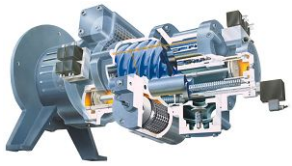
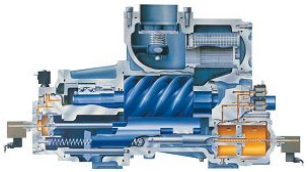
Grasso GmbH Berlin
Service Department

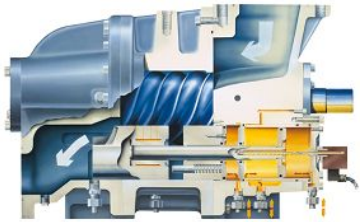
Schulung / Training
Part I

Schraubenverdichter & Komponenten
screw compressors & components

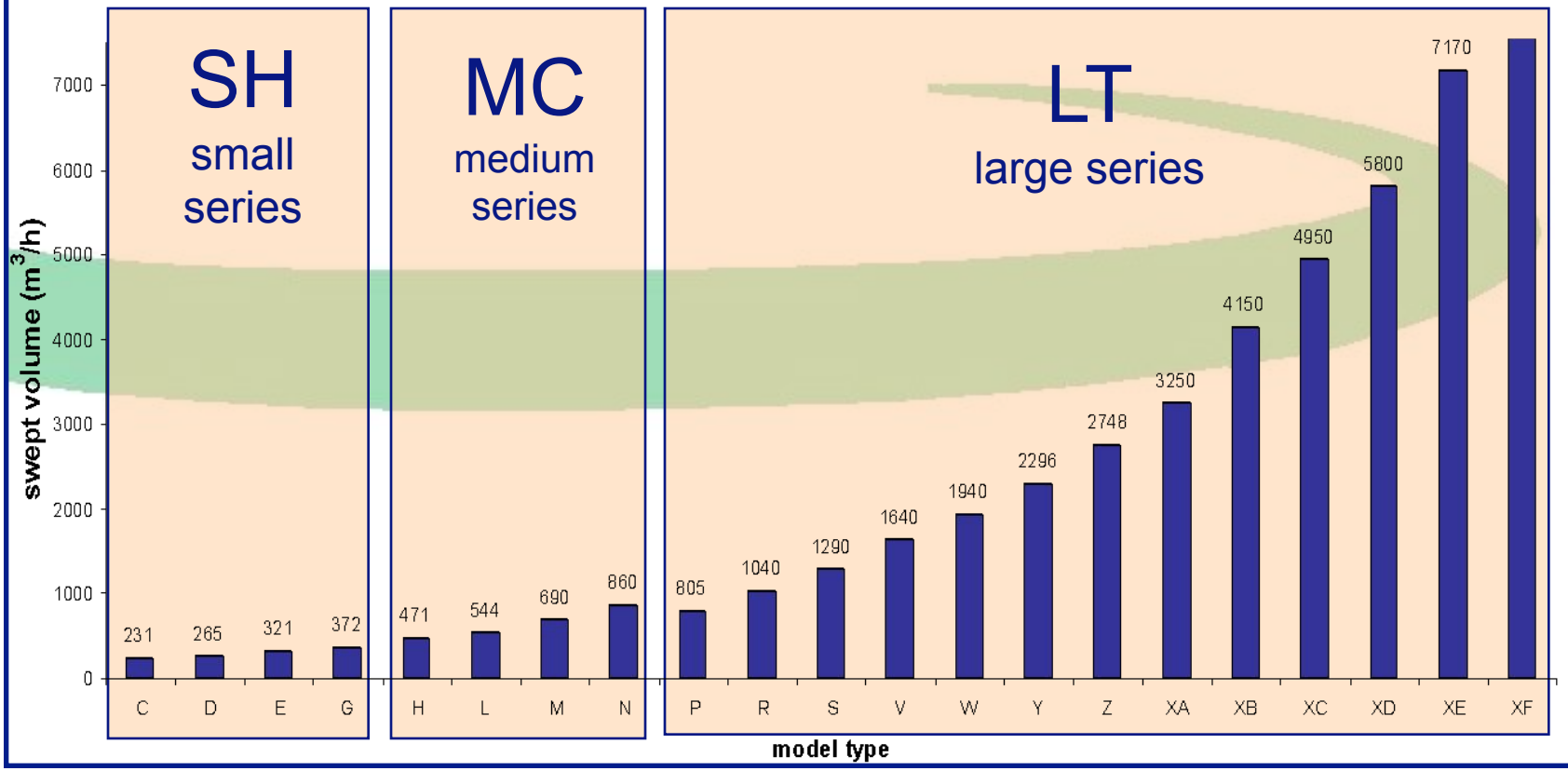
* 2940 U/min (rpm)



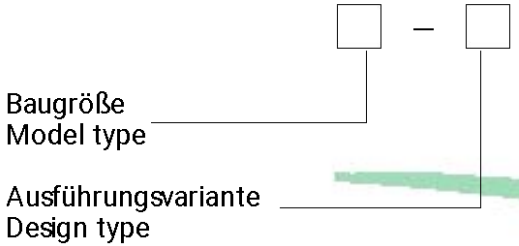




8560



Bezeichnung / Designation code

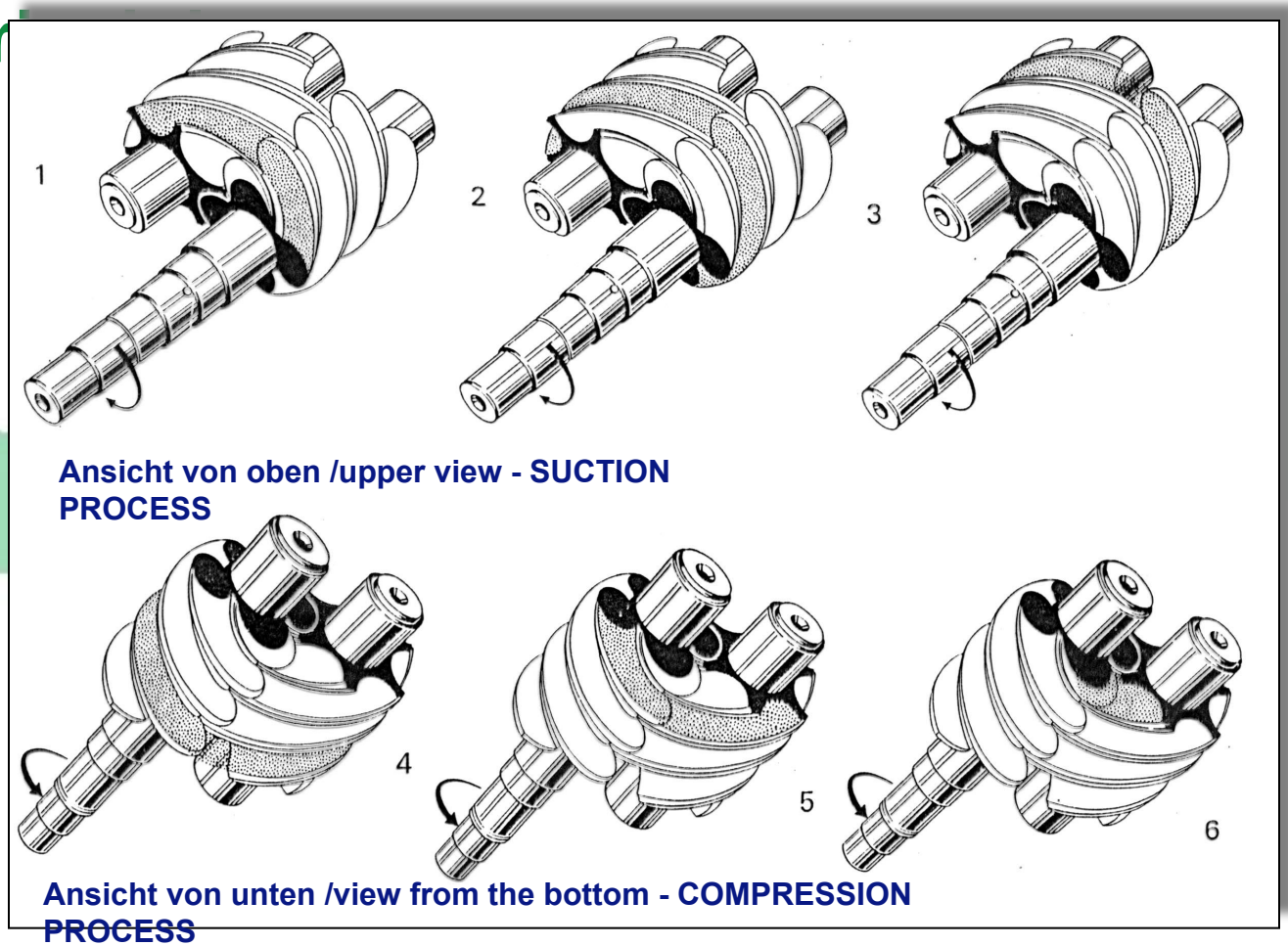


Baugröße/Model type:
C, D, E, G, H, L, M, N, P, R, S, V, Y, Z, XA (a), XB (b), XC (g), XD (d)

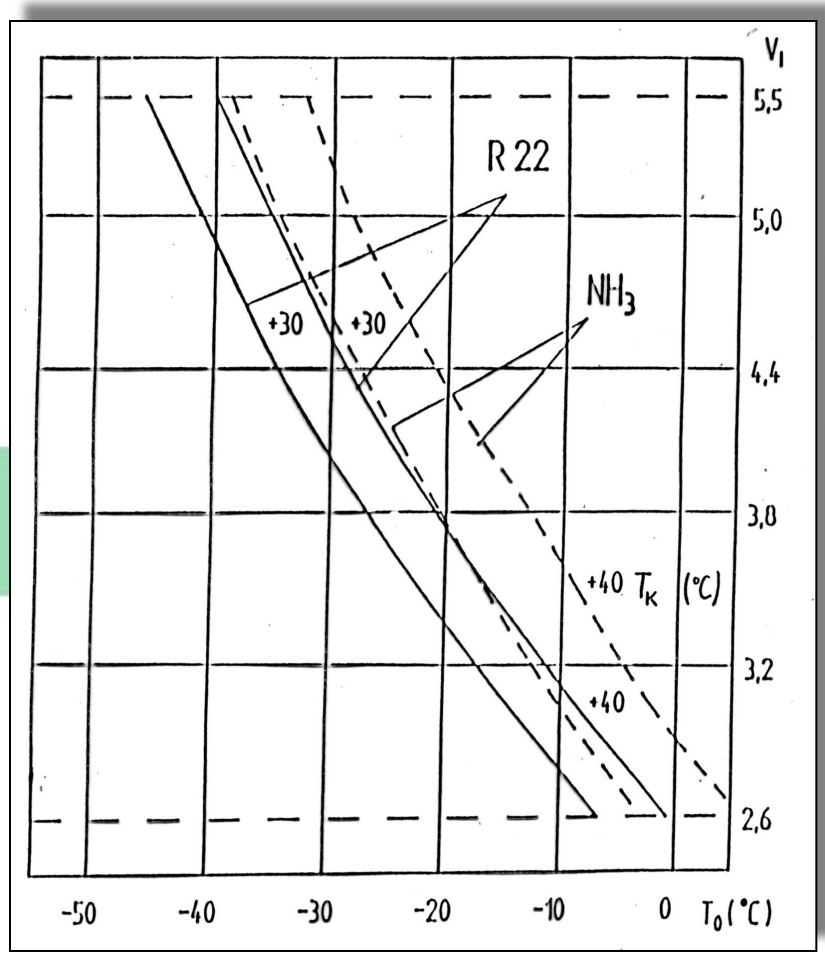
Ausführungsvariante/Design type:

	Merkmale	Features	Vi
1	Vi fest	Vi fixed	2,6
2	Vi fest	Vi fixed	3,6
3	Vi fest	Vi fixed	4,8
4	Vi fest	Vi fixed	5,5
51 ; 52 ; 53	Vi variabel	Vi variable	51: 2,6/4,8; 52: 2,6/4,0; 53: 3,2/4,8
61 ; 62	Booster, Vi fest	Booster, Vi fixed	61: 2,6; 62: 3,6
71 ; 72	Wärmepumpe, Vi fest	Heat pump, Vi fixed	71: 2,6; 72: 3,6
8	2 Leistungsstufen (nur Small Verdichter)	2 power levels (only small compressors)	Vi = 2,6; 3,6 ; 4,8
9	Drehzahlgeregelt (nur Typ G, N)	Frequency controlled (only type G, N)	Vi = stufenlos / Continously adjustable

