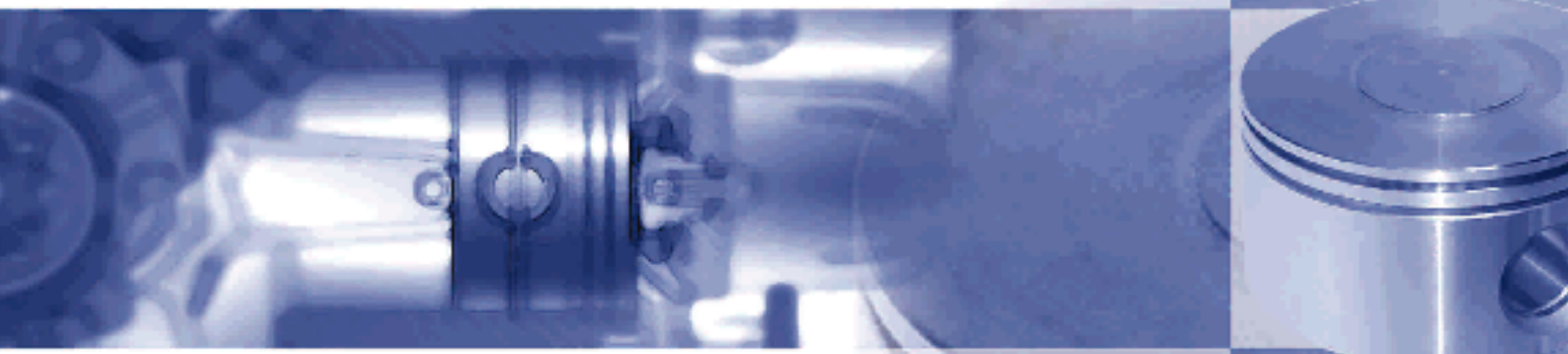
DWM COPELAND



DK, DL and S-Series Semi-Hermetic compressors

Application Guidelines

EMERSON
Climate Technologies

Index

Important Information

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

Safety Information

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

It is not allowed to run a test without the compressor being connected to the system and without refrigerant.
It is of vital importance that the discharge shut-off valve has been fully opened before the compressor is started. If the discharge 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 name -plate are compulsory, and must never be exceeded (see page 5).

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

General Information

Validity of this Manual

This manual only covers DK, DL & S Series Semi-Hermetic Compressors built after 1st January 1996. The “S” Series are characterized by a reed type discharge system.

Delivery

Please check whether the delivery is complete and intact, deficiencies should be immediately reported in writing to your local Copeland Sales Office..

Standard Delivery:
- suction and discharge shut-off valves
- oil charge, oil sight glass
- mounting kit
- motor protector
- holding charge up to 2.5 bar g (dry air)

Packaging

Compressors are individually packed and may be delivered single or on pallets- depending on quantity and size. Accessories may be mounted or delivered loose. Solenoid coils 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!

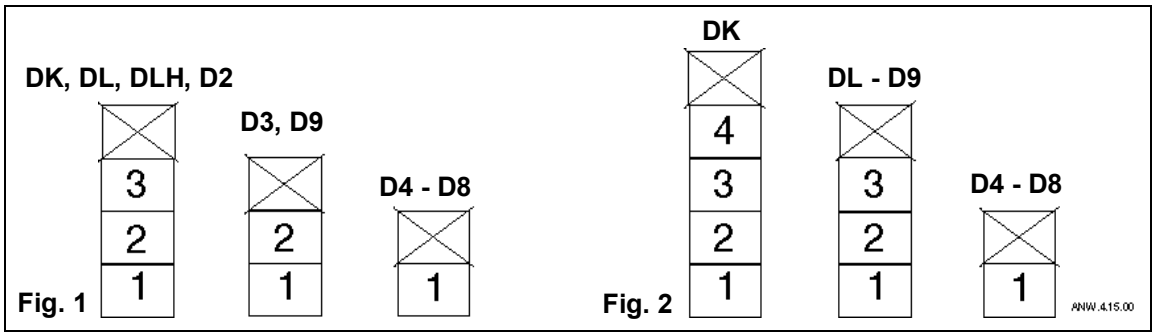


Fig. 1: stacking height for transport
Fig. 2: stacking height for stocking

Transport
Compressors should only be moved with Mechanical Handling 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 figure 3 below to see how to apply other lifting methods safely. The compressors must not be lifted by the service valves or other accessories otherwise damage or refrigerant leaks may occur.

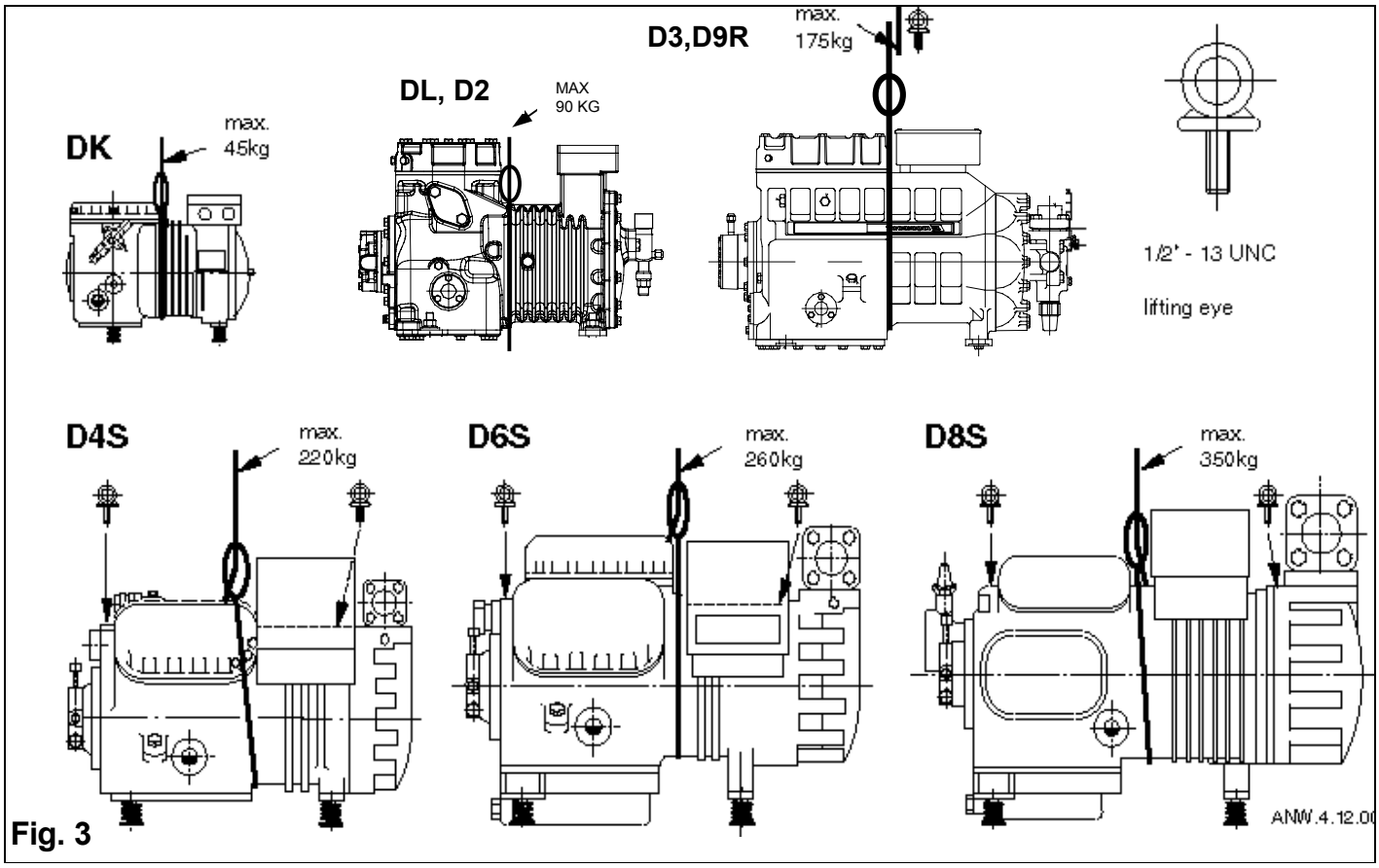


Fig. 3

Design Features

Construction

All DK, DL & S series *c*ompressors are fitted with "**Reed"** valve plates. Basic construction features of the DK can be seen in figure 4 below.

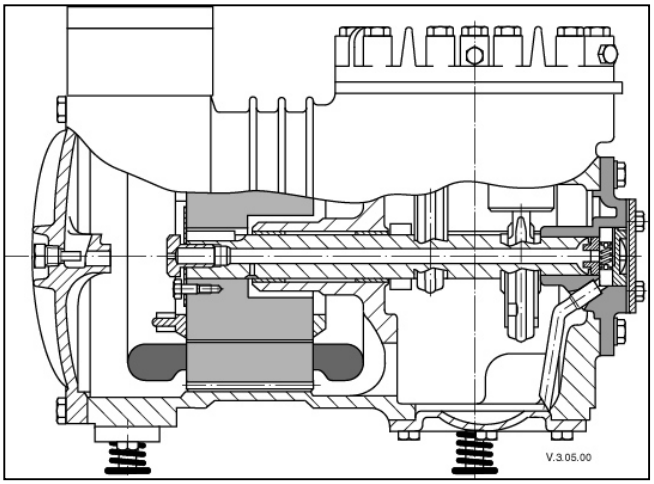


Figure 4 **DK**

Depending on the number of cylinders, the motor cooling and the kind of application there are three different compressor families:

- Models DK & DL air or water-cooled single-stage compressors with two cylinders and a displacement between 3,97 m^3/hr and 22,5m^3/hr. Model **DLH*,** is air-cooled with a displacement of 26,6 m^3/hr
- Refrigerant-cooled single-stage compressors, model **D2S, D3S, D4S, D6S, D8S and D9R** with 2, 3, 4, 6 and 8 cylinders and a displacement between 22,4 m^3/hr and 210 m^3/hr
- Refrigerant-cooled two-stage compressors with 3 cylinders, a displacement of 21,6 m^3/hr (D9TK) and 6 cylinders 84, 7m^3/hr (D6TJ)

Note; D2SA-450, D2SA-45X, D2SC-550 & D2SC-55X are suction vapour cooled whereas "D2SA-450 Air", "D2SA-45X Air", "D2SC-550 Air" & "D2SC- 55X Air" are air-cooled compressors the difference being the position of the suction service valve / port.

In addition air or water-cooled compressors have two different kinds of lubrication:

- K & L compressors using mineral oil or semi-synthetic oil and R22 (HCFC) are equipped with a centrifuge lubrication system.
- K & L ester oil filled compressors for chlorine-free HFC refrigerants like R404A are equipped with an internal oil pump, the DLHA compressor has an external oil pump.

Refrigerant-cooled compressors from D3S upwards are also available as TWIN (Tandem); two compressors of same type coupled together via a common suction chamber.

Two-stage compressors are used when high pressure ratios are required with acceptable discharge temperatures. On low-pressure stage (LP, two cylinders on D9T, four cylinders on D6T) the suction gas will be compressed to the interstage pressure. The gas enters the motor housing and crankcase via the intermediate pressure mixing line. On the high-pressure stage (HP, one cylinder on D9T, two cylinders on D6T), the gas is compressed to the condensing pressure.
Attention: Pressures in two-stage compressors are different from those of single-stage compressors, e. g. motor compartment and crankcase are under interstage pressure.

Internal Pressure Relief Valve
Single-stage compressors (50Hz) with a displacement $\geq$ 50m^3/hr are equipped with an internal pressure relief valve placed between suction chamber and discharge chamber. This valve protects the compressor against bursting if the discharge shut-off valve is accidentally fully closed.
On two-stage compressors this valve is placed between interstage and low-pressure side and opens at ≈ 15 bar (see Fig. 6).

Note: The valve will not protect the installation against dangerous system pressures !
Before operating the compressors the pressure switches and other safety devices must be installed correctly. Maximum allowable pressures must not be exceeded.

For connecting a high-pressure switch there is a tapped hole with plug in 1/8" – 27 NPTF on each cylinder head.

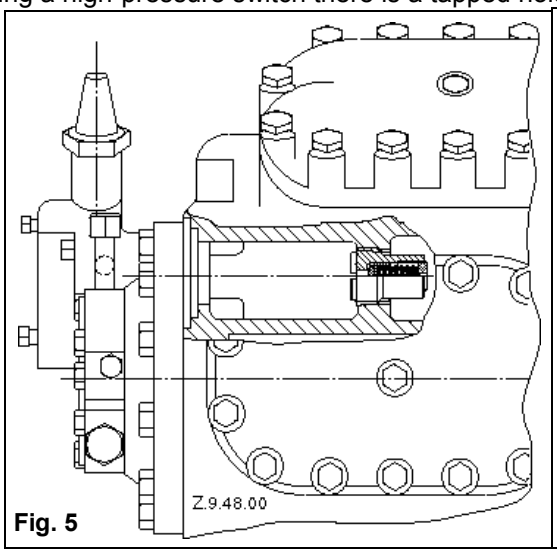


Fig. 5

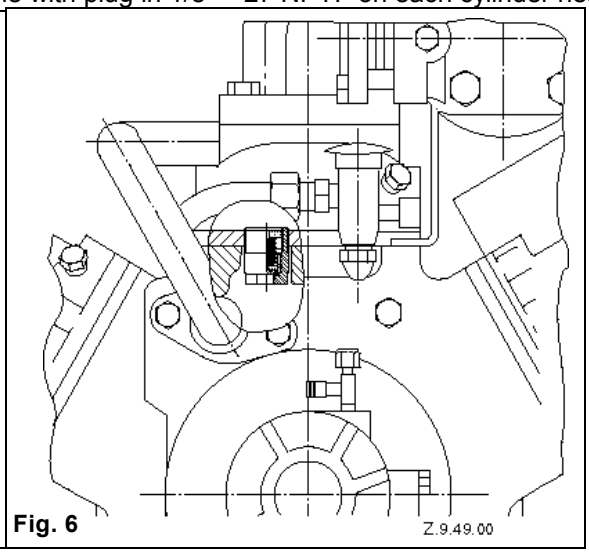


Fig. 6

Maximum Operating Pressures
Maximum operating pressures (according to pr EN 12693) shown on the compressors nameplate are obligatory and must not be exceeded.

High pressure side (HP)	28,0 bar	Low pressure side (LP)	22,5 bar

Note: The compressor operating range may be restricted for various reasons, check the application range limitations in the Copeland Selection software on www.ecopeland.com

Compressor cooling
Compressor motors must always be cooled, and cylinder head cooling may also be needed at certain operating conditions.
DK and DL compressor motors can utilise air or water-cooling. For air cooling, the airflow should be at least 18,5 m^3/hr. Note that the airflow also cools the cylinder heads. This airflow can come from the fan of an air-cooled condenser or from a separate fan. Some high pressure ratio conditions may require additional head cooling.
For water cooling, the water is led through a water coil wound round the motor section. Usually the water coil is connected before the water-cooled condenser. With mains water, a single coil "W" is used, and with cooling-tower connection a split coil "W2" is used. To improve heat transmission, the water coil is embedded into thermocement on motors >0,75 HP but smaller than 4 HP. If cylinder head cooling is also required, an additional fan must be installed with water-cooled compressors.
With suction gas-cooled compressors, the motor is cooled by refrigerant gas that is led over the motor. An additional fan, and in some cases an oil cooler, may be required depending upon the operation condition (see Selection software). For additional fan and oil cooler mounting instructions, please see below.

Refrigeration Oils
The following refrigeration oils are approved from Copeland:

Ester Oils for R134a, 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 or EAL Arctic 22.

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

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

Remarks: chlorine-free refrigerants shall only be used with polyolester, often referred to as ester oil.
Ester oil is very hygroscopic and sensitive to moisture. It influences the chemical stability of the oil. Due to this, ester oil requires a clean and careful handling.
It is essential to install a suitable filter drier to reduce the residual moisture level down to 50ppm or less (measured after a minimal operation of 48 hours).

The diagram below compares the hygroscopic characteristics of EAL Arctic 22 CC with mineral oil (moisture absorbtion in PPM at 25°C and 50% relative humidity).

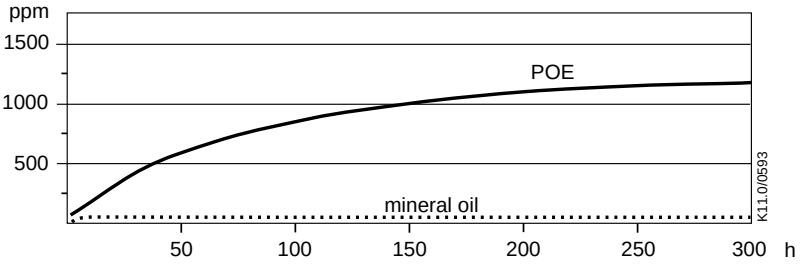
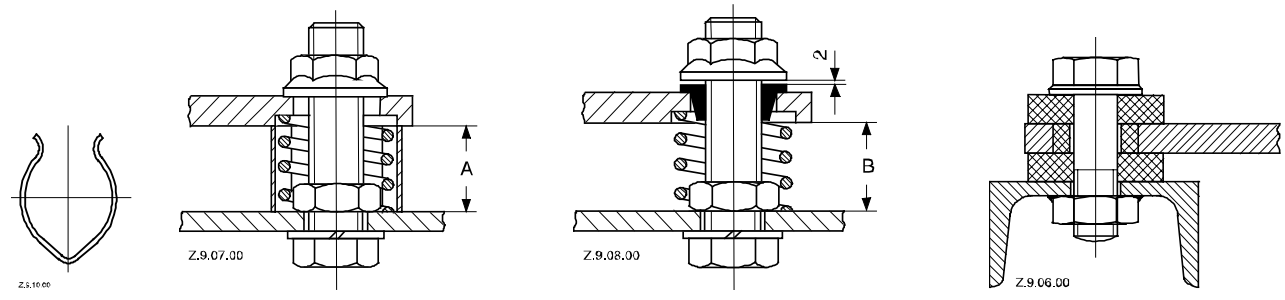


Fig. 7

Mounting Parts
To minimize vibration and start/stop impulses flexible mounting should be used. For this purpose coloured springs are delivered with each compressors. These springs should be mounted according to the table overpage. A compressor may be rigidly mounted (i.e. without springs). In this case more shock and vibration loading will be transmitted to the frame.

To ensure proper lubrication of moving parts, the compressor should be installed horizontally on both axes. TWIN compressors are fitted to mounting rails using rubber pads. If the installation requires a very high level of vibration absorbtion, additional vibration absorbers (available on the market) can be fitted between the rails and the foundation.



Transport position | Operational position | Grommets for TWIN compressors

Fig. 8

Mounting Springs

Compressor		Size A mm	Size B mm	Colour of Springs		Compressor		Size A mm	Size B mm	Colour of Springs	
				Motor	Cylinder					Motor	Cylinder
DKM - 50	/ - 5X	22	25	2 x blue	2 x maroon	D9TH - 1010	/ - ---	34	38	2 x maroon	2 x white
DKM - 75	/ - 7X	22	25			D3SS - ---	/ - 100X	30	35		
DKM - 100	/ - 10X	22	25			D3SS - 1500	/ - ---	30	35	2 x yellow	2 x green
DKJ - 75	/ - 7X	22	25			D9RS - 1500	/ - ---	34	44		
DKJ - 100	/ - 10X	22	25			D4SA - 1000	/ - 100X	34	44		
DKSJ - 100	/ - 10X	22	25			D4SF - 1000	/ - ---	34	44		
DKJ - 150	/ - 15X	22	25	2 x maroon	2 x green	D4SL - 1500	/ - ---	34	44		
DKSJ - 150	/ - 15X	22	25			D4SA - 2000	/ - 200X	34	44		
DKL - 150	/ - 15X	22	25			D4SH - 1500	/ - 150X	34	44		
DKL - ---	/ - 20X	22	25			D4ST - 2000	/ - 200X	34	44	2 x black	
DKSL - 150	/ - 15X	22	25			D4SH - 2500	/ - 250X	34	44		
DKSL - 200	/ - 20X	22	25			D6TA - 1500	/ - 150X	34	44		
DLE - 201	/ - 20X	30	35	2 x blue	2 x blue	D6TH - 2000	/ - 200X	34	44		
DLF - 201	/ - 20X	30	35			D6SF - 2000	/ - ---	34	44		
DLF - 301	/ - 30X	30	35			D6SA - 3000	/ - ---	34	44		
DLJ - 201	/ - 20X	30	35			D4SJ - 2000	/ - 200X	34	44		
DLJ - 301	/ - 30X	30	35			D4SJ - 3000	/ - 300X	34	44		
DLL - 301	/ - 30X	30	35			D6SH - 2000	/ - 200X	34	44		
DLL - 401	/ - 40X	30	44	2 x maroon	2 x maroon	D6SL - 2500	/ - ---	34	44		
DLSG - 401	/ - 40X	30	44			D6SH - 3500	/ - 350X	34	44	2 x blue	2 x red
DLHA - 500	/ - 50X	30	44			D6TJ - 2500	/ - 250X	34	44		
D2SA - 450	/ - 45X	30	44			D6SJ - 3000	/ - 300X	48	44		
D2SC - 550	/ - 55X	30	44			D6SJ - 4000	/ - 400X	48	44		
D2SK - 650	/ - 65X	30	44			D6ST - 3000	/ - ---	48	44		
D3SC - ---	/ - 75X	30	35			D6SK - 5000	/ 500X	48	51	2 x silver	2 x brown
D3SC - 1000	/ - ---	30	35			D8SH - 3700	/ - 370X	48	51		2 x black
D9RA - 500L	/ - ---	30	35			D8SH - ---	/ - 400X	48	51		
D9RA - 750	/ - ---	30	35			D8SJ - 4500	/ - 450X	48	51		
D9RC - 750	/ - ---	30	35			D8SJ - ---	/ - 500X	48	51		
D9TK - 0760	/ - ---	34	38			D8SH - 5000	/ - 500X	48	51		
D9TL - 0760	/ - ---	34	38			D8SJ - 6000	/ - 600X	48	51		
D9TH - 0760	/ - ---	34	38			D8SK - 6000	/ - 600X	48	51		2 x blue
D9RC - 1000	/ - ---	30	35		2 x white	D8SK - 7000	/ - 700X	48	51		
D9RS - 1000	/ - ---	30	35								

Note:
As an option the D6SK-5000 / D6SK-500X can be ordered with 2 x brown mounting springs (motor end) and 2 x black mounting springs (cylinder end) to fit a 6-cylinder footprint. The mounting springs shown in table above are to fit to 8-cylinder footprint which is standard with this compressor.

Running Gear Lubrication

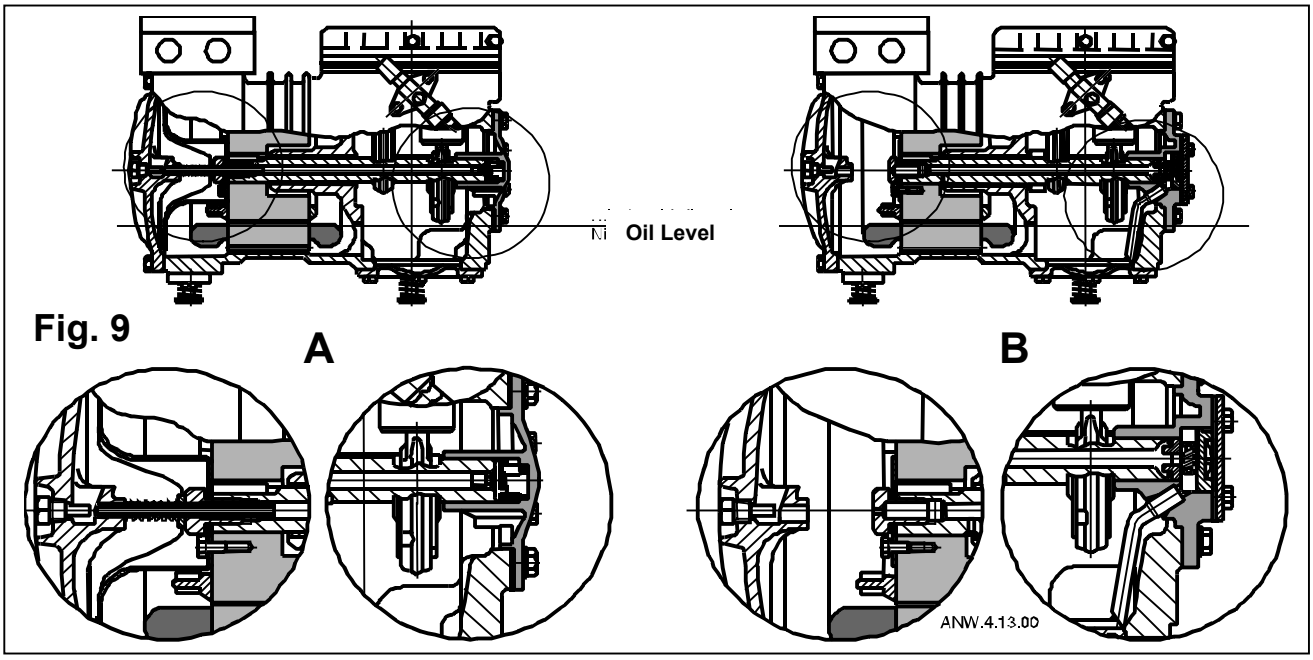


Fig. 9

Air or Water-Cooled Compressors

Air or water-cooled compressors that are filled with mineral oil have an oil centrifuge. The oil supplied is drawn over a magnetic plug in order to separate even the smallest iron particles from the oil (see Fig. 9A).
Air or water-cooled compressors that are lubricated with ester oil have an integral low-pressure oil pump. These compressors, with pump and ester oil filling, are marked with “P” in compressor nomenclature (see Fig. 9B). An exception is the DKSLP – 200 which has an oil pump but is filled with mineral oil.

DK & DL Compressor Oil Circulation
The oil returning from the evaporator reaches the crankcase via an oil separator chamber behind the suction shut-off valve through a small connecting bore. Due to this connecting bore the crankcase pressure will be decreased slowly when the compressor starts. Thus the foaming of the oil and refrigerant mixture will be reduced.

Suction gas-cooled Compressors

The oil pumps used for STANDARD compressors are independent of their rotating direction. They are designed to accommodate fittings for an OPS1, SENTRONIC oil safety system or a standard oil pressure switch. For basic components and mounting instructions see pages 51 & 52.

Oil Circulation

Oil is returned through a suction screen with the suction gases and separated in the motor chamber. It reaches the crankcase by way of a non-return valve in the partition between motor and crankcase. This valve prevents any backflow of oil into the motor due to the pressure difference arising between motor and crankcase, e.g. on compressor start-up The valve does not reopen until the pressure has been equalised by means of a second non return valve or equalisation bore. This second valve or equalisation bore connects the crankcase and suction side cylinder head. It slowly reduces the pressure difference by means of the “venturi” effect. The oil foams less and only limited oil/refrigerant foam is transferred to the oil pump, thus slowing down pressure decrease in the crankcase over a certain period of time. It reduces the foaming of the oil/refrigerant mixture which would occur if pressure decreased rapidly.

Oil Pressure Switch

The oil pressure of suction gas cooled compressors and of the DLH must be controlled by an oil pressure switch which 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.

The 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.

Note: The low pressure oil pump of air or water-cooled compressors has no connection for an oil pressure switch.

The following oil pressure switches are approved:

Manufacturer	Type
ALCO CONTROLS	FD 113 ZU
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

Oil Level

All compressors are delivered with sufficient oil for normal operation (see table on page 16). 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 on this page. The level can also be checked within 10 sec. of compressor shut-down.

When an oil regulator is in use the oil level may be slightly higher because the oil separator will reduce excessive oil circulation.

