

DWM COPELAND

DK, DL and S-Series
Semi-Hermetic compressors

Application Guidelines



EMERSON
Climate Technologies

APPLICATION GUIDELINES: DWMCOPELAND SEMI-HERMETIC COMPRESSORS DK, DL, S

Application Guidelines: DWMCopeland Semi-Hermetic Compressors DK, DL, S	1
Important Information	4
1 Safety Information	4
2 General Information	4
2.1 Validity of this Manual	4
2.2 Delivery	4
2.3 Packaging	5
2.4 Transport	5
3 Design Features	6
3.1 Construction	6
3.2 Internal Pressure Relief Valve	7
3.3 Maximum Operating Pressures	7
3.4 Compressor cooling	7
3.5 Refrigeration Oils	8
3.6 Mounting Parts	8
3.7 Running Gear Lubrication	10
3.8 Air or Water-Cooled Compressors	10
3.9 DK & DL Compressor Oil Circulation	10
3.10 Suction gas-cooled Compressors	10
3.11 Oil Circulation	10
3.12 Oil Pressure Switch	11
3.13 Oil Level	11
3.14 Oil Pressure	11
3.15 Oil Separation & Management for Booster Applications	11
3.16 Start-up	12
3.17 Leak Test	12
3.18 Evacuation (Drying)	12
3.19 Charging with Refrigerant	12
3.20 System Cleanliness	12
4 Electrical Information	12
4.1 Electrical Connections	12
4.2 Single-Phase Motors - Code C	13
4.3 Three Phase Motors	13
4.4 Direct-on-Line Start Motors – Code T	13
4.5 Star-Delta Motor (Y/Δ) – Code E	13
4.6 Part-Winding Motor (YY/Y) - Code A	13
4.7 Part-Winding Motor (Δ/Δ) for the 8-cylinder motor-compressors - Code B	13
5 Motor Protection	14
5.1 Overcurrent Thermal Protection Switch for Single-Phase Motors, System A	14
5.2 Thermistor Protection, System W	14
6 Nameplates	14
7 Model Designation	16
7.1 Air or Water Cooled Compressors	16
7.2 Standard Compressors, Suction Gas-Cooled TWIN Compressor	17
8 Technical data on Accessories	18
9 Compressor Connections	20
9.1 DK	20
9.2 DL	20
9.3 DLH	21
9.4 D9R	21
9.5 D2S	22

9.6	D3S.....	22
9.7	D4S.....	23
9.8	D6S.....	23
9.9	D6SJ*.....	24
9.10	D6SK.....	25
9.11	D8S.....	26
9.12	D9T.....	27
9.13	D6T.....	28
9.14	D6TJ.....	29
9.15	Pressure gauge connections at shut-off valves.....	29
9.16	Tightening Torques.....	30
10	R22 Low Temperature Applications using D2SA–450/X Air & D2SC–550/X Air Compressors.....	31
11	Discharge Temperature Control Valve (DTC).....	31
12	Fan Installation.....	32
12.1	7 W Fan, Vertical, for Compressors DK.....	32
12.2	Additional Fan 25 W, Horizontal.....	32
12.3	Wiring Diagram 25 W Fan.....	33
12.3.1	Attention (25 W Fan).....	33
12.4	Additional Fan 75 Z, Vertical.....	34
12.5	Electrical Connection.....	34
12.6	Motor Protection (fan).....	34
12.7	Wiring Diagrams for Fan 75 Z.....	35
12.8	75 Z Fan Mounting.....	35
12.9	Bracket Tightening Torque & Dimensions.....	36
13	Unloaded Start.....	37
13.1	DLH, D2S, D3S & D9R.....	37
13.1.1	DLH, D2S Retrofit Kit (Mounting position see Fig. 25).....	37
13.1.2	D9R Retrofit Kit (Mounting position see Fig. 26).....	37
13.1.3	D3S Retrofit Kit (Mounting position see Fig. 27).....	38
13.2	D4S – D8S.....	38
13.2.1	Mounting Position of the Non-Return Valve.....	39
13.2.2	Non-Return Valve.....	39
13.2.3	Retrofit Kit for D4S – D8S.....	39
14	Capacity Control.....	41
14.1	Capacity Control D9R.....	41
14.2	Capacity Control D4S, D6S & D8S.....	41
14.2.1	Inactive Capacity Control.....	42
14.2.2	Normal Operation (Full load).....	42
14.2.3	Capacity Controlled Operation (Part load).....	42
14.3	Selection of Capacity Control D4S – D8S, R22.....	43
14.4	Application Range D4S – D8S, R22.....	43
14.4.1	D4SA / H / J & D6SA / H / J.....	43
14.4.2	D8SH / J.....	44
14.4.3	D8SK – 7000.....	44
14.5	Selection of Capacity Control D4S – D8S, R407C mid point.....	45
14.6	Application Range D4S – D8S, R407C mid point.....	45
14.6.1	D4SA / H / J & D6SA / H / J.....	45
14.6.2	D8SH / J.....	46
14.6.3	D8SK-700X.....	46
14.7	Selection of Capacity Control D4S – D8S, R404A.....	47
14.8	Application Range D4S – D8S, R404A.....	47
14.8.1	D4SF / L / T & D6SF / L / T / U.....	47
14.8.2	D4SA / H / J & D6SA / H / J & D8SH / J.....	48
15	TWIN Compressors D44S – D88S.....	49
15.1	New Suction Chamber.....	50
16	Crankcase Heater.....	50
16.1	27 Watt Heater Element for DK.....	51

16.2	70 Watt and 100 Watt Heater Element.....	51
16.3	200 Watt Heater Element	51
17	Oil Pump	51
17.1	DLH, D2S, D3S, D4S, D6S/T, D8S & D9R/T Compressors	51
17.2	Adapter	53
17.3	Oil Pump Gasket.....	53
18	OPS1 Oil Differential Pressure Switch.....	54
18.1	Application:	54
18.2	Functional description:.....	54
19	New SENTRONIC ^{+TM} Oil Pressure Safety System.....	55
19.1	Technical Data	55
19.2	Operation	55
19.3	Mounting	56
19.4	Electrical Connection	56
19.5	Operation Test	56
19.6	Interchangeability of Sentronic TM & Sentronic ^{+TM} Modules & Sensors	57
19.6.1	Connecting the Sentronic ^{+TM} module to an old Sentronic TM sensor.....	57
19.6.2	Connecting the old Sentronic TM module to a new Sentronic ^{+TM} sensor.....	58
20	Oil-Pressure Differential Switch	59
21	Discharge Temperature Protection	60
21.1	Mounting Position for Sensors.....	61
21.2	Release Module INT 69 V (re-set lock)	61
21.3	Functional Commissioning Checks	62
22	Electrical Installation	62
23	Principal Wiring Diagrams.....	64
23.1	Jumper Position Compressor Motor	64
23.2	Release Module INT69 and INT69 TM	65
23.3	Discharge Temperature Protection.....	65
23.4	Oil Pressure Switch 1 (OPS1)	66
23.5	SETRONIC Oil Pressure Control	67
23.6	Oil Pressure Switch - ALCO FD 113 ZU (A22 - 057).....	67
24	Causes of Failure	68
24.1	Lubrication Problems	68
24.2	Oil Dilution.....	68
24.3	Refrigerant Migration	68
24.4	Inadequate Suction Superheat	68
24.5	Acid Formation.....	69
24.6	Inadequate Compressor Cooling	69
24.7	High Discharge Temperatures.....	69
24.8	Motor Burn-out due to Undersize Contactors	69
24.9	Motor Burn-out due to By-passed or Disconnected Protectors.....	69
25	Technical Application Questions.....	69

IMPORTANT INFORMATION

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

1 Safety Information

Only qualified personnel should install and repair COPELAND compressors.

- Refrigerant compressors must be employed only for the use they are made for.
- Approved refrigerants and refrigeration oils only must be used.
- Do not start the compressor until it is charged with refrigerant.
- Correctly used, the compressor and the pressure line piping may reach temperatures that may cause burning if touched.

- When working on an open system wear safety goggles.
- If the refrigerant needs to be removed from the system, do not disperse it into the environment use the correct reclaim equipment & method.
- For storage, use original packaging and avoid collisions and tilting.

- Trained electrical personnel must connect the unit and its accessories.
- 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.

- It is not allowed to run a test without the compressor being connected to a system and without refrigerant. It is of vital importance that the discharge stop valve has been fully opened before the compressor is started. If the discharge stop valve is closed or partly closed an unacceptable pressure with accordingly high temperatures may develop in the cylinder head. When operating with air the so-called diesel effect may occur, i.e. the air sucked in is mixed with oil gas and can explode due to the high temperature in the cylinder head, and thereby destroy the compressor.

The compressor is part of a system that is under pressure, and is therefore subject to the local safety regulations, (EN 378). The maximum operating pressures stamped on the name-plate are compulsory, and must never be exceeded (see page 7).

2 General Information

2.1 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.

2.2 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)

2.3 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!

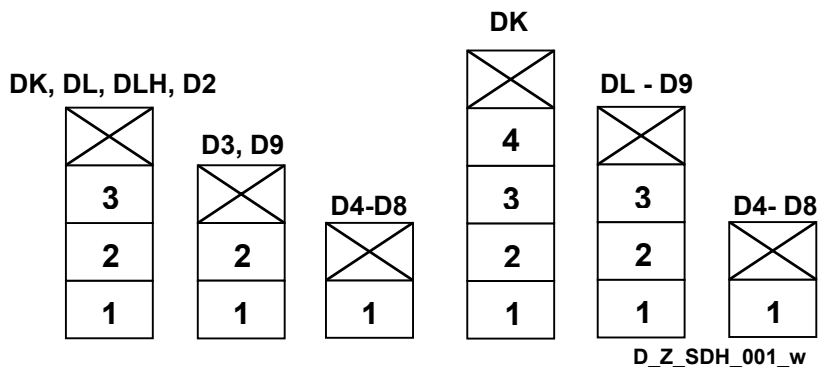


Fig. 1 + 2

2.4 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.

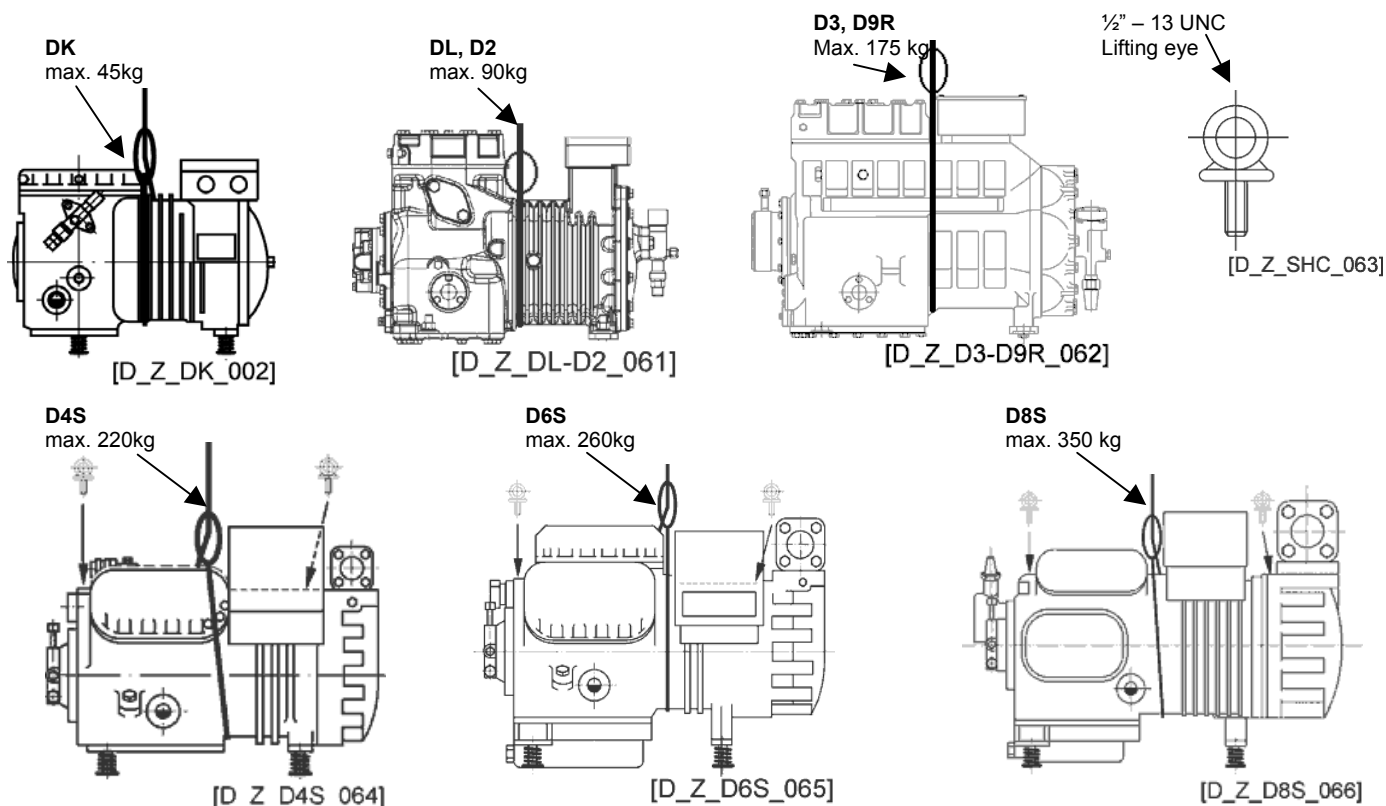
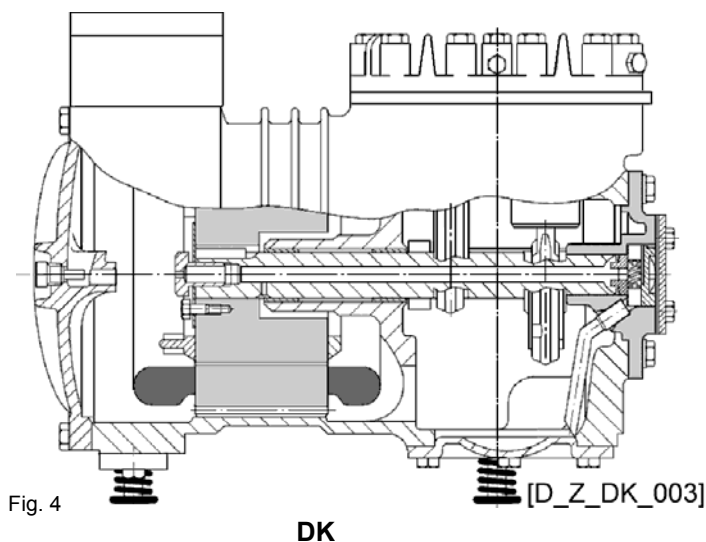


Fig.3

3 Design Features

3.1 Construction

All DK, DL & S series compressors are fitted with “Reed” valve plates. Basic construction features of the DK can be seen in figure 4 below.



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 m³/hr and 22,5m³/hr. Model DLH*, is air-cooled with a displacement of 26,6 m³/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 m³/hr and 210 m³/hr
- Refrigerant-cooled two-stage compressors with 3 cylinders, a displacement of 21,6 m³/hr (D9TK) and 6 cylinders 84, 7m³/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.

3.2 Internal Pressure Relief Valve

Single-stage compressors (50Hz) with a displacement > 50m³/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.

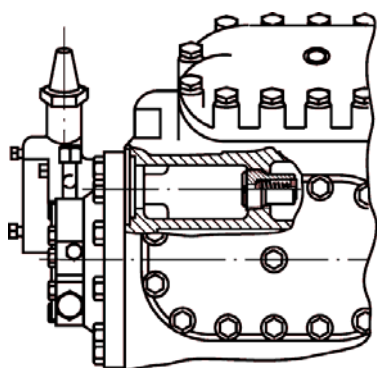


Fig.5 [D_Z_DK-DL-S_004_hr]

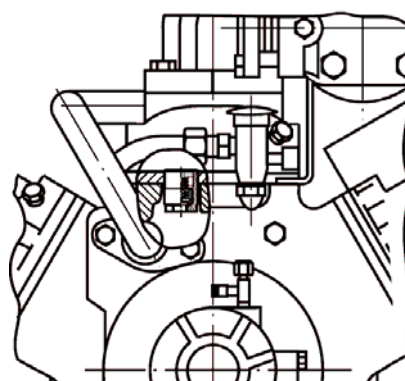


Fig.6 [D_Z_DK-DL-S_005]

3.3 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

3.4 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 m³/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.

3.5 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.

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

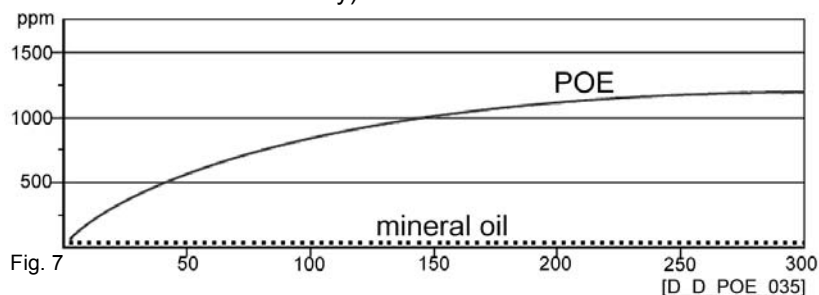
All compressors using ester oil are marked with an "X" in the motor code. Brand-new "X" compressors can also operate using R22.

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 absorbion in PPM at 25°C and 50% relative humidity).



3.6 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 absorption, additional vibration absorbers (available on the market) can be fitted between the rails and the foundation.

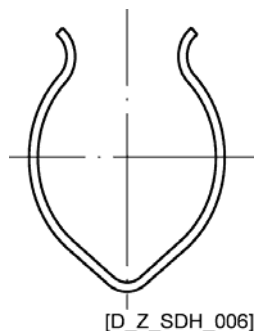
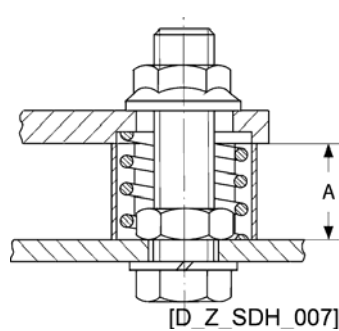
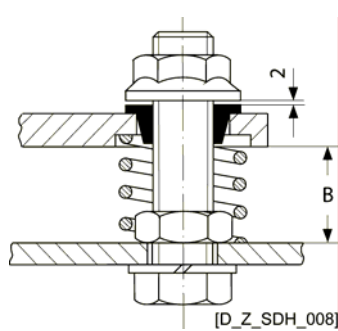


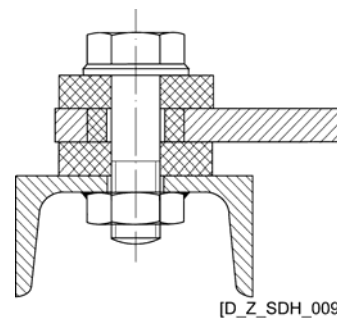
Fig.8



Transport position



Operational position



Grommets for TWIN compressors

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	D9RC - 1000	/ - ---	30	35	2 x maroon	2 x white
DKM - 75	/ - 7X	22	25			D9RS - 1000	/ - ---	30	35		
DKM - 100	/ - 10X	22	25			D3SS - 1000	/ - 100X	30	35		
DKJ - 75	/ - 7X	22	25			D3SS - 1500	/ - 150X	30	35	2 x yellow	2 x green
DKJ - 100	/ - 10X	22	25			D9RS - 1500	/ - ---	34	44		
DKSJ - 100	/ - 10X	22	25	D4SA - 1000	/ - 100X	34	44				
DKJ - 150	/ - 15X	22	25	2 x maroon	2 x green	D4SF - 1000	/ - ---	34	44		
DKSJ - 150	/ - 15X	22	25			D4SL - 1500	/ - ---	34	44		
DKL - 150	/ - 15X	22	25			D4SA - 2000	/ - 200X	34	44		
DKL - ---	/ - 20X	22	25			D4SH - 1500	/ - 150X	34	44		
DKSL - 150	/ - 15X	22	25			D4ST - 2000	/ - 200X	34	44	2 x black	
DKSL - 200	/ - 20X	22	25	D4SH - 2500	/ - 250X	34	44				
DLE - 201	/ - 20X	30	35	2 x blue	2 x blue	D6TA - 1500	/ - 150X	34	44		
DLF - 201	/ - 20X	30	35			D6TH - 2000	/ - 200X	34	44		
DLF - 301	/ - 30X	30	35			D6SF - 2000	/ - ---	34	44		
DLJ - 201	/ - 20X	30	35			D6SA - 3000	/ - ---	34	44		
DLJ - 301	/ - 30X	30	35			D4SJ - 2000	/ - 200X	34	44		
DLL - 301	/ - 30X	30	35	2 x maroon	2 x maroon	D4SJ - 3000	/ - 300X	34	44	2 x blue	
DLL - 401	/ - 40X	30	44			D6SH - 2000	/ - 200X	34	44		
DLSG - 401	/ - 40X	30	44			D6SL - 2500	/ - ---	34	44		
DLHA - 500	/ - 50X	30	44			D6SH - 3500	/ - 350X	34	44		
D2SA - 450	/ - 45X	30	44			D6TJ - 2500	/ - 250X	34	44		
D2SA - 550	/ - 55X	30	44			D6SJ - 3000	/ - 300X	48	44	2 x brown	2 x black
D2SC - 550	/ - 55X	30	44			D6SJ - 4000	/ - 400X	48	44		
D2SC - 650	/ - 65X	30	44			D6ST - 3000	/ - ---	48	44		
D2SK - 650	/ - 65X	30	44			D6SU - 4000	/ - 400X	48	44		
D3SA - 750	/ - 75X	30	44			D6SK - ---	/ - 400X	48	51	2 x silver	2 x brown
D3SC - 750	/ - 75X	30	35			D6SK - 5000	/ 500X	48	51		
D3SC - 1000	/ - 100X	30	35			D8SH - 3700	/ - 370X	48	51		
D9RA - 500L	/ - ---	30	35			D8SH - ---	/ - 400X	48	51		
D9RA - 750	/ - ---	30	35			D8SJ - 4500	/ - 450X	48	51		2 x black
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		
D9TH - 1010	/ - ---	34	38	2 x white	D8SK - 7000	/ - 700X	48	51			

D_T_SHC_016

Note:

As an option the D6SK-500X & D6SK-5000 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 the table above are to fit to 8-cylinder footprint which is standard with this compressor.

As an option the D6SK-400X, D6SU-400X & D6SU-4000 can be ordered with 2 x silver mounting springs (motor end) and 2 x brown mounting springs (cylinder end) to fit a 8-cylinder footprint. The mounting springs shown in the table above are to fit to 6-cylinder footprint which is standard with these compressors.

3.7 Running Gear Lubrication

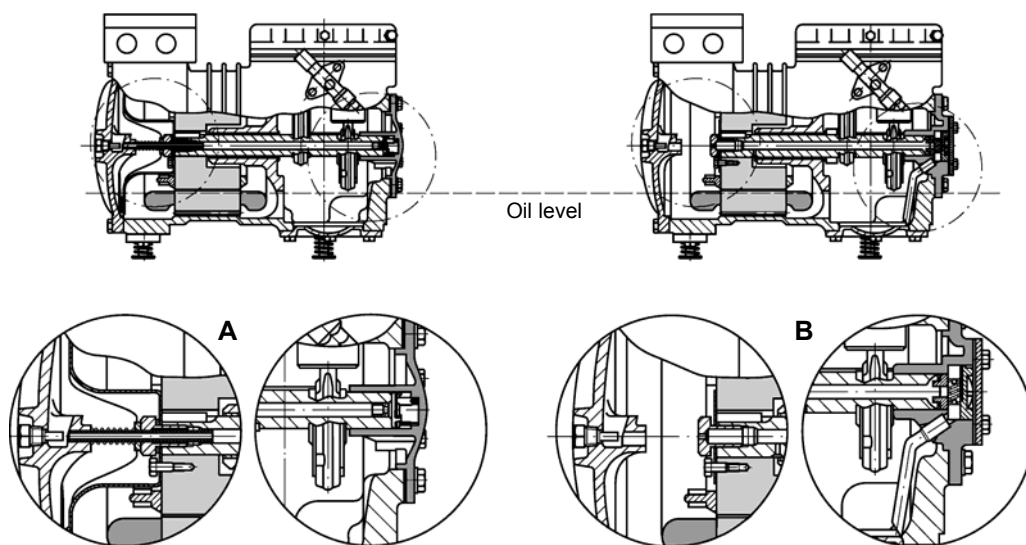


Fig 9

[D_Z_SDH_010]

3.8 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.