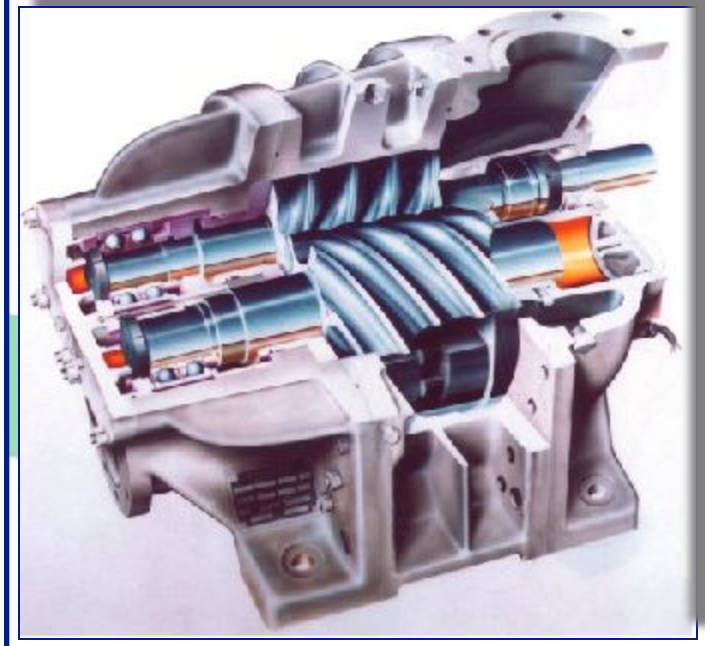
Verdichtungsprinzip / Compression pr

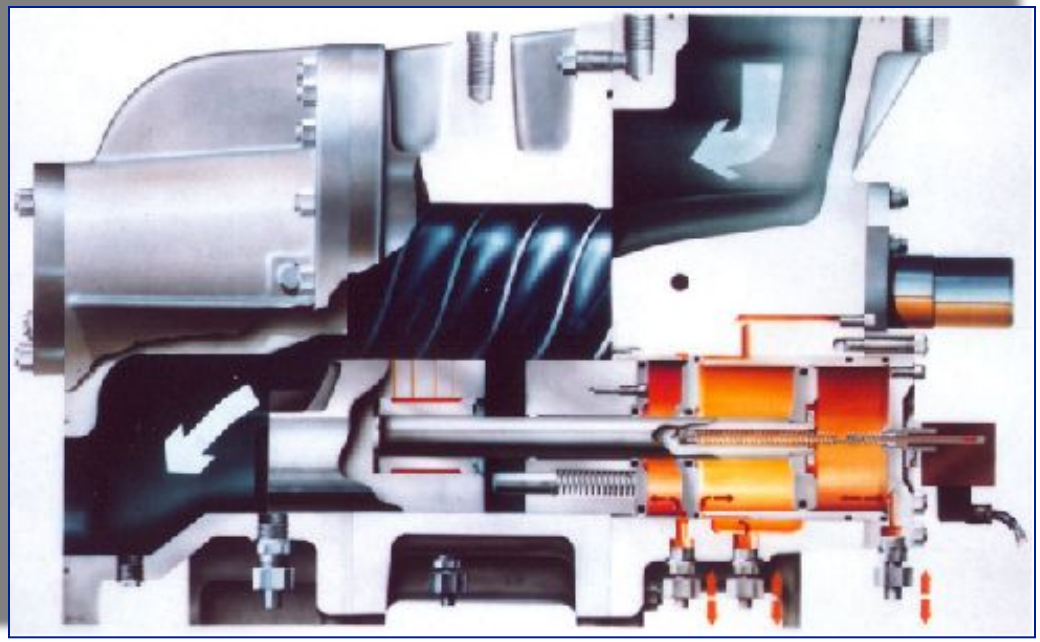


Vi-Diagramm / Vi-diagram



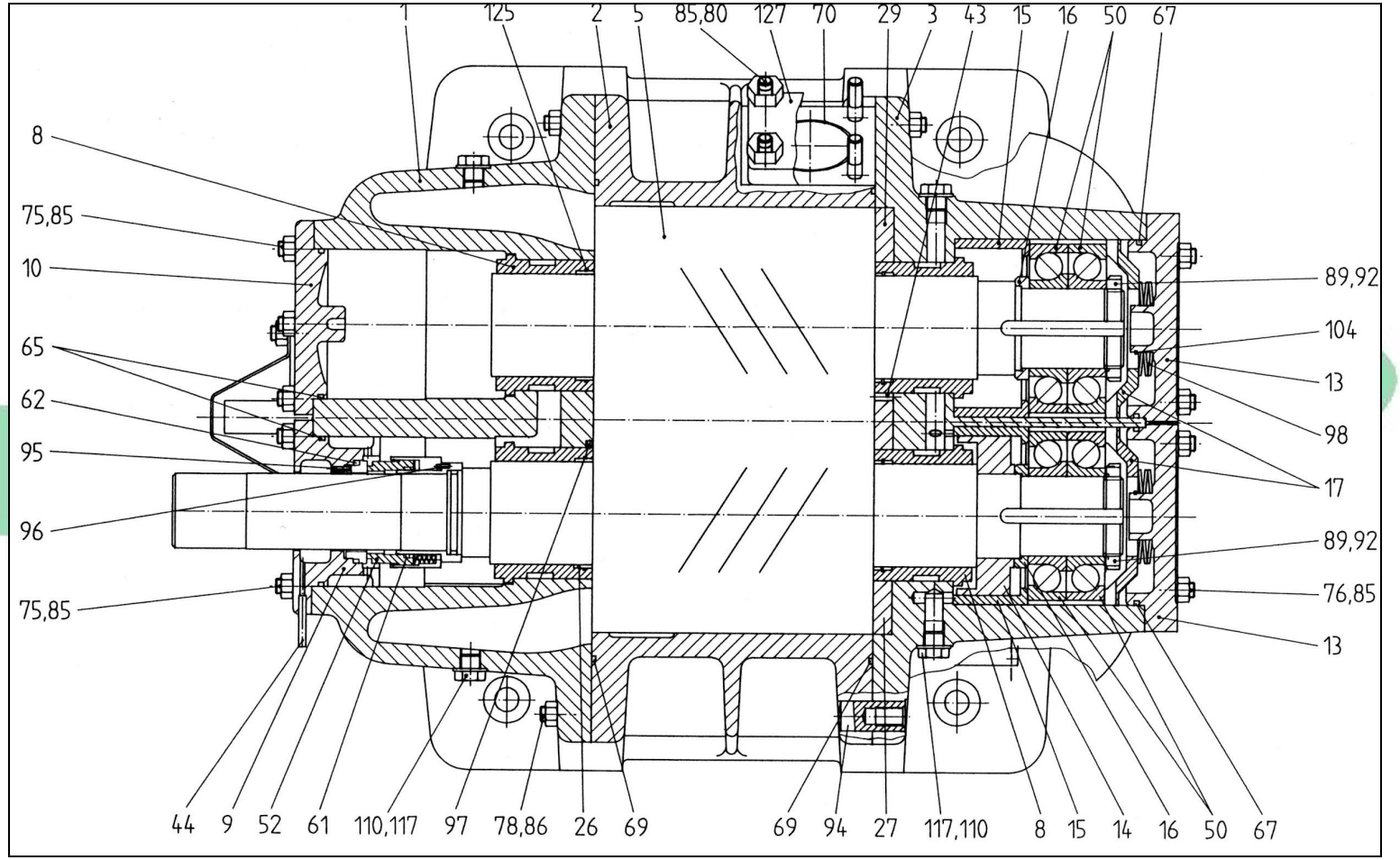
Verdichter / Compressor - LARGE



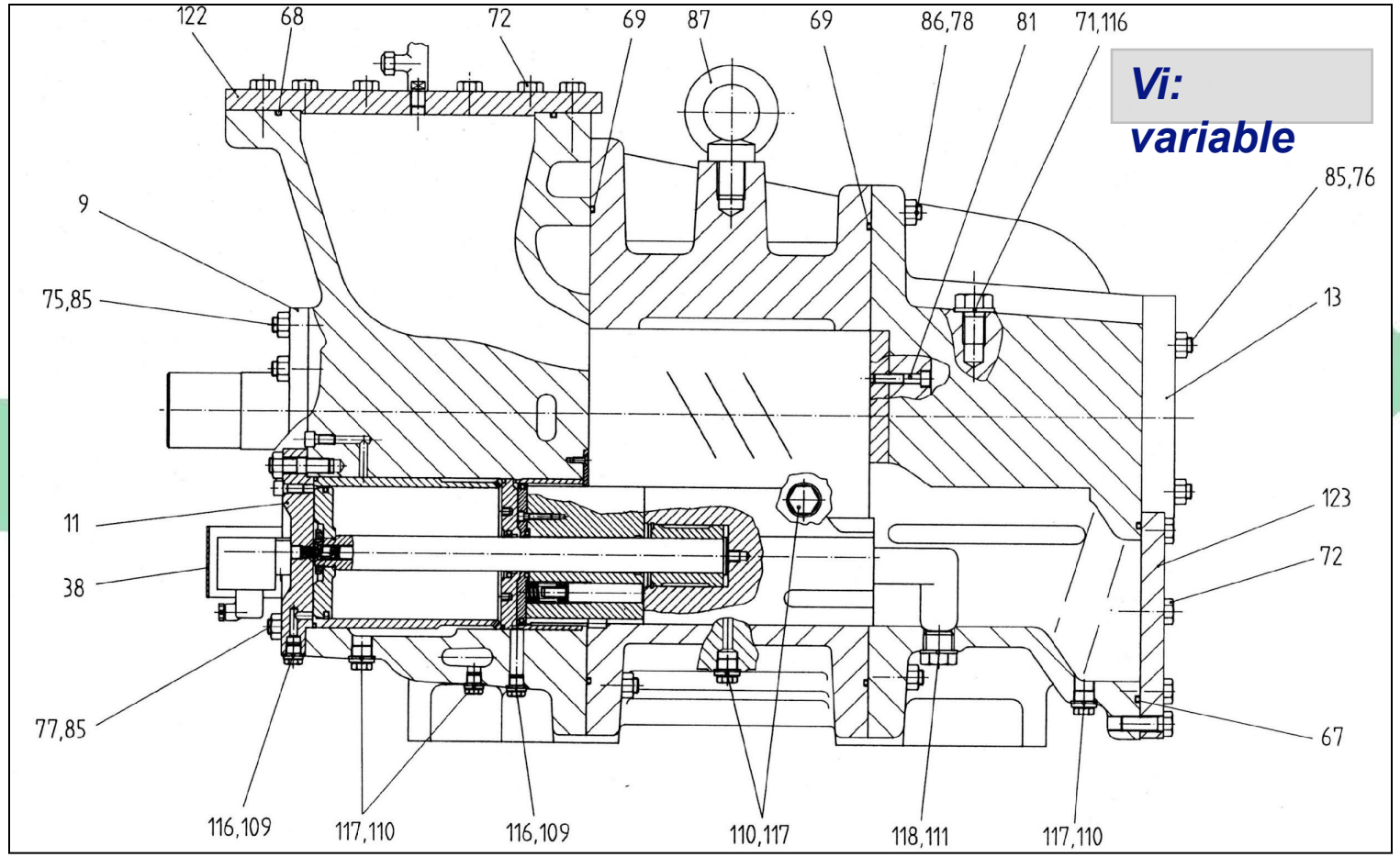


Vi: variable

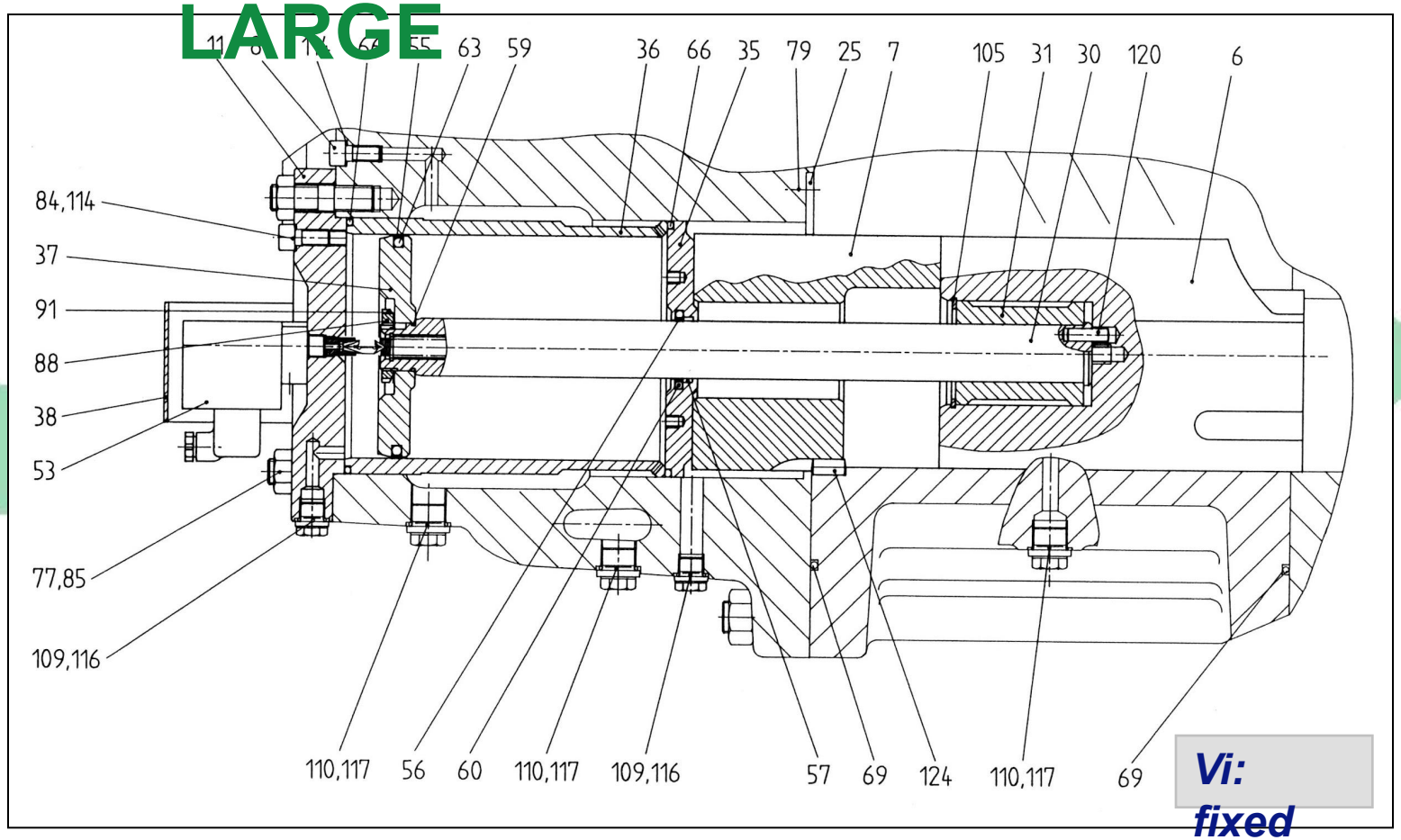
Verdichter / Compressor LARGE



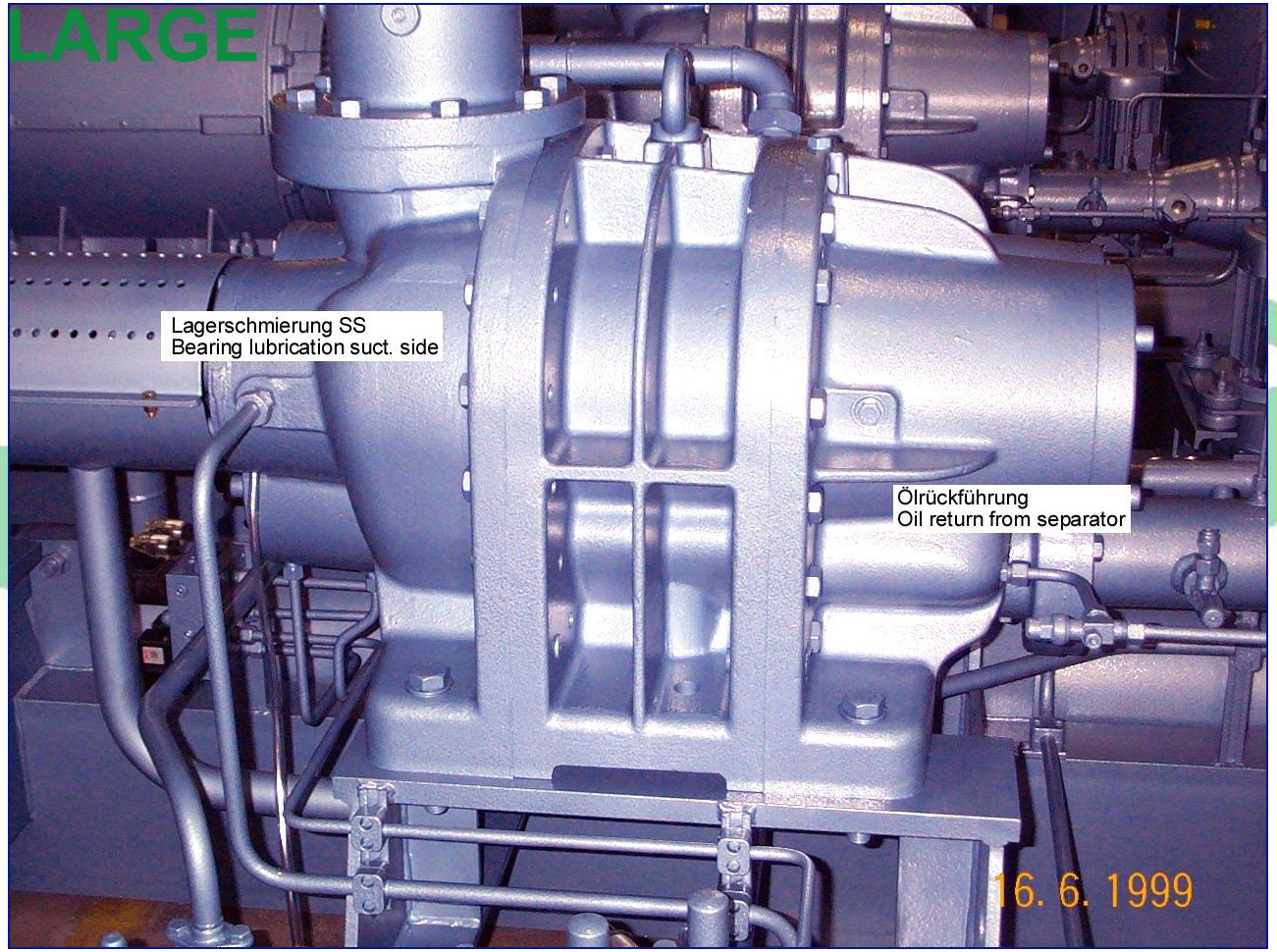
Verdichter / Compressor



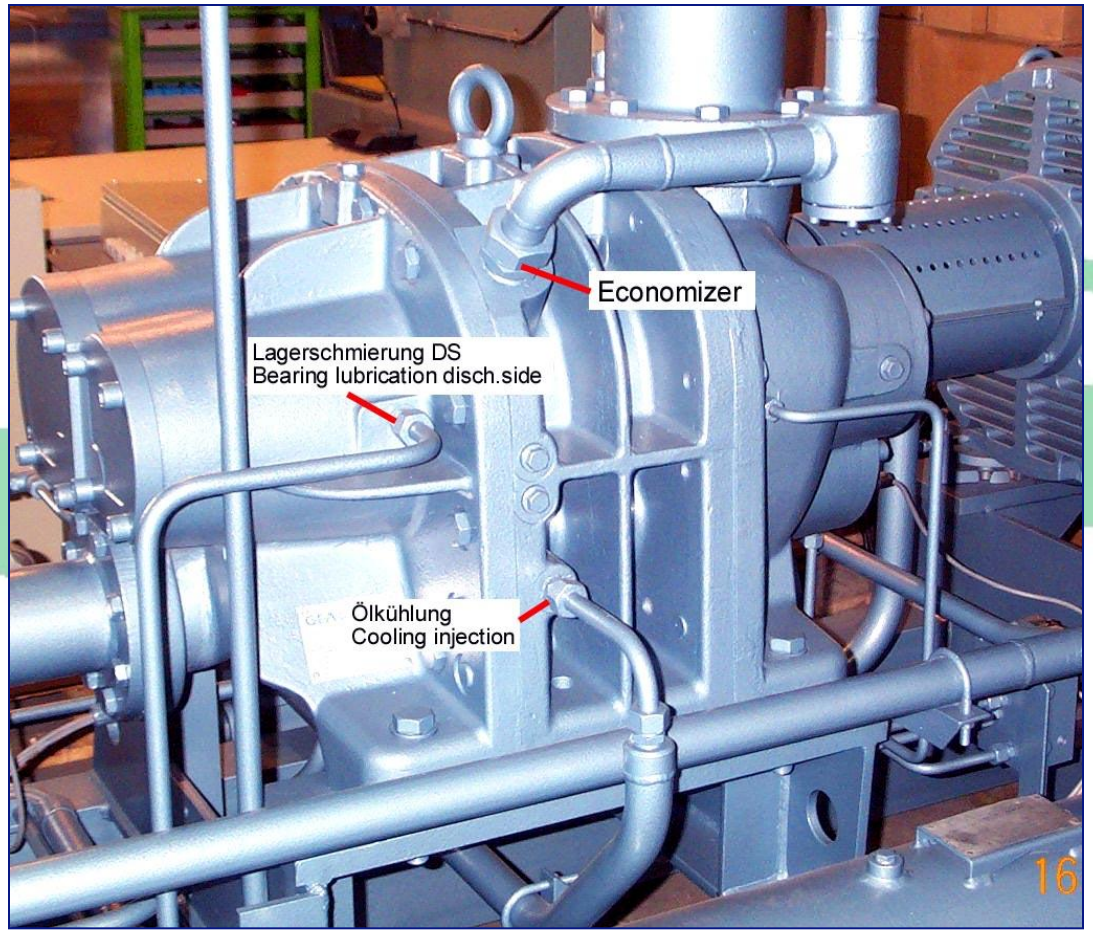
Verdichter / Compressor LARGE



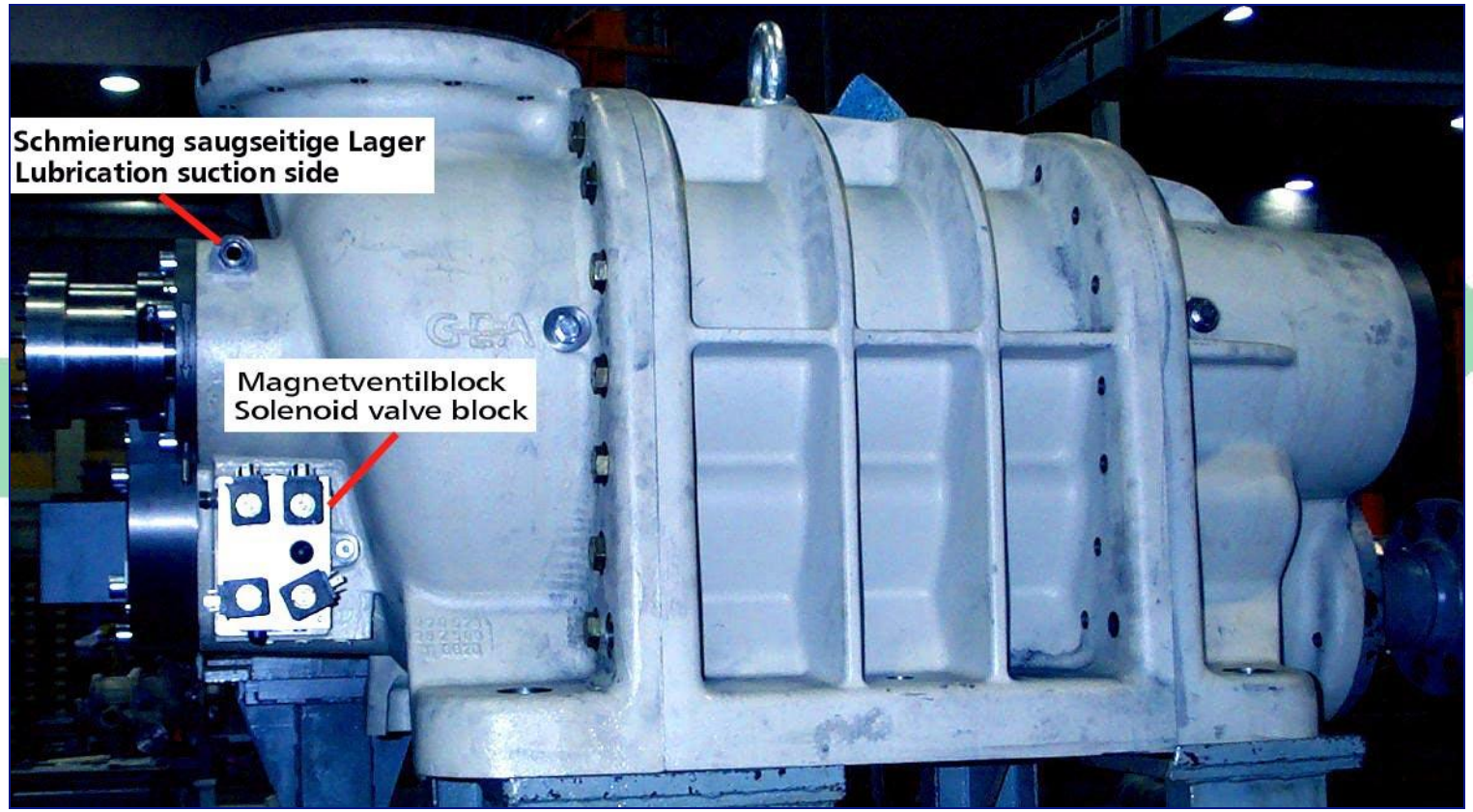
Verdichteranschlüsse / Oil connections



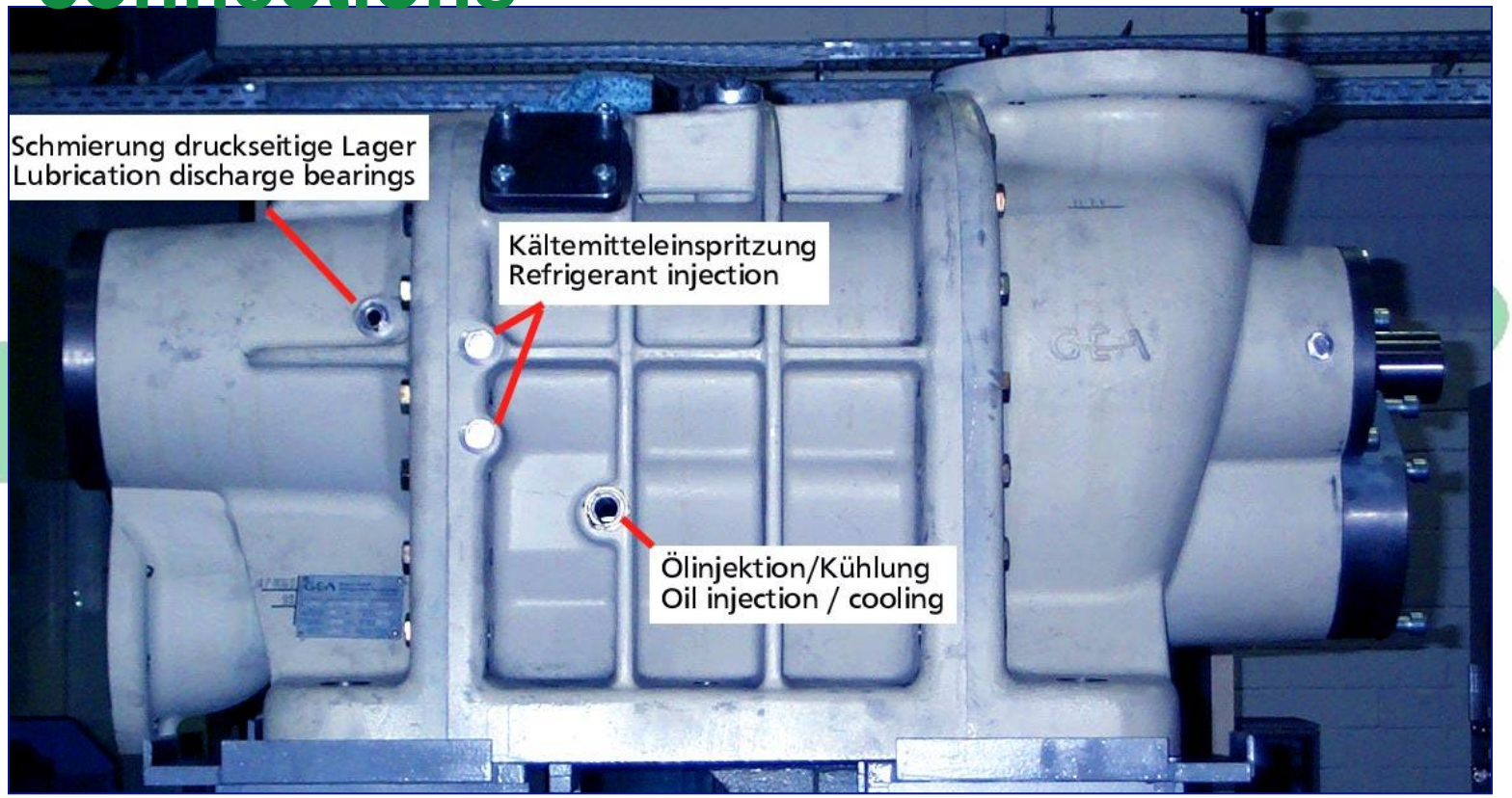
Verdichteranschlüsse / Ports - LARGE



Position MV-Block / Solenoid block

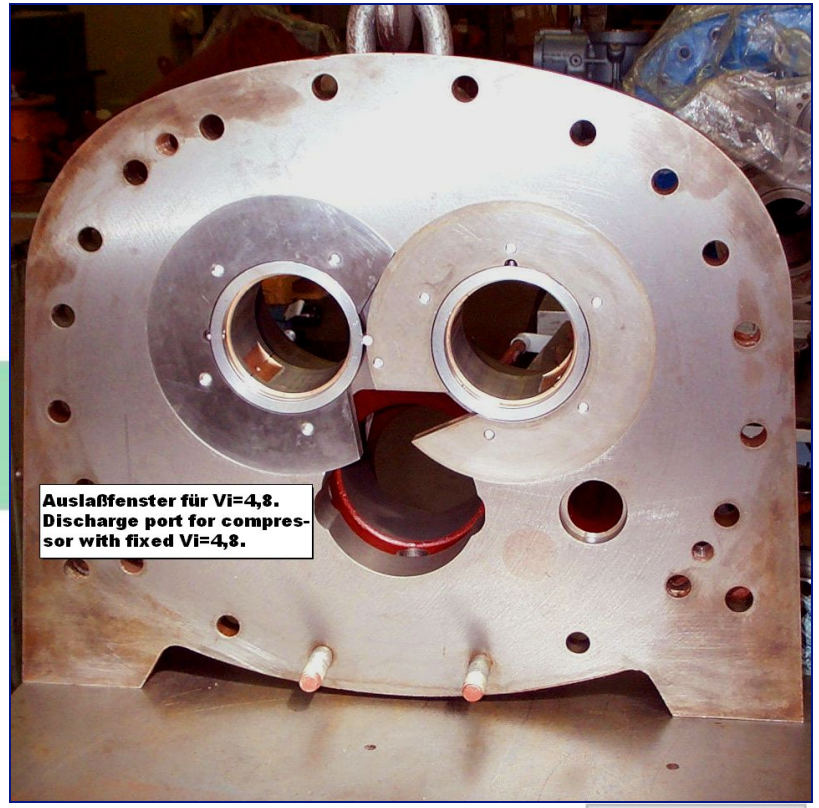


Verdichteranschlüsse / Oil connections



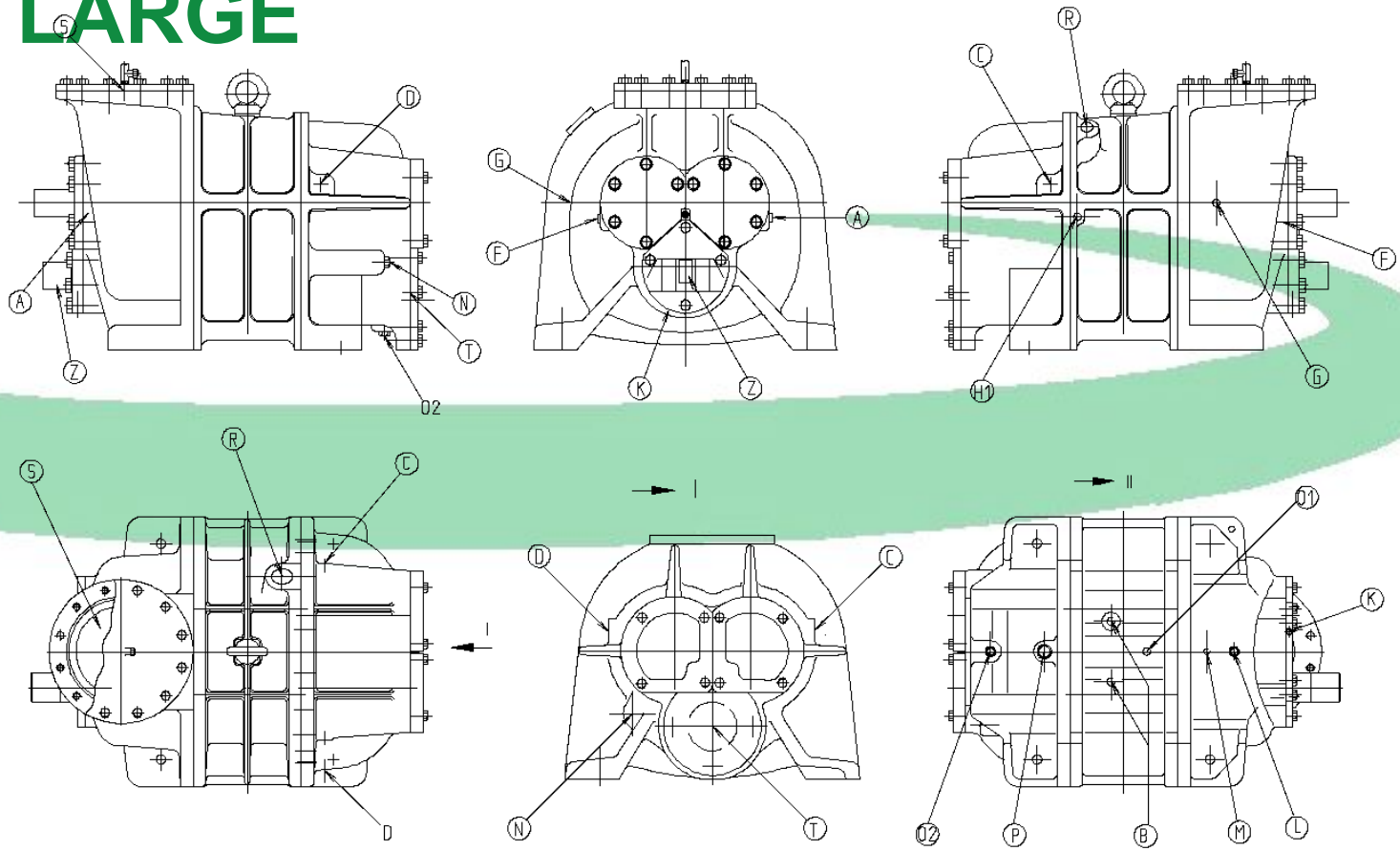
Rotorgehäuse
Rotor casing

Druckgehäuse
Discharge casing



Vi: fixed

Anschlüsse / Connections - Series LARGE

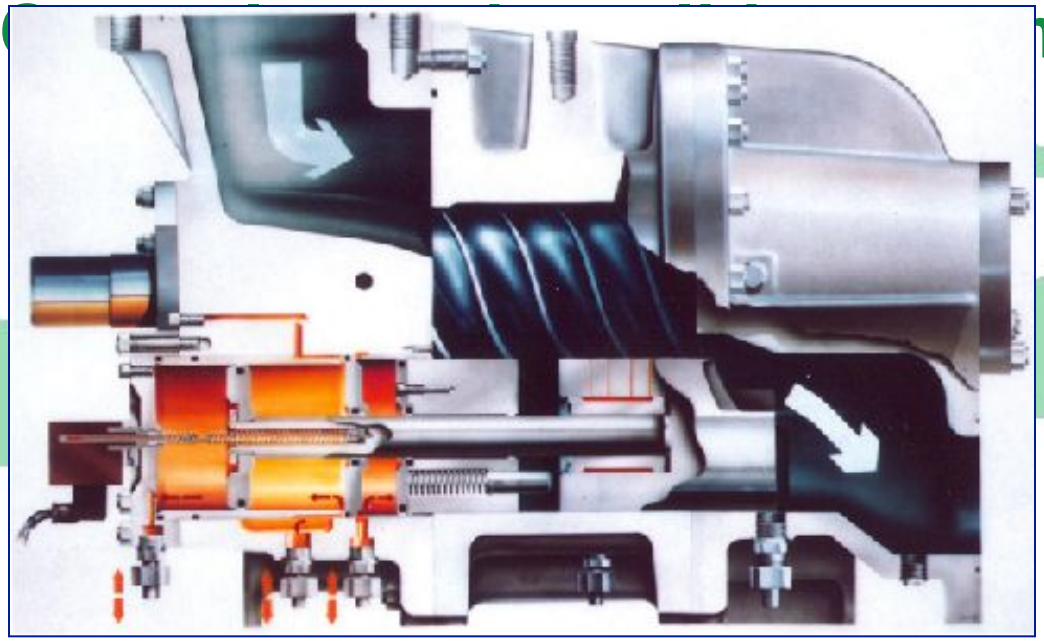


Anschlüsse / Connections - Series LARGE

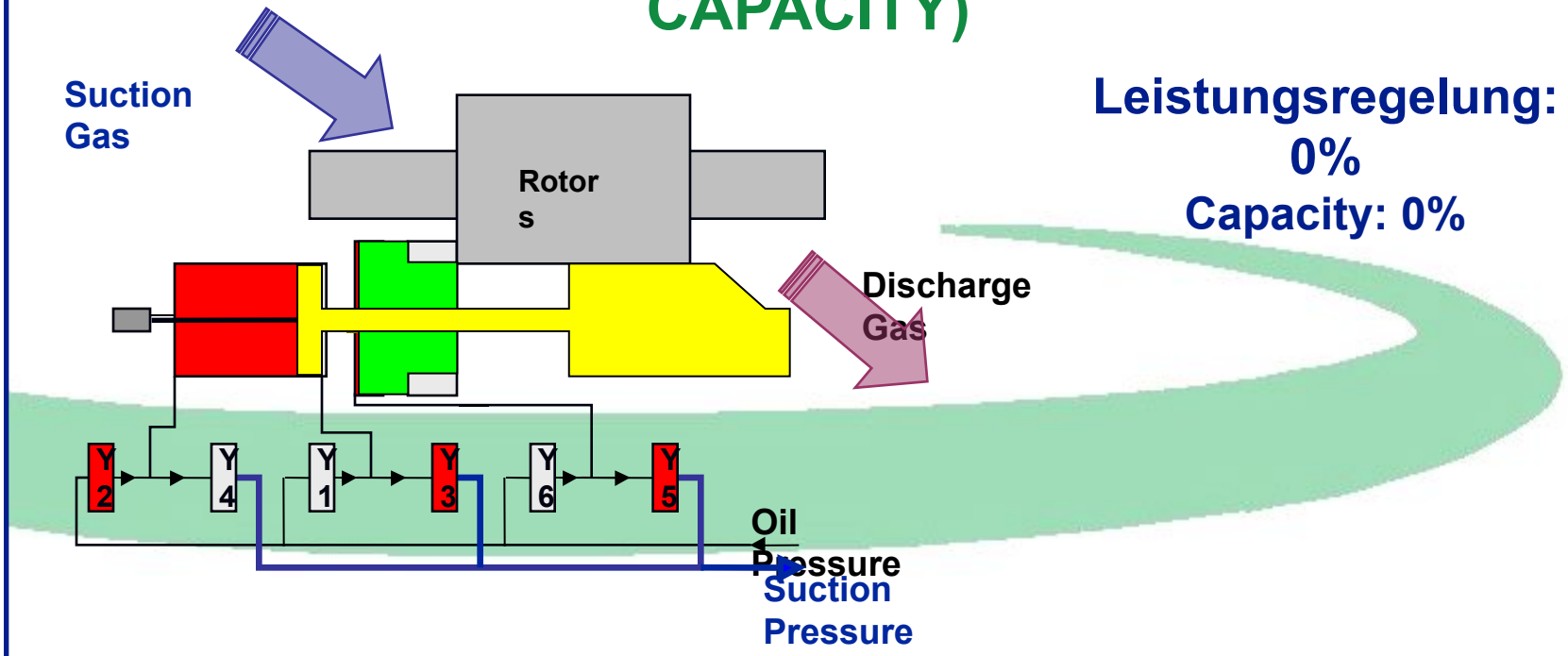
Connections Screw compressors LT Series,
Types : P, R, S, V, Y, Z, XA, XB, XC, XD, XE, XF

Anschl. Item	Zweck	Description	Anschl. Item	Zweck	Description
S	Saugstutzen	Suction nozzle	H2	Kältemitteleinspritzung (HD)	Refrigerant liquid injection (HP)
T	Druckstutzen	Discharge nozzle	K	Leistungsregelung, Regelrichtung Teillast	Oil supply, direction part load
A	Gleitringdichtung, saugseitige Lagerung	shaft seal, suction side bearing	L	Leistungsregelung, Regelrichtung Vollast	Oil supply, direction full load
B	Öleinspritzung Arbeitsraum	Oil injection compression chamber	M	Ölzu-/ -rückführung bei variablem Vi	Oil supply and return, variable Vi
C	Ölzuführung druck-seitige Lagerung, Ausgleichskolben	discharge side bearing, balance piston	N	Ölrückführung Ölabscheider	Oil return oil separator
D	Ausgleichskolben Wärmepumpe	balance piston heat pump	P	Gasschwingungsschutz	Gas pulsation protection
F	Zusatzöleinspritzung	Additional oil injection	R	Economizer-Anschluß	Economizer port
G	Ölrückführung Leistungsregelung	Oil return capacity control	O1	Ölablaßschraube	Oil drain plug
H1	Kältemittel-einspritzung (ND)	Refrigerant liquid injection (LP)	O2	Ölablaßschraube	Oil drain plug

Regelung – Tandem Schiebersystem



Startbedingung /Start Condition (INCREASE CAPACITY)



Leistungsregelung: 0%
Capacity: 0%

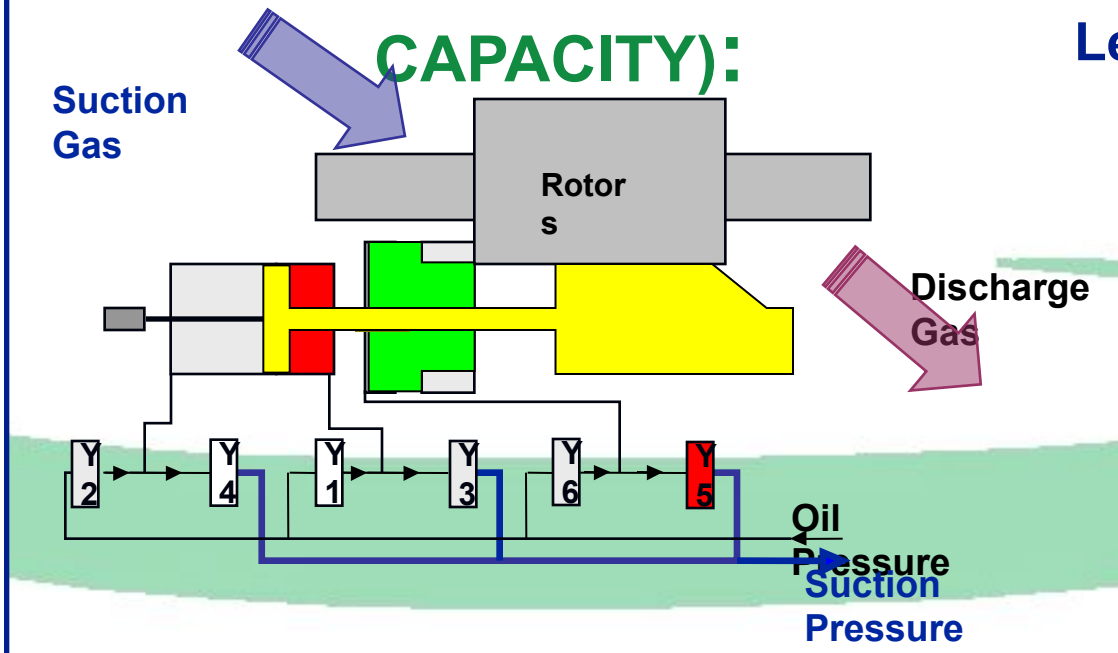
- Magnetventile Y2, Y3, Y5 mit Dauersignal angesteuert

Leistungsanzeige: 0%

Solenoid valves Y2, Y3, Y5 constantly energized

Capacity indication: 0%

MODE 1 (INCREASE CAPACITY):



Leistungsregelung: 0% -X%

Capacity: 0% - X%

with X% = 73%-100%

Depends on:
- **Vi (Po,Pk,refrigerant)**
- **Compressor model**

1. **Magnetventile Y1, Y4 gepulst angesteuert (Ansteuerung von Primärschieber)**
2. **Magnetventile Y5 mit Dauersignal angesteuert (Vi-Schlitten nicht angesteuert)**

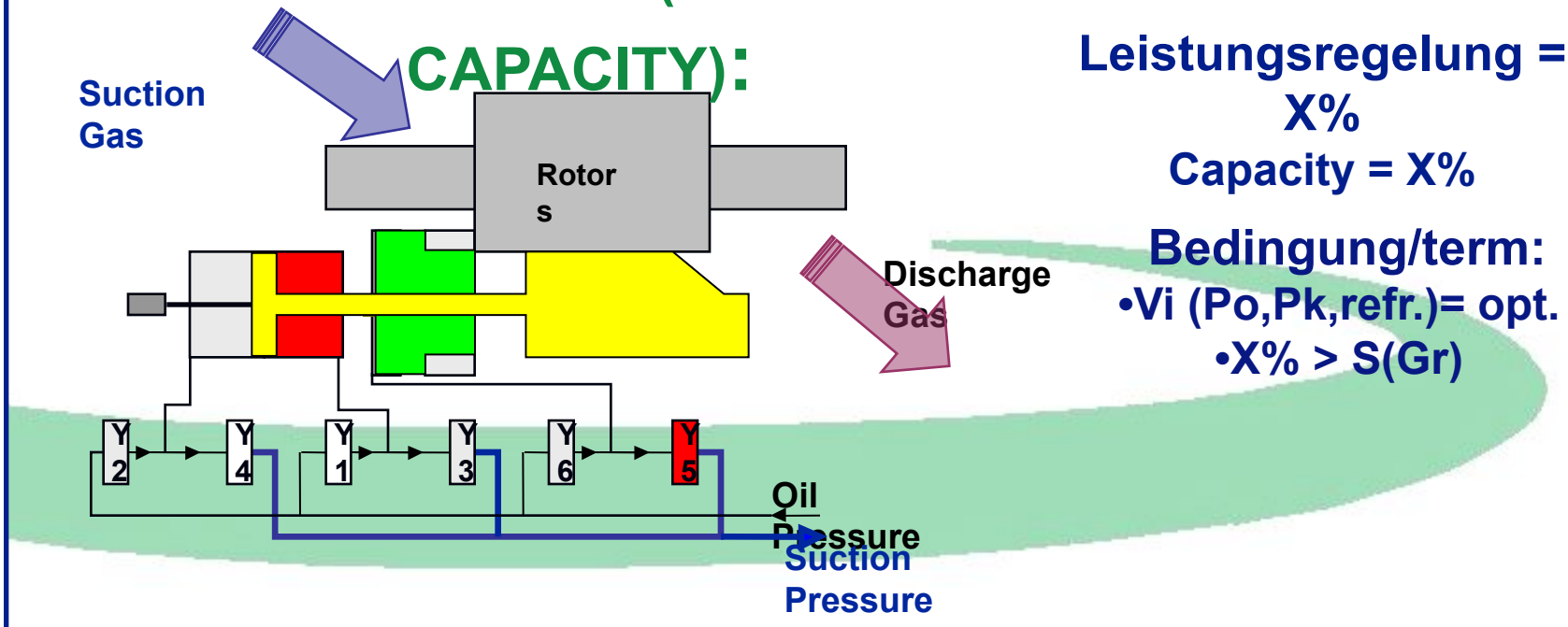
Leistungsanzeige: Pos. von Primärschieber

1. **Solenoid valves Y1, Y4 pulsed energized (primary slide is controlled)**
2. **Solenoid valve Y5 constantly energized (Vi-slide not controlled)**

Capacity indication: primary slide position

Vi-Regelung LARGE / Vi-Control LARGE

End of MODE 1 (INCREASE CAPACITY):



Leistungsregelung = X%

Capacity = X%

Bedingung/term:

- **Vi (Po,Pk,refr.)= opt.**
- **X% > S(Gr)**

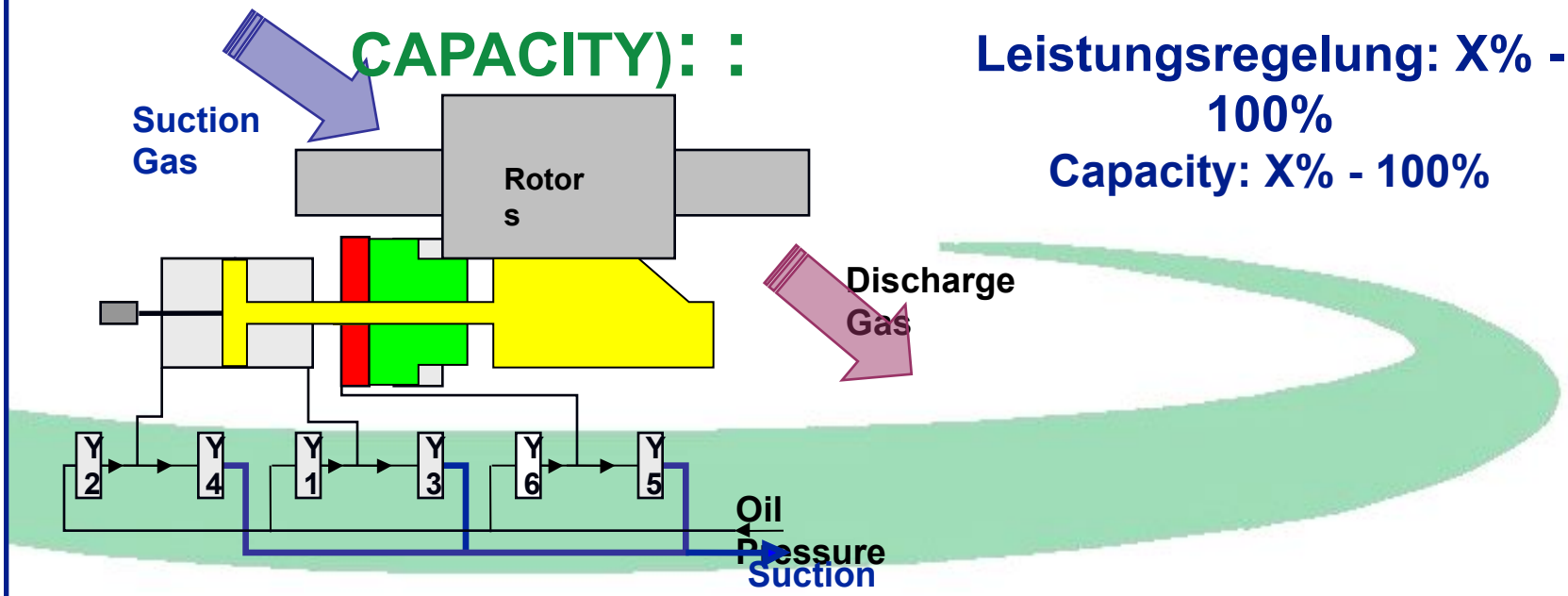
1. **Magnetventile Y1, Y4 gepulst angesteuert (Ansteuerung von Primärschieber)**
2. **Magnetventile Y5 mit Dauersignal angesteuert (Vi-Schlitten nicht angesteuert)**

Leistungsanzeige: Pos. von Primärschieber

1. **Solenoid valves Y1, Y4 pulsed energized (primary slide is controlled)**
2. **Solenoid valve Y5 constantly energized (Vi-slide not controlled)**

Capacity indication: primary slide position

MODE 2 (INCREASE CAPACITY): :



Leistungsregelung: X% - 100%
Capacity: X% - 100%

1. Magnetventile Y6 gepulst angesteuert (Vi-Schlitten angesteuert)
2. Stellung Primärschieber wird gemäß Betriebs- bedingungen nachgeregelt (Y1, Y4 oder Y2,Y3 gepulst angesteuert)