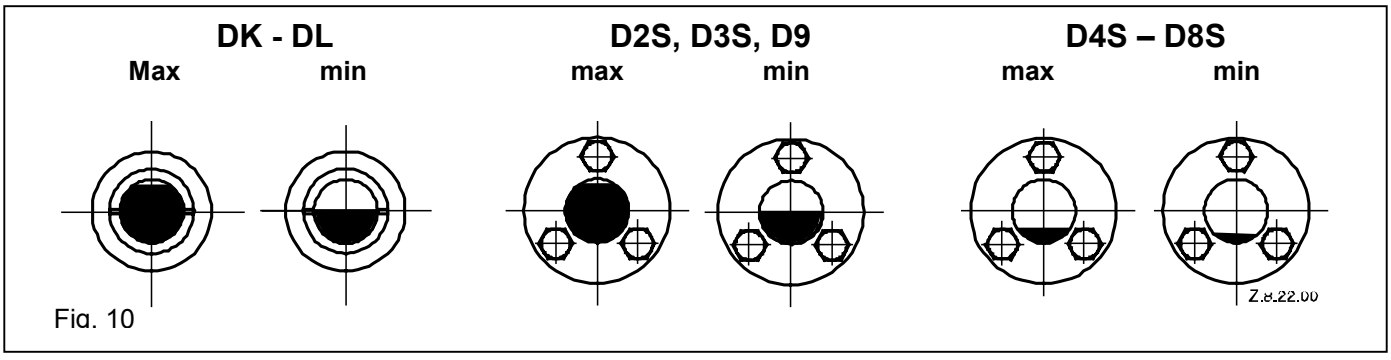


Fig. 10

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, 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.

During irregular operating conditions (e.g. a blocked suction filter), the pressure measured at the suction shut-off valve of the compressor may differ widely from that measured at the crankcase, therefore pressure drops have to be avoided.

Start-up

The compressor must be equipped according to our technical documentation considering the application intended. Make sure of this before start-up.

For brazing connections where dissimilar or ferric metals are joined a silver alloy rod with a minimum of 30% silver shall be used being either flux coated or with a separate flux.

Bolt torque settings are listed on page 26 & 27.

With the exception of rubber coated metallic gaskets (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 valves 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.
Due to the factory holding charge of dry air the compressor is under pressure (about 1 to 2.5 bar), this is to indicate the compressor does not leak.
When plugs are removed from the compressor in order to connect a pressure gauge or to fill in oil, the plug may pop out under pressure 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
When brazing the system should be swept with an inert gas such as oxygen free nitrogen at a very low pressure! 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.

Electrical Information

Electrical Connections

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.

Single-Phase Motors - Code C

Compressors up to model DKSL-15X are available with single –phase motors. They have one main and one auxiliary winding and are delivered with a capacitor and relay assembly, consisting of a start and run capacitor and a potential relay. Assembly must be in accordance with the position of the relay shown on the wiring diagram.

Three Phase Motors

All compressors can be started Direct-On-Line.
The necessary position of bridges for direct-on-line start (depending on type of motor and/or mains voltage) is shown on the principle Wiring on page 63.

Direct-on-Line Start Motors – Code T

This motor is only suitable for one voltage and can only be started Direct-On-Line. The motor winding is internally connected into delta or star and 3 winding ends are connected to the terminals U, V, W in the terminal box.

Star-Delta Motor (Y/Δ) – Code E

With the help of bridges, this motor is interchangeable for star (Y) or delta (Δ) operation. It is suitable for two voltages (e. g. 230V in delta, 400V in star connection). If the supply voltage and the nominal voltage of the motor in Δ-connection are identical, the star connection motor can also be used for starting (remove bridges!).

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

PWS motors contain two separate windings (2/3 + 1/3) which are internally connected in star and operated in parallel. You cannot change the voltage by changing the electrical connections, the motor is only suitable for one voltage.
The first part winding, the 2/3 winding on terminals 1-2-3 can be used for part winding start (remove the bridges). After a time delay of 1 ± 0.1 seconds the second part winding, the 1/3 winding on terminals 7-8-9 must be brought on line.

Attention:

In order not to endanger the motor, the connection of first terminals 1, 2 & 3 and second terminals 7, 8 & 9 Part Winding to the mains must be identical. The connections of the first and second part winding must be equiphase.

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

From January 1994 onwards, these compressors are equipped with a new part-winding motor. Compared with the code A part-winding motor used before, the torque has been increased both for 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. You cannot change the voltage by changing the electrical connections, the motor is only suitable for one voltage.
In spite of the increased torque provided the locked rotor current (full winding) and the maximum operating current remain unchanged.

If the motor is supplied with power by terminals 1–2–3 (without bridges), a true part-winding start is put into effect. The starting current is **68%** of the value for across-the-line starting. After a time delay of 1 ± 0.1 seconds the second part winding, the 2/5 winding on terminals 7-8-9 must be brought on line.
When the motor is started via terminals 7-8-9 (without bridges), the starting current is **54%**.
The distribution of current to both windings is independent of the load:

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

Attention:

In order not to endanger the motor, the connection of first and second part winding to the mains L1, L2 and L3 must be identical. The connections of the first and second part winding must be equiphase.

Motor Protection

Each compressor has a motor protector. An external overload protection is not necessary.

Overcurrent Thermal Protection Switch for Single-Phase Motors, System A
This switch, a bimetal switch is installed in the terminal box. It is heated by the motor current, and by the motor bundle of laminations, and combines the function of an overcurrent tripping device and thermal protection switch. When the switch responds, it interrupts the voltage supply to the motor directly, not the control line. When the motor winding cools off, it switches on again automatically.

Danger
When the motor stopped due to the overcurrent thermal protection switch, the compressor still is under voltage!

Thermistor Protection, System W
All 3-phase motors with a "W" in the motor code have a thermistor protection device. The temperature dependent resistance of the thermistor (also PTC-resistance) is used to sense the winding temperature. A chain of 3 thermistors (with DK, DL, DLH, D9R, D9T, D2S, D3S) or two chains of 3 each (with D4S, D6S, D6T, D8S) connected in series are embedded in the motor windings in such a manner that the temperature of the thermistors can follow with little inertia.
An electronic release module is required which switches a control relay, depending on the thermistor resistance. The release module INT 69 for one thermistor chain or two chains with a 5 min time delay, INT69TM for two chains, is installed in the terminal box to which the thermistors are connected (see page 63).
The maximum test voltage for thermistors is 3 V.
The resistance of each thermistor chain on a cold compressor should be ≤ 750 Ω.

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

Model	Class	Option
DK / DL / D2S	IP 54	---
D9R / D9T	IP 54	IP 56*
D3S	IP 54	IP 56*
D4S	IP 54	IP 56*
D6S / D6T	IP 54	IP 56*
D8S	IP 54	IP 56*

* external overload protector

Nameplates

DK, DL, D2 & D9

D4S, D6S/T, D8S

D3S

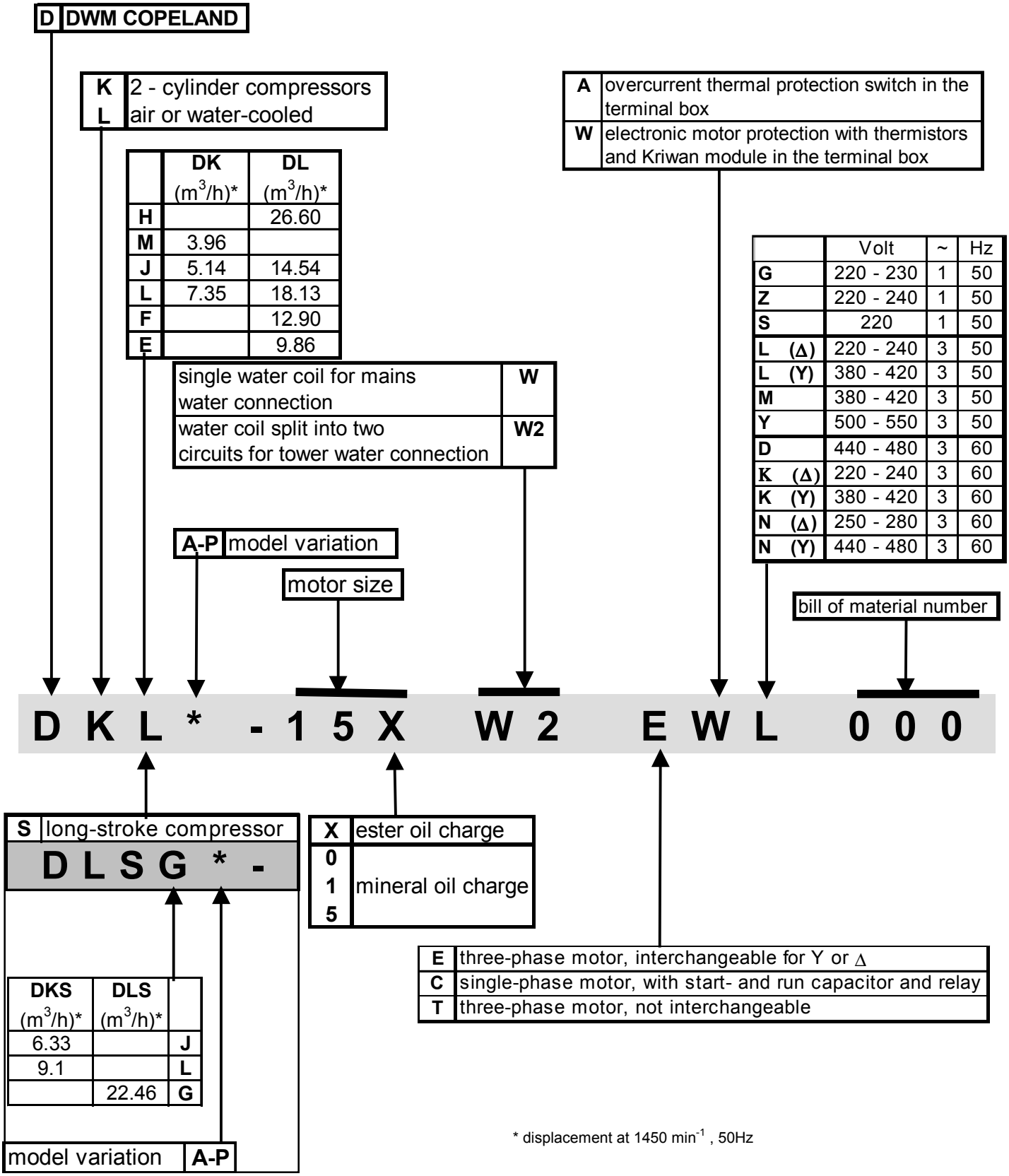
Information
All important information for identification of the compressor is printed on the nameplate. The type of refrigerant used should be stamped on the nameplate by the installer.

The date of production:
With DK, DL, D9 the year of production
With D4S, D6S and D8S the year and week of production – and in addition the year and month (Jan. = A, Feb. = B, ...Dec. = L) as part of the serial number.

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.

Model Designation

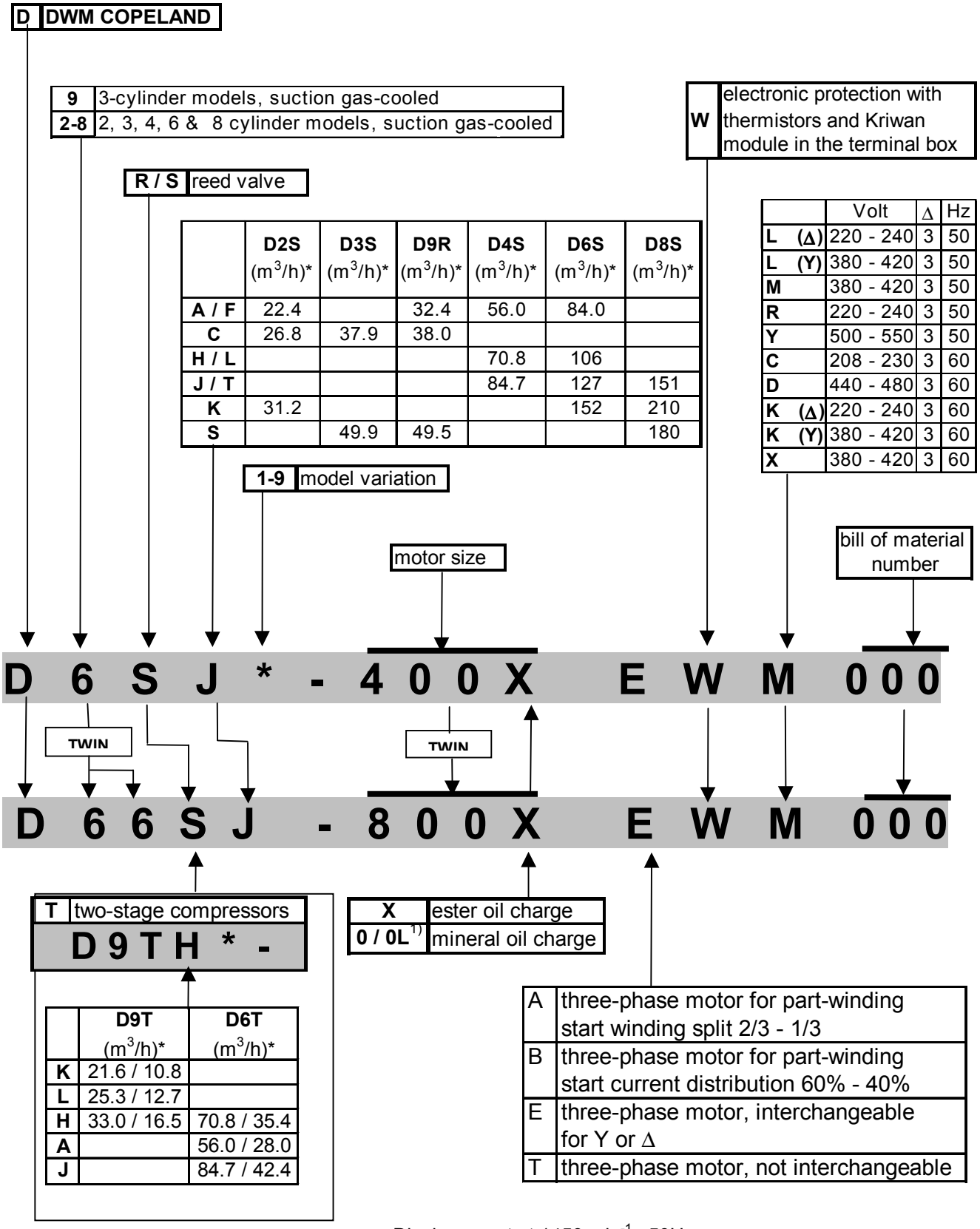
Air or Water Cooled Compressors



* displacement at 1450 min^{-1} , 50Hz

Model Designation

Standard Compressors, Suction Gas-Cooled TWIN Compressor



	D2S (m^3/h)*	D3S (m^3/h)*	D9R (m^3/h)*	D4S (m^3/h)*	D6S (m^3/h)*	D8S (m^3/h)*
A / F	22.4		32.4	56.0	84.0	
C	26.8	37.9	38.0			
H / L				70.8	106	
J / T				84.7	127	151
K	31.2				152	210
S		49.9	49.5			180

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

	D9T (m^3/h)*	D6T (m^3/h)*
K	21.6 / 10.8	
L	25.3 / 12.7	
H	33.0 / 16.5	70.8 / 35.4
A		56.0 / 28.0
J		84.7 / 42.4

- Displacement at 1450 min^{-1} , 50Hz;

1) OL = Low temperature valve plate

Technical Data on Accessories

Motor-Compressor	Capacity Control	Unloaded Start			Crankcase Heater (Int) (Watts)			Oil Charge	Suction Line Size (sweat)	Discharge Line Size (sweat)
		Solenoid Valve	Pilot Valve	Check Valve1						
	0ptional							l		
DKM - 50 / - 5X	-	-	-	-	27	-	-	0.6	Ø 1/2"	Ø 1/2"
DKM - 75 / - 7X	-	-	-	-	27	-	-	0.6	Ø 1/2"	Ø 1/2"
DKM - 100 / - 10X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKJ - 75 / - 7X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKJ - 100 / - 10X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKJ - 150 / - 15X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKSJ - 100 / - 10X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKSJ - 150 / - 15X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKL - 150 / - 15X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKL - --- / - 20X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKSL - --- / - 15X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DKSL - 200 / - 20X	-	-	-	-	27	-	-	0.6	Ø 5/8"	Ø 1/2"
DLE - 201 / - 20X	-	-	-	-	70	-	-	2.3	Ø 7/8"	Ø 5/8"
DLF - 201 / - 20X	-	-	-	-	70	-	-	2.3	Ø 7/8"	Ø 5/8"
DLF - 301 / - 30X	-	-	-	-	70	-	-	2.3	Ø 7/8"	Ø 5/8"
DLJ - 201 / - 20X	-	-	-	-	70	-	-	2.3	Ø 7/8"	Ø 5/8"
DLJ - 301 / - 30X	-	-	-	-	70	-	-	2.3	Ø 7/8"	Ø 5/8"
DLL - 301 / - 30X	-	-	-	-	70	-	-	2.3	Ø 1 1/8"	Ø 5/8"
DLL - 401 / - 40X	-	-	-	-	70	-	-	2.3	Ø 1 1/8"	Ø 5/8"
DLSG - 401 / - 40X	-	-	-	-	70	-	-	2.3	Ø 1 1/8"	Ø 5/8"
DLHA - 500 / - 50X	-	EVR 15	-	NRV 22S Ø 22	70	-	-	1.6	Ø 1 1/8"	Ø 7/8"
D9RA - 500L / - ---	33%	EVR 20	-	NRV 22S Ø 22	70	-	-	3.8	Ø 1 3/8"	Ø 7/8"
D9RA - 750 / - ---	33%	EVR 20	-	NRV 28S Ø 28	70	-	-	3.8	Ø 1 3/8"	Ø 7/8"
D9RC - 750 / - ---	33%	EVR 20	-	NRV 28S Ø 28	70	-	-	3.8	Ø 1 3/8"	Ø 1 1/8"
D9RC - 1000 / - ---	33%	EVR 20	-	NRV 28S Ø 28	70	-	-	3.8	Ø 1 3/8"	Ø 1 1/8"
D9RS - 1000 / - ---	33%	EVR 20	-	NRV 28S Ø 28	70	-	-	3.8	Ø 1 3/8"	Ø 1 1/8"
D9RS - 1500 / - ---	33%	EVR 20	-	NRV 28S Ø 28	70	-	-	3.8	Ø 1 5/8"	Ø 1 1/8"
D2SA - 450 / - 45X	-	EVR 15	-	NRV 22S Ø 22	70	-	-	2.5	Ø 1 1/8"	Ø 7/8"
D2SC - 550 / - 55X	-	EVR 15	-	NRV 22S Ø 22	70	-	-	2.5	Ø 1 1/8"	Ø 7/8"
D2SK - 650 / - 65X	-	EVR 15	-	NRV 22S Ø 22	70	-	-	2.5	Ø 1 1/8"	Ø 7/8"
D3SC - 1000 / - 75X	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3.7	Ø 1 3/8"	Ø 1 1/8"
D3SS - --- / - 100X	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3.7	Ø 1 3/8"	Ø 1 1/8"
D3SS - 1500 / - ---	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3.7	Ø 1 3/8"	Ø 1 1/8"
D4SA - 1000 / - 100X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.5	Ø 1 5/8"	Ø 1 1/8"
D4SF - 1000 / - 100X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.5	Ø 1 5/8"	Ø 1 1/8"

Technical Data on Accessories

Motor-Compressor	Capacity Control	Unloaded Start			Crankcase Heater (Int) (Watts)			Oil Charge	Suction Line Size (sweat)	Discharge Line Size (sweat)
		Solenoid Valve	Pilot Valve	Check Valve1						
	Optional							l		
D4SA - 2000 / - 200X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	3.6	Ø 1 5/8"	Ø 1 1/8"
D4SH - 1500 / - 150X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	3.6	Ø 1 5/8"	Ø 1 1/8"
D4SL - 1500 / - 150X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	3.6	Ø 1 5/8"	Ø 1 1/8"
D4SH - 2500 / - 250X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.0	Ø 2 1/8"	Ø 1 1/8"
D4ST - 2000 / - 200X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.0	Ø 2 1/8"	Ø 1 3/8"
D4SJ - 2000 / - 200X	50%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.3	Ø 2 1/8"	Ø 1 3/8"
D4SJ - 3000 / - 300X	50%	-	705 RA 001	NRV 28S Ø 28	-	100	-	4.0	Ø 2 1/8"	Ø 1 3/8"
D6SF - 2000 / - 250X	33% + 66%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.3	Ø 2 1/8"	Ø 1 3/8"
D6SA - 3000 / - 300X	33% + 66%	-	705 RA 001	NRV 28S Ø 28	-	100	-	4.3	Ø 2 1/8"	Ø 1 3/8"
D6SH - 2000 / - 200X	33% + 66%	-	705 RA 001	NRV 28S Ø 28	-	100	-	4.3	Ø 2 1/8"	Ø 1 3/8"
D6SL - 2500 / - 250X	33% + 66%	-	705 RA 001	NRV 22S Ø 22	-	100	-	4.3	Ø 2 1/8"	Ø 1 3/8"
D6SH - 3500 / - 350X	33% + 66%	-	705 RA 001	NRV 28S Ø 28	-	100	-	4.3	Ø 2 1/8"	Ø 1 3/8"
D6ST - 3200 / - 320X	33% + 66%	-	705 RA 001	NRV 22S Ø 22	-	100	-	7.4	Ø 2 1/8"	Ø 1 3/8"
D6SJ - 3000 / - 300X	33% + 66%	-	705 RA 001	NRV 28S Ø 28	-	100[2]	200	7.4	Ø 2 1/8"	Ø 1 3/8"
D6SJ - 4000 / - 400X	33% + 66%	-	705 RA 001	NRV 28S Ø 28	-	100[2]	200	7.4	Ø 2 1/8"	Ø 1 3/8"
D6SK - 5000 / - 500X	33% + 66%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.4	Ø 2 1/8"	Ø 1 3/8"
D8SH - 3700 / - 370X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 2 5/8"	Ø 1 5/8"
D8SH - --- / - 400X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 2 5/8"	Ø 1 5/8"
D8SH - 5000 / - 500X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 2 5/8"	Ø 1 5/8"
D8SJ - 4500 / - 450X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 2 5/8"	Ø 1 5/8"
D8SJ - --- / - 500X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 2 5/8"	Ø 1 5/8"
D8SJ - 6000 / - 600X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 3 1/8"	Ø 1 5/8"
D8SK - --- / - 600X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 3 1/8"	Ø 1 5/8"
D8SK - 7000 / - 700X	50% + 75%	-	705 RA 001	NRV 35S Ø 42	-	100[2]	200	7.7	Ø 3 1/8"	Ø 2 1/8"
D9TL - 0760 / - ---	-	-	-	-	70	-	-	3.6	Ø 1 3/8"	Ø 7/8"
D9TH - 0760 / - ---	-	-	-	-	70	-	-	3.6	Ø 1 3/8"	Ø 7/8"
D9TK - 0760 / - ---					70	-	-	3.6	Ø 1 3/8"	Ø 7/8"
D9TH - 1010 / - ---	-	-	-	-	70	-	-	3.6	Ø 1 3/8"	Ø 7/8"
D6TA - 1500 / - 150X	-	-	-	-	-	100	-	4.3	Ø 1 5/8"	Ø 1 3/8"
D6TH - 2000 / - 200X	-	-	-	-	-	100	-	4.3	Ø 1 5/8"	Ø 1 3/8"
D6TJ - 2500 / - 250X	-	-	-	-	-	100[2]	200	7.4	Ø 1 5/8"	Ø 1 3/8"

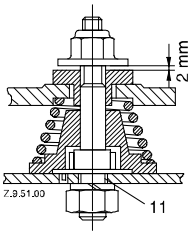
[1] for TWIN-compressors and in parallel compressor operation with enforced spring (Type NRV**H** …)

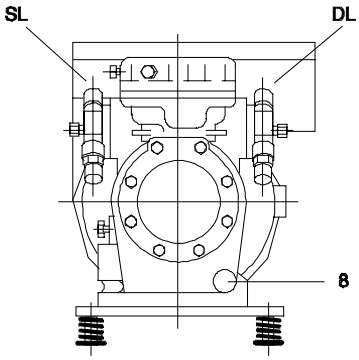
[2] possible as an addition, minimum is 200 W

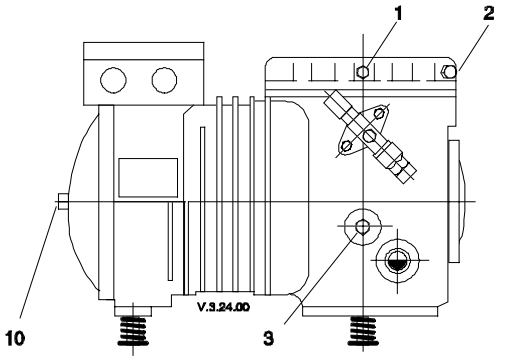
Compressor Connections

DK

DKM – 50	DKM – 5X	DKJ – 100	DKJ – 10X	DKL – 150	DKL – 15X
DKM – 75	DKM – 7X	DKJ – 150	DKJ – 15X	DKSL - 150	DKL – 20X
DKM – 100	DKM – 10X	DKSJ - 100	DKSJ – 10X	DKSL –200	DKSL – 15X
DKJ – 75	DKJ – 7X	DKSJ - 150	DKSJ – 15X	DKSL – 20X	



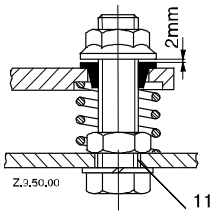


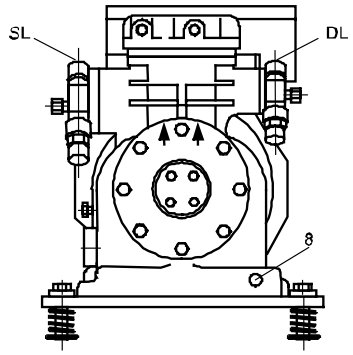


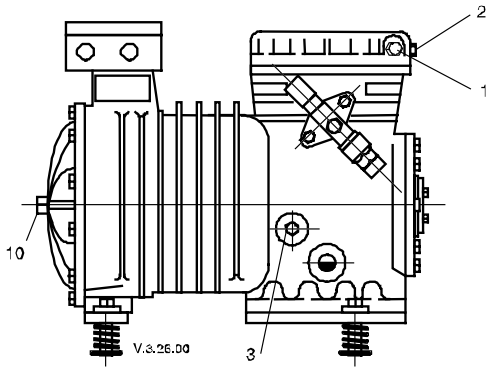
SL	Suction line	(sw eat)	See Page 16	6	Oil-pressure connection		----	
DL	Discharge line	(sw eat)		7	Oil screen		----	
1	Plug low -pressure connection	1/8" - 27 NPTF		8	Pocket for heater w ith protection plug	M 25	x	1.5
2	Plug high-pressure connection	1/8" - 27 NPTF		9	Plug high-pressure connection		----	
3	Plug oil charge	1/8" - 27 NPTF		10	Magnetic plug	1/8"	- 27	NPTF
4	Connection oil-pressure control H.P	----		11	Base mountings	Ø	11	mm
5	Plug oil-pressure control L.P.	----						

DL

DLE – 201	DLE – 20X	DLJ – 201	DLJ – 20X	DLL – 401	DLL – 40X
DLF – 201	DLF – 20X	DLJ – 301	DLJ – 30X	DLSG – 401	DLSG – 40X
DLF – 301	DLF – 30X	DLL – 301	DLL – 30X		



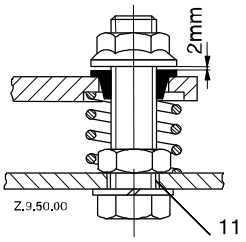


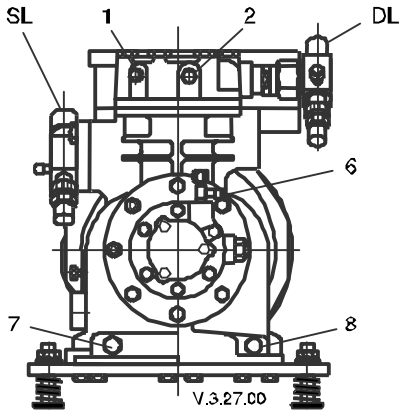


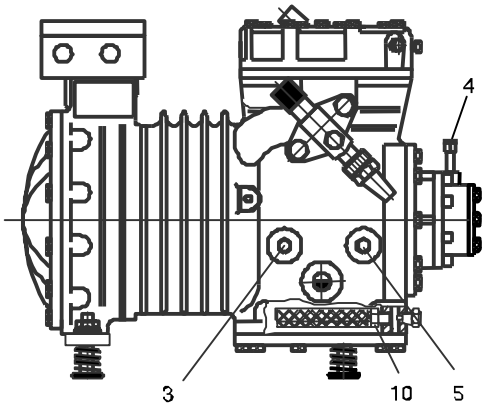
SL	Suction line	(sweat)	See Page 16	6	Oil-pressure connection		----	
DL	Discharge line	(sweat)		7	Oil screen built-in		----	
1	Plug low-pressure connection	1/8" - 27 NPTF		8	Pocket for heater with protection plug	3/8"	- 18	NPSL
2	Plug high-pressure connection	1/8" - 27 NPTF		9	Plug high-pressure connection		----	
3	Plug oil charge	1/4" - 18 NPTF		10	Magnetic plug	1/8"	- 27	NPTF
4	Connection oil-pressure control H.P.	----		11	Base mountings	Ø	14	mm
5	Plug oil-pressure control L.P.	----						

