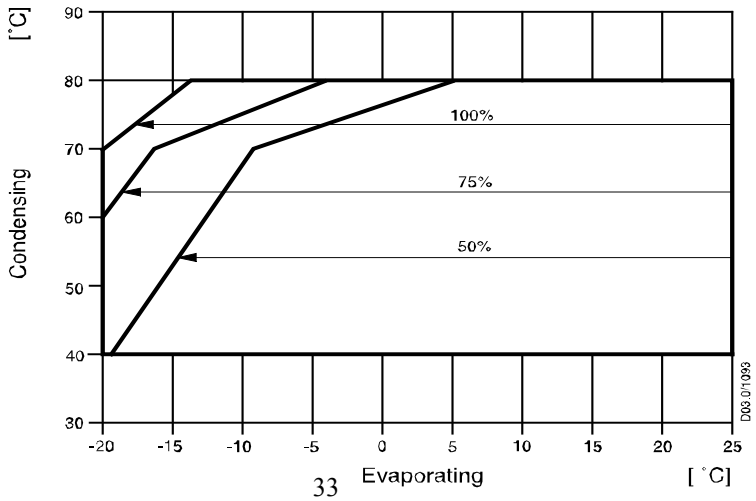



**Diagram 10**
Superheat 20 K



**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 | 3 / 4 | 100% | 66% | 33% | 67/34 | 68/34 | |
| D8DH-5000 | 4 / 4 | 100% | 75% | 50% | 76/52 | 80/58 | 12 |
| D8DJ-6000 | 5 / 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

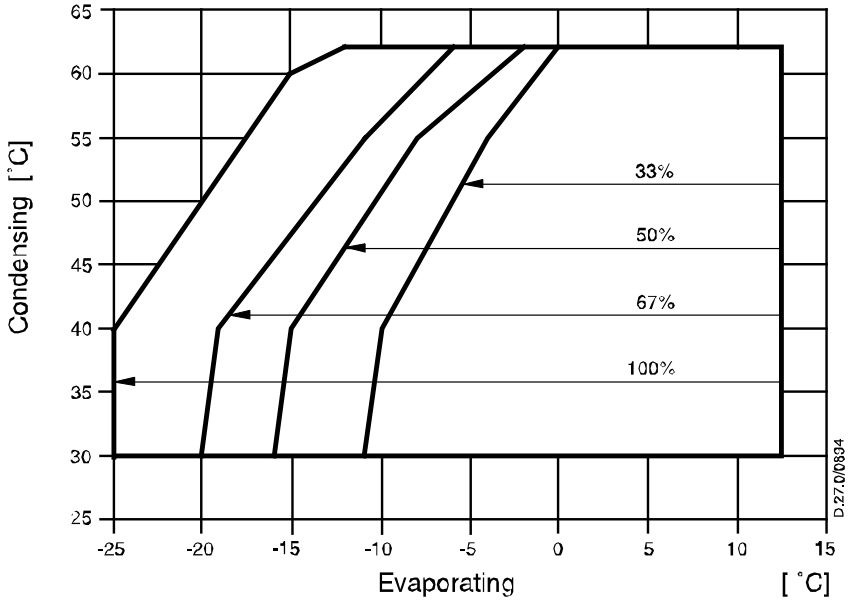
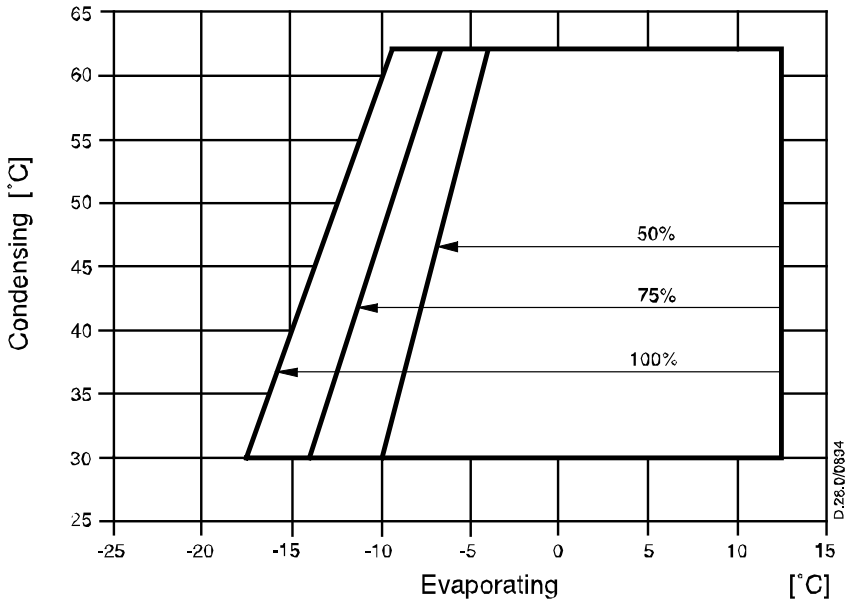



**Diagram 12**
Suction gas temperature 25°C



**Selection of Capacity Control**

| Compressor | Number of Cylinders with Capacity Control | Capacity Regulating Step | | | Remaining Refrigeration Capacity / Power Input (average values) % | | | | | | | | 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