3.9 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.

3.10 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 52 & 53.

3.11 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.

3.12 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.

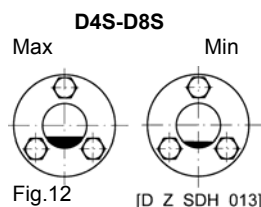
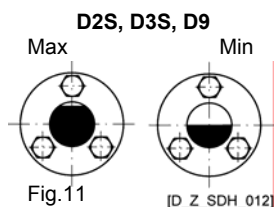
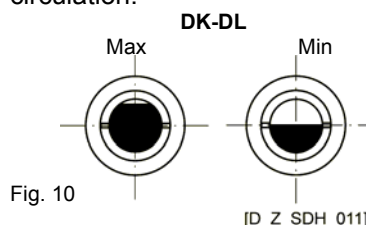
Note: The low pressure oil pump of air or water-cooled compressors has no connection for an oil pressure switch. The following oil pressure switches are approved:

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

D_T_SHC_017

3.13 Oil Level

All compressors are delivered with sufficient oil for normal operation (see table on page 18). 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.



3.14 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.

3.15 Oil Separation & Management for Booster Applications

In direct-stage refrigeration systems oil carried over from each compressor may accumulate in one of the compressors in series resulting in a lack of lubrication for the others. To ensure each compressor has the correct amount of oil returned, Copeland recommends the use of a highly efficient cyclone or coalescent type oil separator with an oil management system. The oil separator shall be installed in the discharge line of the high stage compressor, it will separate the oil from the discharge gas and pass it to an oil reservoir. The oil will then pass from the oil reservoir through the oil management system to each individual compressor ensuring full lubrication and extended compressor life & reliability.

3.16 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 30.

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:

3.17 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.

3.18 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.

3.19 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.

3.20 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.

4 Electrical Information

4.1 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.

4.2 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.

4.3 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 64.

4.4 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.

4.5 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!).

4.6 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.

4.7 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.

5 Motor Protection

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

5.1 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!

5.2 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 65).

The maximum test voltage for thermistors is 3 V.

The resistance of each thermistor chain on a cold compressor should be $\leq 750 \Omega$.

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

D_T_SHC_018

6 Nameplates

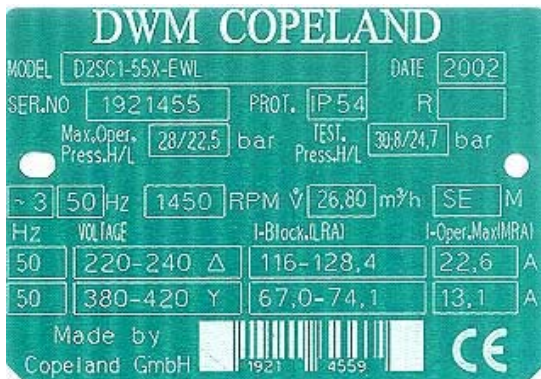


Fig 13a DK, DL, D2 & D9

[D_P_NP_007]

DWM COPELAND



Fig 13b D4S, D6S/T, D8S

[D_P_NP_006]



Fig 13c

D3S

[D_P_NP_004]

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:

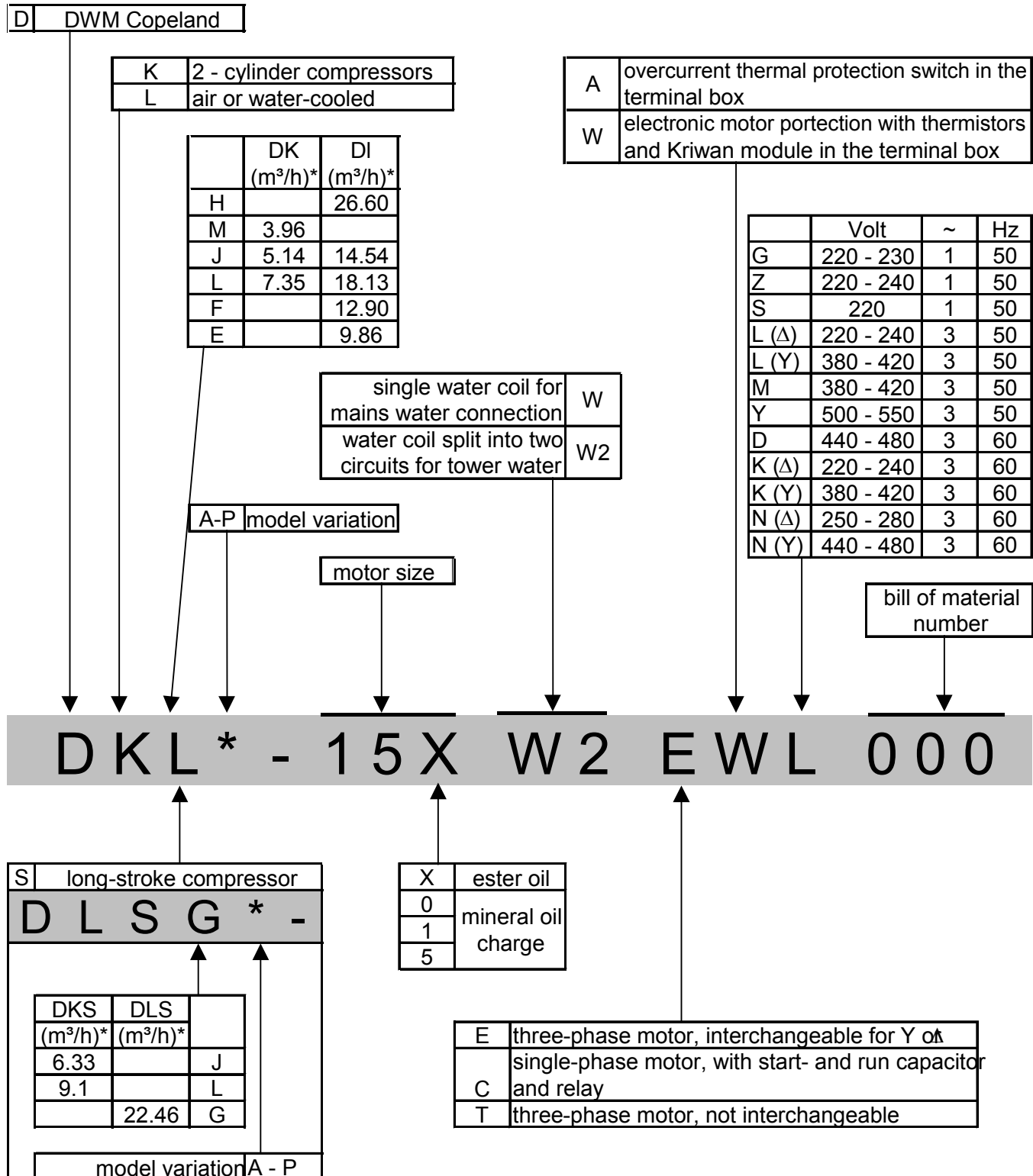
With DK, DL, D9 the year of production

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.

7 Model Designation

7.1 Air or Water Cooled Compressors



* displacement at 1450 min⁻¹, 50 Hz

D_T_SHC_070

7.2 Standard Compressors, Suction Gas-Cooled TWIN Compressor

D	DWM Copeland
---	--------------

9	3-cylinder models, suction gas-cooled
2-8	2, 3, 4, 6 & 8 cylinder models, suction gas-cooled

R / S	reed valve
-------	------------

	D2S (m³/h)*	D3S (m³/h)*	D9R (m³/h)*	D4S (m³/h)*	D6S (m³/h)*	D8S (m³/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

1-9	model variation
-----	-----------------

motor size

W	electronic protection with thermistors and Kriwan module in the terminal box
---	--

	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

bill of material number

D 6 S J * - 4 0 0 X E W M 0 0 0

TWIN

TWIN

D 6 6 S J - 8 0 0 X E W M 0 0 0

T	two-stage compressors	
D 9 T H * -		
	D9T (m³/h)*	D6T (m³/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

X	ester oil charge
0 / OL ¹	mineral oil charge

A	three-phase motor for part-winding start winding split 2/3 - 1/3
B	three-phase motor for part-winding start current distribution 60% - 40%
E	three-phase motor, interchangeable for Y or Δ
T	three-phase motor, not interchangeable

* displacement at 1450 min⁻¹, 50 Hz

¹ OL = low temperature valve plate

D_T_SHC_071

8 Technical data on Accessories

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							I			
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 - 150 / - 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"	
D2SA - 550 / - 55X	-	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"	
D2SC - 650 / - 65X	-	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"	
D3SA - 750 / - 75X	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3,7	Ø 1 3/8"	Ø 1 1/8"	
D3SC - 750 / - 75X	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3,7	Ø 1 3/8"	Ø 1 1/8"	
D3SC - 1000 / - 100X	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3,7	Ø 1 3/8"	Ø 1 1/8"	

D_T_SHC_019

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							I		
D3SS - 1000 / - 100X	-	EVR 20	-	NRV 28S Ø 28	70	-	-	3,7	Ø 1 3/8"	Ø 1 1/8"
D3SS - 1500 / - 150X	-	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"
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 ²	200	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"
D6SU - 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 - --- / - 400X	33% + 66%	-	705 RA 001	NRV 35S Ø 42	-	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"

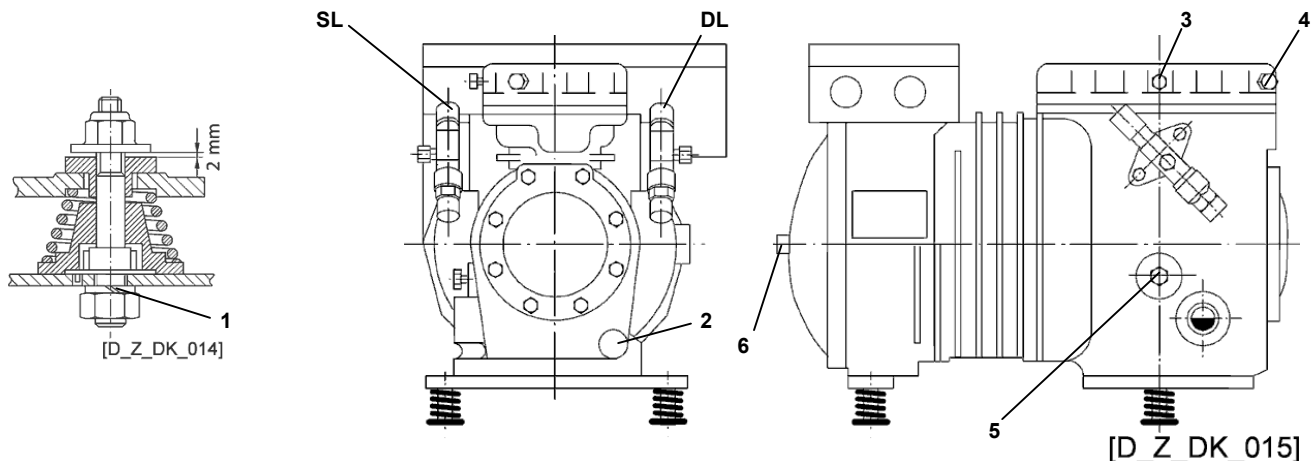
¹ for TWIN-compressors and in parallel compressor operation with enforced spring (Type NRVH ...)

² possible as an addition, minimum is 200 W

9 Compressor Connections

9.1 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	

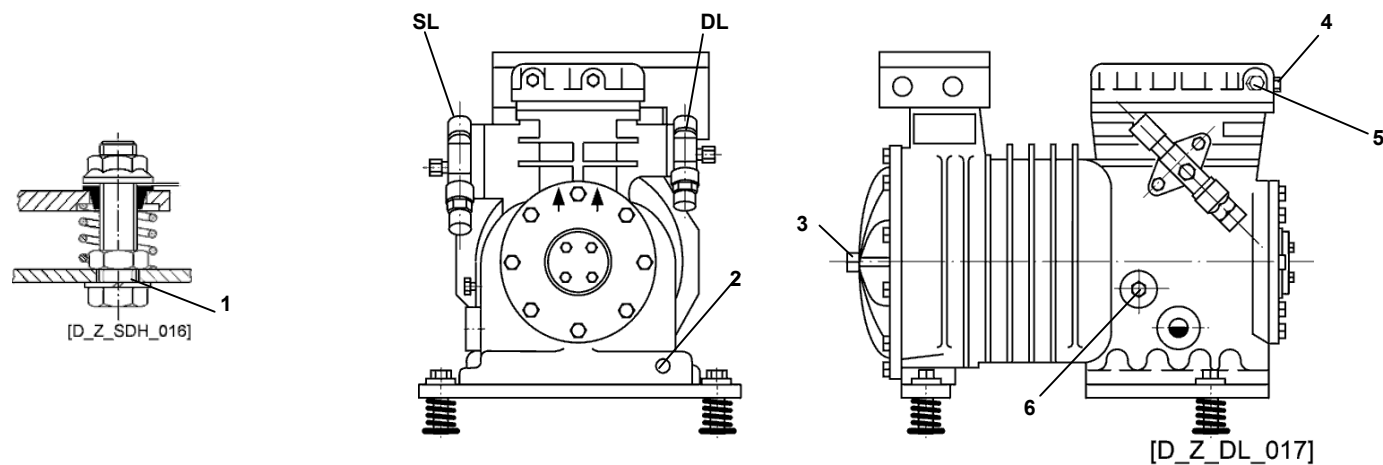


SL	Suction line (sweat)	See Table D_T_A_016	3	Plug low-pressure connection	1/8" - 27	NPTF
DL	Discharge line (sweat)		4	Plug high-pressure connection	1/8" - 27	NPTF
1	Base mountings	Ø - 11 mm	5	Plug oil charge	1/8" - 27	NPTF
2	Pocket for heater with protection plug	M 25 x 1,5	6	Magnetic plug	1/8" - 27	NPTF

D_T_DK_002

9.2 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		

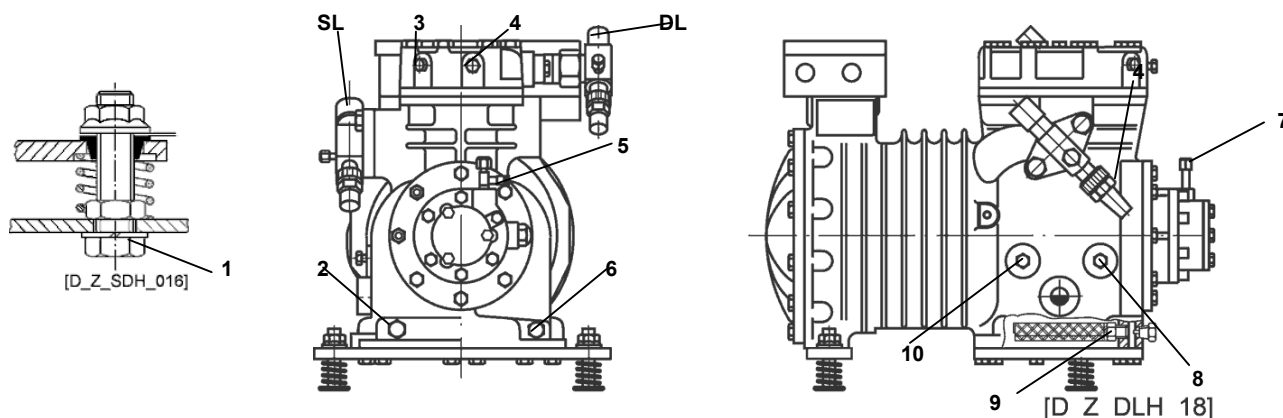


SL	Suction line (sweat)	See Table D_T_A_016	3	Magnetic plug	1/8" - 27	NPTF
DL	Discharge line (sweat)		4	Plug high-pressure connection	1/8" - 27	NPTF
1	Base mountings	Ø - 14 mm	5	Plug low-pressure connection	1/8" - 27	NPTF
2	Pocket for heater with protection plug	3/8" - 18 NPSL	6	Plug oil charge	1/4" - 18	NPTF

D_T_DL_004

9.3 DLH

DLHA – 500 DLHA – 50X

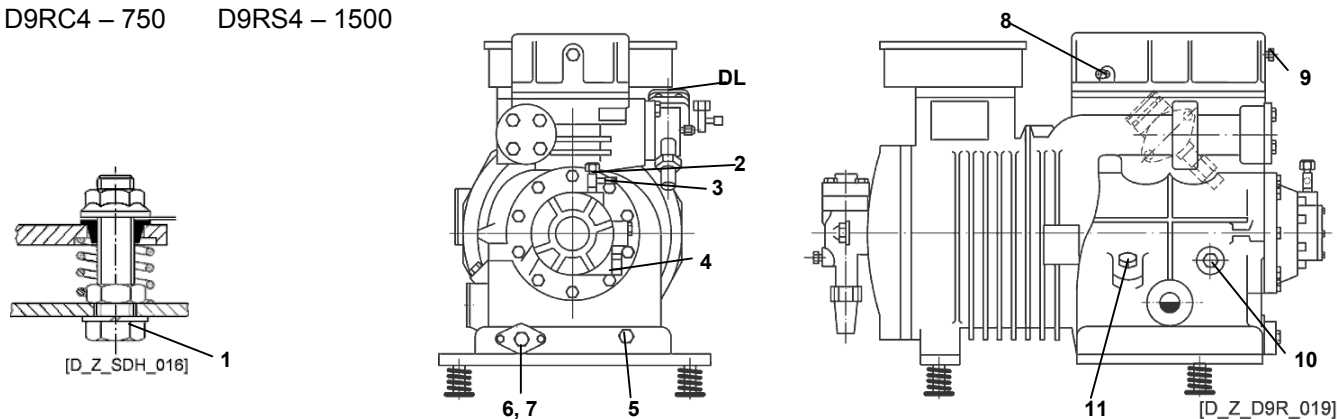


SL	Suction line (sweat)	See Table D_T_A_016	5	Oil pressure connection	$\frac{1}{4}$ " - 6 mm Schrader
DL	Discharge line (sweat)		6	Pocket for heater with protection plug	$\frac{3}{8}$ " - 18 NPSL
1	Base mountings	$\varnothing$ - 12 mm	7	Connection oil pressure control H.P.	$\frac{1}{4}$ " i Ö 6 mm
2	Magnetic plug	$\frac{3}{8}$ " - 18 NPTF	8	Plug oil pressure control L.P.	$\frac{1}{4}$ " - 18 NPTF
3	Plug low-pressure connection	$\frac{1}{8}$ " - 27 NPTF	9	Oil screen built-in	----
4	Plug high-pressure connection	$\frac{1}{8}$ " - 27 NPTF	10	Plug oil charge	$\frac{1}{4}$ " - 18 NPTF

D_T_DLH_005

9.4 D9R

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



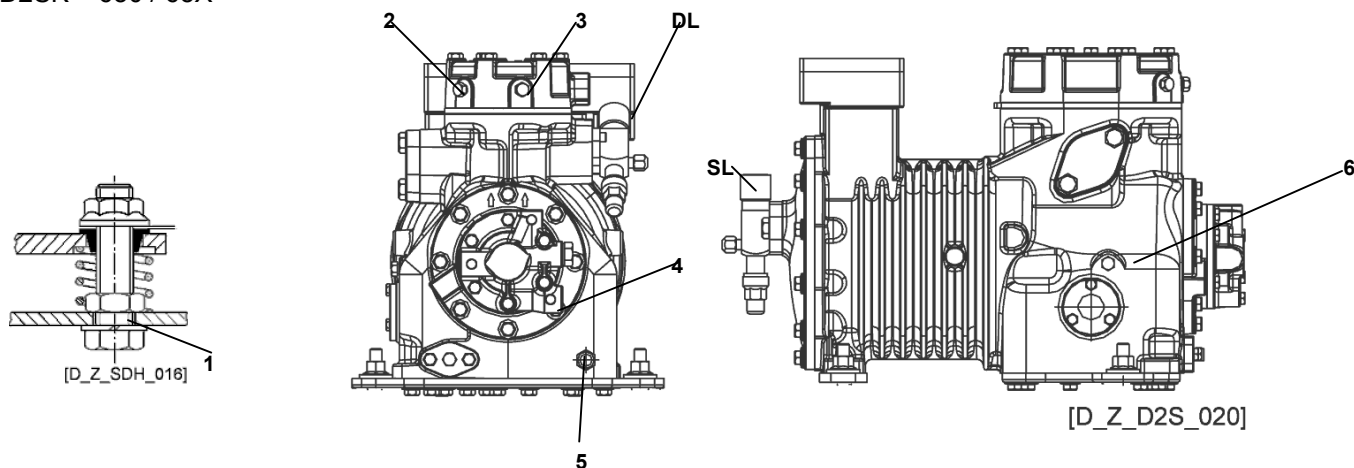
SL	Suction line (sweat)	See Table D_T_A_016	6	Oil screen built-in	
DL	Discharge line (sweat)		7	Magnetic plug	$\frac{1}{8}$ " - 27 NPTF
1	Base mountings	$\varnothing$ - 18 mm	8	Plug low-pressure connection	$\frac{1}{8}$ " - 27 NPTF
2	Connection oil pressure control H.P.	$\frac{1}{4}$ " i Ö 6 mm	9	Plug high-pressure connection	$\frac{1}{8}$ " - 27 NPTF
3	Oil-pressure connection	$\frac{1}{4}$ " - 6 mm Schrader	10	Plug oil pressure control L.P.	$\frac{1}{4}$ " - 18 NPTF
4	Sensor connection OPS1		11	Plug oil charge	$\frac{1}{4}$ " - 18 NPTF
5	Sleeve (crankcase heater)	$\frac{3}{8}$ " - 18 NPSL			

D_T_D9R_006

9.5 D2S

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

D2SA – 550 / 55X
D2SC – 650 / 65X



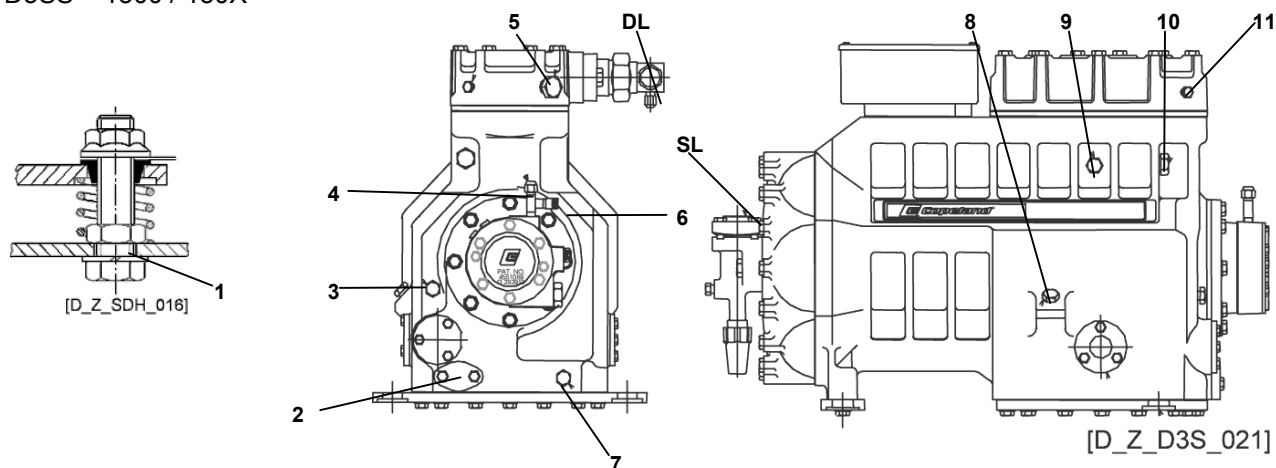
SL	Suction line (sweat)	See Table D_T_A_016	3	Plug high-pressure connection	1/8" - 27	NPTF
DL	Discharge line (sweat)		4	Sensor connection OPS1		
1	Base mountings	Ø - 14 mm	5	Pocket for heater with protection plug	3/8" - 18	NPSL
2	Plug low-pressure connection	1/8" - 27 NPTF	6	Plug oil charge	1/4" - 18	NPTF