Leistungsanzeige:
(Position von Primärschieber + 100%) / 2

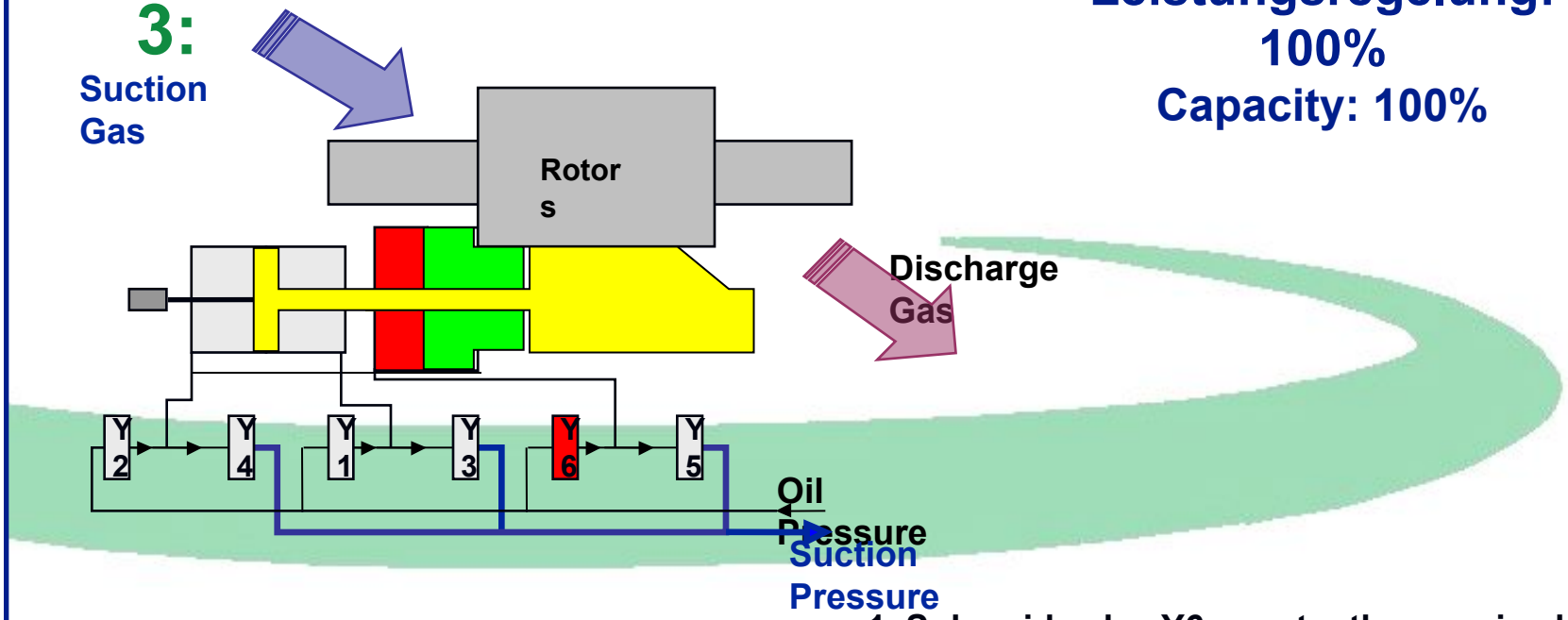
1. Solenoid valve Y6 pulsed energized (Vi-slide controlled)
2. primary slide is readjusted according to operating values (Y1, Y4 or Y2, Y3 pulsed energized)

Capacity indication:
(primary slide position + 100%) / 2

Vi-Regelung LARGE / Vi-Control LARGE

MODE 3:

Suction Gas



Leistungsregelung: 100%
Capacity: 100%

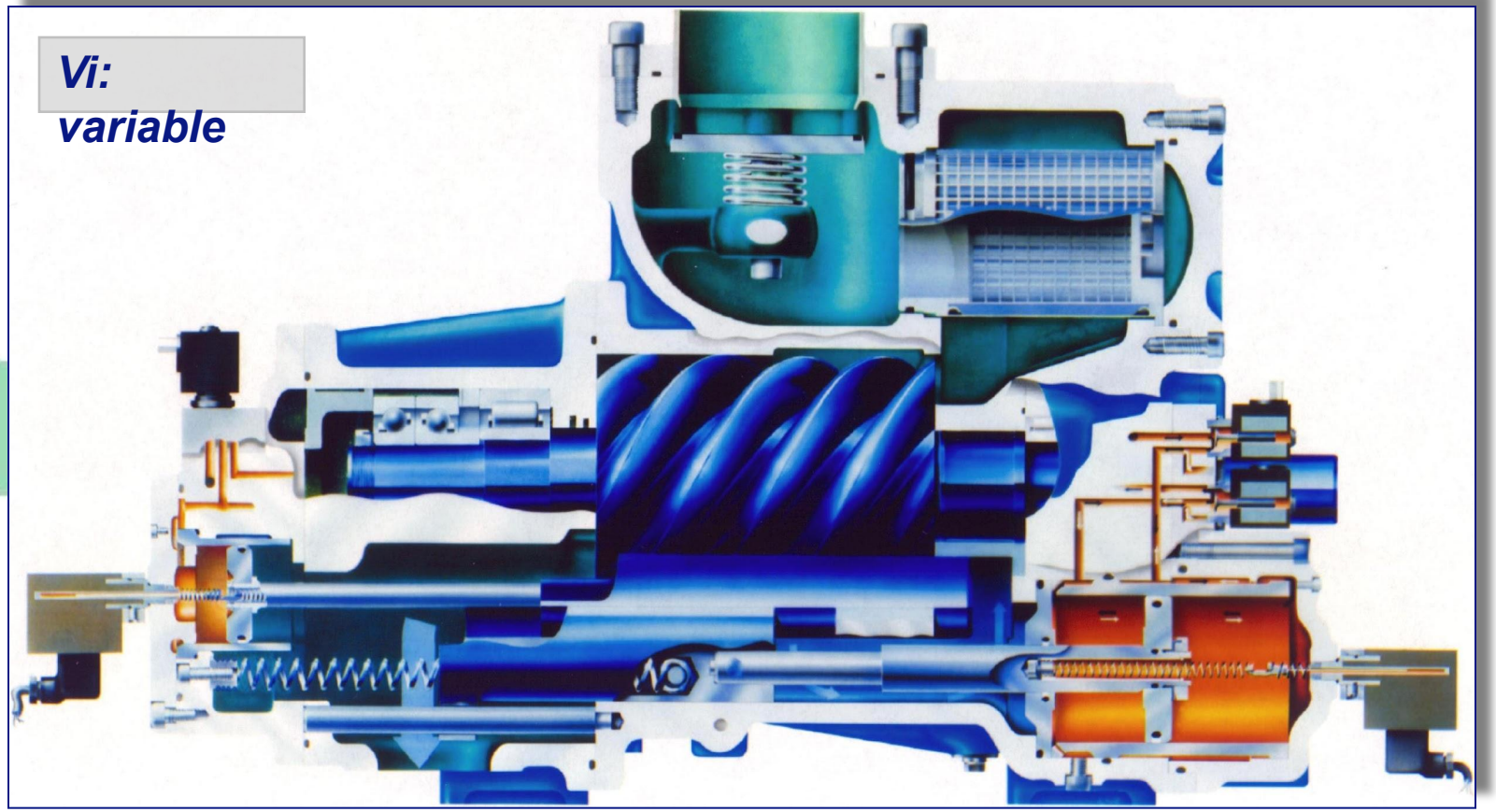
1. Magnetventile Y6 mit Dauersignal angesteuert
   (Vi-Schlitten angesteuert)
2. Stellung Primärschieber wird nachgeregelt
   (Y1, Y4 oder Y2, Y3 gepulst angesteuert)

Leistungsanzeige: 100%

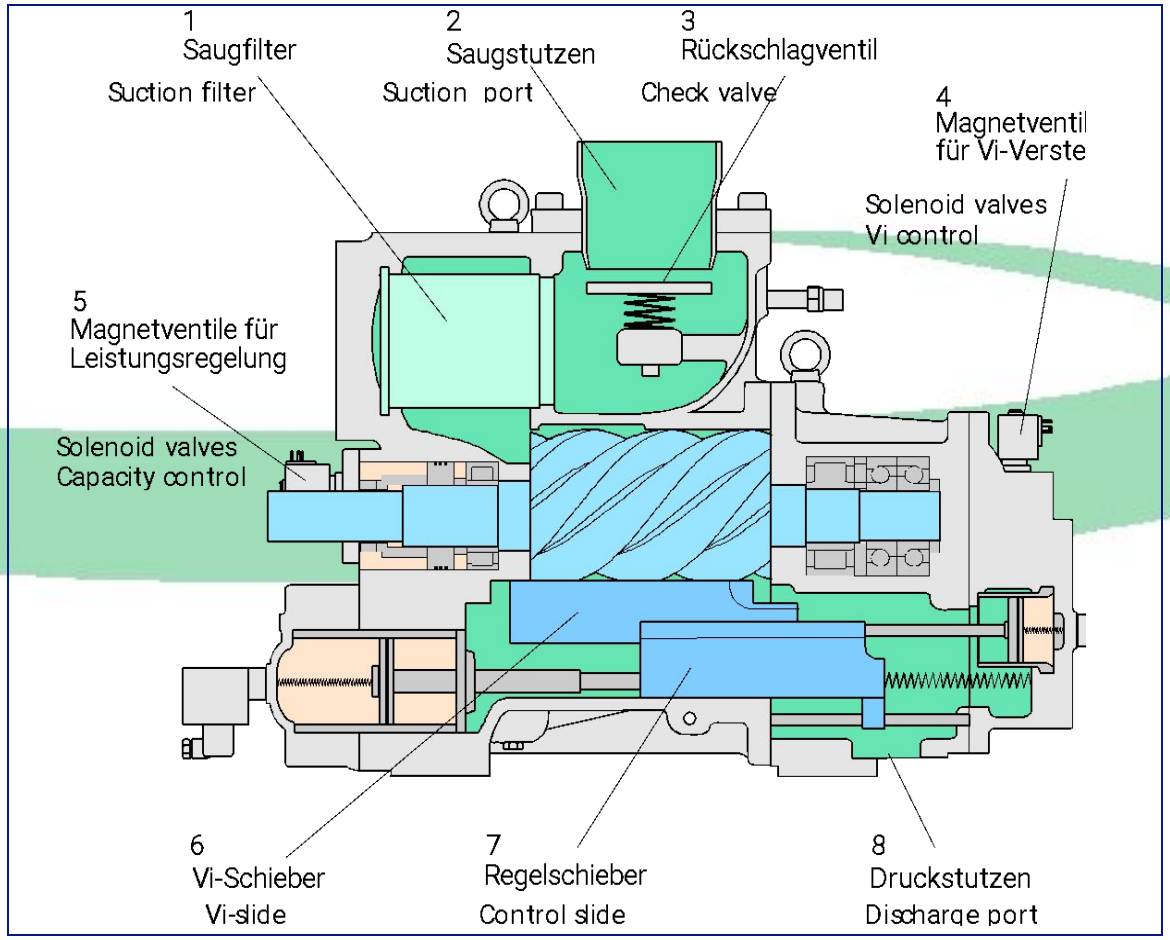
1. Solenoid valve Y6 constantly energized
   (Vi-slide controlled)
2. primary slide is readjusted according to operating values
   (Y1, Y4 or Y2,Y3 pulsed energized)

Capacity indication: 100%

Verdichter / Compressor MEDIUM

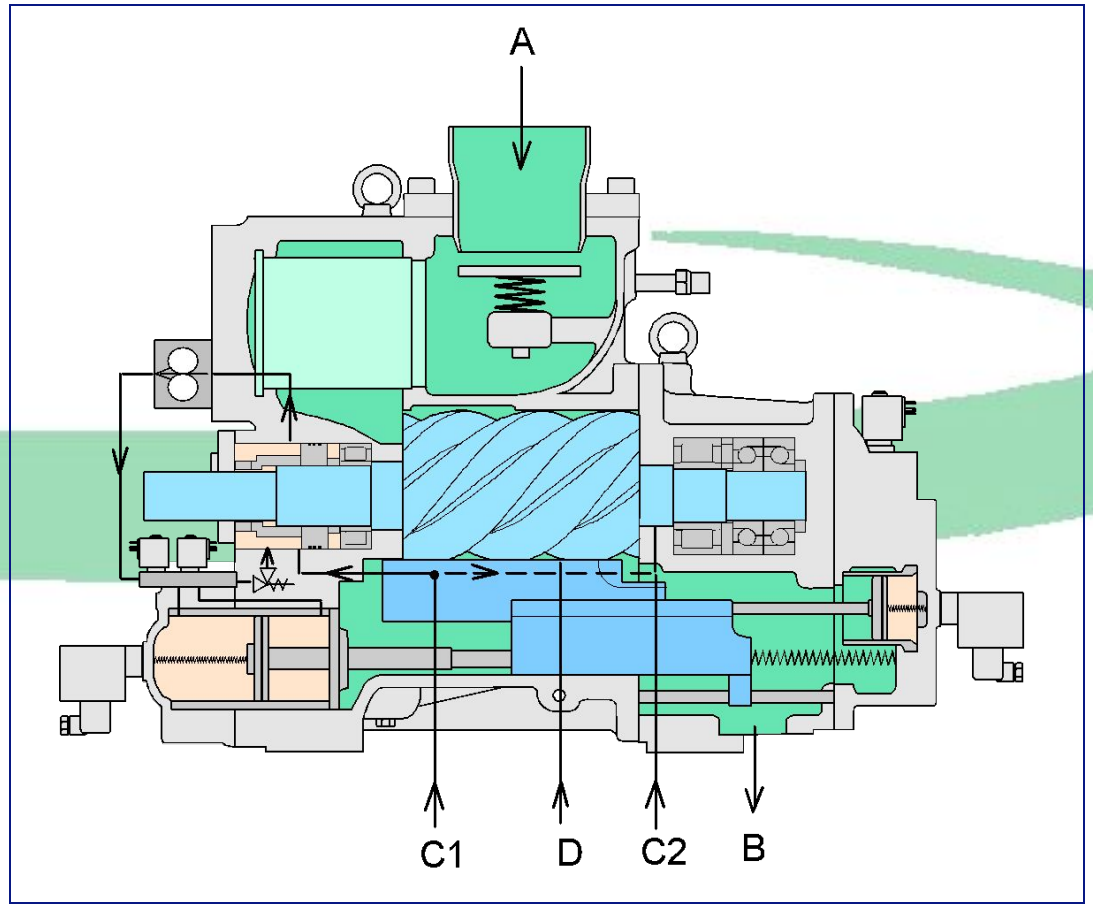


Verdichter / Compressor MEDIUM



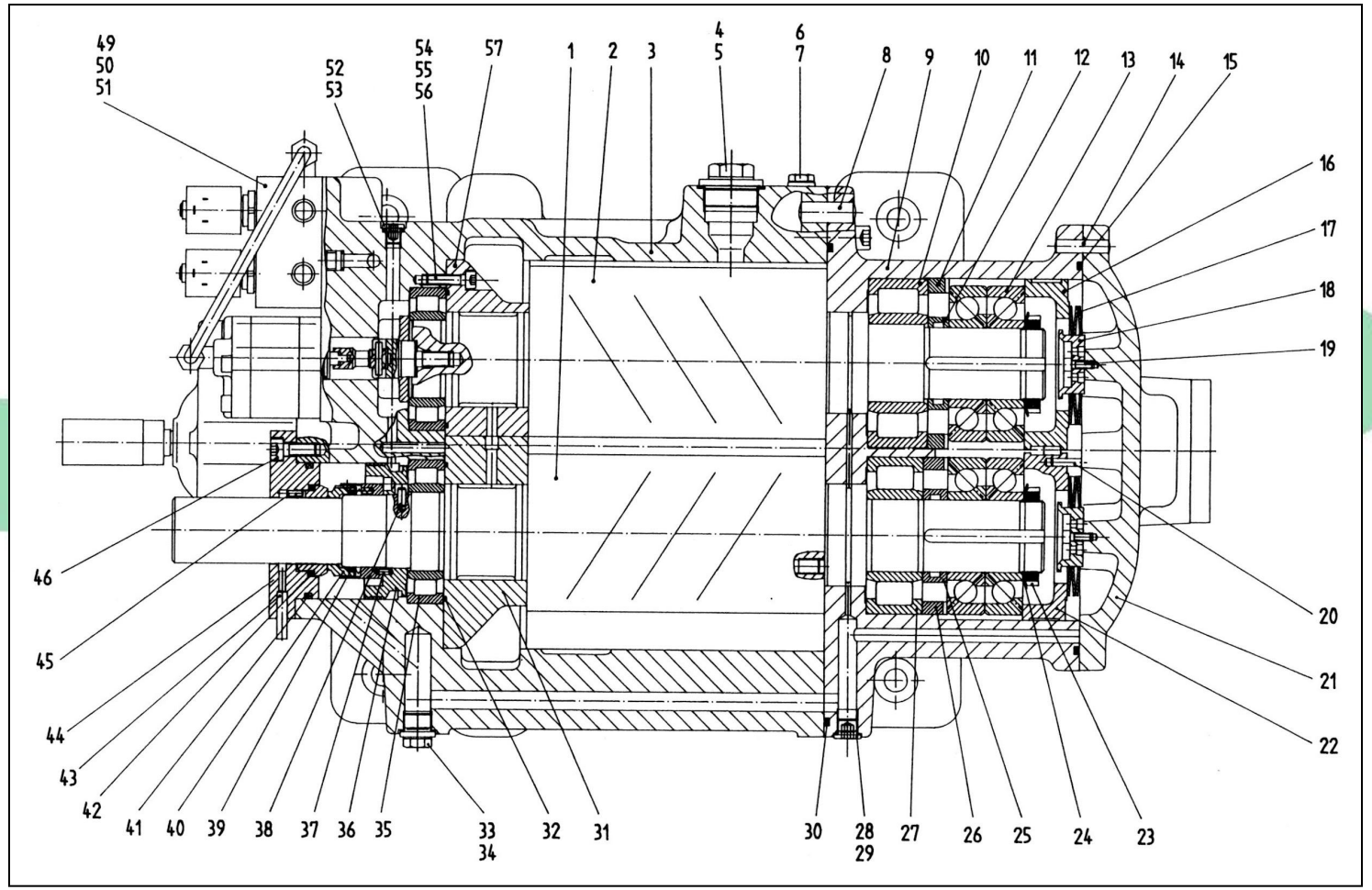
Vi: variable

interner Ölkreislauf / Internal oil circuit

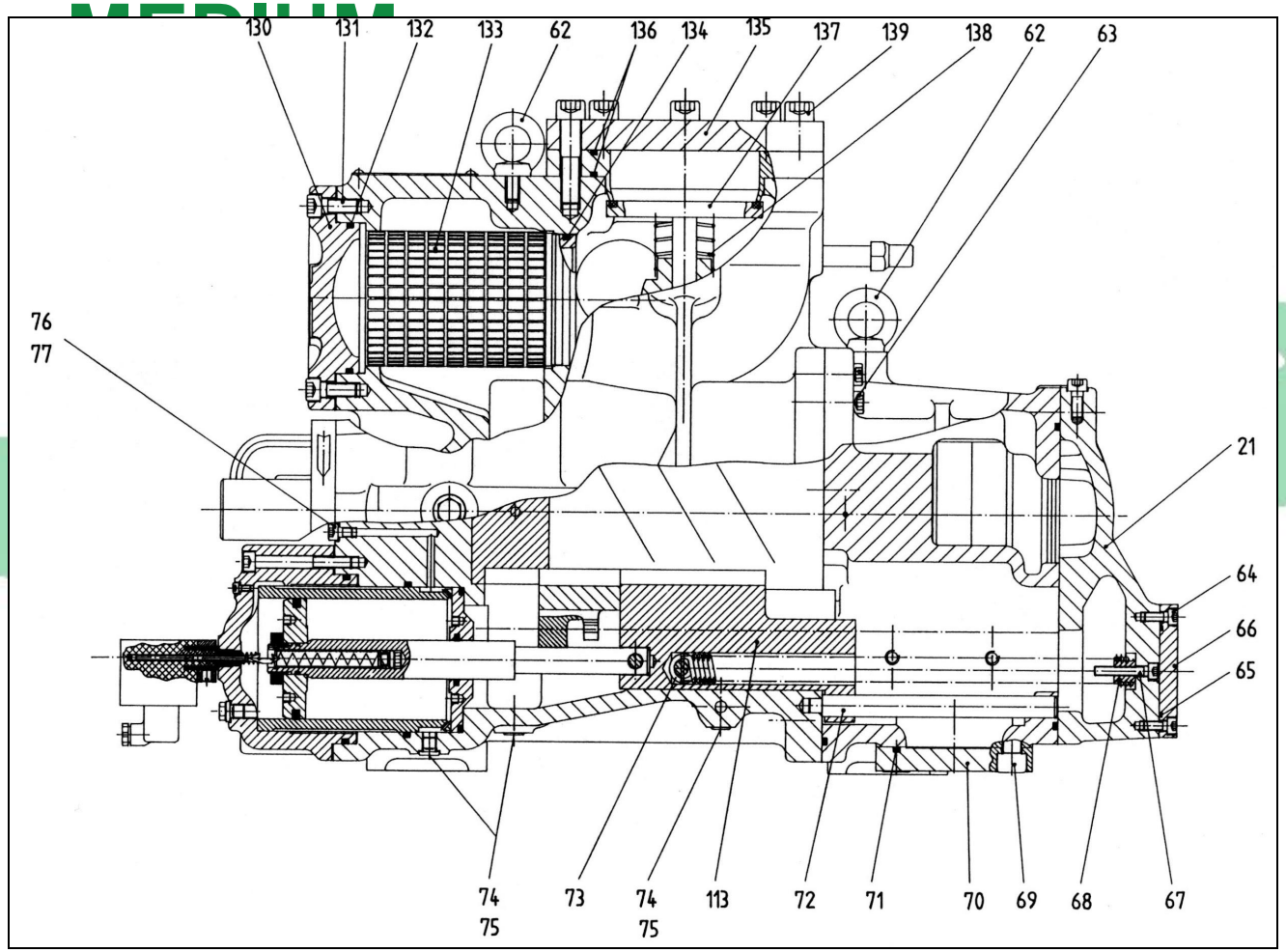


Vi: variable

Verdichter / Compressor

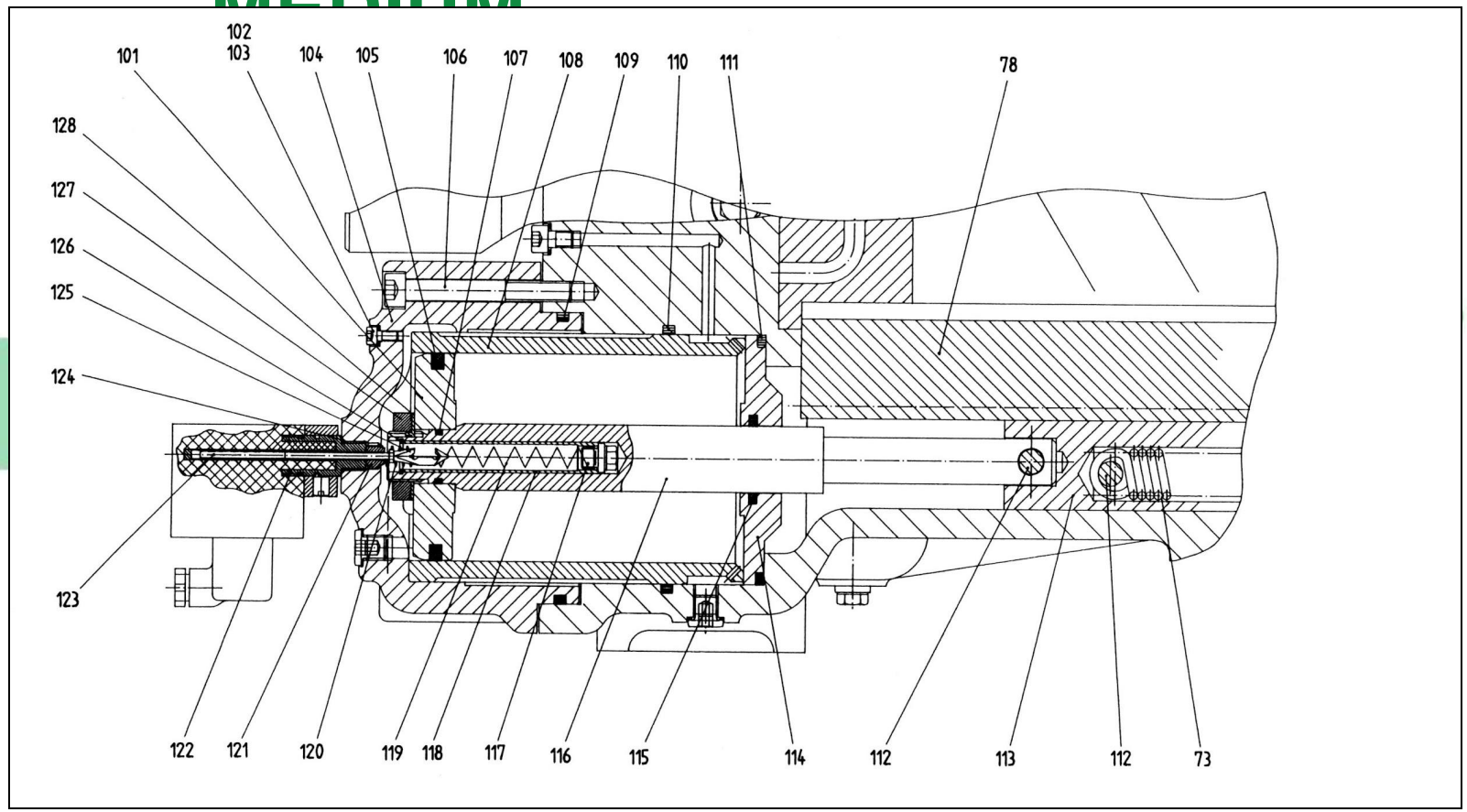


Verdichter / Compressor MEDIUM



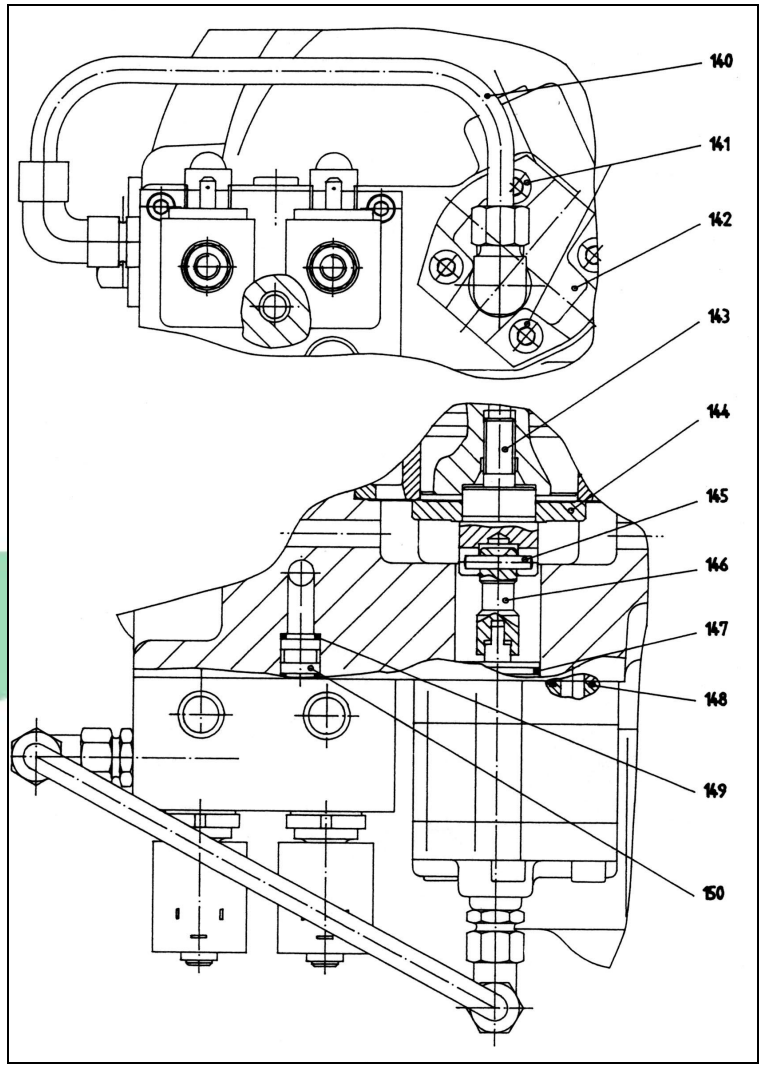
Vi: fixed

Verdichter / Compressor MEDIUM

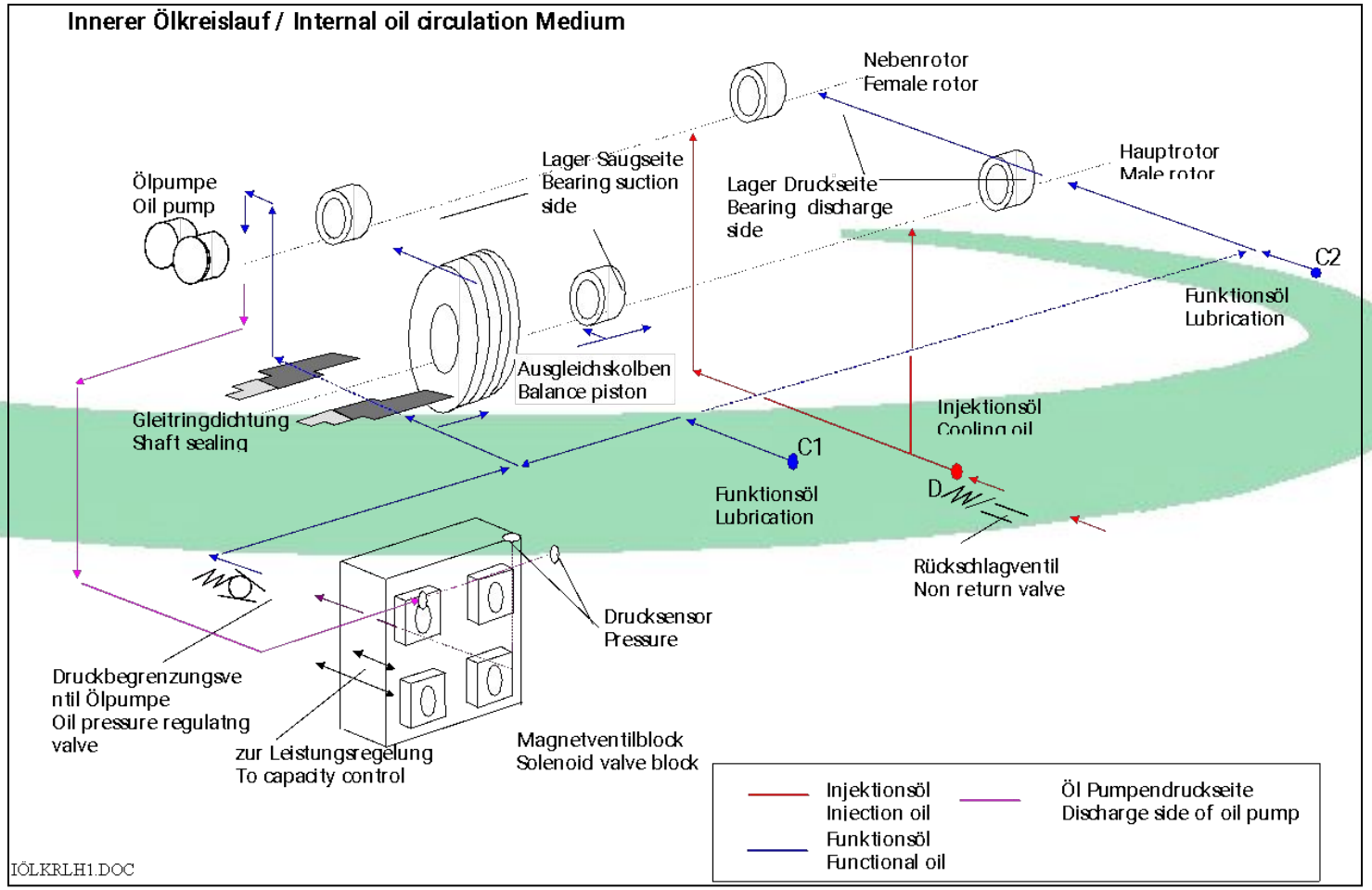


MEDIUM – Drawing (solenoid valve block)

Verdichter / Compressor
MEDIUM



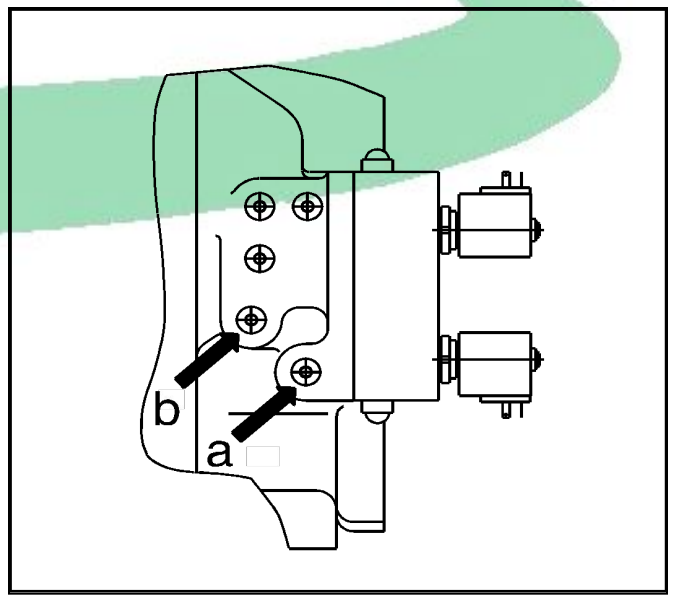
Verdichter / Compressor MEDIUM



Verdichter / Compressor
MEDIUM

Anordnung der Entlüftungsschrauben der Leistungsregelung
a: Vorderer Hydraulikraum
b: Hinterer Hydraulikraum

