# COMPRESSOR
## Maintenance and Service Instructions

These Maintenance and Service Instructions are intended for your Stal Compressor. They contain technical data on the compressor, lubrication recommendations, lists of parts, recommendations on routine maintenance and information necessary for the installation of the compressor.

In accordance with our Delivery Conditions, we give a one-year guarantee for the compressor with regard to material and workmanship, provided the comperssor is correctly installed and that the plant, in which it is incorporated, is properly designed. Since proper operation and maintenance of the compressor also constitute conditions for the validity of the guarantee clause in our Delivery Conditions, it is imperative that the operating personnel should be well acquainted with these instructions.



**Sabroe Refrigeration AB**



Compressor Designation .....

Compressor Mfg. No. .....

Reference No. 330201

In the event you should need any additional information on your Stal Compressor, please contact your local representative, or

**Sabroe Refrigeration AB**
601 87 NORRKÖPING
Telephone: + 46 11 21 40 00
Telefax: + 46 11 10 23 42

**When communicating, please always quote the above reference number.**

# INSTRUCTION FILE, LIST OF CONTENTS
## For unit types SV, SZ 85

| Heading | Manual sheet | SVA SVB | SVR | SZ | Scope | Code position Variant code letter |
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| Heading | Manual sheet | SVA SVB | SVR | SZ | Scope | Code position Variant code letter |
|---|---|---|---|---|---|---|
| Control equipment | 4848-J-710E | | | | Control cabinet | C/H |
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| | 4848-J-505E | | | | StalExcom dataset list SE700 | C/B–G |
| | 4848-N-780E | | | | Stalectronic 700 Operator's Manual for SV80 Compressor Units | C/B–G |
| | 4848-N-570E | | | | Slide position sensor | C/B–G |
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| | 4848-N-590E | | | | Oil cooler | M/B–K |
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| | 4848-R-210E | x | x | x | Spare parts, compressor | |
| | 4848-R-020E | x | x | x | Small set of tools | |

Remark. Only manual sheets valid for the unit have been marked with a cross.
Shaded areas mean that manual sheets are chosen acc. to code position and variant code letter.

SABROE REFRIGERATION AB 1995-06-13

# INSTRUCCIONES DE SEGURIDAD

Para usar la máquina deberán cumplirse las siguientes condiciones:

1. Sólo deberá emplearse para la compresión de gases que generen refrigeración o calor.

2. Sólo deberá emplearse con el refrigerante especificado en la placa de características.

3. La máquina no deberá usarse para otras finalidades.

4. Sabroe Refrigeration AB no asume responsabilidad alguna sobre la máquina si ésta ha sido modificada.

5. La máquina no deberá emplearse en atmósferas explosivas.

6. No deberá colocarse de forma que entre en contacto con alimentos.

**Durante la instalación, operación y mantenimiento, deberá dedicarse una atención especial a lo siguiente:**

1. Todas las tareas de instalación, operación y mantenimiento de la máquina sólo deberá realizarlas personal adiestrado y cualificado.

2. Deberán leerse las instrucciones antes de la instalación, operación o mantenimiento.

3. Su ubicación en la sala de máquinas deberá permitir una rápida evacuación del personal.

4. Al izarla se corre el riesgo de accidentes. Usar para ello las anillas de elevación de la máquina y un equipo de elevación aprobado y adaptado al peso de la máquina.

5. No circular cerca de una máquina parada, puesto que puede ponerse en marcha sin preaviso si está equipada con control remoto o automático, y causar daños personales. No permitir a personas no autorizadas entrar en la sala de máquinas.

6. Las tuberías y otros componentes pueden estar muy calientes o muy fríos, causando quemaduras o congelación, respectivamente. Es necesario obrar con precaución al tocar la máquina.

7. Utilizar protección auditiva en las proximidades de la máquina para evitar lesiones en el oído.

8. El trabajo de mantenimiento debe hacerse sólo por personas autorizadas. Durante las operaciones de mantenimiento, deberá obrarse de modo que el compresor no pueda ponerse en marcha, para evitar el riesgo accidentes. Desconectar el interruptor de suministro eléctrico del circuito principal. Ese interruptor deberá estar cerrado bajo llave mientras se esté trabajando en la máquina.

9. Durante las tareas de mantenimiento y otros trabajos, existe el riesgo de inhalar gases peligrosos. Asegurar una ventilación apropiada alrededor de la máquina.

10. Asegurarse de que la máquina esté bien fría antes de empezar a trabajar en ella, para evitar el riesgo de sufrir quemaduras.

11. No llevar ropa de vestir suelta o demasiado holgada, joyas o reloj de pulsera al trabajar con la máquina. Asegurarse de que el cabello, si es largo, no entre en contacto con la máquina.

12. El sistema de refrigerante está presurizado. Antes de empezar a trabajar en el sistema, la presión deberá reducirse cuidadosamente al nivel atmosférico. Los escapes de gas pueden producir daños.

13. El refrigerante no deberá evacuarse al aire, debido a que constituye un peligro para el ambiente. Las tuberías utilizadas para vaciar o llenar con refrigerante deben soportar las presiones existentes, de lo contrario se corre el riesgo de que revienten.

14. El refrigerante puede ser peligroso para la salud. Usar el equipo de protección prescrito, por ej. guantes, anteojos y caretas de respiración. En caso de que entrara en contacto con la piel, inhalación, etc., seguir las instrucciones aplicables al refrigerante respectivo. Ponerse inmediatamente en contacto con un médico.

15. El aceite puede ser peligroso para la salud y causar irritación en la piel. Usar el equipo de protección prescrito, por ej. guantes, anteojos y caretas de respiración. En caso de que entrara en contacto con la piel, o de inhalación, seguir las instrucciones aplicables al aceite respectivo. Ponerse inmediatamente en contacto con un médico.

16. Al cambiar el aceite, recordar que éste puede tener una temperatura elevada y contener gas refrigerante, y ocasionar quemaduras y otras lesiones. Es esencial obrar con precaución.

17. Las herramientas y repuestos olvidados después de las tareas de mantenimiento pueden causar lesiones o daños.

18. No intentar localizar las fugas con las manos o cualquier otra parte del cuerpo. Se corre el riesgo de daños por congelación.

19. No exponer la máquina a una temperatura superior a la permitida, debido a que se corre el riesgo de explosión.

20. Antes de poner en marcha la máquina después de haberle dado mantenimiento, controlar que:

    Se hayan montado todas las protecciones de seguridad, correctamente ajustadas.
    Todos los pernos y tornillos estén correctamente apretados.
    Todas las válvulas estén correctamente ajustadas.
    No haya personas en la zona de riesgo.
    No se hayan olvidado herramientas en la máquina o en sus proximidades.

21. No permanecer sobre la máquina, puesto que se corre el riesgo de resbalar. Pueden producirse daños en las tuberías y el equipo de seguridad.

22. Mantener la máquina limpia, eliminando el polvo y la suciedad, ya que pueden causar incendios o perturbaciones operativas.

23. Controlar periódicamente que los letreros de advertencia, etc, estén intactos y fácilmente visibles. Los letreros perdidos o dañados, etc., deben reemplazarse inmediatamente.

24. Sabroe Refrigeration AB no asume responsabilidad alguna por el uso de repuestos que no sean originales.

Sabroe Refrigeration AB
601 87 Norrköping
Suecia

# DECLARATION OF AIRBORNE NOISE EMISSION

SV 85

## DECLARED NOISE EMISSION VALUES in accordance with ISO 4871

| | | |
|---|---|---|
| Declared A-weighted Sound Power Level, $L_{WAd}$, in dB re 1 pW. | **103** | dB(A) |
| Declared A-weighted Emission Sound Pressure Level, $L_{pAd}$, in dB re 20 µPa, at 1m distance from the reference box in free field conditions. | **86** | dB(A) |

Measurements are taken in accordance with ISO 9614-2.
Determined A-weighted Emission Sound Pressure Level in accordance with ISO 11 203.

### Operating conditions at measurement

Working medium : R22
Suction pressure : 5.0 Bara
Discharge pressure : 15.3 Bara
Oil separator : TAS 1000C
Electric motor : Schorch BN 315X (400 kW) IP23

NOTE! The acoustic nature of the surroundings in which the unit is mounted and located, may alter the characteristic and level of noise. These site conditions are not under ABB Stal Refrigeration's control.

# ELECTRIC DRIVE MOTORS

All screw compressor units are adapted for standard motors in 2-pole version.

A motor dimensional sketch must always be enclosed with the order specification.

For units of type SVA, SVB and SVR it is recommended that the motor terminal box is mounted on top of the motor.

If a side-mounted terminal box is selected, it should be mounted as a first choice on the left side of the motor as seen towards the shaft end of the motor. If a terminal box mounted on the right side is selected, the dimensions of the box must be checked against the dimensions of the unit in order to avoid any collision with the oil cooler.

The cable inlet on the terminal box should always point upwards when the box is mounted on the side of the motor.

The motor should be selected on the basis of the compressor power consumption. Remember that more power is consumed during a defrosting cycle or cooling process (high evaporating temperature) than at normal working conditions.

The output rating of the motor should be at least 5% higher than the compressor's highest power consumption. However, for compressor units equipped with the Stalectronic system, motor output can be limited automatically to prevent overloading. This means that if a Stalectronic system is installed, the motor will not have to deliver any "excess output".