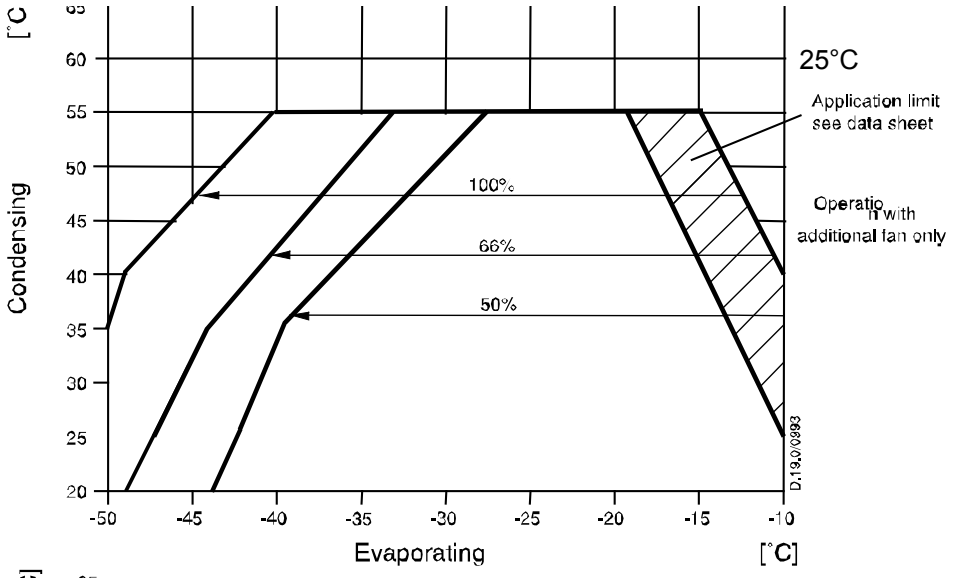



**Diagram 14**
Suction gas temperature 25°C

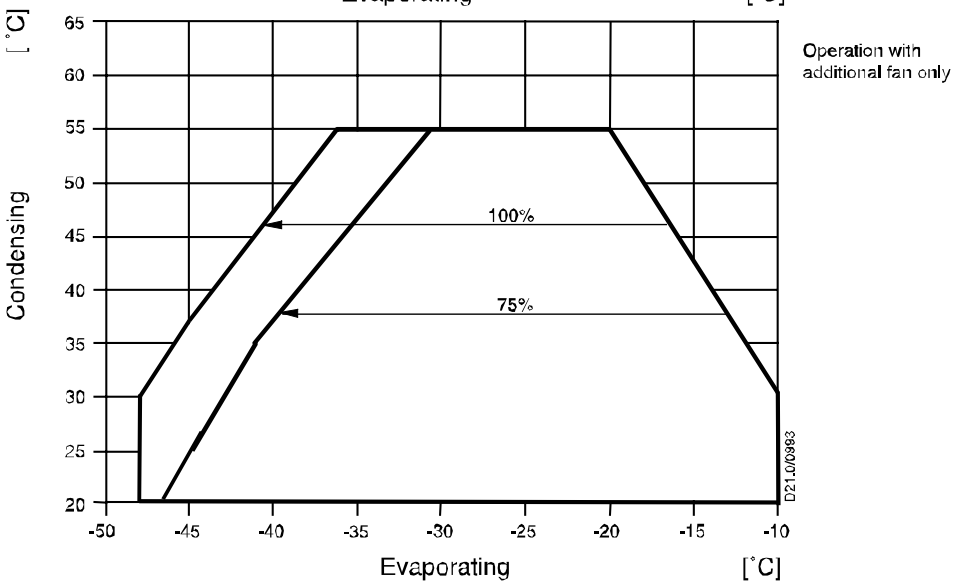



**Diagram 15**
Suction gas temperature 25°C

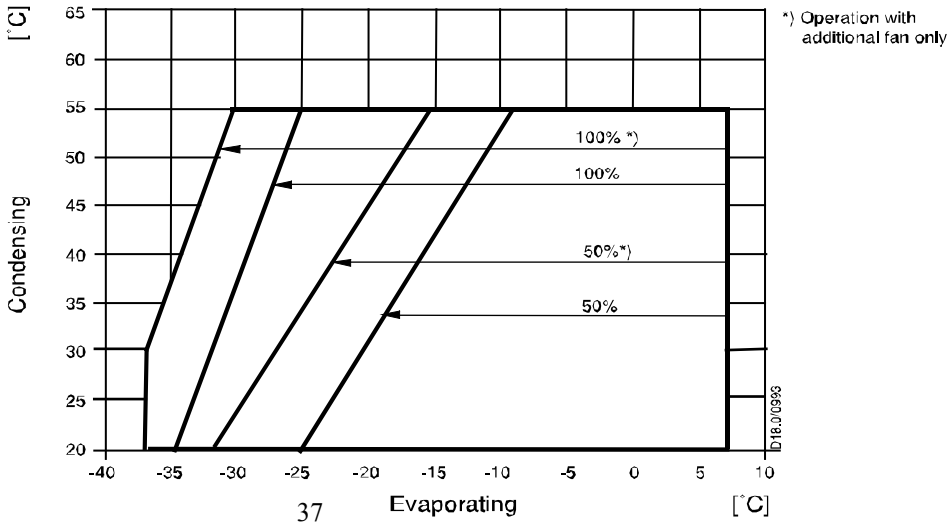


**Diagram 16**
Suction gas temperature 25°C Reduction to 33% with standard additional Ventilation not possible due to lack of space

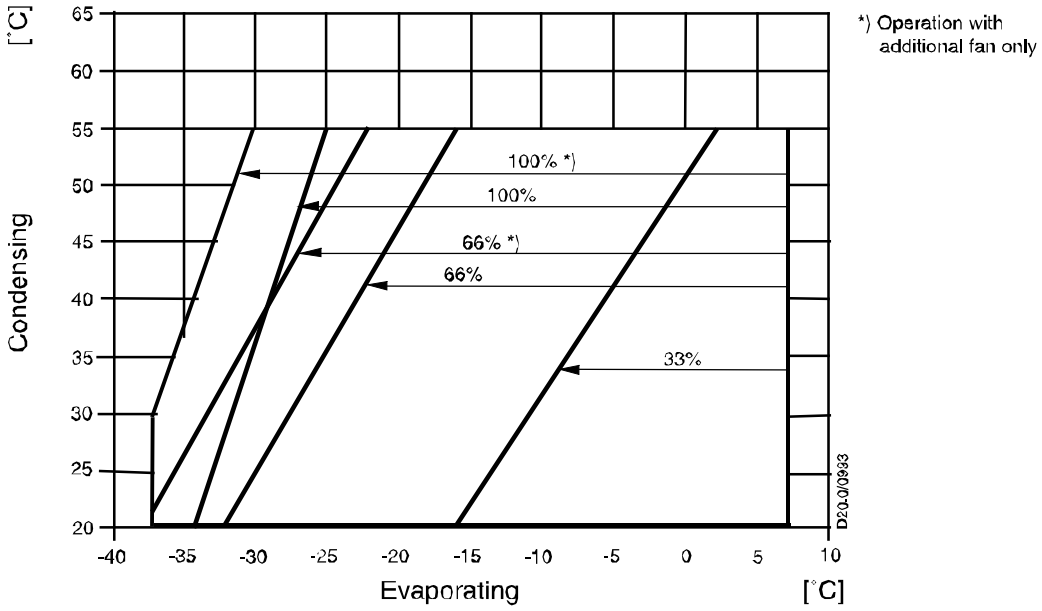
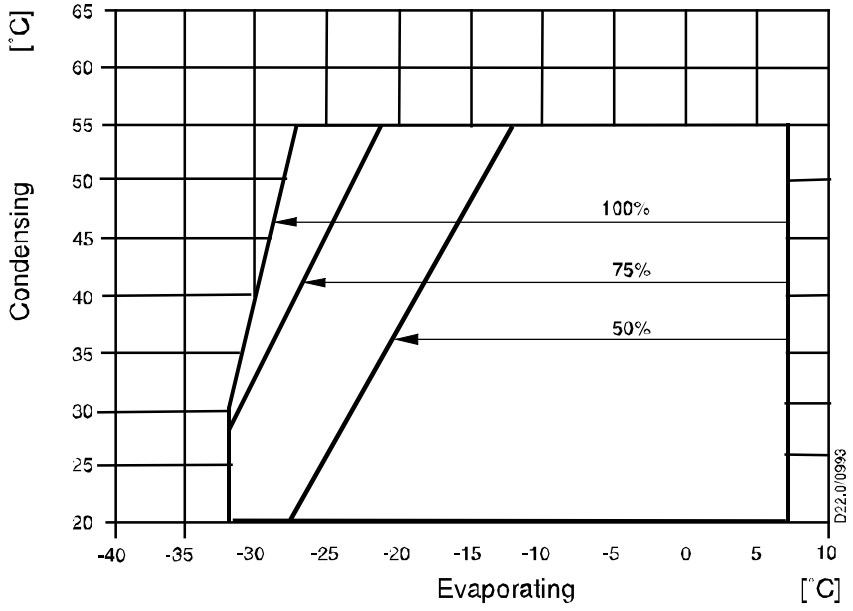



**Diagram 17**
Suction gas temperature 25°C



**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

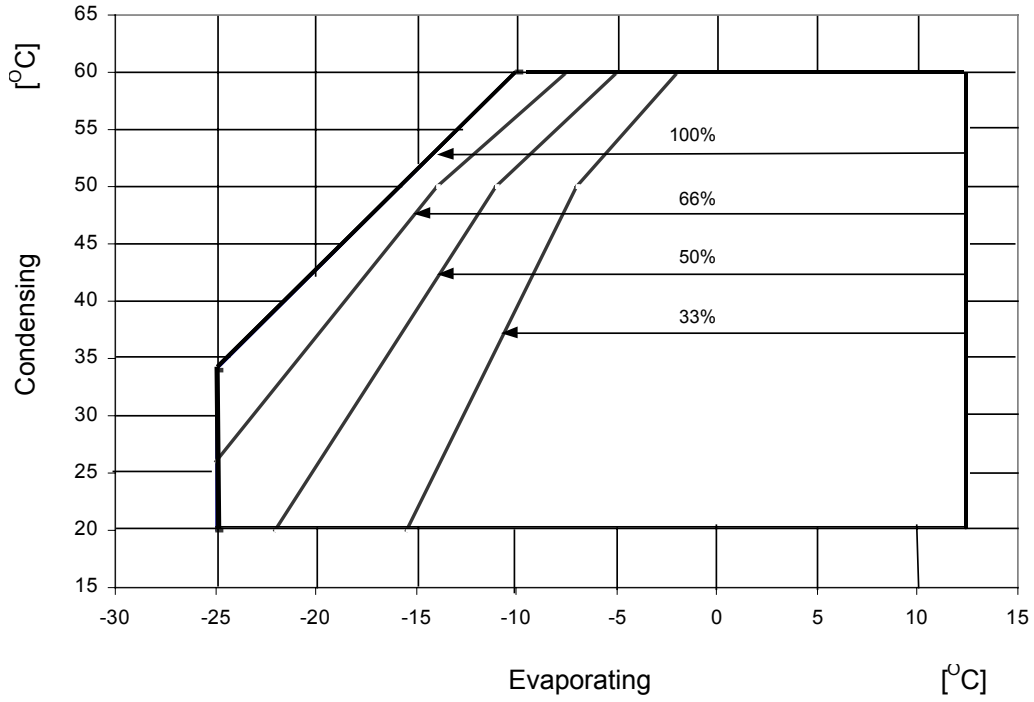
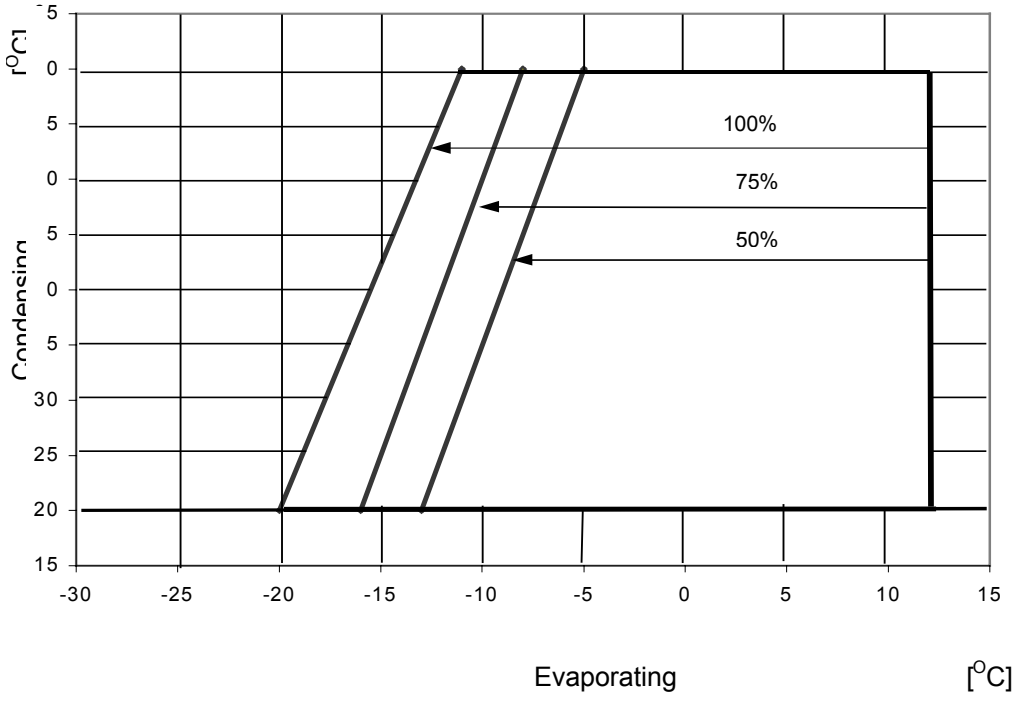
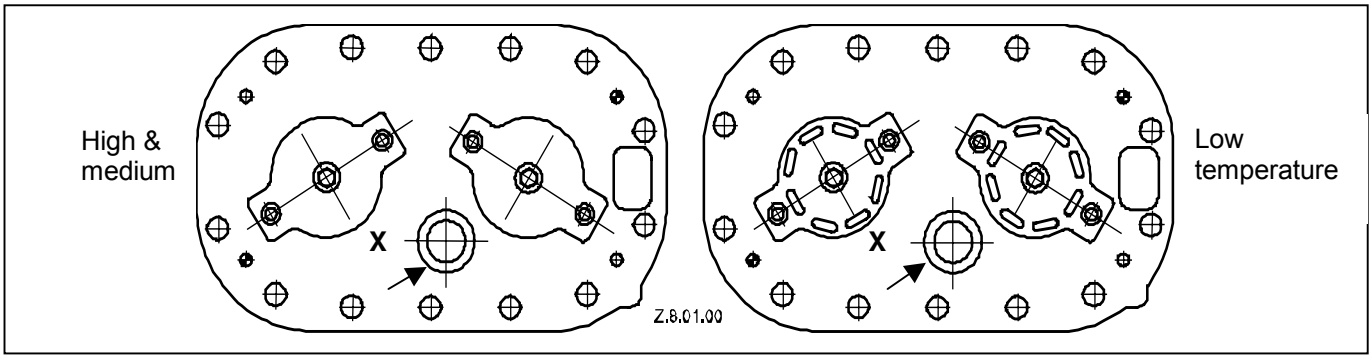