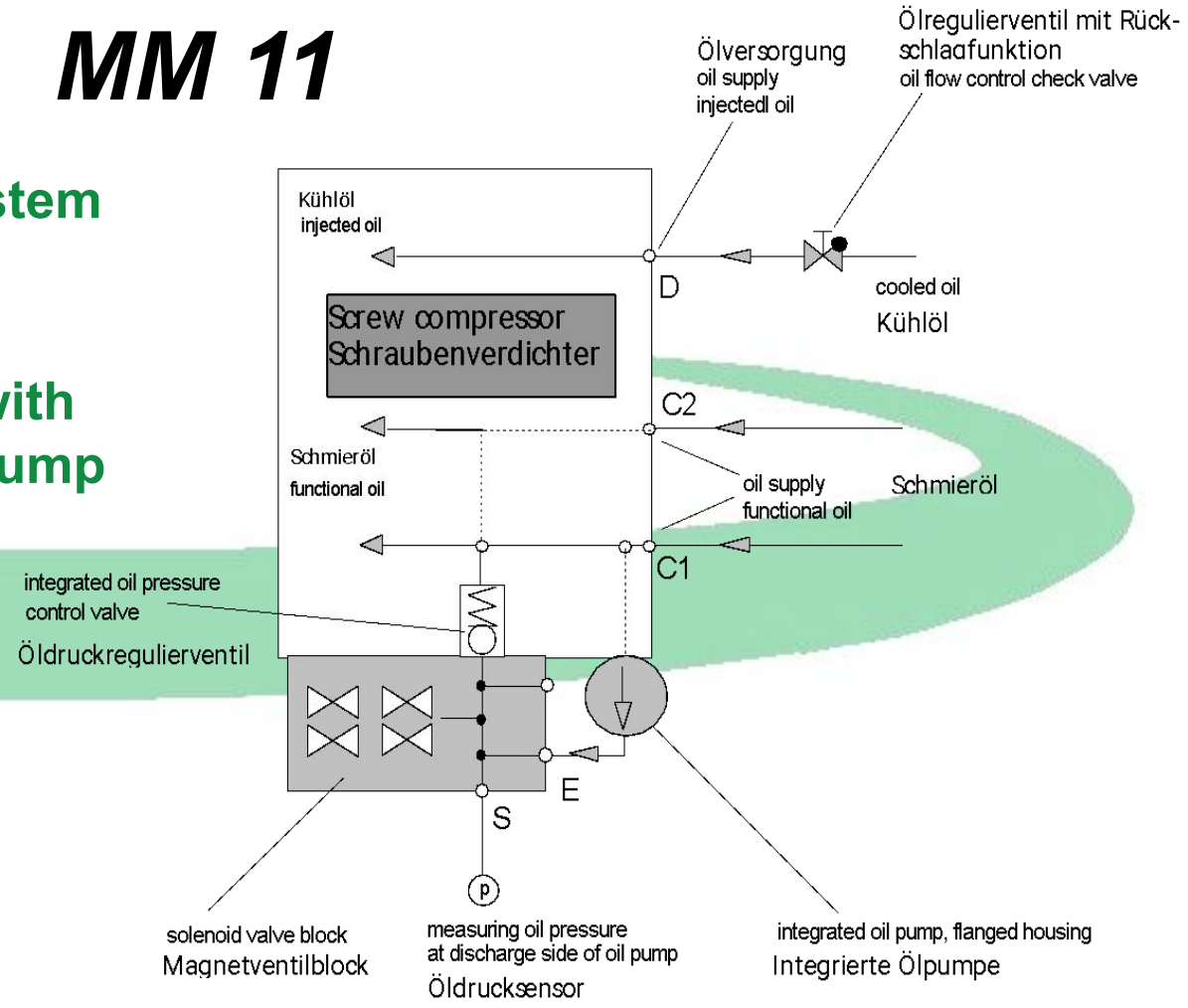
Arrangement of venting screws for the hydraulic chambers of the cap. Control
a: front chamber
b: back chamber



MM 11

Ölversorgungssystem mit integrierter Ölpumpe

Oil management with integrated oil pump

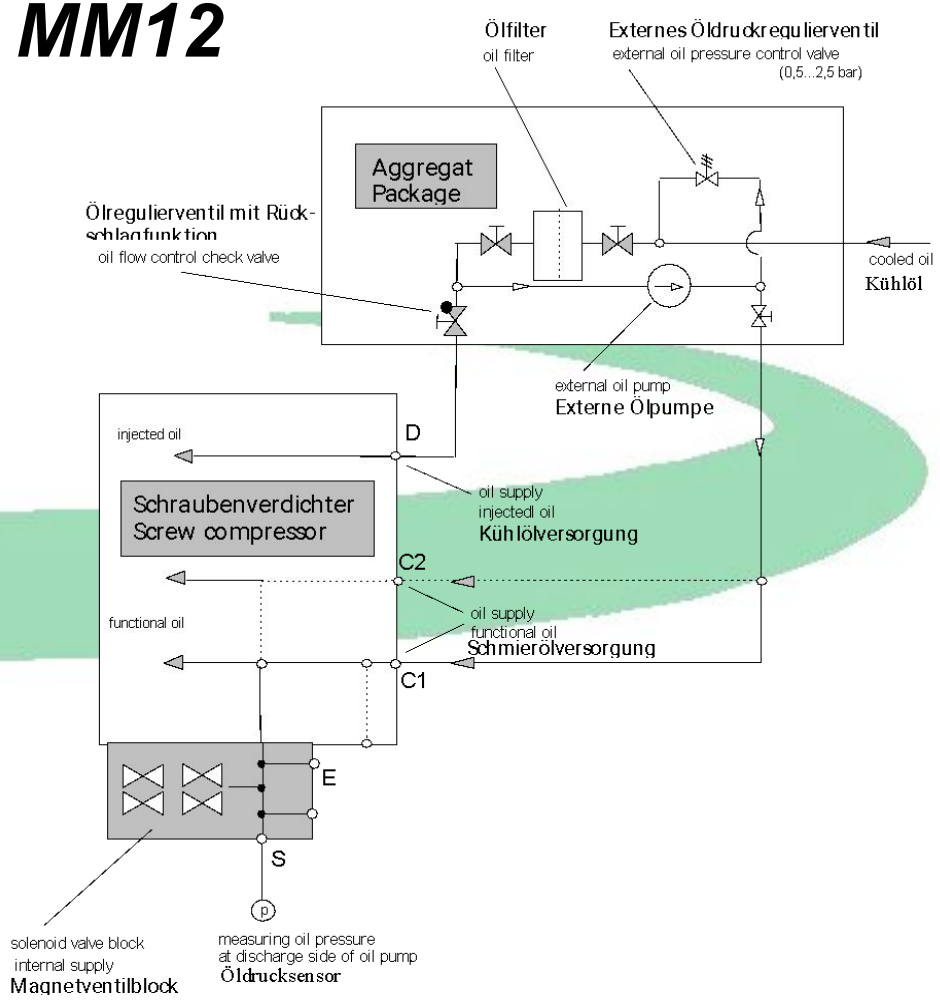


MEDIUM – oil management: MM12

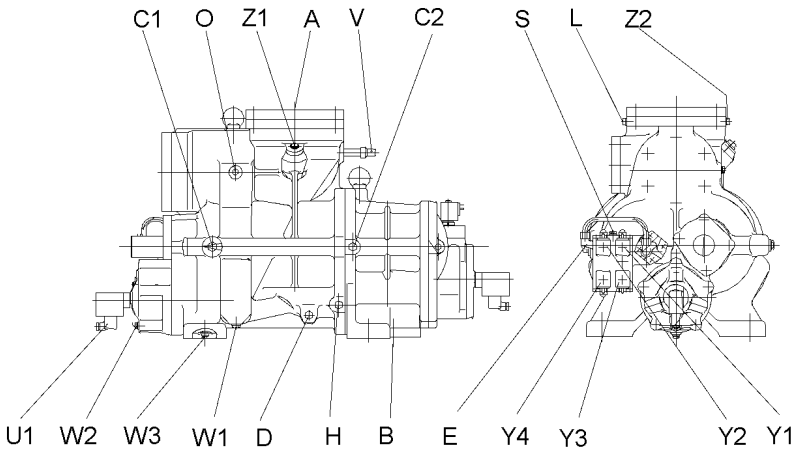
Ölversorgungssystem mit externer Ölpumpe

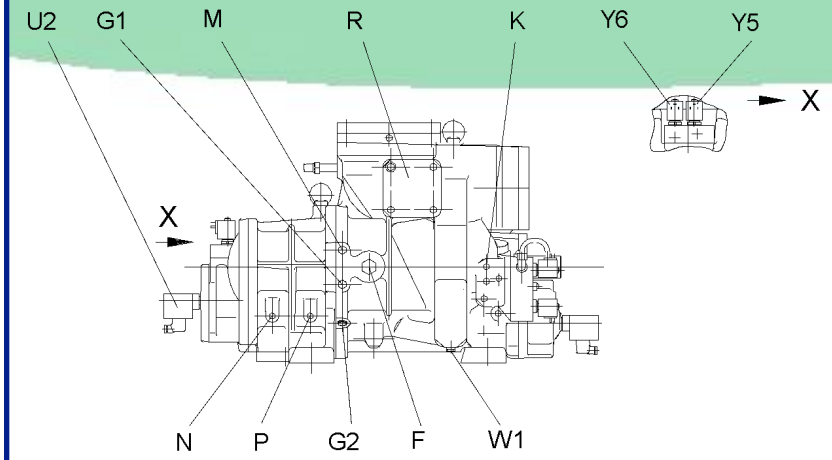
Oil management with external oil pump

MM12



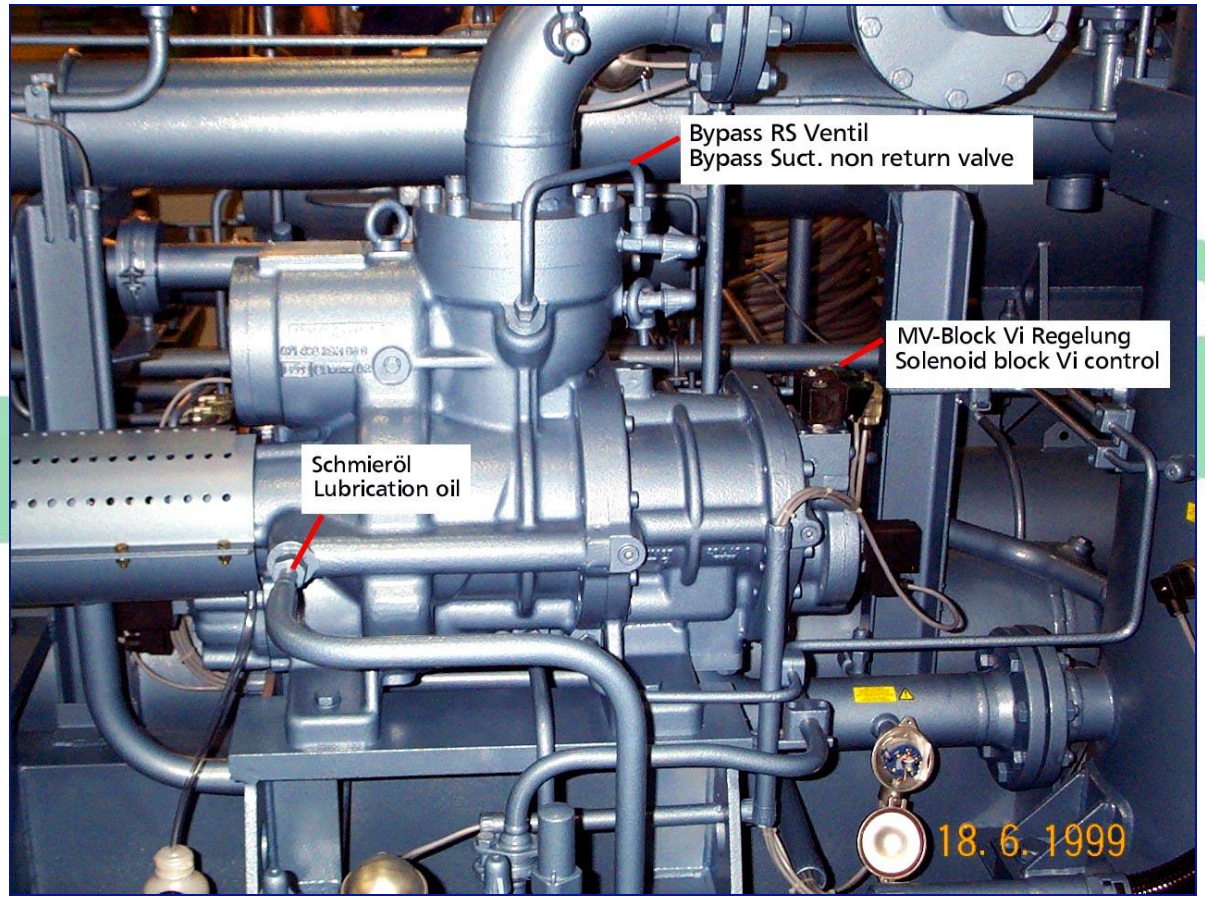
MEDIUM – Listing connections



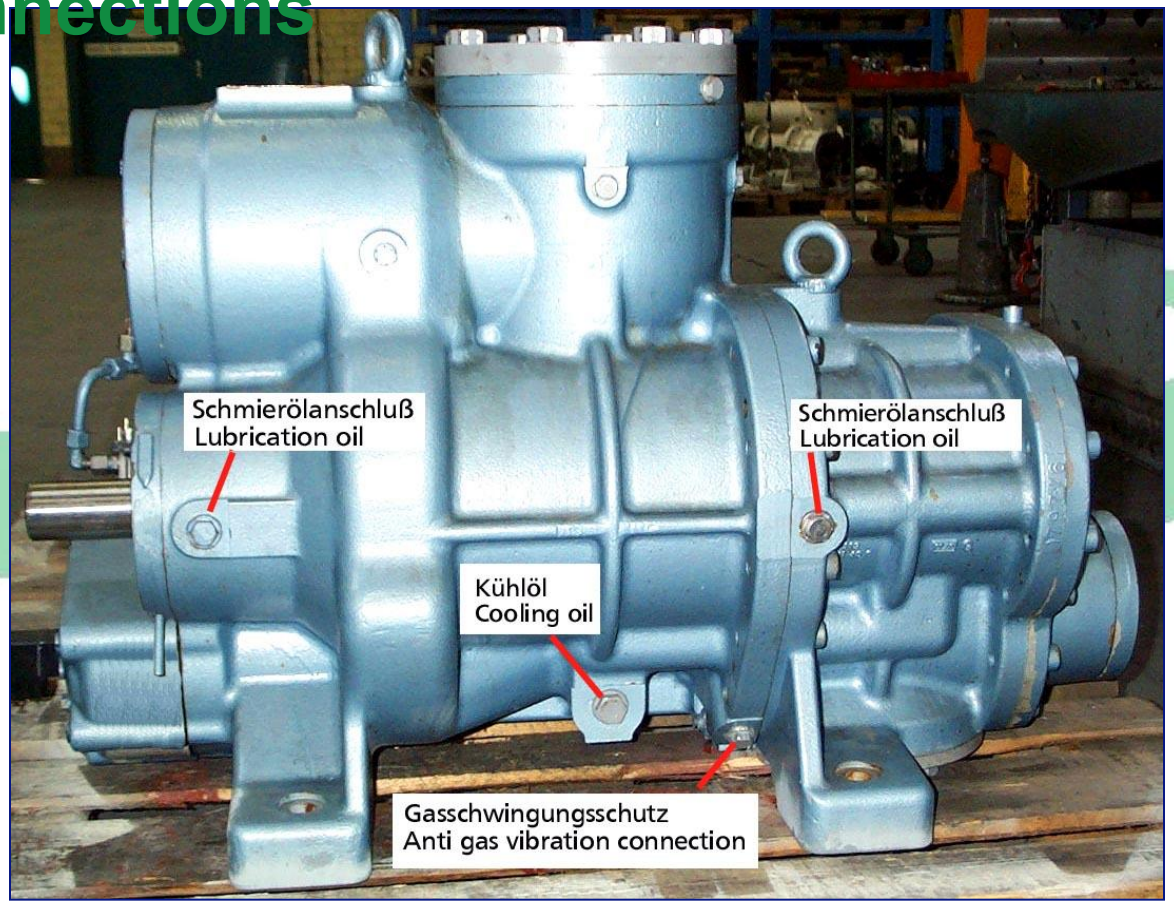


Anschluß Item	Zweck	Description
A	Saugstutzen	Suction port
B	Druckstutzen	Discharge port
C1	Funktionsöl	Lubrication oil
C2	Funktionsöl	Lubrication oil
D	Öleinspritzung Arbeitsraum	Oil injection (cooling)
E	Ölzuführung Leistungsregelung von Ölpumpe	Oil supply capacity control from oil pump
F	Economizer	Economizer
G1	Kältemitteleinspritzung (LP)	Refrigerant liquid injection (LP)
G2	Kältemitteleinspritzung (HP)	Refrigerant liquid injection (HP)
H	Gasschwingungsschutz	Gas pulsation protection
K	Zusatzöleinspritzung	Additional oil injection
L	Messung Saugdruck	Suction pressure
M	Ölrückführung Ölabscheider	Oil return oil separator
N	Messung Enddruck	Discharge pressure
O	Messung Saugtemperatur	Suction temperature
P	Messung Endtemperatur	Discharge temperature
R	Anschluß Überströmventil	Connection overflow valve
S	Messung Öldruck Ölpumpe	Oil pressure oil pump
V	Entlüftung Verdichter	Ventilation compressor
W1	Ölablaßschraube	Oil drain plug
W2	Ölablaßschraube	Oil drain plug
W3	Ölablaßschraube	Oil drain plug
Z1	Zusatzanschluß	Additional connection
Z2	Zusatzanschluß	Additional connection

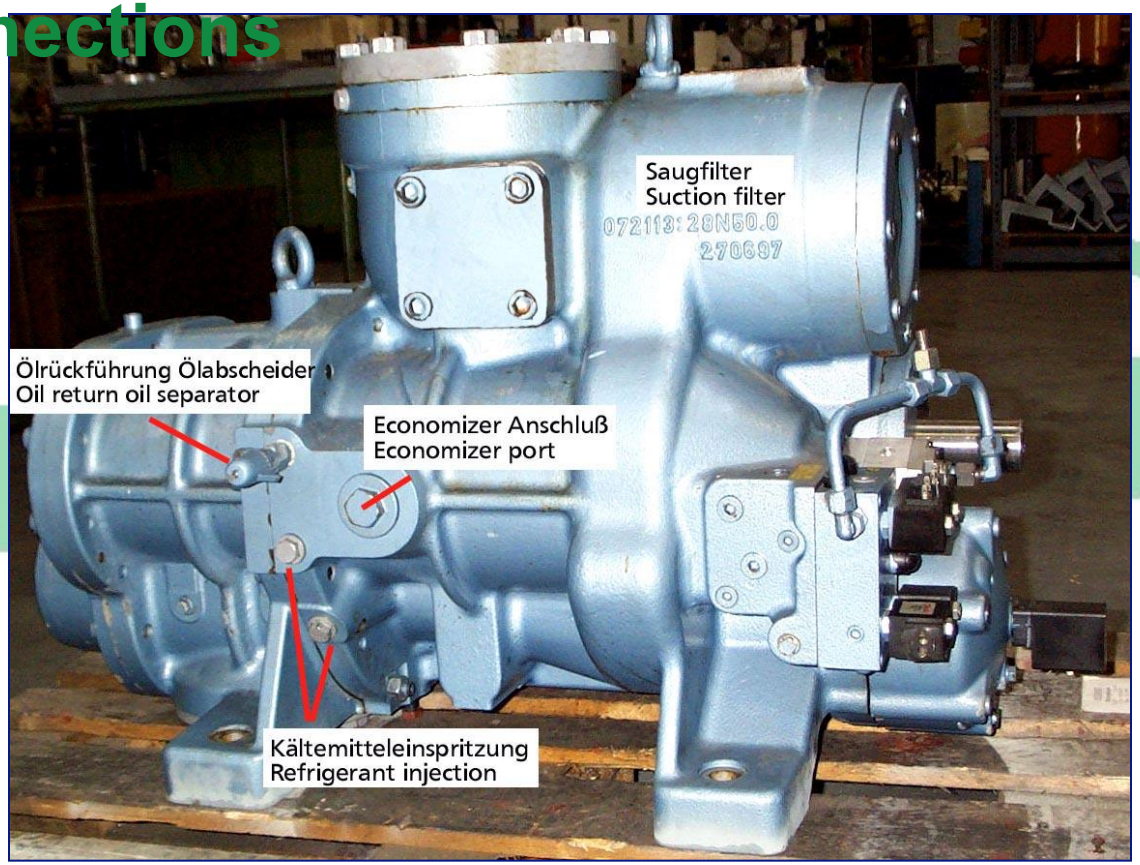
MEDIUM: Verdichteranschlüsse / Ports



MEDIUM - Verdichteranschlüsse / Oil connections

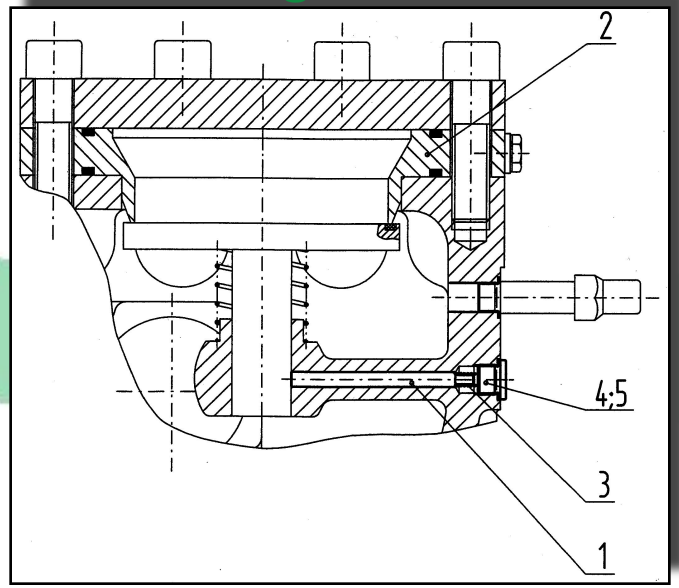


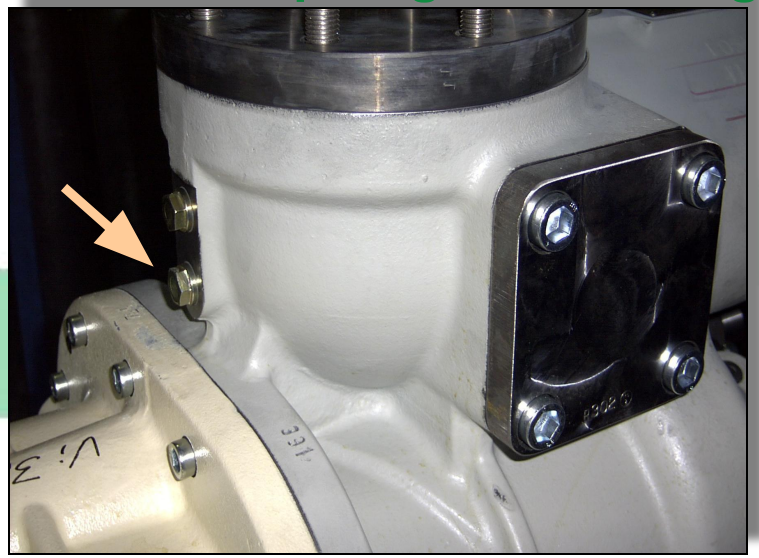
MEDIUM - Verdichteranschlüsse / Oil connections



Check Valve - damping device non-adjustable

Rückschlagventil – nicht einstellbare Dämpfungseinrichtung

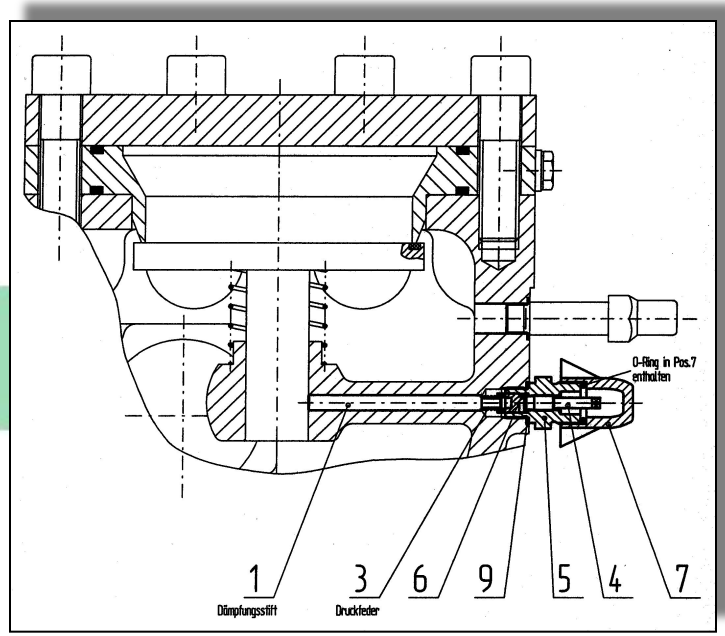


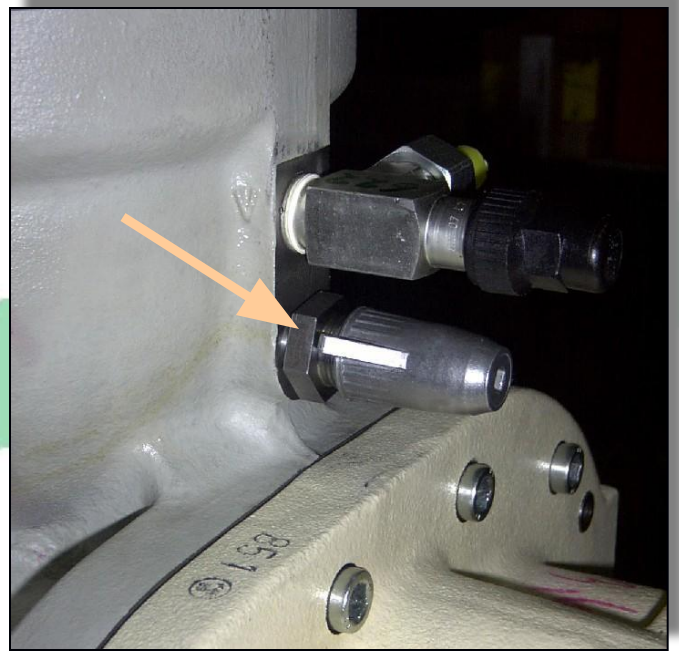


Einführung / Introduction: 05/2000

Check Valve - damping device adjustable

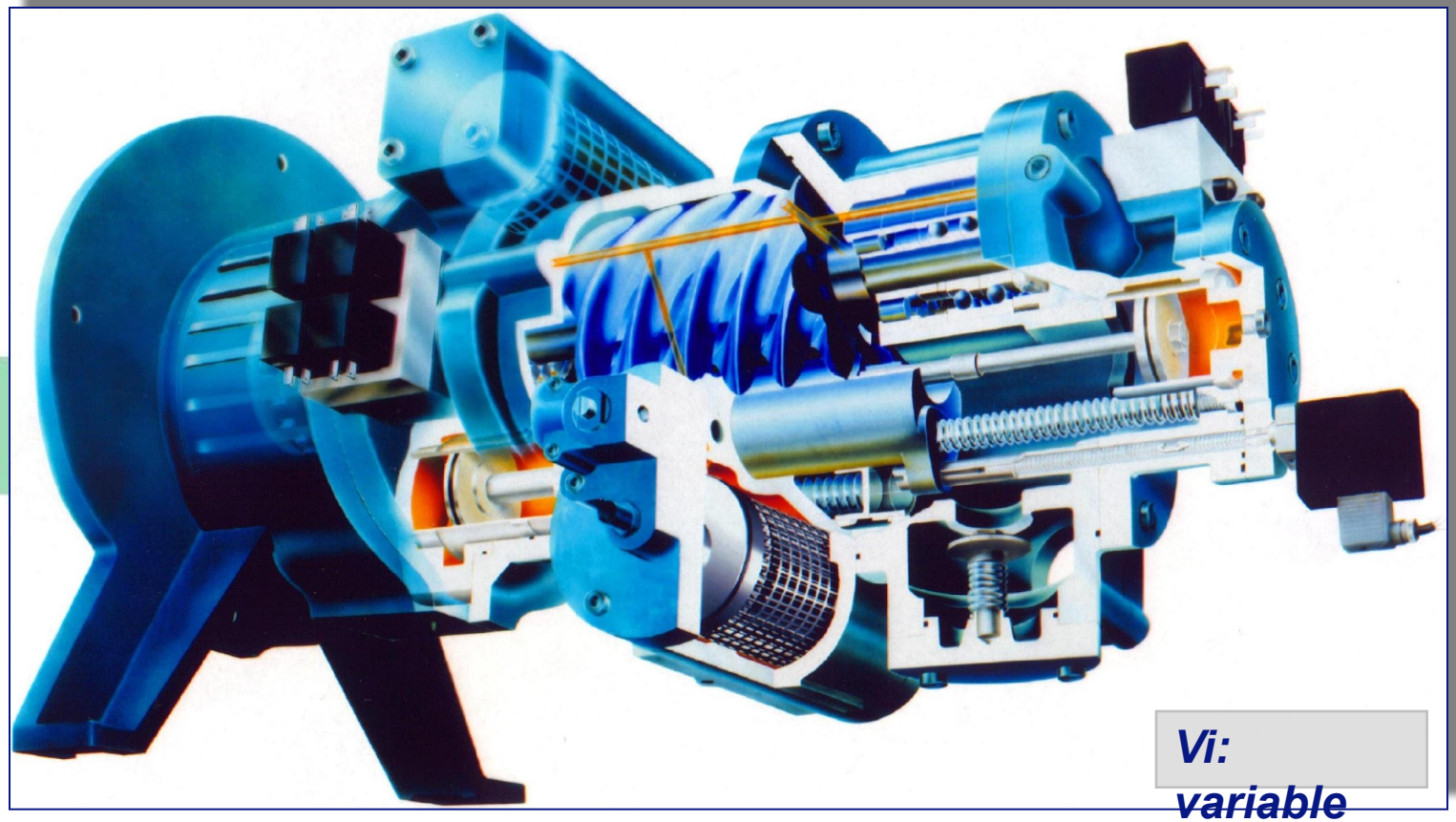
Rückschlagventil – einstellbare Dämpfungseinrichtung