Moreover, the Stalectronic system is equipped with a built-in time delay function which makes certain that the startup rate does not exceed four starts per hour. Check to see that the motor you have selected will permit this startup rate.

For Y/D-starting, the motor starting torque must be checked against that of the compressor.

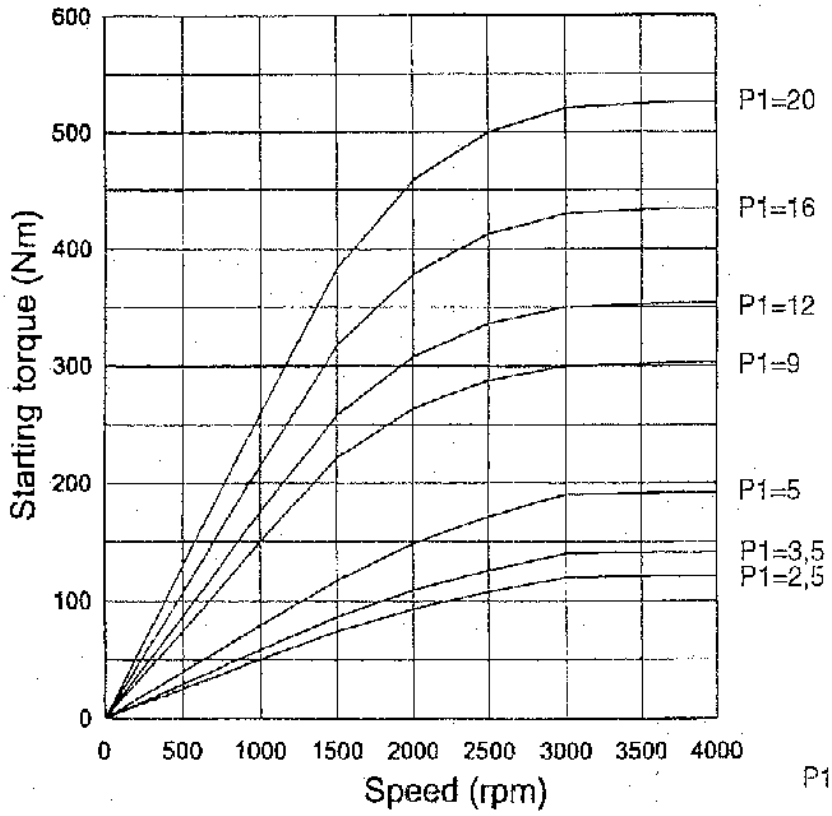
The diagrams on the following pages show the compressor starting torque at different discharge pressures. These compressor starting torques can be reduced with 15% in the speed range 0–2500 rpm, if P1 (discharge pressure) is higher than 6 bar(a) and the pressure ratio P1/P2 (discharge pressure/suction pressure) is lower than 6.

The motor starting torque must be at least 10% higher than the compressor starting torque throughout the entire speed range.
**Note** that the torque of the motor will be reduced in proportion to the square of the voltage drop.

For all units and compressor sizes, the direction of rotation of the motor must be **counter-clockwise** as seen towards the shaft end of the motor.

## S81

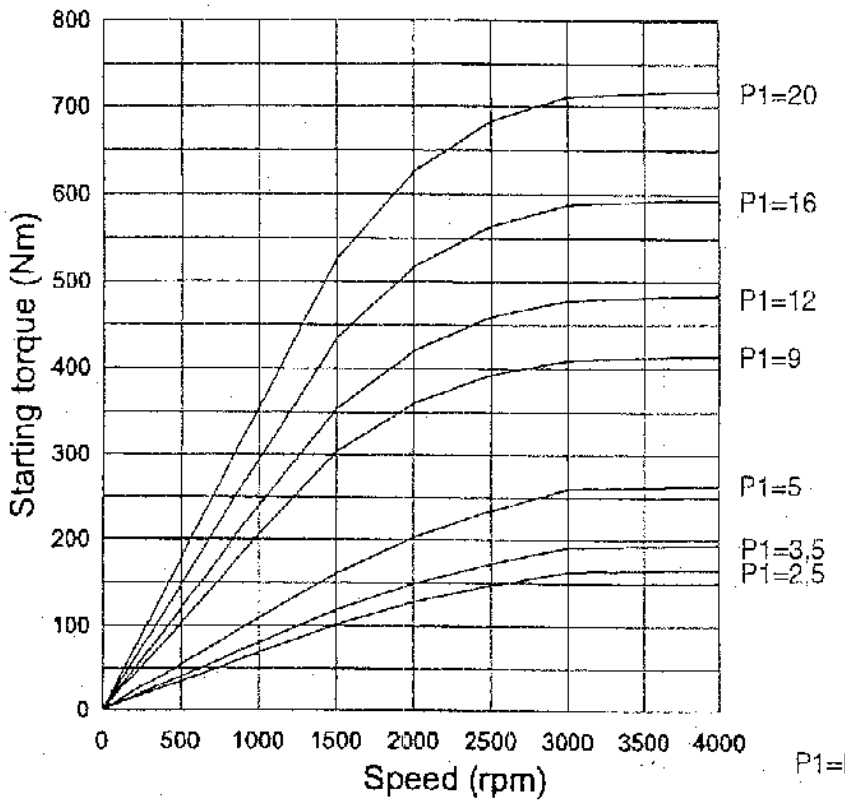
Moment of inertia J=0,46 kgm$^2$ incl. shaft coupling




P1=Discharge pressure, bar(a)

## S83

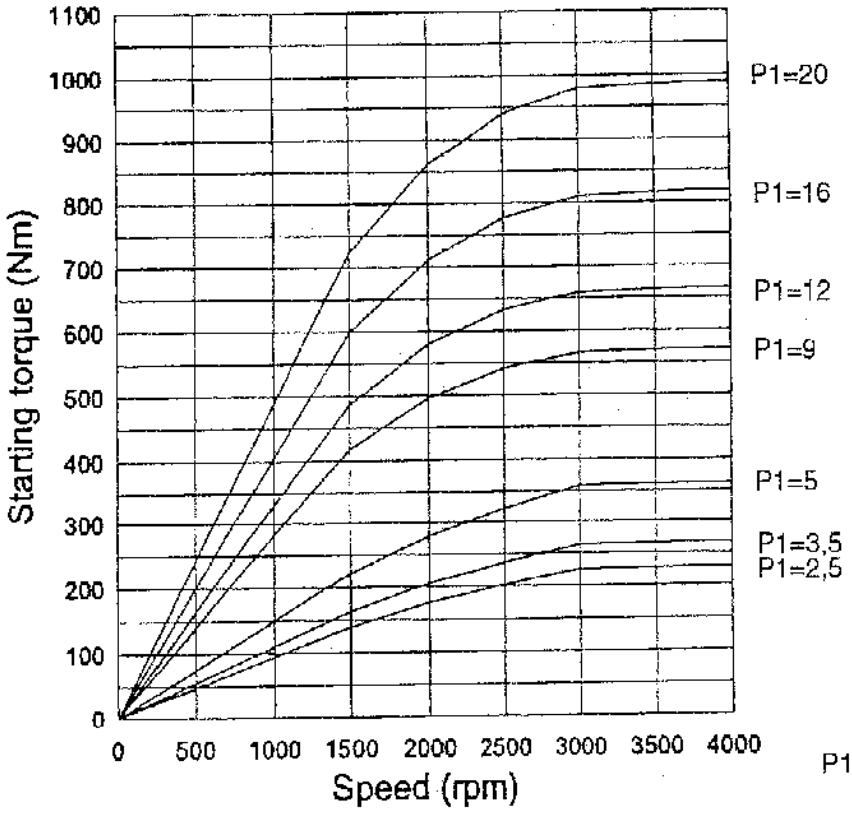
Moment of inertia J=0,65 kgm$^2$ incl. shaft coupling




P1=Discharge pressure, bar(a)

## S85

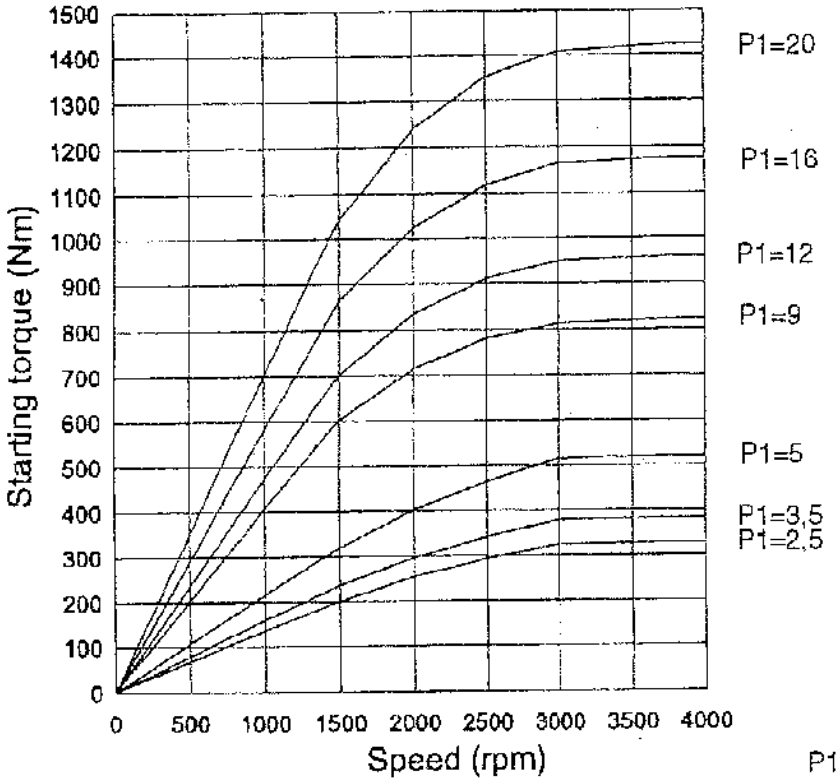
Moment of inertia J=1,06 kgm$^2$ incl. shaft coupling