DLH

DLHA – 500 DLHA – 50X



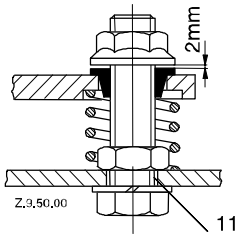


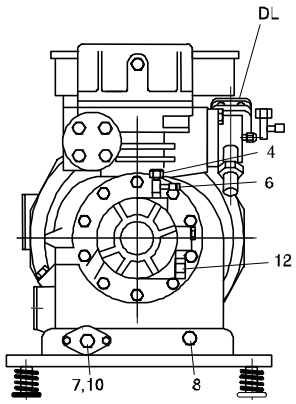


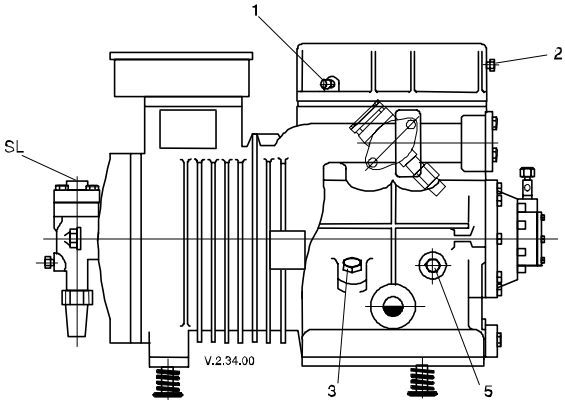
SL	Suction line	(sweat)	See Page 16		6	Oil-pressure connection	1/4"	6	mm Schrader
DL	Discharge line	(sweat)			7	Magnetic plug	3/8"	18	NPTF
1	Plug low-pressure connection	1/8"	27	NPTF	8	Pocket for heater with protection plug	3/8"	18	NPSL
2	Plug high-pressure connection	1/8"	27	NPTF	9	Plug high-pressure connection		----	
3	Plug oil charge	1/4"	18	NPTF	10	Oil screen built-in		----	
4	Connection oil-pressure control H.P.	1/4"	6	mm	11	Base mountings	Ø	12	mm
5	Plug oil-pressure control L.P.	1/4"	18	NPTF					

D9R

D9RA4 – 500L D9RC4 – 1000
D9RA4 – 750 D9RS4 – 1000
D9RC4 – 750 D9RS4 - 1500



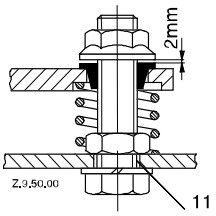


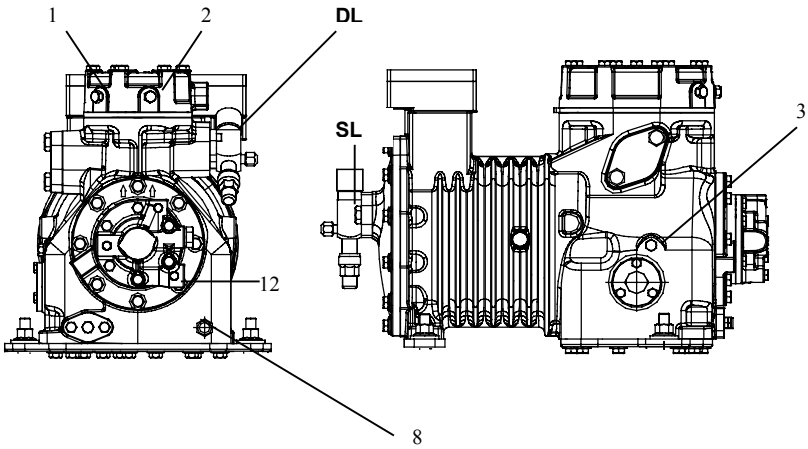


SL	Suction line	(sweat)	See Page 16		6	Oil-pressure connection	1/4"	6	mm Schrader
DL	Discharge line	(sweat)			7	Oil screen built-in			
1	Plug low-pressure connection	1/8"	27	NPTF	8	Sleeve (crankcase heater)	3/8"	18	NPSL
2	Plug high-pressure connection	1/8"	27	NPTF	9	Plug high-pressure connection		----	
3	Plug oil charge	1/4"	18	NPTF	10	Magnetic plug	1/8"	27	NPTF
4	Connection oil-pressure control H.P.	1/4"	6	mm	11	Base mountings	Ø	18	mm
5	Plug oil-pressure control L.P.	1/4"	18	NPTF	12	Sensor connection OPS1			

D2S

D2SA – 450 D2SA – 45X
D2SC – 550 D2SC – 55X
D2SK – 650 D2SK – 65X

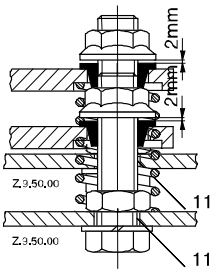


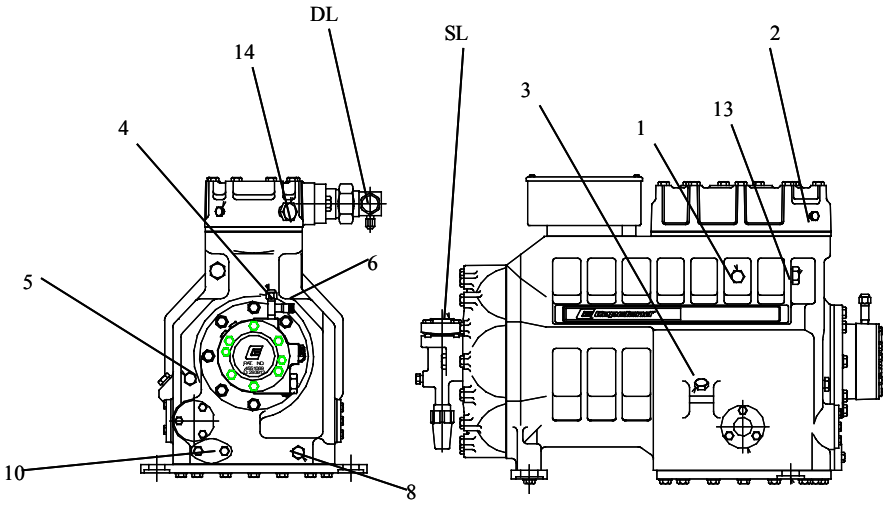


SL	Suction line	(sw eat)	See Page 16	6	Oil-pressure connection		----	
DL	Discharge line	(sw eat)		7	Oil screen built-in		----	
1	Plug low -pressure connection		1/8" - 27 NPTF	8	Pocket for heater w ith protection plug		3/8" - 18	NPSL
2	Plug high-pressure connection		1/8" - 27 NPTF	9	Plug high-pressure connection		----	
3	Plug oil charge		1/4" - 18 NPTF	10	Magnetic plug		1/8" - 27	NPTF
4	Connection oil-pressure control		----	11	Base mountings	Ø	14	mm
5	Plug oil-pressure control L.P.		----	12	Sensor connection OPS1			

D3S

D3SC - 1000 D3SC – 75X
D3SS – 1500 D3SS – 100X

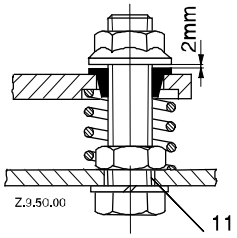


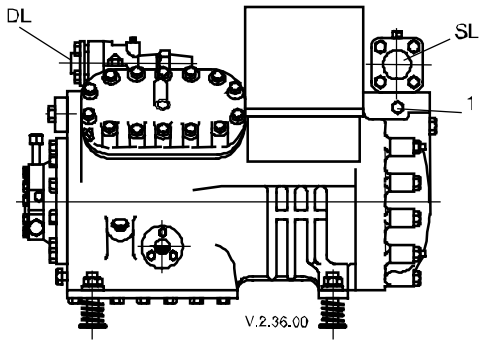


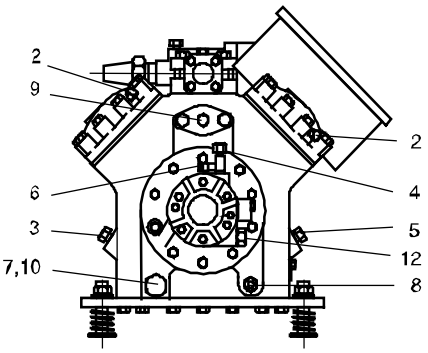
SL	Suction line	(sw eat)	See Page 16	7	Oil screen built in		----	
DL	Discharge line	(sw eat)		8	Sleeve (crankcase heater)		3/8" - 18	NPSL
1	DTC valve plug connection		1/8" - 27 NPTF	9	Plug high-pressure connection		1/8" - 27	NPTF
2	Plug low -pressure connection		1/8" - 27 NPTF	10	Magnetic plug		1/8" - 27	NPTF
3	Plug oil charge		1/4" - 18 NPTF	11	Base mountings	Ø	18	mm
4	Oil-pressure control H.P.		1/4" - 6mm	12	Sensor connection		----	
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	14	Plug high-pressure connection		----	

D4S

D4SA –1000 D4SA – 100X D4ST – 2000 D4SJ – 200X
D4SF – 1000 D4SA – 200X D4SH – 2500 D4SJ – 300X
D4SL – 1500 D4SH – 150X D4SJ - 2000
D4SA – 2000 D4ST – 200X D4SJ - 3000
D4SH – 1500 D4SH – 250X



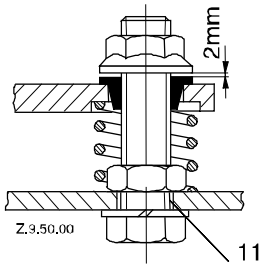


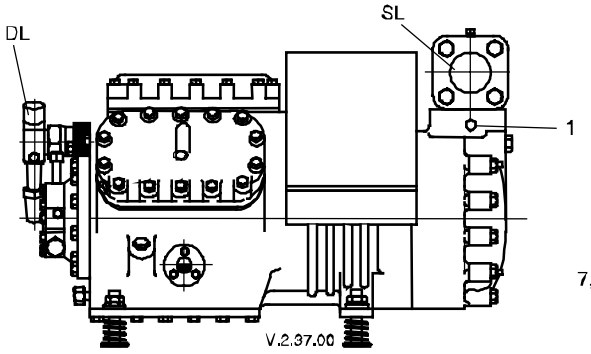


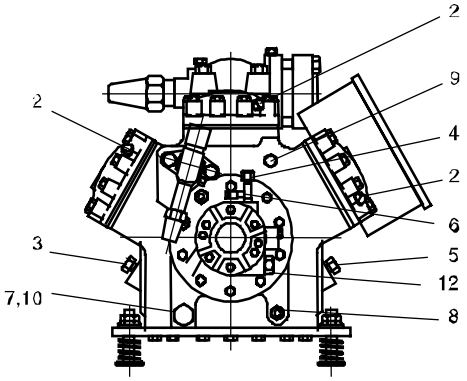
SL	Suction line (sweat)	See Pages 16 & 17	6	Oil-pressure connection	¼	6 mm schrader
DL	Discharge line (sweat)		7	Oil screen built-in	-	
1	Plug low-pressure connection	1/8" - 27 NPTF	8	Sleeve (crankcase heater)	1/2" - 14	NPSL
2	Plug high-pressure connection	1/8" - 27 NPTF	9	Plug high-pressure connection	1/8" - 27	NPTF
3	Plug oil charge	1/4" - 18 NPTF	10	Magnetic plug	1" - 16	UN
4	Connection oil-pressure control H.P. ¼		11	Base mountings	Ø 18	mm
5	Plug oil-pressure control L.P.	1/4" - 18 NPTF	12	Sensor connection OPS1		

D6S

D6SF – 2000 D6SH – 2000 D6SH – 200X
D6SA – 3000 D6SH – 3500 D6SH – 350X
D6SL - 2500



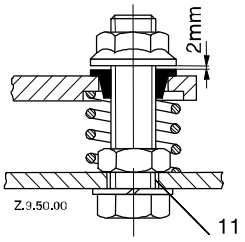


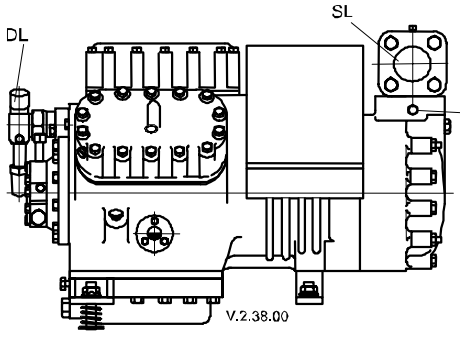


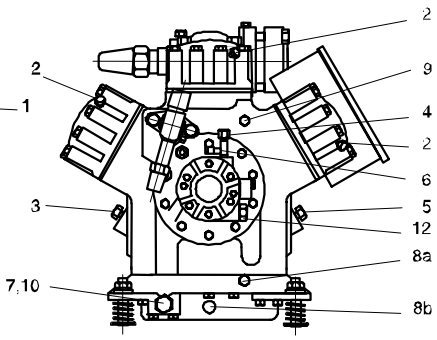
SL	Suction line	See Page 17	6	Oil-pressure	¼	6 mm schrader
DL	Discharge line		7	Oil screen built-	-	
1	Plug low-pressure	1/8" - 27 NPTF	8	Sleeve (crankcase	1/2" - 14	NPSL
2	Plug high-pressure	1/8" - 27 NPTF	9	Plug high-pressure	1/4" - 18	NPTF
3	Plug oil charge	1/4" - 18 NPTF	10	Magnetic plug	1" - 16	NPTF
4	Connection oil-pressure control H.P. ¼		11	Base mountings	Ø 18	mm
5	Plug oil-pressure control	1/4" - 18 NPTF	12	Sensor connection		

D6SJ*

D6SJ – 3000 D6SJ - 300X
D6SJ – 4000 D6SJ – 400X



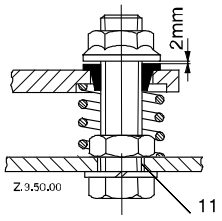


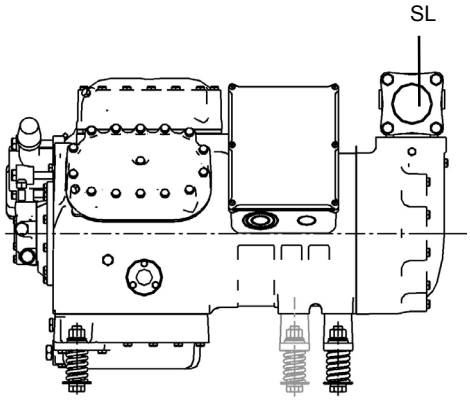


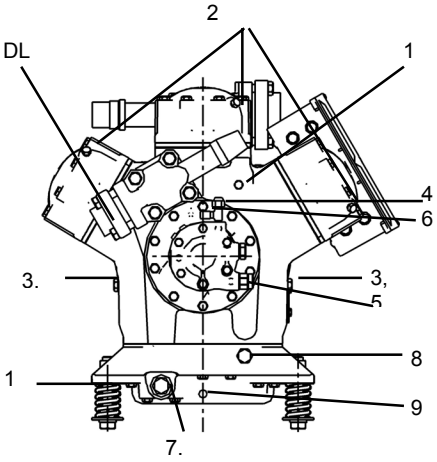
SL	Suction line (sweat)	Ø 2⅛"	6	Oil pressure connection	¼" ≈ 6mm Schraeder
DL	Discharge line (sweat)	Ø 1⅜"	7	Oil screen built in	
1	Plug low pressure connection	⅛" - 27 NPTF	8a	Plug crankcase heater	½" - 14 NPTF
2	Plug high pressure connection	⅛" - 27 NPTF	8b	Bore crankcase heater	Ø - ½"
3	Plug oil charge	¼" - 18 NPTF	9	Plug high pressure connection	¼" - 18 NPTF
4	Connection oil pressure control H.P.	¼" ≈ 6mm	10	Magnetic plug	1" - 16 NPTF
5	Plug oil pressure control L.P.	¼" - 18 NPTF	11	Base mountings	Ø - 18 mm
			12	Sensor connection OPS1	

D6SK

D6SK1-2000 D6SK1-200X







Note: The D6SK can be mounted to fit a 6-cylinder or 8-cylinder footprint. (See page 7- Mounting Parts)

SL	Suction line sweat	Ø 2⅛	7	Oil screen built in	
DL	Discharge line sweat	Ø 1⅜"	8	Plug crankcase heater	½" – 14 NPTF
1	Plug low pressure connection	⅛" - 27 NPTF	9	Bore crankcase heater	Ø ½"
2	Plug high pressure connection	⅛" - 27 NPTF	10	Plug HP connection	¼" - 18 NPTF
3	Plug oil charge	¼" - 18 NPTF	11	Magnetic plug	1" - 16 UN
4	Connection oil pressure control HP	Ø¼" ~ 6mm	12	Base mounting	Ø 18mm
5	Connection oil pressure control LP	¼" – 18 NPTF	13	Sensor connection OPS1	
6	Oil pressure connection	7/16"- UNF Schrader			

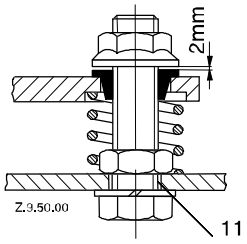
D8S

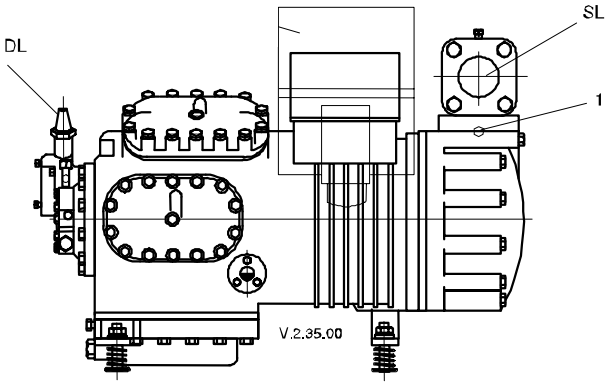
D8SH – 3700
D8SJ – 4500
D8SH – 5000
D8SJ - 6000

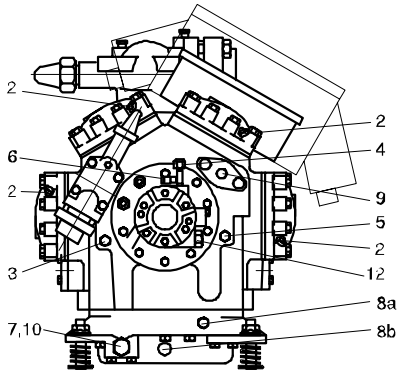
D8SH – 370X
D8SH – 400X
D8SJ – 450X
D8SJ – 500X

D8SK – 6000
D8SK – 7000

D8SH – 500X
D8SJ – 600X
D8SK – 600X
D8SK – 7600X



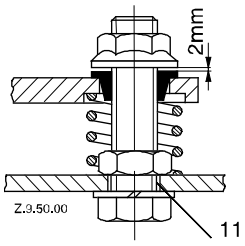


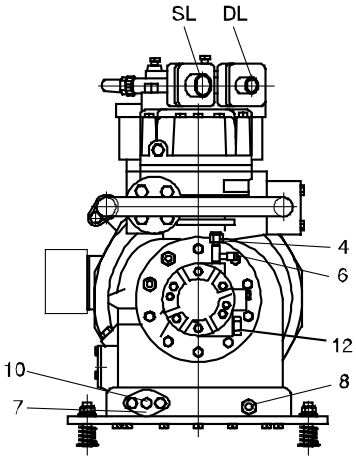


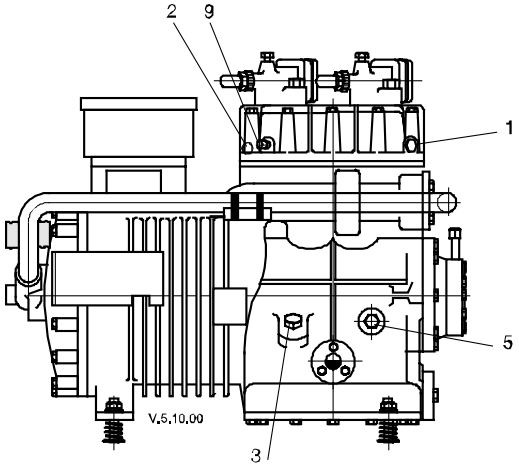
SL	Suction line	(sweat)	Ø 2⅝"	6	Oil pressure connection	¼" ≈ 6mm Schraeder
DL	Discharge line	(sweat)	Ø 1⅝"	7	Oil screen built in	
1	Plug low pressure connection		⅛" - 27 NPTF	8a	Plug crankcase heater	½" - 14 NPTF
2	Plug high pressure connection		⅛" - 27 NPTF	8b	Bore crankcase heater	Ø - ½"
3	Plug oil charge		¼" - 18 NPTF	9	Plug high pressure connection	⅛" - 27 NPTF
4	Connection oil pressure control H.P. ¼" ≈ 6mm			10	Magnetic plug	1" - 16 NPTF
5	Plug oil pressure control L.P.		¼" - 18 NPTF	11	Base mountings	Ø - 18 mm
				12	Sensor connection OPS1	

D9T

D9TK – 0760
D9TL – 0760
D9TH - 0760
D9TH - 1010



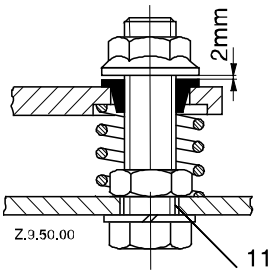


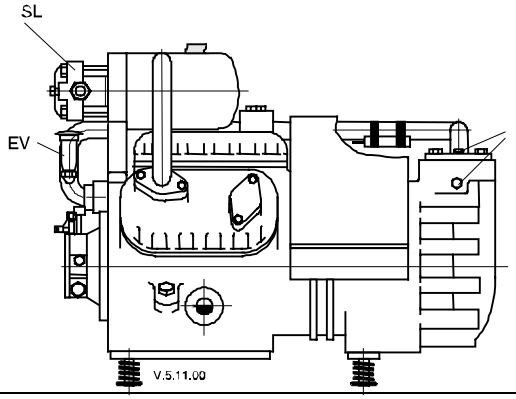


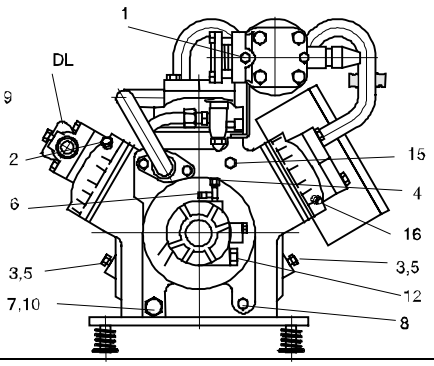
SL	Suction line	(sweat)	Ø 1⅜"	6	Oil pressure connection	¼" ≈ 6mm Schraeder
DL	Discharge line	(sweat)	Ø ⅞"	7	Oil screen built in	
1	Plug low pressure connection		⅛" - 27 NPTF	8	Sleeve crankcase heater	½" - 14 NPSL
2	Plug high pressure connection		⅛" - 27 NPTF	9	Plug interstage pressure	⅛" - 27 NPTF
3	Plug oil charge		¼" - 18 NPTF	10	Magnetic plug	⅛" - 27 NPTF
4	Connection oil pressure control H.P. ¼" ≈ 6mm			11	Base mountings	Ø - 18 mm
5	Plug oil pressure control L.P.		¼" - 18 NPTF	12	Sensor connection OPS1	

D6T

D6TA – 1500 D6TA – 150X
D6TH – 2000 D6TH – 200X



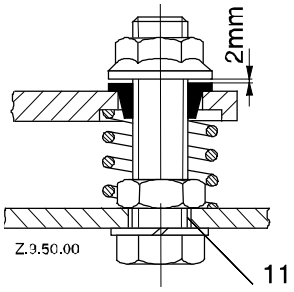


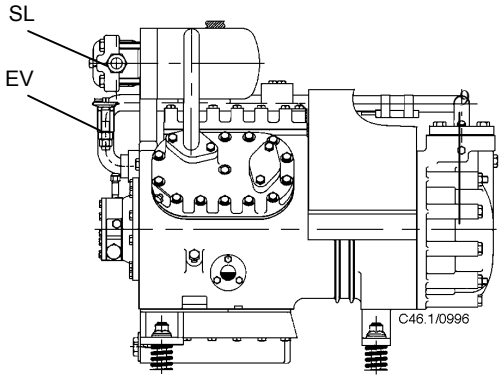


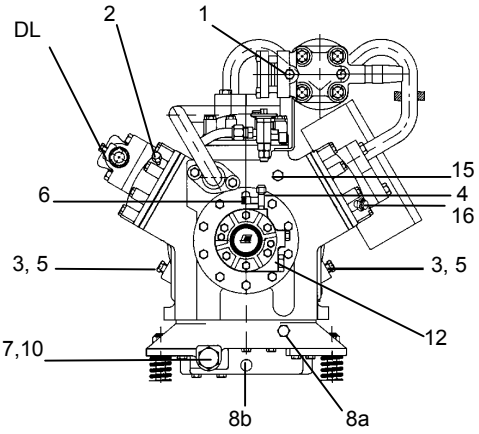
SL	Suction line	(sweat)	Ø 1⅝"	7	Oil screen built in	
DL	Discharge line	(sweat)	Ø 1⅜"	8	Bore crankcase heater	Ø - ½"
EV	De-superheating expansion valve			9	Intermediate press. connection	⅛" - 27 NPTF
1	Plug low pressure connection		¼" - 18 NPTF	10	Magnetic plug	1" - 16 NPTF
2	Plug high pressure connection		⅛" - 27 NPTF	11	Base mountings	Ø - 18 mm
3	Plug oil charge		¼" - 18 NPTF	12	Sensor connection OPS1	
4	Connection oil pressure control H.P.		¼" ≈ 6mm	15	Plug interm. press. Connection	¼" - 18 NPTF
5	Plug oil pressure control L.P.		¼" - 18 NPTF	16	Interm. press.connection	¼" ≈ 6mm Schraeder
6	Oil pressure connection		¼" ≈ 6mm Schraeder			

D6TJ

D6TJ – 2500 D6TJ – 250X







SL	Suction line	(sweat)	Ø 1⅝"	8a	Plug crankcase heater	½" - 14 NPTF
DL	Discharge line	(sweat)	Ø 1⅜"	8b	Bore crankcase heater	Ø - ½"
1	Plug low pressure connection		¼" - 18 NPTF	9	Intermediate press. connection	⅛" - 27 NPTF
2	Plug high pressure connection		⅛" - 27 NPTF	10	Magnetic plug	1" - 16 NPTF
3	Plug oil charge		¼" - 18 NPTF	11	Base mountings	Ø - 18 mm
4	Connection oil pressure control H.P.		¼" ≈ 6mm	12	Sensor connection OPS1	
5	Plug oil pressure control L.P.		¼" - 18 NPTF	15	Plug interm. press. connection	¼" - 18 NPTF
6	Oil pressure connection		¼" ≈ 6mm Schraeder	16	Interm. press.connection	¼" ≈ 6mm schraeder
7	Oil screen built in			EV	Desuperheating expansion valve	