D_T_D2S_007

9.6 D3S

D3SA – 750 / 75X
D3SC – 750 / 75X
D3SS – 1500 / 150X

D3SC – 1000 / 100X
D3SS – 1000 / 100X

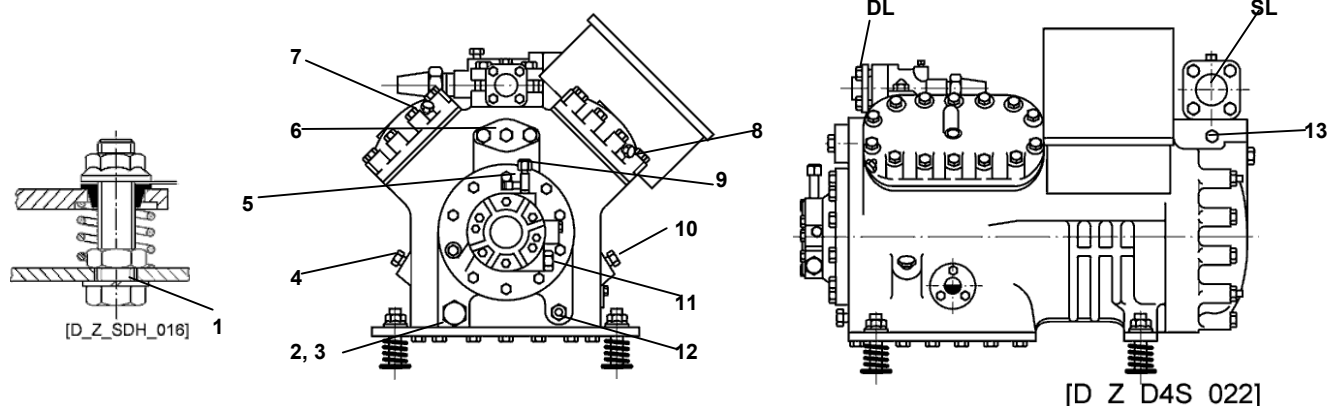


SL	Suction line (sweat)	See Table D_T_A_016	6	Oil pressure connection	7/16" -	UNF
DL	Discharge line (sweat)		7	Sleeve (crankcase heater)	3/8" - 18	NPSL
1	Base mountings	Ø - 18 mm	8	Plug oil charge	1/4" - 18	NPTF
2	Magnetic plug	1/8" - 27 NPTF	9	DTC valve plug connection	1/8" - 27	NPTF
3	Plug oil pressure control L.P.	1/4" - 18 NPTF	10	Plug low pressure connection	1/2" - 14	NPTF
4	Connection oil pressure control H.P.	1/4" i Ö 6 mm	11	Plug low-pressure connection	1/8" - 27	NPTF
5	Plug high pressure connection	----				

D_T_D3S_003

9.7 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

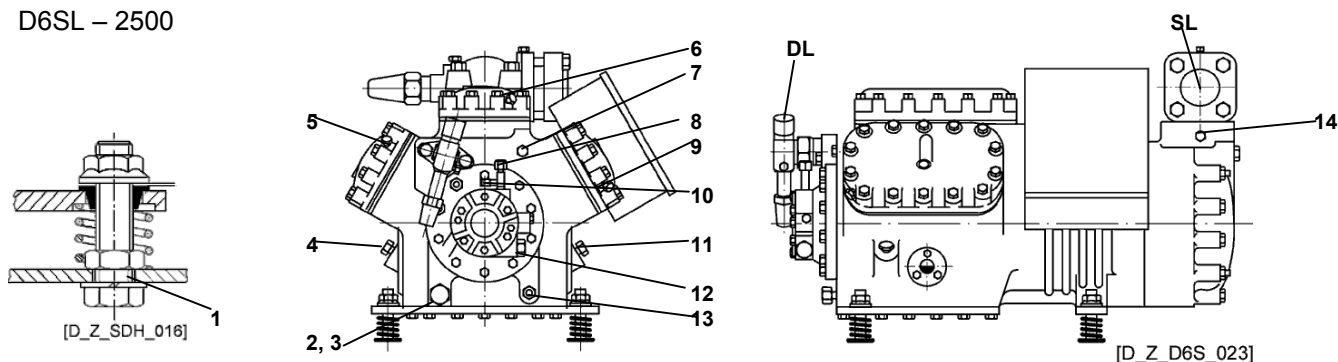


SL	Suction line (sweat)	See Table D_T_A_016	7	Plug high-pressure connection	1/8" - 27	NPTF
DL	Discharge line (sweat)		8	Plug high-pressure connection	1/8" - 27	NPTF
1	Base mountings	Ø - 18 mm	9	Connection oil-pressure control H.P.	1/4"	
2	Plug oil charge	1/4" - 18 NPTF	10	Plug oil-pressure control H.P.	1/4" - 18	NPTF
3	Magnetic plug	1" - 16 UN	11	Sensor Connection OPS1		
4	Plug oil charge	1/4" - 18 NPTF	12	Sleeve (crankcase heater)	1/2" - 14	NPSL
5	Oil-pressure connection	1/4" 6 mm Schraeder	13	Plug low-pressure connection	1/8" - 27	NPTF
6	plug high-pressure connection	1/8" - 27 NPTF				

D_T_D4S_008

9.8 D6S

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



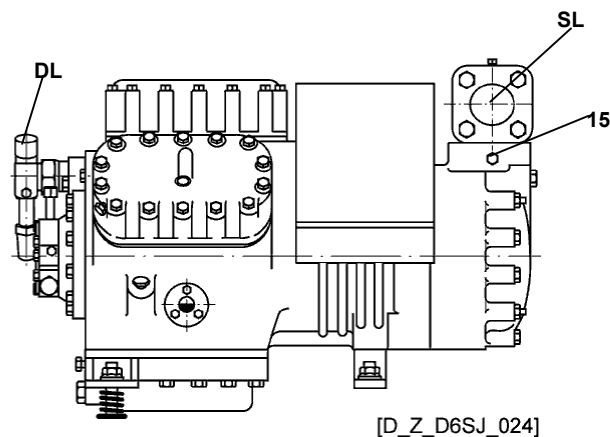
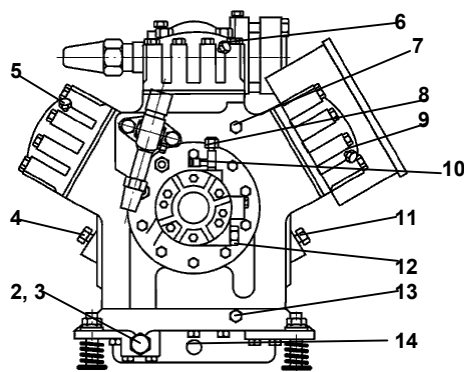
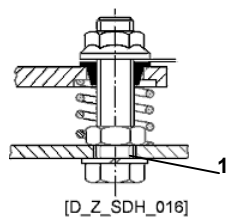
SL	Suction line (sweat)	See Table D_T_A_016	7	Plug high-pressure	1/4" - 18	NPTF
DL	Discharge line (sweat)		8	Connection oil-pressure control H.P.	1/4"	
1	Base mountings	Ø 18 mm	9	Plug high pressure	1/8" - 27	NPTF
2	Oil screen built-in	-	10	Oil-pressure	1/4" 6 mm Schraeder	
3	Magnetic plug	1" - 16 NPTF	11	Plug oil-pressure control	1/4" - 18	NPTF
4	Plug oil charge	1/4" - 18 NPTF	12	Sensor connection		
5	Plug high-pressure	1/8" - 27 NPTF	13	Sleeve (crankcase heater)	1/2" - 14	NPSL
6	Plug high-pressure	1/8" - 27 NPTF	14	Plug low-pressure	1/8" - 27	NPTF

D_T_D6S_009

9.9 D6SJ*

D6SJ – 3000 D6SJ - 300X

D6SJ – 4000 D6SJ – 400X

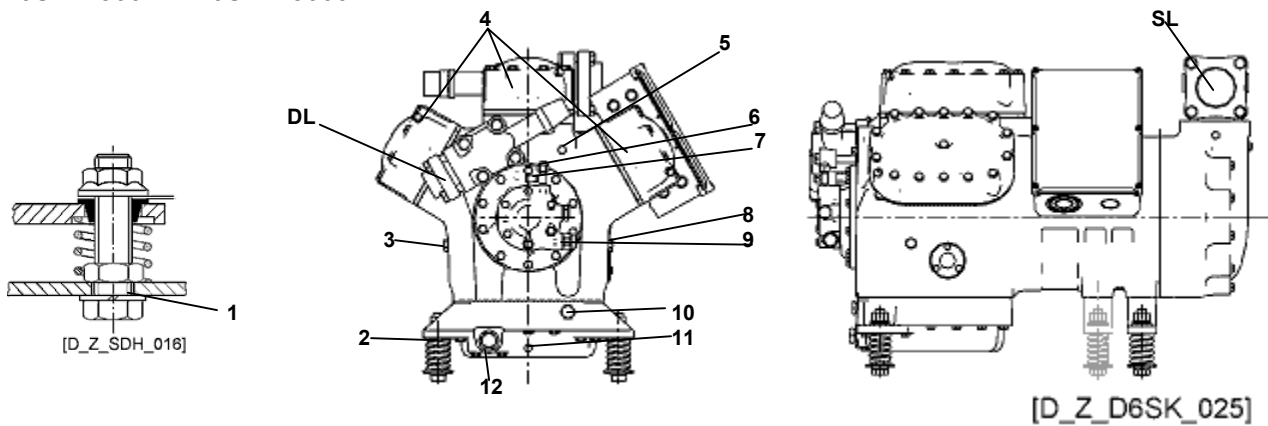


SL	Suction line (sweat)	Ø - 2 1/8"	8	Connection oil pressure control H.P.	1/4" i Ö 6 mm
DL	Discharge line (sweat)	Ø - 1 3/8"	9	Plug high pressure connection	1/8" - 27 NPTF
1	Base mountings	Ø - 18 mm	10	Oil pressure connection	1/4" i Ö 6 mm Schraeder
2	Oil screen built in		11	Plug oil pressure control L.P.	1/4" - 18 NPTF
3	Magnetic plug	1" - 16 NPTF	12	Sensor connection OPS1	
4	Plug oil charge	1/4" - 18 NPTF	13	Plug crankcase heater	1/2" - 14 NPTF
5	Plug high pressure connection	1/8" - 27 NPTF	14	Bore crankcase heater	Ø - 1/2"
6	Plug high pressure connection	1/8" - 27 NPTF	15	Plug low pressure connection	1/8" - 27 NPTF
7	Plug high pressure connection	1/4" - 18 NPTF			

D_T_D6SJ_010

9.10 D6SK

D6SU – 400X D6SU – 4000
D6SK – 400X
D6SK – 500X D6SK – 5000



SL	Suction line (sweat)	Ø - 2 1/8"	6	Connection oil pressure control H.P.	Ø 1/4" i Ö 6 mm
DL	Discharge line (sweat)	Ø - 1 3/8"	7	Oil pressure connection	7/16" - UNF Schraeder
1	Base mounting	Ø - 18 mm	8	Plug oil charge	1/4" - 18 NPTF
2	Magnetic plug	1" - 16 UN	9	Connection oil pressure control L.P.	1/4" - 18 NPTF
3	Plug oil charge	1/4" - 18 NPTF	10	Plug crankcase heater	1/2" - 14 NPTF
4	Plug high pressure connection	1/8" - 27 NPTF	11	Bore crankcase heater	Ø - 1/2"
5	Plug low pressure connection	1/8" - 27 NPTF	12	Oil screen built in	

D_T_D6SK_011

Note: The D6SK can be mounted to fit a 6-cylinder or 8-cylinder footprint. (See page 9- Mounting Parts)

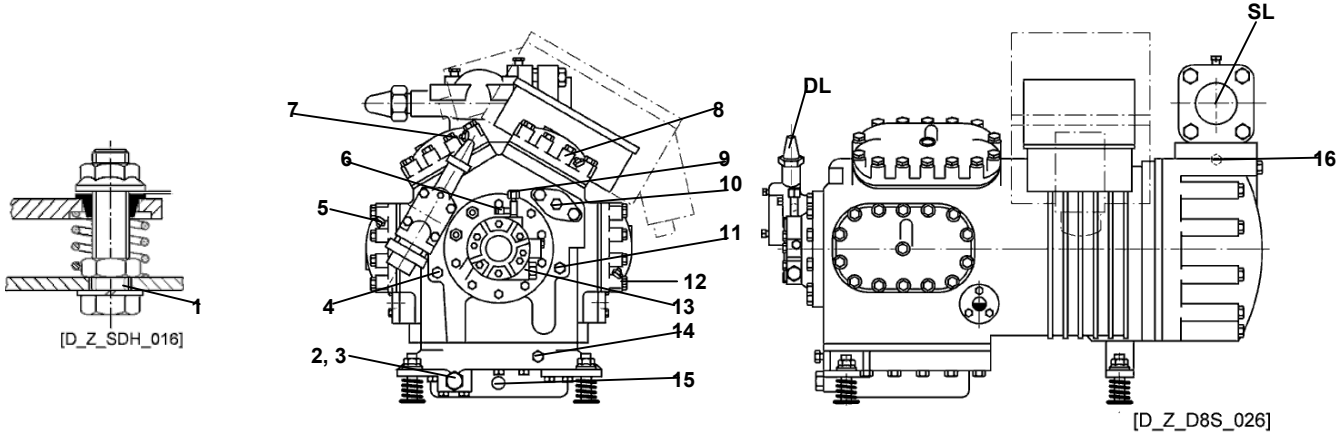
9.11 D8S

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 – 700X

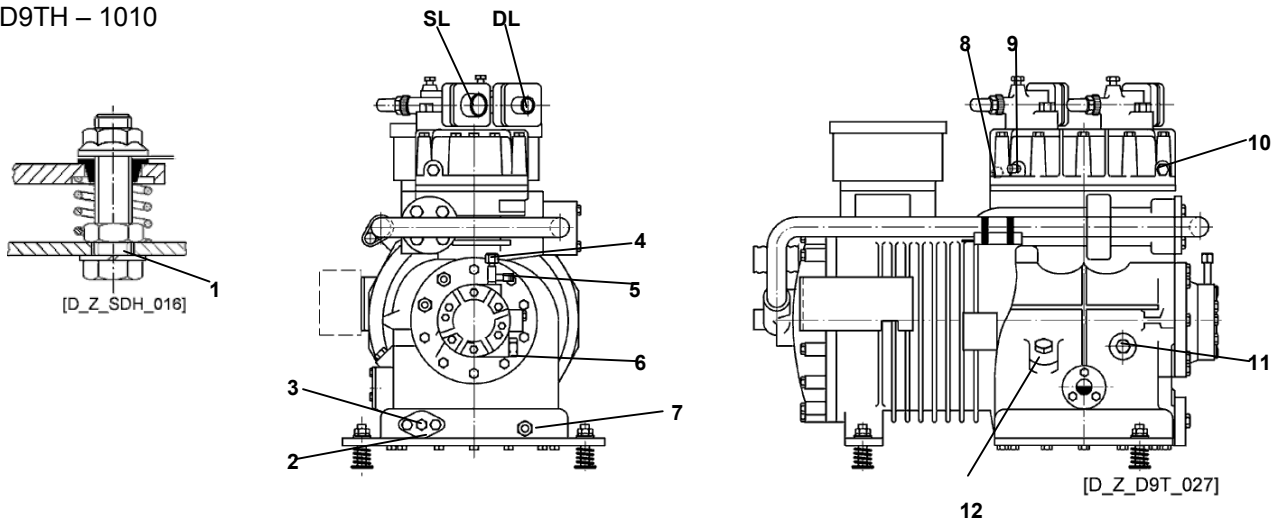


SL	Suction line (sweat)	Ø - 2 5/8"	8	Plug high pressure connection	1/8" - 27	NPTF
DL	Discharge line (sweat)	Ø - 1 5/8"	9	Connection oil pressure control H.P.	1/4" i Ö 6	mm
1	Base mountings	Ø - 18 mm	10	Plug high pressure connection	1/8" - 27	NPTF
2	Oil screen built in		11	Plug oil pressure control L.P.	1/4" - 18	NPTF
3	Magnetic plug	1" - 16 NPTF	12	Plug high pressure connection	1/8" - 27	NPTF
4	Plug oil charge	1/4" - 18 NPTF	13	Sensor connection OPS1		
5	Plug high pressure connection	1/8" - 27 NPTF	14	Plug crankcase heater	1/2" - 14	NPTF
6	Oil pressure connection	1/4" i Ö 6 mm Schraeder	15	Bore crankcase heater	Ø - 1/2"	
7	Plug high pressure connection	1/8" - 27 NPTF	16	Plug low pressure connection	1/8" - 27	NPTF

D_T_D8S_012

9.12 D9T

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

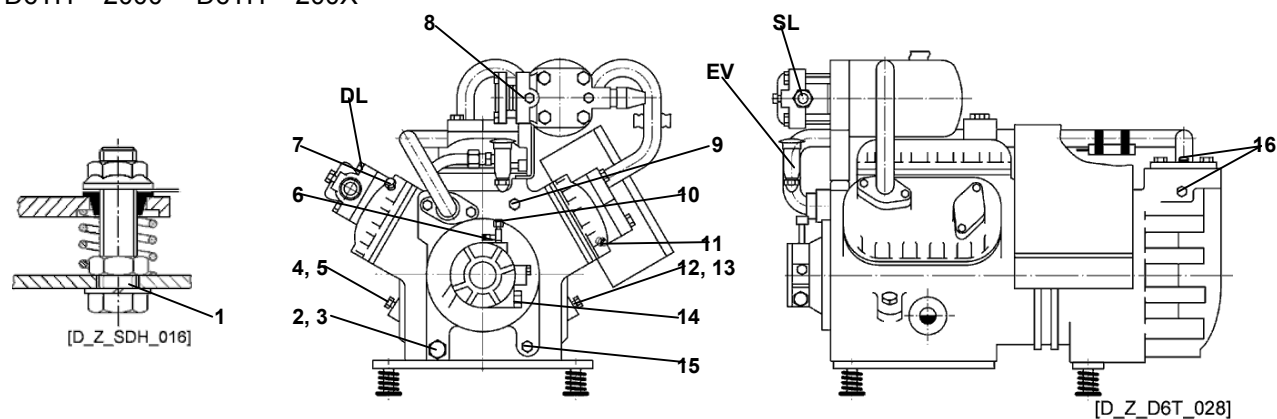


SL	Suction line (sweat)	Ø - 13/8"	6	Sensor connection OPS1	
DL	Discharge line (sweat)	Ø - 7/8"	7	Sleeve crankcase heater	1/2" - 14 NPTF
1	Base mountings	Ø - 18 mm	8	Plug high pressure connection	1/8" - 27 NPTF
2	Oil screen built in		9	Plug interstage pressure	1/8" - 27 NPTF
3	Magnetic plug	1/8" - 27 NPTF	10	Plug low pressure connection	1/8" - 27 NPTF
4	Connection oil pressure control H.P.	1/4" i Ö 6 mm	11	Plug oil pressure control L.P.	1/4" - 18 NPTF
5	Oil pressure connection	1/4" i Ö 6 mm Schraeder	12	Plug oil charge	1/4" - 18 NPTF

D_T_D9T_013

9.13 D6T

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

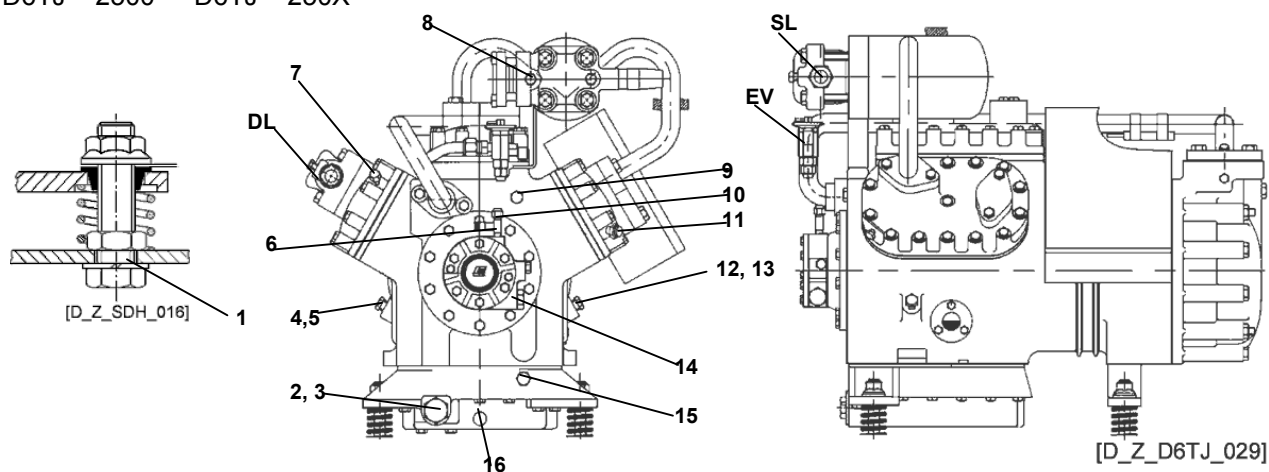


SL	Suction line (sweat)	Ø - 1 5/8"	8	Plug low pressure connection	1/4" - 18	NPTF
DL	Discharge line (sweat)	Ø - 1 3/8"	9	Plug interm. press. connection	1/4" - 18	NPTF
EV	De-superheating expansion valve		10	Connection oil pressure control H.P.	1/4" i Ö 6	mm
1	Base mountings	Ø - 18 mm	11	Interm. press.connection	1/4" i Ö 6	mm Schraeder
2	Oil screen built in		12	Plug oil charge	1/4" - 18	NPTF
3	Magnetic plug	1" - 16 NPTF	13	Plug oil pressure control L.P.	1/4" - 18	NPTF
4	Plug oil charge	1/4" - 18 NPTF	14	Sensor connection OPS1		
5	Plug oil pressure control L.P.	1/4" - 18 NPTF	15	Bore crankcase heater	Ø - 1/2"	
6	Oil pressure connection	1/4" i Ö 6 mm Schraeder	16	Intermediate press. connection	1/8" - 27	NPTF
7	Plug high pressure connection	1/8" - 27 NPTF				

D_T_D6T_014

9.14 D6TJ

D6TJ – 2500 D6TJ – 250X



SL	Suction line (sweat)	Ø - 1 5/8"	8	Plug low pressure connection	1/4" - 18	NPTF
DL	Discharge line (sweat)	Ø - 1 3/8"	9	Plug interm. press. connection	1/4" - 18	NPTF
EV	De-superheating expansion valve		10	Connection oil pressure control H.P.	1/4" i Ö 6	mm
1	Base mountings	Ø - 18 mm	11	Interm. press.connection	1/4" i Ö 6	mm Schraeder
2	Oil screen built in		12	Plug oil charge	1/4" - 18	NPTF
3	Magnetic plug	1" - 16 NPTF	13	Plug oil pressure control L.P.	1/4" - 18	NPTF
4	Plug oil charge	1/4" - 18 NPTF	14	Sensor connection OPS1		
5	Plug oil pressure control L.P.	1/4" - 18 NPTF	15	Plug crankcase heater	1/2" - 14	NPTF
6	Oil pressure connection	1/4" i Ö 6 mm Schraeder	16	Bore crankcase heater	Ø - 1/2"	
7	Plug high pressure connection	1/8" - 27 NPTF	D_T_D6TJ_015			

D_T_D6TJ_015

9.15 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 NTPF		1/4" - 18 NTPF	
DK, DL, D2S	1	1				
D9R, D9T, D6T			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

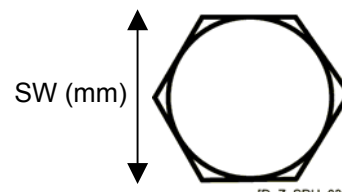
SV = suction valve

1, 2 = number of pressure gauge connections

DV = discharge valve

* = see single compressor

D_T_SHC_021



9.16 Tightening Torques

Tightening Torques (Nm)

	DK	DL, DLH	D2S	D9R, D9T	D3S	D4S D4SJ	D6S, D6T D6SJ/K/U	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
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	1/4"-20 UNC 11 - 12 Nm	1/4"-20 UNC 11 - 12 Nm	1/4"-20 UNC 11 - 12 Nm	1/4"-28 UNF 5 - 5.5 Nm SW 11	10 - 32 UNF 3 - 4 Nm SW 9.0	1/4"-28 UNF 4.5 - 5.7 Nm SW 11	1/4"-28 UNF 4.5 - 5.7 Nm SW 11	1/4"-28 UNF 4.5 - 5.7 Nm SW 11
Terminal stud thermistors	SW 11	SW 11	SW 11	10 - 32 UNF 2.4 - 2.6 Nm SW 9	1/4"-28 UNF 5 - 6.5 Nm SW 11	10 - 32 UNF 3.4 - 4 Nm SW 9	10 - 32 UNF 3.4 - 4 Nm SW 9	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

10 R22 Low Temperature Applications using D2SA-450/X Air & D2SC-550/X Air Compressors

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).