Diagram 19 - D8D
Suction gas temperature 25° C



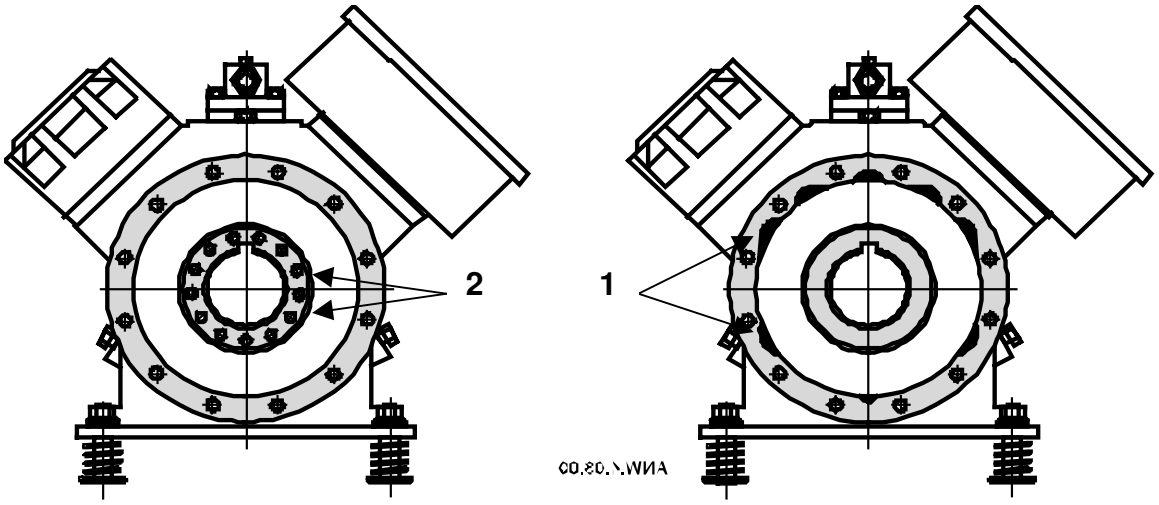
**Discus Valve Plates D4D - D6D**

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

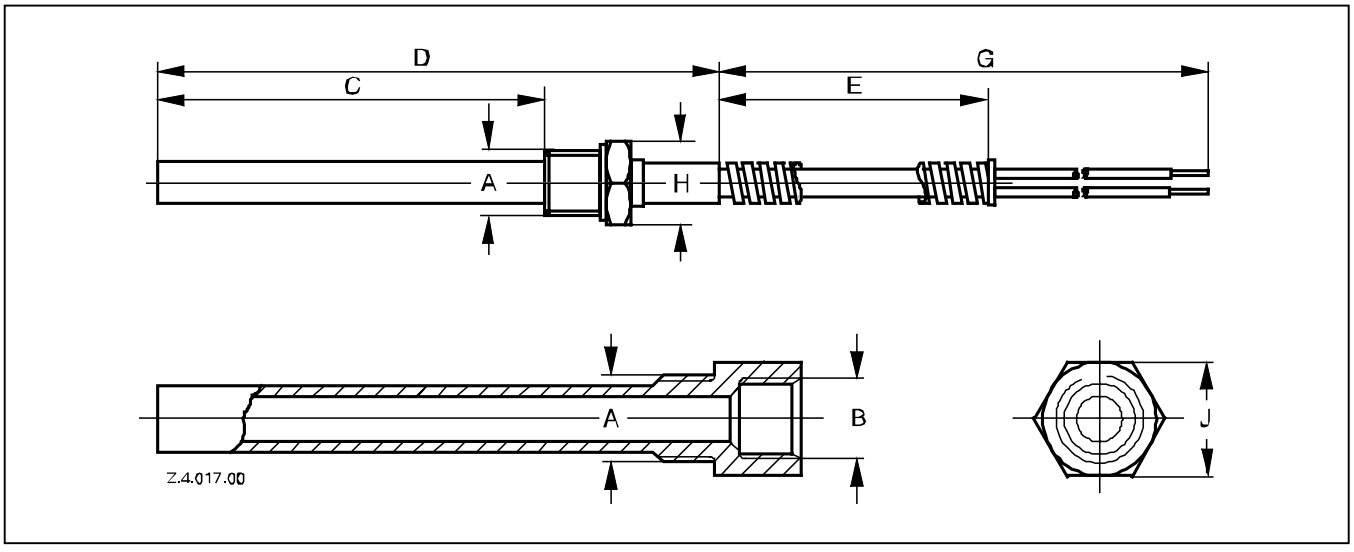
The oil in the crankcase absorbs large or small amounts of refrigerant according to pressure and temperature. When the compressor is out of service, the amount of refrigerant absorbed may be so high that the oil level in the compressor rises creating the impression that the quantity of oil is large. 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 location of the compressor has a lower temperature than the remaining parts of the system. When the system is not in service, this may result in condensation of refrigerant at the coolest position of the system – i.e. 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 will 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 internal crankcase heater is mounted with heat sink paste in a special pocket or heater sleeve. Due to this improvement a fast and easy exchange of the heater or its retrofitting is possible without opening of refrigeration cycle.
The individual data sheets show the mounting position.

Standard D2D and D3D compressors are fitted with a crankcase heater sleeve which take a 70 W heater, D4D and D6D compressors a 100 W heater. D6DJ, D6DT, and D8D have a separate bore in the deep oil sump for a 200 W heater.
The space between the heater and the sleeve should be filled with special heat sink paste to improve the heat transfer. The heater can be changed without opening the refrigeration circuit thereby preventing release of refrigerant to the atmosphere.