Pressure Gauge Connections at Shut-off Valves

Compressors	Socket with Cap Nut		Sealing Plug			
	SV	DV	SV	DV	SV	DV
	$^{7}/_{16}$" - 20 UNF		$^{1}/_{8}$" - 27 NPTF		$^{1}/_{4}$" - 18 NPTF	
DK, DL, D2S	1	1				
D9R, D9T, D3S			2	2		
D9RS-1500				2	2	
D9R (Tandem)				*	2	*
D4SA-1000/ D4SH-1500/ D4SA-2000				2	2	
D4SF-1000/ D4SL-1500		1			2	
D4SH-2500/ D4SJ-2000/ D4SJ-3000				2	2	
D4S (Tandem)				*	2	*
D6S		1			2	
D6T				2	2	
D6S (Tandem)				*	2	*
D8S					2	2
D8S (Tandem)					2	2

SV = suction valve DV = discharge valve

1, 2 = number of pressure gauge connections

* = see single compressor

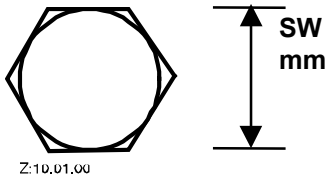
Tightening Torques (Nm)

	DK	DL, DLH,	D2S	D9R, D9T	D3S	D4S D4SJ	D6S,D6T D6SJ/K	D8S D8SJ
Suction shut-off valve	5/16"-18 UNC 29 - 30 Nm SW 12.7	1/2"-13 UNC 38 - 40 Nm SW 19	1/2"-13 UNC 38 - 40 Nm SW 19	1/2"-13 UNC 69 - 82 Nm SW 19	1/2"-13 UNC 69 - 82 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19 5/8"-11 UNC 1) 122 - 149 Nm SW 23.8	1/2"-13 UNC 72 - 81 Nm SW 19 5/8"-11 UNC 1) 122 - 149 Nm SW 23.8	5/8"-11 UNC 122 - 149 Nm SW 23.8
Discharge shut-off valve 2)	5/16"-18 UNC 29 - 30 Nm SW 12.7	5/16"-18 UNC 29 - 30 Nm SW 12.7	5/16"-18 UNC 29 - 30 Nm SW 12.7	5/16"-18 UNC 69 - 82 Nm SW 8	1/2"-13 UNC 69 - 82 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19
Rotalock nut			1 1/4"-12 UNF 28 - 42 Nm SW 36		1 3/4"-12 UNF 42 - 55 Nm SW 50			
Plug 1, 2, 9, 3 (DK only)	1/8"-27 NPTF 28 - 30 Nm SW 12.7	1/8"-27 NPTF 28 - 30 Nm SW 12.7	1/8"-27 NPTF 28 - 30 Nm SW 12.7	1/8"-27 NPTF 28 - 30 Nm SW 12.7	1/8"-27 NPTF 22 - 25 Nm SW 12.7	1/8"-27 NPTF 28 - 30 Nm SW 12.7	1/8"-27 NPTF 28 - 30 Nm SW 12.7	1/8"-27 NPTF 28 - 30 Nm SW 12.7
Plug 3,5,15, 9 (D6S only)	- - -	1/4"-18 NPTF 45 - 50 Nm SW 17.5	1/4"-18 NPTF 45 - 50 Nm SW 17.5	1/4"-18 NPTF 45 - 50 Nm SW 17.5	1/4"-18 NPTF 45 - 50 Nm SW 17.5	1/4"-18 NPTF 27 - 34 Nm SW 17.5	1/4"-18 NPTF 27 - 34 Nm SW 17.5	1/4"-18 NPTF 27 - 34 Nm SW 17.5
Plug 8a crankcase heater)	- - -	- - -	- - -	- - -	3/8"-18 NPTF 48 - 52 Nm SW 22	- - -	1/2"-14 NPTF 1a) 45 - 50 Nm SW 17.5	1/2"-14 NPTF 45 - 50 Nm SW 17.5
Oil sight glass	1 1/8"-12 UNF 18 - 20 Nm - - -	1 1/8"-12 UNF 18 - 20 Nm - - -	1 1/8"-12 UNF 18 - 20 Nm - - -	1/4"-20 UNC 7 - 8 Nm SW 11	1/4"-20 UNC 7 - 8 Nm SW 11	1/4"-20 UNC 4 - 5 Nm SW 11	1/4"-20 UNC 4 - 5 Nm SW 11	1/4"-20 UNC 4 - 5 Nm SW 11
Blind flange for oil screen	- - -	- - -	5/16"-18 UNC 26 - 32 Nm SW 12.7	5/16"-18 UNC 26 - 32 Nm SW 12.7	5/16"-18 UNC 26 - 32 Nm SW 12.7	- - -	- - -	- - -
Oil pump	- - -	5/16"-18 UNC 3 32 - 37 Nm SW 6.4	5/16"-18 UNC 3) 32 - 37 Nm SW 6.4	5/16"-18 UNC 32 - 37 Nm SW 12.7	5/16"-18 UNC 32 - 37 Nm SW 12.7	5/16"-18 UNC 35 - 38 Nm SW 12.7	5/16"-18 UNC 35 - 38 Nm SW 12.7	5/16"-18 UNC 35 - 38 Nm SW 12.7
Magnetic plug 5)	1/8" - 27 NPTF 28 - 30 Nm SW 12.7	1/8" - 27 NPTF 28 - 30 Nm SW 12.7	1/8" - 27 NPTF 28 - 30 Nm SW 12.7	1/8" - 27 NPTF 28 - 30 Nm SW 12.7	1/8" - 27 NPTF 28 - 30 Nm SW 12.7	1"-16 UN 136 - 203 Nm SW 25.4	1"-16 UN 136 - 203 Nm SW 25.4	1"-16 UN 136 - 203 Nm SW 25.4
Cylinder head	5/16"-18 UNC 29 - 30 Nm SW 12.7	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2
Bottom plate	5/16"-18 UNC 29 - 30 Nm SW 12.7	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2
Mounting foot	5/16"-18 UNC 29 - 30 Nm SW 12.7	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 40 - 45 Nm SW 14.2	3/8"-16 UNC 40 - 45 Nm SW 14.2	3/8"-16 UNC 40 - 45 Nm SW 14.2
Stator cover	5/16"-18 UNC 29 - 30 Nm SW 12.7	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	1/2"-13 UNC 72 - 81 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19

Tightening Torques (Nm)

	DK	DL, DLH	D2S	D9R D9T	D3S	D4S D4SJ	D6S,D6T D6SJ/K	D8S D8SJ
Bearing cover	5/16"-18 UNC 29 - 30 Nm SW 12.7	3/8"-16 UNC 50 - 54 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	1/2"-13 UNC 72 - 81 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19	1/2"-13 UNC 72 - 81 Nm SW 19
Housing cover	5/16"-18 UNC 29 - 30 Nm SW 12.7	3/8"-16 UNC 50 - 54 Nm SW 14.2	3/8"-16 UNC 50 - 54 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 58 - 69 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2
Mounting plate for terminals	- - -	- - -	- - -	5/16"-18 UNC 32 - 40 Nm SW 12.7	5/16"-18 UNC 32 - 40 Nm SW 12.7	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2	3/8"-16 UNC 57 - 68 Nm SW 14.2
Terminal stud Terminal stud thermistors	1/4"-20 UNC 11 - 12 Nm SW 11	1/4"-20 UNC 11 - 12 Nm SW 11	1/4"-20 UNC 11 - 12 Nm SW 11	1/4"-28 UNF 5 - 5.5 Nm SW 11 10 - 32 UNF 2.4 - 2.6 Nm SW 9	10 - 32 UNF 3 - 4 Nm SW 9.0 1/4"-28 UNF 5 - 6.5 Nm SW 11	1/4"-28 UNF 4.5 - 5.7 Nm SW 11 10 - 32 UNF 3.4 - 4 Nm SW 9	1/4"-28 UNF 4.5 - 5.7 Nm SW 11 10 - 32 UNF 3.4 - 4 Nm SW 9	1/4"-28 UNF 4.5 - 5.7 Nm SW 11 10 - 32 UNF 3.4 - 4 Nm SW 9
Bolt for connecting rod	- - -	- - -	1/4"-28 UNF 4) 15 - 18 Nm	1/4"-28 UNF 4) 15 - 18 Nm	1/4"-28 UNF 4) 15 - 18 Nm	1/4"-28 UNF 4) 15 - 18 Nm - - -	1/4"-28 UNF 4) 15 - 18 Nm - - -	1/4"-28 UNF 4) 15 - 18 Nm - - -

1) Compressors D4SJ / D6SJ / D6TJ
1a) Compressors D6SJ / D6TJ
2) Rotalock adaptor with DLH
3) DLH only
4) "Torx"-screw (with Loctite 242 C)
5) DLH 3/8" - 18 NPTF / 22-25 Nm / SW 12.7



R22 low temperature applications require suction superheat limitations for both the D2S and D3S compressors, refer to the operating envelope in Select for details. With the D2S range this is achieved by repositioning the suction valve, moving it from the motor cover end to the compressor body. This changes the compressor from a suction gas cooled model to an air-cooled model. We now have the “D2SA – 45X Air”, “D2SA – 450 Air” , “D2SC – 55X Air” and “D2SC – 550 Air” air-cooled compressors. The D2SK – 65X and D2SK – 650 models cannot be run at low temperatures using R22. The smallest D3SC model should be used for these applications (almost the same capacity at low temperature as the D2SK).

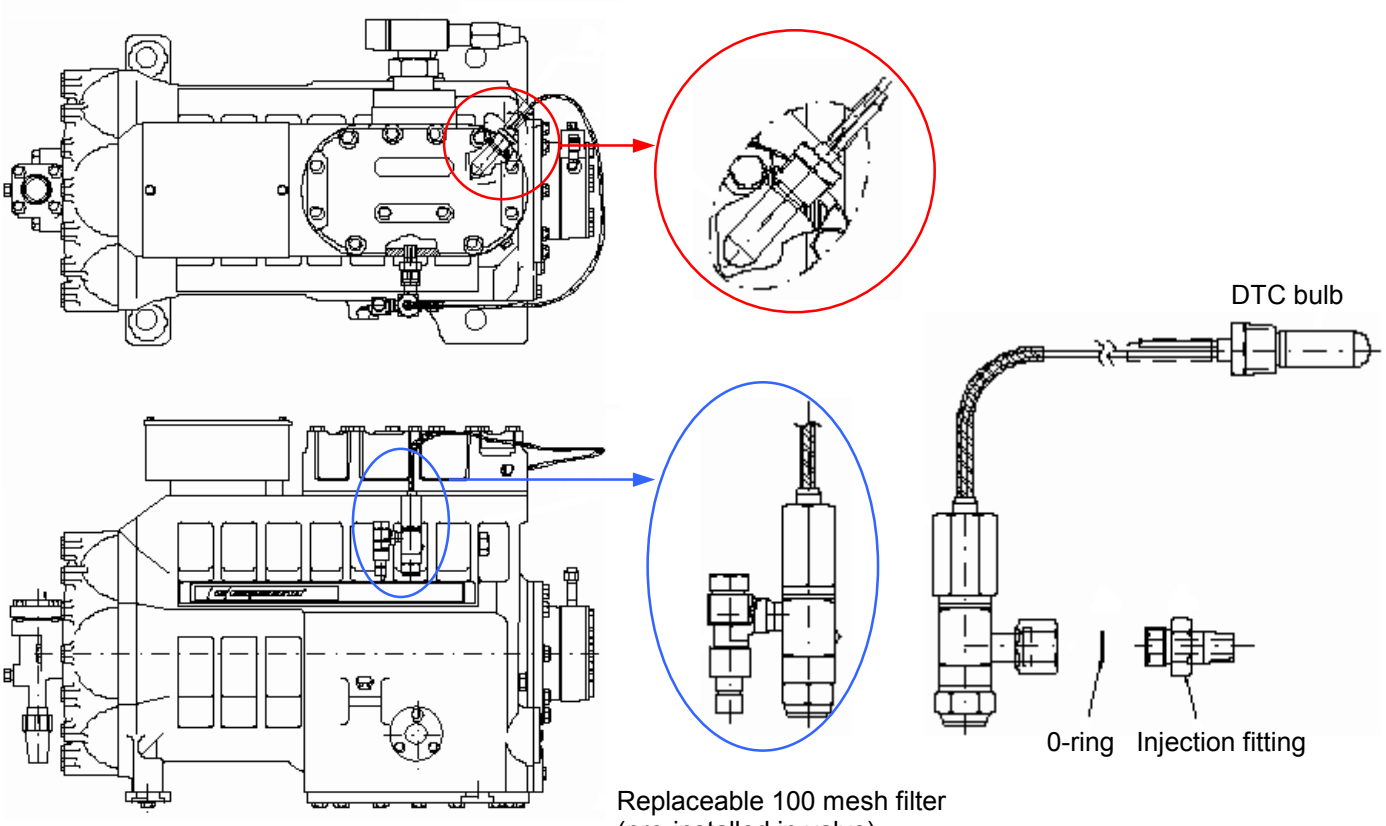
Discharge Temperature Control Valve (DTC)

With the D3S models to obtain limited suction superheat temperatures a liquid injection method is used (DTC valve) installed on the compressor body. The DTC valve liquid injection system is a low cost and reliable solution, it can be obtained as an optional extra.

To fit the DTC valve:

Location and Fitting of the DTC valve

DTC - Discharge Temperature Control Valve



1 Pump down then isolate the compressor from the refrigerant system by closing the suction and discharge service valves. Reclaim refrigerant from the compressor using manifold and gauges to ensure there is no pressure (positive or negative) in the compressor.
2 Remove ½” NPT plug from the cylinder head at the location shown.
3 **Rotating the entire DTC valve,** thread the sensing DTC bulb into the hole where the plug was (use thread sealant) and torque bulb to 57 – 67 Nm.
4 Remove ⅛” NPT plug from the cylinder body at the location shown.
5 Install injection fitting (use thread sealant) and torque fitting to 27 – 34 Nm.
6 Attach the DTC valve to the injection fitting making sure the O-ring is used between the two parts and torque to 24 – 27 Nm.
7 Ensure liquid refrigerant is available in the line feeding the DTC valve prior to starting the compressor. Failure to do this will result in damage to the valve and compressor.

Fan Installation

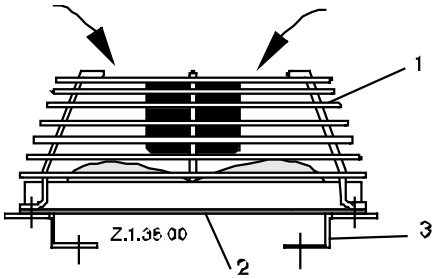
7 W Fan, Vertical, for Compressors DK

For cylinder head cooling of DK-compressors there is a 7 Watt fan available as option. It has a vertical airflow direction (see Fig. 12), and will be fixed directly to the cylinder head and mount the pre-assembled fan with the enclosed screws (5/16" – 18 UNC * 1,875").

Tightening torque	29 to 30 Nm
Motor voltage	220 V – 1 Ph – 50 Hz
Protection class (according to IEC 529)	IP 42

The fan assembly consists of:
Motor with fan blade, fan guard (1), cover for fan guard (2), and two mounting brackets (3).

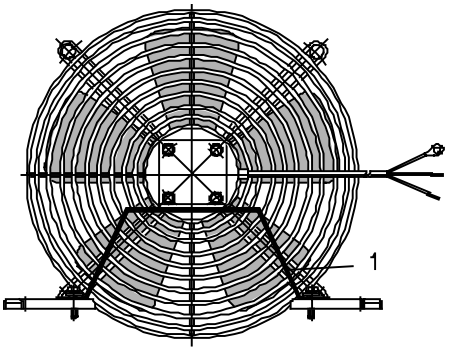
Fig. 11

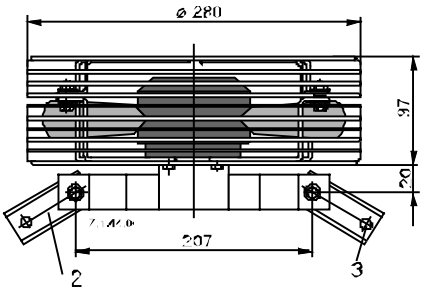


Additional Fan 25 W, Horizontal

A 25-Watt horizontal fan is used for ventilating DK compressors. It is available as an option for DL models. The single-phase motor is external-rotor motor with the fan blades permanently fixed to the rotor.
Fan motor, protection guard and fixing bracket are pre-assembled (see Fig. 12). The fan is laterally mounted at the compressor-fastening screws with two fixing straps (according to the instructions from the mounting kit). The fixing straps are included in the mounting kit and compensate the distance between the holes in the compressor feet.

Fig. 12





1 Mounting bracket 2 Adapter bracket 3 Bolt hole for securing to compressor

Attention:
The fan must be mounted on the side of the discharge shut-off valve (see figures below).

DK

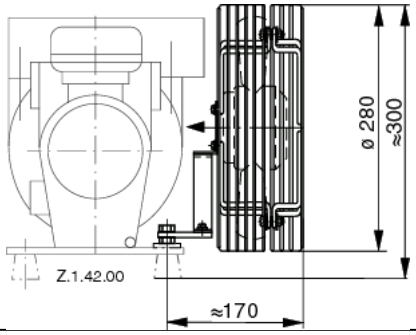


Fig.13

DL

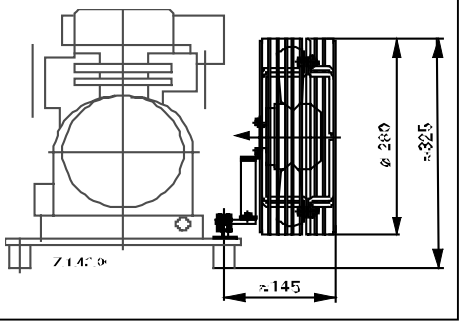


Fig.14

Technical Data of Fan 25 W

motor voltage ± 15%	230 V / 1 Ph	230 V / 1 Ph
frequency	50 Hz	60 Hz
current input	0.53 A	0.46 A
power input	72 W	67 W
protection class (acc. To IEC 34)	IP 44	
connection cable (3 leads), length	600 mm	
connection cable, cross section	0.5 mm^2	
motor protection, n.c. (F10)	-	
nominal voltage	250 V AC	
nom. Current at cosΦ = 1	2.5 A	
nom. Current at cosΦ = 0 6	1.6 A	
max. breaking current	5 A	

Wiring Diagram 25 W Fan

The fan motor can be connected via the terminal box of the compressor (see wiring diagram on terminal box cover of compressor). The 25-W fan has no terminal box. The three lead cable goes directly into the motor.

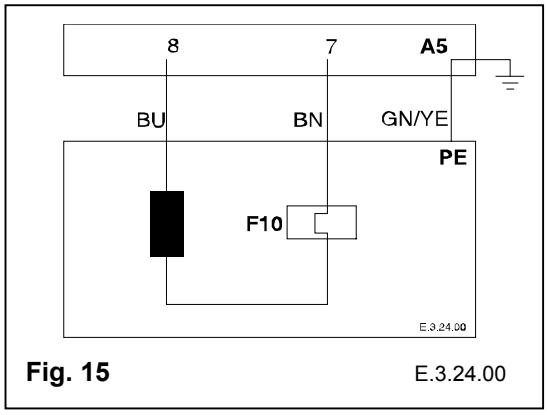


Fig. 15 E.3.24.00

Legend (Figure15)

A5 = Compressor terminal box
F10 = Thermal protection switch of fan motor
PE = Earth connection
BU = Blue
BN = Brown
GN/YE = Green/Yellow

Attention (25 W Fan)

The thermal protection switch of the fan motor is in line with the mains. If the protector trips, only the fan will be switched off, and the compressor will no longer be cooled.
Note that the compressor motor will still be protected by an over current thermal protection switch or thermistor protection. However, since there is no cylinder head cooling, the compressor is endangered.
The addition of a current sensing relay in the fan motor connection which interrupts the control line of the compressor motor when the fan stops, will help to avoid this situation.

Additional Fan 75 Z, Vertical

The additional fan type 75 Z is used for all compressor series (except DK). The complete fan consists of an external-rotor motor with the fan blades permanently fixed to the rotor and the fan guard. For installation, a mounting kit that fits to each compressor is delivered with the compressor (see Fig. 20).
When ordering, please specify the type of compressor, capacity control and oil cooler (if existing) in order to receive the correct fixing bracket.

Electrical Connection

The fan motor can be connected via the terminal box of compressor (see wiring diagram on terminal box cover of compressor). The three-phase motors have no terminal box. The motor cables (6 or 9 leads) lead directly into the motor.
The single-phase motors have a terminal box for wiring the run capacitor (5µF/400V) and the motor (see Fig. 16, position 9). Here the connection will be done by a three lead cable to the terminal box of compressor.

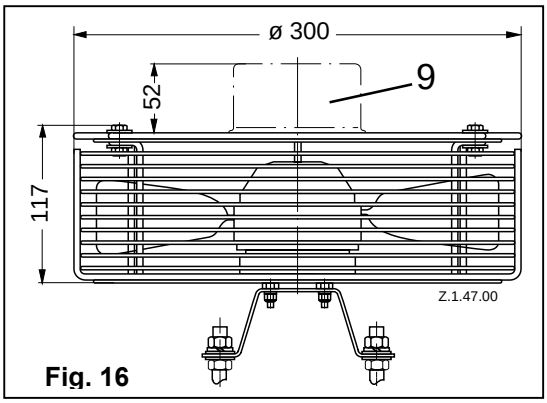


Fig. 16

Technical Data of Fan 75 Z							
	Motor Voltage						
	230 V ±15%		**230 V Δ ±15%**		**400 V Y ±15%**		**500 V Y +6/-10%**
	1Ph /50 Hz	1Ph /60 Hz	3Ph /50 Hz	3Ph /60 Hz	3Ph /50 Hz	3Ph /60 Hz	3Ph /50 Hz
Current Input	0.34 A		0.31 A	0.33 A	0.18 A	0.19 A	0.15 A
Power Input	75 W		70 W	96 W	70 W	96 W	70 W
Protection Class acc. to IEC 34)				IP 54			
Lead (Cores). Length	(3) / 600 mm		(9) / 600 mm		(9) / 600 mm		(6) / 600 mm
Lead, cross-section				0.5 mm^2			

Motor Protection (fan)
A thermal protection switch protects the fan motors. The protection switch of the three-phase operated fans **must** be looped into the control circuit otherwise the fan motor is not protected.
For single-phase operated fan motors the thermal protection switch is in line with the power supply (see wiring diagrams).

Attention
If the thermal protection switch trips on single-phase operation, only the fan will be switched off and the compressor will no longer be cooled.
The compressor motor will still be protected by an over current thermal protection switch or thermistor protection, but since there is no cylinder head cooling the compressor is endangered.
A current sensing relay in the fan motor connection which interrupts the control line of the compressor motor when the fan stops, will help to avoid this situation.

Technical Data (Fan Motor Protection)

Normally closed		
Operating voltage AC	12-500 V	
Duty classification	< 10 /h	
Nominal voltage	250 V AC	500 V AC
Nom. current at cos	2.5 A	0.75 A
Nom. current at cos	1.6 A	0.5 A
Max. breaking current	5 A	2.5 A

Wiring Diagrams for Fan 75 Z

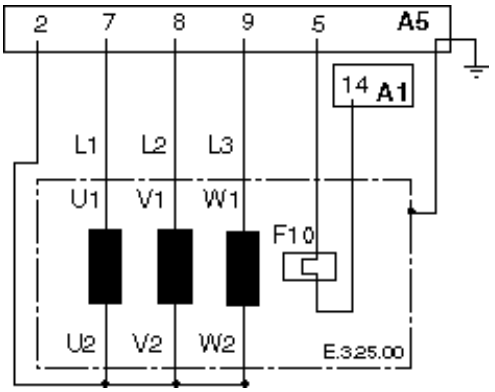


Fig.17 Star Connection

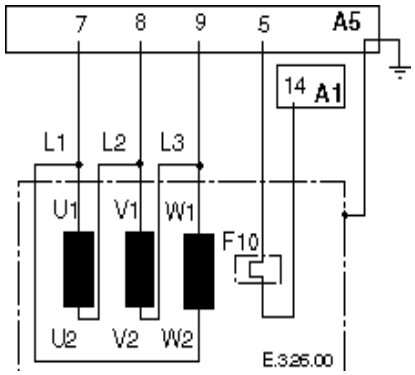


Fig.18 Delta Connection

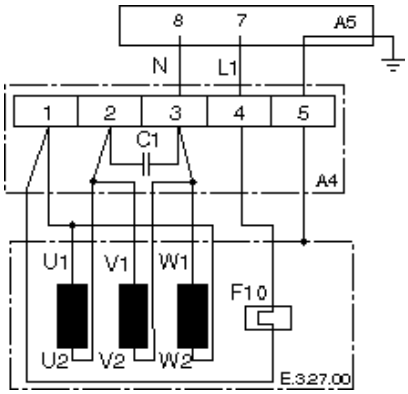


Fig.19 Steinmetz Connection for Single-phase operation

Legend

A1 = Module for compressor motor protection
A4 = Terminal box at single –phase operation
A5 = Terminal box of compressor
C1 = Run capacitor

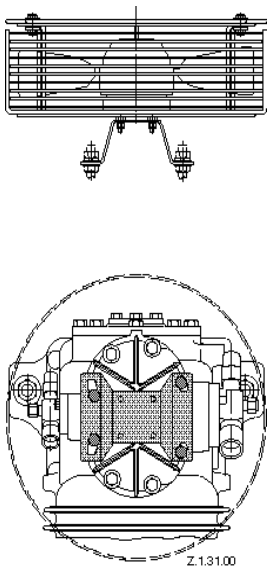
Colour Code

U1 = Brown (BN)
U2 = Red (RD)
V1 = Blue (BU)
V2 = Grey (GY)
W1 = Black (BK)
W2 = Orange (OG)
F10 = White (WH)
PE = Green/Yellow (GN/YE)

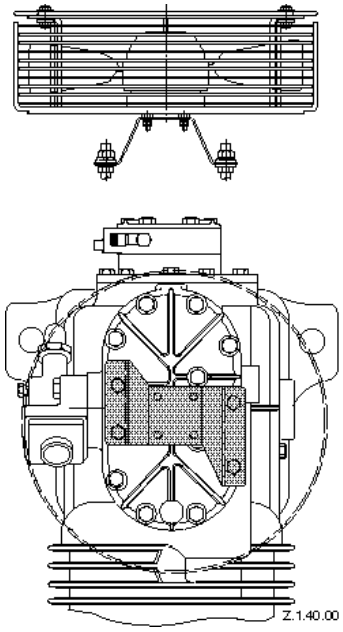
Note
The fan must blow air towards the compressor!
Check the direction of rotation after electrical connection!