P1=Discharge pressure, bar(a)

## S87

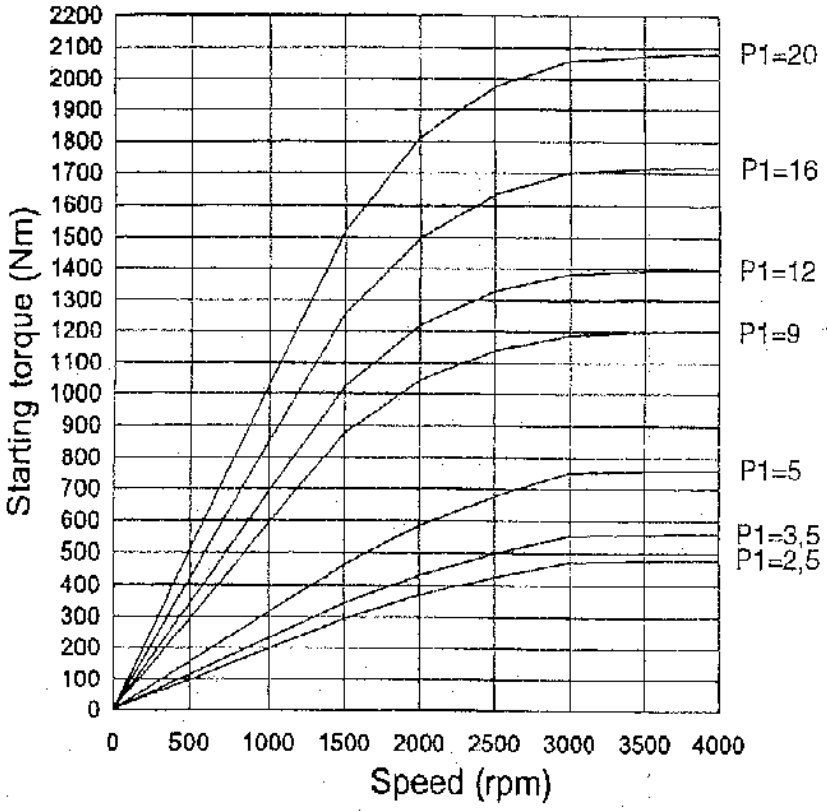
Moment of inertia J=1,68 kgm$^2$ incl. shaft coupling




P1=Discharge pressure, bar(a)

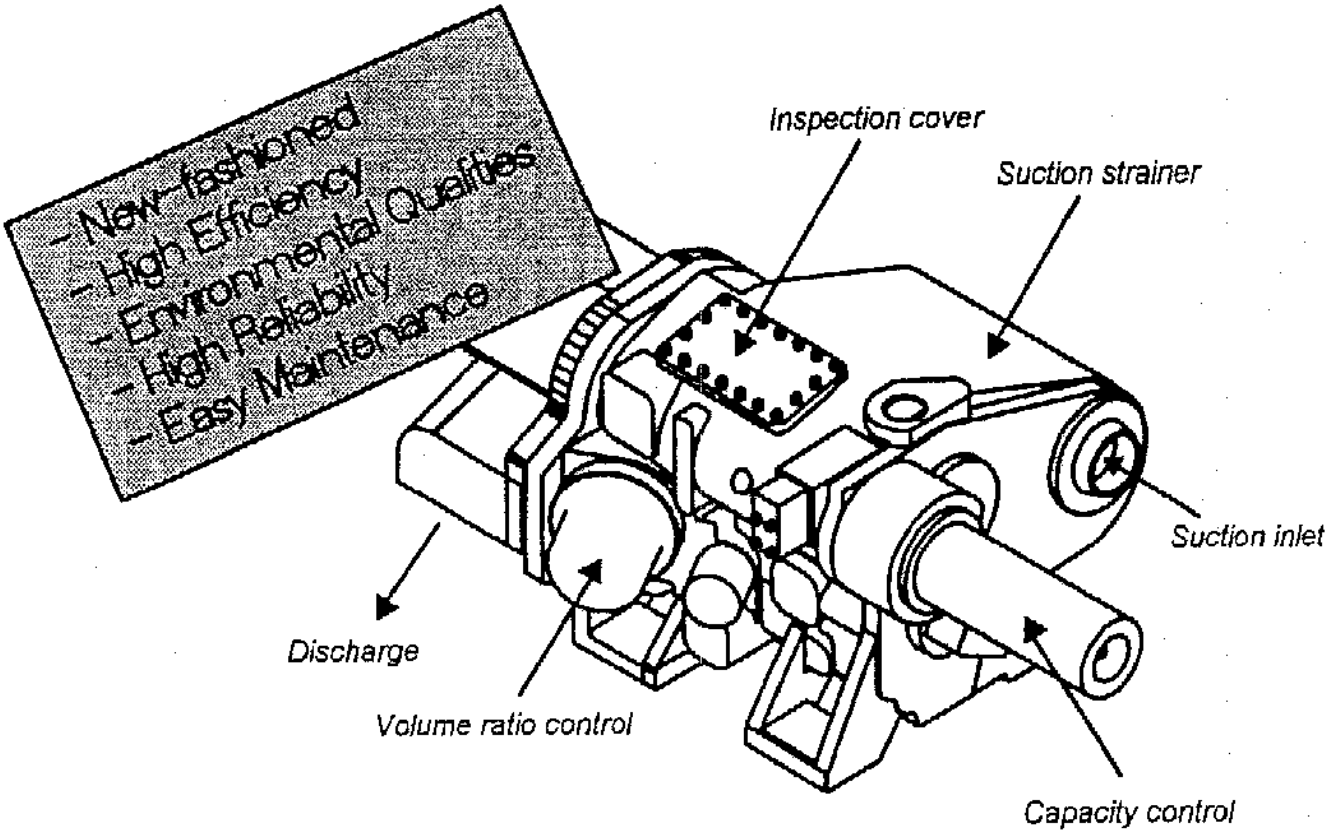
## S89

Moment of inertia J=3,4 kgm$^2$ incl. shaft coupling




P1=Discharge pressure, bar(a)

# SCREW COMPRESSORS TYPE S80




*The S80 series of Stal-Maxi screw compressors incorporates benefits based on more than 30 years of experience in designing, manufacturing and operating screw compressors. Besides the new and different appearance, there are a number of properties contributing to high efficiency, environmental qualities, high reliability and easy maintenance. The series consists of five different sizes, each individually optimized in terms of rotor dimensions, thereby ensuring the best efficiency possible.*

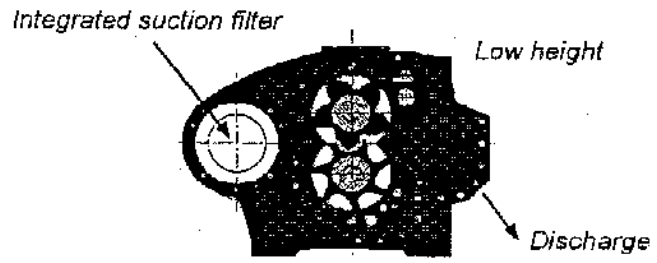
## Swept volumes

| Compressor Size | Swept Volume 2950 rpm ($m^3/h$) | Swept Volume 3540 rpm ($m^3/h$) | Rotor Diameter (mm) | L/D-ratio (-) | Weight (kg) |
|---|---|---|---|---|---|
| S81 | 961 | 1153 | 193 | 1.7 | 875 |
| S83 | 1313 | 1576 | 212 | 1.7 | 1100 |
| S85 | 1809 | 2171 | 237 | 1.7 | 1300 |
| S87 | 2604 | 3125 | 267 | 1.7 | 1735 |
| S89 | 3801 | 4561 | 304 | 1.7 | 2500 |

## Other data

Rotor lobe combination 5+7
Male rotor drive, rotation clockwise
Angular contact ball bearings (thrust)
Cylindrical roller bearings (radial)

Self-shifting volume ratio, 2.6 and 4.8
Max permissible suction pressure: 10 bar abs.
Max permissible discharge pressure: 26 bar abs.
Integrated suction filter: 60µ




No connections underneath

## New and different

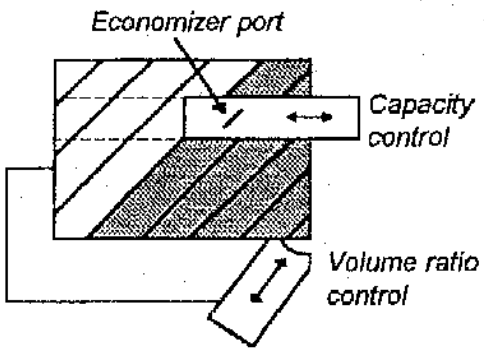
Compared to conventional screw compressors, the design of the S80 compressor is very different, as is shown by the orientation of the rotors, the integrated suction filter and the absence of connections under the compressor. This means benefits when it comes to installation, reliability and maintenance.