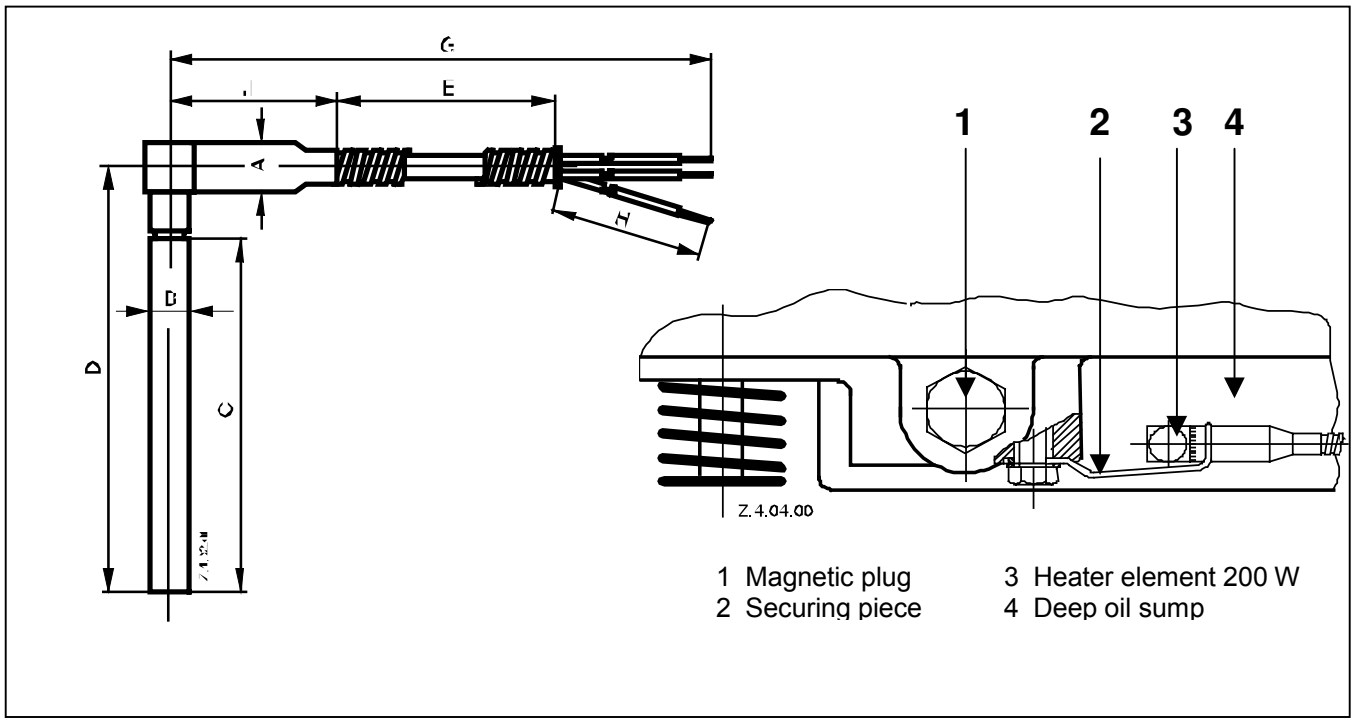
Internal Heater Element 70 Watt / 100 Watt and Heater Sleeve



| 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 |

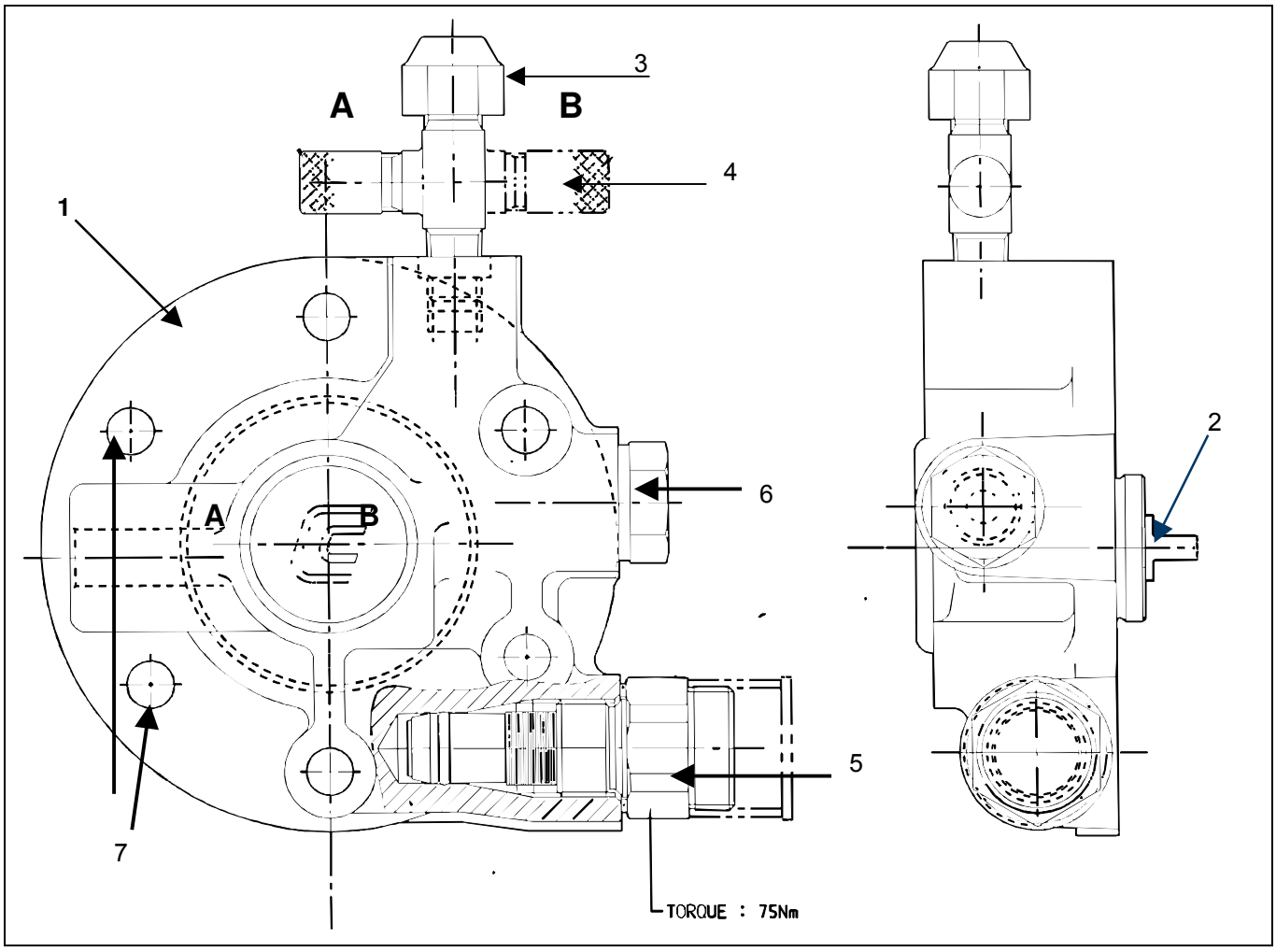
* with deep oil sump

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.




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

1 Oil pump housing
2 Oil pump rotor
3 Flare connection of high-pressureside capillary tube of 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 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**

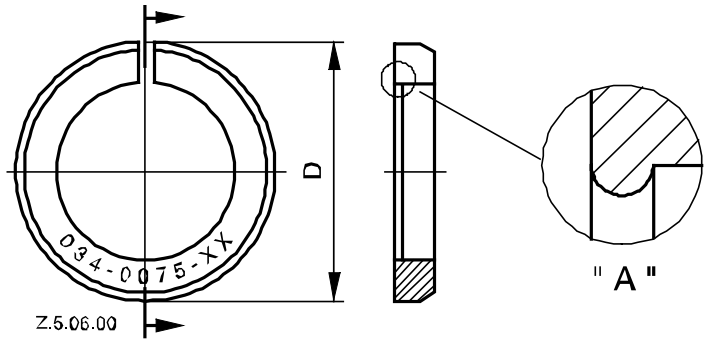
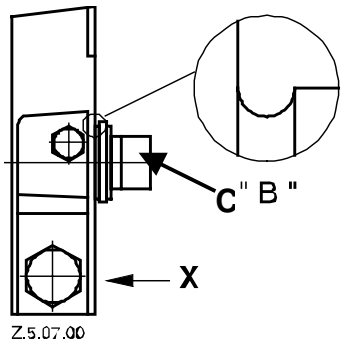


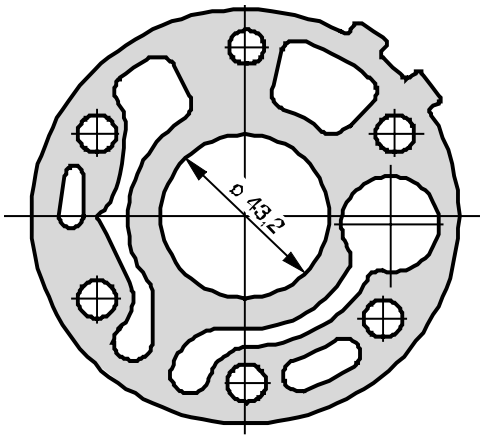

**Fig. 2**



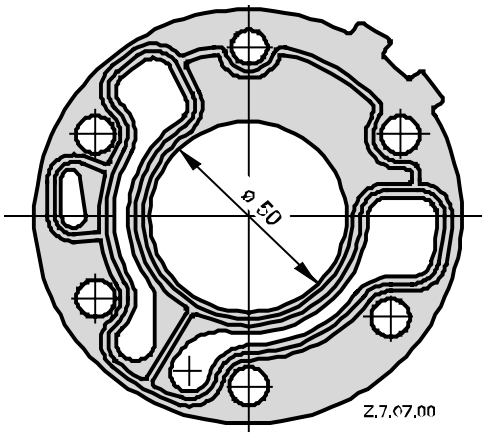

| Compressor | Adapter | Gasket Material |
|---|---|---|
| D2D | without | Neoprene |
| D3D | D = 40.4 mm | Neoprene |
| D4D, D6D, D8D | D = 49.2 mm | Wolverine |