75 Z Fan Mounting

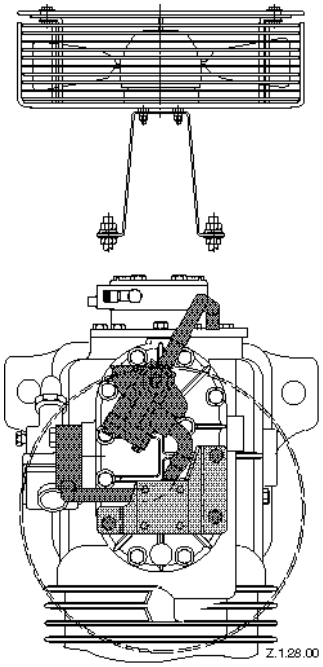
DL / DLH / D2S



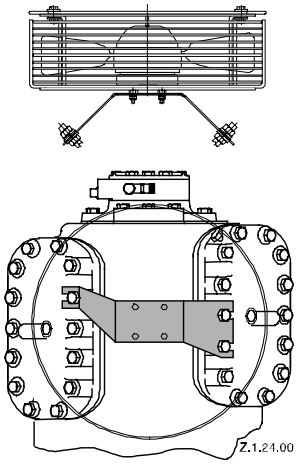
D3S / D9R



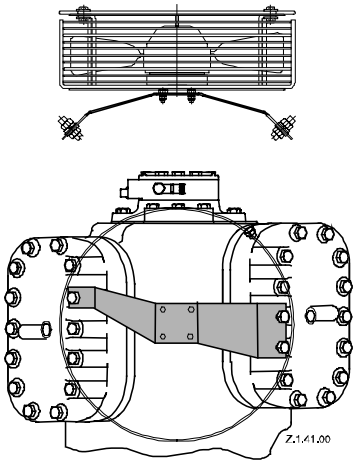
D9R **with capacity control**



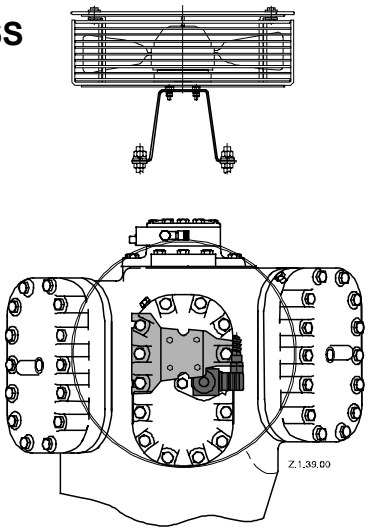
D4SA
D4SH



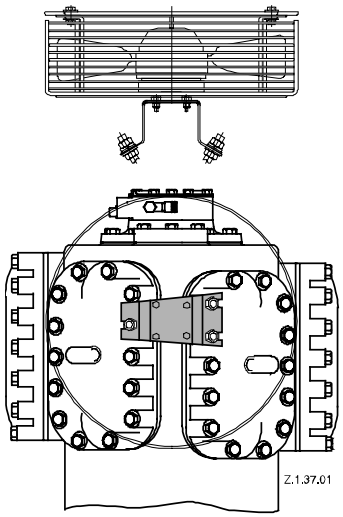
D4SJ



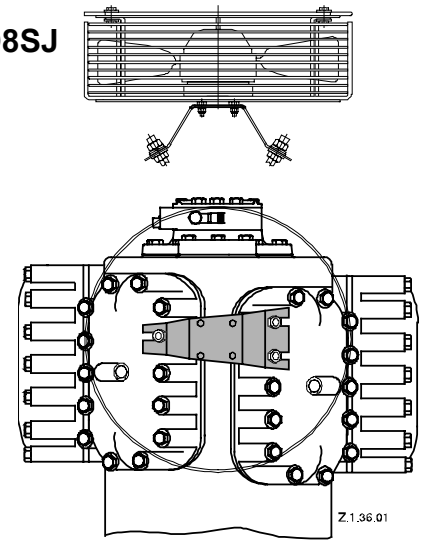
D6S



D8SH



D8SJ



Bracket Tightening Torque & Dimensions

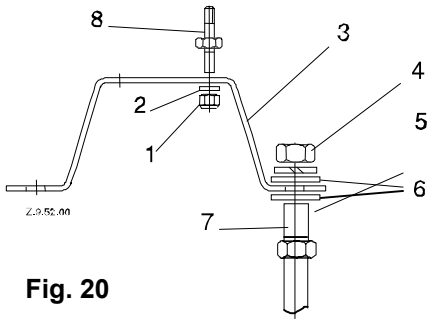


Fig. 20

Legend Fig. 20

1 = Lock nut (1.2 – 2Nm)
2 = Washer
3 = Bracket
4 = Nut (40 – 80 Nm)
5 = Spring Washer
6 = Washer
7 = Stud (see Table 1)
8 = Bolts for Fan

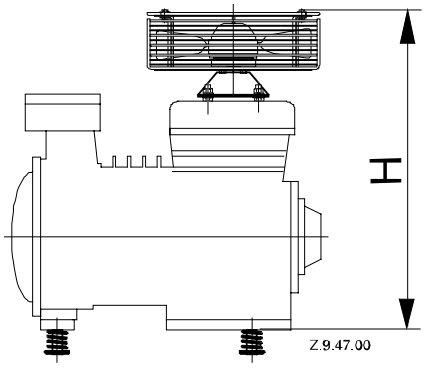


Fig. 21

Table 1: Tightening Torques and Dimensions

Compressor		DL,D2S	D9R[1),]D3S	D4SA	D4SH	D4SJ	D6SA	D6SH	D6SJ/K	D8SH	D8SJ
Tightening Torque	Nm	58 - 69	50 - 54	58 - 69	58 - 69	58 - 69	58 - 69	58 - 69	58 - 69	58 - 69	58 - 69
Dimension H (Fig. 21)	mm	448	598 / 688	522	529	545	591	597	629	621	649

1) w ith / w ithout capacity control

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 (operating maximum), without consideration being given to transient phenomena. In the case of high-powered motors the breakaway starting currents become so large that they lead to disruptive voltage dips in the mains. The compressors that are subject to current limitation must therefore by all means be equipped with starting load reduction to guarantee perfect starting even when the voltages amount to less than approximately 85% of the voltage on the nameplate.
Unloaded start is not available from Copeland for 2-stage compressors.

DLH, D2S, D3S & D9R
For DLH, D2S, D3S and D9R compressors an external unloaded start device is available. When ordered it will be delivered mounted to the compressor. Only the coil of the solenoid valve has to be connected, and the non-return valve fitted according to Fig. 25.

DLH, D2S Retrofit Kit (Mounting position see Fig. 22)
1 Piping assembly with valve body (1 x)
2 Gasket, flange discharge side (2 x
3 Gasket, flange suction side (2 x)
Solenoid coil (1 x)
Check valve NRV 22S (1 x, order separately)
Hexagonal screw, suction side ½" – 13 UNC x 2 ¼" (2 x)
Hexagonal screw, discharge side 5/16" – 18 UNC x 2" (2 x)

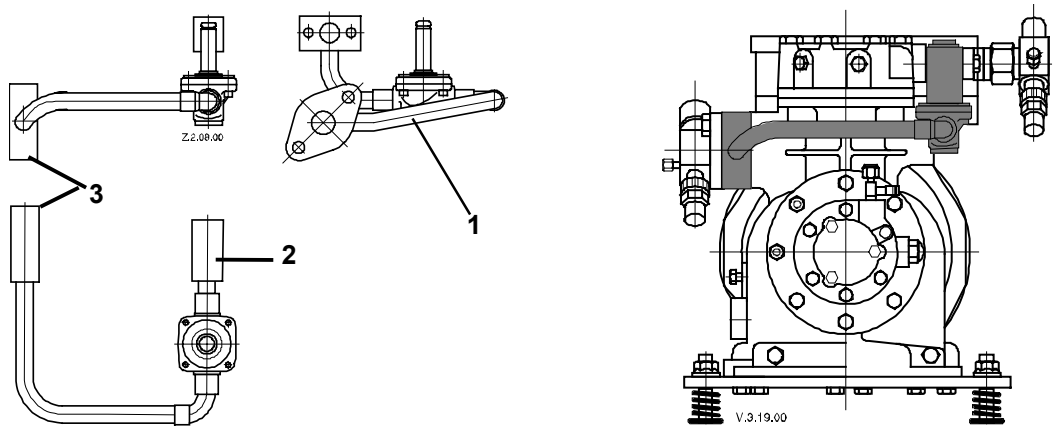


Fig. 22

D9R Retrofit Kit (Mounting position see Fig. 23)
1 Piping assembly with valve body (1 x)
2 Gasket, flange discharge side (2 x)
3 Gasket, flange suction side (1 x)
4 Solenoid coil (1 x)
Bolt, discharge side (2 x) ½" – 13 UNC x 3"
Check valve (1 x) see page 18, order separately

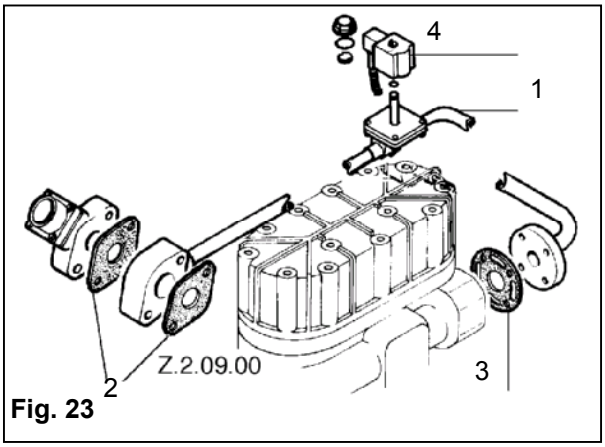


Fig. 23

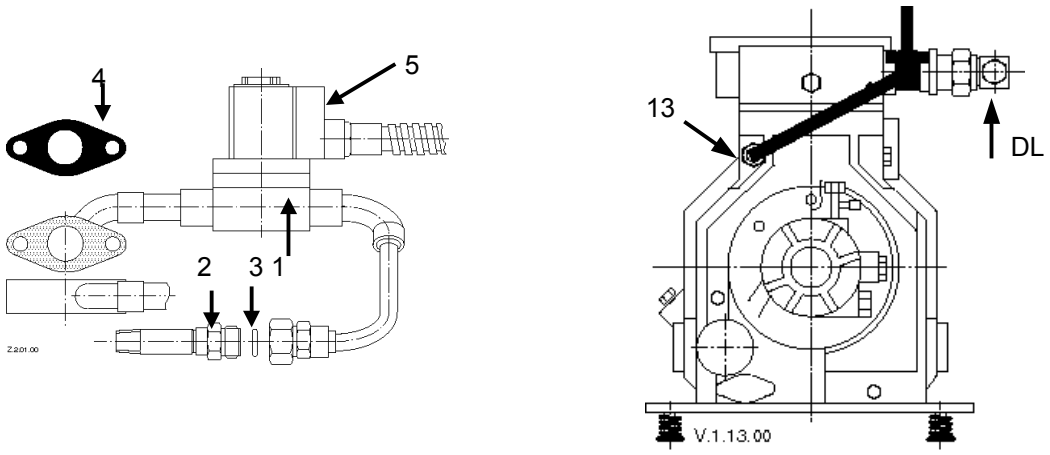
Note: If ordering a retrofit kit for a capacity-controlled D9R-compressor the information “for capacity-controlled motor compressor” must be provided! Piping assemblies with or without capacity control are different.

D3S Retrofit Kit (Mounting position see Fig. 24)
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) 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.

Fig.24

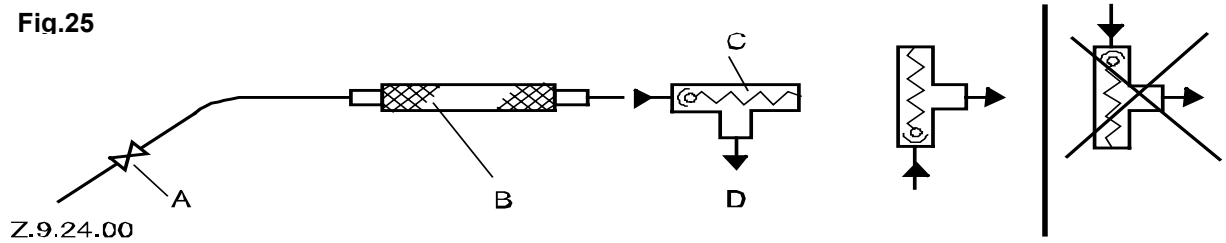


D4S – D8S
Compressors of the D4S, D6S & D8S range use an internal unloaded start system. When a compressor is ordered with unloaded start, it is supplied with a special cylinder head and and control piston fitted. The control valve and coil are supplied loose, must be fitted before the compressor is put into operation.
The unloaded start is factory fitted as shown in the illustrations overpage. In theory 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 an oil cooler. Capacity control must be fitted on specified banks only.
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	-

Mounting Position of the Non-Return Valve

Fig.25



A Compressor shut-off valve B Vibration absorber C Non-return valve D To condenser

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 by-pass line.

Non-Return Valve

The check valves are to be selected in accordance with the table below 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.
Note: The Non-Return Valve (NRVH) for TWIN / parallel compressor operation has a stronger spring than the NRV for single compressor operation.

Compressor	Non-Return Valve	Compressor[1)]	Non-Return Valve
DLH / D2S	NRV 22S $_{E}$ 22		
D4S	NRV 22S $_{E}$ 22	D44S	2 X NRVH 22S $_{E}$ 22
D3S / D4SJ	NRV 28S $_{E}$ 28	D44SJ	2 X NRVH 28S $_{E}$ 28
D6SF / L / T	NRV 22S $_{E}$ 22	D66SF / L / T	2 X NRVH 22S $_{E}$ 22
D6SA / H / J	NRV 28S $_{E}$ 28	D66SA / H / J	2 X NRVH 28S $_{E}$ 28
D6SK	NRV 35S $_{E}$ 42	D66SK	2 X NRVH 35S $_{E}$ 42
D8SH / J / K	NRV 42S $_{E}$ 42	D88SH / J / K	2 X NRVH 42S $_{E}$ 42

1) also for parallel compressor operation

Retrofit Kit for D4S – D8S
1x Cylinder head for unloaded start
1x Control valve with coil
1x Gasket cylinder head
1x Gasket valve plate
1x Gasket for valve flange (see Fig. 26)
2x hexagon cap screw ½" – 13 UNC x 1"
1x check valve (see page 17 order separately)

Mounting
Since capacity control devices may only be applied to specific banks of 4, 6, and 8 cylinder compressors, the unloaded start device is factory mounted on one of the other cylinder banks (as shown in Fig. 26).
If capacity control is omitted the unloaded start can also take another position if necessary.

Note: The position of the unloaded start device differs from the previous compressor D6R

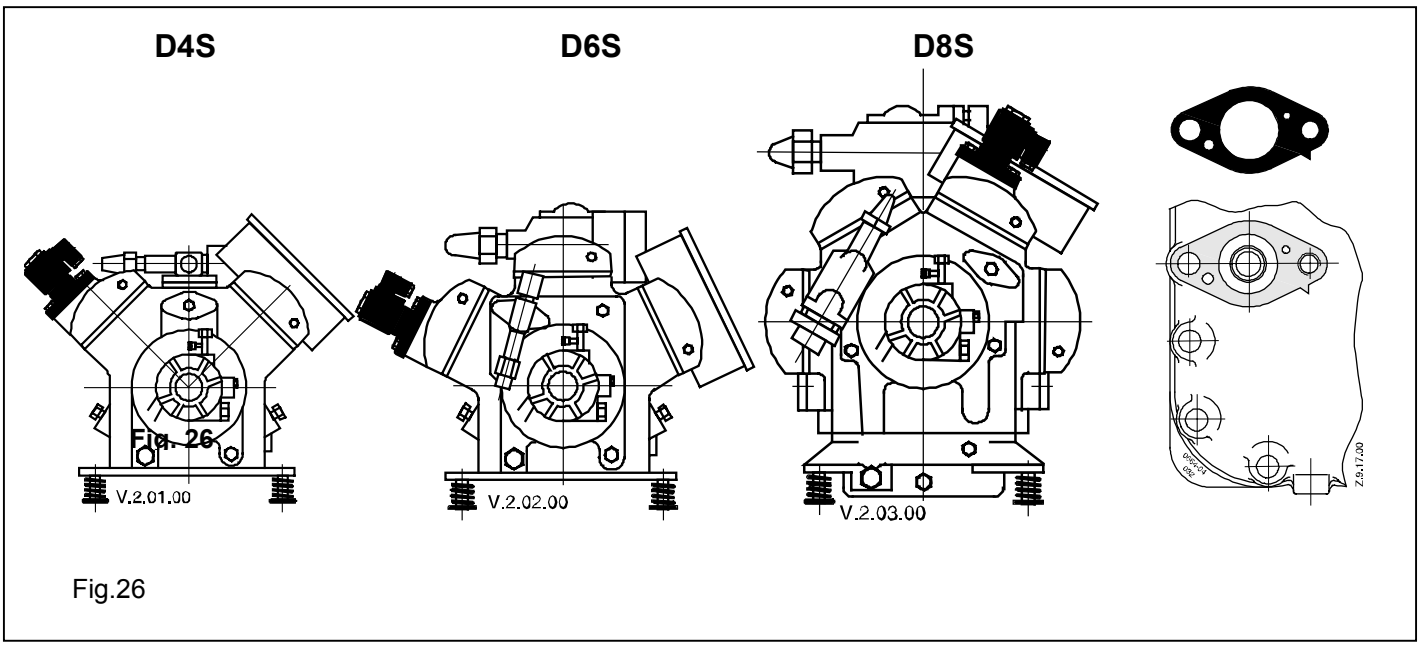


Fig. 26

Fig.26

D4S, D6S, D8S

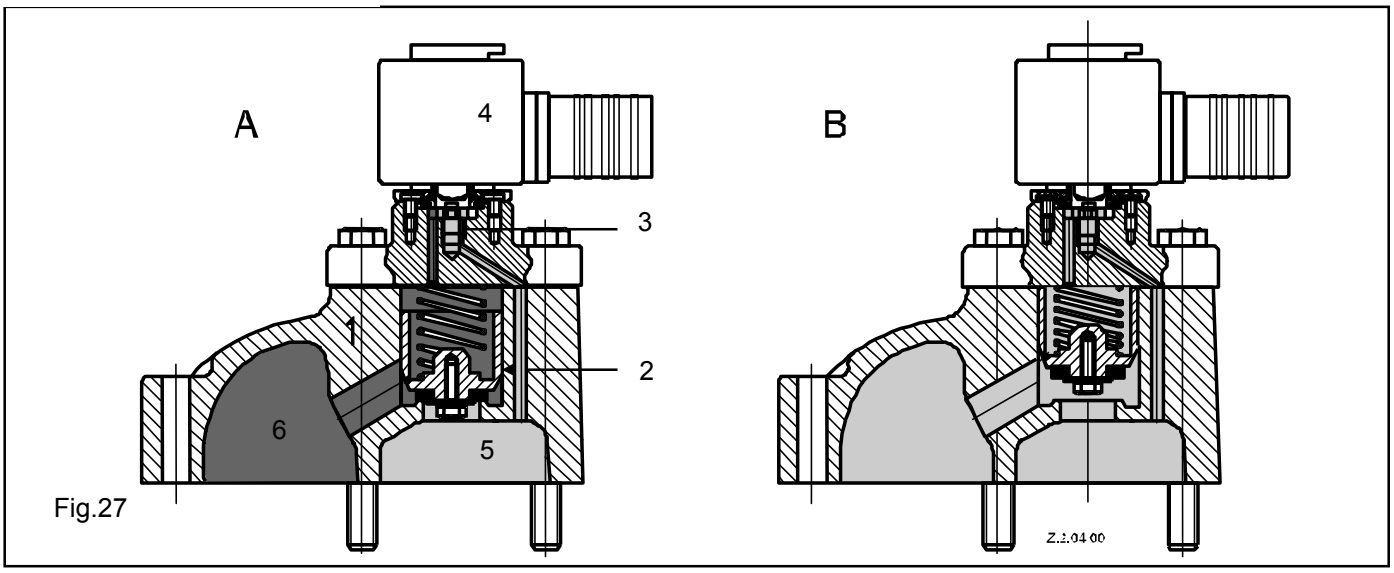


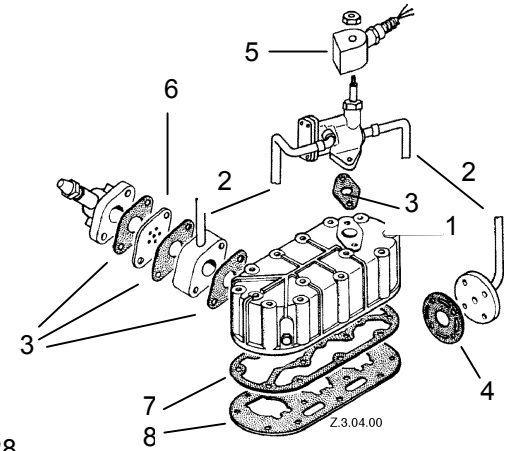
Fig.27

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

For the 3 (D9R only), 4, 6 and 8 cylinder compressor a mechanical capacity control is available. Be aware that unloaded operation changes the application range of the compressor.

Capacity Control D9R
The D9R compressor has an external capacity control mechanism. During unloaded operation the mass flow of one cylinder (33%) is led back to the suction channel via a by-pass. When a compressor is ordered with capacity control it will be factory mounted. A conversion kit is available (see Fig. 28)



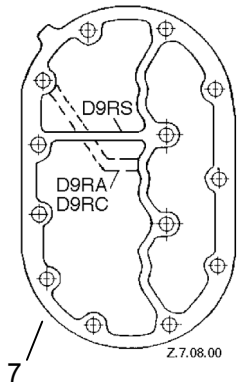


Fig.28

Conversion Kit D9R
1 Cylinder head for capacity control (1x)
2 Piping assembly (1 x) with valve body
3 Gasket flange (4 x) discharge side, solenoid valve
4 Gasket flange (1 x) suction side,
5 Solenoid coil (1 x)
6 Muffler plate (1 x)
7 Gasket cylinder head (1 x)
8 Gasket valve plate (1 x)
Hexagonal screw, flange solenoid valve (2 x) ½" – 13 UNC x 1"
2 x hexagonal screw, discharge side ½" – 13 UNC x 3"

Danger
Do not operate the compressor unless the capacity control piping is fitted to the compressor. The discharge gas from one cylinder always passes via the solenoid valve, blanking this path may result in dangerously high pressure in the cylinder head.

Capacity Control D4S, D6S & D8S
These compressors have an internal capacity control, they work on the principle of blocking the suction gas passage to two or more cylinders. They require the use of a special cylinder head and a control valve with solenoid coil. These items may be ordered installed at the factory or in a kit form for later installation.

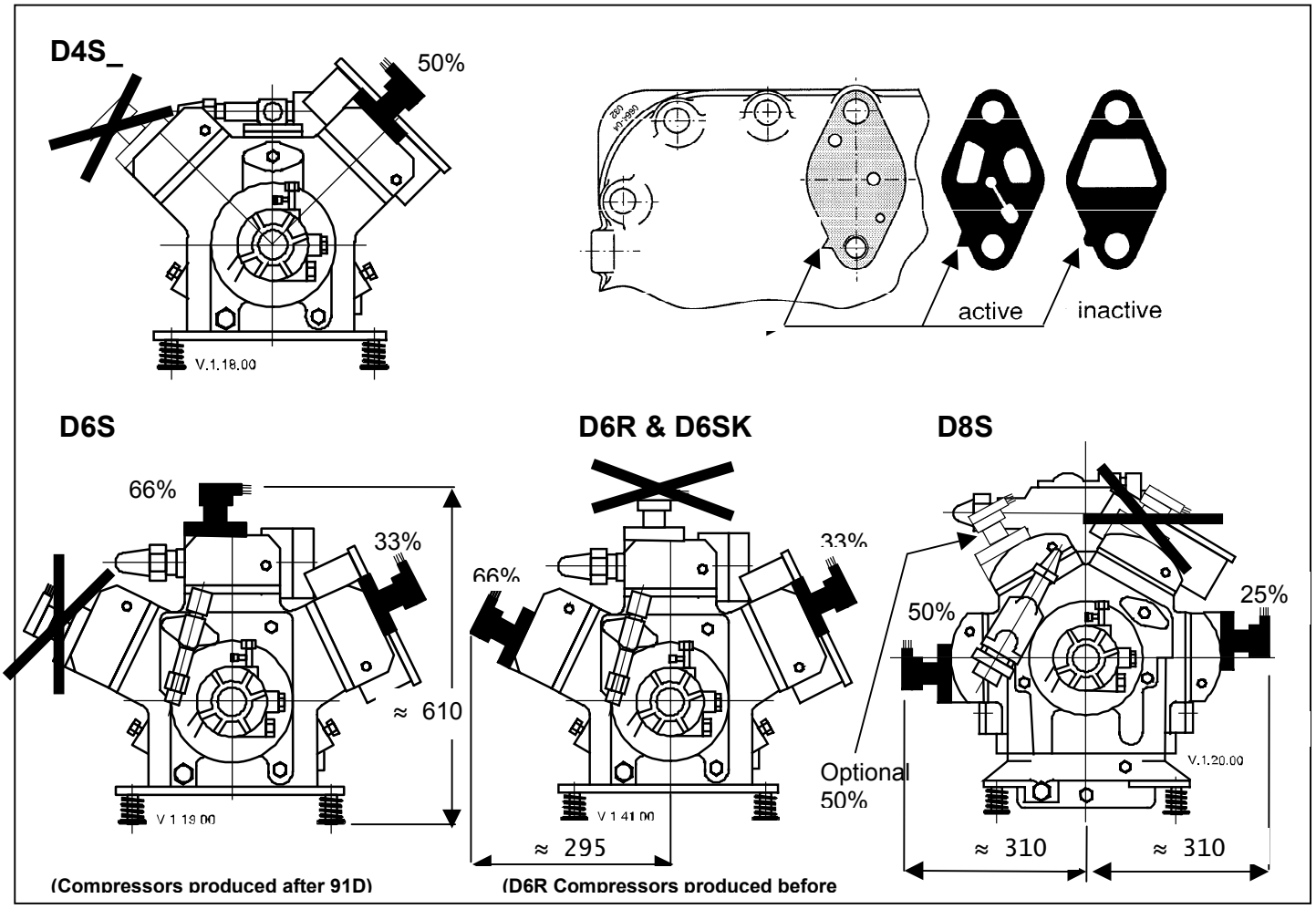
The suction port of the valve plate will be closed by a control piston (blocked suction). To prevent transport damage the solenoid valve is supplied loose and the cylinder head is fitted with a shipping plate, therefore the shipping plate with gasket must be removed and the solenoid valve with new gasket mounted. Do not put the compressor into operation with the shipping plate this could result in erratic operation of the control piston and inadequate cooling capacity.

Inactive Capacity Control
Compressors D4S, D6S and D8S can be ordered with **inactive** capacity control. There is a gasket under the shipping plate that allows operation on 100% capacity. To convert to active capacity control all that is needed is to fit the solenoid valve with the active gasket instead of the shipping plate.

Normal Operation (Full load)
When the solenoid coil is **not energised** 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 energised 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.

Fig. 29 Position of Capacity Control



Capacity control must be fitted in the following positions:

D4S	50%	terminal box side
D6SK 1st step	33%	terminal box side
D6SK 2nd step	66%	lower cylinder head on discharge valve side
D6S 1st step	33%	terminal box side
D6S 2nd step	66%	upper cylinder head
D8S 1st step	25%	lower cylinder head on terminal box side
D8S 2nd step	50%	lower cylinder head on discharge valve side

Note: The position of the capacity control differs from the previous compressor D6R!