The S80 also incorporates other examples of new design, such as rotors with the 5+7 lobe combination and a novel design and installation of the slide valve.

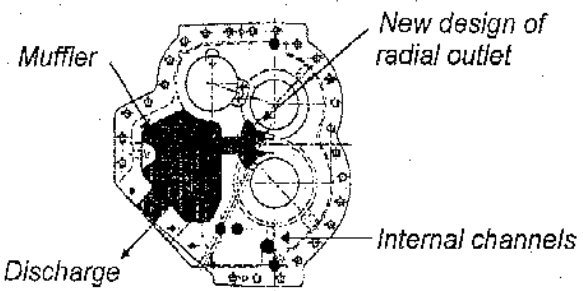
## Excellent efficiency

A notable feature is the movable economizer port, which maintains a true intermediate pressure at partial loads, and thus increases the COP. In addition, the capacity and volume ratio controls are separated, thereby eliminating conflicts.

Furthermore, each size in the series is **individually optimized** in terms of the ratio between the length and diameter of the rotors, which ensures better overall efficiency and a broader operating range compared to conventional series, consisting of "long" and "short" machines.




Volume diagram




## Environmental qualities

Because of **numerous internal channels** and the **integrated oil pump**, almost all external pipes for distribution of oil and control are eliminated. Thus, the potential leakage risks are reduced to a minimum.

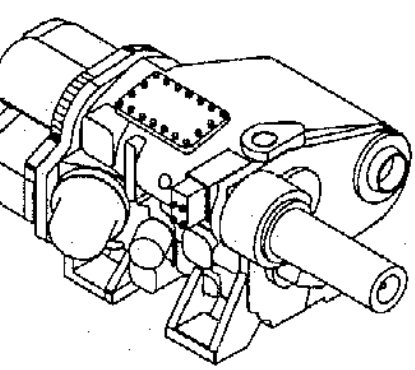
Also important to the local environment is the **low sound level** of the S80 compressors. Contributing features are the generously dimensioned castings, the 5+7 rotor lobe combination in connection with a new rotor profile, a novel design of the discharge port and a muffler in the rotor housing.

## Reliability and maintenance

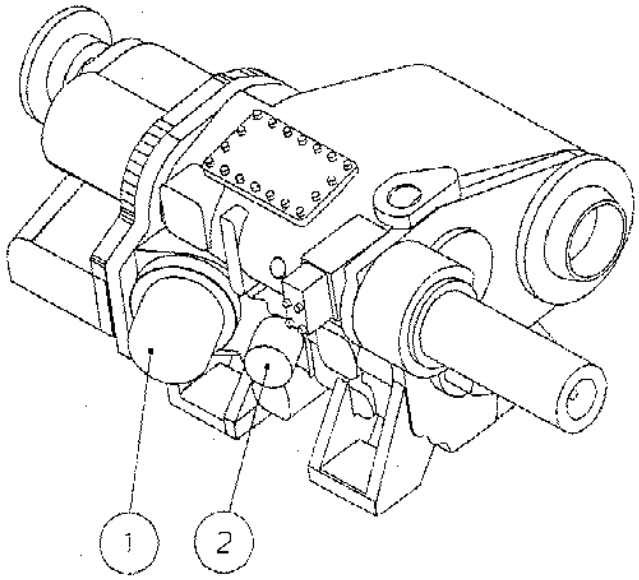
Reliability and maintenance have been two very important keywords in development of the S80 compressor.

For example, with normal running conditions with ammonia the life expectancy of the **anti-friction bearing system** is 100 000 hours of operation.

Maintenance is simplified due to few outside connections and no connections under the compressor. It is possible to inspect the rotors without disassembling the compressor and all bearing clearances are final and factory set.



# VARIABLE BUILT-IN VOLUME RATIO




1. $\vartheta_i$ -piston
2. Control valve

Fig. 1 Type S80 Stal-Maxi screw compressor



## HOW A SCREW COMPRESSOR OPERATES

The screw compressor operates with distinct working phases and built-in volume ratio. For optimum efficiency, the built-in volume ratio $\vartheta_i$ must have a fixed relationship to the actual volume ratio, namely:

$P1/P2 = (V2/V1)^n$. See Fig. 2.

This means that the pressure in the interlobe space, PK, at the instant when it opens to the discharge port, must be the same as the compressor's discharge pressure.

Any deviation from the optimum ratio causes losses in the compressor either in the form of overcompression (see Fig. 3) or reverse flow (see Fig. 4).

In the past, requirements calling for a wide working range (and thus widely varying pressure ratios) were met by providing different fixed pressure ratios ($\vartheta_i$). Usually three fixed pressure ratios were provided, and this required three different versions of a compressor.

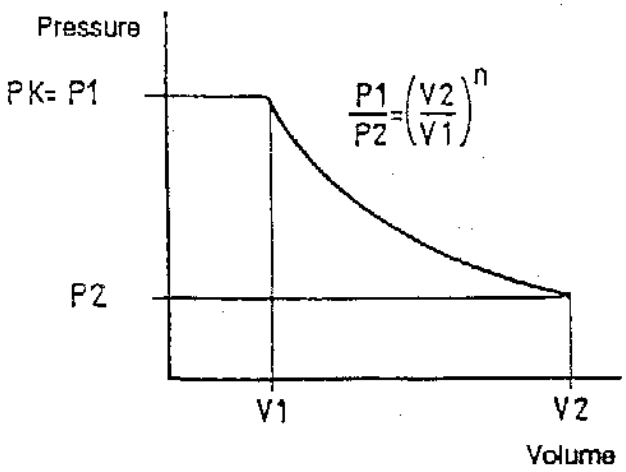



Fig. 2 Optimum operating ratio

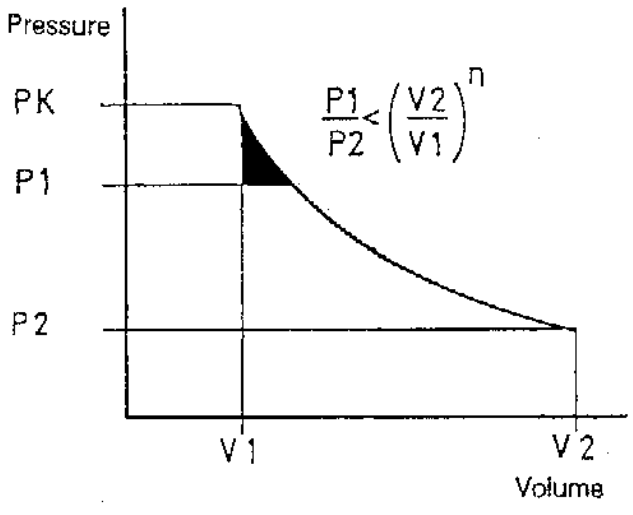



Fig. 3 Loss caused by overcompression

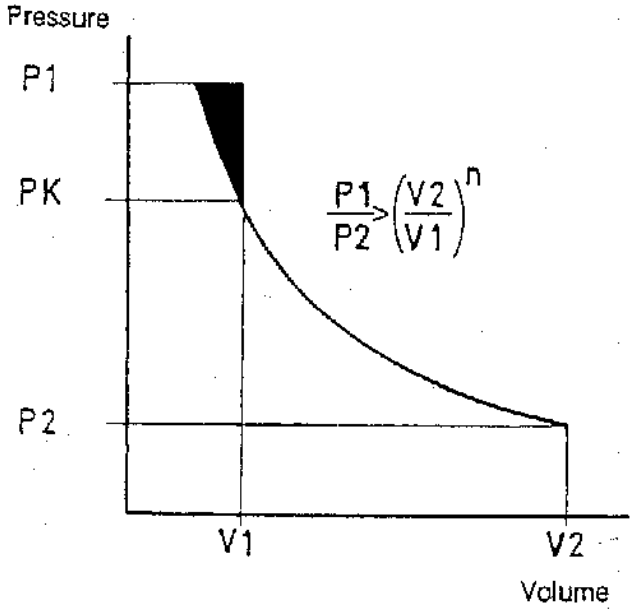



Fig. 4 Loss caused by reverse flow

In principle, there are two ways to vary $\vartheta_i$ continuously and in steps.

A continuously variable $\vartheta_i$ requires a highly advanced control and regulating system. Stepped regulation can be controlled with far simplier equipment.

In the Stal-Maxi S80, $\vartheta_i$ is regulated in two steps. Changeover between steps is controlled by a pressure-sensing mechanical control valve connected directly to the compressor (item 1 in Fig. 1). Stepped regulation reduces the efficiency within a small, limited range somewhat compared with what can be attained using continuous control. See Fig. 5.

In practice, however, this difference is virtually negligible.