11 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

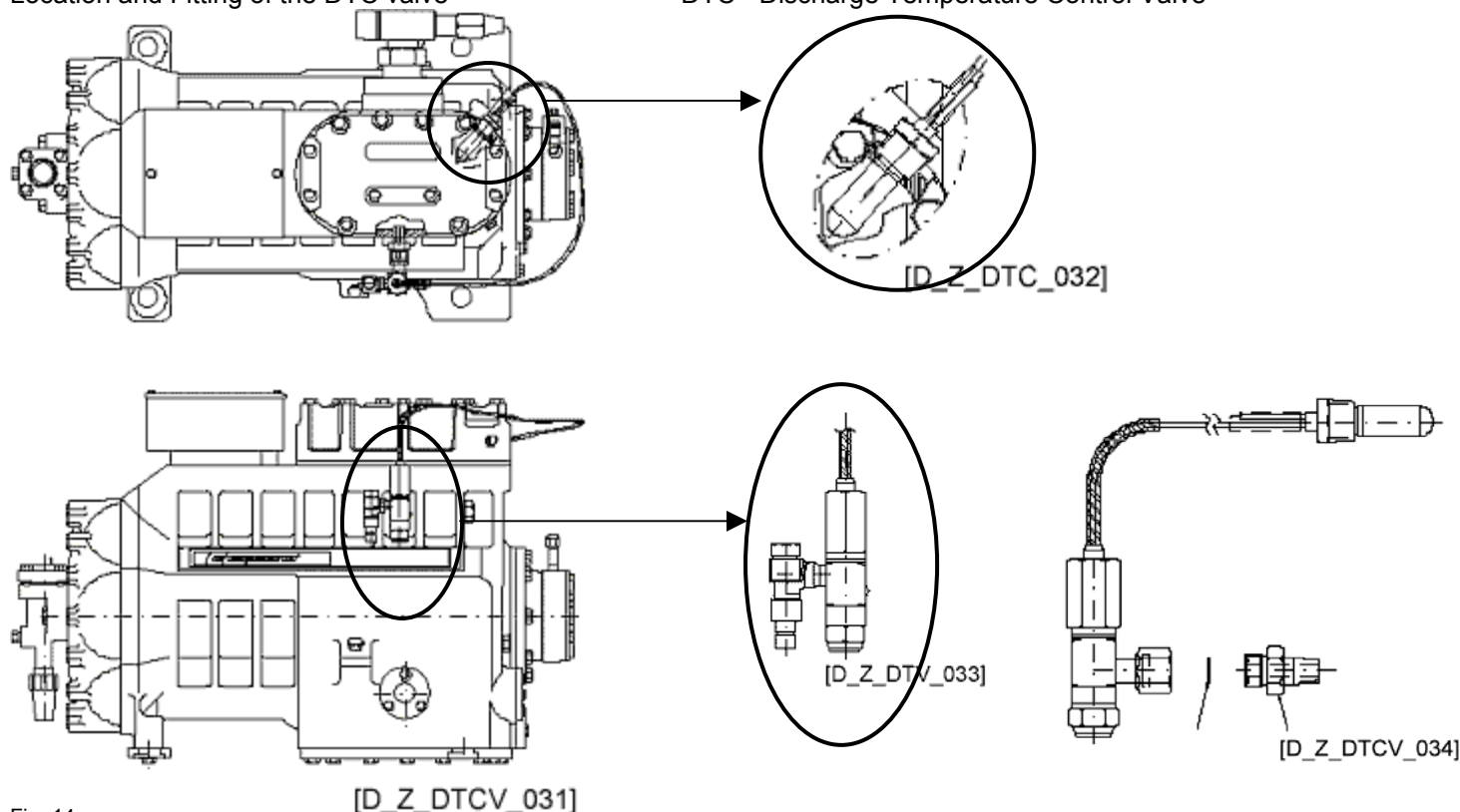


Fig 14

- 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.

12 Fan Installation

12.1 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).

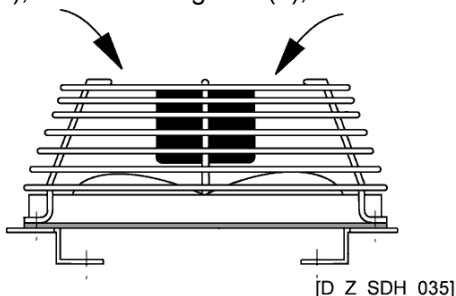


Fig 15

12.2 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. 16). 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.

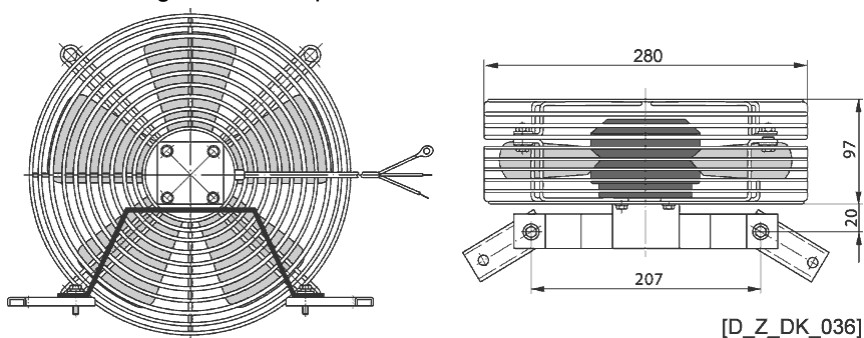


Fig 16

Attention:

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

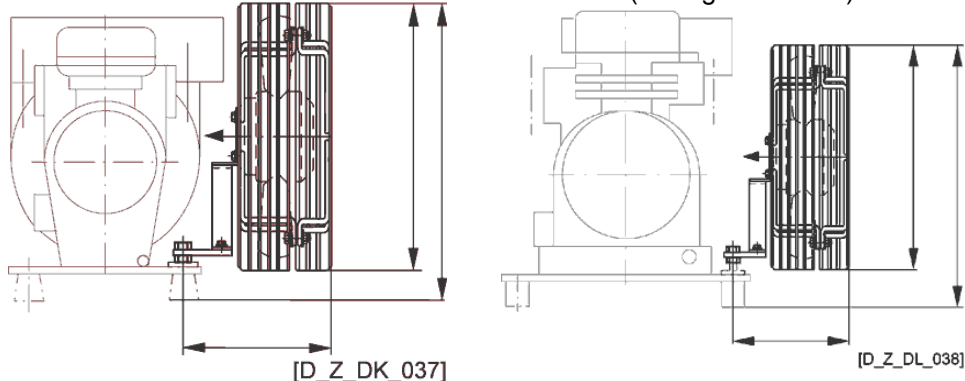


Fig 16 + 17

Technical Data of Fan 25 W

motor voltage $\pm 15\%$	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 $\cos\Phi = 1$	2.5 A	
nom. Current at $\cos\Phi = 0.6$	1.6 A	
max. breaking current	5 A	

D_T_SHC_023

12.3 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.

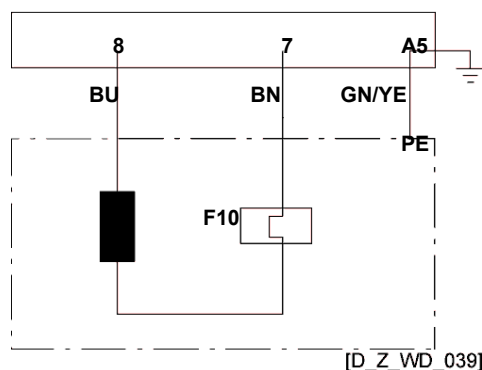


Fig 18

Legend

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

12.3.1 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.

12.4 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. 27).

When ordering, please specify the type of compressor, capacity control and oil cooler (if existing) in order to receive the correct fixing bracket.

12.5 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 (5 μ F/400V) and the motor (see Fig. 19, position 9). Here the connection will be done by a three lead cable to the terminal box of compressor.

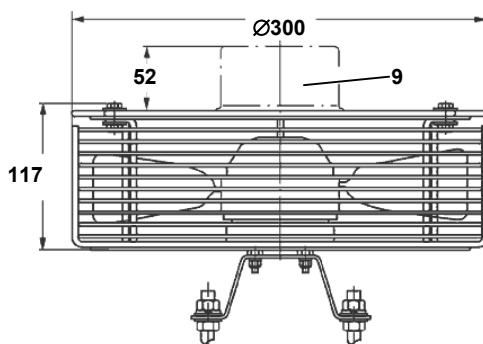


Fig 19

Technical Data of Fan 75 Z							
	Motor Voltage						
	230 V +15%		230 V ? +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			

D_T_SHC_024

12.6 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.

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

D_T_SHC_141

12.7 Wiring Diagrams for Fan 75 Z

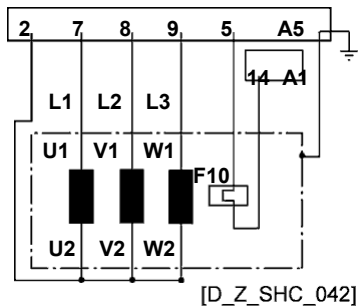


Fig. 20 Star Connection

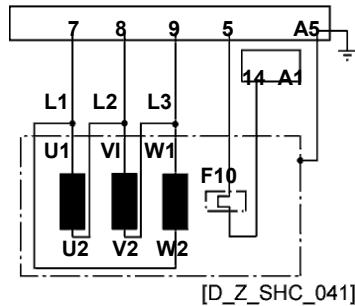


Fig. 21 Delta Connection

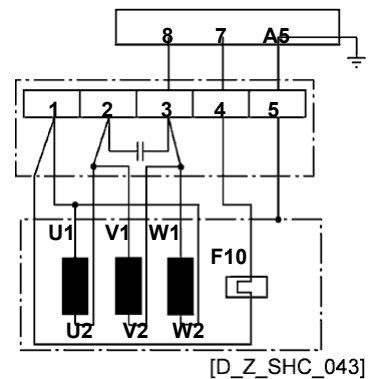


Fig. 22 Steinmetz Connection for single phase operation

Legend

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

Colour Code

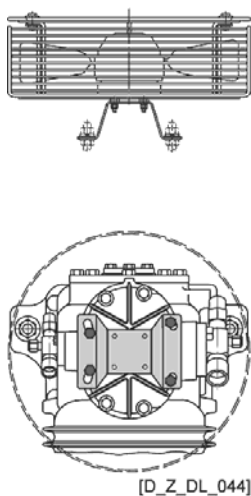
U1 = Brown (BN)	V2 = Grey (GY)	F10 = White (WH)
U2 = Red (RD)	W1 = Black (BK)	PE = Green/Yellow (GN/YE)
V1 = Blue (BU)	W2 = Orange (OG)	

Note

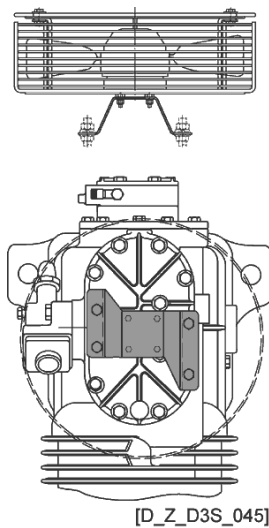
The fan must blow air towards the compressor!
 Check the direction of rotation after electrical connection!

12.8 75 Z Fan Mounting

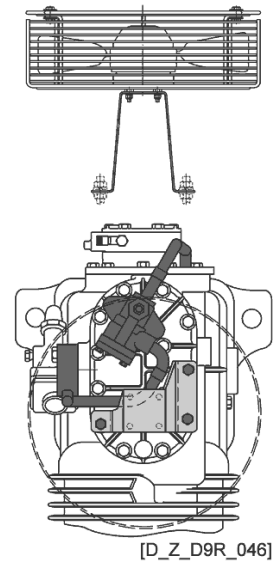
DL / DLH / D2S

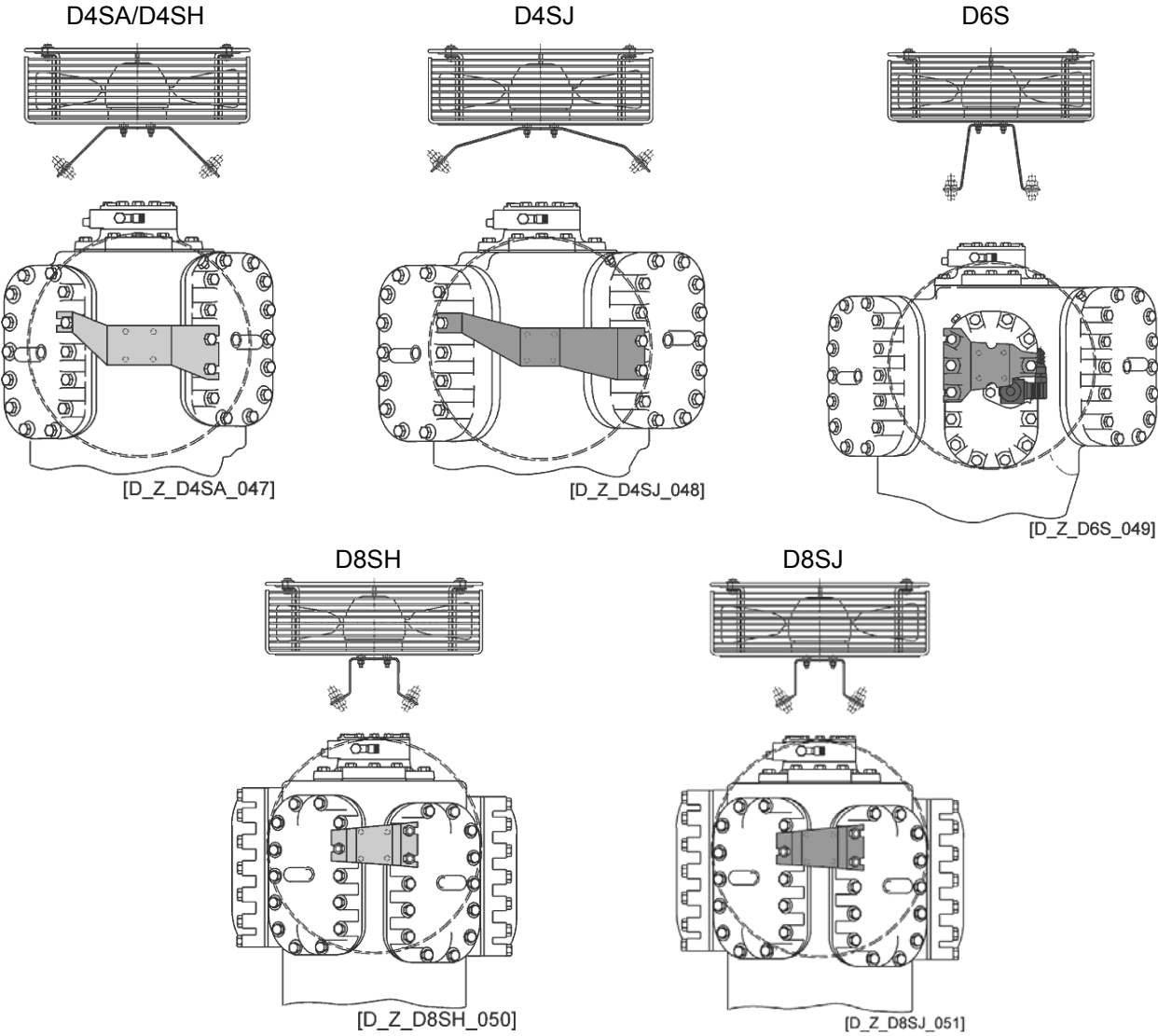


3S/D9R



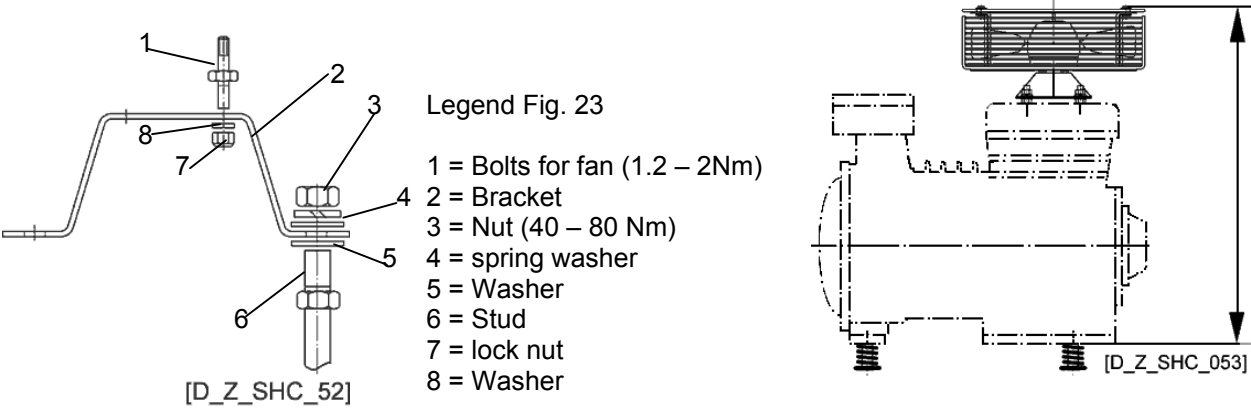
D9R with capacity control





12.9 Bracket Tightening Torque & Dimensions

Fig 23 +24



Tightening Torques and Dimensions

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

1) with / without capacity control

13 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.

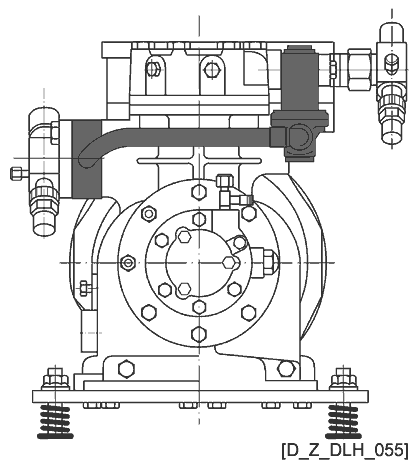
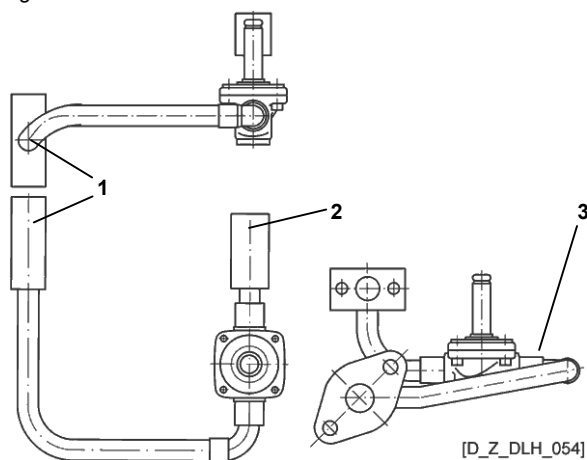
13.1 DLH, D2S, D3S & D9R

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. 29.

13.1.1 DLH, D2S Retrofit Kit (Mounting position see Fig. 25)

- 1 Gasket, flange suction side (2 x)
- 2 Gasket, flange discharge side (2 x)
- 3 Piping assembly with valve body (1 x)
- Solenoid coil (1 x)
- Check valve NRV 22S (1 x, order separately)
- Hexagonal screw, suction side $\frac{1}{2}$ " – 13 UNC x 2 $\frac{1}{4}$ " (2 x)
- Hexagonal screw, discharge side $\frac{5}{16}$ " – 18 UNC x 2" (2 x)

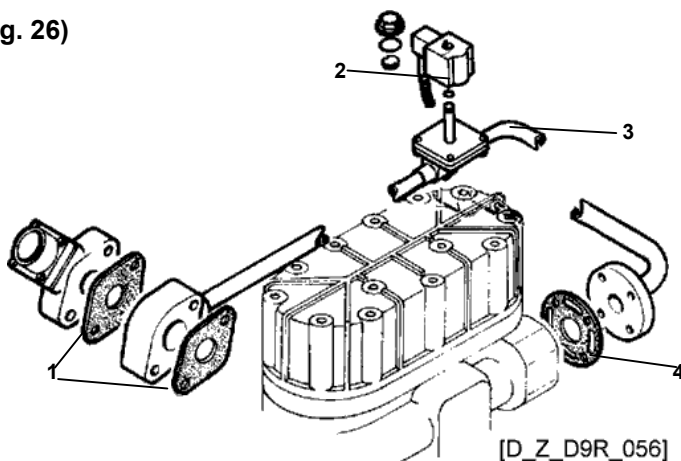
Fig 25



13.1.2 D9R Retrofit Kit (Mounting position see Fig. 26)

- 1 Gasket, flange discharge side (2 x)
- 2 Solenoid coil (1 x)
- 3 Piping assembly with valve body (1 x)
- 4 Gasket, flange suction side (1 x)
- Bolt, discharge side (2 x) $\frac{1}{2}$ " – 13 UNC x 3"
- Check valve (1 x) see page 18, order separately

Fig.26



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.

13.1.3 D3S Retrofit Kit (Mounting position see Fig. 27)

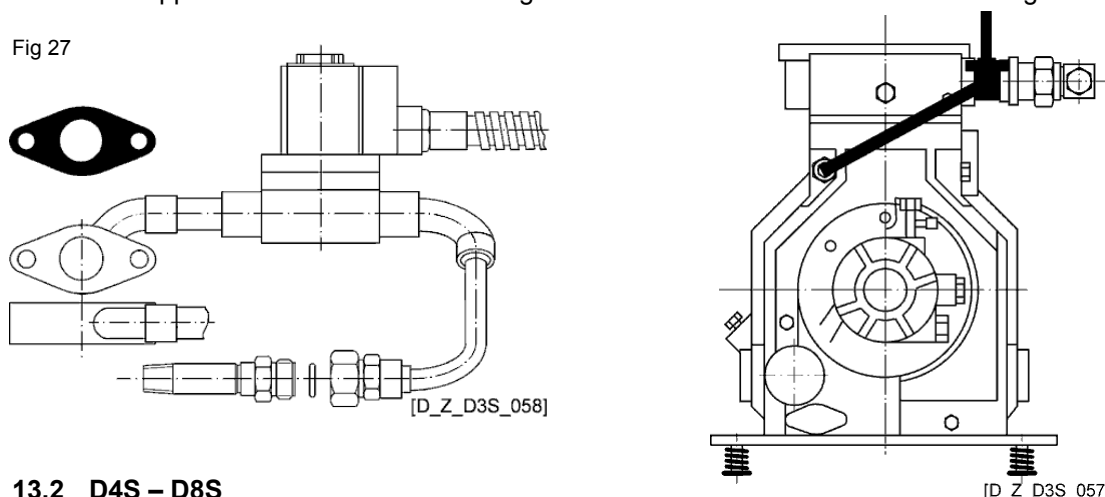
This consists of the following parts:

- 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 27



13.2 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	-

D_T_SHC_026

13.2.1 Mounting Position of the Non-Return Valve

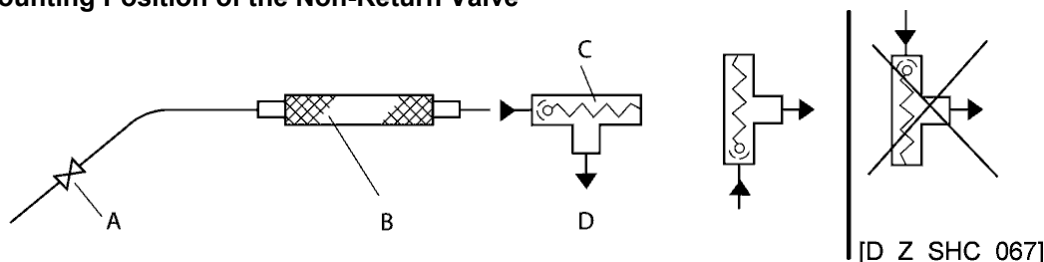


Fig 29

- 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.