Retrofit Kit includes;

1 x Cylinder head for capacity control
1 x Gasket kit
1 x Solenoid valve assembly (No 703 RB 001)
2 x Mounting screws

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

Capacity Control **D4S - D8S** Selection Table **R 22**

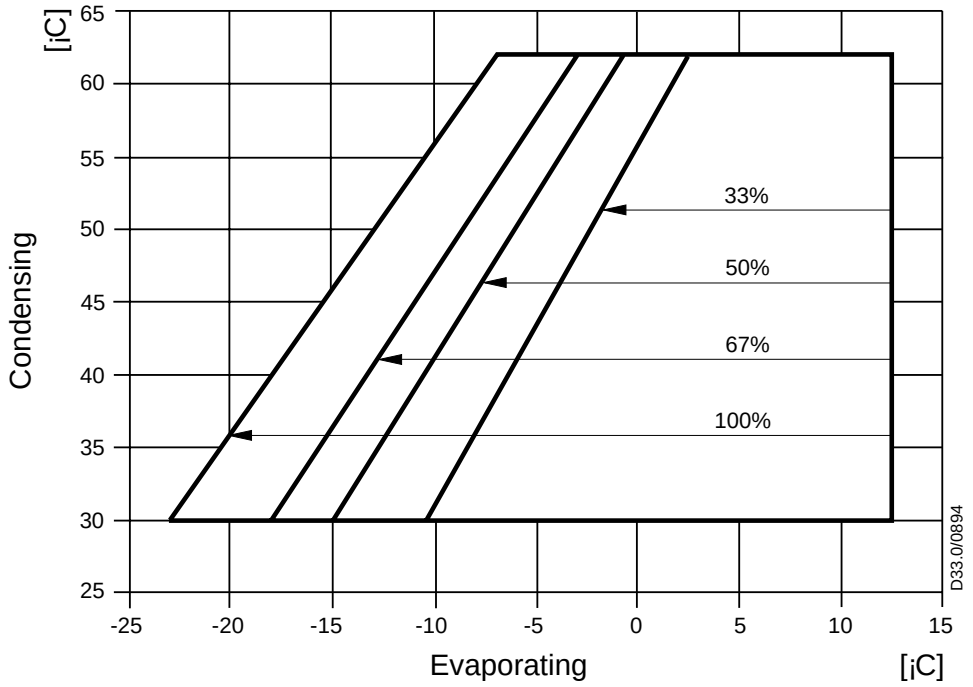
Selection of Capacity Control

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Step			Remaining Refrigeration Capacity % (average values)	Remaining Power Input % (average values)	Diagram No
		0	1	2	Application Range		
					H / M	H / M	
D4SA-2000	2	100%	50%		51	53	1
D4SH-2500	2	100%	50%		51	53	
D4SJ-3000	2	100%	50%		51	53	
D6SA-3000	2 / 4	100%	66%	33%	67/34	68/34	
D6SH-3500	2 / 4	100%	66%	33%	67/34	68/34	
D6SJ-4000	2 / 4	100%	66%	33%	67/34	68/34	
D8SH-5000	2 / 4	100%	75%	50%	76/53	79/57	2A
D8SJ-6000	2 / 4	100%	75%	50%	76/53	79/57	
D8SK-7000	2 / 4	100%	75%	50%	76/53	79/57	2B

Application limit see data sheets and application diagrams
H = high temperature
M = medium temperature

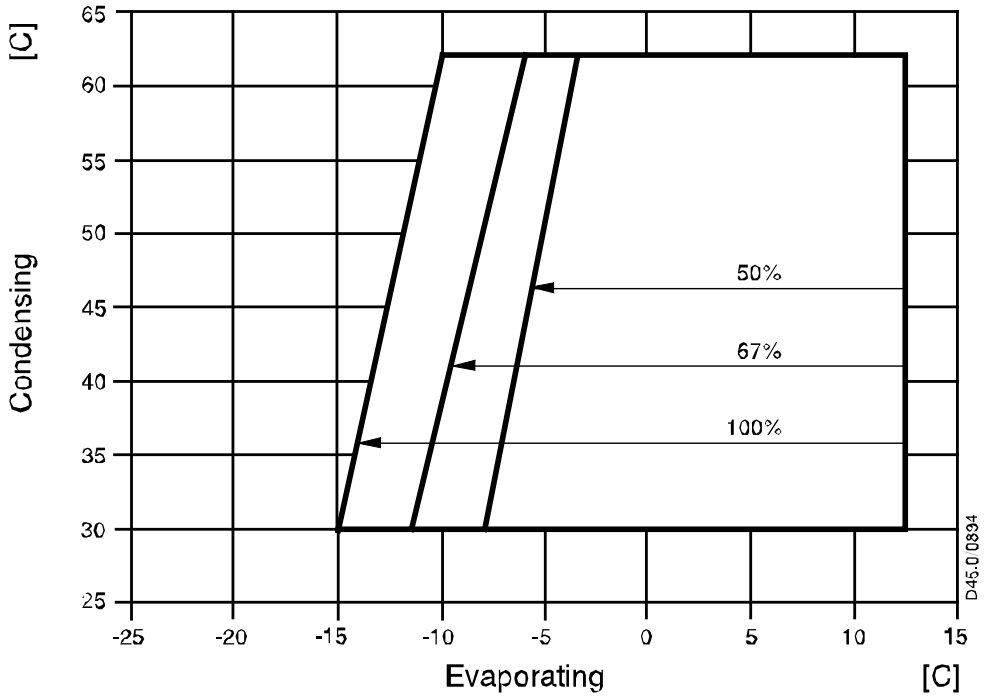
D4SA / H / J & D6SA / H / J

Diagram 1 Suction gas temperature 25^0C



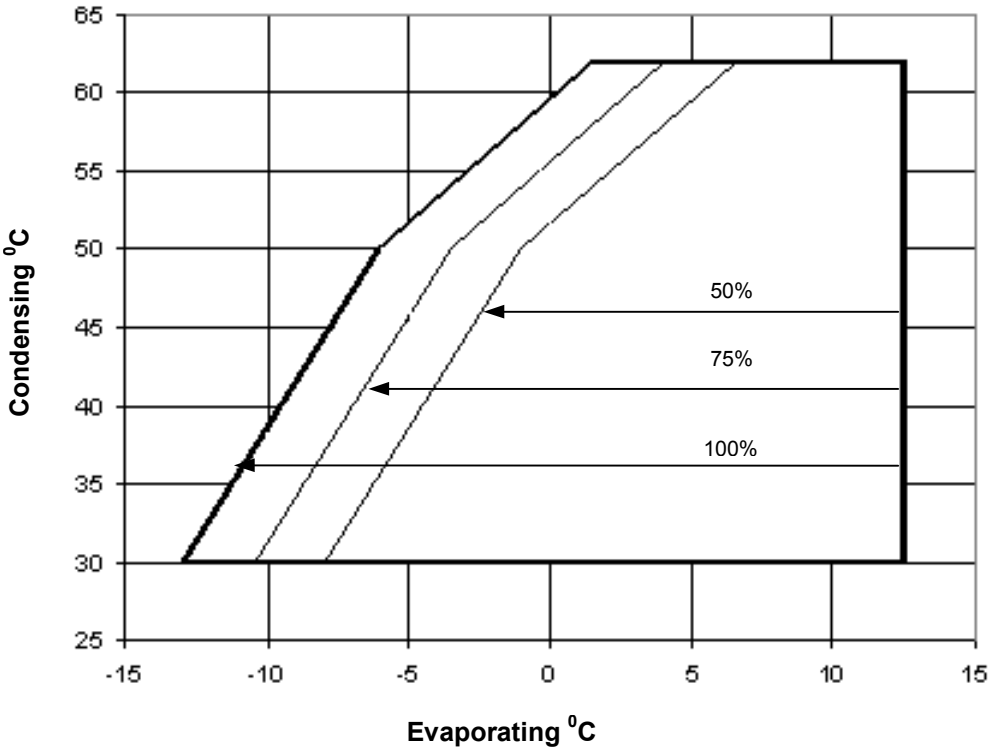
D8SH / J

Diagram 2A Suction gas temperature 25^{0}C



D8SK – 7000

Diagram 2B Suction gas temperature 25^{0}C



Selection of Capacity Control (mid-point)

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Step			Remaining Refrigeration Capacity % (average values)	Remaining Power Input % (average values)	Diagram No
		0	1	2	Application Range		
					H / M	H / M	
D4SA-200X	2	100%	50%		51	53	3
D4SH-250X	2	100%	50%		51	53	
D4SJ-300X	2	100%	50%		51	53	
D6SA-300X	2 / 4	100%	66%	33%	67/34	68/34	
D6SH-350X	2 / 4	100%	66%	33%	67/34	68/34	
D6SJ-400X	2 / 4	100%	66%	33%	67/34	68/34	
D8SH-500X	2 / 4	100%	75%	50%	76/53	79/57	4
D8SJ-600X	2 / 4	100%	75%	50%	76/53	79/57	
D8SK-700X	2 / 4	100%	75%	50%	76/53	79/57	5

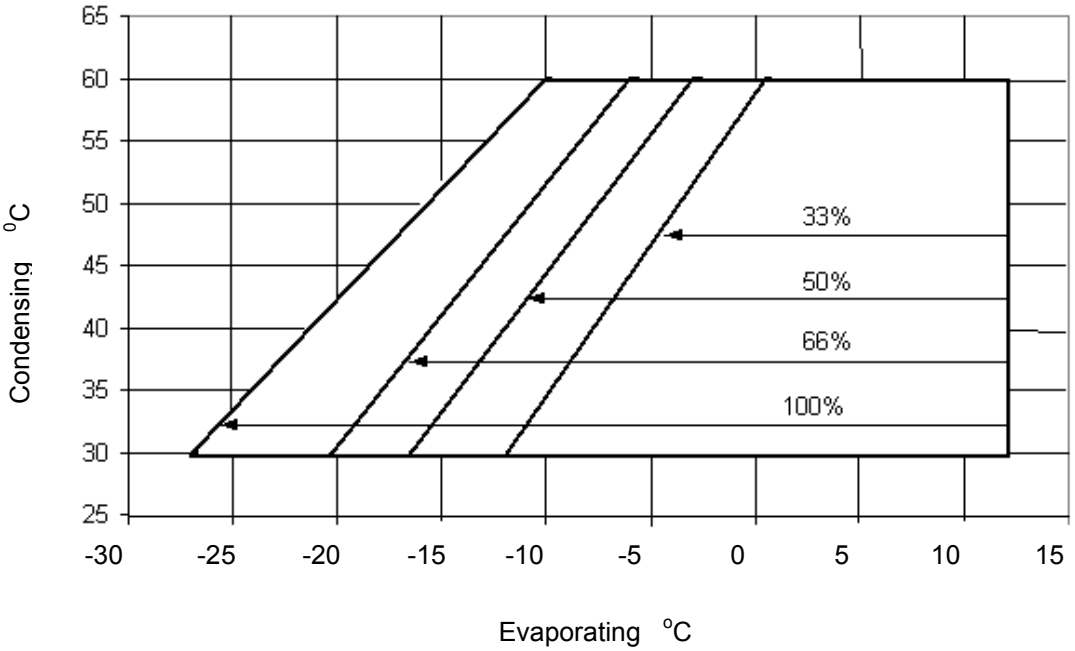
Application limit see data sheets and application diagrams

H = high temperature

M = medium temperature

D4SA / H / J & D6SA / H / J

Diagram 3 Suction gas temperature 25^{0}C



D8SH / J

Diagram 4 Suction gas temperature 25^{0}C

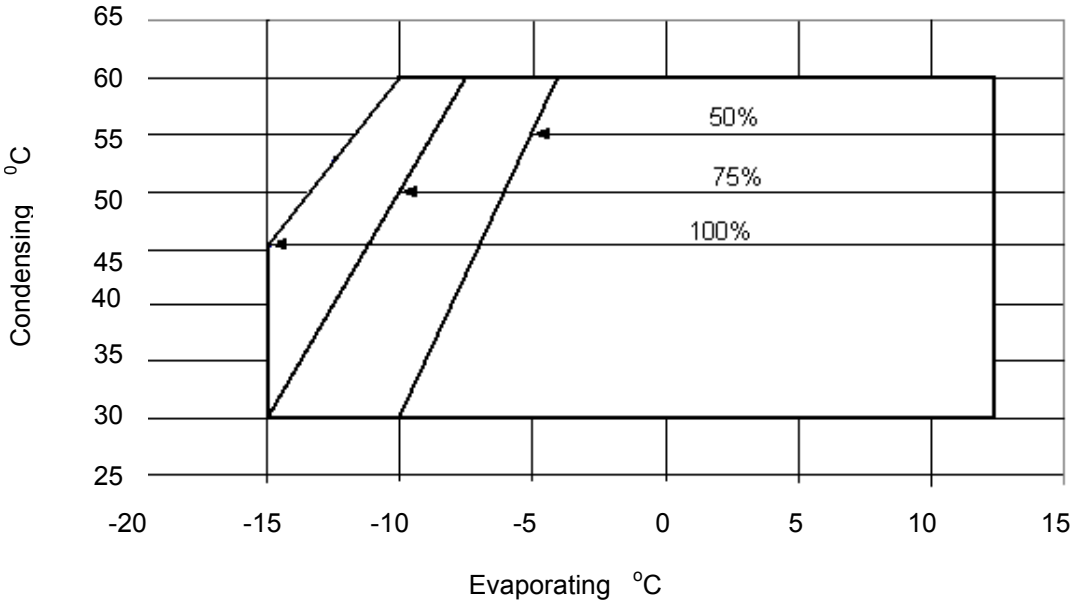
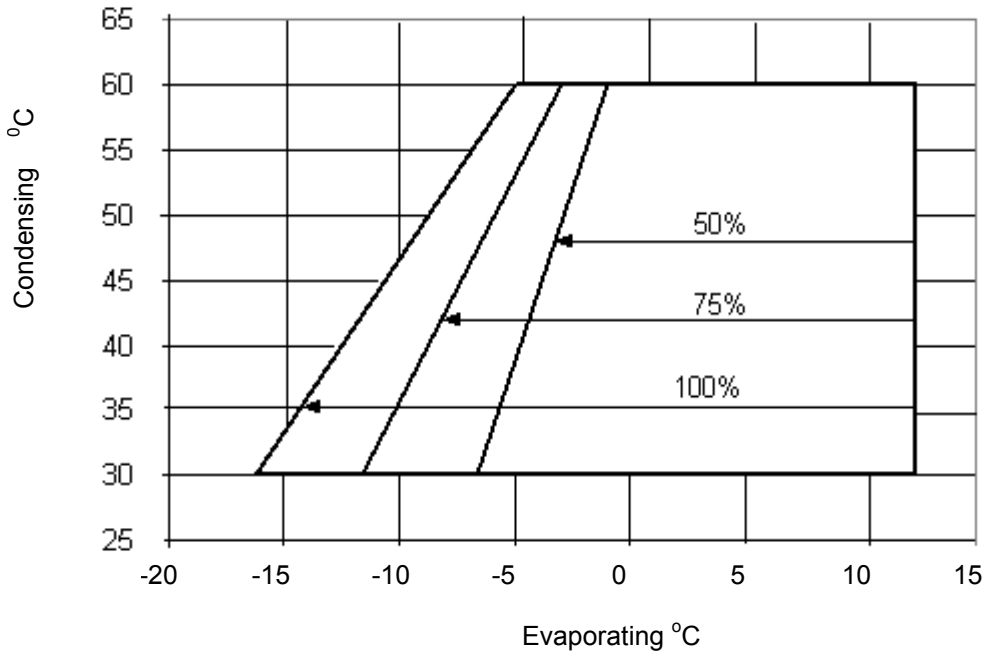


Diagram 5 Suction gas temperature 25^0C



Selection of Capacity Control

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Steps			Remaining Ref. Capacity % (average values)			Remaining Power Input % (average values)			Diagram No
		0	1	2	Application Range						
					H	M	L	H	M	L	
D4SF-100X	2	100%	50%				52			59	6 & 7
D4SL-150X	2	100%	50%				52			59	
D4ST-200X	2	100%	50%				52			59	
D4SA-200X	2	100%	50%		51	52		53	59		8 & 9
D4SH-250X	2	100%	50%		51	52		53	59		
D4SJ-300X	2	100%	50%		51	52		53	59		
D6SF-200X	2 / 4	100%	66%	33%			68/34			70/41	6 & 7
D6SL-250X	2 / 4	100%	66%	33%			68/34			70/41	
D6ST-320X	2 / 4	100%	66%	33%			68/34			70/41	
D6SA-300X	2 / 4	100%	66%	33%	67/34	68/34		68/36	70/41		8 & 9
D6SH-350X	2 / 4	100%	66%	33%	67/34	68/34		68/36	70/41		
D6SJ-400X	2 / 4	100%	66%	33%	67/34	68/34		68/36	70/41		
D8SH-370X	2 / 4	100%	75%	50%	76/53	76/53		79/56	80/58		
D8SJ-450X	2 / 4	100%	75%	50%	76/53	76/53		79/56	80/58		
D8SH-500X	2 / 4	100%	75%	50%	76/53	76/53		79/56	80/58		
D8SJ-600X	2 / 4	100%	75%	50%	76/53	76/53		79/56	80/58		

Application limit see data sheets and application diagrams

H = high temperature
M = medium temperature
L = low temperature

D4SF / L / T & D6SF / L / T

Diagram 6: Suction gas temperature 25^{0}C

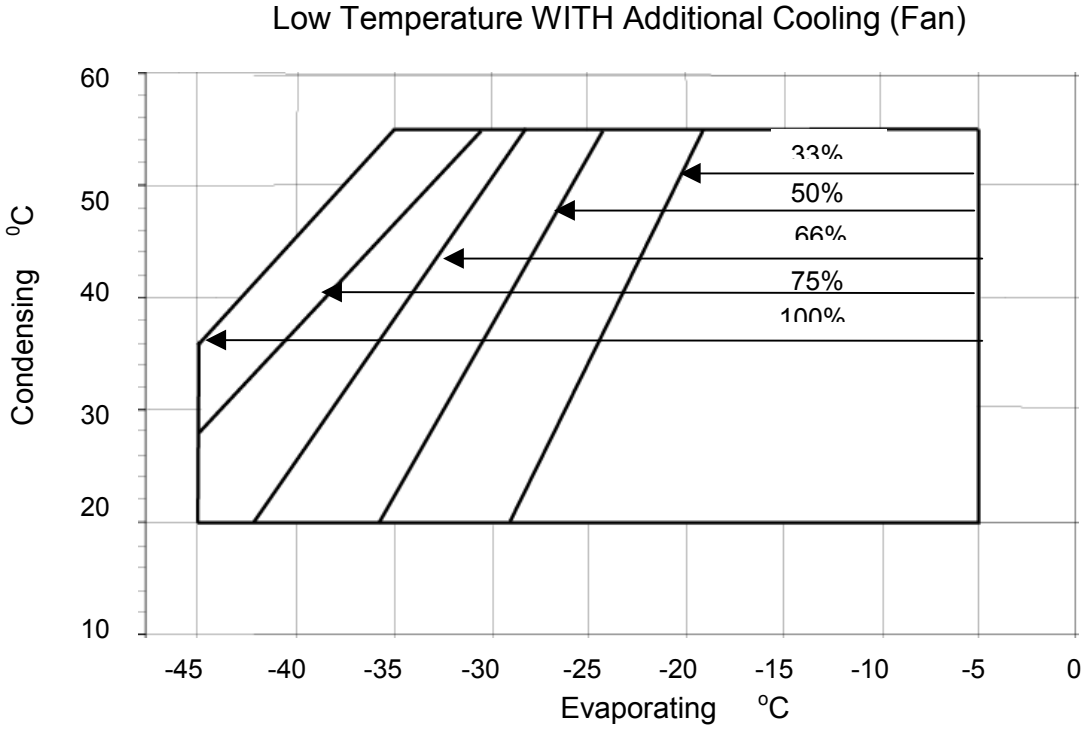
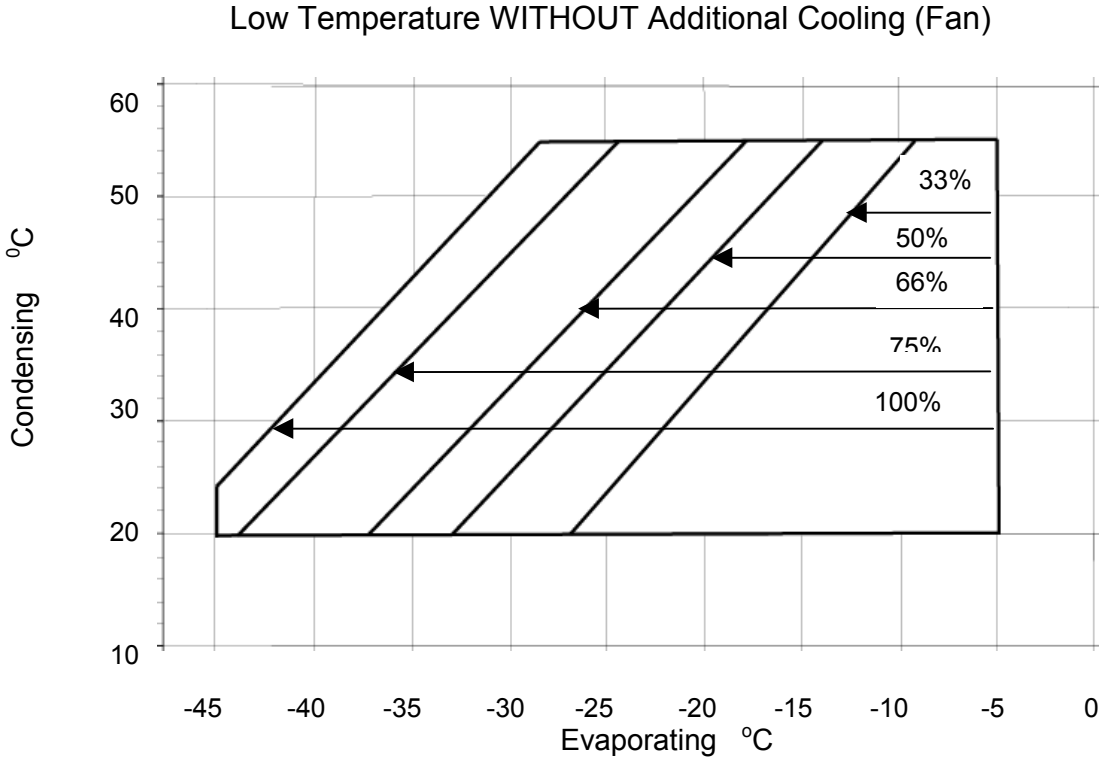


Diagram 7: Suction gas temperature 25^{0}C



D4SA / H / J & D6SA / H / J & D8SH / J

Diagram 8: Suction gas temperature 25^{0}C

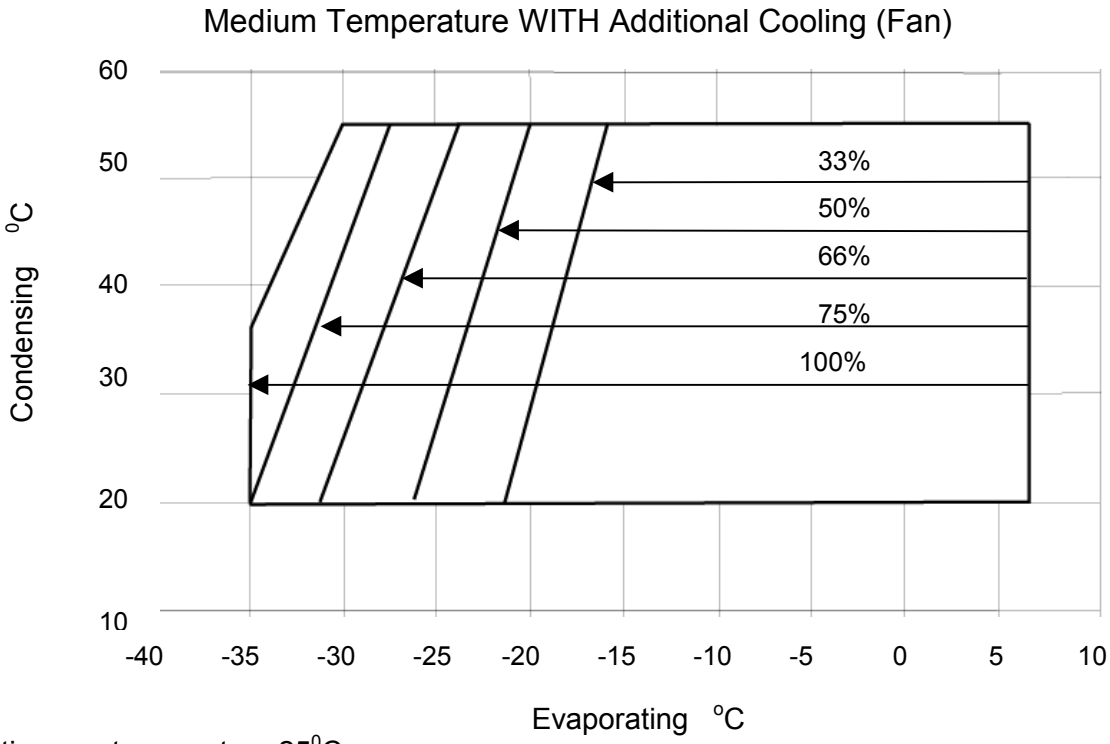
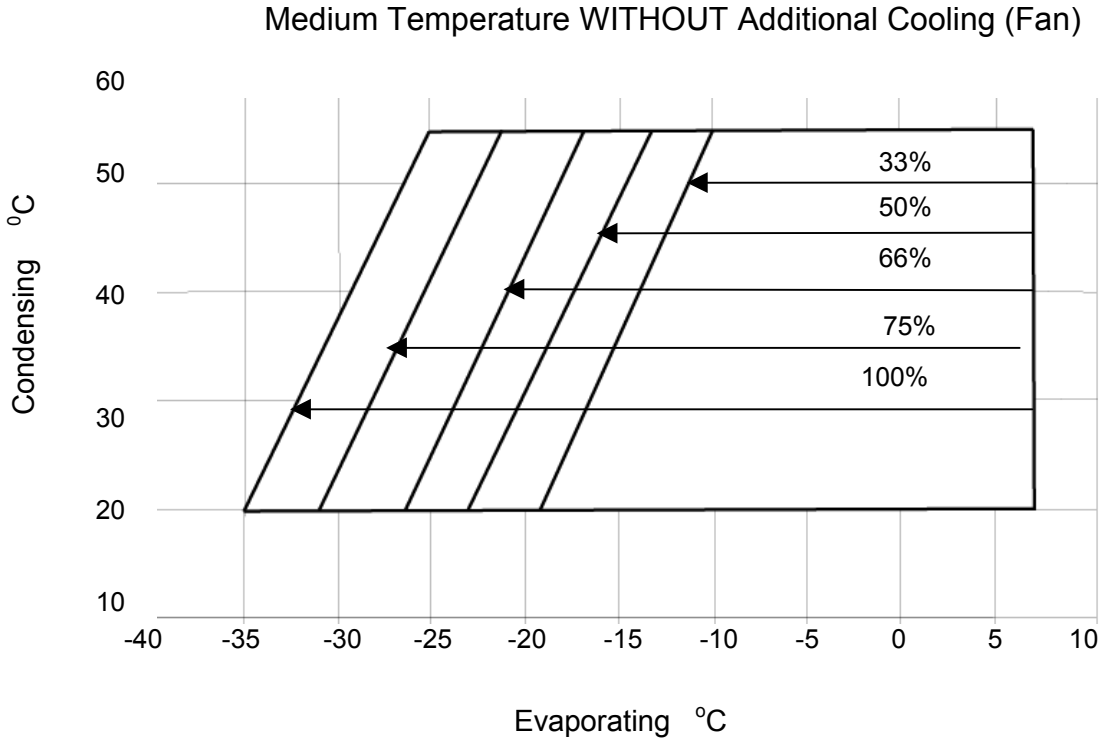


Diagram 9 Suction gas temperature 25^{0}C



TWIN Compressors D44S – D88S

Compressors D4S and D6S are manufactured using by-pass bodies (see figure 30). The suction gas flows through passages around the stator (1) and not through holes in the rotor (2) as in the past, this reduces losses and thereby increases efficiency. The D8S has not been affected by these changes.

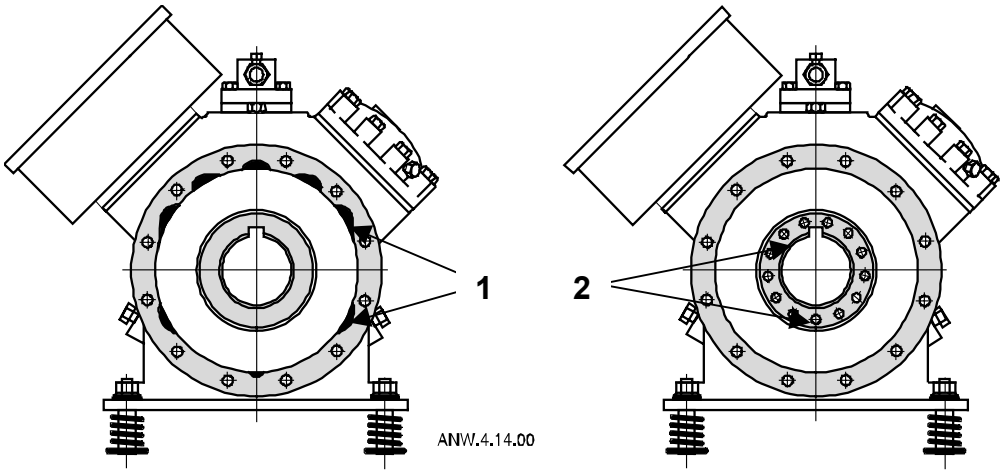


Fig.30 View of compressor motor after removal of suction chamber (by-pass body left)

New Suction Chamber
Due to the change in the motor cooling, a new suction chamber for D44S & D66S TWIN compressors is necessary. The new chamber has by-pass slots that the previous suction chamber does not have. Therefore it is not allowed to use the previous suction chamber with compressors with by-pass bodies. However compressors that still have the holes in the rotor can use the new suction chamber.

TWIN compressors with by-pass bodies require the new suction chamber that has by-pass slots.