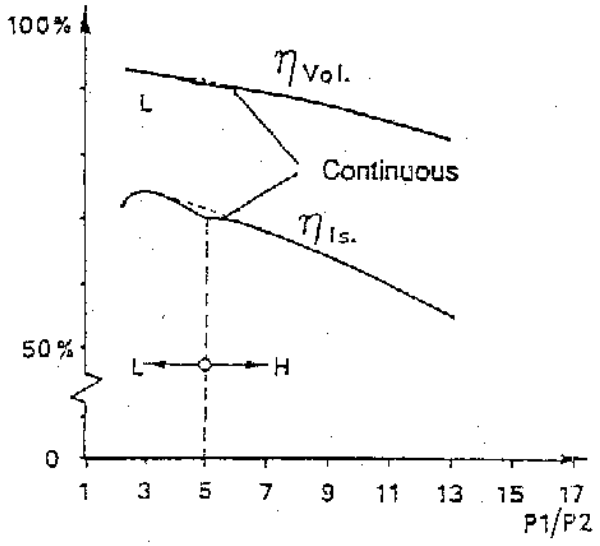



Fig. 5. Comparison between the Stal-Maxi system and a continous $\vartheta_i$ regulation

## DESIGN

See Fig. 6.

The regulating system consists of a $\vartheta_i$-piston (1), hydraulic unit (2) and control valve (3). The $\vartheta_i$-piston is cylindrical throughout most of its length. One of its ends is designed to match the radial discharge port used for low $\vartheta_i$ (2.6) in the rotor casing. When it is inserted all the way it contacts the rotors with minimum clearance to the radial discharge port used for high $\vartheta_i$ (4.8).

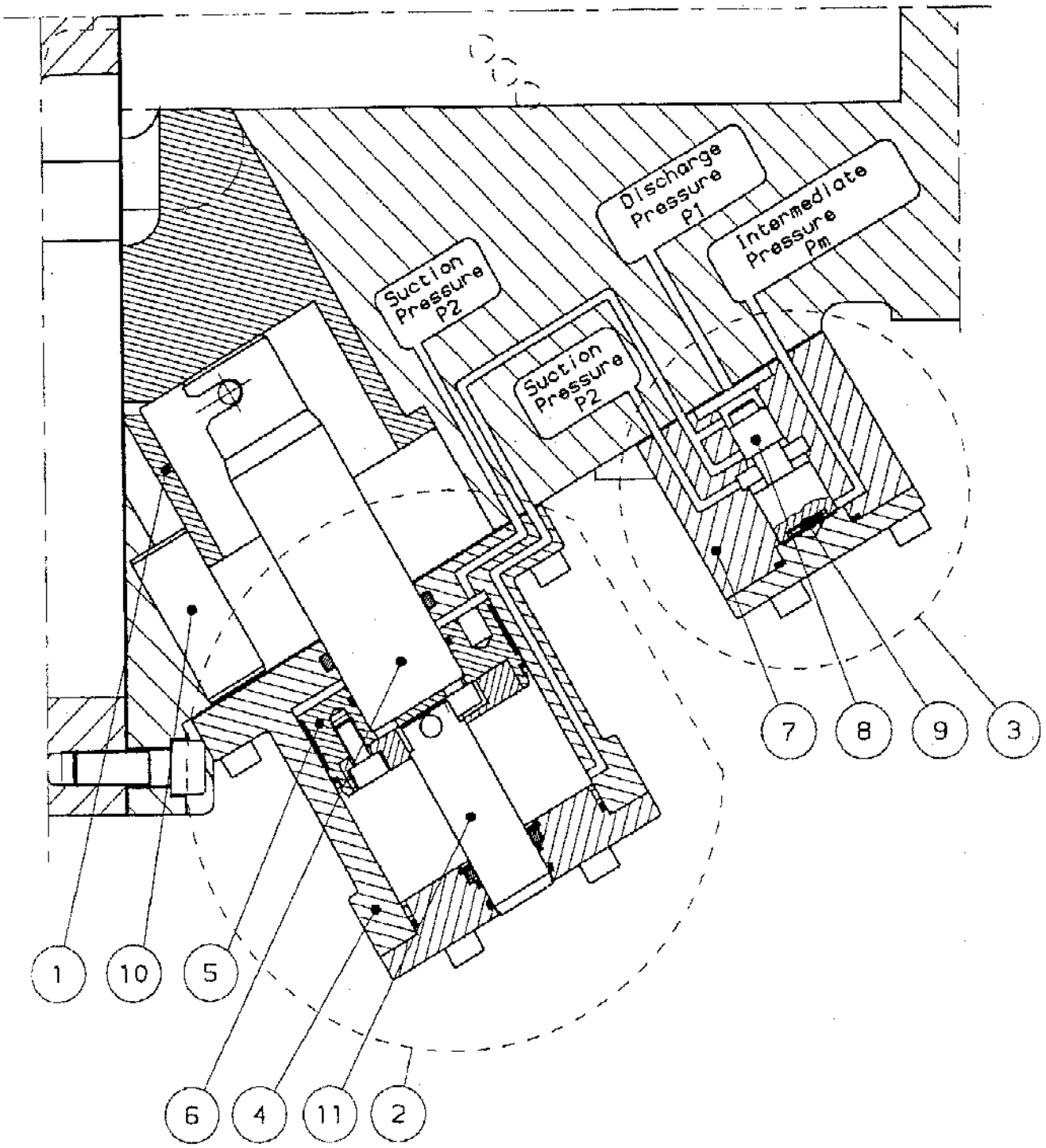
The $\vartheta_i$-piston is mounted to the discharge end plane. This provides an unbroken sealing face between the rotor casing and the drain casing which, in turn, makes it possible to dismount the hydraulic unit and $\vartheta_i$-piston for inspection or service without disassembling the entire compressor.

The $\vartheta_i$-piston is secured rotationally with a guide pin (10) and is not joined permanently to the hydraulic unit's piston rod (6). Both end faces of the $\vartheta_i$-piston are always acted on by the compressor's high pressure (P1), but the side of the piston that faces the rotor casing discharge port is also acted on by the pressure in the discharge port. As a result, it is always pressed against the hydraulic unit's piston rod (6).

The hydraulic unit (2) consists of a cylinder (4), piston (5) and a piston rod (6). The area of the piston on the indicator side (5) is acted on by the compressor's high pressure (P1) at high $\vartheta_i$ (4.8) or by the compressor's low pressure (P2) at low $\vartheta_i$ (2.6).
The space between the piston and the cylinder on the piston rod side (5) is always connected to low pressure (P2).
The piston rod (6) is sealed into the cylinder by high pressure P1 and its free end is always acted on by high pressure P1. The indicator (11) shows the position of the $\vartheta_i$-piston. The outer end of the indicator (11) acts on atmospheric pressure. When the compressor is idle, the equalizing pressure makes the $\vartheta_i$-piston to move out ($\vartheta_i$ 2.6).

The piston (8) in the control valve is actuated by different pressure levels emanating from the compressor's working chamber. The piston has two pressure-sensing ends that differ in size. The larger end is actuated by an intermediate pressure (Pm) in the compressor, and the smaller is actuated by a high pressure (P1).

The middle part of the piston is connected to the compressor's suction pressure. The only purpose of the spring (9) is to move the piston when the compressor is idle to the end position that provides unloaded starting.




1. Bi-piston
2. Hydraulic unit
3. Control valve
4. Cylinder
5. Piston
6. Piston rod
7. Cylinder
8. Piston
9. Spring
10. Guide pin
11. Indicator

Fig. 6

## OPERATION

### Changeover levels

The intermediate pressure level and the piston areas have been selected to provide a changeover level (P1/P2) of 5.0. See Figs. 5 and 7.

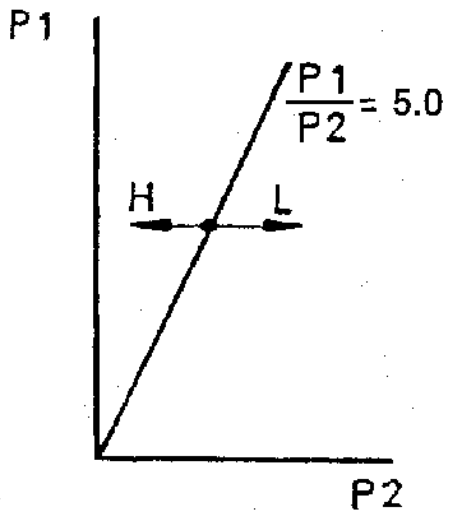



Fig. 7 Change over level between low (L) and high (H) ϑi

The system's characteristics also provide a slight hysteresis effect that prevents the piston (and thus the valve body) from fluctuating.

### Low P1/P2 → low ϑi

Intermediate pressure Pm is a function of inlet pressure P2, and also of the physical position of the intermediate pressure outlet in the working chamber. See Fig. 8. Unavoidable internal leakage also affects the intermediate pressure, but to a very limited extent. It is this slight internal leakage that causes the aforesaid hysteresis. This minimized and controlled internal leakage thus has a positive effect.

A low P1/P2 thus provides a low P1/Pm and vice versa.