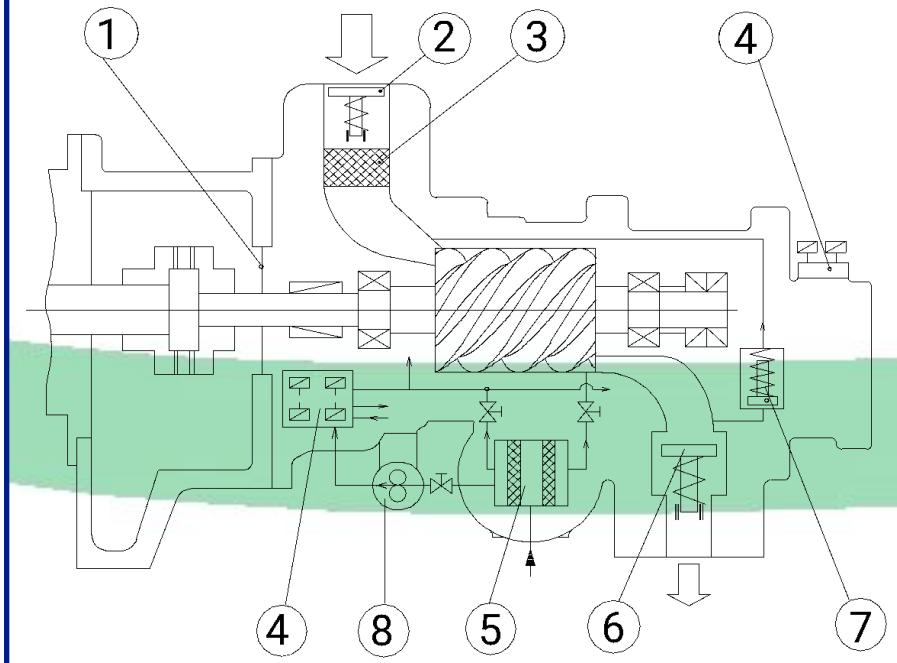
Einführung / Introduction: 03/2002

Verdichter / Compressor SMALL



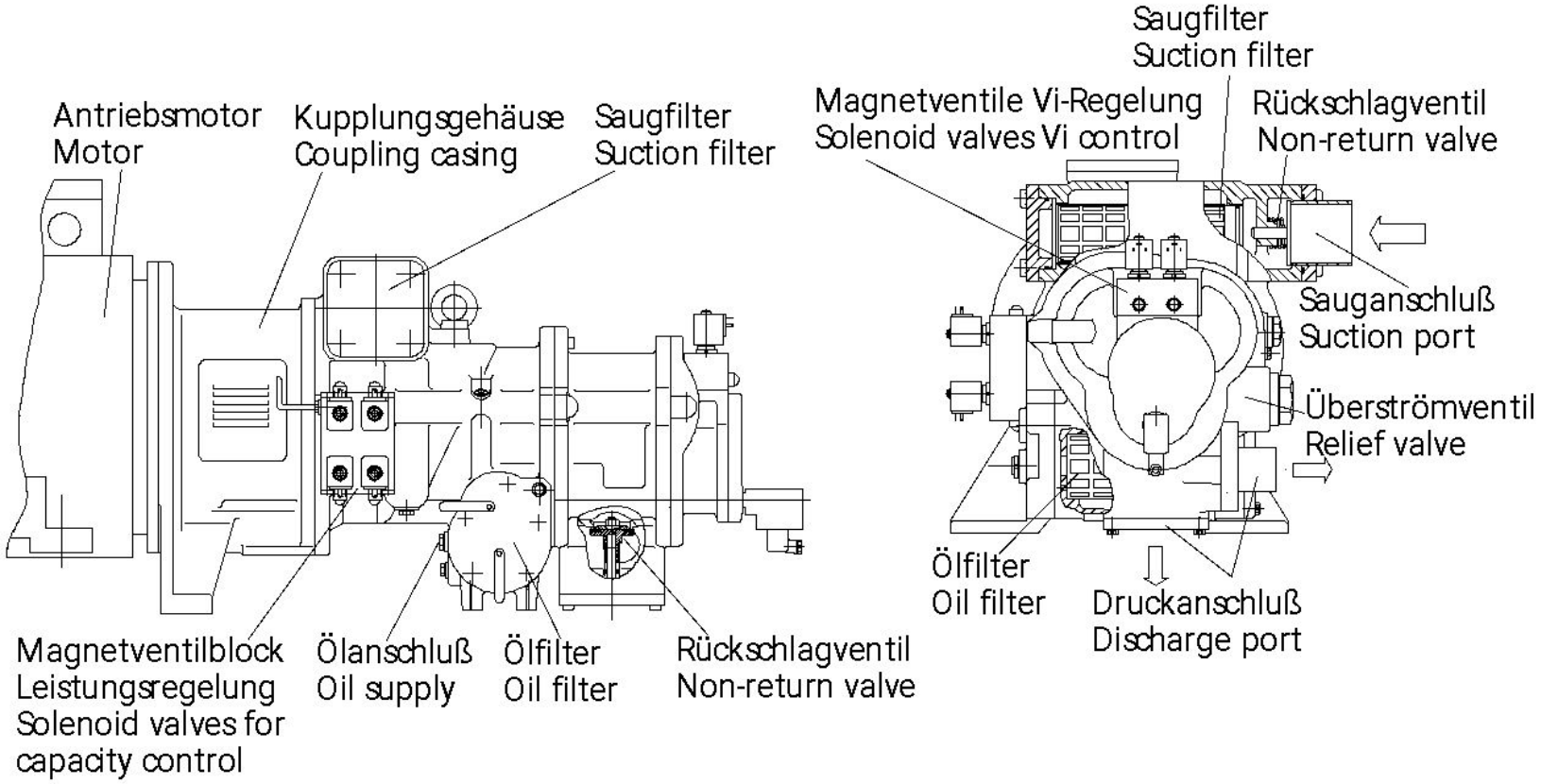
Vi: variable

SMALL – main components I

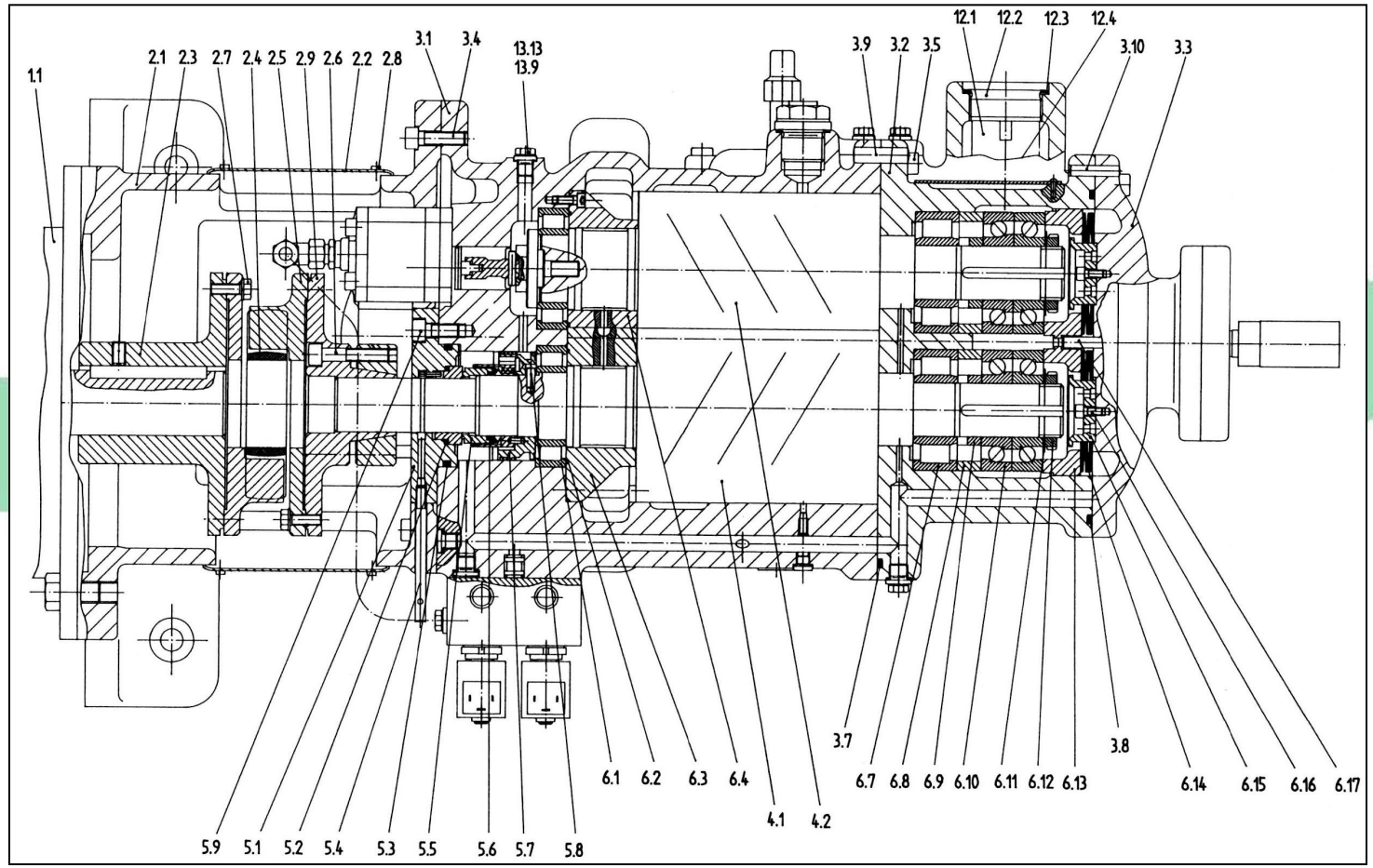


1	Zentrierflansch	Flange connection
2	Rückschlagventil Saugseite	Non-return valve
3	Saugfilter	Suction filter
4	Magnetventile für Leistungs-regelung und Vi-Verstellung	Solenoid valve for capacity control
5	Ölfilter mit Absperrventilen	Oil filter
6	Rückschlagventil Druckseite	Non-return valve
7	Überströmventil	Relief valve
8	Ölpumpe	Oil pump

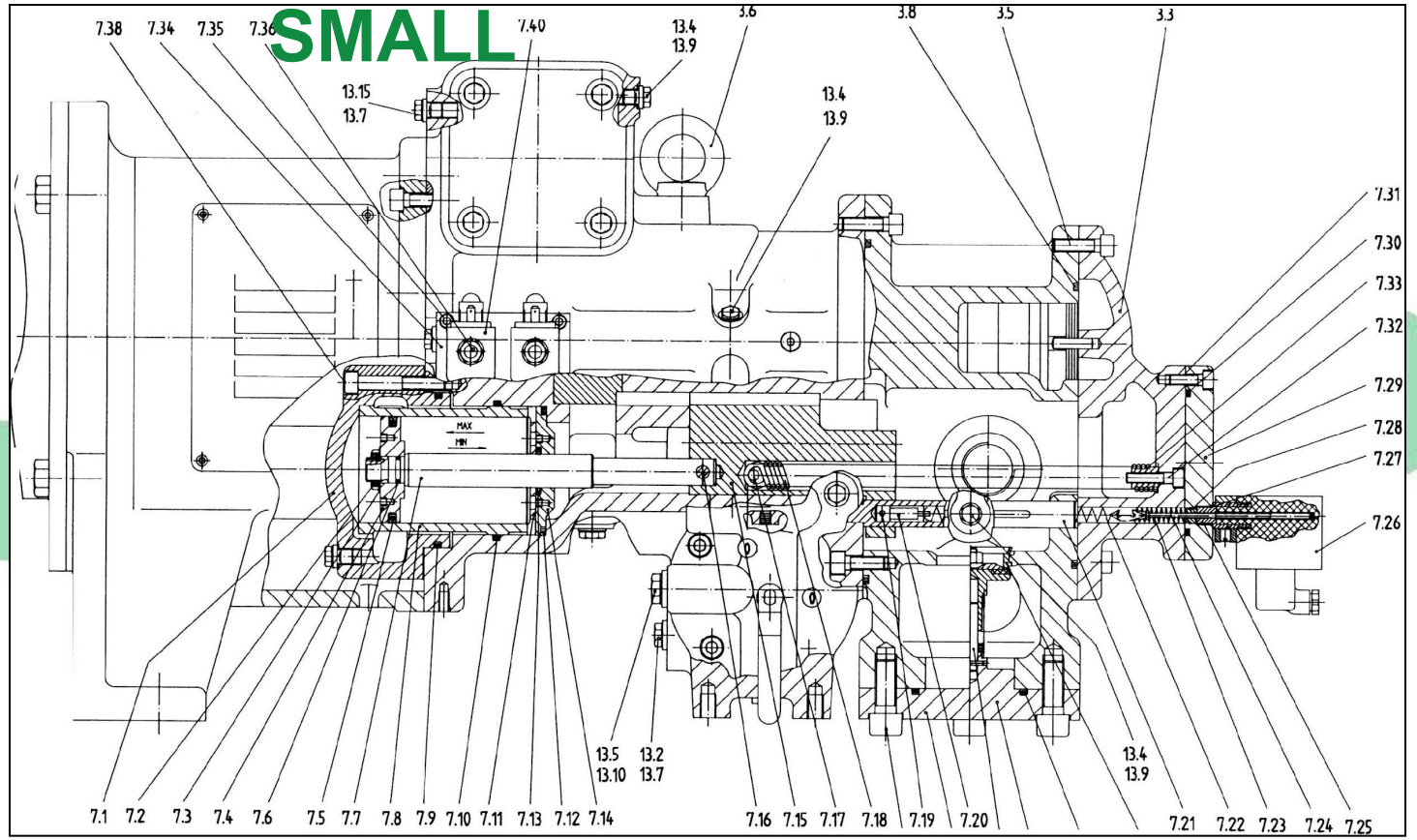
SMALL – main components II



Verdichter / Compressor SMALL

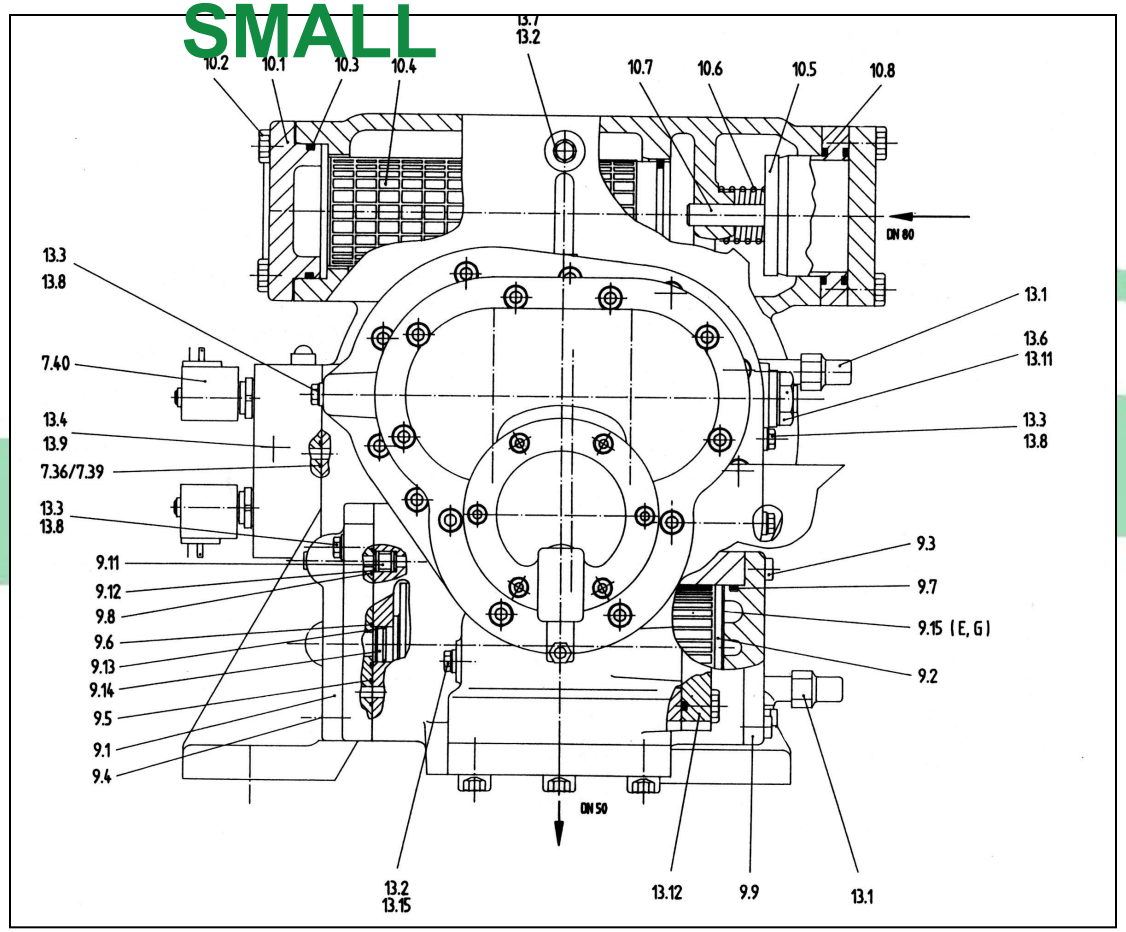


Verdichter / Compressor SMALL



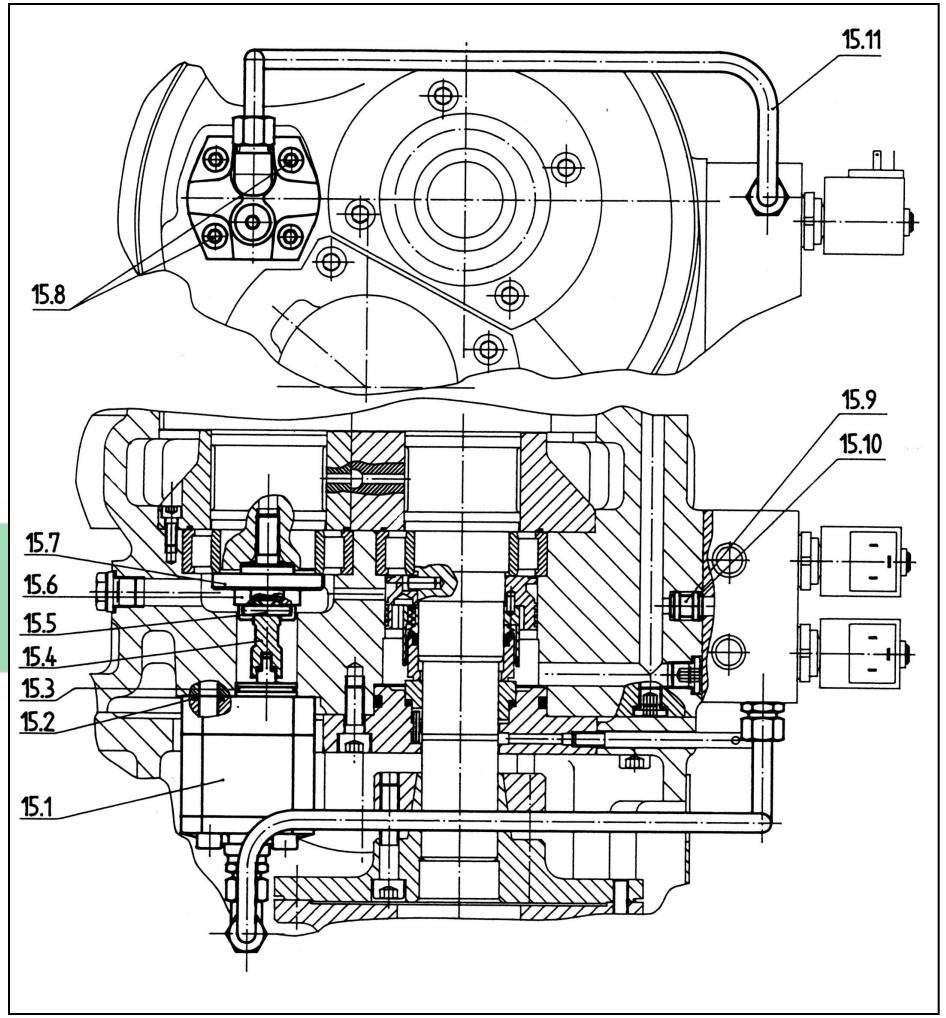
Vi: variable

Verdichter / Compressor SMALL

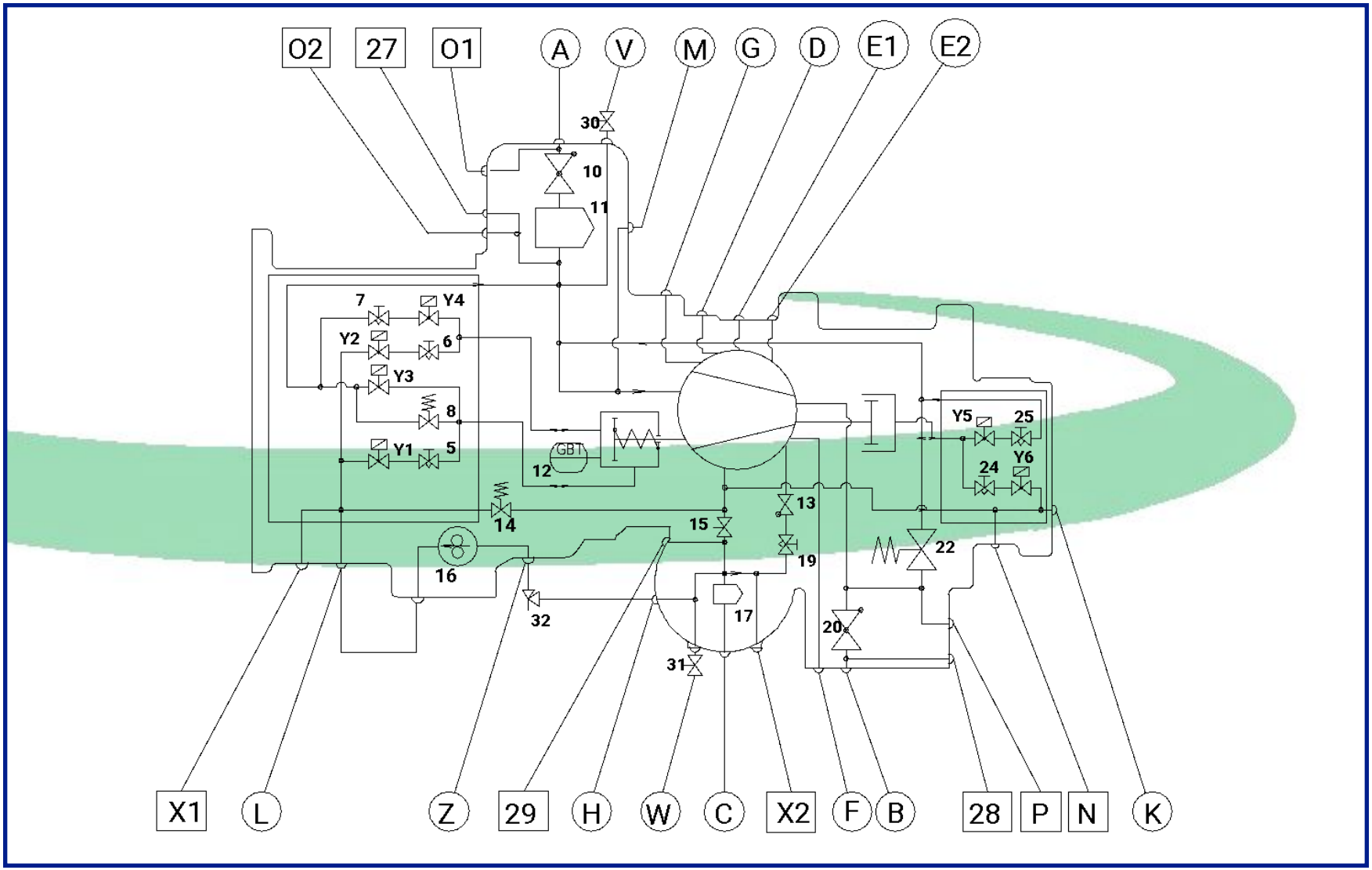


SMALL – drawing (oil pump)

Verdichter SMALL
Compressor SMALL



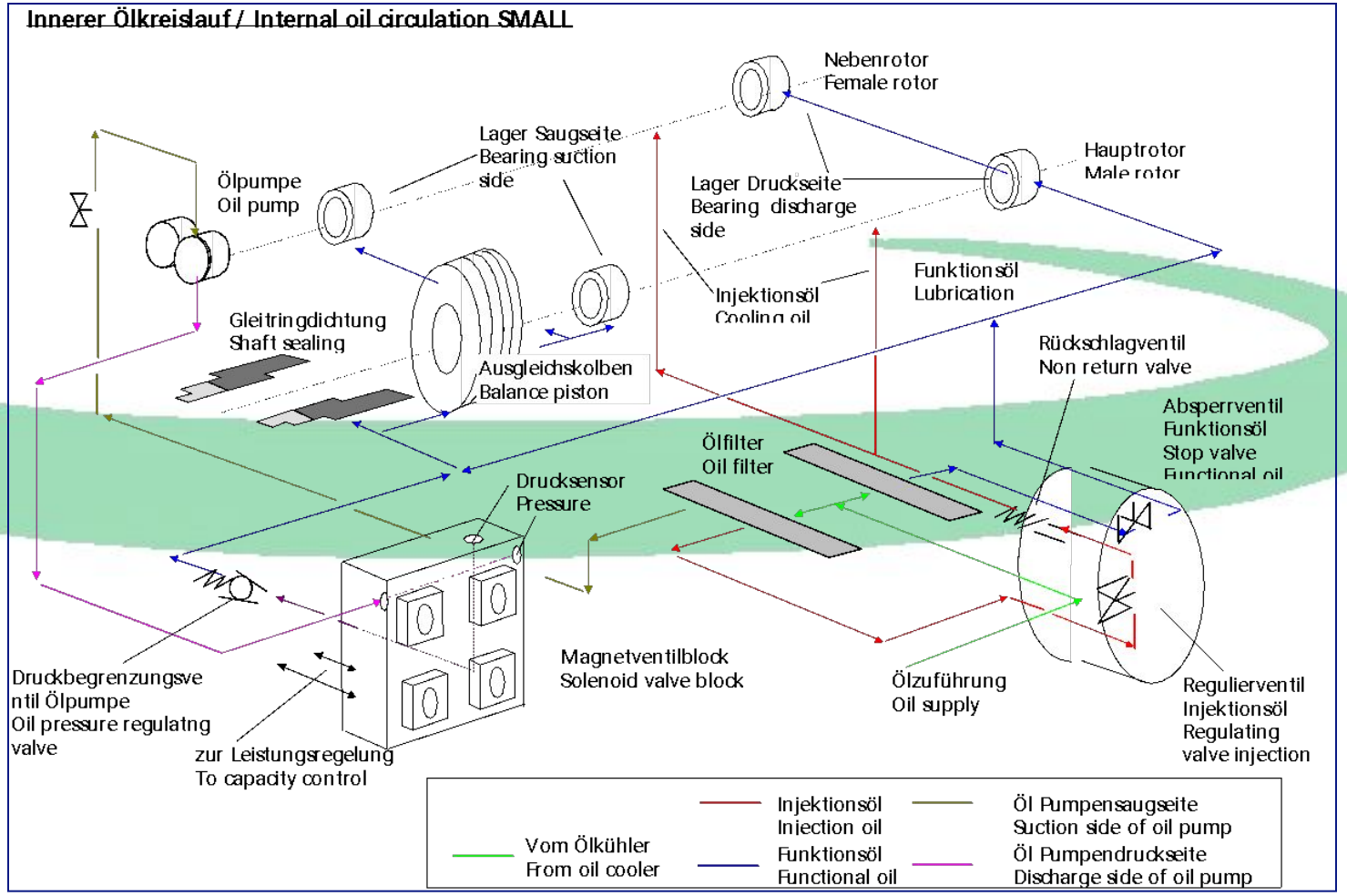
SMALL – ports & connectors



SMALL – Listing ports

Anschluß Item	Zweck	Purpose	Anschluß Item	Zweck	Purpose	Anschluß Item	Zweck	Purpose
A	Saugstutzen	Suction nozzle	K	Ölzuführung Funktionsöl bei externer Ölpumpe	supply function oil external oil pump	O2	Zusatzanschluß	Additional connection
B1/ B2	Druckstutzen unten Druckstutzen seitlich	discharge side, below discharge side, lateral	L	Ölzuführung Leistungsregelung von Ölpumpe	Oil supply capacity control from oil pump	P	Messung Enddruck	Measure discharge pressure
C	Ölzuführung	Oil supply	M	Ölrückführung Ölabscheider	Oil return oil separator	R	Ölfilteraustritt externe Ölpume	Outlet oil strainer at the external oil pump
D	Economizer	Economizer	U	Ölablaßschraube	Oil drain plug	27	Meßaufnehmer Saugtemperatur	Pickup suction temperature
E1	Kältemitteleinspritzung (ND)	Refrigerant liquid injection (LP)	V	Entlüftung Verdichter (Ventil 30)	Ventilation compressor (Valve 30)	28	Meßaufnehmer Endtemperatur	Pickup discharge temperature
E2	Kältemitteleinspritzung (HD)	Refrigerant liquid injection (HP)	W	Entleerung Ölfilter (Ventil 31)	drain oil filter (Valve 31)	29	Meßaufnehmer Öltemperatur	Pickup oil temperature
F	Gasschwingungsschutz	Gas pulsation protection	Z	Ölzuführung angeflanschte Ölpumpe	oil supply flanged oil pump	30	Entlüftungsventil Verdichter	Vent valve compressor
G	Zusatzöleinspritzung	Additional oil injection	N	Messung Öldruck Lagerung	measure oil pressure bearing	31	Entleerungsventil Ölfilter	Drain valve oil filter
G1	Ölfilteraustritt zum Anschluß G	outlet oil stainer at the connection G	O1	Messung Saugdruck	Measure suction pressure	32	Absperrventil Pumpensaugseite	Stop valve oil pump suction side
H	Ölfilteraustritt zur Ölpumpe (Anschluß Z)	outlet oil strainer at the oil pump (connection Z)						

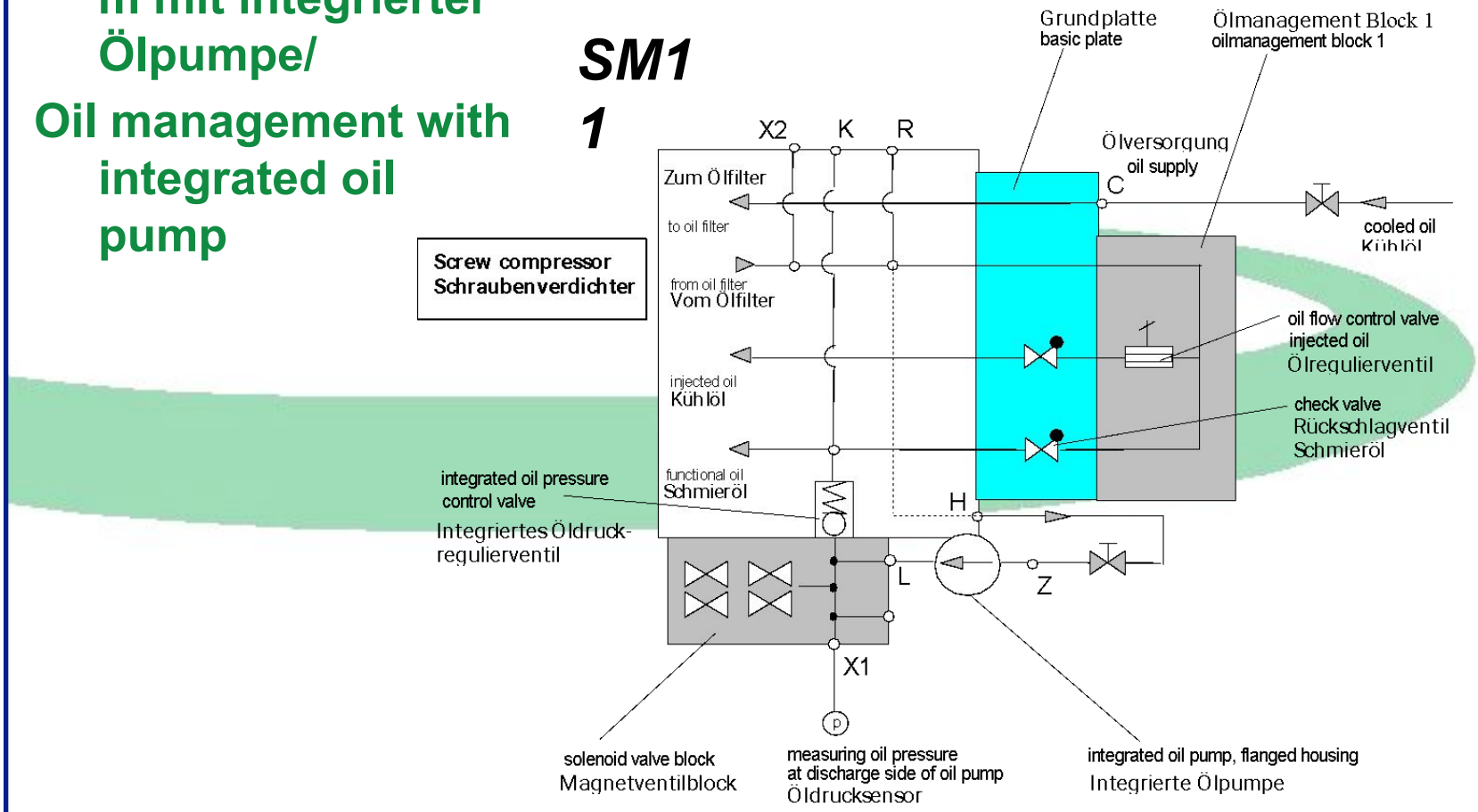
Verdichter / Compressor SMALL



Ölversorgungssystem mit integrierter Ölpumpe/

Oil management with integrated oil pump

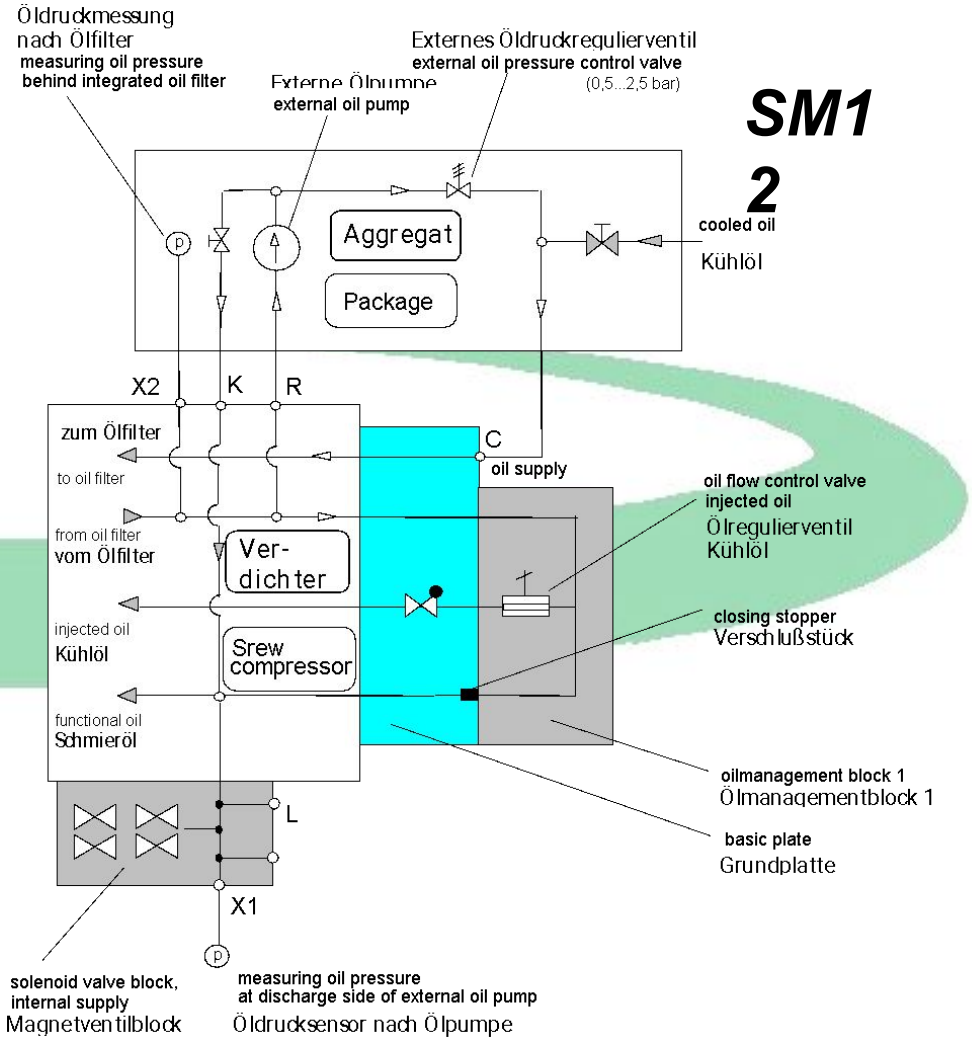
SM11



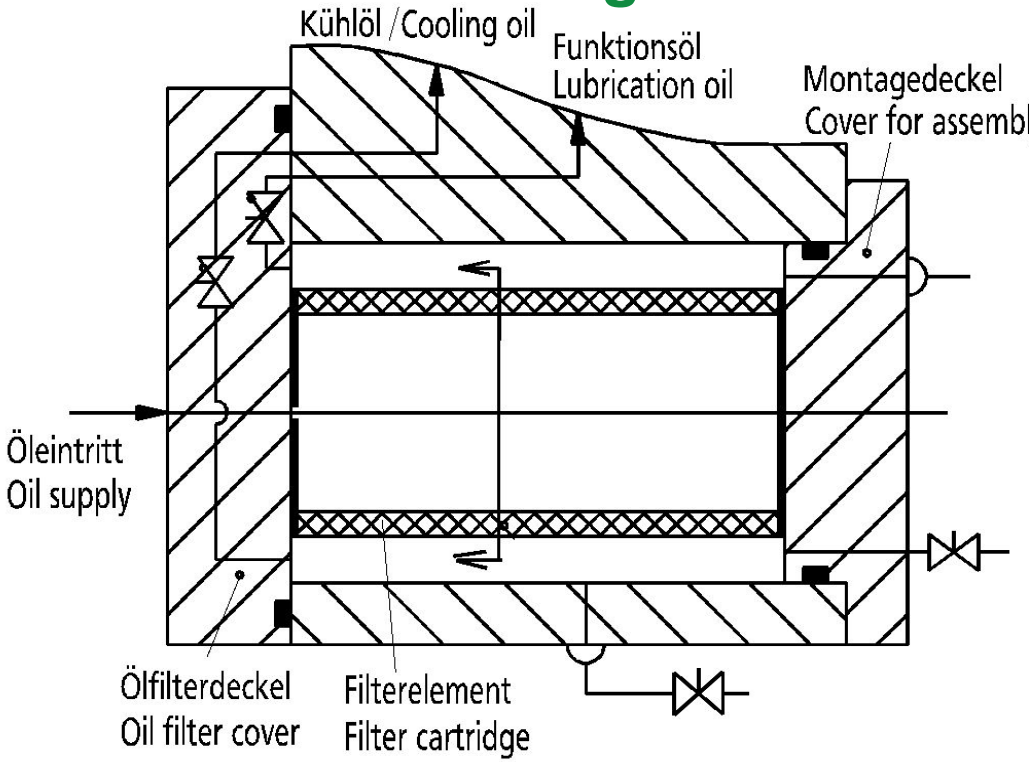
SMALL – oil management: SM12

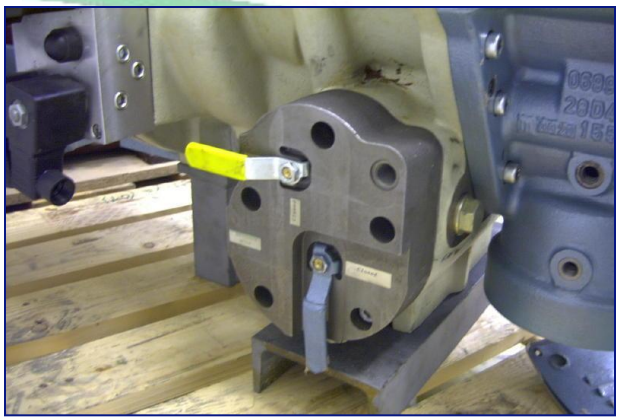
Ölversorgungssystem mit externer Ölpumpe