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.
D44SF - 2000 D44SF - 3000 D44SA - 4000	**019-0042-99**	**019-0050-99**
D44SH - 5000 D44SJ - 6000 D66S . - . . . . D66T . -	**019-0004-99**	**019-0049-99**

Crankcase Heater

All Standard compressors have a chamber or a sleeve for mounting a crankcase heater.
The oil in the crankcase absorbs large or small amounts of refrigerant depending on the pressure and temperature. When the compressor is out of service the amount of refrigerant absorbed may be so high that the oil level in the compressor rises creating the impression that the quantity of oil is large. When starting the compressor the pressure in the crankcase decreases and the oil foams due to the vapourising refrigerant. The pistons draw up the foam, 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 the compressor off-cycle. 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 the refrigeration system.

27 Watt Heater Element for DK
The internal crankcase heater for DK compressors is a self regulating 27 Watt PTC heater (see figure 31).

70 Watt and 100 Watt Heater Element
The 70 Watt heater for DL, D2S compressors are screwed into a pocket. Heaters for D3S and D9 compressors are screwed into a sleeve (see figure 32).

200 Watt Heater Element
The heater element of compressors that are equipped with a deep oil sump are inserted into a special chamber and fixed to the compressor body (see figure 33).

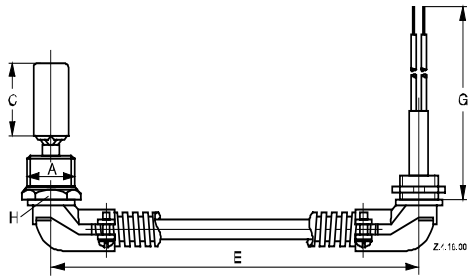


Fig.31

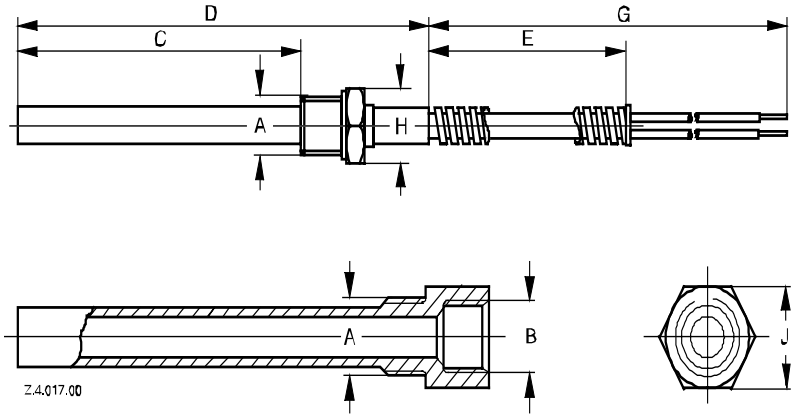
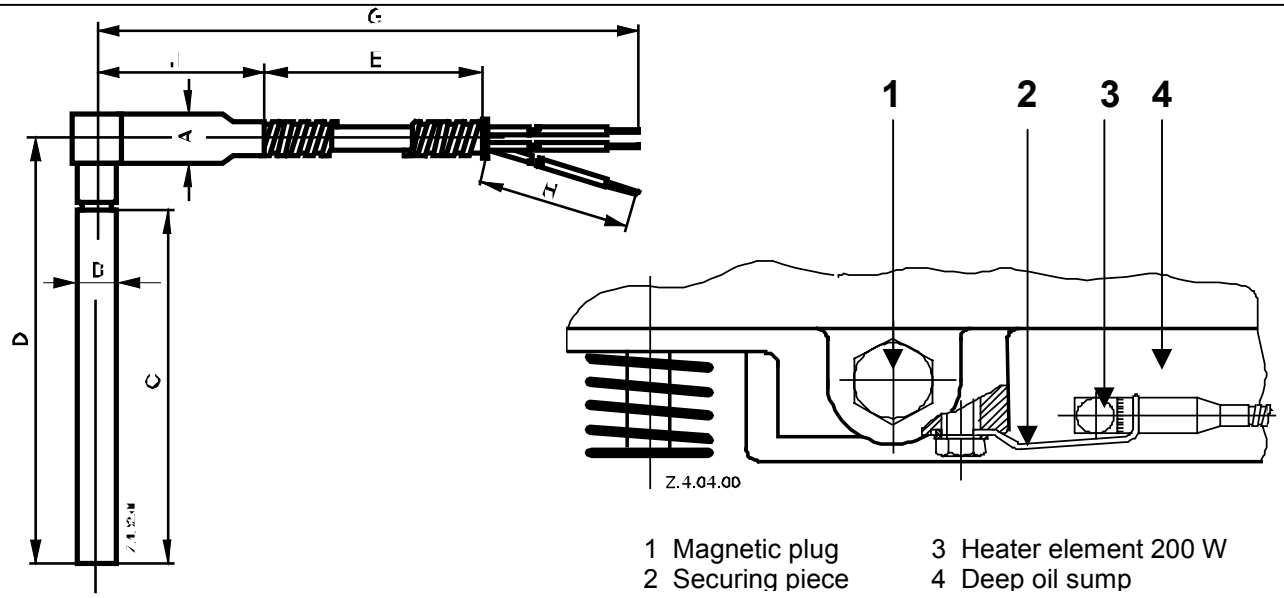


Fig.32

For dimensions see next page

Compressor	Heater (Watt)	Connections		Dimensions (mm)					
		A	B	C	D	E	G	H	J
DK	27	M25 x 1.5	-	32.5	-	490	250	27	-
DL, D2S	70	3/8" -18 NPTF	3/8" -18 NPSL	68	119	710	900	19	22
D3S, D9	70	3/8" -18 NPTF	3/8" -18 NPSL	112	163	710	900	19	22
D4S, D6S	100	1/2" -14 NPTF	1/2" -14 NPSL	125	190	600	750	22	27
D6SJ/T/K, D8S	200	Ø14 mm	Ø12.62 mm	103	126	700	900	200	50

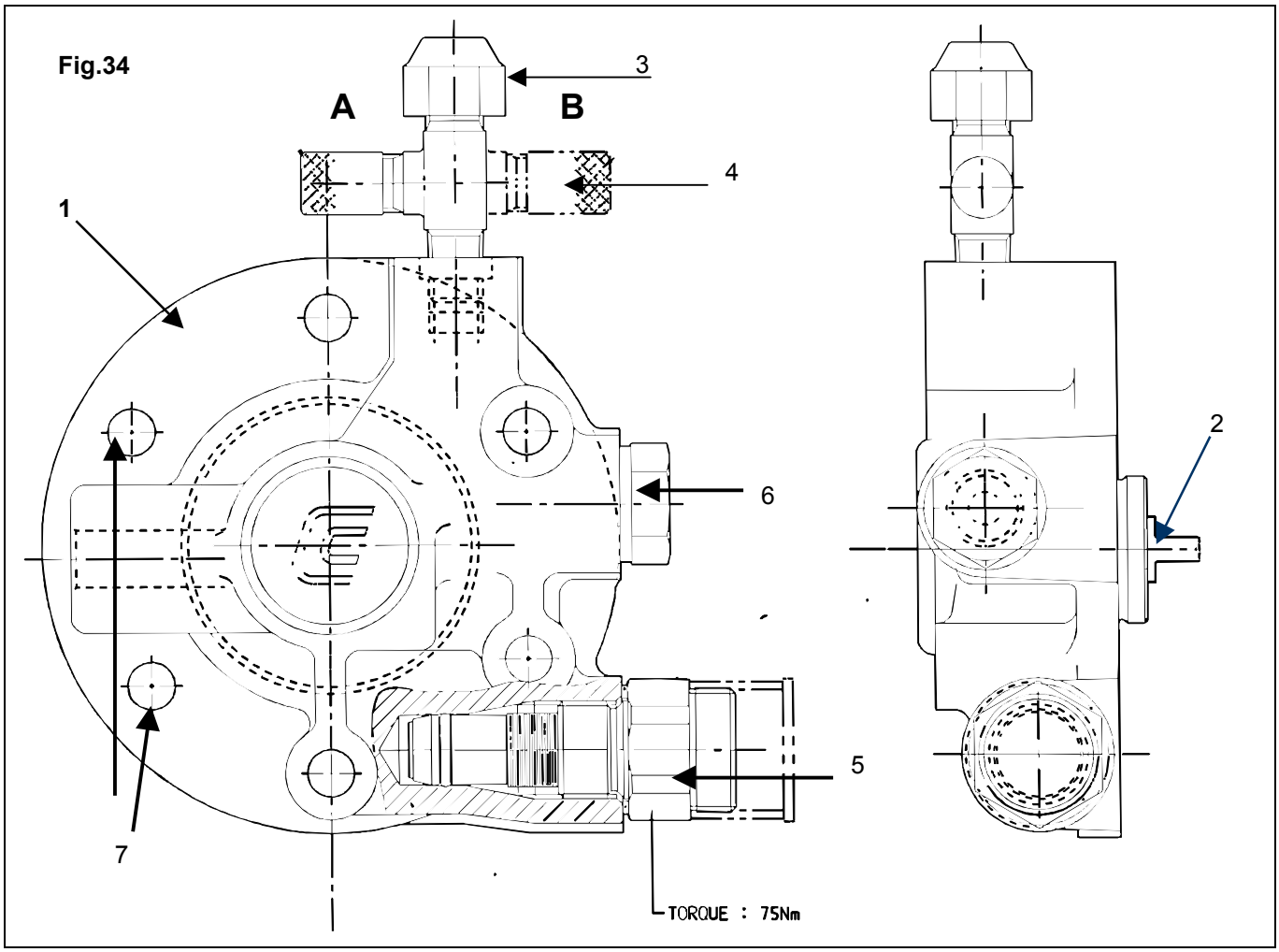


1 Magnetic plug
2 Securing piece
3 Heater element 200 W
4 Deep oil sump

Fig.33

Oil Pump

DLH, D2S, D3S, D4S, D6S/T, D8S & D9R/T Compressors
The D2S to D8S/D9R/T refrigerant cooled compressors and the DLH air-cooled compressor are **pressure lubricated**. The directionally independent oil pump is driven by the crankshaft and generates an oil pressure that is normally in the range 1 to 4 bar above the suction pressure. A relief valve ensures that the oil pressure does not exceed the permitted level. The oil is sucked up from the crankcase via an oil screen.
All 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)



A position D4, D6, D8
B position D2, D3, D9

1 Oil pump housing
2 Oil pump rotor
3 Flare connection of high-pressure side capillary tube of approved oil pressure control
4 $^{7}/_{16}$" - UNF Schraeder 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. 35).
The adapter ring is fixed to the pump case on the side of the cam pin (see Fig. 36). For fixing the ring there is a bead (see Fig. 35, section „A“) which snaps in into the cavity of the pump case (see Fig. 36, section „B“).
The oil pump shaft cam pin and the slot of the crankshaft must be properly aligned (see Fig. 36, C).

Compressor	Adapter	Gasket Material
D2S, D3S, D9	D = 40.4 mm	Wolverine
D4S, D6S, D8S	D = 49.2 mm	Wolverine

Fig. 35

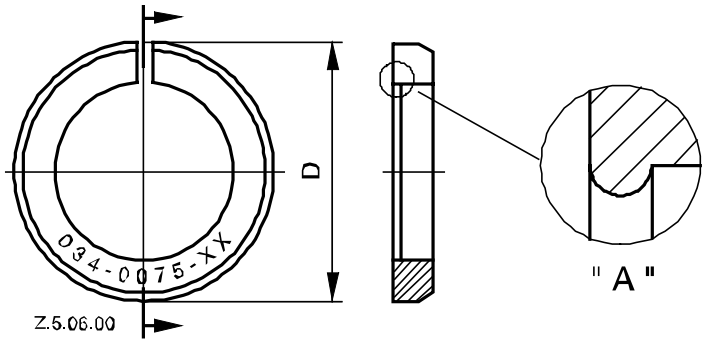
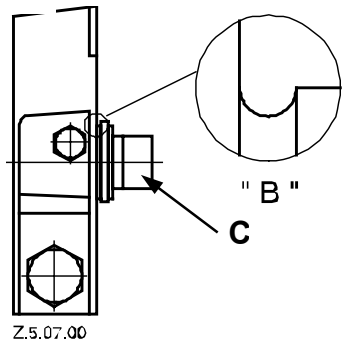
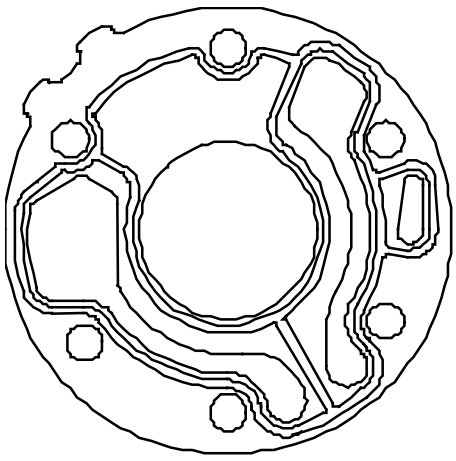


Fig. 36



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

D2S, D3S, D9R / T



D4S, D6S / T, D8S

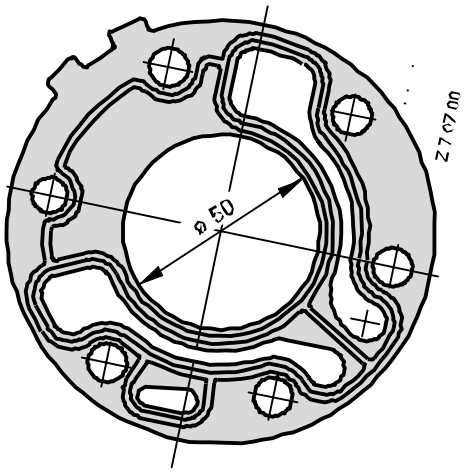


Fig.37

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.

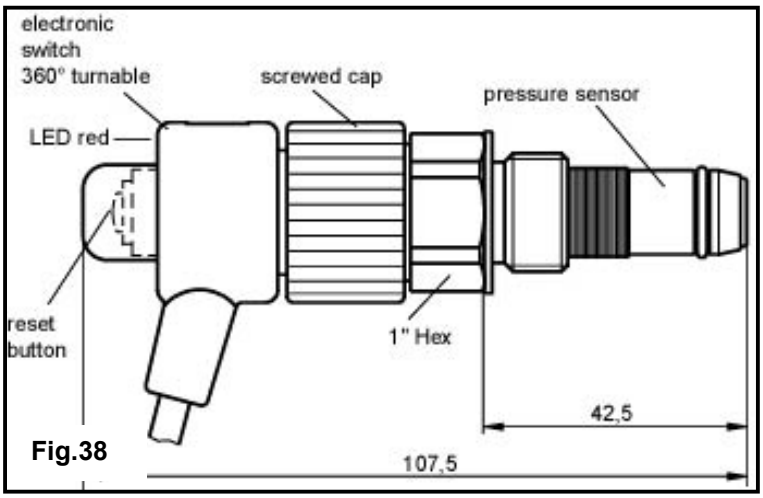


Fig.38

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:

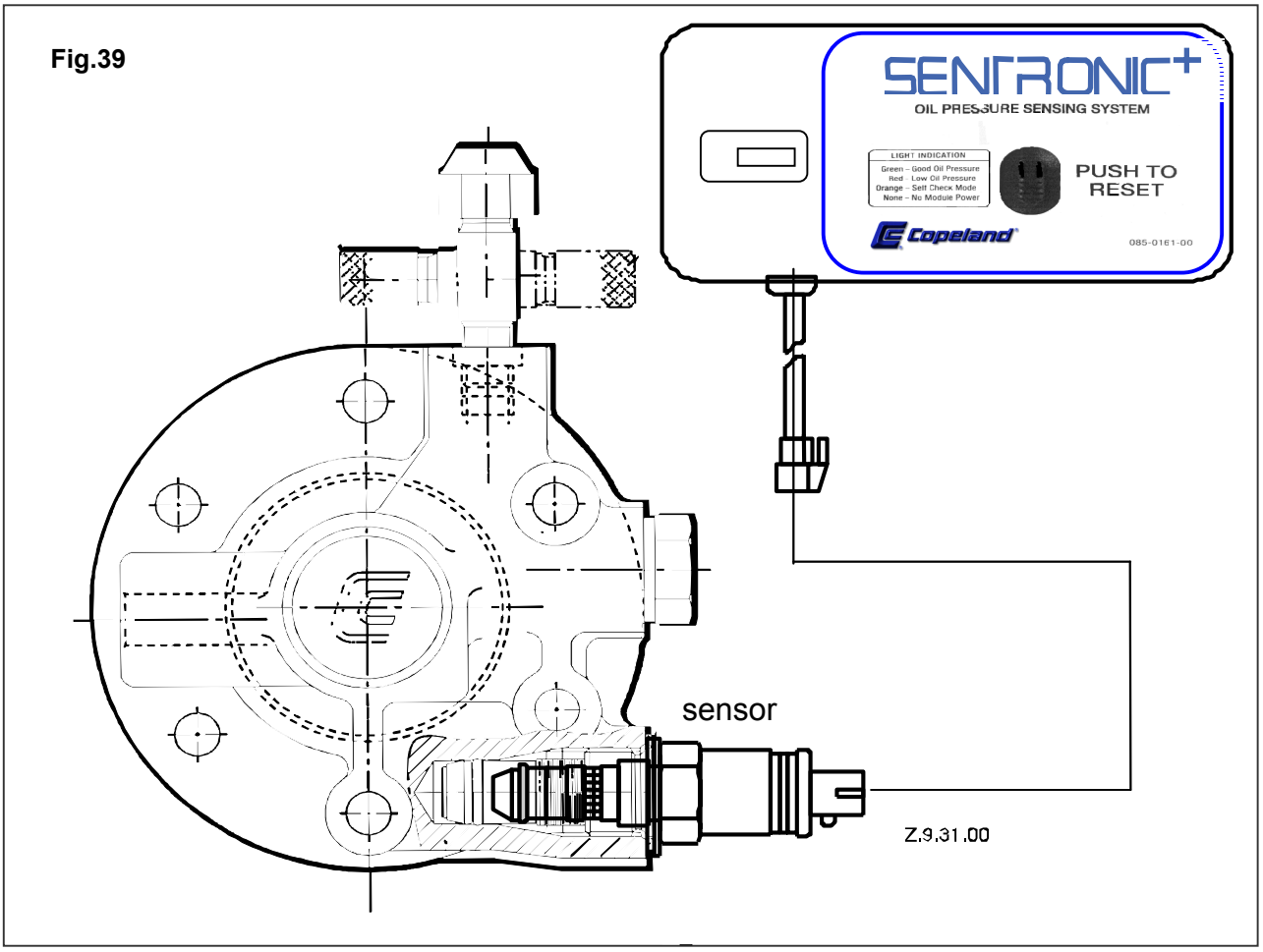
Supply voltage	AC 50/60 Hz 230V +/– 10% 10VA
Ambient temperature range	-30…..+60°C
Time delay	120 s
Cut-in pressure (fixed)	0,95 bar +/- 0,15 bar
Cut-out pressure (fixed)	0,63 bar +/- 0,15 bar
Switching capacity	AC 250 V, max. 2,5A, 720 VA ind.
Refrigerant compatibility	yes (brass)
Protection class according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

NEW SENTRONIC^{+TM} Oil Pressure Safety System

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

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

Fig.39



Technical Data

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

Operation

The differential pressure between the pump outlet and the crankcase is measured by the sensor and converted to an electronic signal. If the net oil pressure of a running compressor drops to 0.55 ± 0.1 bar the compressor will be shut down after a time delay of 120 ±15 sec. During periods of erratic oil pressure the module will monitor the pressure and add the periods of time when it is under the cut-in point of 0.9 ± 0.1 bar. When these periods of inadequate oil pressure total 2 min the module will shut down the compressor. When 4 minutes of adequate pressure are measured the timer resets to zero. In case of interruption of the power supply the SENTRONIC module holds stored information for one min.

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 65.
Power is supplied to the module on terminals “240V” or “120V” and “2”. Neutral must be connected to terminal “2”. The control circuit is to be connected on terminal “L” and “M”. The “A” terminal can be used to power an external alarm. An earth connection is also provided.
The module operation is powered by an internal transformer which is connected across terminal “2” and “120” or “240” depending on voltage.

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

The sensor can be checked with an ohmmeter. Disconnect the cable and 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 Schraeder 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 that 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 pages following).
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.

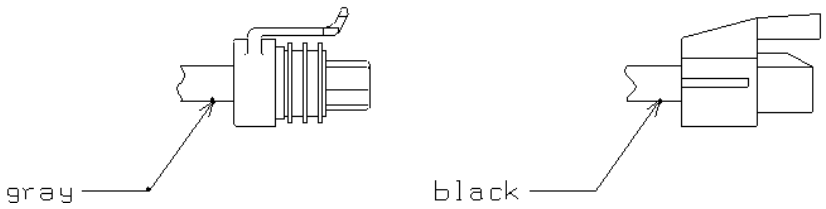
Interchangeability of Sentronic™ & Sentronic+™ Modules & Sensors

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 that is gray for identification purposes, see illustration below.



New Sentronic+ Old Sentronic

Connecting the Sentronic+ module to an old 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 overpage.
- Install the module to the compressor and make wiring and sensor connections per the general instructions.

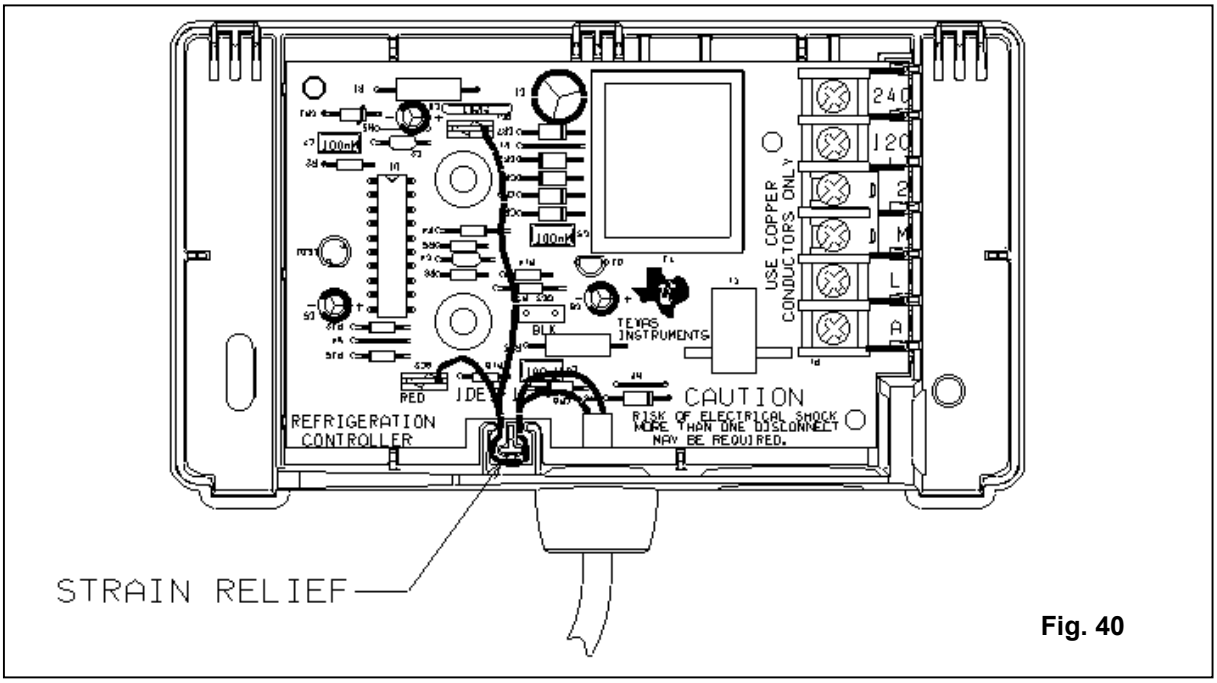


Fig. 40

Connecting the old Sentronic module to a new 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 supplied with the module.

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 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 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-in pressure: 0.90 ± 0.1 bar
time delay: 120 ± 15 sec

The bracket for this switch is supplied loose with 4 and 6 cylinder compressors.

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 DLH – D8

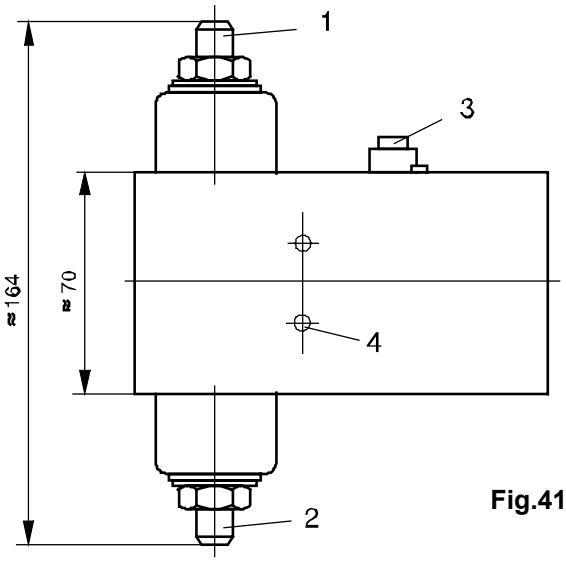
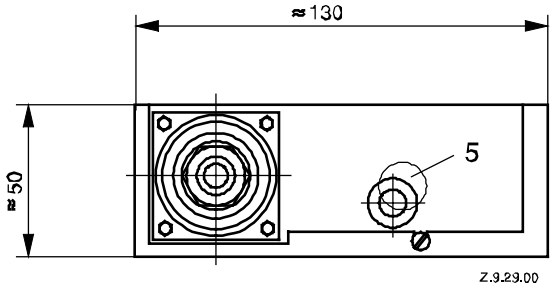
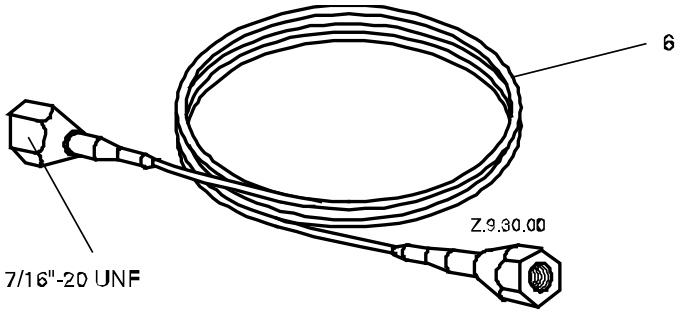


Fig.41





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

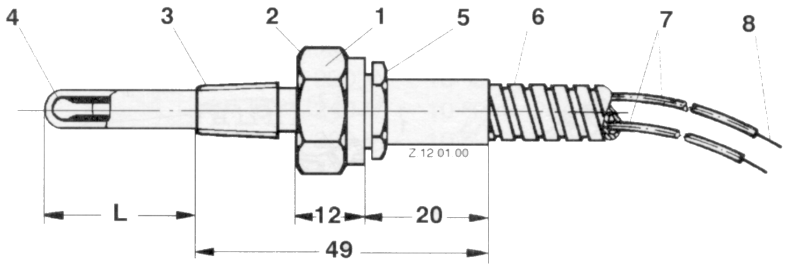
Technical Data FD 113 ZU	**(A22-057)**
cut-out oil	0.63 ± 0.14 bar
cut-in oil	0.90 ± 0.1 bar
time delay	120 ± 15 s
inductive load (AC 11)	3 A / 230 V AC
inductive load (DC 11)	0.1 A / 230 V DC
max. ambient temperature	70° C
manual reset	
built-in alarm connection	

[1] tentative data

Discharge Temperature Protection

A discharge temperature protection is available for all suction gas cooled D9R, D4S, D6S and D8S compressors. A PTC sensor, one for each cylinder head, measures the temperature directly at the discharge valve. If the maximum admissible discharge temperature is exceeded in one or more cylinder heads, the electronic release module INT 69 V will interrupt the control circuit and lock it.
The re-set lock can be overridden by a short term interruption of the voltage by means of a reset button. This must be installed by the customer (see principle wiring diagrams page 64).