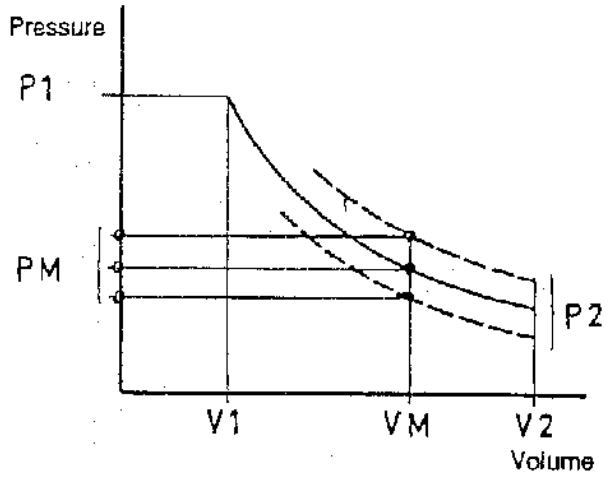
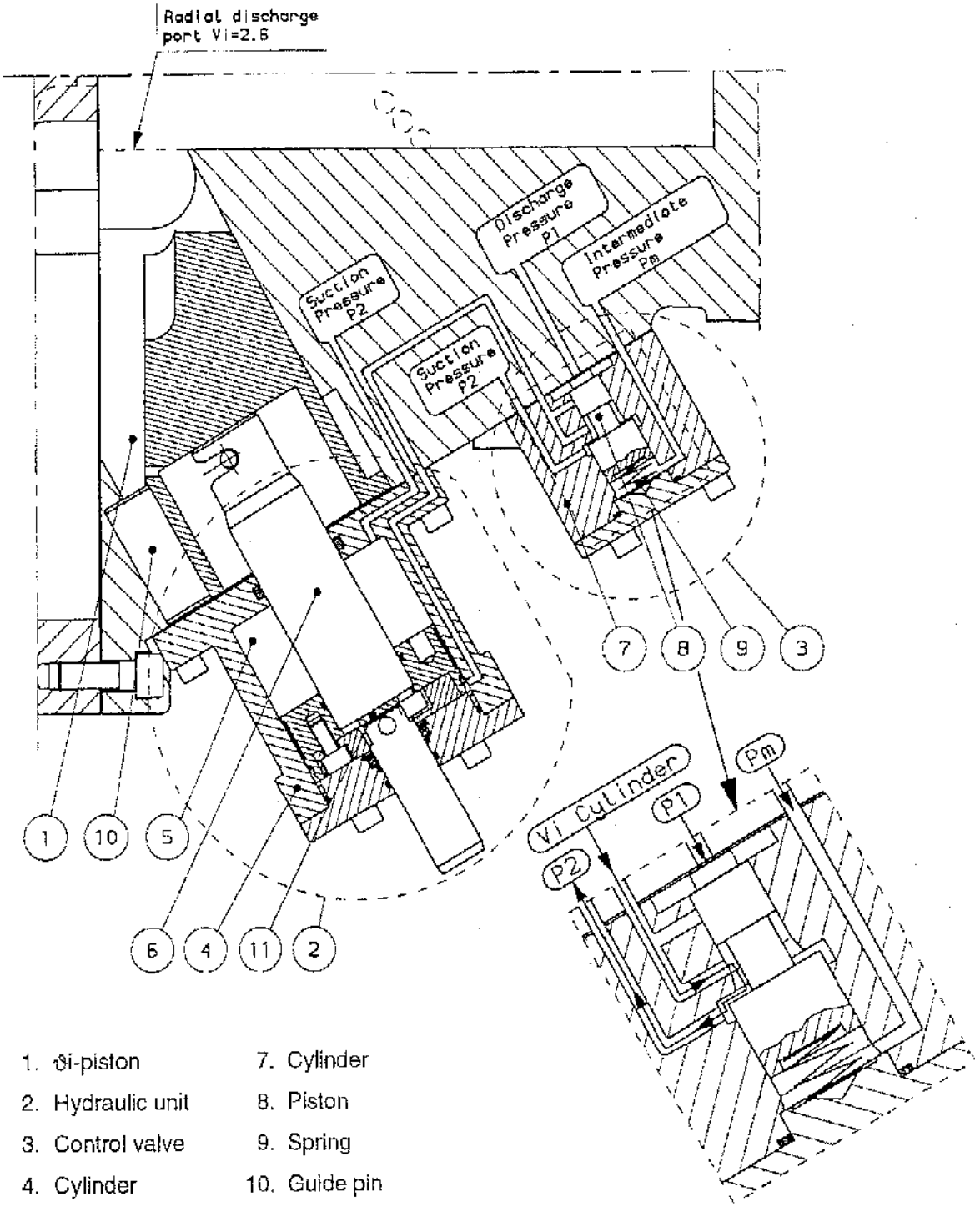



Fig. 8 Intermediate pressure that depends on inlet pressure

Fig. 9 shows the $\vartheta_i$-piston at its low $\vartheta_i$ position.

Intermediate pressure Pm acts on the piston's (8) larger area in the control valve, and this force exceeds that exerted by high pressure P1 on the smaller area of the piston. As a result, the piston moves to the position shown in the illustration. The space between the indicator side of the piston (5) and the cylinder (4) is now connected to the compressor's low pressure P2.

The free end of the piston rod (6) is acted on by P1, and as a result the oil in this space is drained via the control valve to the compressor's inlet pressure. The $\vartheta_i$-piston (1) is pressed outwards together with the piston rod to low $\vartheta_i$ position by the pressure in the compressor's discharge port.




1. $\vartheta_i$-piston
2. Hydraulic unit
3. Control valve
4. Cylinder
5. Piston
6. Piston rod
7. Cylinder
8. Piston
9. Spring
10. Guide pin
11. Indicator

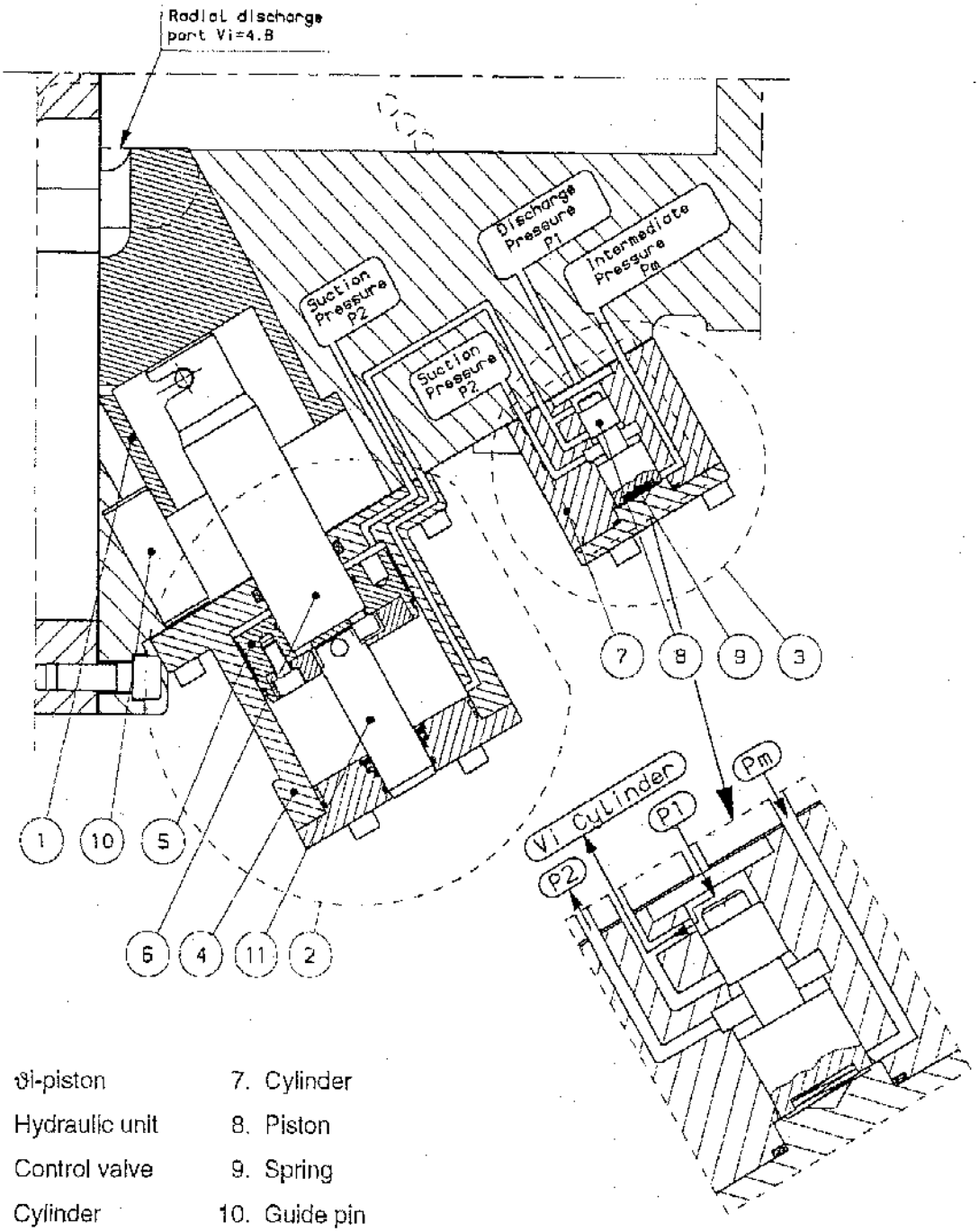
Fig. 9. Low $\vartheta_i$

**High P1/P2 → high $\vartheta_i$**

At a high P1/P2 (and thus also a high P1/Pm), the force exerted on the smaller piston area exceeds the force exerted on the larger area on which the intermediate pressure acts.