Oil management with external oil pump

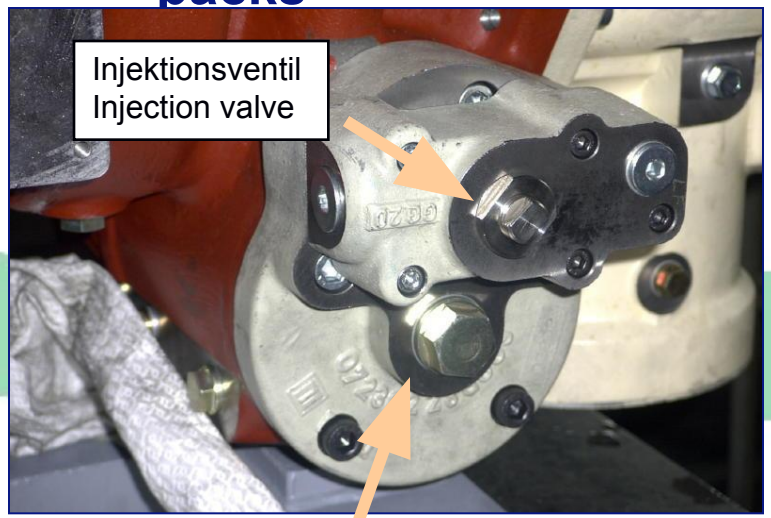


Alte Ausführung: bis ~ 01/1999
Old design: till ~01/1999

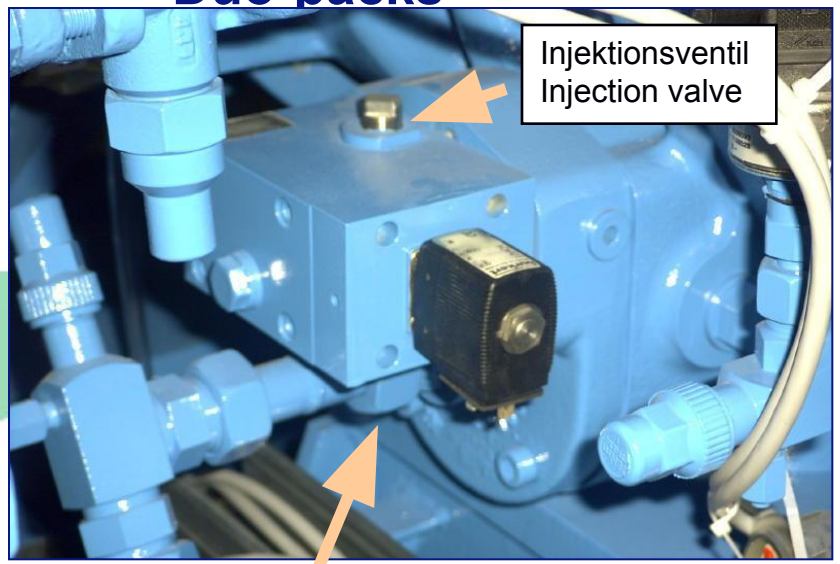




Oil management block 1 for mono packs

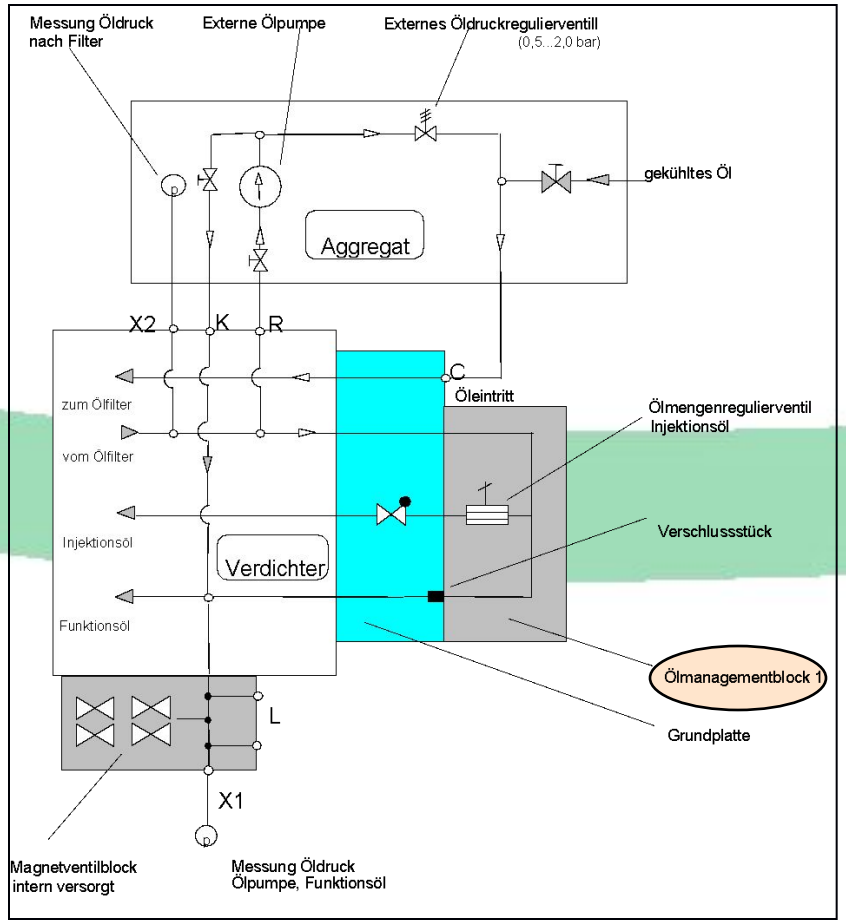


Oil management block 2 for Duo-packs

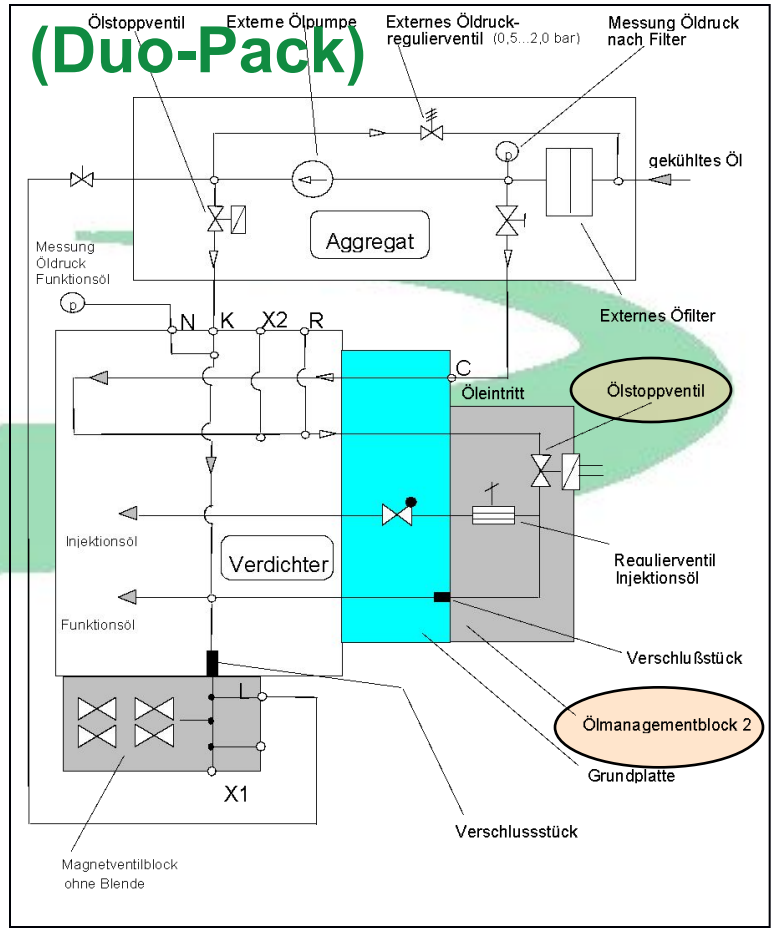


SMALL – oil managements

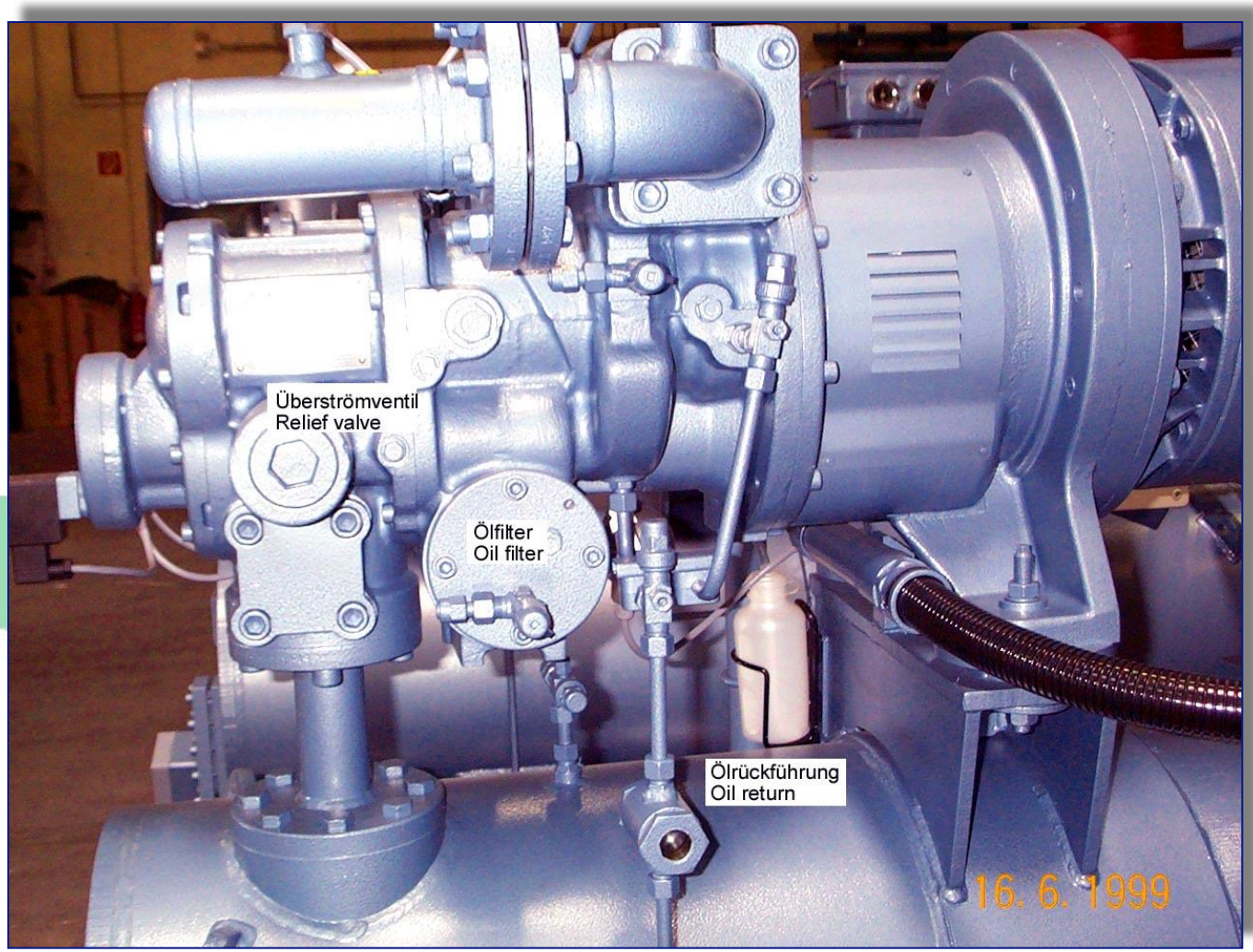
SM12 (Mono Pack)



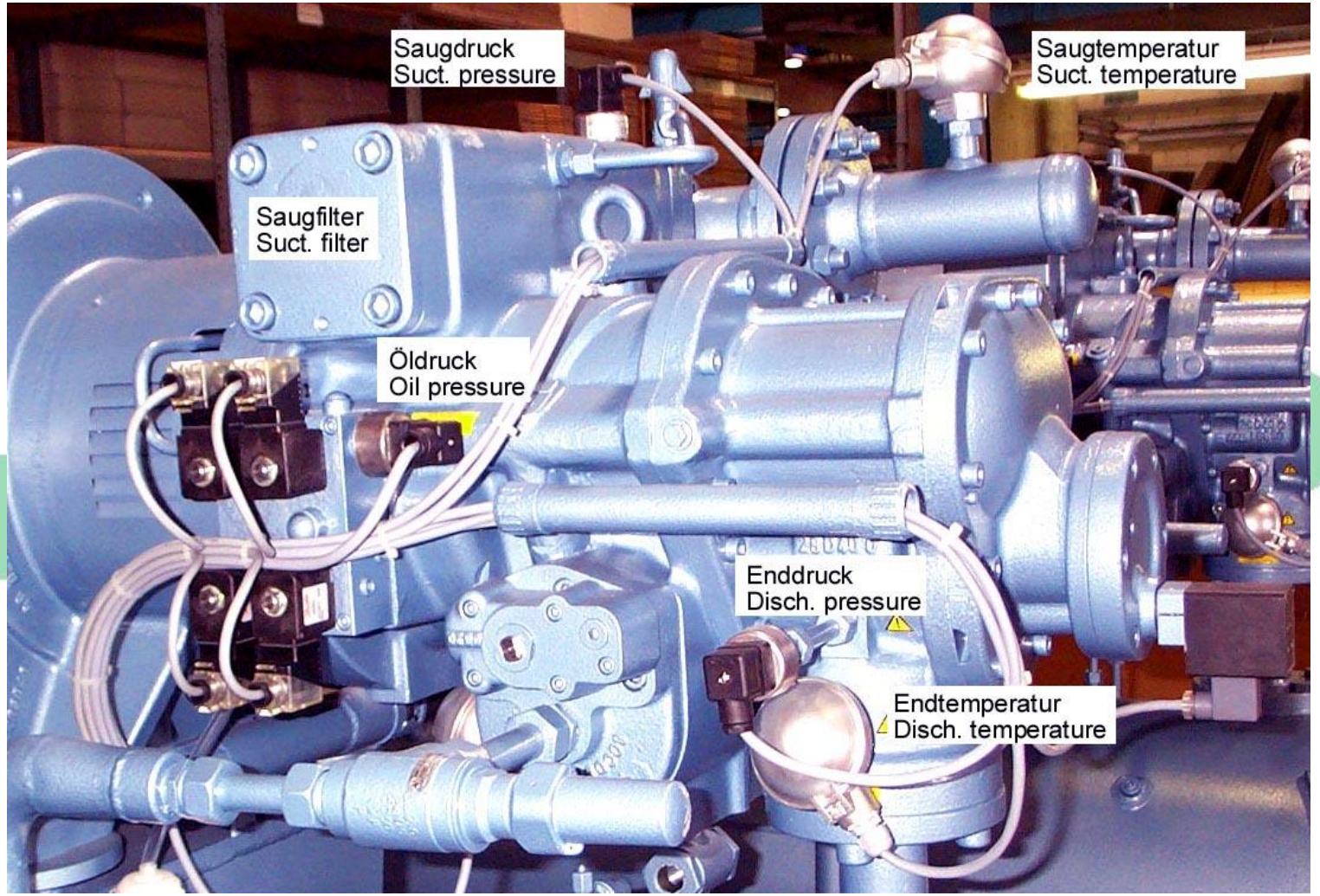
SD12-R1 (Duo-Pack)



SMALL – Picture I

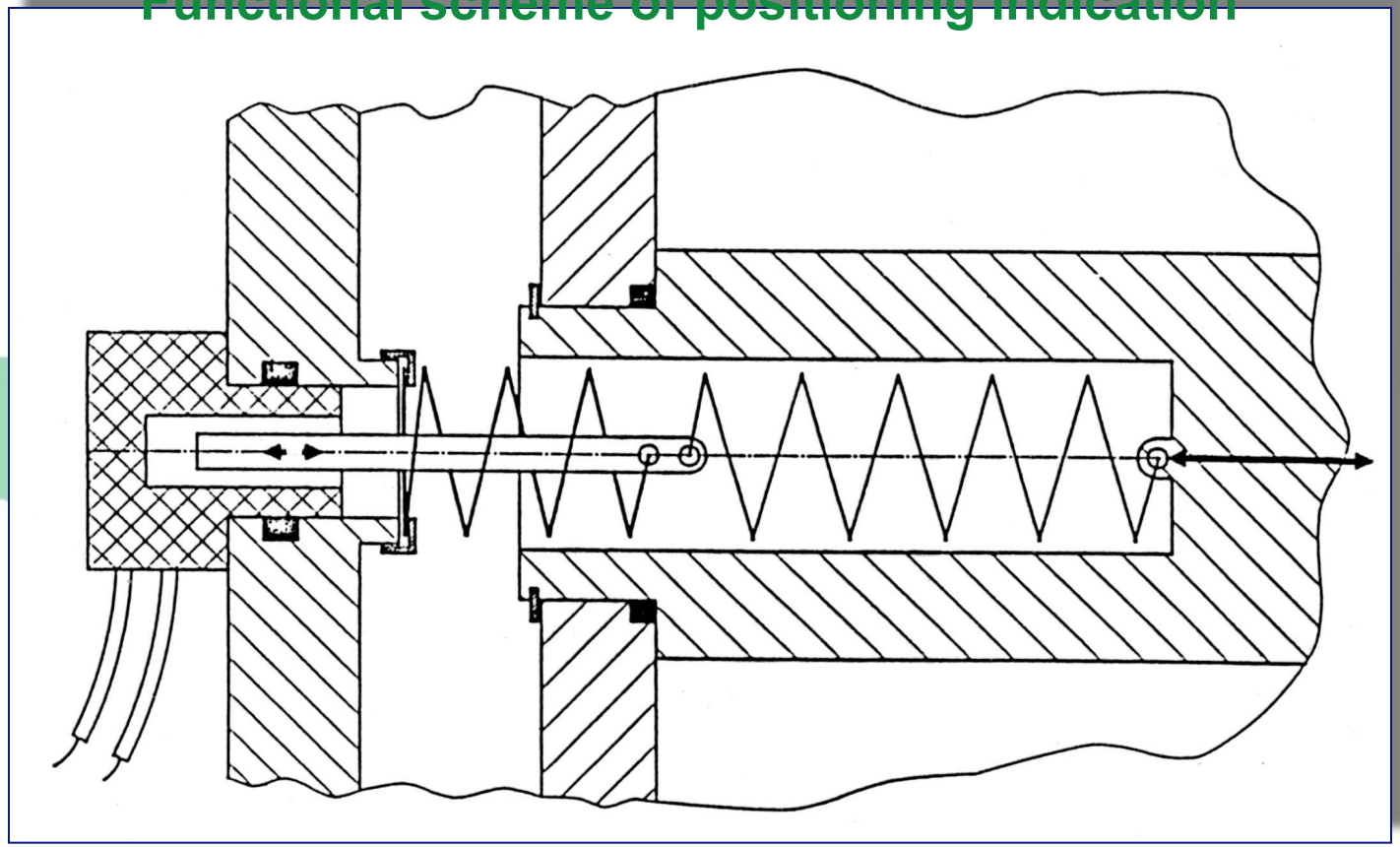


SMALL – Picture II

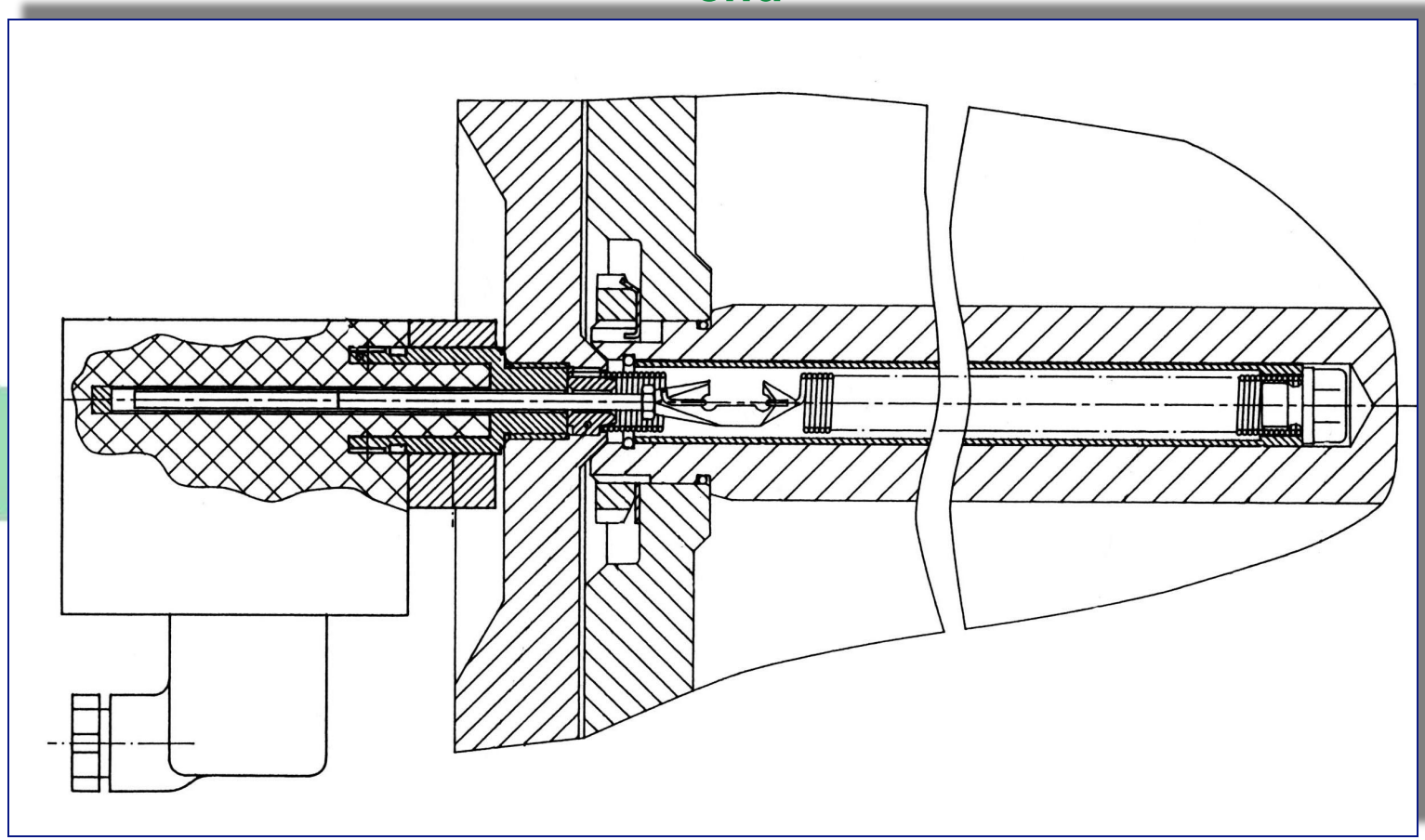


Funktionsschema der Positionsanzeige

Functional scheme of positioning indication

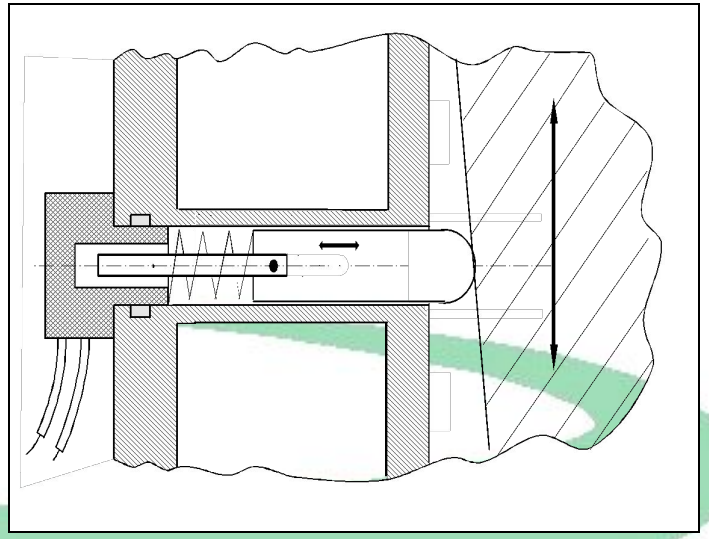


HDT am Sauggehäuse / positioning sensor at suction end



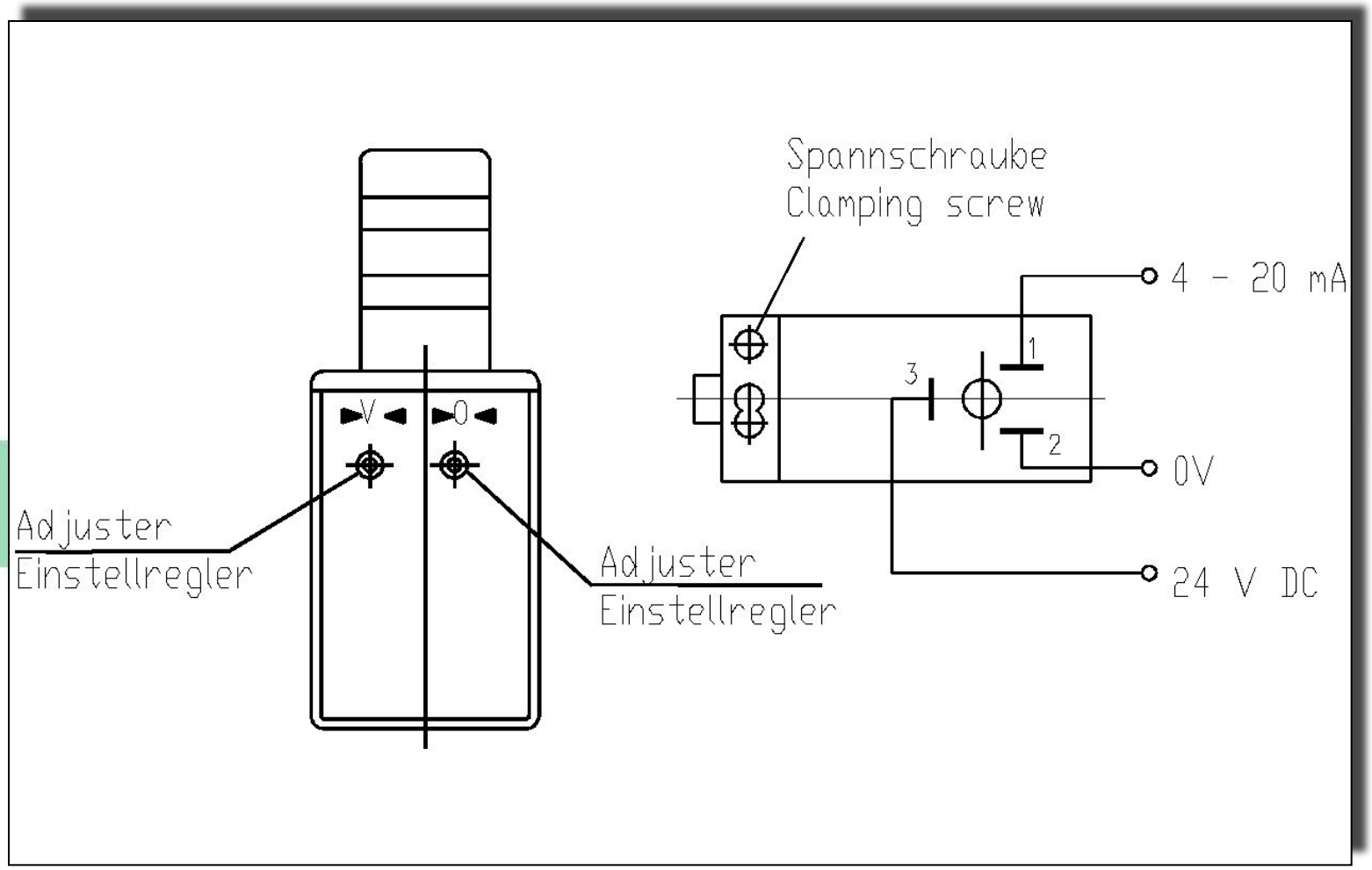
XB, XC, XD,XE,XF:

HDT Funktionschema
Function scheme for positioning sensor

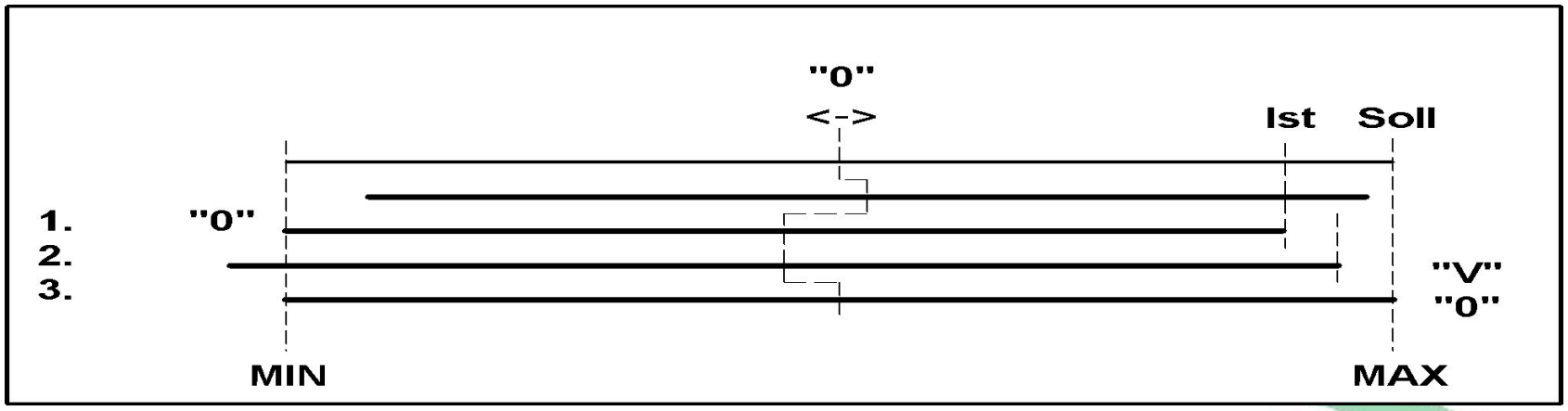


HDT am Rotorgehäuse
positioning sensor at rotor casing

Wegsensor (HDT) / positioning indicator



Einstellung HDT / Adjustment positioning sensor



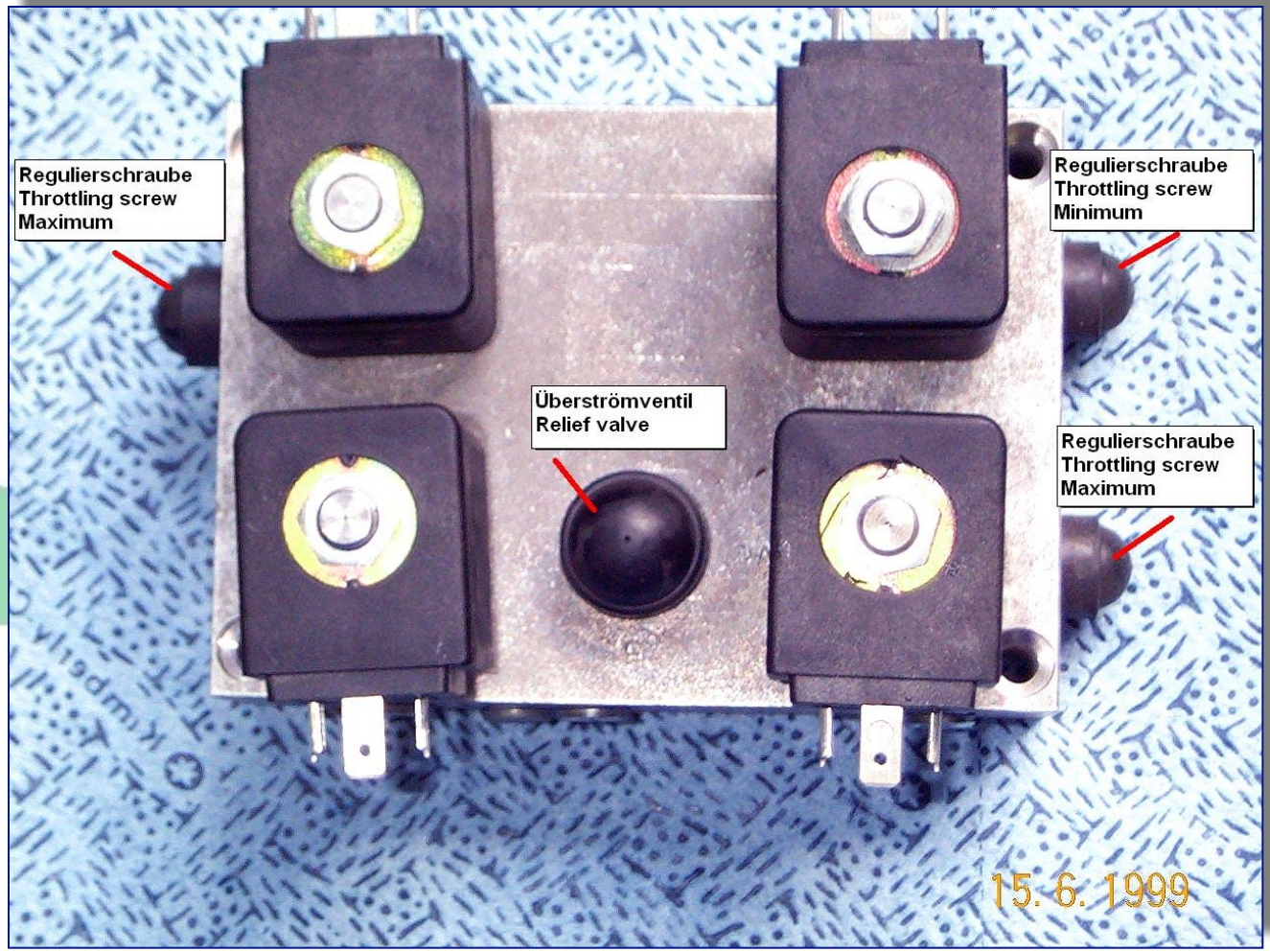
Einstellung:

1. Regelschieber (113) in **MIN**-Stellung bringen (an der Gewindestange in Richtung Druckseite bis zum Anschlag ziehen). In **MIN**-Position des Schiebers am Einstellregler "**O**" **$4^{+0,2}$ mA** einstellen.
2. Regelschieber in **MAX**-Stellung bringen (mit der Gewindestange in Richtung Saugseite bis zum Anschlag schieben).
   In **MAX**-Position des Schiebers am Einstellregler "**V**" möglichst genau auf den **Mittelwert zwischen Ist- und Sollwert** korrigieren (siehe Abb. Justierung des Wegsensors).
3. In **MAX**-Position des Schiebers am Einstellregler "**O**" den Ausgangsendwert **$20^{+0,5}$mA** einstellen.