13.2.2 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 Ø 22		
D4S	NRV 22S Ø 22	D44S	2 X NRVH 22S Ø 22
D3S / D4SJ	NRV 28S Ø 28	D44SJ	2 X NRVH 28S Ø 28
D6SF / L / T	NRV 22S Ø 22	D66SF / L / T	2 X NRVH 22S Ø 22
D6SA / H / J / U	NRV 28S Ø 28	D66SA / H / J	2 X NRVH 28S Ø 28
D6SK	NRV 35S Ø 42	D66SK	2 X NRVH 35S Ø 42
D8SH / J / K	NRV 42S Ø 42	D88SH / J / K	2 X NRVH 42S Ø 42

1) also for parallel compressor operation

D_T_SHC_027

13.2.3 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. 30)
- 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. 30).

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

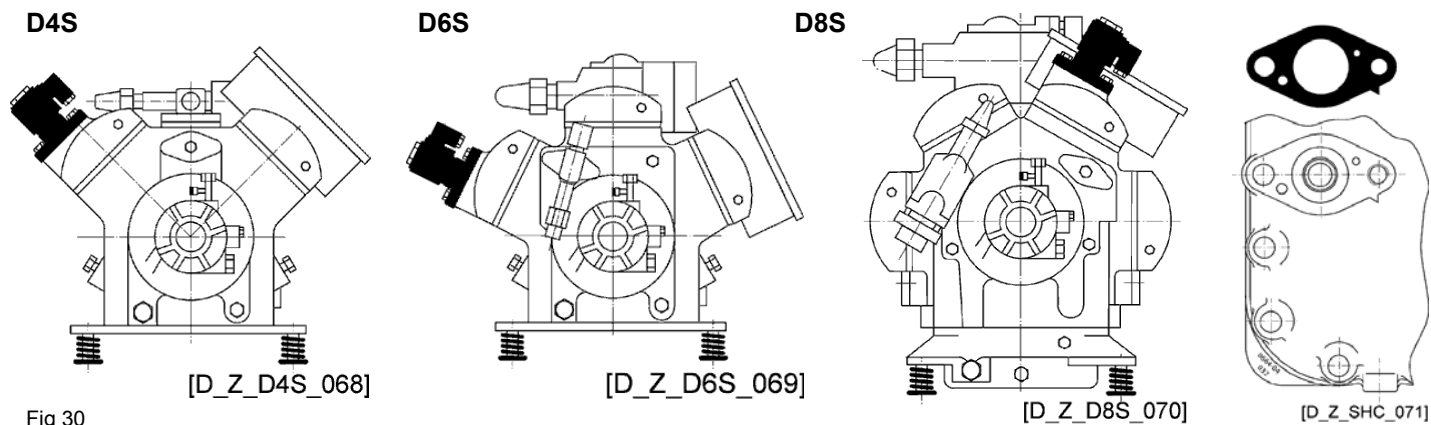


Fig 30

D4S, D6S, D8S

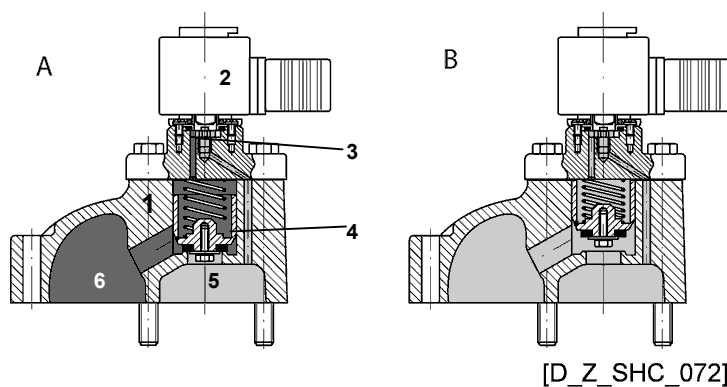


Fig 31

A Standard operation

B Unloaded start operation

1 Special cylinder head

2 Solenoid

3 Valve

5 Low side in the cylinder head

4 Spring loaded control piston

6 High side in the

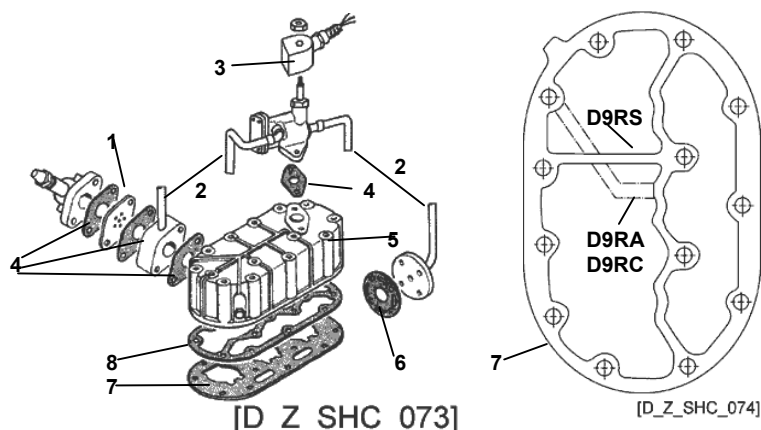
14 Capacity Control

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.

14.1 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. 32)

Fig 32



Conversion Kit D9R

- 1 Muffler plate (1 x)
- 2 Piping assembly (1 x) with valve body
- 3 Solenoid coil (1x)
- 4 Gasket flange (4 x) discharge side, solenoid valve
- 5 Cylinder head for capacity control (1x)
- 6 Gasket flange (1 x) suction side, Solenoid coil (1 x)
- 7 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"
- 8 Gasket cylinder head (1 x)

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.

14.2 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.

14.2.1 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.

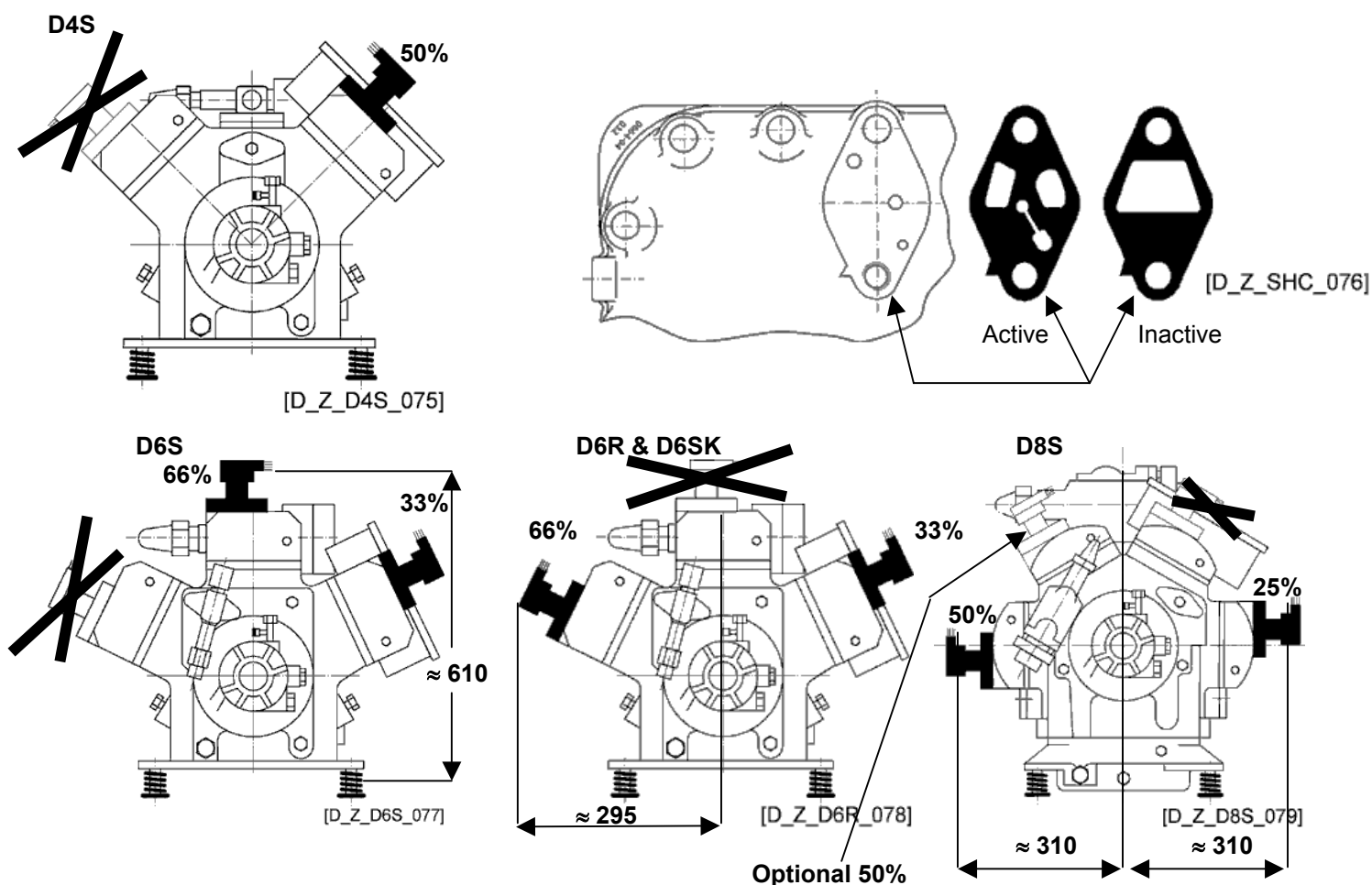
14.2.2 Normal Operation (Full load)

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.

14.2.3 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. 33 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)

14.3 Selection of Capacity Control D4S – D8S, R22

D4S - D8S

R 22

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

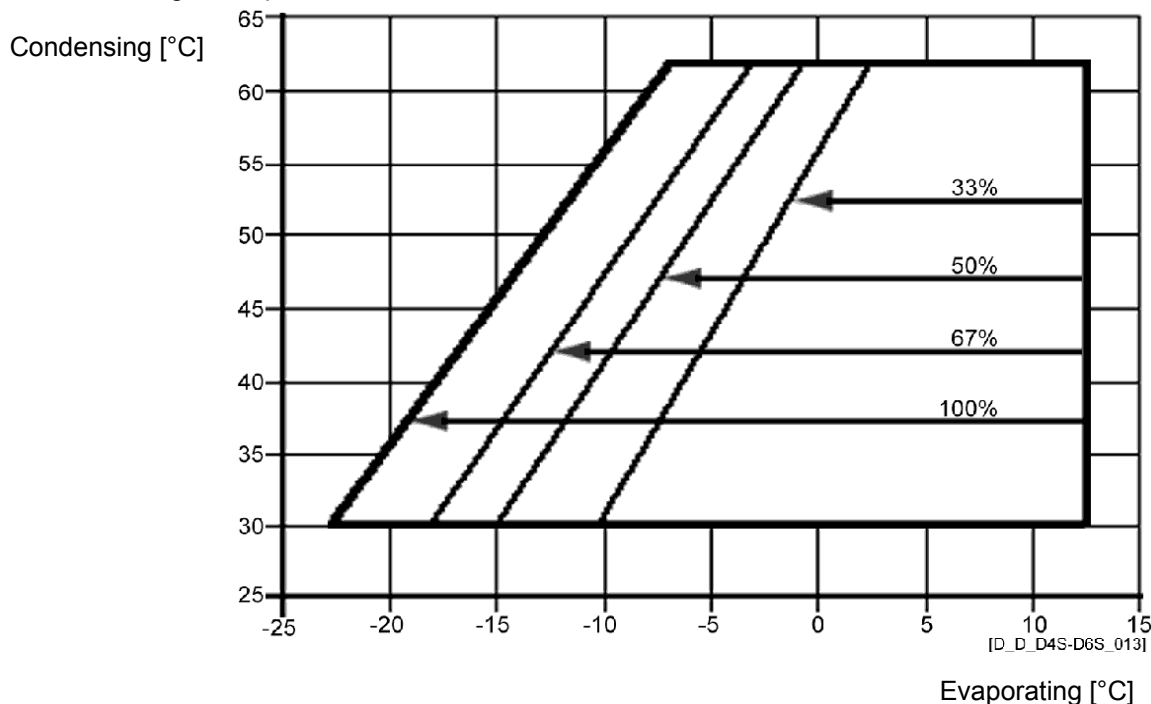
M = medium temperature

D_T_SHC_029

14.4 Application Range D4S – D8S, R22

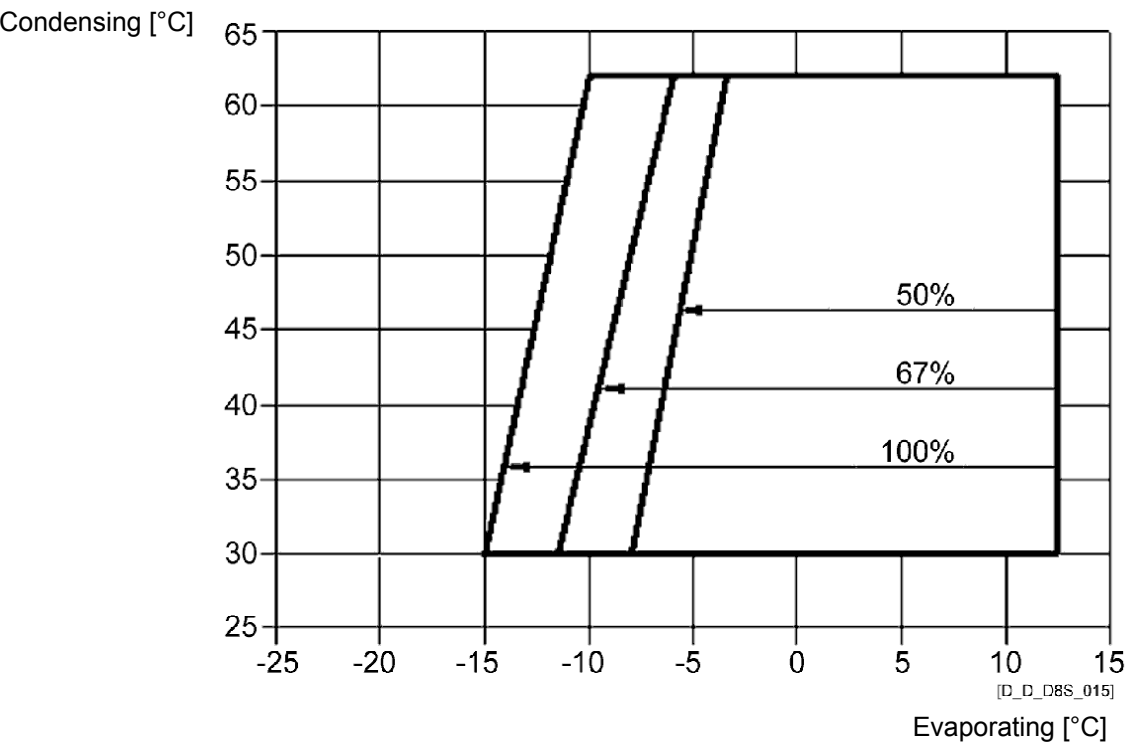
14.4.1 D4SA / H / J & D6SA / H / J

Diagram 1 Suction gas temperature 25 °C



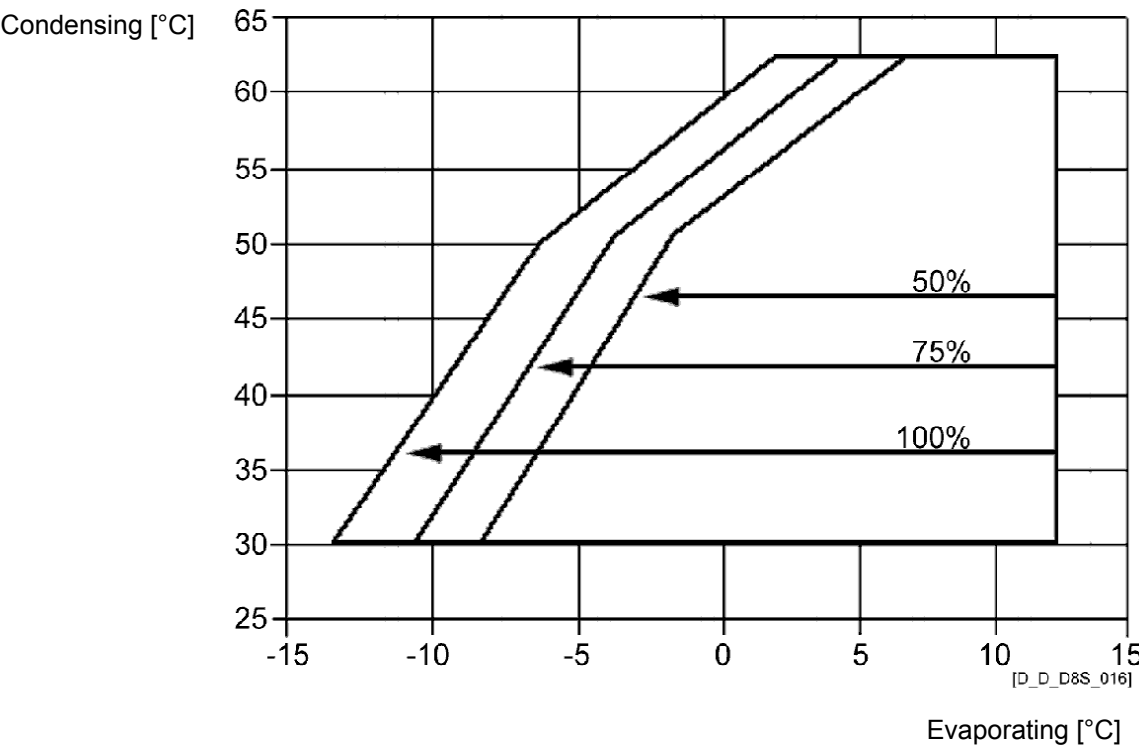
14.4.2 D8SH / J

Diagram 2A Suction gas temperature 25°C



14.4.3 D8SK – 7000

Diagram 2B Suction gas temperature 25°C



14.5 Selection of Capacity Control D4S – D8S, R407C mid point

D4S - D8S

R 407C (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	4
D8SH-500X	2 / 4	100%	75%	50%	76/53	79/57	
D8SJ-600X	2 / 4	100%	75%	50%	76/53	79/57	5
D8SK-700X	2 / 4	100%	75%	50%	76/53	79/57	