**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**



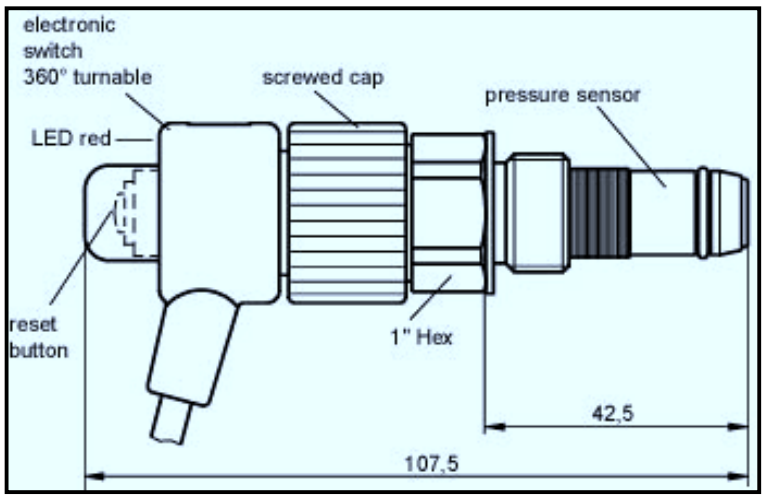

**D4D, D6D, D8D**



# 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/ 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.

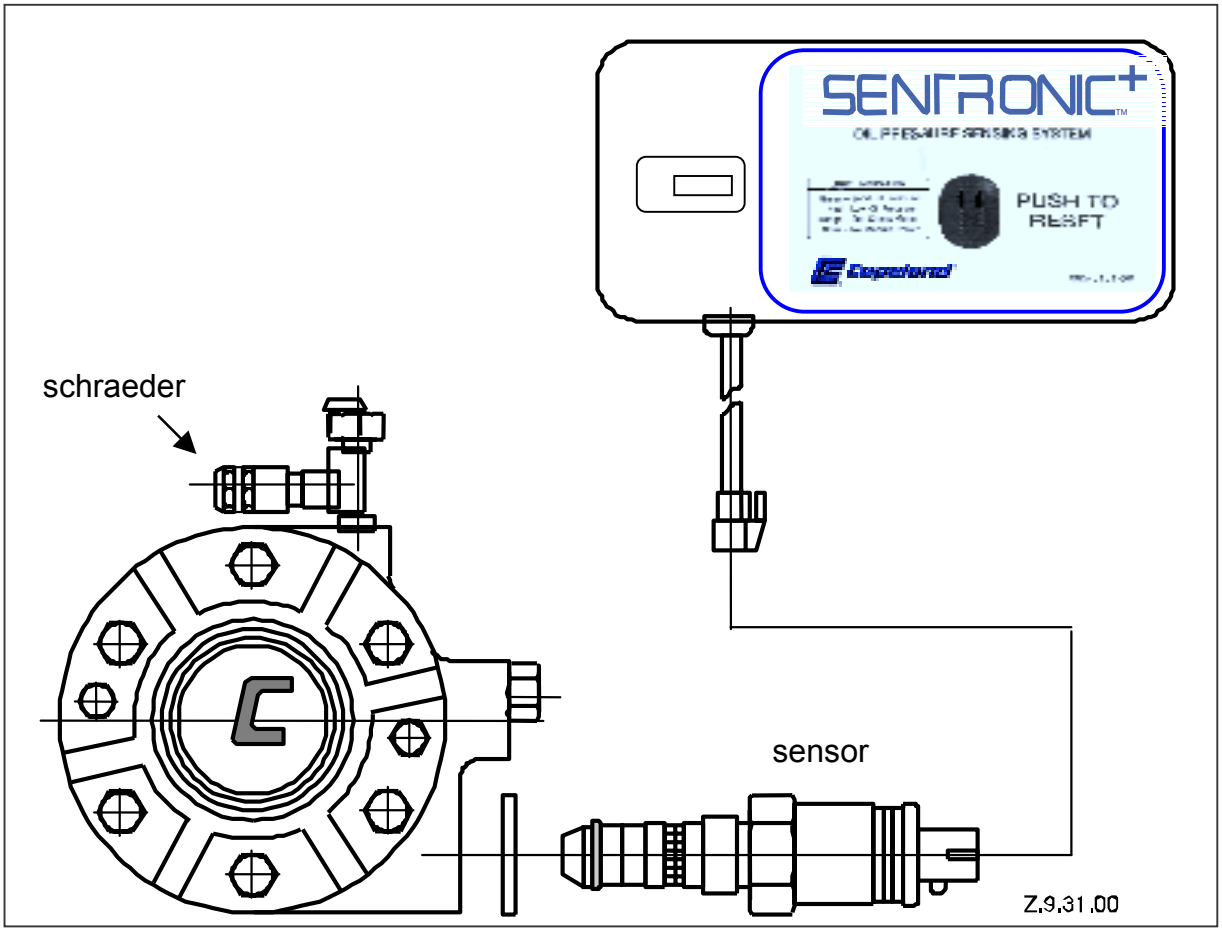
**Technical data:**

| | |
|---|---|
| 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+™ 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) |




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.

**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 (torque 2.5 Nm). The assembly is then mounted on the bearing housing cover studs using self locking nuts (torque 25 Nm).
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 57.
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 be tween “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 60 cm 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.

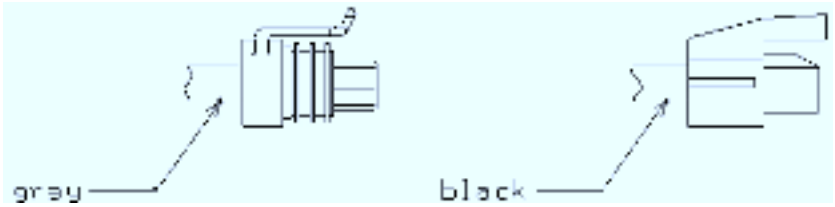
# Interchangeability of Sentronic™ & Sentronic+™ Modules & Sensors

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:

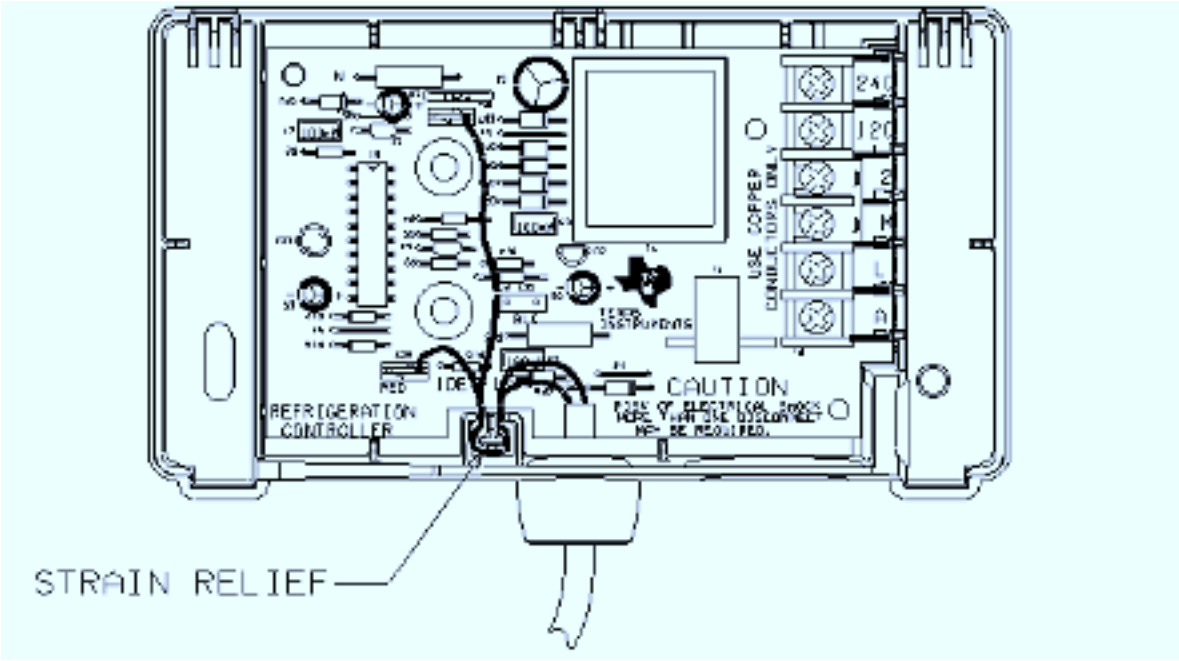
- Disconnect power to the old module
- Disconnect the cable from the sensor
- Remove the cover from the old module
- Remove the two cable quick connections from the circuit board
- Using pliers, squeeze the strain relief slots and pull to remove the cable from the module
- Remove the old module from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