As a result, the piston moves to the position shown in Fig. 10. This change in the direction of the resultant force is attributable to the difference between high pressure P1 and intermediate pressure Pm.

At this piston (9) position, a link opens between high pressure and the indicator side of the hydraulic piston (5). Moreover, the piston (9) presses the $\vartheta_i$-piston to the high $\vartheta_i$ position via the piston rod (6).




1. $\vartheta_i$-piston
2. Hydraulic unit
3. Control valve
4. Cylinder
5. Piston
6. Piston rod
7. Cylinder
8. Piston
9. Spring
10. Guide pin
11. Indicator

Fig. 10. High $\vartheta_i$

**Stopping and starting**
When the compressor stops, the spring (10) moves the piston (9) to the position that provides a low Vi. This helps to provide unloading the next time the compressor is started.

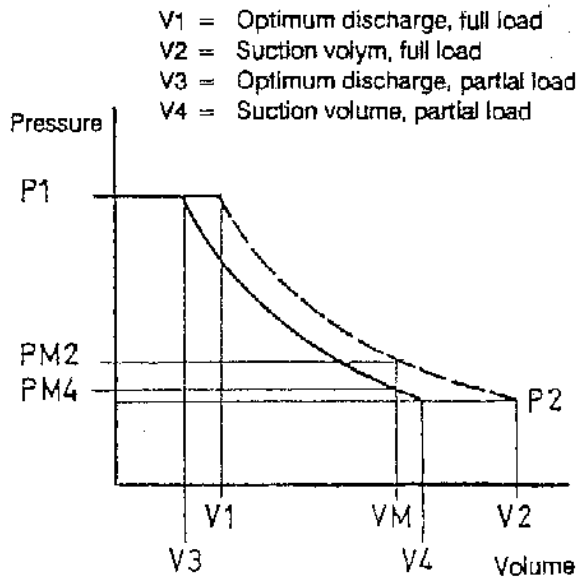



Fig. 11 PV diagram, full load and partial load

Fig. 11 shows that if optimum V1/V2 is provided at full load, discharge opening must be delayed at partial load in order to provide a corresponding optimum (V3/V4).

The diagram shows that when the compressor is operating at partial load, the intermediate pressure is affected in the same way as it is by an increased pressure ratio P1/P2. That is to say, when P1/Pm increases, the control system responds as shown in Fig. 10.

The built-in volume ratio thus adapts itself automatically to the prevailing operating conditions, and partial-load efficiency is considerably higher than for a fixed discharge port.

# CAPACITY CONTROL

## GENERAL

In type S80 screw compressors, capacity is controlled using a slide valve located obliquely above the male rotor's bore. When the axially movable slide is all the way in (towards the inlet side), the compressor operates at maximum capacity. See Fig.1.

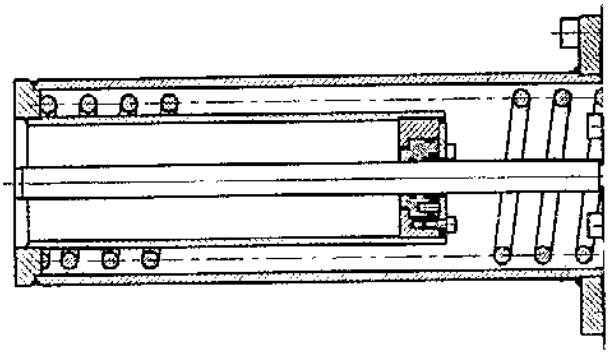
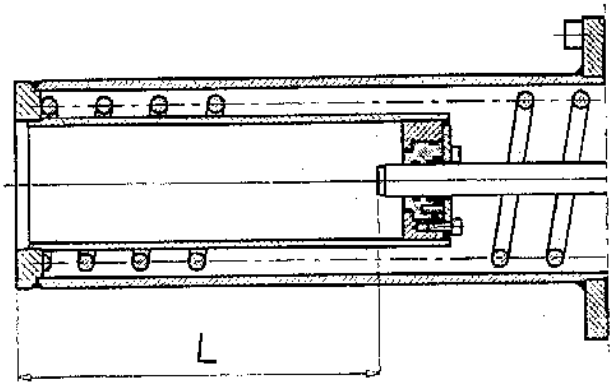


Fig. 1 Location of position indicator at maximum capacity

When the slide moves towards the discharge side, part of the gas flows back to the suction side, without being compressed, via a recirculation duct in the rotor casing. When the slide has moved as far as possible away from the suction side, the compressor operates at minimum capacity. See Fig. 2.




| Compressor | S81 | S83 | S85 | S87 | S89 |
|---|---|---|---|---|---|
| L= | 220 | 260 | 300 | 340 | 380 |

Fig. 2 Location of position indicator at minimum capacity

Capacity is increased and decreased steplessly between 100% and 10-20%. The ratio between slide position and capacity is linear.

## OPERATION

The slide is connected to a hydraulic piston via a piston rod. A second piston rod is also connected to the hydraulic piston, and its purpose is to visually indicate the slide position. The piston (double acting design) moves axially in response to the difference between the oil pump pressure and the suction pressure.

Moreover, a spring that acts on the hydraulic piston makes it possible to unload the compressor when stopping. The piston is controlled by means of a four way solenoid valve.

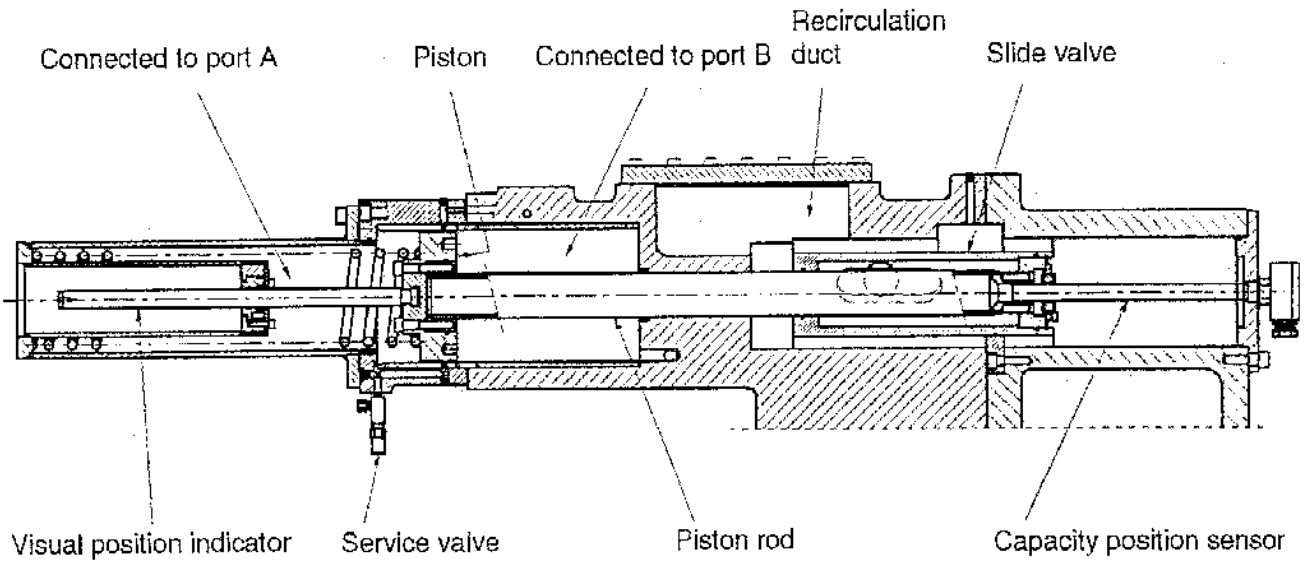



Fig. 3

**Increase**
See fig. 4
Solenoid valve SV15 is energized (upper solenoid, Fig. 7).

Pressurized oil from the pump flows via conn. P to conn. B on the solenoid valve and continues to the side of the hydraulic cylinder which is towards the slide valve.

Oil is drained from the side of the hydraulic cylinder which is towards the spring housing via conn. A to conn. T on the solenoid valve and then to suction pressure.

**Decrease**
See Fig. 5
Solenoid valve SV16 is energized (lower solenoid, Fig. 7).

Pressurized oil from the pump flows via conn. P to conn. A on the solenoid valve and continues to the side of the hydraulic cylinder which is towards the spring housing.

Oil is drained from the side of the hydraulic cylinder which is towards the slide valve via conn. B to conn. T on the solenoid valve and then to suction pressure.

**Steady state**
See Fig. 6
Both solenoids are de-energized.
Both sides of the hydraulic cylinder are blocked.

**Unloaded starting**
When the compressor is stopped, the capacity control piston must be returned to its minimum capacity position before restarting can take place. If this were not, the starting torque would be too high.

Consequently, solenoid SV16 (lower solenoid) must be energized for at least ten minutes after stop, during which time the spring presses the hydraulic piston to its minimum position. In order to reduce the unloading time on S85, S87 and S89, a check valve has been fitted to drain enclosed oil from the space around the capacity position sensor to the outlet conn.
See Manual Sheet "List of Parts".

**Service**
When servicing, the hydraulic cylinder must be drained of the enclosed pressurized oil. Move the slide valve to its minimum position. Energize SV16 while the compressor is being evacuated. If the slide valve has not reached its minimum position, energize SV15 as well. The rest of the oil in the spring housing is drained off via the service valve. See Fig. 3.