Application limit: see data sheets and application diagrams

H = high temperature

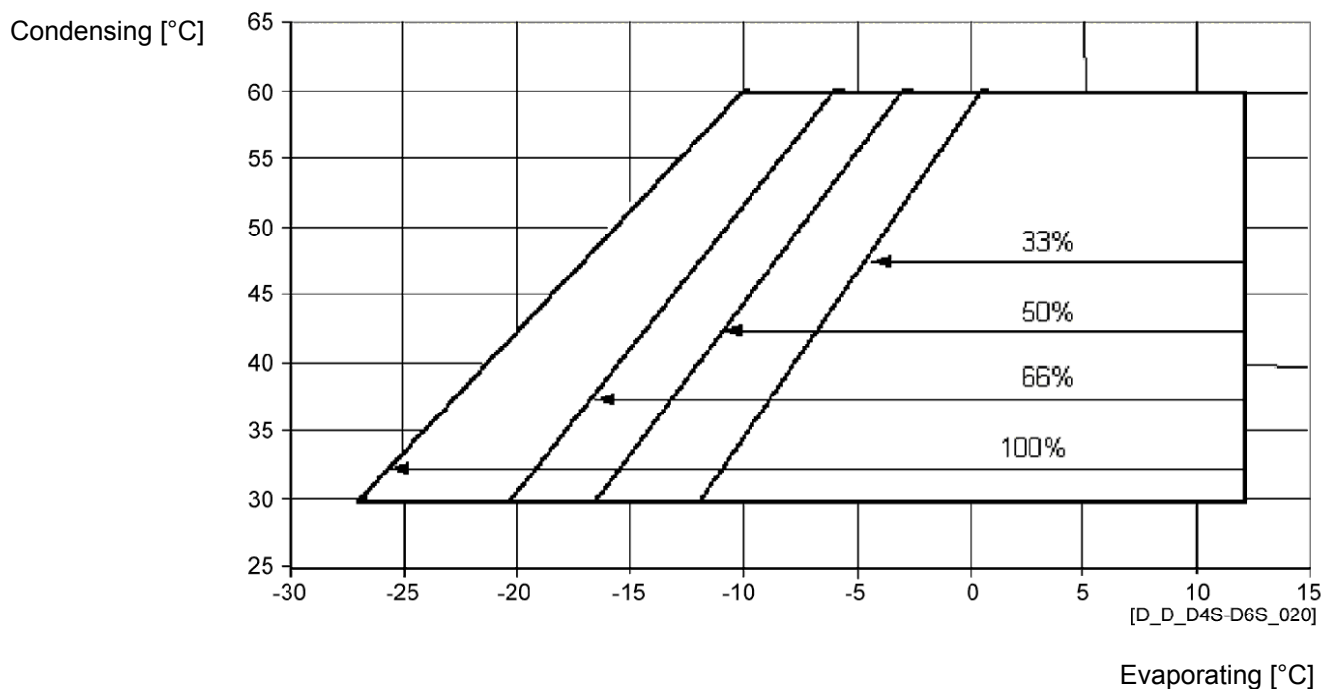
M = medium temperature

D_T_SHC_030

14.6 Application Range D4S – D8S, R407C mid point

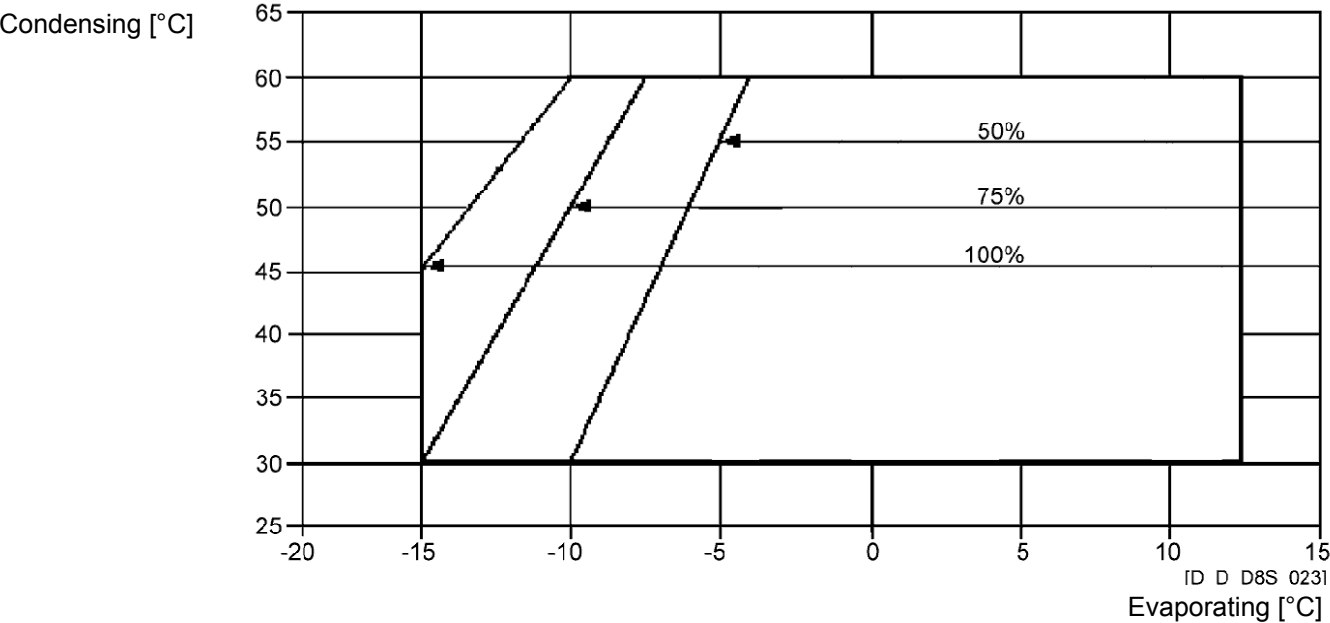
14.6.1 D4SA / H / J & D6SA / H / J

Diagram 3 Suction gas temperature 25°C



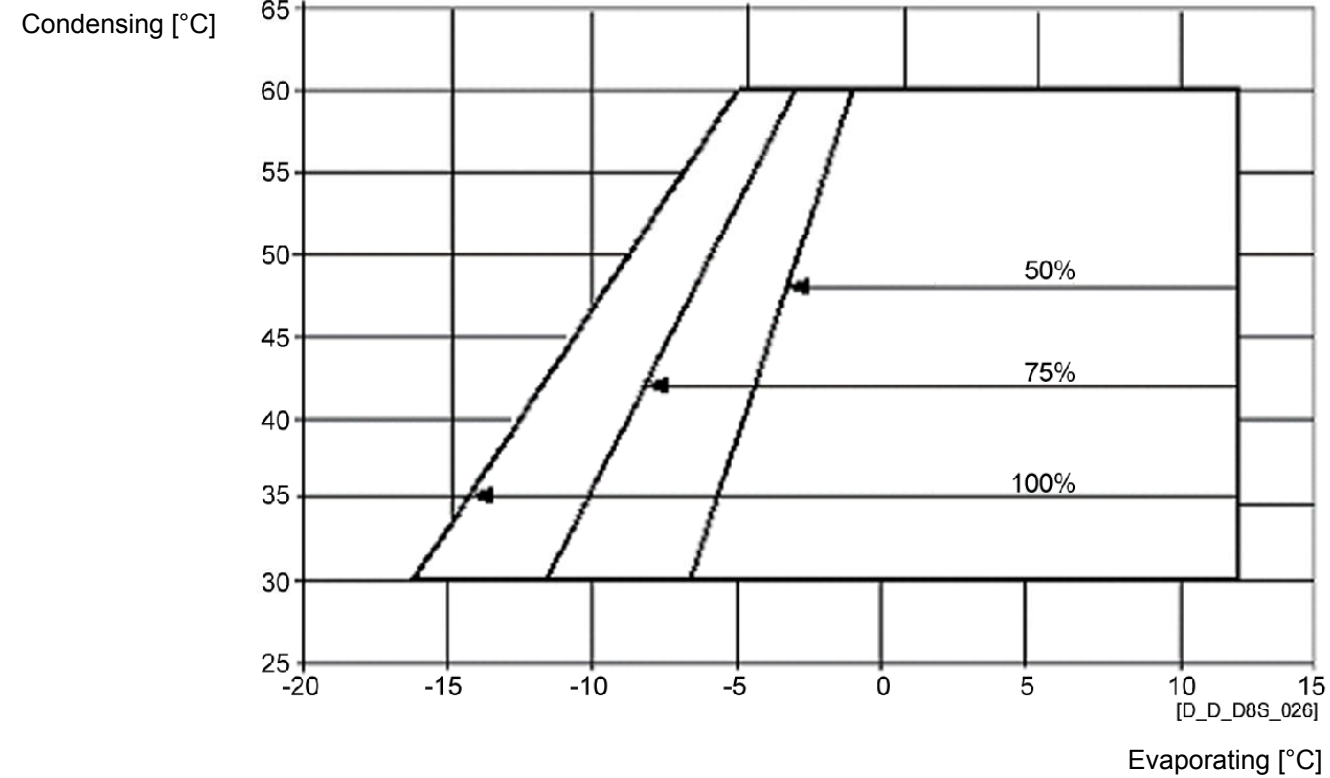
14.6.2 D8SH / J

Diagram 4 Suction gas temperature 25°C



14.6.3 D8SK-700X

Diagram 5 Suction gas temperature 25°C



14.7 Selection of Capacity Control D4S – D8S, R404A

D4S - D8S

R 404A

Compressor	Number of Cylinders with Capacity Control	Capacity Regulating Steps			Remaining Refrigeration 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	
D6SU-400X	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

D_T_SHC_031

14.8 Application Range D4S – D8S, R404A

14.8.1 D4SF / L / T & D6SF / L / T / U

Diagram 6: Suction gas temperature 25°C
Low Temperature WITH Additional Cooling (Fan)

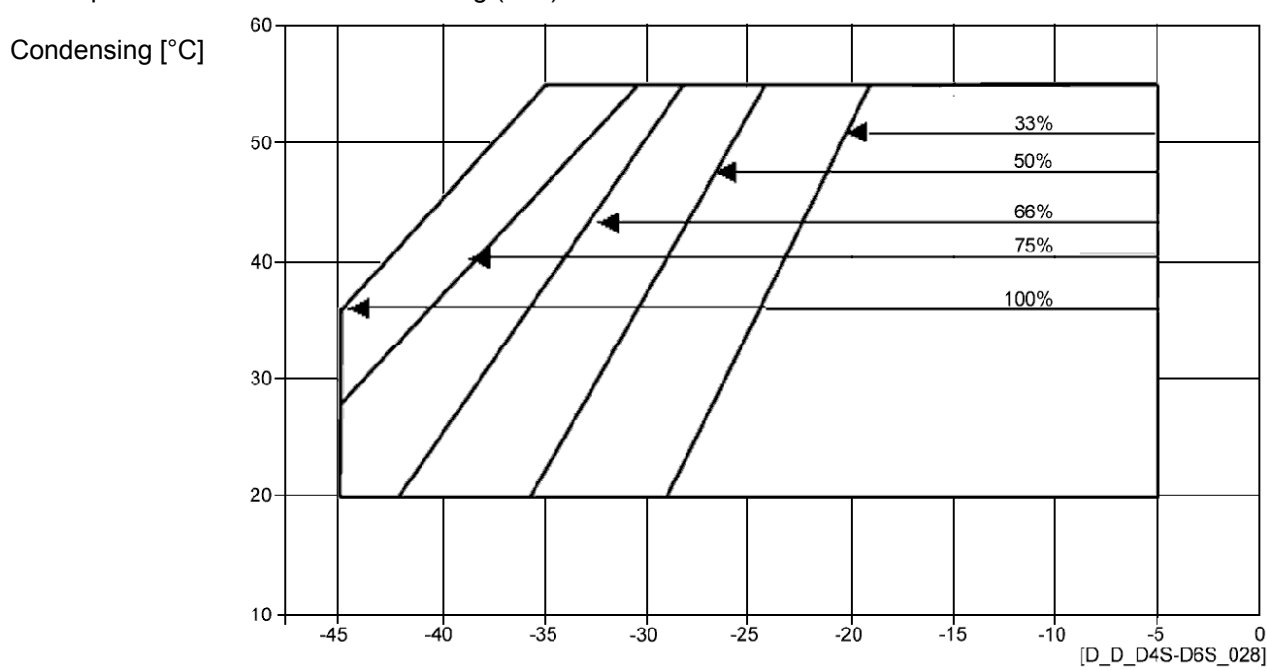
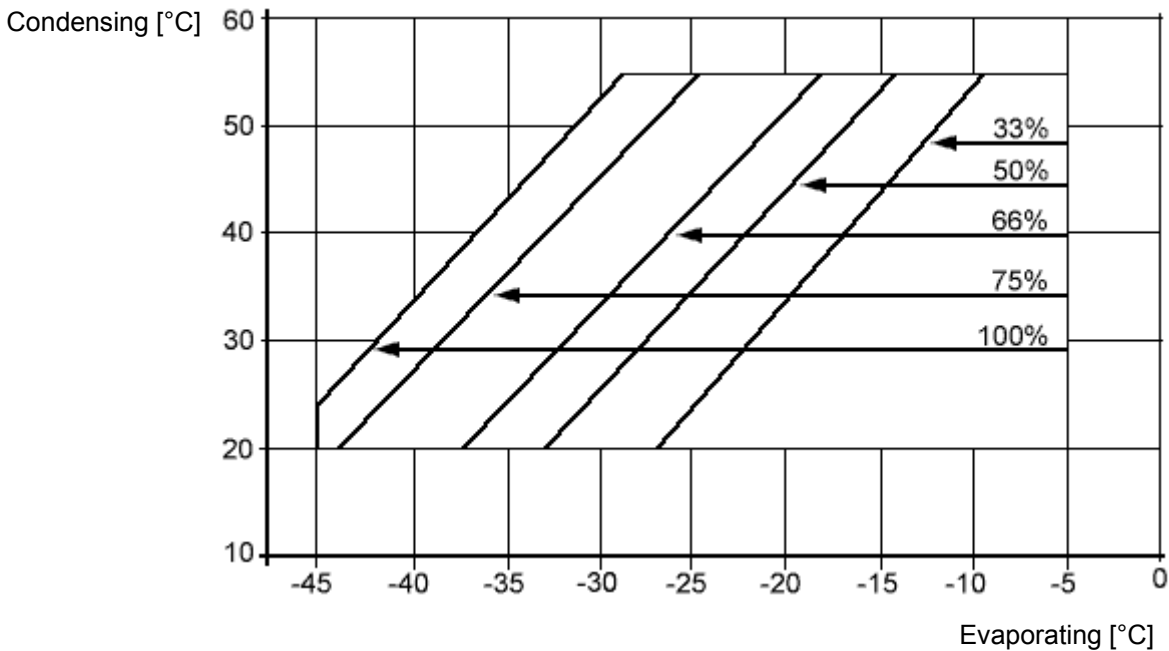


Diagram 7: Suction gas temperature 25°C
Low Temperature WITHOUT Additional Cooling (Fan)



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

Diagram 8: Suction gas temperature 25°C
Medium Temperature WITH Additional Cooling (Fan)

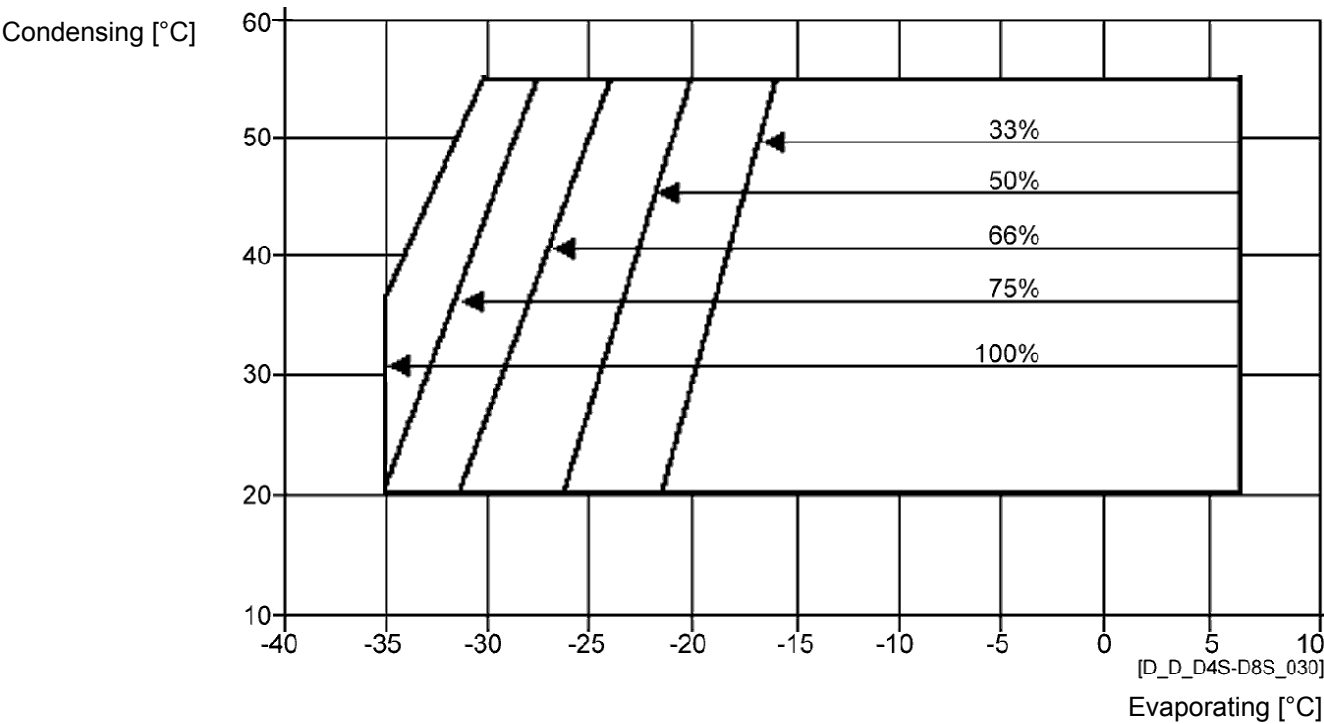
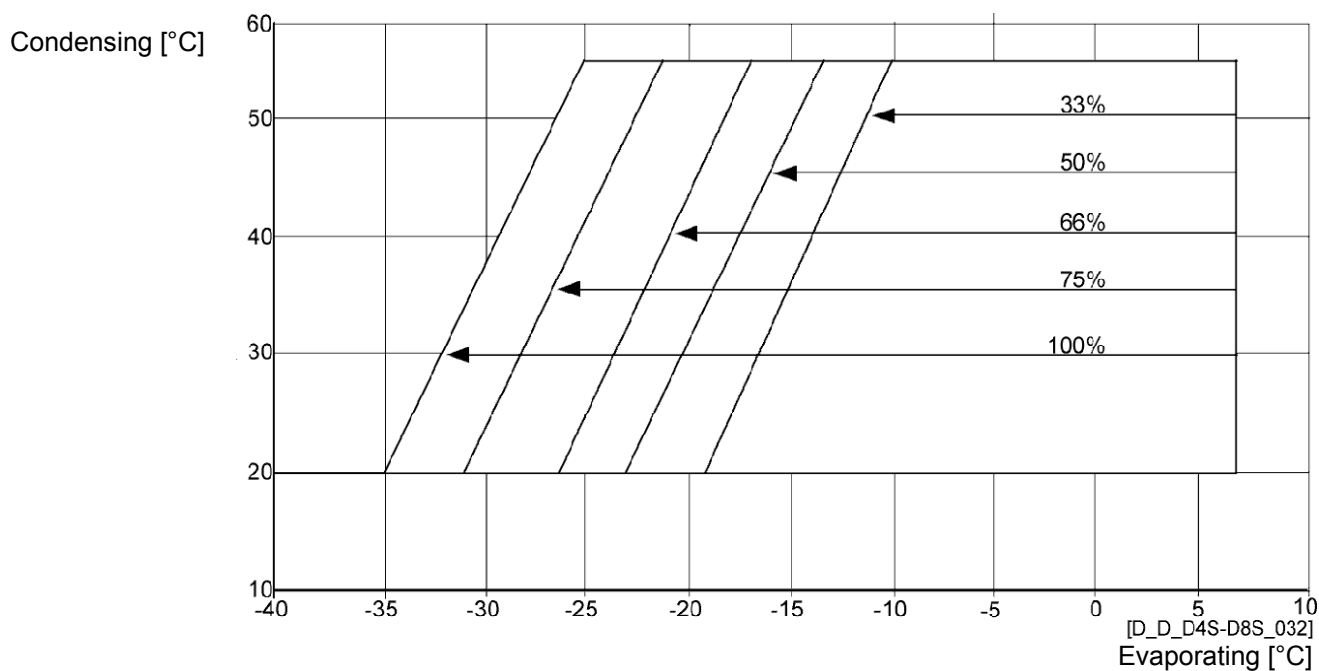


Diagram 9 Suction gas temperature 25°C
Medium Temperature WITHOUT Additional Cooling (Fan)



15 TWIN Compressors D44S – D88S

Compressors D4S and D6S are manufactured using by-pass bodies (see figure 34). 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.

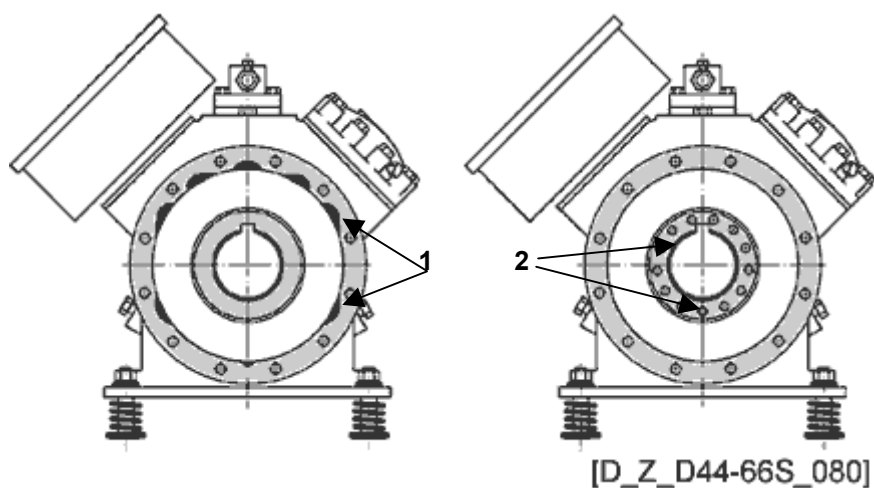


Fig.34 View of compressor motor after removal of suction chamber (by-pass body left)

15.1 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	019-0042-99	019-0050-99
D44SF - 3000		
D44SA - 4000		
D44SH - 5000	019-0004-99	019-0049-99
D44SJ - 6000		
D66S . -		
D66T . -		

D_T_SHC_032

16 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:

- 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,
- 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.

16.1 27 Watt Heater Element for DK

The internal crankcase heater for DK compressors is a self regulating 27 Watt PTC heater (see figure 35).

16.2 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 36).

16.3 200 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 37).

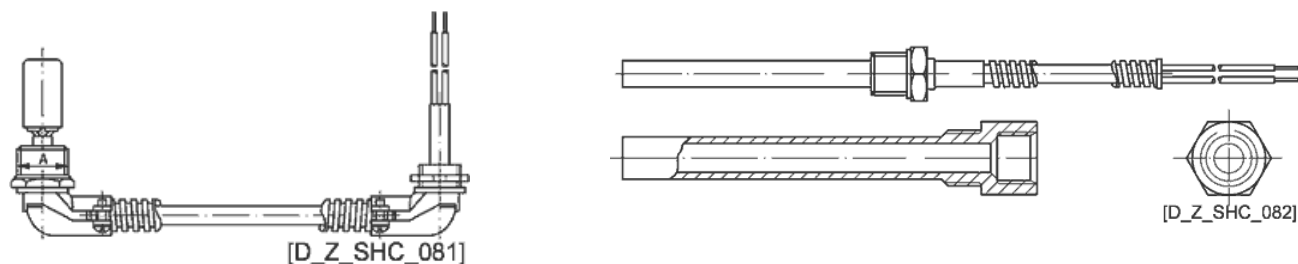


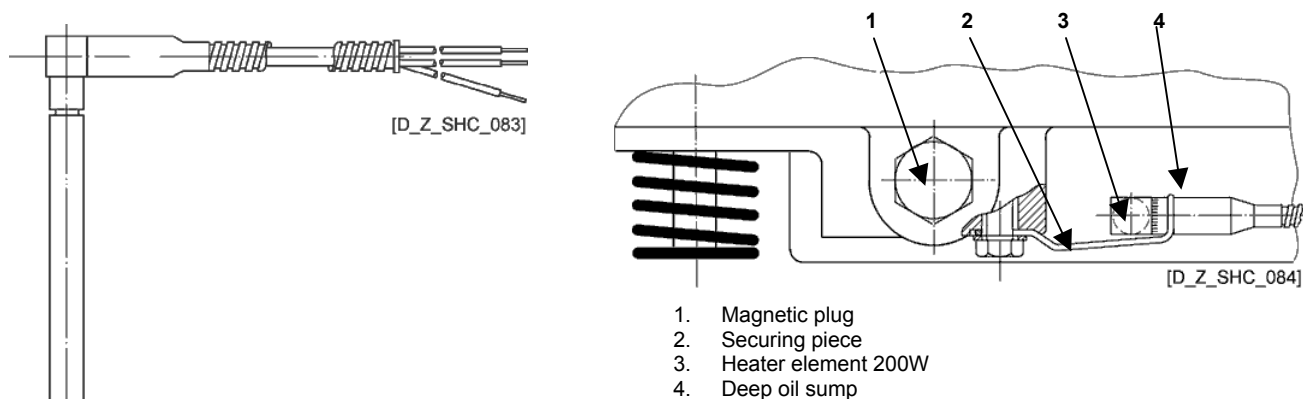
Fig 35 + 36

For dimensions see next page

Fig 37

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/K/T/U, D8S	200	Ø14 mm	Ø12.62 mm	103	126	700	900	200	50

D_T_SHC_033



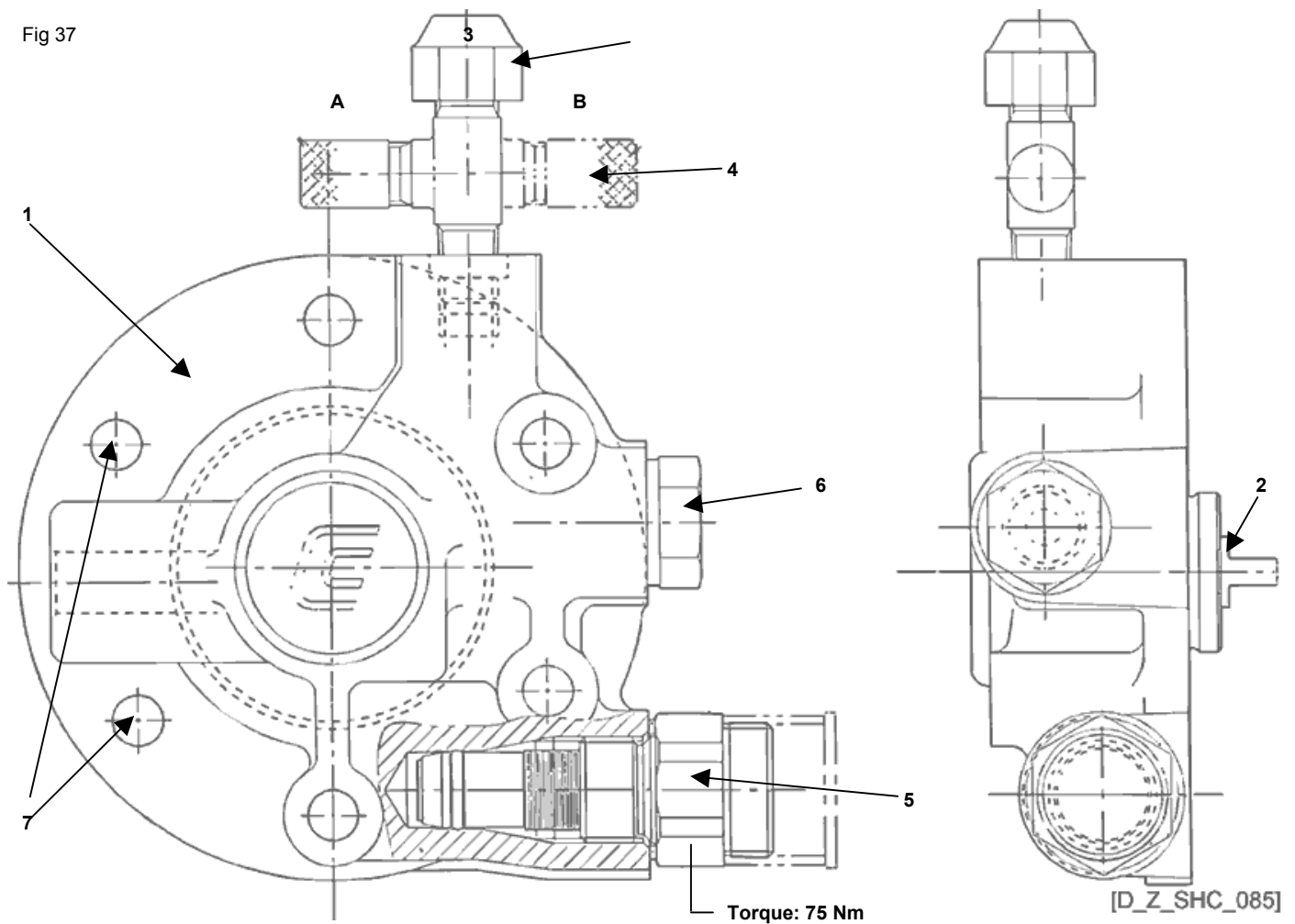
17 Oil Pump

17.1 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)

Fig 37



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 $\frac{1}{16}$ " - 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)

D_T_SHC_034

17.2 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. 38).