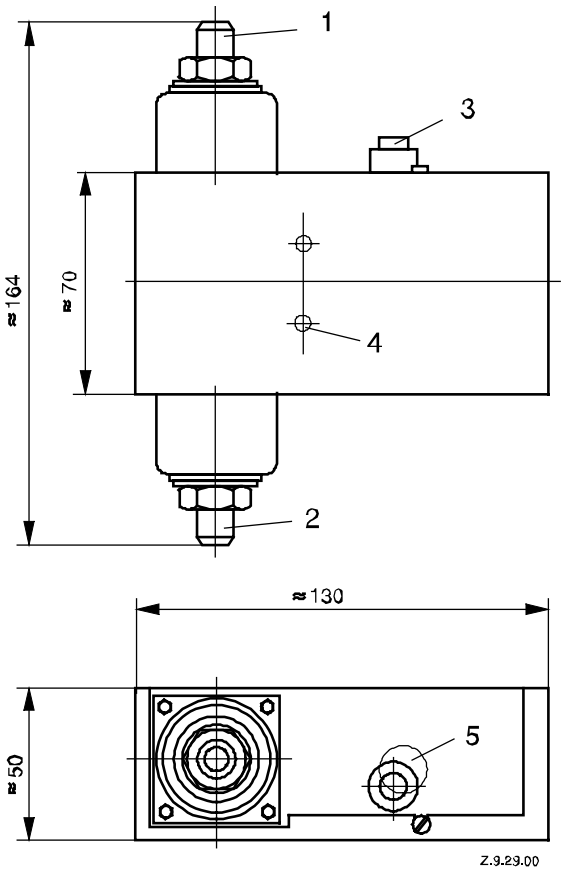
**Proper oil-pressure safety control with an approved switch is a condition of warranty!**

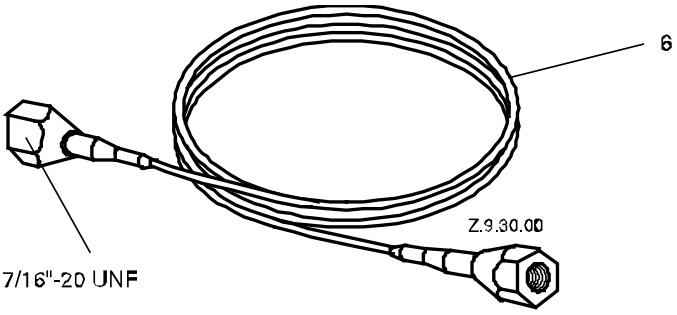
Specifications for electro-mechanical oil –pressure switches follow:
cut-out pressure: 0.63 ± 0.14 bar
cut-on pressure: 0.90 ± 0.1 bar
time delay: 120 ± 15 sec

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)** | **DLH, D2 - D8** | **24..240 V AC/DC** | **yes** | **IP 30** |
| Ranco | P 30 - 5842 | DLH, D2 - D8 | 120/240 V | yes | IP 20 |
| Danfoss | MP 55 | DLH, D2 - D8 | 110/220 V | yes | |
| | P 45 NCA - 12 | DLH, D2 - D8 | 120/240 V | no | IP 30 |
| Penn | P 45 NCB - 3 | DLH, D2 - D8 | 120/240 V | yes | |
| | P 45 NAA - 3 | DLH, D2 - D8 | 24 V | no | |
| | P 45 NCA - 9104 | DLH, 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 blushing | |
| 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

For detailed electrical information please see Technical Bulletin No. 12.
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 or 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.

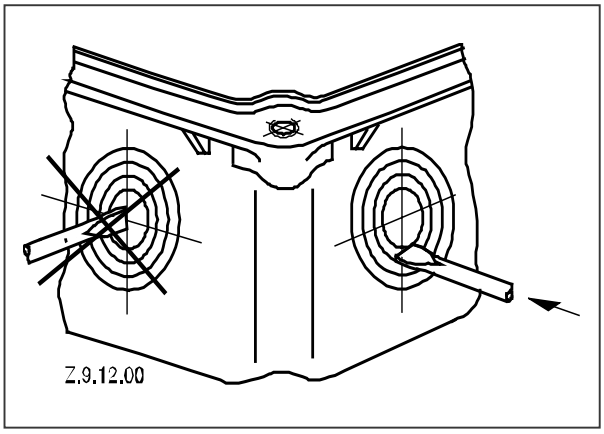
50 Hz = 380 V ==> 60 Hz = 456 V
60 Hz = 420 V ==> 50 Hz = 350 V

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.

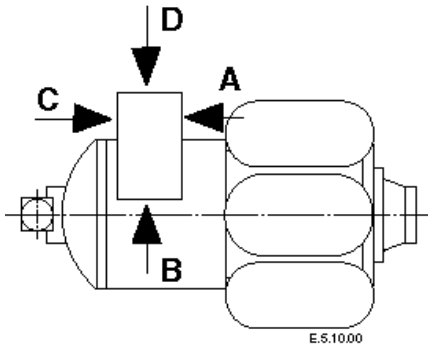
Terminal boxes with IP56 protection class have no connection strips for reasons of space. D2D and D3D terminal boxes with IP56 (according to IEC 34) protection class do not contain motor protectors. The modules must be mounted separately. In such cases the wires to the module should be kept well away 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 screw driver!**

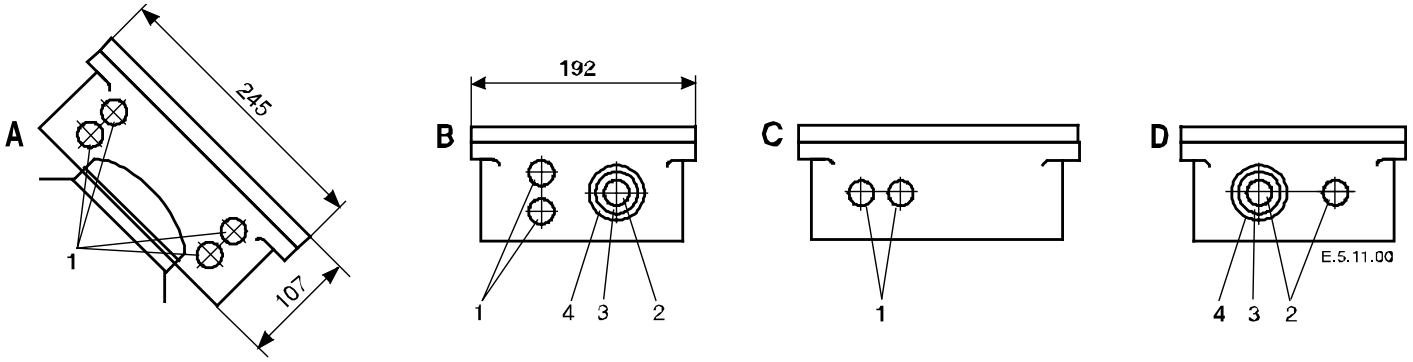


| Position at terminal box | Previous terminal box | | | New terminal box | | |
|---|---|---|---|---|---|---|
| | Hole at terminal box diameter mm | Cable bushing Pg | Outside diameter mm | Hole at terminal box diameter mm | Cable bushing metric | Outside diameter mm |
| 1 | 21.5 | 13.5 | 20.4 | 20.6 | 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