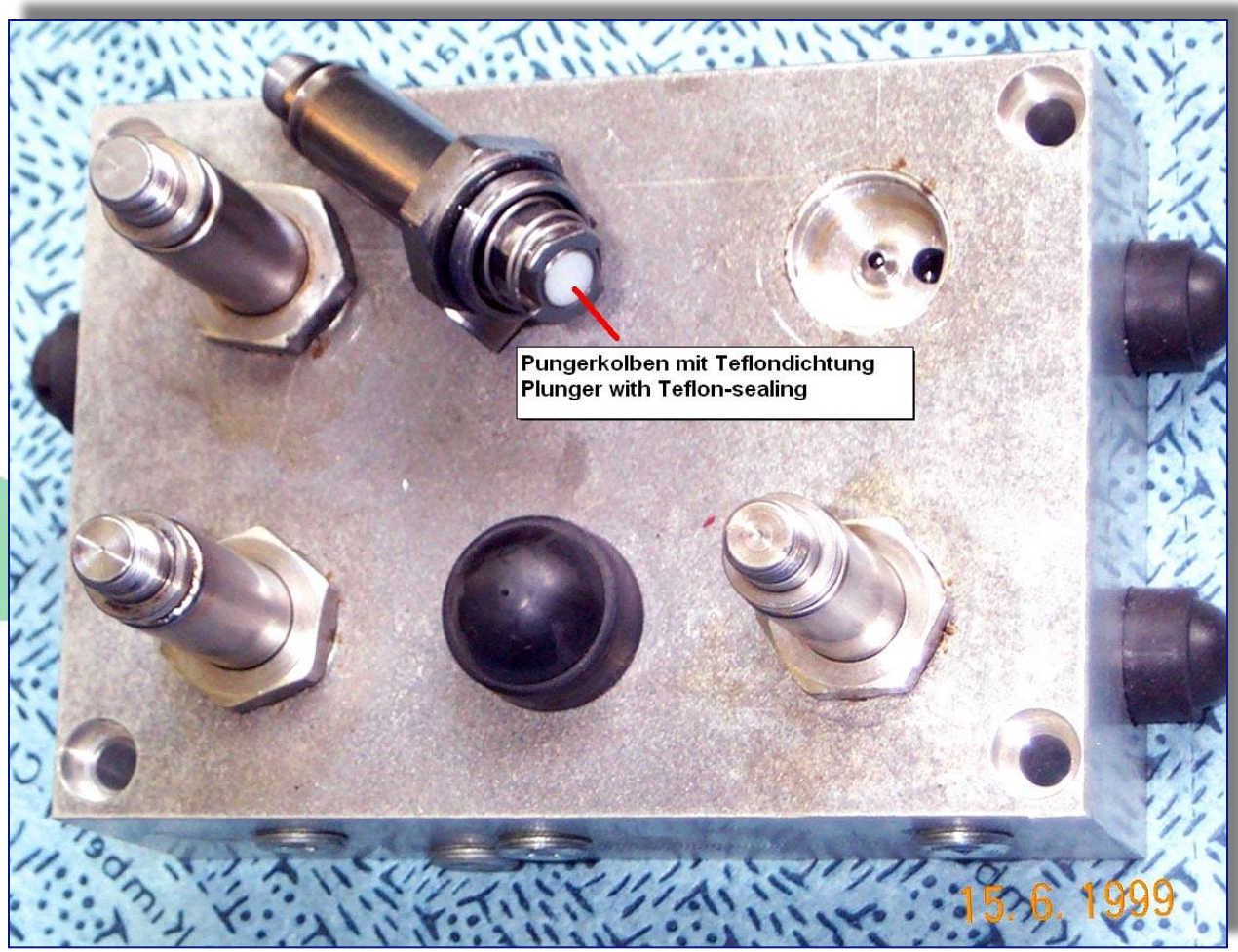
Calibrating:

1. Bring the control slide (113) to the MIN-position (pull it along the threaded rod towards the discharge side as far as the limit stop). With the slide in its MIN-position, use the adjustment controller "O" to set the value of $4^{+0,2}$ mA.
2. Bring the control slide to the MAX-position (push it towards the suction side as far as the limit stop by means of the threaded rod). With the slide in its MAX-positon, use the adjustment controller "V" to correct the midpoint between the actual value and the setpoint as accurately as possible (see figure 11.2).
3. With the slide in its MAX-position, use the adjustment controller "O" to set the output end value of $20^{+0,5}$ mA.

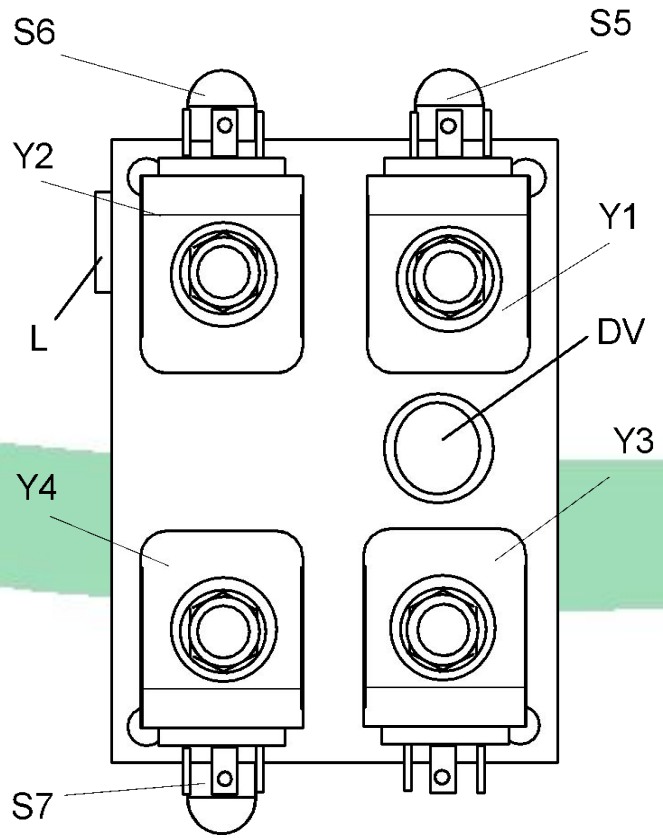
Magnetventilblock / solenoid valve block



Magnetventilblock / solenoid valve block



Magnetventilblock / solenoid valve block



Steuerung/ Control

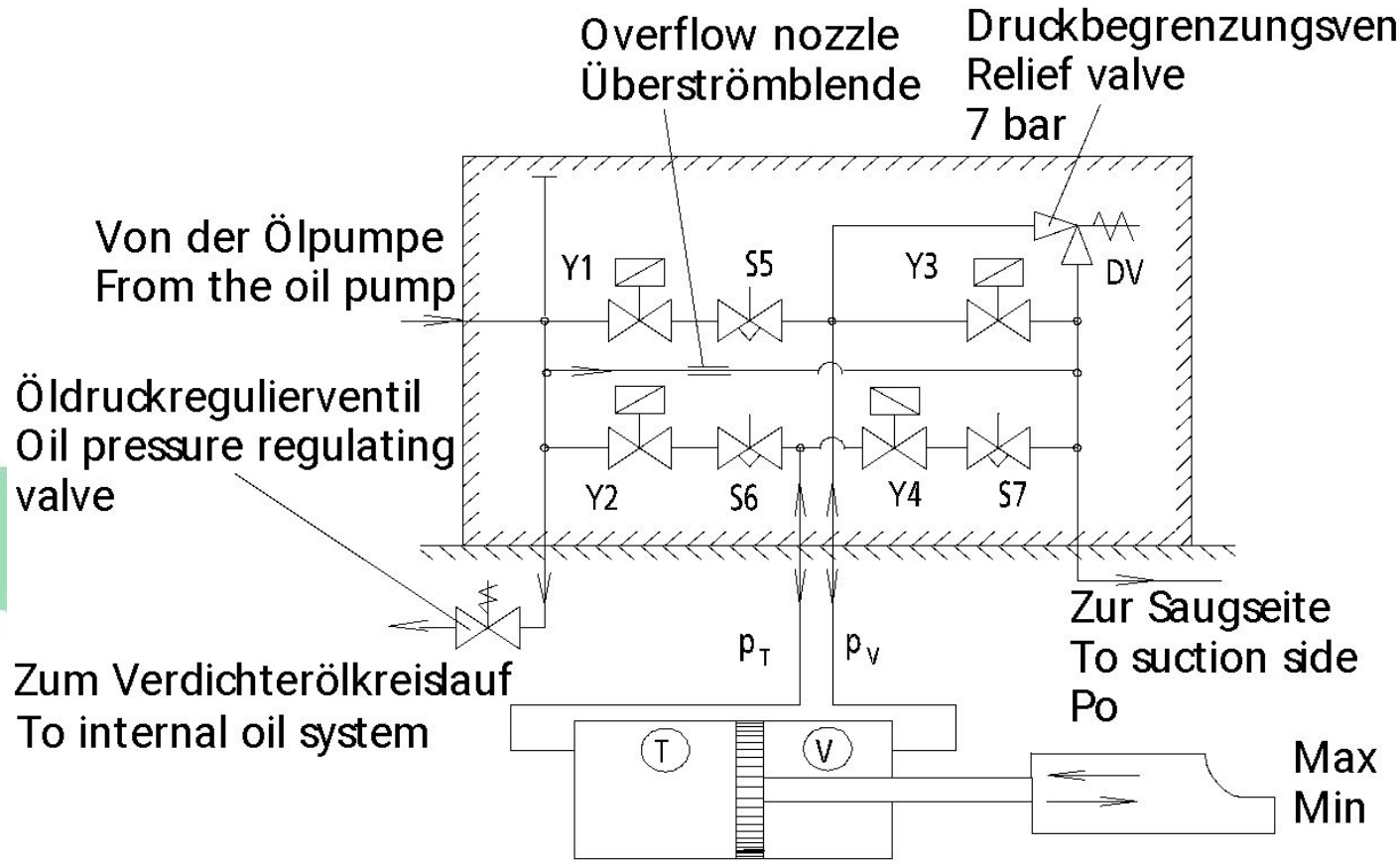
to MAX:

- Y1, Y4 - auf/open
- Y2, Y3 - zu/closed

to MIN:

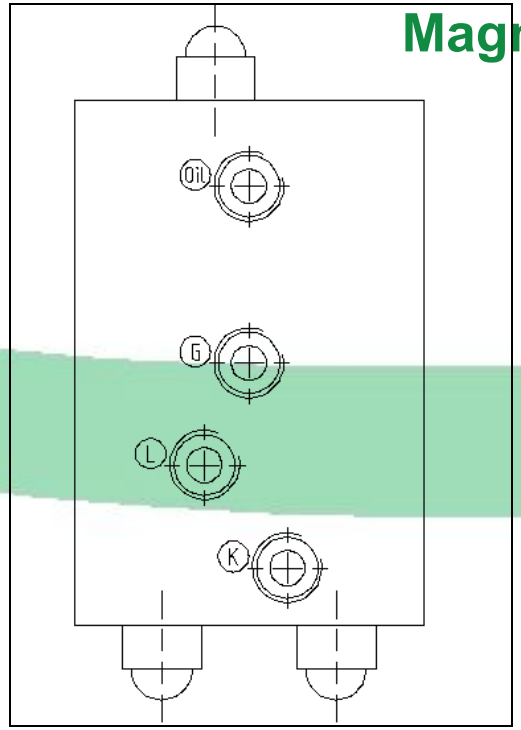
- Y1, Y4 - zu/closed
- Y2, Y3 - auf/open

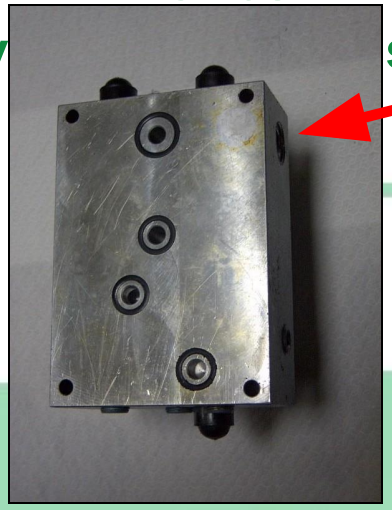
MVBL intern / solenoid valve block – internal piping



Solenoid valve block - Ports

Magnetv schlüsse



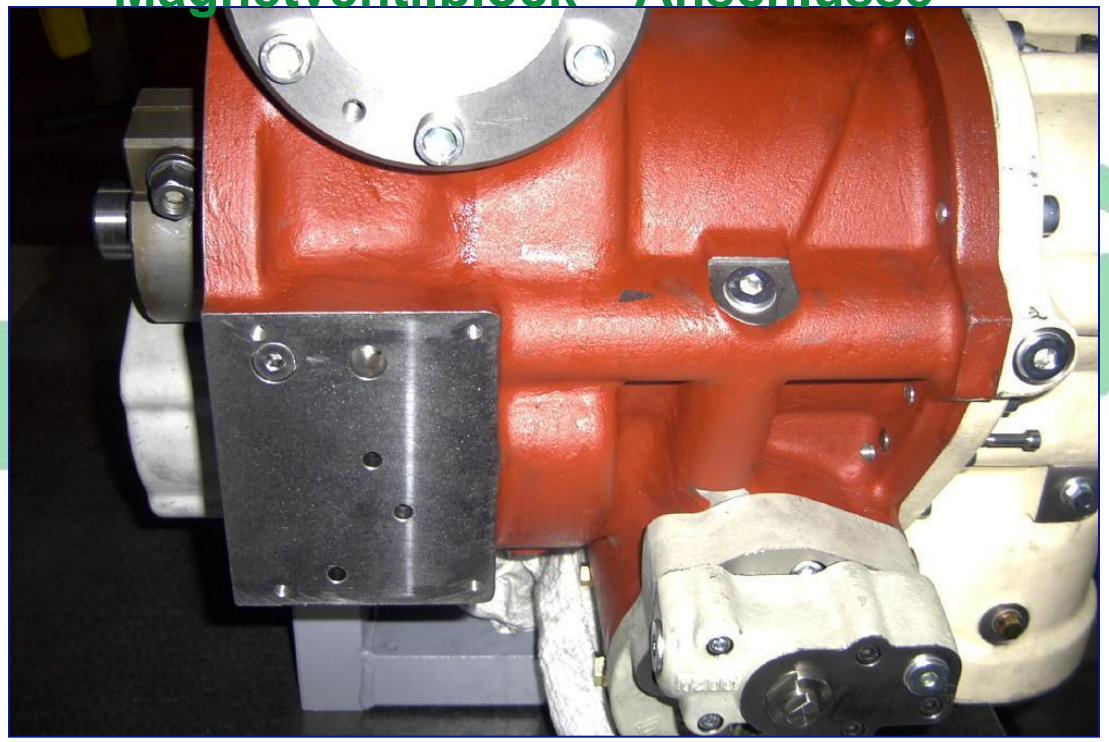


Ölzuführung bei integrierter Ölpumpe
Oil supply if integrated oil pump

	Anschlüsse /Ports
Öl / oil	Druckölanschluß von Ölpumpe / Oil from oil pump
G	Ölrückführung zur Saugseite / Oil return to suction side
L	Ölzuführung Richtung Volllast / Oil supply – direction full load
K	Ölzuführung Richtung Teilast / Oil supply – direction part load

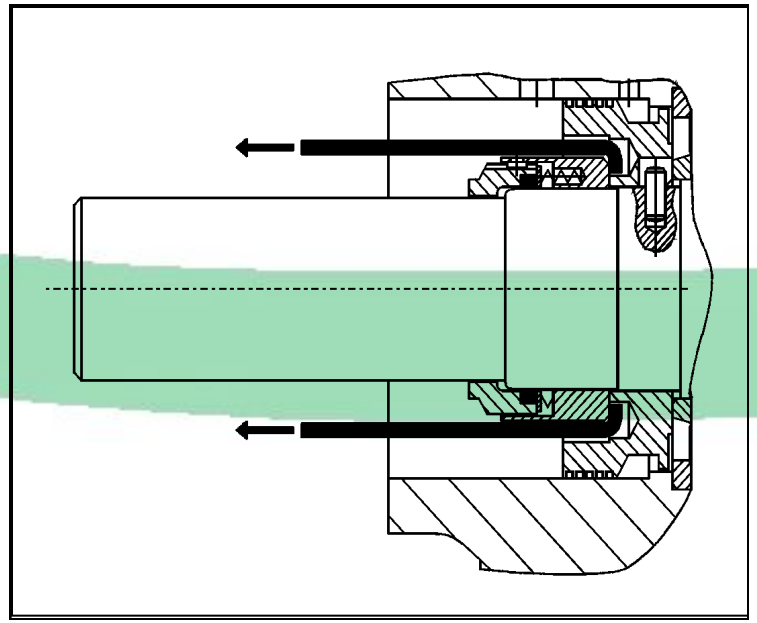
Solenoid valve block - Ports

Magnetventilblock – Anschlüsse

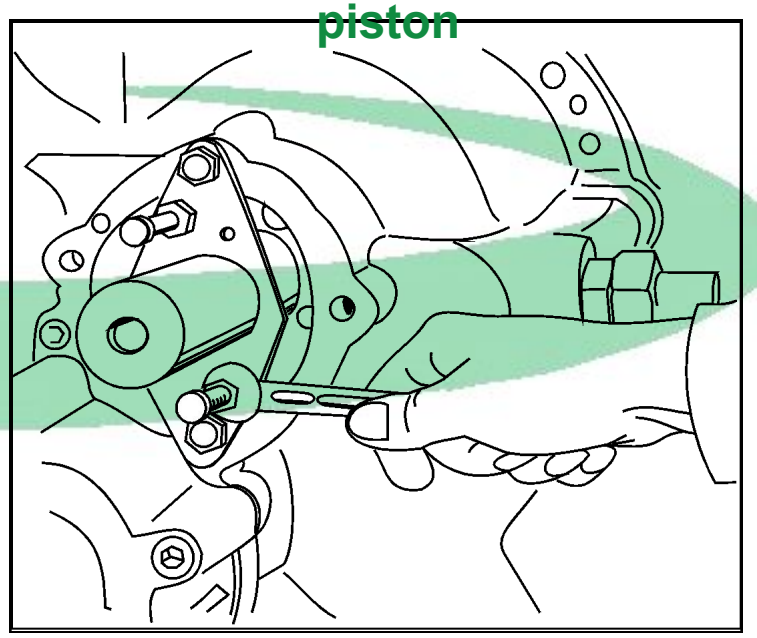


Reparatur Verdichter / repair compressor

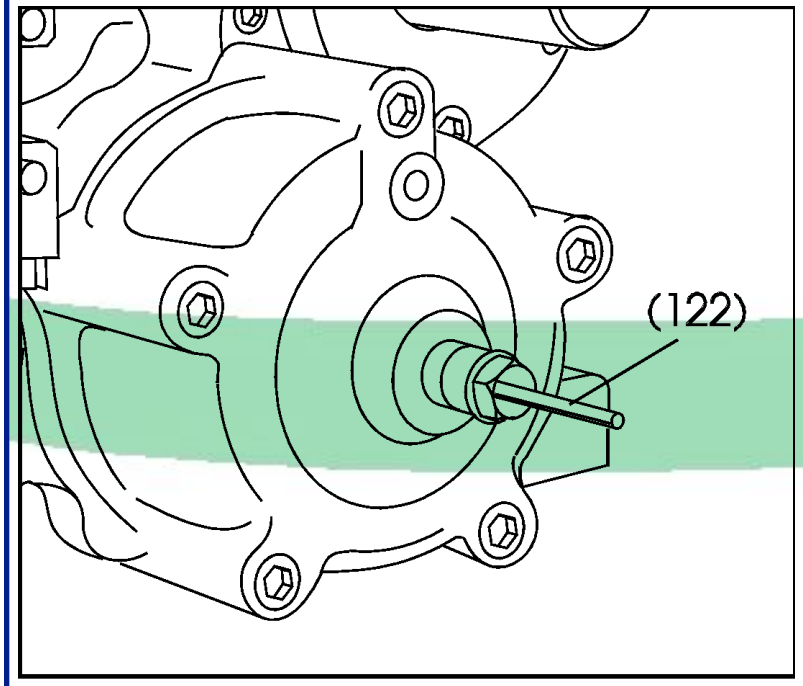
Austausch Gleitringdichtung Exchange shaft seal

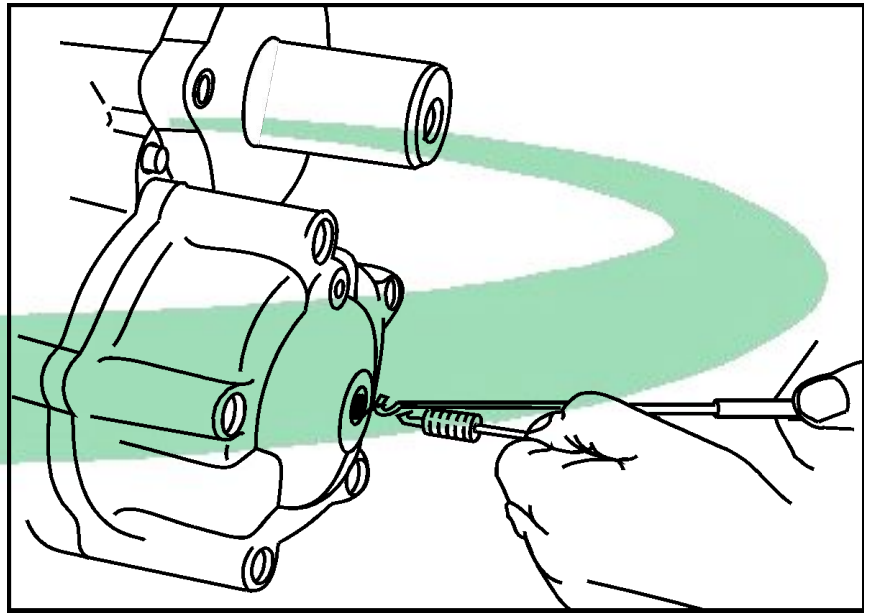


SMALL & MEDIUM: Ausbau Ausgleichskolben Dismantling balance piston

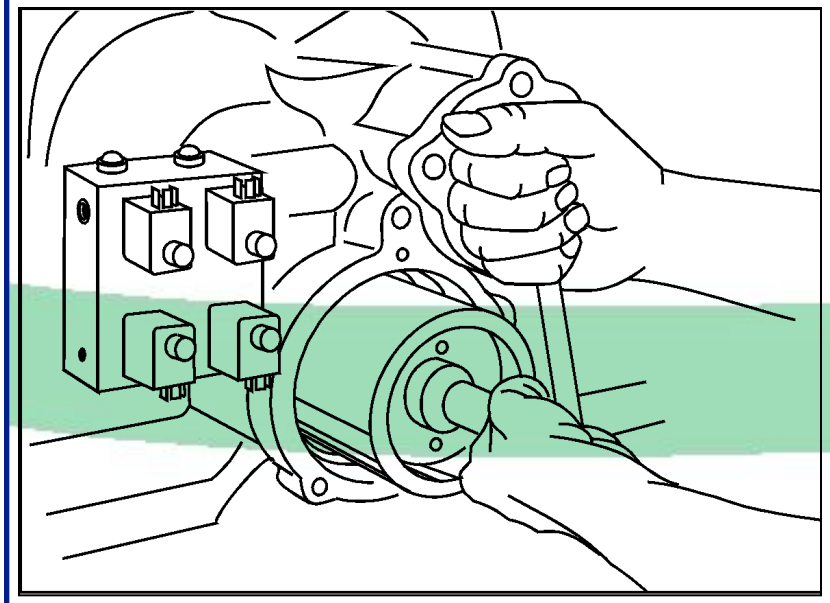


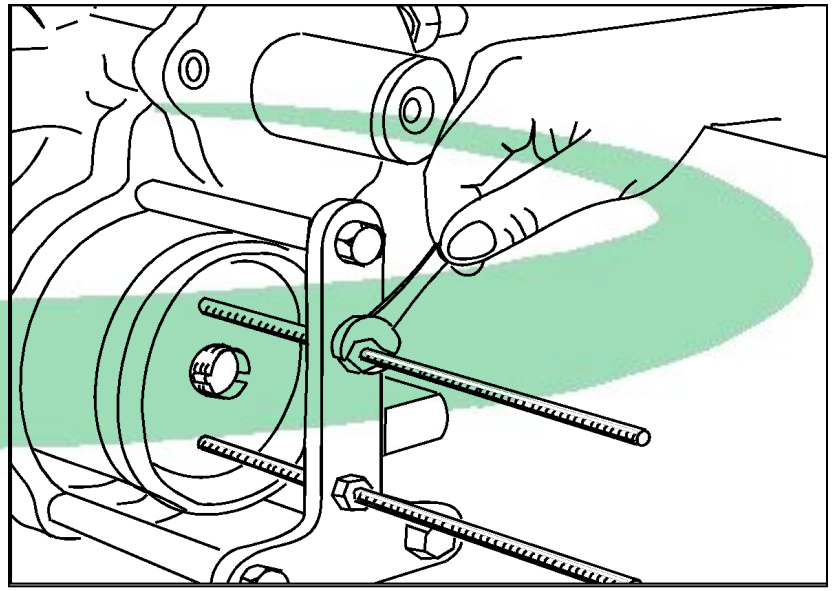
Demontage Wegsensorsystem
Dismantling position indication system





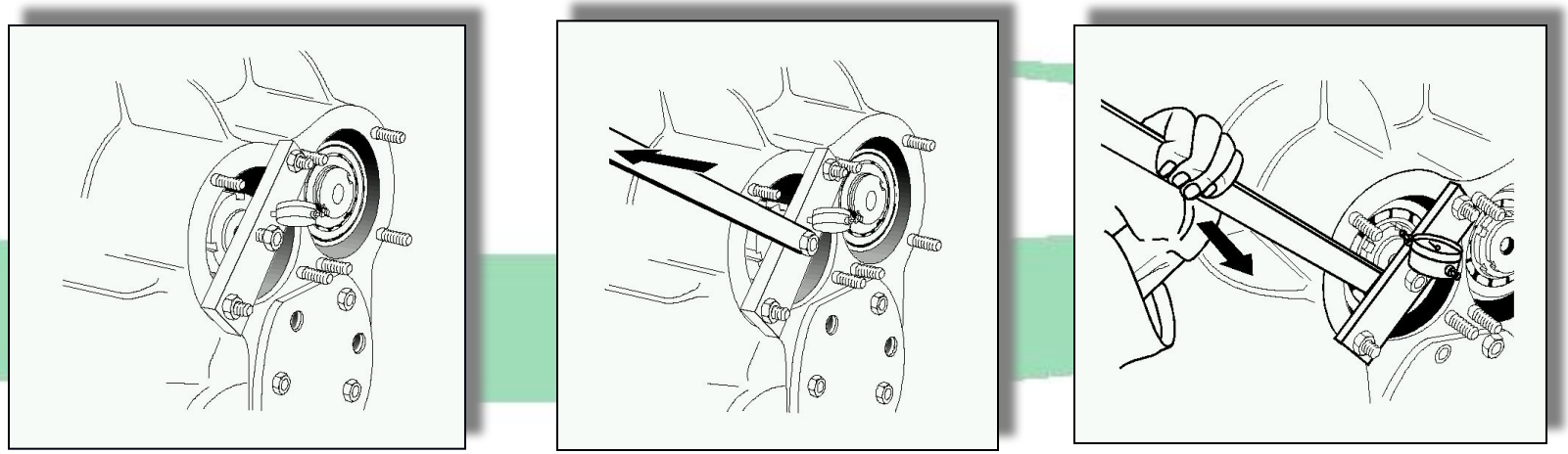
Demontage
Leistungsverstellung
Dismantling capacity control system