The adapter ring is fixed to the pump case on the side of the cam pin (see Fig. 39). 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. 39, section „B“).

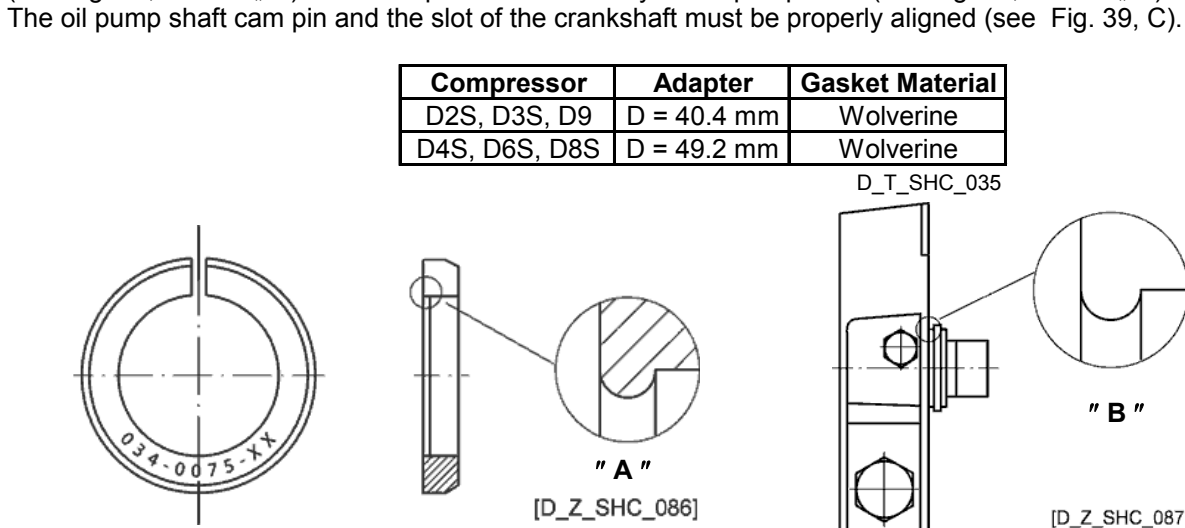
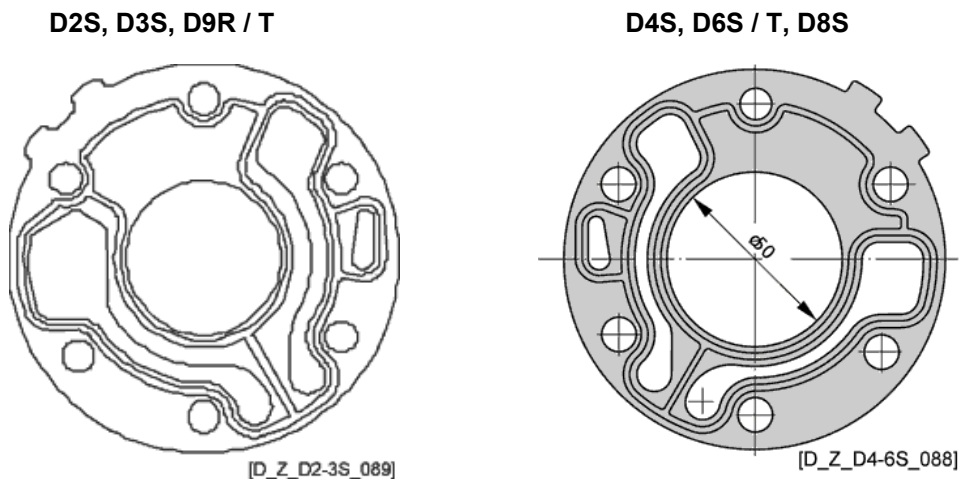


Fig 38 + 39

17.3 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.

Fig 40



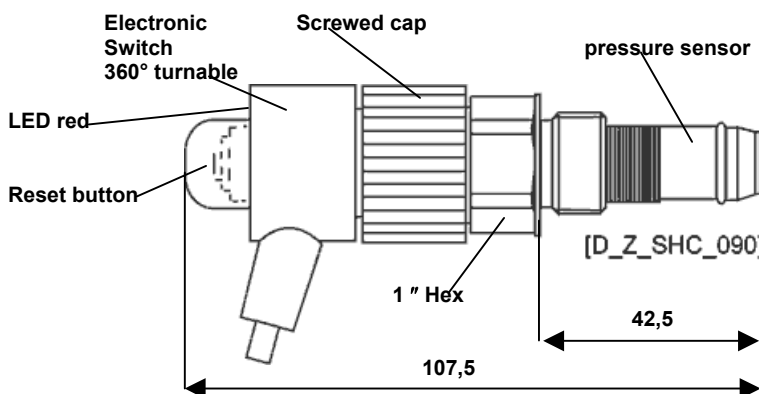
18 OPS1 Oil Differential Pressure Switch

18.1 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 41: OPS1 drawing



18.2 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

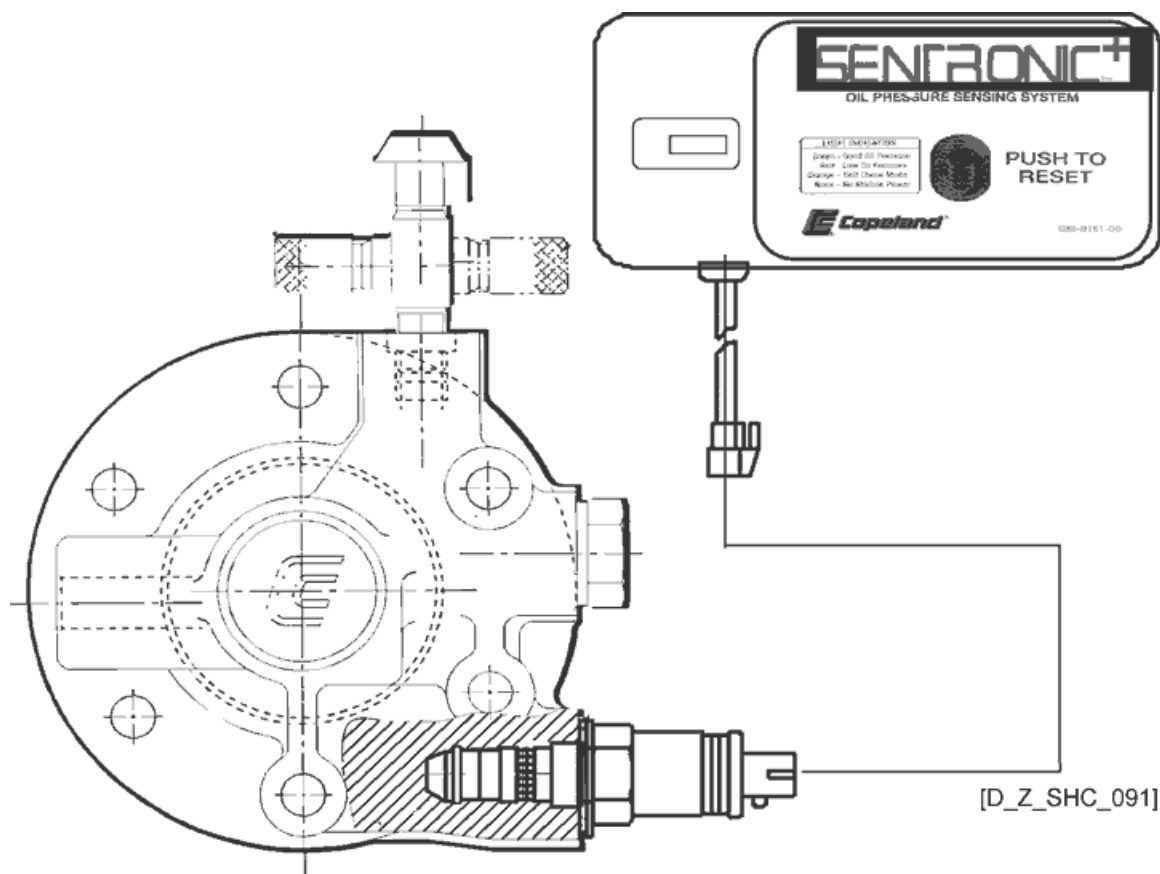
D_T_SHC_036

19 New SENTRONIC⁺™ 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 42



19.1 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			

19.2 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.

19.3 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.

19.4 Electrical Connection

See wiring diagram on page 66.

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.

19.5 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 $\pm$ 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⁺™ 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.

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

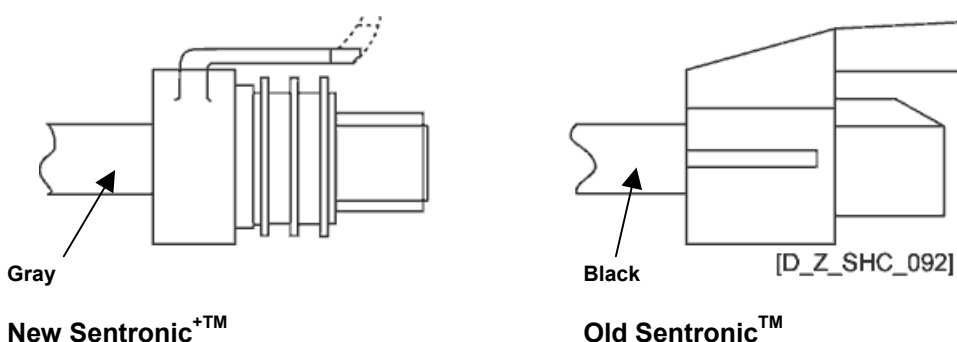
The new Sentronic+™ oil pressure control uses both a new module and a new sensor. The sensors and module can be made compatible with older generation components if the following steps are taken:

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.

Fig 43



19.6.1 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

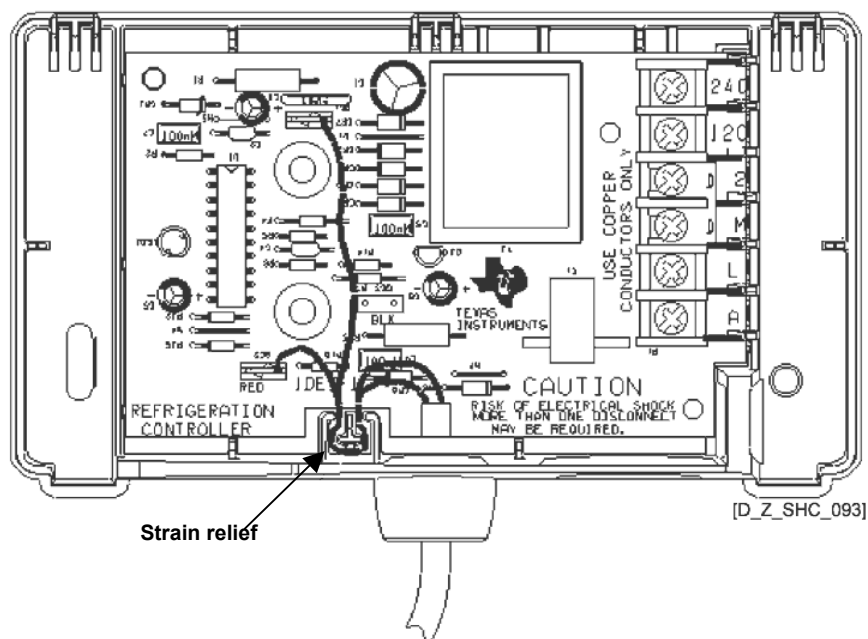
Removing the cable from the new Sentronic+™ module:

- 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 44



19.6.2 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 SentronicTM module terminal strip is designed to accept a bare wire end instead of a spade terminal
- If a SentronicTM 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.

20 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.

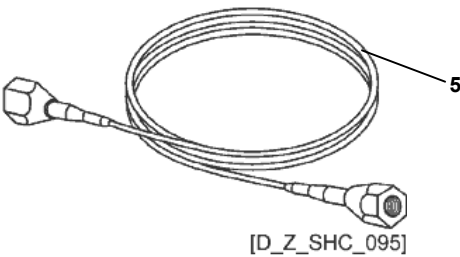
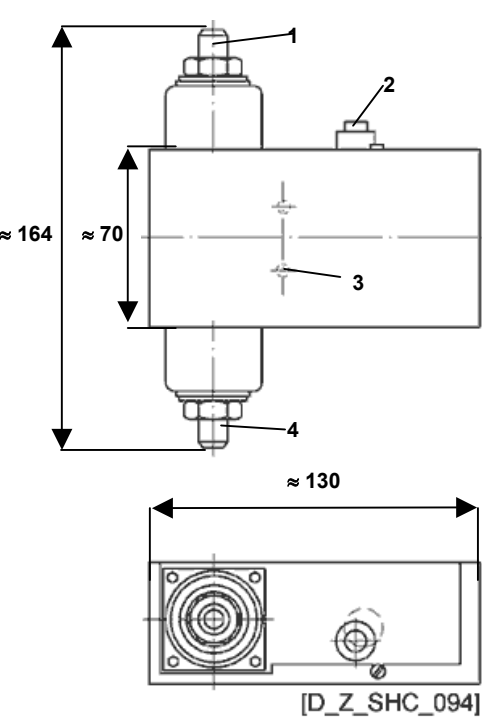
Supplier	Model No.	for Compressor	Voltage	Alarm Contact	Protection Class ¹⁾
Alco Controls	FD 113 ZU (A22-057)	DLH, D2 - D8	24..240 V AC/DC	yes	IP 30
Ranco	P 30 - 5842	DLH, D2 - D8	120/240 V	yes	IP 20
Danfoss	MP 55	DLH, D2 - D8	110/220 V	yes	
	P 45 NCA - 12	DLH, D2 - D8	120/240 V	no	IP 30
Penn	P 45 NCB - 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

D_T_SHC_037

Oil Pressure Differential Switch Alco FD 113 ZU

DLH – D8



1	crankcase connection	7/16" - 20 UNF
2	manual reset button	7/16" - 20 UNF
3	mounting bracket holes	
4	connection for oil pump	10 - 32 UNF B2
5	capillary tube Cu	1000 mm
6	cable blushing	

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	

Fig 45

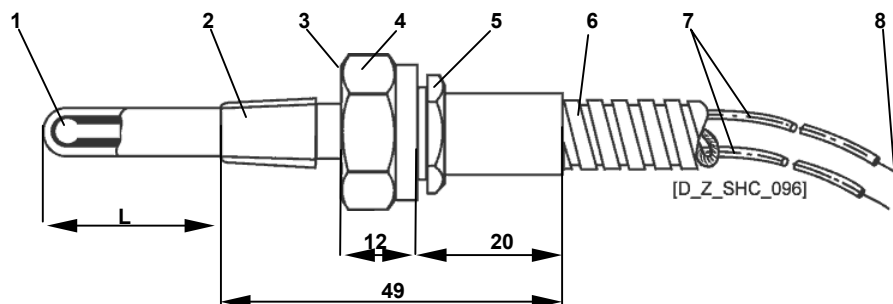
¹⁾ tentative data

21 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 65).

Fig 46



- | | | | |
|---|-----------------------|---|-----------------------------|
| 1 | Sensor (PTC) | 5 | PG 9 (15.2mm dia.) |
| 2 | Thread 1/8" – 27 NPTF | 6 | Corrugated hose (10mm dia.) |
| 3 | Hexagon SW 19 | 7 | Cable 0.75mm ² |
| 4 | Material No. | 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	2	50	155 °C	700	850
D6SJ, D6SA, D6SK	3				
D6SU, D8SJ, D8SK	4				
D4SH, D4SL, D6SH	2	25	145 °C	700	850
D6SL, D6ST	3				
D8SH	4				

1) NAT = nominal response temperature

D_T_SHC_039

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 the table must be mounted at the suitable position in the cylinder head (see fig.47). 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.

21.1 Mounting Position for Sensors

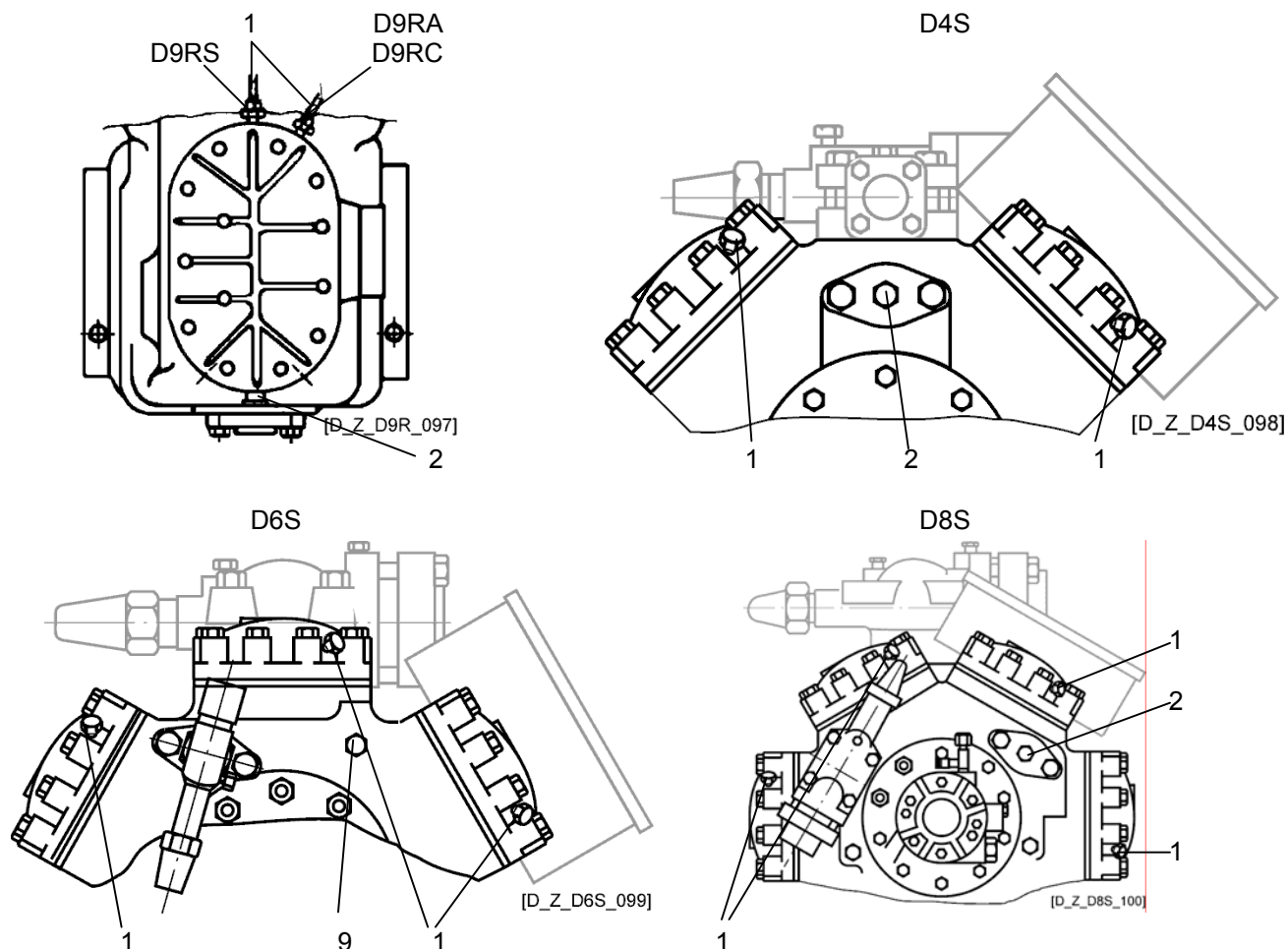


Fig 47

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 65).

21.2 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)	4mm ²
Making capacity (cos Ø ≥ 0.3)	11A
Breaking capacity	3A
Continuous current (max.)	5A
Position of installation	Any

21.3 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 65):
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.

22 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 $\pm 10\%$ 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 $\pm 10\%$

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 2.5 Ω .

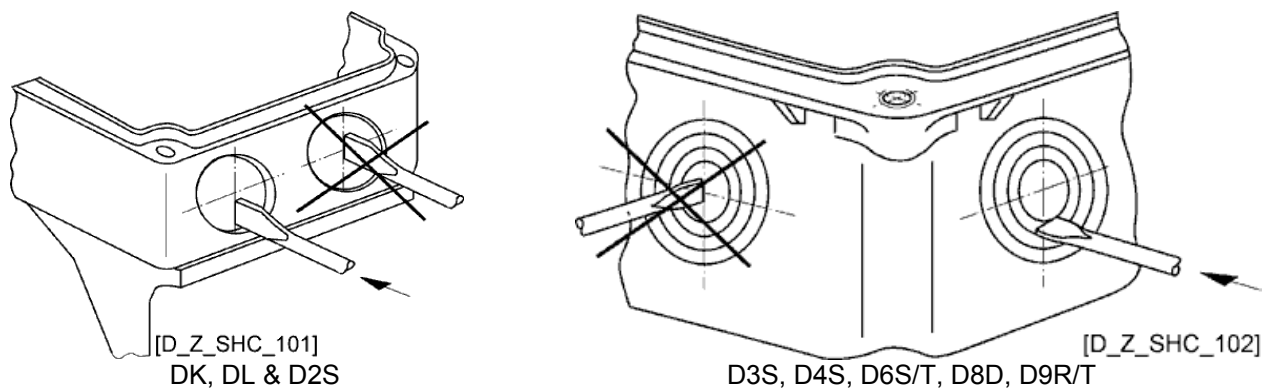


Fig 48: Terminal box preparation diagram for cable gland fitting: Note position of screwdriver!