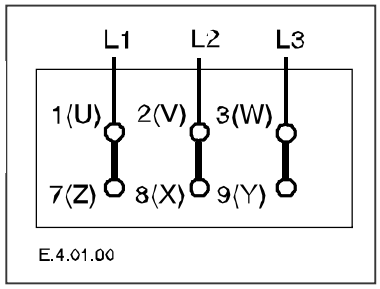


# Principal Wiring Diagrams

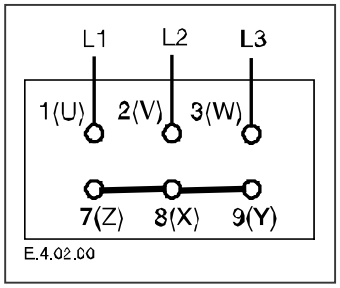
## 1. Jumper Position Motor-Compressor

### Star-Delta-Motor Y - Δ **Code E**

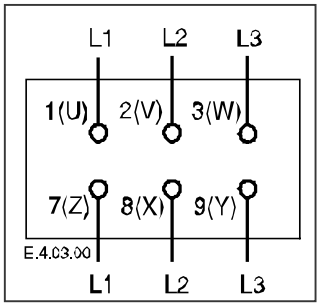
**Across-the-Line Start Δ**




**Across-the-Line Start Y**

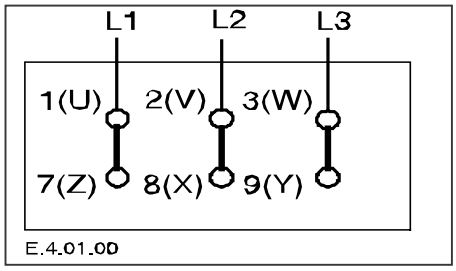



**Star-Delta-Start Y - Δ**

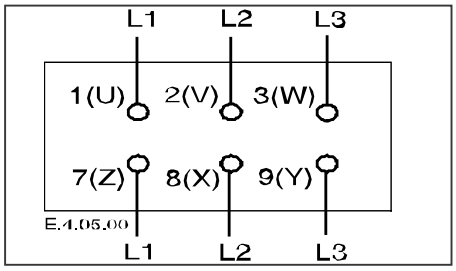



### Part-Winding motor: Y – Y **Code A**

**Across-the-Line Start Y - Y**

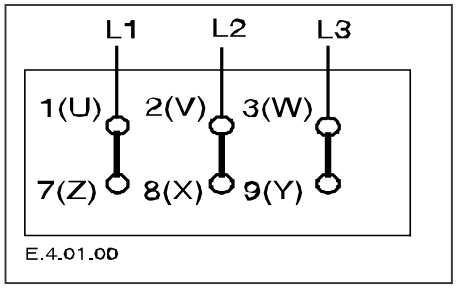



**Part-Winding Start, first Start Step 1–2-3 Y - Y**

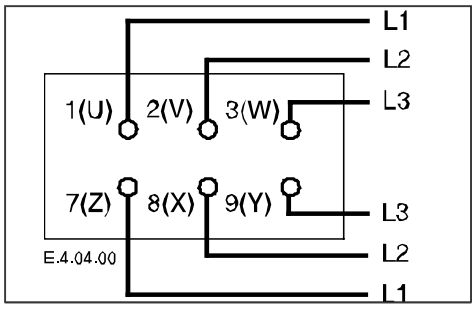



### Part-Winding motor: Δ - Δ **Code B**

**Across-the-Line Start Δ - Δ**



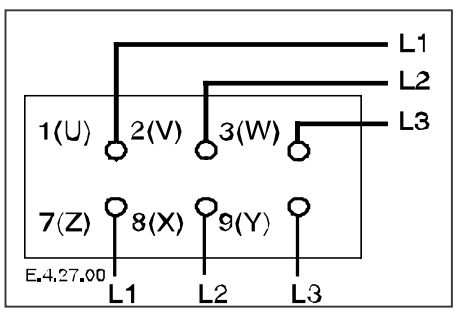

**Across-the-Line Start Δ - Δ**



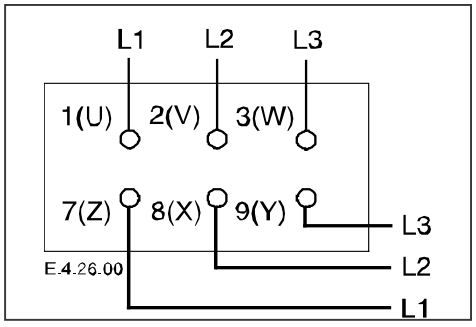

**D8DH* - 5000 BWC, D8DJ* - 6000 BWC**

### Part-Winding motor: Δ - Δ **Code B**

**Part-Winding Start, Starting Wiring via Terminals 1–2-3**

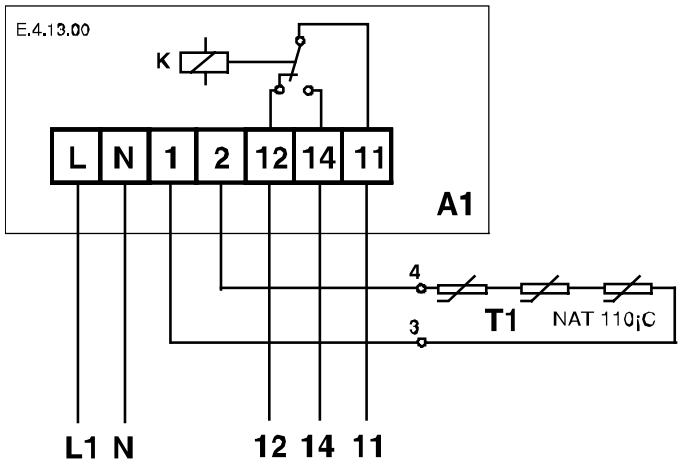



**Part-Winding Start, Starting Wiring via Terminals 7-8-9**

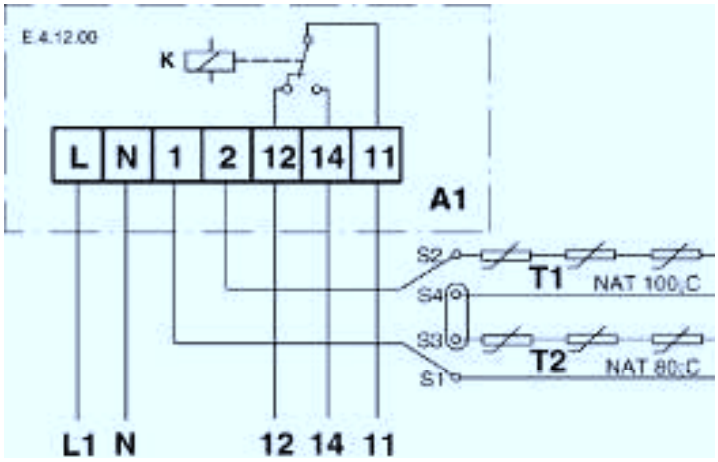


## 2. Release Module INT69 and INT69 TM

### INT 69 (D2D, D3D)

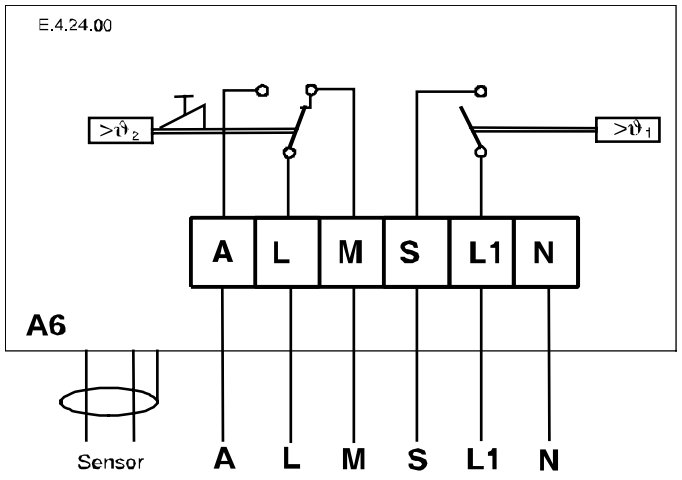



### INT 69 TM (D4D – D8D)



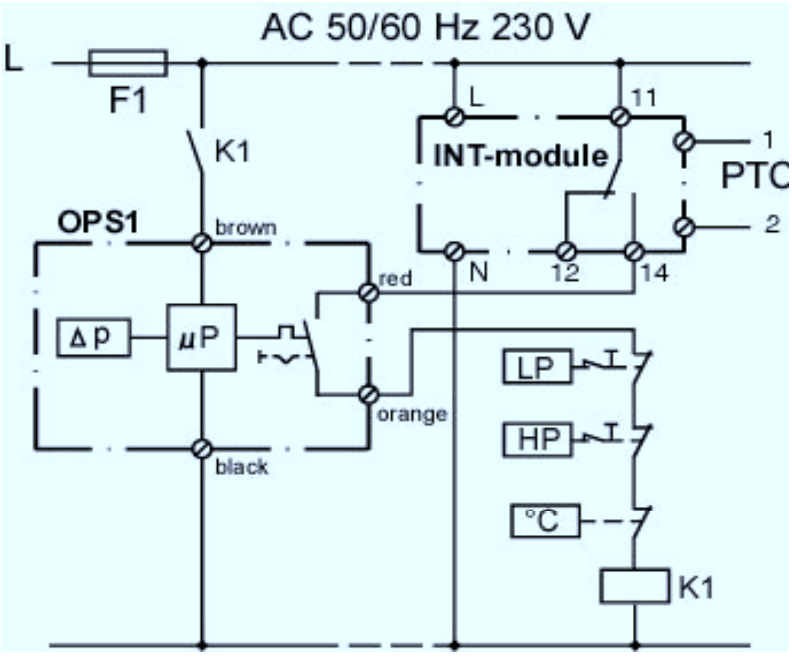

| | |
|---|---|
| L | voltage connection |
| N | neutral connection |
| 1+2 | thermistor chain connection |
| 12 | alarm connection |
| 14 | control circuit |
| 11 | control Voltage connection |
| 3+4 | cable bushings of thermistor connections in terminal box D2D, D3D |
| S1-S4 | cable bushings of thermistor connections in terminal box D4D - D8D |
| T1+T2 | thermistor chain (about 90Ω - 750Ω per chain at +20°C) |
| A1 | release module |