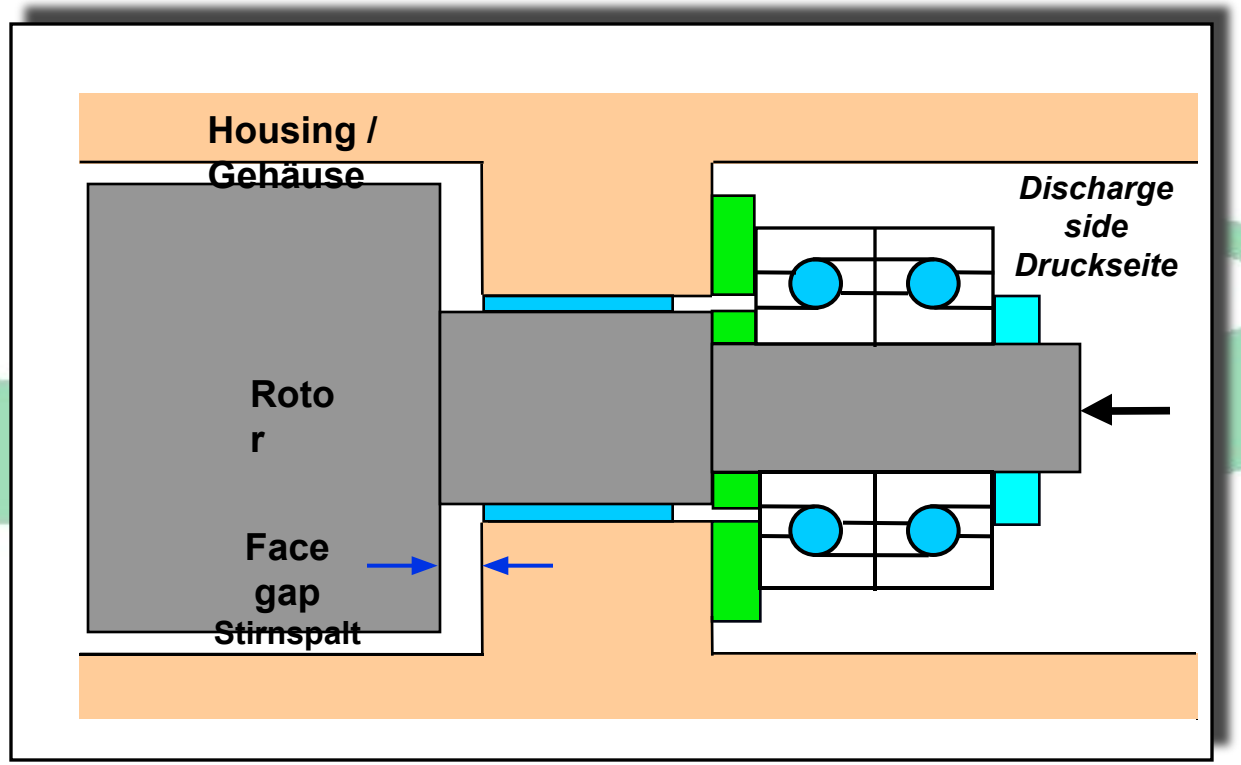


Einstellung Stirnspalt / Messung Axialspiel

Face gap adjustment / Measurement axial play



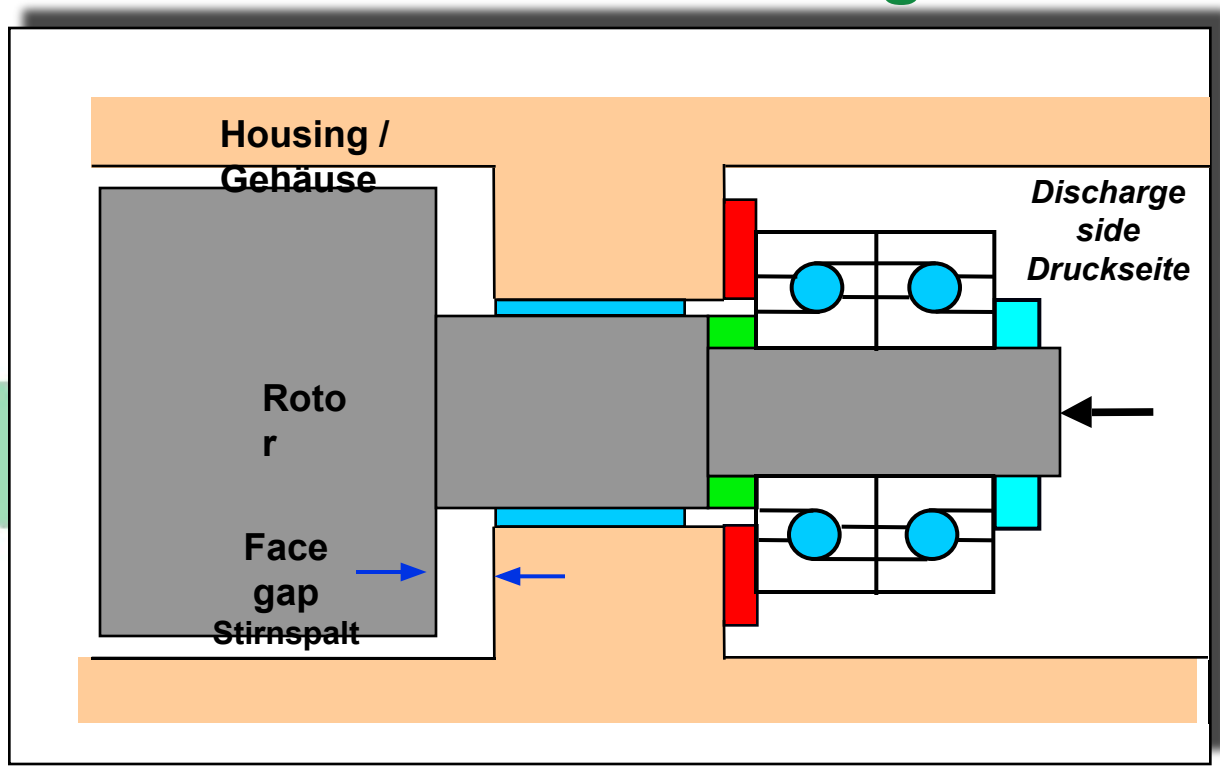
Stirnspalt – bei Herstellung
Face gap – at Factory first build



- *Werkseinstellung: MIN 0,04mm – MAX 0,1mm (baureihenabhängig)*
- *Adjusted Value: Min 0.04mm - Max 0.1mm (model dependent)*

Stirnspalteinstellung – bei Herstellung

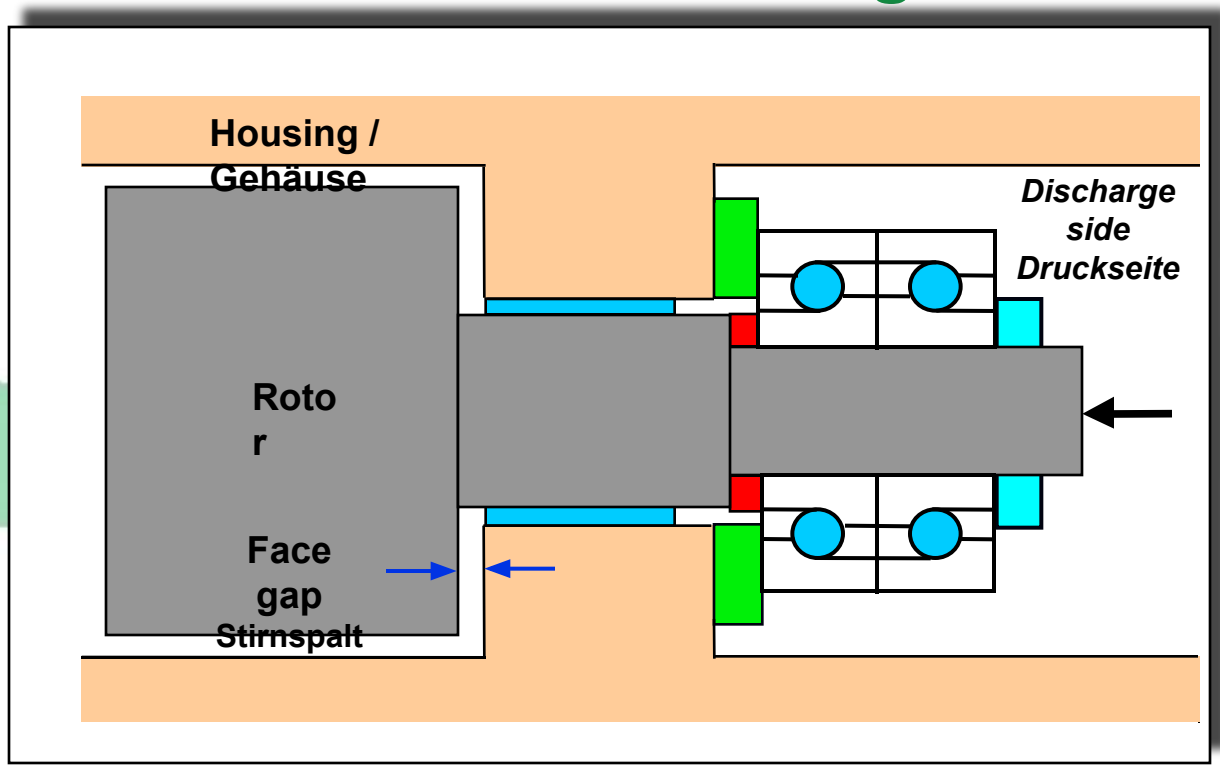
build



- *Stirnspaltvergrößerung – Einschleifen des äußeren Distanzrings*
- *face gap increases if the outer ring is ground down*

Stirnspalteinstellung – bei Herstellung

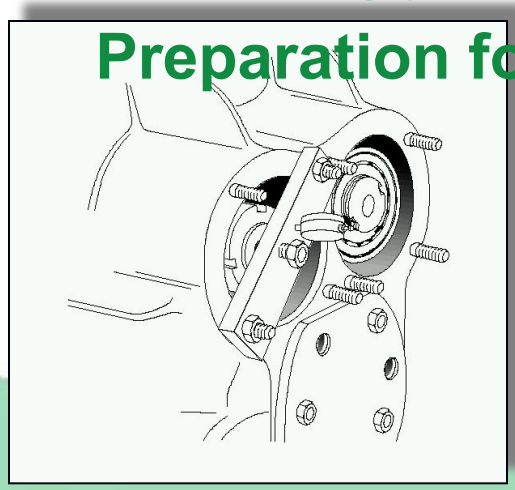
build



- *Stirnspaltverkleinerung – Einschleifen des inneren Distanzrings*
- *face gap decreases if the inner ring is ground down*

Vorbereitung zur Stirnspaltmessung

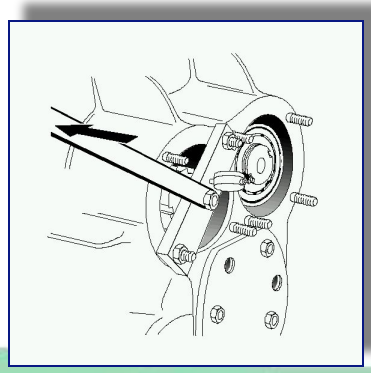
Preparation for face gap measurement



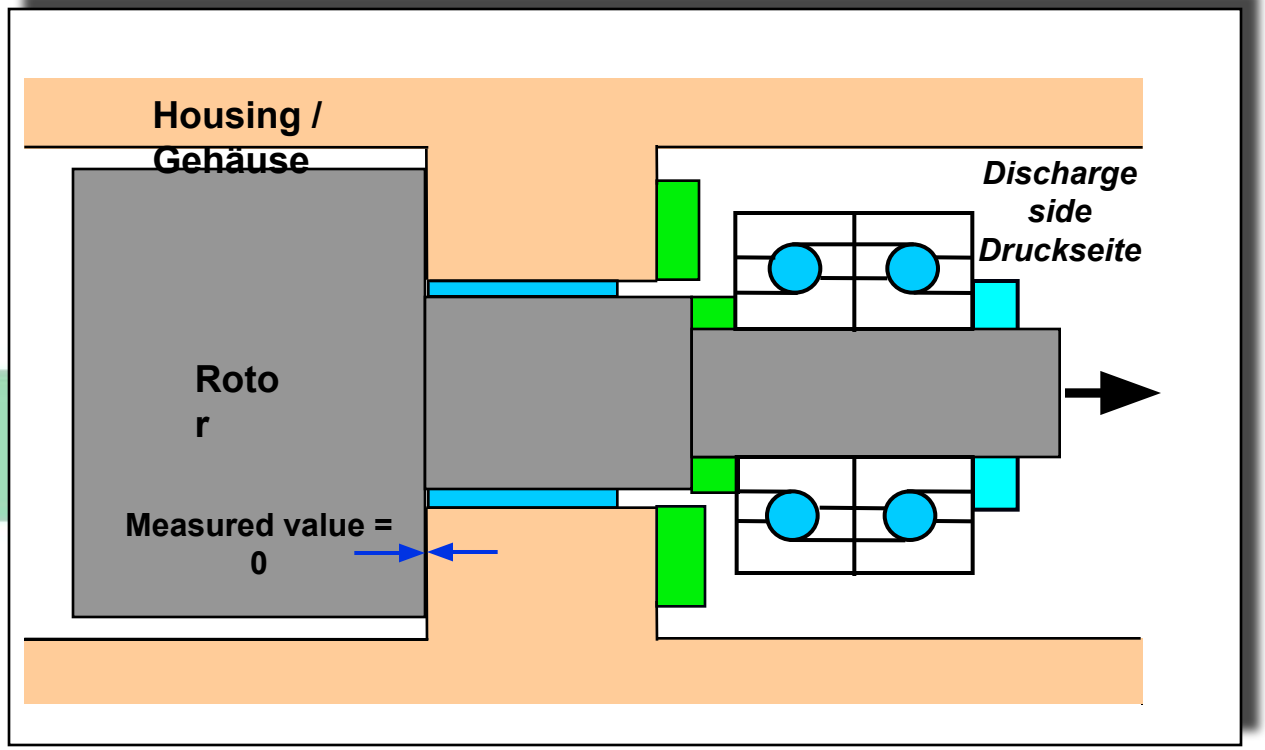
- Verdichter drucklos machen
- Abbau Kupplungschutz
- Lockern Kupplungsitz
- Zugfeder lösen
- Abbau druckseitiger Abschlußflansch
- Druckstück herausnehmen
- Meßuhr installieren

- Depressurize compressor
- Remove coupling guard
- Loosen coupling seat
- Loosen tension spring
- Remove cover plates, plate springs,
- Remove thrust piece(discharge side)
- Install gauge

Meßposition (Druckseite)

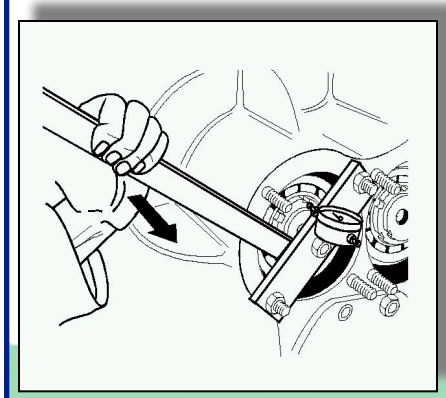


Rotor forced to Discharge side

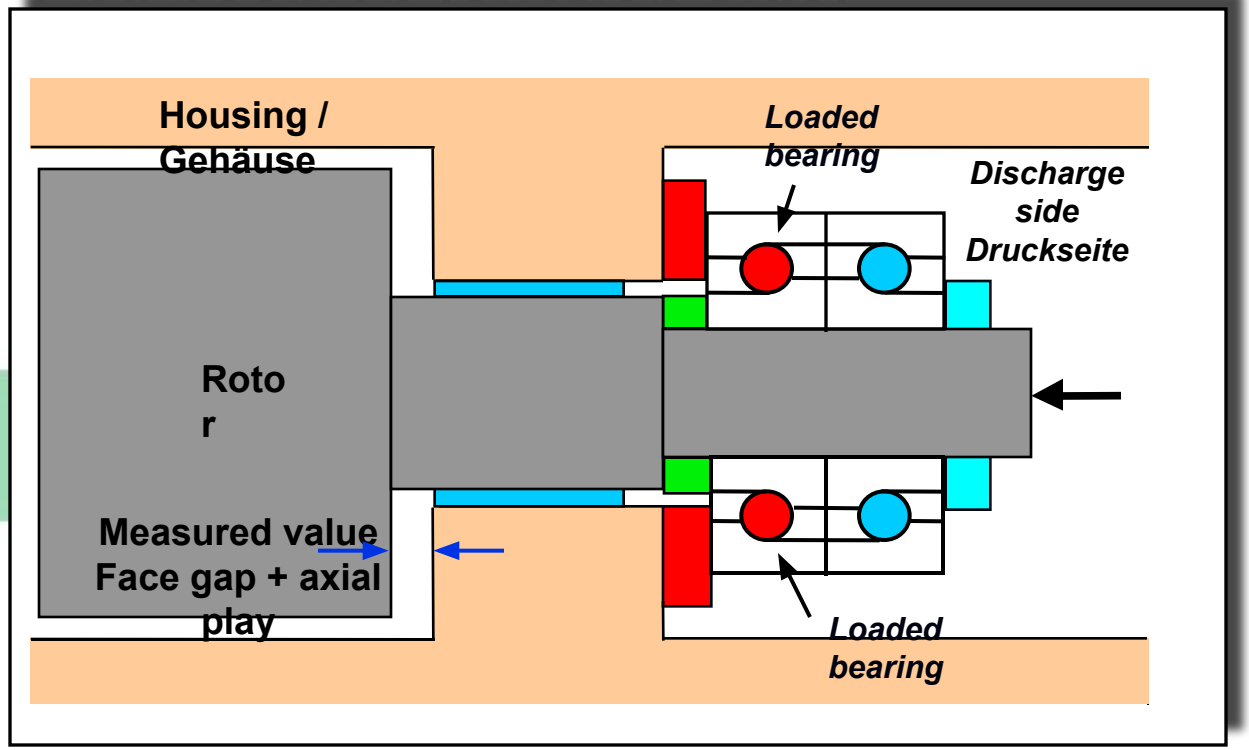


•Meßwert = 0 / Meßuhr auf 0 setzen
•Measured value = 0 / Reset gauge to continue

Meßposition (Saugseite)



Rotor forced to suction side



- *Meßwert: Axialversatz = Stirnspalt + Axialspiel (Spiel des inneren Lagers)*
- *Measured value: Axial displacement = Face gap + axial play (clearance of loaded inner bearing)*

Grenwerte / Limit values for Grasso screw compressors

Maximal zulässige Axialspiele / Maximum permissible axial plays

Die Axiallager sind zu ersetzen, wenn die unten angegebenen Axialspiele überschritten werden oder:

- die Lager einen unnormalen Geräuschpegel aufweisen
- Unnormales Laufbild (z.B.Vibrationen) auftritt
- Optische Mängel am Lager (z.B Käfigverschleiß) festzustellen ist

The axial bearings have to be exchanged if the axial play is greater than the mentioned limit or:

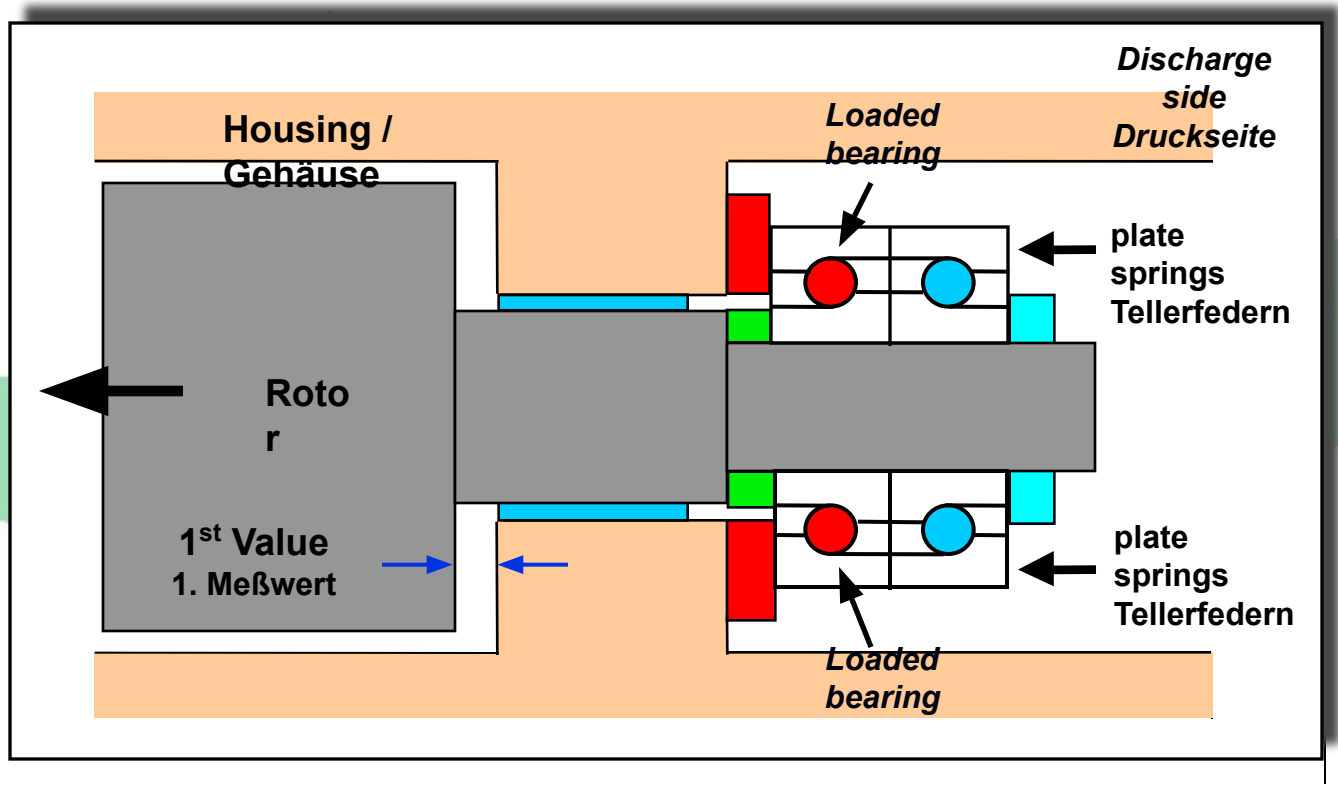
- if they are making strange noise
- Unnormal operating characteristics (e.g. vibrations)
- Optical defect are recognizable

Type of the compressor	Face gap (mm) *	Axial play (mm)
C, D, E, G	0,04 - 0,07	0,15
H, L	0,04 - 0,07**	0.15
M, N	0,05 - 0.08	0,15
P	0,07 - 0,10	0,2
R, S	0,07 - 0,10	0,2
V,W, Y	0,07 - 0,10	0,25
Z, Xa, Xb, Xc, Xd	0,07 - 0,10	0,3

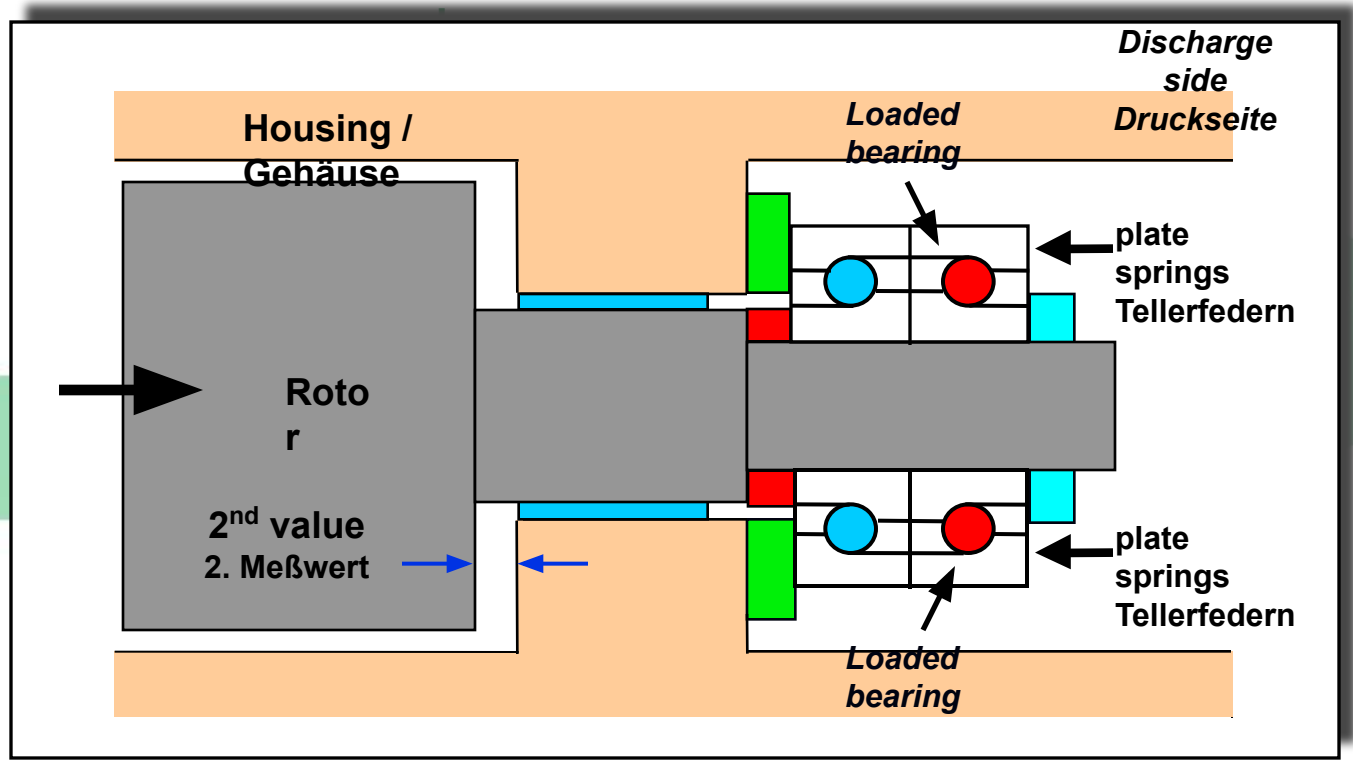
**adjusted at newly built compressor in the Grasso company/ Einstellung bei Verdichterneubau*

*** Before 2003 - Face gap (H,L-compressors): 0.05 – 0.08mm*

1. Meßposition (Saugseite)

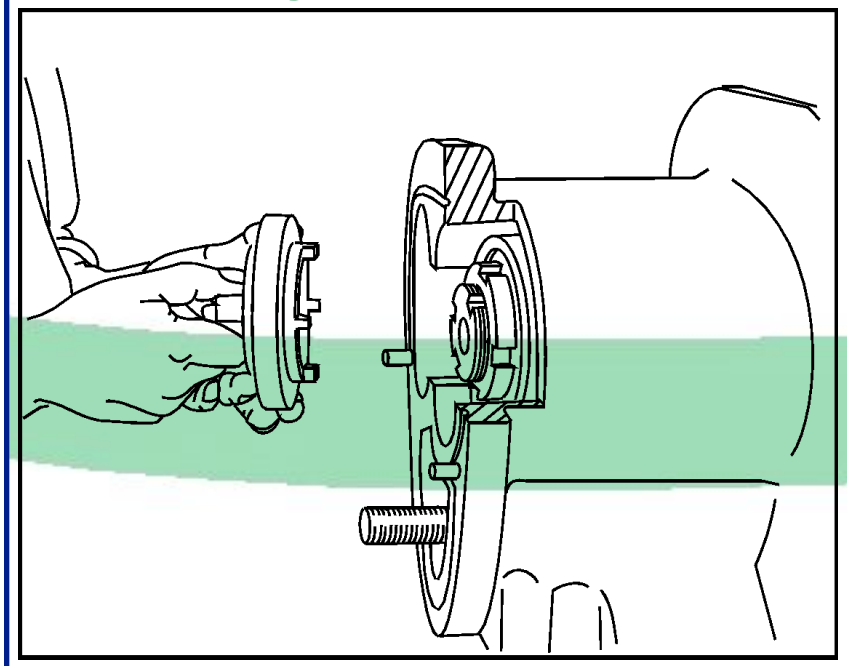


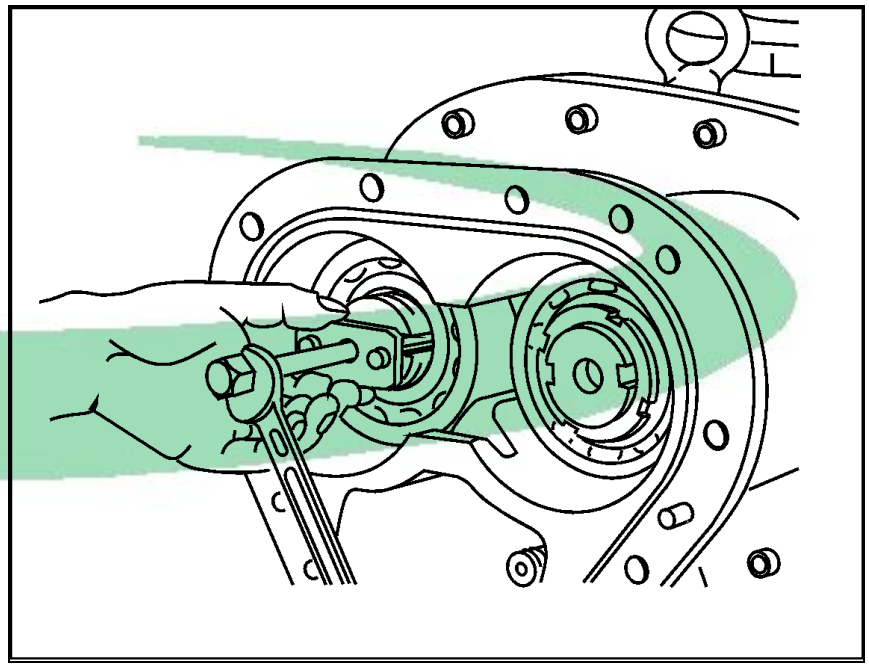
2. Meßposition (Druckseite)



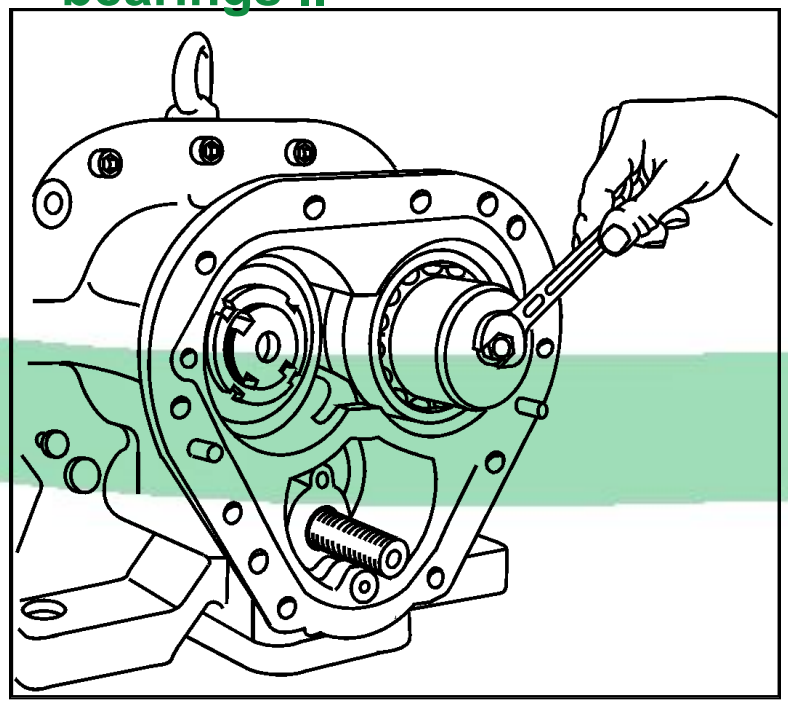
- *1. Meßwert (Druckseite) – 2. Meßwert (Saugseite) = Axialspiel*
- *1nd Value (discharge) – 2st Value (suction) = Axial play*

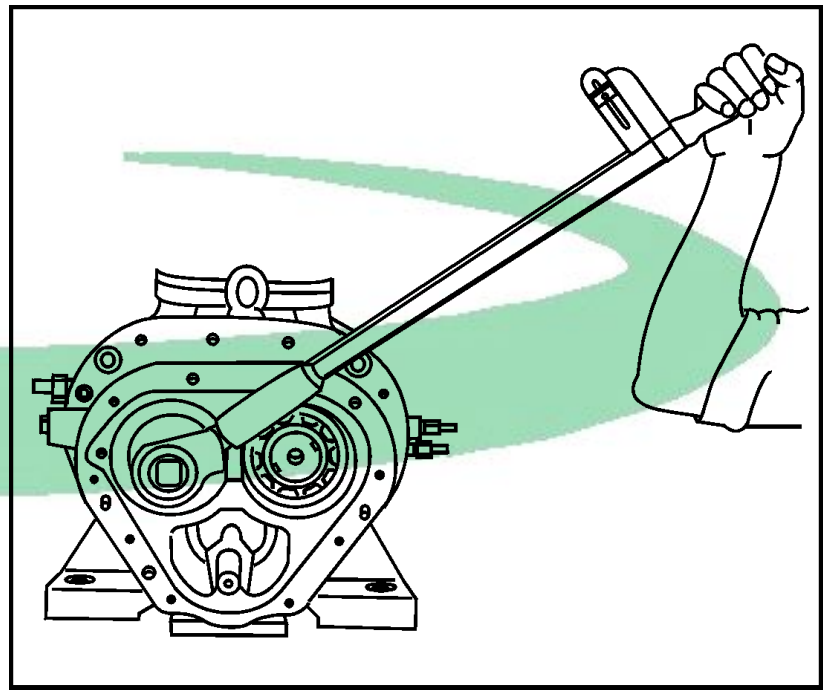
Ausbau Axiallager I
Exchange of angular ball bearings I





Ausbau Axiallager II
Exchange of angular ball bearings II





Anzugmoment - Nutmuttern Axiallager
Tightening torque – grooved nut of axial bearing

Type of the compressor	Male Rotor	Female Rotor
C, D, E, G	150Nm	150Nm
H, L, M, N	400Nm	400Nm
P	400Nm	400Nm
R, S	500Nm	400Nm
V,W, Y	500Nm	500Nm
Z, XA	600Nm	500Nm
XB, XC, XD	900Nm	700Nm

*auch im Bedienungshandbuch nachzuschlagen
*see also user manual

Typen - Gleitringdichtung
Type of shaft seals

Art der eingebauten GLRD ist Kompressortypabhängig
Type of installed shaft seal is compressor type dependend

***Vor Einbau bitte Madenschraube entfernen**
Before assembling grub screw has to be removed

Tolerierte Leckraten von GLRD

Tolerated Leakage rates of shaft seals

Type of the compressor		oil leakage rate	
C, D, E, G	~0,5ml/h	~1..2	drops/ min
H, L, M, N	~1,0ml/h	~2...3	drops/ min
P, R, S	~3,5ml/h	~9...10	drops/ min
V,W, Y, Z, XA	~9,0ml/h	~20…22	drops/ min
XB, XC, XD	~10,0ml/h		

Rückholfeder / Tension spring (SMALL & MEDIUM)

**Alte Ausführung / Old design
till: 08/1999**

**Neue Ausführung / New design
from: 09/1999**

Rückholfeder / Tension spring (Small & MEDIUM)

Service Ausführung / Service design