Position at terminal box	Previous terminal box			New terminal box		
	Hole at terminal	Cable bushing	Outside	Hole at terminal	Cable bushing	Outside
	box diameter mm	Pg	diameter mm	box diameter mm	metric	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) D_T_SHC_040

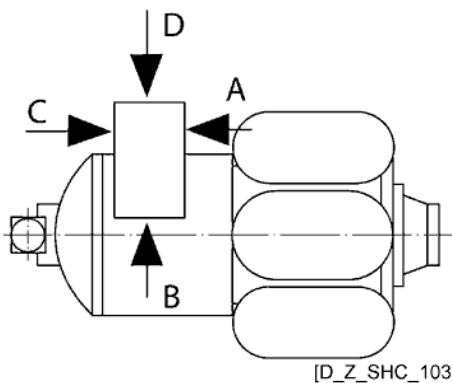


Fig 49

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

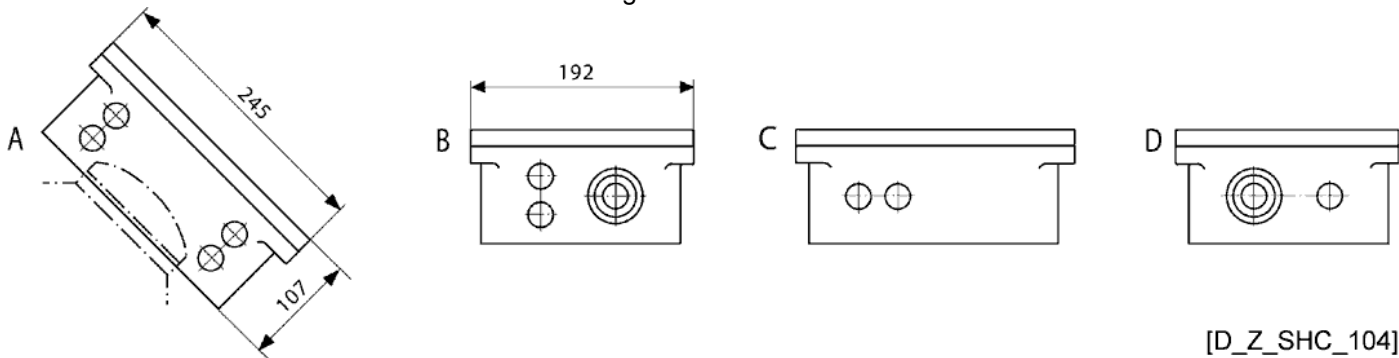
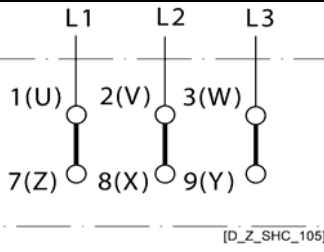
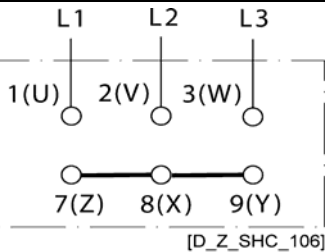
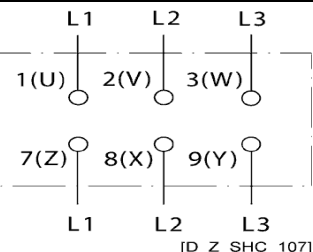
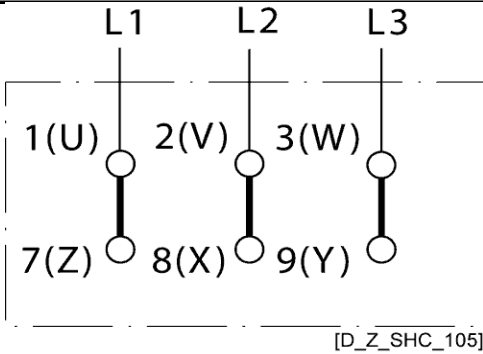
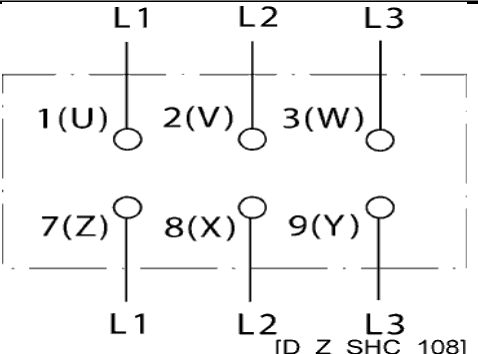
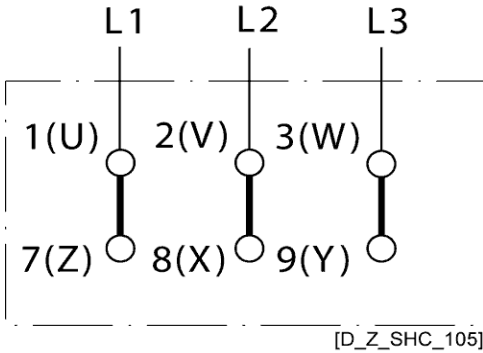
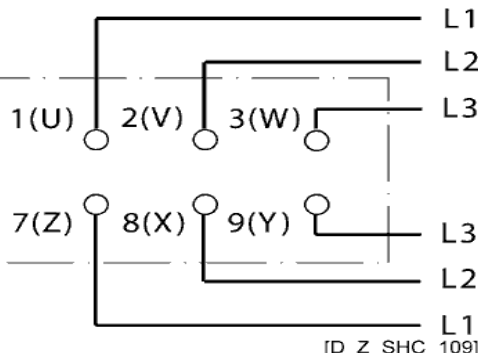
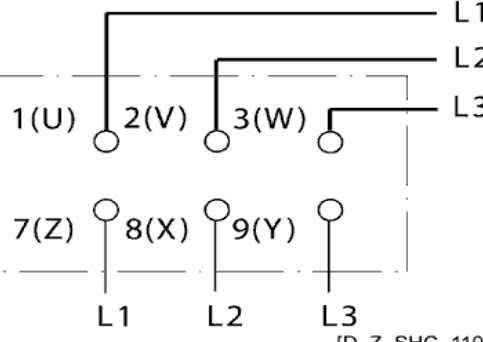
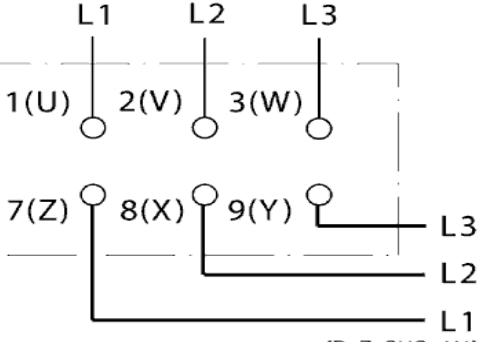


Fig 50

23 Principal Wiring Diagrams

23.1 Jumper Position Compressor Motor

Star-delta-motor Y - D Code E	Direct-on-line start Δ  [D_Z_SHC_105]	Direct-on-line start Y  [D_Z_SHC_106]	Direct-on-line start Y - Δ  [D_Z_SHC_107]
	Direct-on-line start Y - Y  [D_Z_SHC_105]	Part-winding start, first start step 1-2-3 Y - Y  [D_Z_SHC_108]	
	Direct-on-line start $\Delta - \Delta$  [D_Z_SHC_105]	Direct-on-line start $\Delta - \Delta$  [D_Z_SHC_109] D8SH*-5000 BWC, D8SJ*-6000 BWC	
Part-winding motor $\Delta - \Delta$ Code B	Part-winding start, starting wiring via terminals 1-2-3  [D_Z_SHC_110]	Part-winding start, starting wiring via terminals 7-8-9  [D_Z_SHC_111]	

D_T_SHC_140

23.2 Release Module INT69 and INT69 TM

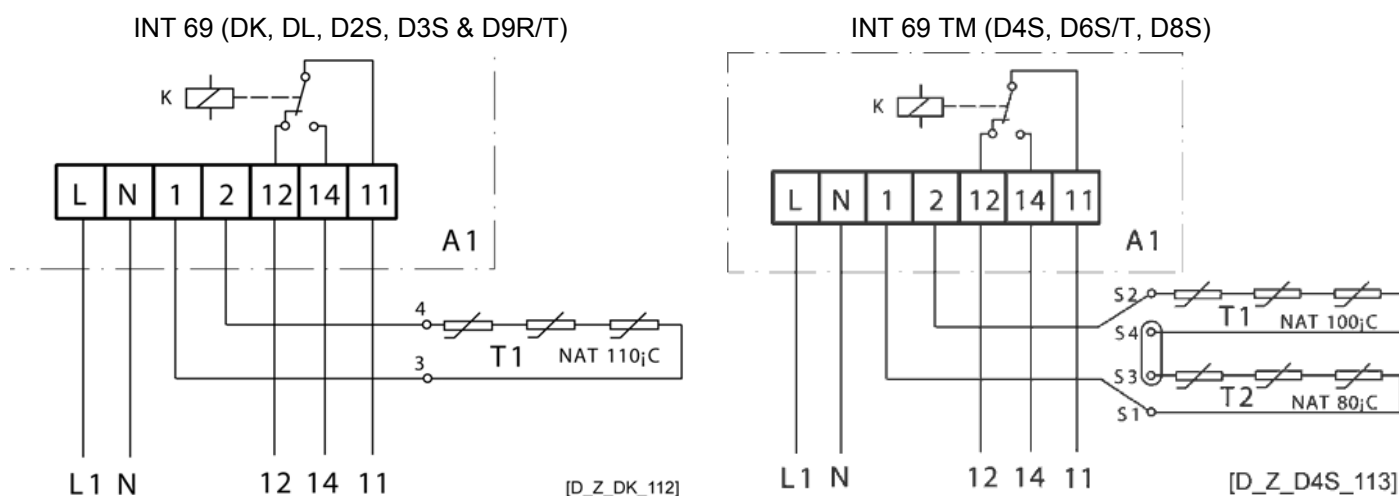
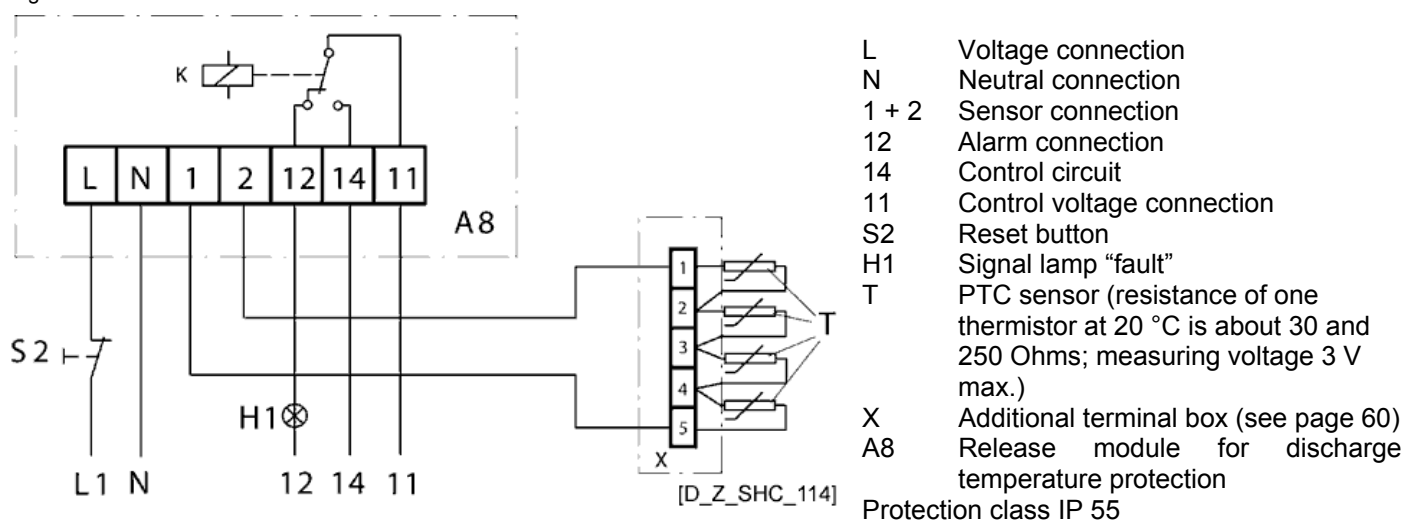


Fig 51

- 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

23.3 Discharge Temperature Protection

Fig 52



23.4 Oil Pressure Switch 1 (OPS1)

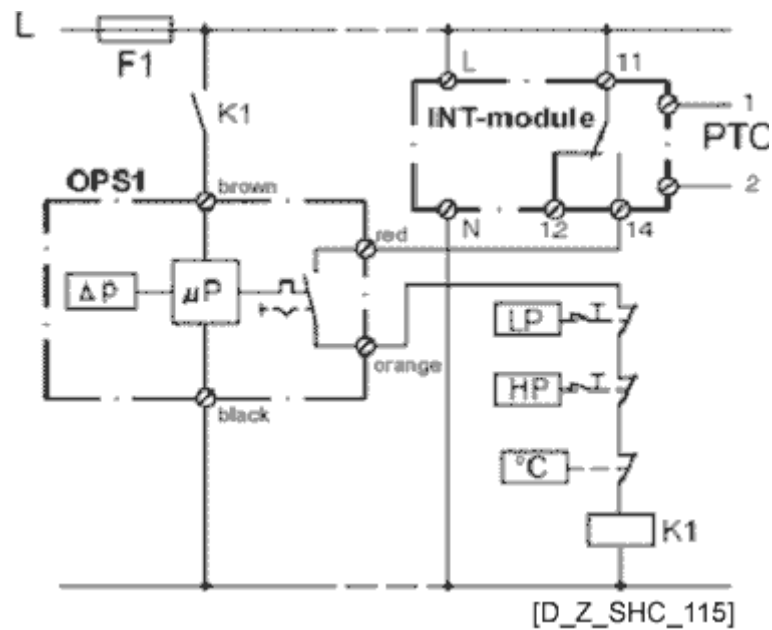


Fig 53

Wiring diagram OPS1 with aux. Relay KD (alarm integration)

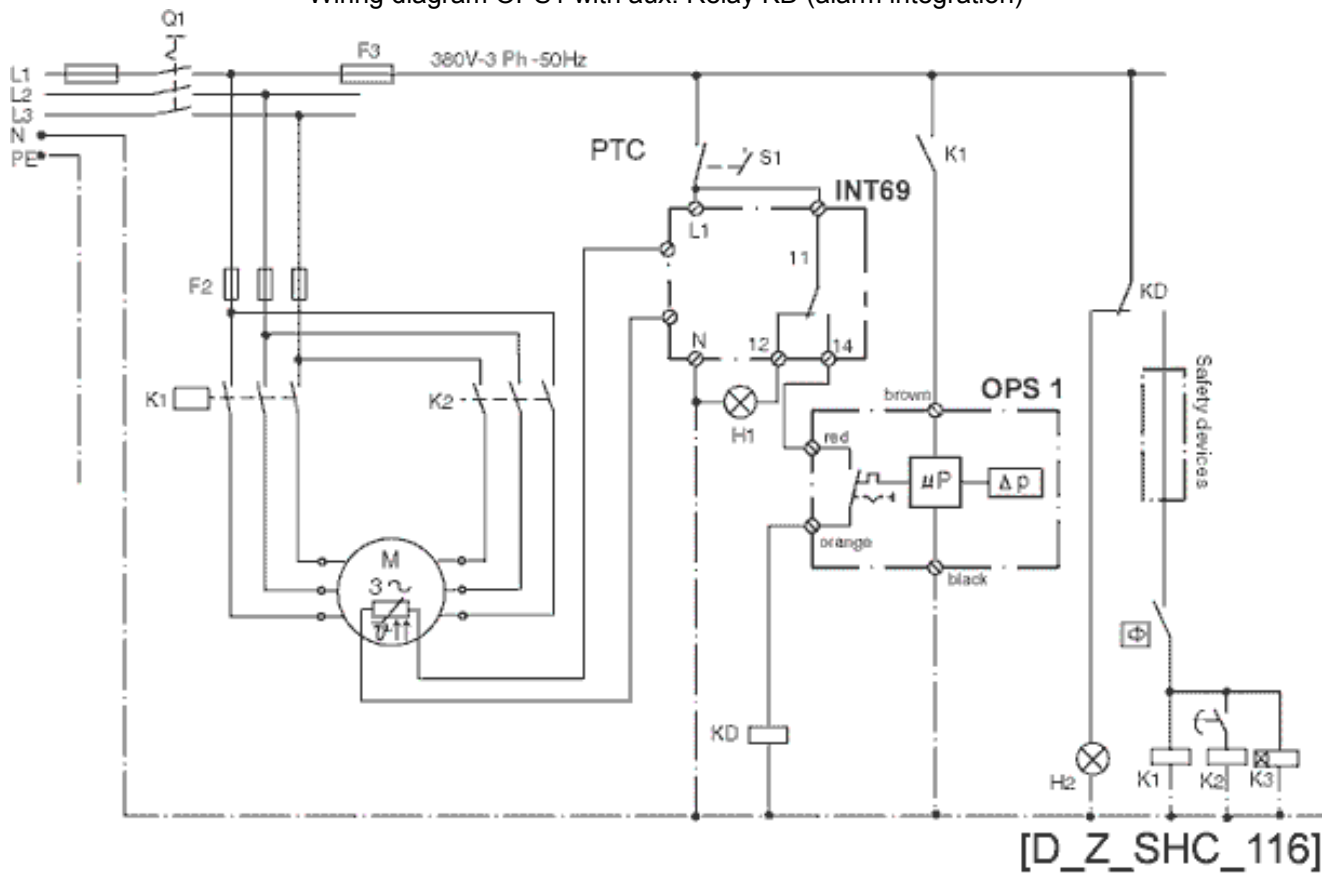


Fig 54

23.5 SENTRONIC Oil Pressure Control

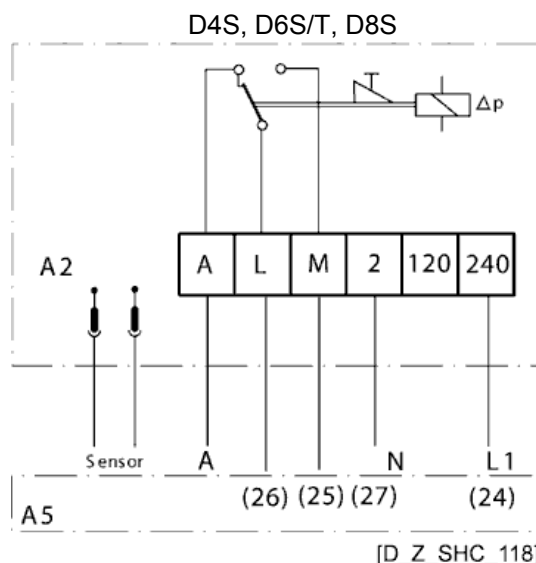
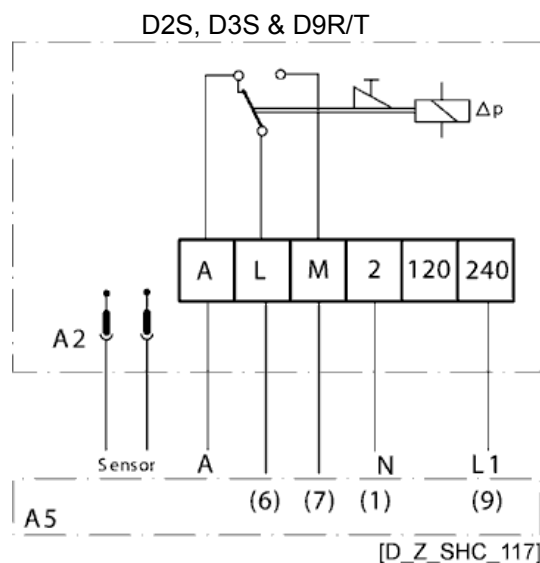


Fig 55

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

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

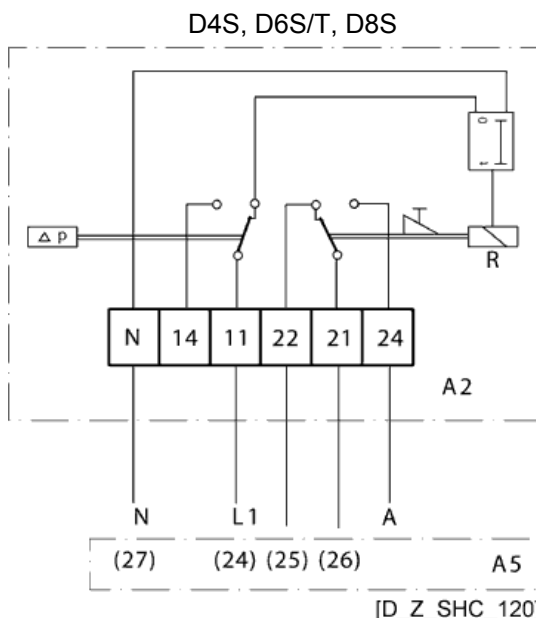
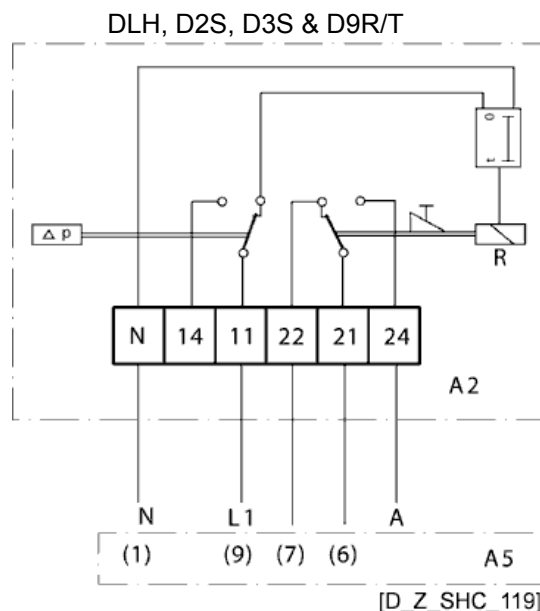


Fig 56

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

24 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.

24.1 Lubrication Problems

Compressors are delivered with an initial oil charge. The correct oil level is shown on page 11.

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 system 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.

24.2 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.

24.3 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.

24.4 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.

24.5 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 burn-out.

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.

24.6 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.

24.7 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.

24.8 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.

24.9 Motor Burn-out 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.

25 Technical Application Questions

Questions relating to application or technical assistance on Standard compressors should be addressed to your local Sales Office.

Notes

Benelux

Deltakade 7
NL-5928 PX Venlo
Tel. +31 (0) 77 324 0234
Fax +31 (0) 77 324 0235

Deutschland/Österreich & Schweiz

Senefelder Straße 3
D-63477 Maintal
Tel. +49 (0)6109 6059 0
Fax +49 (0)6109 6059 40

France/Greece & Maghreb

8, Allee Du Moulin Berger
F-69130 Ecully
Tel. +33 (0)4 78668570
Fax +33 (0)4 78668571

Italia

Via Ramazzotti, 26
I-21047 Saronno (va)
Tel. +39 02 961781
Fax +39 02 96178888

España & Portugal

Diputacion, 238 AT.8
E-08007 Barcelona
Tel. +34 93 4123752
Fax +34 93 4124215

UK & Ireland

Colthrop Way
GB- Thatcham, Berkshire - RG19 4 NQ
Tel. +44 (0)1635 87 6161
Fax +44 (0)1635 877111

Sweden/Denmark/Norway & Finland

Östbergavägen 4, P.O.Box 10
S-59021 Väderstad
Tel. +46 (0) 142 70520
Fax +46 (0) 142 70521

Eastern Europe, Turkey & Iran

27, Rue des Trois Bourdons
B-4840 Welkenraedt
Tel. +32 (0) 87 305 061
Fax +32 (0) 87 305 506

Poland

11A, Konstruktorska
PL-02-673 Warszawa
Tel. +48 225 458 9205
Fax +48 225 458 9255

Russia & CIS

Malaya Trubestkaya, 8-11th Floor
RUS-119881 Moscow
Tel. +7 095 232 94 72
Fax +7 095 232 03 56

Middle East & Africa

PO BOX 26382, R/A 8, FD-2
Jebel Ali, Dubai - UAE
Tel. +9714 883 2828
Fax +9714 883 2848

Asia/Pacific

10/F, Pioneer Building, 213 Wai Yip Street,
Kwun Tong, Kowloon - Hong Kong
Tel. +852 28 66 31 08
Fax +852 25 20 62 27

Latin America

7975 North West 154Th Street - Suite 300
Miami Lakes, FL, 33016 - USA
Tel. +1 305 818 8880
Fax +1 305 818 8888



Copeland Marketing & Sales - 27, Rue des Trois Bourdons - B 4840 Welkenraedt, Belgium
Tel. +32 (0) 87 305411 - Fax +32 (0) 87 305506 - internet: www.ecopeland.com - email: eCommerce@eCopeland.com

The Emerson logo is a trademark and service mark of Emerson Electric Co. Copeland Corporation is a division of Emerson Electric Co. Copeland is a registered trademark. All other trademarks are property of their respective owners. Information contained in this brochure is subject to change without notification.

© 2005 Copeland