## 3. DEMAND COOLING



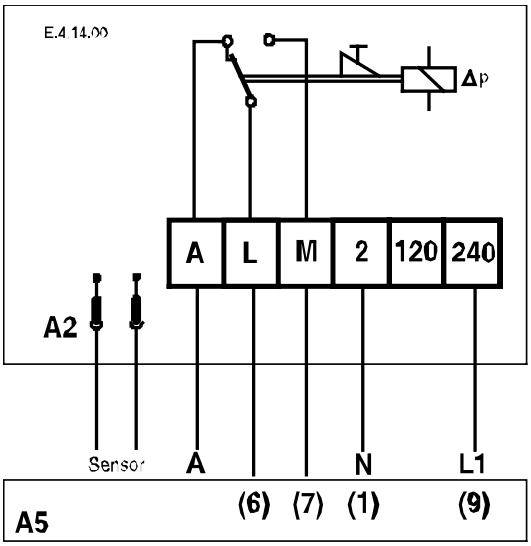

| | |
|---|---|
| A | alarm connection |
| L | control voltage connection |
| M | control circuit |
| S | injection valve connection |
| L1 | voltage connection |
| N | neutral connection |
| ϑ1 | temperature control device for energising the injection valve |
| ϑ2 | temperature control device for switch ing off the compressor |
| A6 | DEMAND COOLING Module |

## 4. Oil Pressure Switch 1 (OPS1)

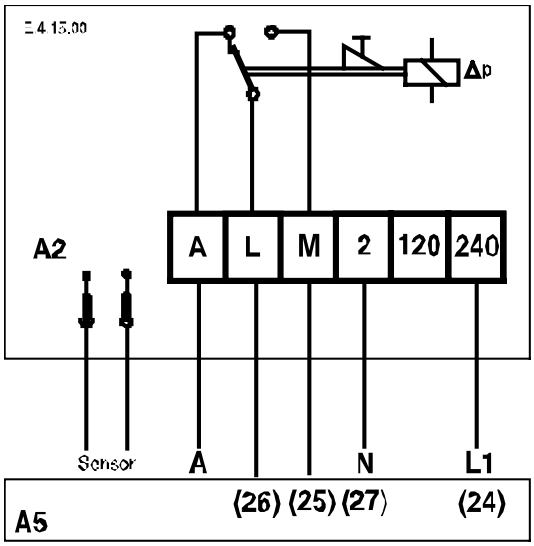



## 5. SENTRONIC Oil Pressure Control

### D2D, D3D



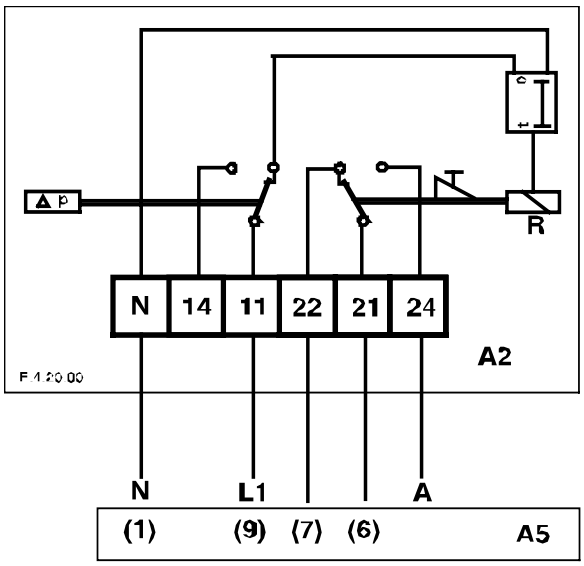

### D4D – D8D



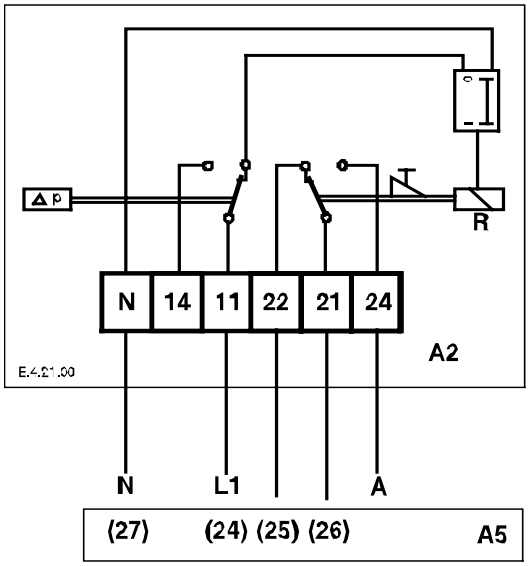

A alarm connection
L control voltage connection
M control circuit
2 neutral connection
L1 voltage connection
A2 oil pressure switch
A5 compressor terminal box

## 6. Oil Pressure Switch - ALCO FD 113 ZU

### D2D, D3D

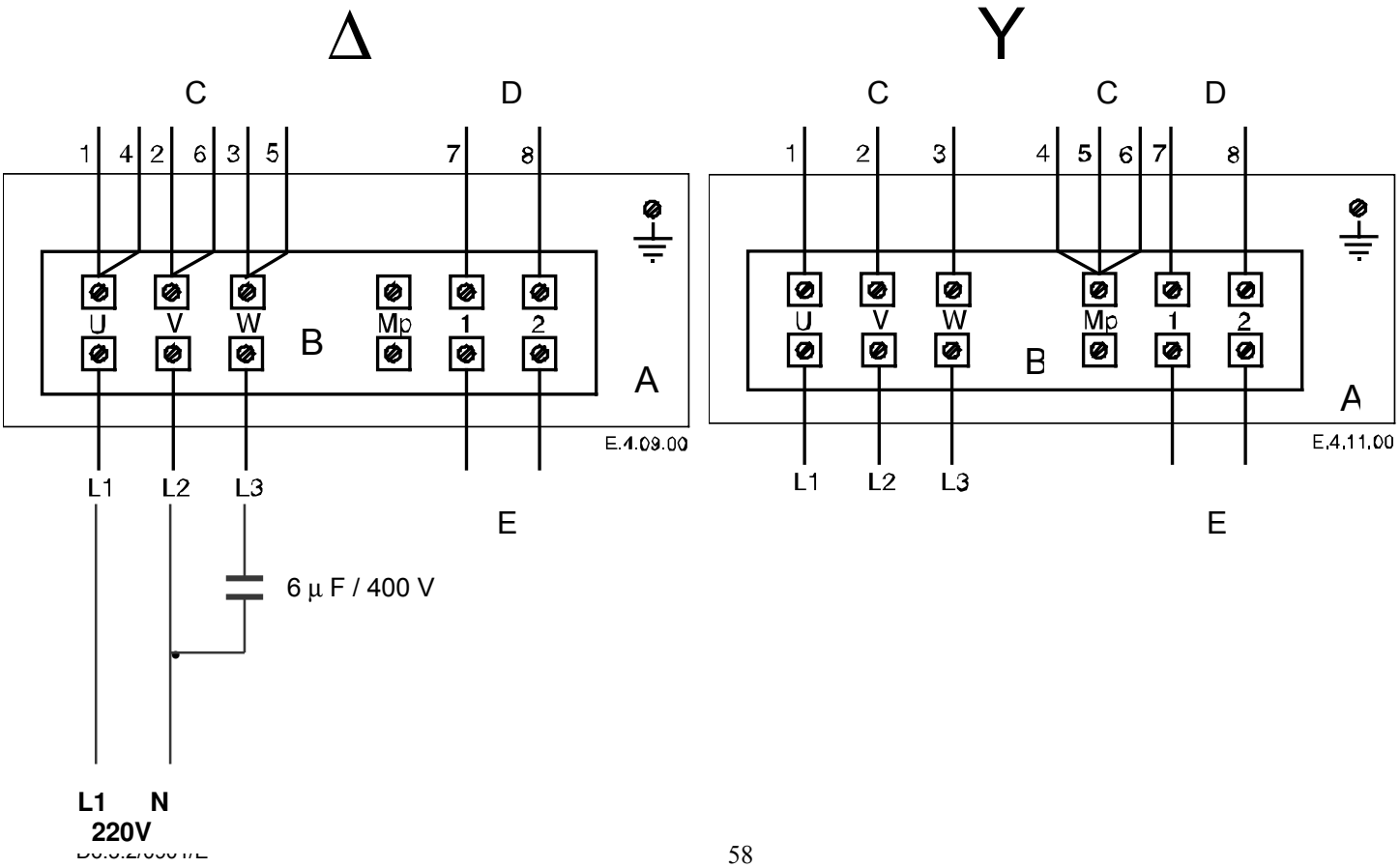



### D4D – D8D




| | | |
|---|---|---|
| N neutral connection | 22 control circuit | A5 compressor terminal box |
| 11 voltage connection | 24 alarm connection | R relay |
| 21 control voltage connection | A2 oil pressure switch | t time delay |

## 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 and 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.