Fig.42



1 Material No.
2 Hexagon SW 19
3 Thread ⅛" – 27 NPTF
4 Sensor (PTC)
5 PG 9 (15.2mm dia.)
6 Corrugated hose (10mm dia.)
7 Cable 0.75mm^2
8 Tin plate

Sensor

Compressor	Number	**Length L mm**	NAT[1)]	Length of sheathing mm	Cable Length mm
D9RA, D9RC	1	**16**	145 °C	300	450
D9RS	1	**16**	140 °C	300	450
D4SA, D4SJ D6SJ, D6SA, D6SK D8SJ, D8SK	2 3 4	**50**	155 °C	700	850
D4SH, D4SL, D6SH D6SL, D6ST D8SH	2 3 4	**25**	145 °C	700	850

1) NAT = nominal response temperature

When a compressor is ordered with discharge temperature protection, the sensors are factory mounted but still have to be connected.
Due to lack of space the release module INT 69V has to be mounted in the switch cabinet. The connection cables between sensor and the release module must be twisted and the resistance of both leads should not exceed 2.5 Ohms.
Field installation of the discharge temperature protection is also possible. The appropriate sensor according to Table 2 must be mounted at the suitable position in the cylinder head (see fig.43). The plugs have to be removed and the sensors fitted using putty which is resistant to refrigerants.

Attention
If the compressor is under pressure reduce the pressure before servicing.

Mounting Position for Sensors

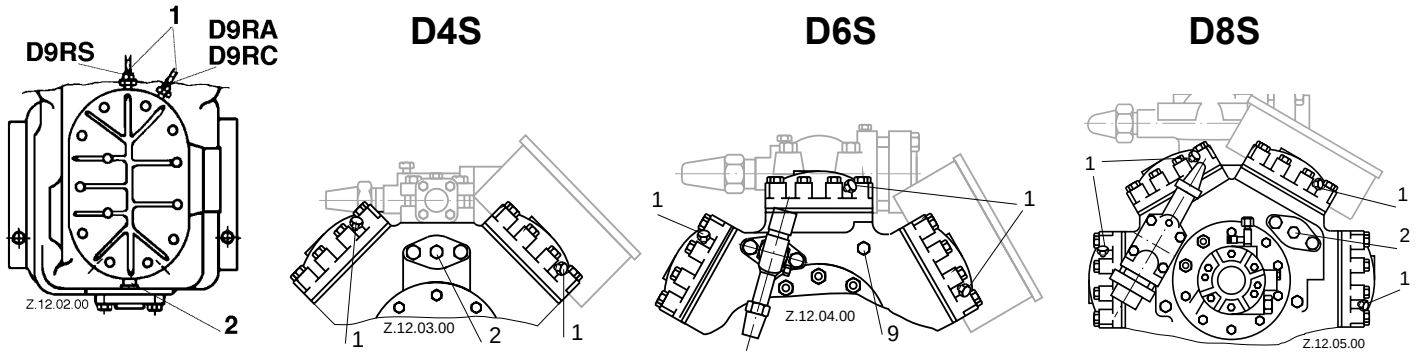


Fig.43

1 Mounting position of sensor 2,9 Plug high pressure side

With the standard compressor D9R, there are no holes for the discharge temperature protection, therefore the cylinder head has to be changed for the subsequent sensor installation.
4, 6 and 8 cylinder compressors have tapped holes where the 2, 3 or 4 sensors have to be connected in series.
We recommend the installation of an additional terminal box near the compressor, and to run the lead from the terminal box to the release module (see page 64).

Release Module INT 69 V (re-set lock)

Voltage supply (± 10%)	220 – 240V
Frequency	40 – 60Hz
Ambient temperature	-20 to +50°C
Protection class	IP 55
Terminals (max)	4mm²
Making capacity (cos Ø ≥ 0.3)	11A
Breaking capacity	3A
Continuous current (max.)	5A
Position of installation	Any

Functional Commissioning Checks

The re-set module has a re-set lock, this has to be observed during testing.

a) Voltage (± 10%) between terminals should be (see wiring diagram on page 64):
   L – N 220 – 240V
   11 – N 220 – 240V

b) Remove thermistor lines from terminals 1 and 2. Voltage between terminals 12 and N should be 220 – 240V plus the fault indicator should be on.

c) Terminals 1 and 2 must be bridged. The voltage between terminals N and 14 (after de-pressing the re-set button) should be 220 – 240V.

If these conditions are not found there must be a fault in the release module.

Electrical Installation

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

Example: Compressor model DLL*- 301 EWL
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

DK, DL & “S” Series Semi-Hermetic 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 factory connected, the power supply and the control circuit must be wired according to the wiring diagram (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 D4,D6 ,D8 etc have been implemented.

Terminal boxes with IP56 protection class have no connection strips for reasons of space. D9R/T terminal boxes with IP56 (according to IEC 529) protection class do not contain the motor protection module. The module INT 69 must be mounted separately. In such cases the wires to the module should be twisted or shielded and 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 screwdriver!

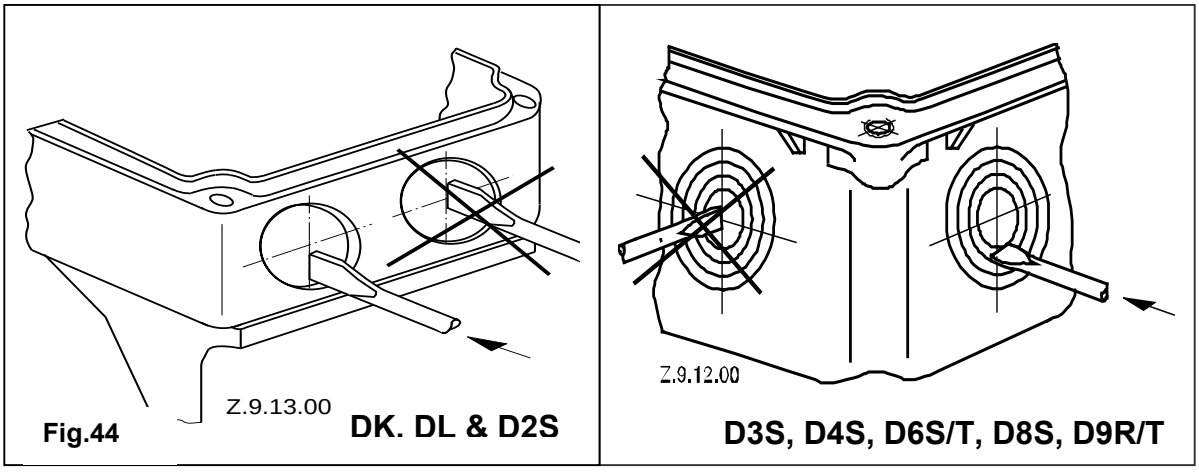
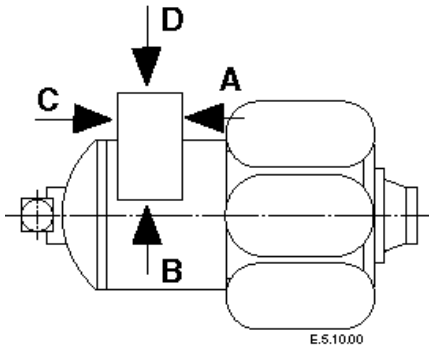


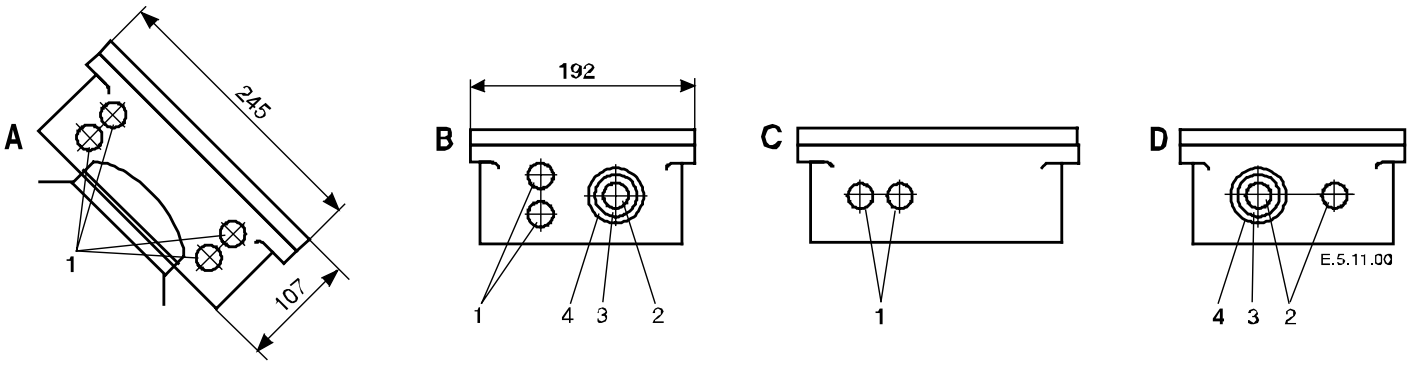
Fig.44 **DK. DL & D2S** **D3S, D4S, D6S/T, D8S, D9R/T**

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

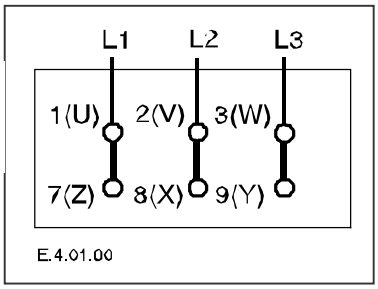


Principal Wiring Diagrams

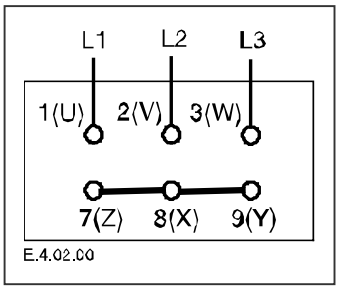
1. Jumper Position Compressor Motor

Star-Delta-Motor Y - Δ Code E

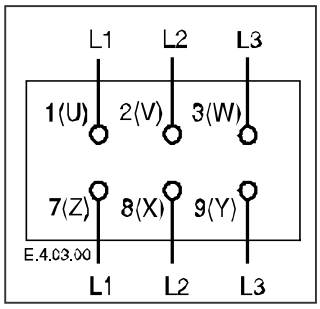
Direct-On-Line Start Δ



Direct-On-Line Start Y

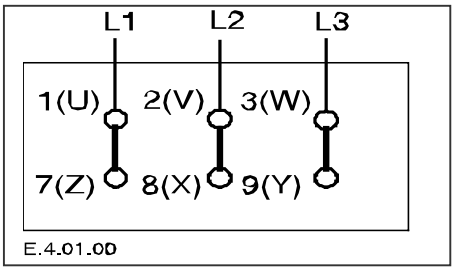


Star-Delta-Start Y - Δ

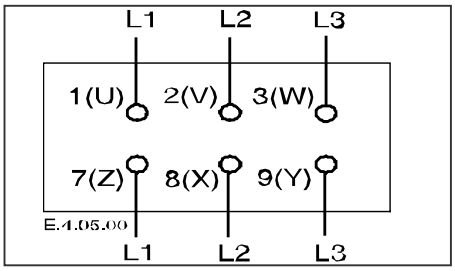


Part-Winding motor: Y – Y Code A

Direct-On-Line Start Y - Y

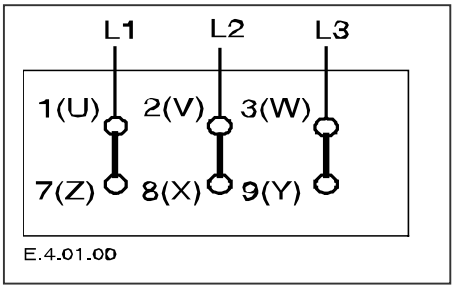


Part-Winding Start, first Start Step 1–2-3 Y - Y

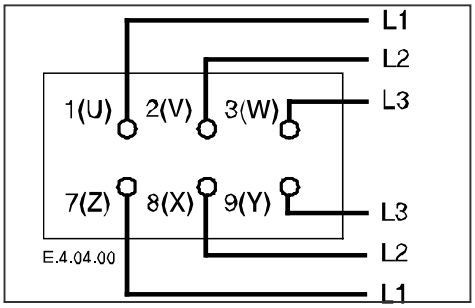


Part-Winding motor: Δ - Δ Code B

Direct-On-Line Start Δ - Δ



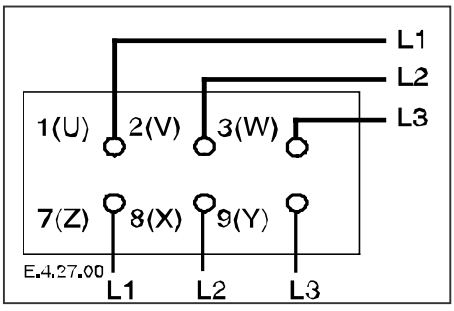
Direct-On-Line Start Δ - Δ



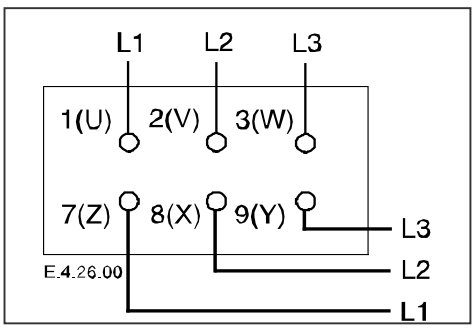
D8SH*-5000 BWC, D8SJ*-6000 BWC

Part-Winding motor: Δ - Δ Code B

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

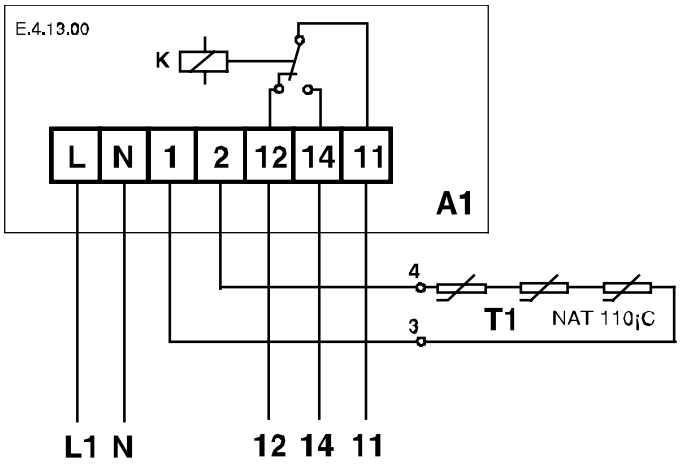


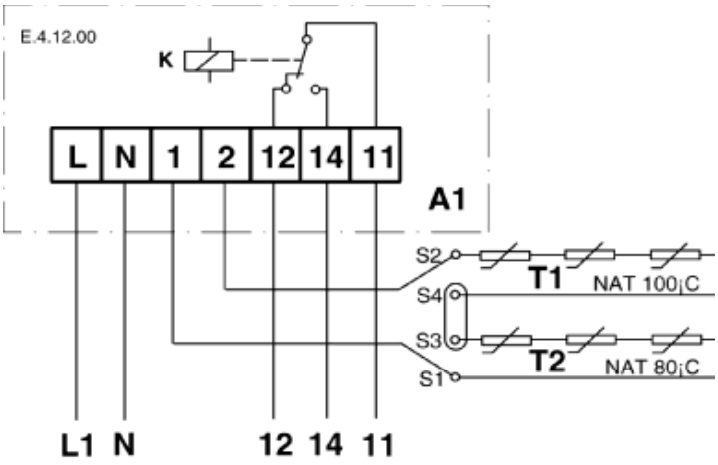
Part-Winding Start, Starting Wiring via Terminals 7-8-9



2. Release Module INT69 and INT69 TM

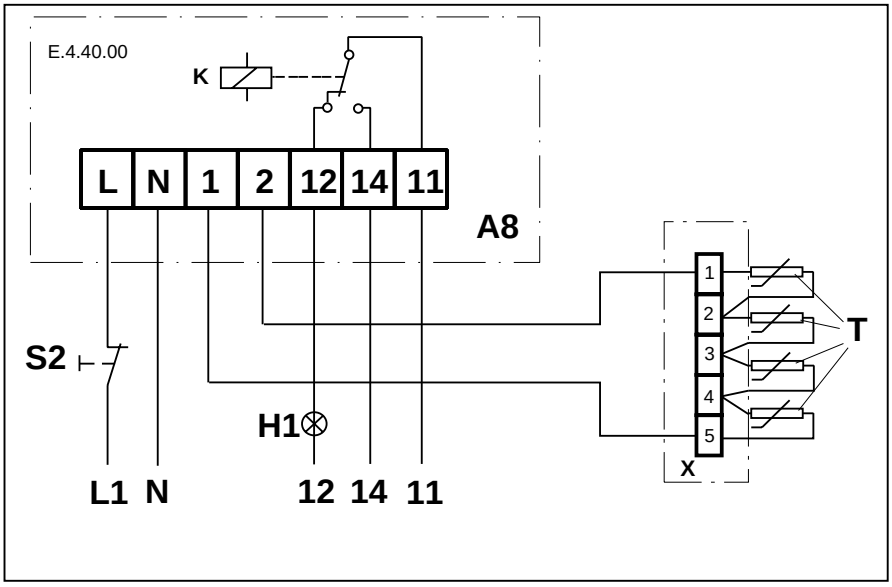
INT 69 (DK, DL, D2S, D3S & D9R/T) **INT 69 TM (D4S, D6S/T, D8S)**





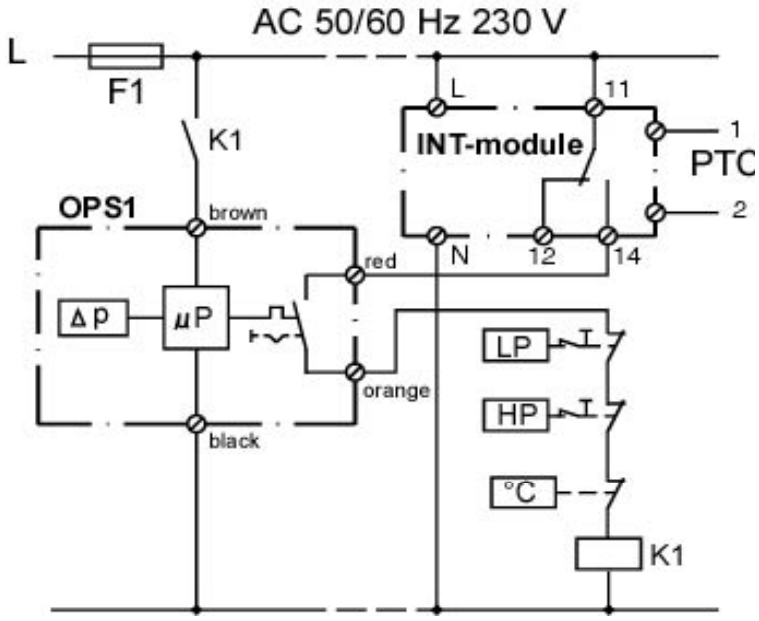
L Voltage connection
N Neutral connection
1+2 Thermistor chain connection
12 Alarm connection
14 Control circuit
11 Control Voltage connection
3+4 Cable bushings of thermistor connections in terminal box D9, (for DK, DL not marked)
S1-S4 Cable bushings of thermistor connections in terminal box D4S - D8S
T1+T2 Thermistor chain (about 90Ω - 750Ω per chain at +20°C)
A1 Release module
NAT Nominal response temperature
Protection Class IP 20

3. Discharge Temperature Protection

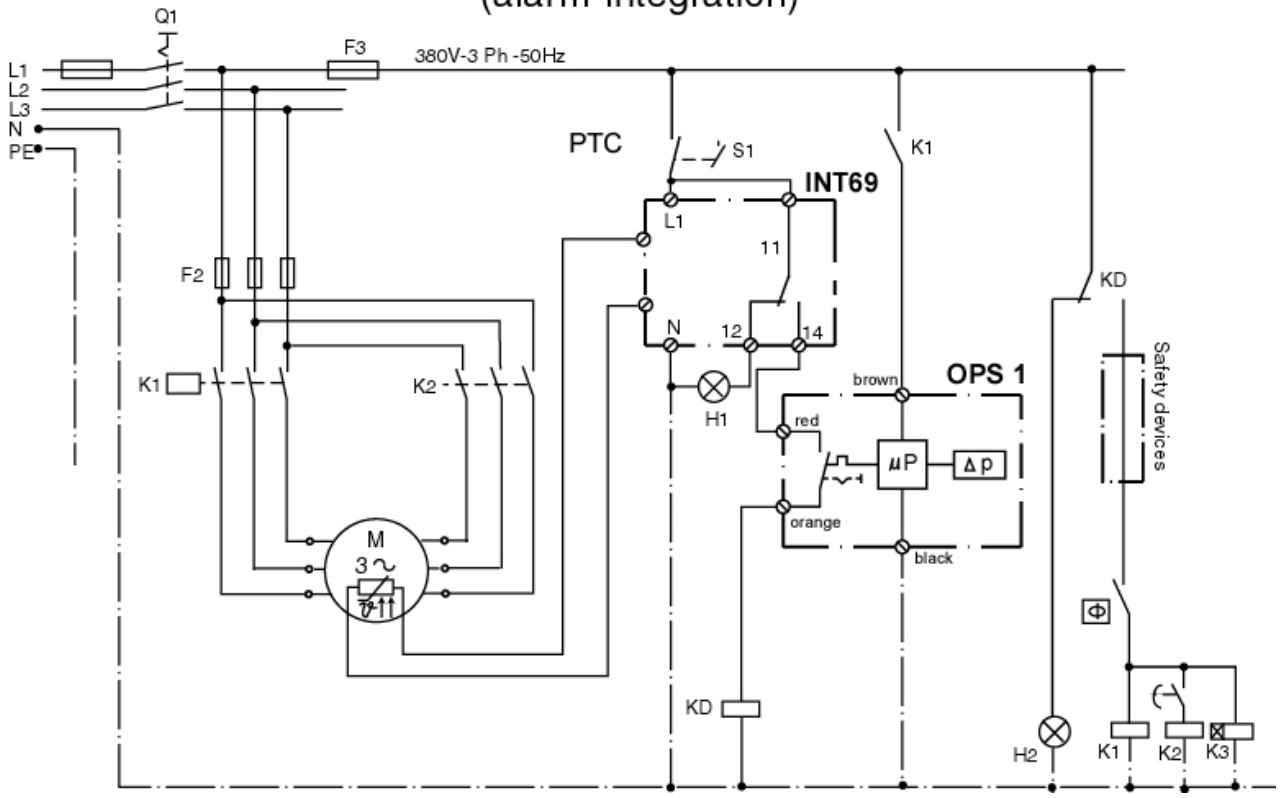


L Voltage connection
N Neutral connection
1 + 2 Sensor connection
12 Alarm connection
14 Control circuit
11 Control voltage connection
S2 Reset button
H1 Signal lamp “fault”
T PTC sensor (resistance of one thermistor at 20°C is about 30 and 250 Ohms; measuring voltage 3 V max.)
X Additional terminal box (see page 60)
A8 Release module for discharge temperature protection
Protection class IP 55

4. Oil Pressure Switch 1 (OPS1)

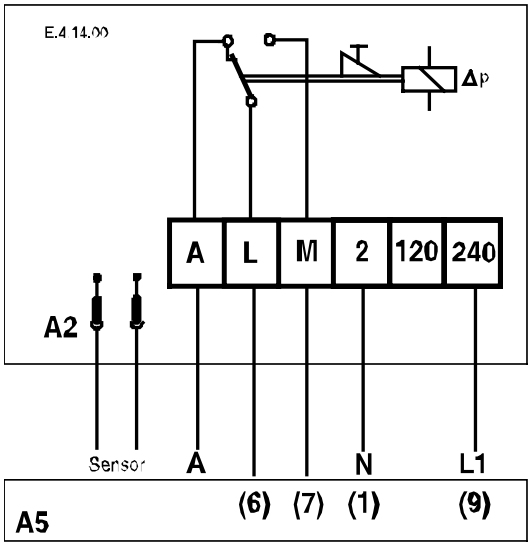


Wiring diagram OPS 1 with aux. relay KD
(alarm-integration)

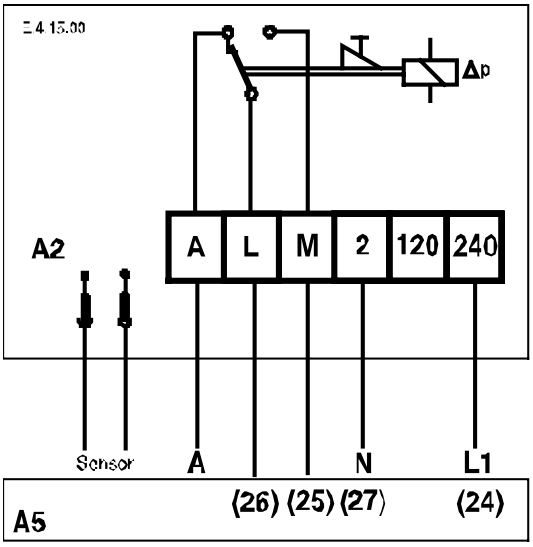


5. SENTRONIC Oil Pressure Control

D2S, D3S & D9R/T



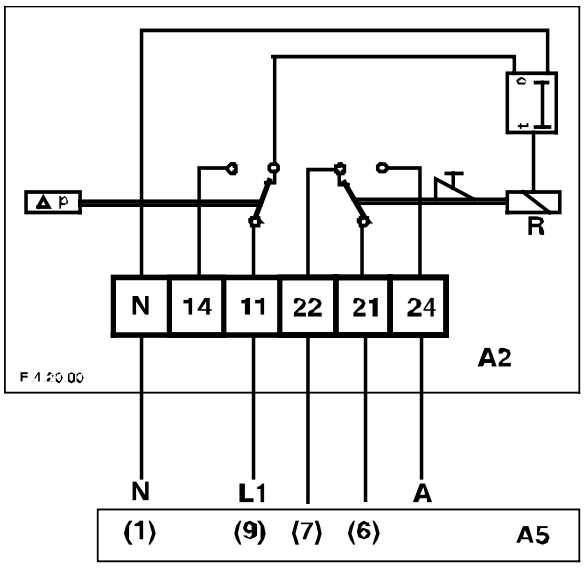
D4S, D6S/T, D8S



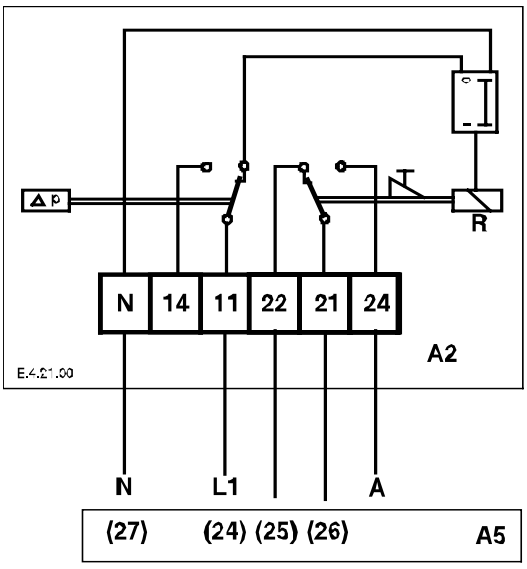
A alarm connection
L control voltage connection
M control circuit
2 neutral connection
L1 voltage connection
A2 oil pressure switch
A5 compressor terminal box
Protection class IP 31

6. Oil Pressure Switch - ALCO FD 113 ZU (A22 - 057)

DLH, D2S, D3S & D9R/T



D4S, D6S/T, D8S



N neutral connection
11 voltage connection
21 control voltage connection
22 control circuit
24 alarm connection
A2 oil pressure switch
A5 compressor terminal box
R relay
t time delay
Protection class IP 30

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 initial oil charge. The correct oil level is shown on page 9.
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 insufficient to return the oil to the compressor via the suction side, the result being 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 the gas velocity may not be high enough to return oil to the compressor.

d) Faulty or badly designed oil return system.

e) Incorrect pipework.

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 that 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. 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. Example: R22 with a crankcase pressure of 8.03 bar and temperature of 22°C, the crankcase would contain a mixture of 35% R22 and 65% oil by weight. 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 not 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 that 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.
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 Standard compressors should be addressed to your local Sales Office.