If the coil is out of function, the solenoid valve can be forced open by pressing the inner part of the coil.

**NOTE:** When dismounting the spring housing, the utmost care must be taken since the unloading spring is preloaded.

**Spare parts**

| | Complete valve | Coil |
|---|---|---|
| 240 V/60 Hz, 220 V/50 Hz | 1921 438-1 | 1921 470-1 |
| 120 V/60 Hz, 110 V/50 Hz | 1921 438-2 | 1921 470-2 |
| 24 V/50–60 Hz | 1921 438-3 | 1921 470-3 |

| Compr. | Orifice, conn. P | Orifice conn. T |
|---|---|---|
| S81 | 1921 439-4 ø2 mm | 1921 439-3 ø1.5 mm |
| S83 | 1921 439-4 ø2 mm | 1921 439-3 ø1.5 mm |
| S85 | 1921 439-5 ø2.5 mm | 1921 439-4 ø2 mm |
| S87 | 1921 439-5 ø2.5 mm | 1921 439-4 ø2 mm |
| S89 | None | 1921 439-6 ø3.5 mm |

| | | |
|---|---|---|
| 4 O-rings | 3921 5284 708 | ø9.25×1.78 |
| 4 Screws | 3921 2175 335 | |

Increase

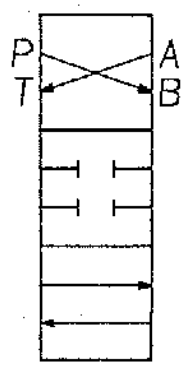



Fig. 4

Decrease

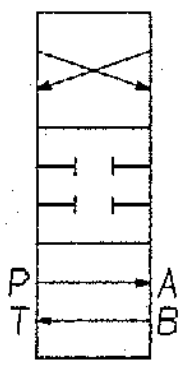



Fig. 5

Steady state

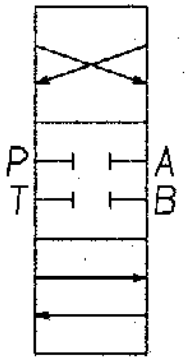
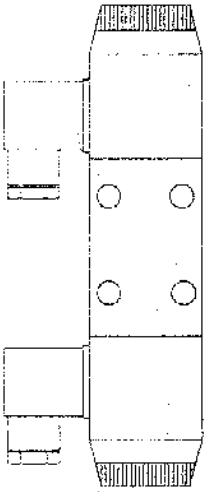



Fig. 6

SV15 Increase



SV16 Decrease

Fig. 7

# MOVABLE ECONOMIZER PORT

## GENERAL

In type S80 screw compressors, an optimal intermediate pressure can be maintained even at partial loads thanks to a movable economizer port. Fig. 1 (below) illustrates such an optimal intermediate pressure.

Q2=Refrigerating capacity without economizer

Q2eco=Refrigerating capacity with economizer

COPeco=COP with economizer

Point 1 indicates the location of the intermediate pressure in an S80 compressor.

Point 2 indicates a) the location at which a fixed economizer-port/intermediate-pressure would provide a short circuit to low pressure at the same time as for a movable economizer port.

For a fixed economizer port, a trade-off must be made by locating the port at one of the two following positions:

a) The optimal full-load position which causes too early short-circuiting to low pressure at partial load.

b) A position where the built-in volume ratio (Vi) is too high in order to proved later short-circuiting to low pressure at partial load.

This trade-off is completely avoided with screw compressors of type S80, since the port is at an optimal intermediate pressure even at partial load.



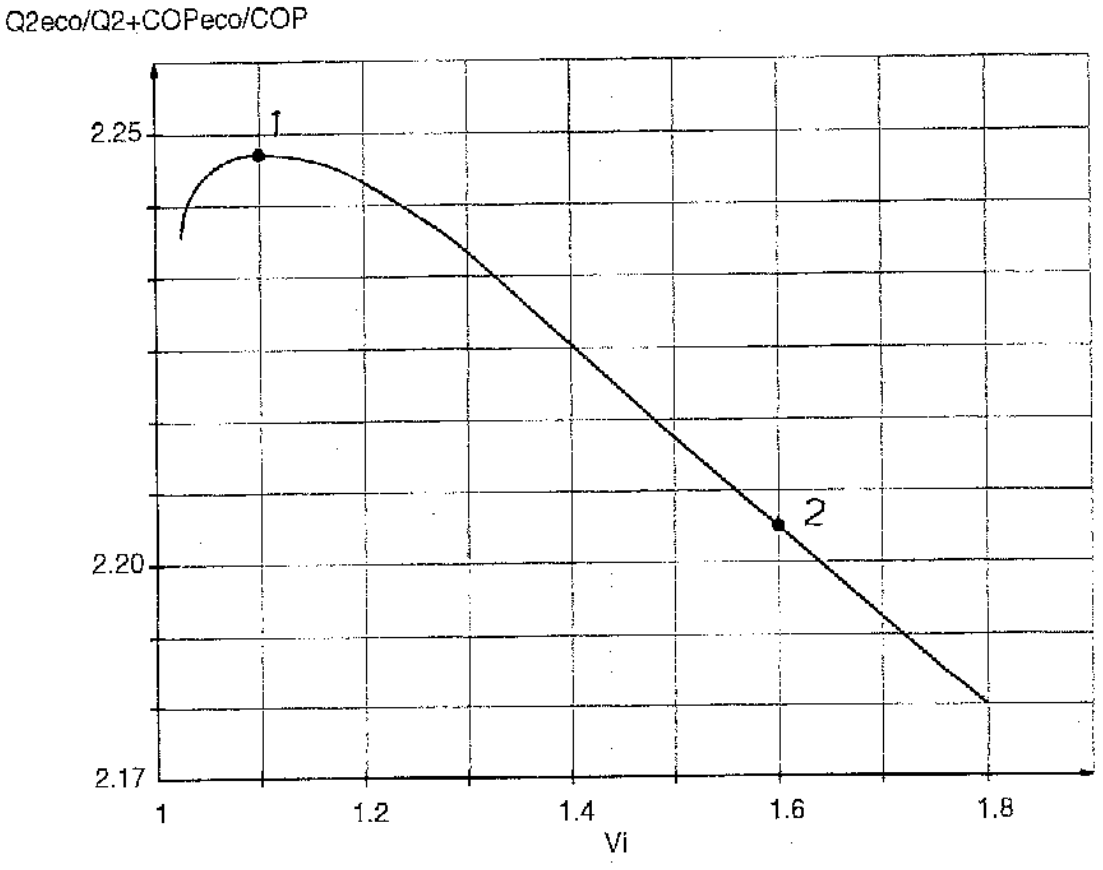



Fig. 1 Optimal intermediate pressure

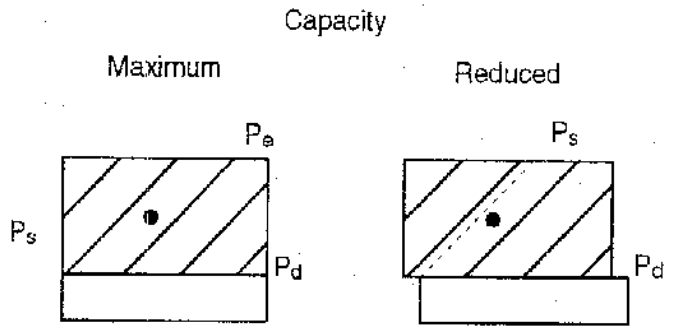



Fig. 2 Fixed economizer port

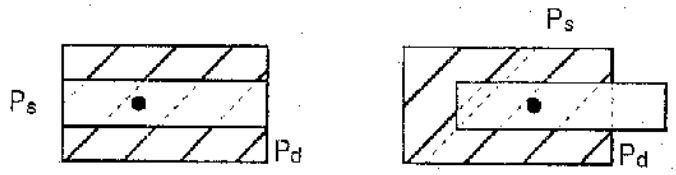



Fig. 3 Movable economizer port

The movable economizer port is implemented by the port being located in the capacity slide valve. As the slide moves, this port is always at an optimal intermediate pressure (see Fig. 1).

When the slide moves to the right in Fig. 1 the compressor becomes partially unloaded. A more detailed description of compressor capacity control is presented in a separate Manual Sheet.

The movable economizer port improves efficiency down to about 60% of capacity. When the compressor is unloaded further, the partial-load efficiency decrease is greater than the increase provided by the economizer.

# INTERNAL OIL SYSTEM

S85, S87, S89

Inside the compressor, oil is moved by means of an oil pump and also by means of the differences between a) high pressure and b) different intermediate pressures in the compressor. The oil pump (internal gear pump) is driven by the female rotor shaft. The oil pump capacity is 50 l/min at 3000 rpm and 60 l/min at 3600 rpm.

When the compressor is started, the pump starts and the differences between a) high pressure and b) different intermediate pressures supply the compressor lube points with oil. The amount of oil is determined by an orifice at each lube point in the compressor (see illustration).

The oil pump provides the bearings on the discharge side and the capacity control system with oil.

Most of the oil is sprayed into the rotors at intermediate pressure Pm1. This oil mixes with the gas, seals off the rotors, lubricates the driving contact between the meshing rotors, cools the working medium and then continues to the oil separator where it is separated from the gas. This pressure difference also moves oil to the shaft seal and to the inlet bearings.

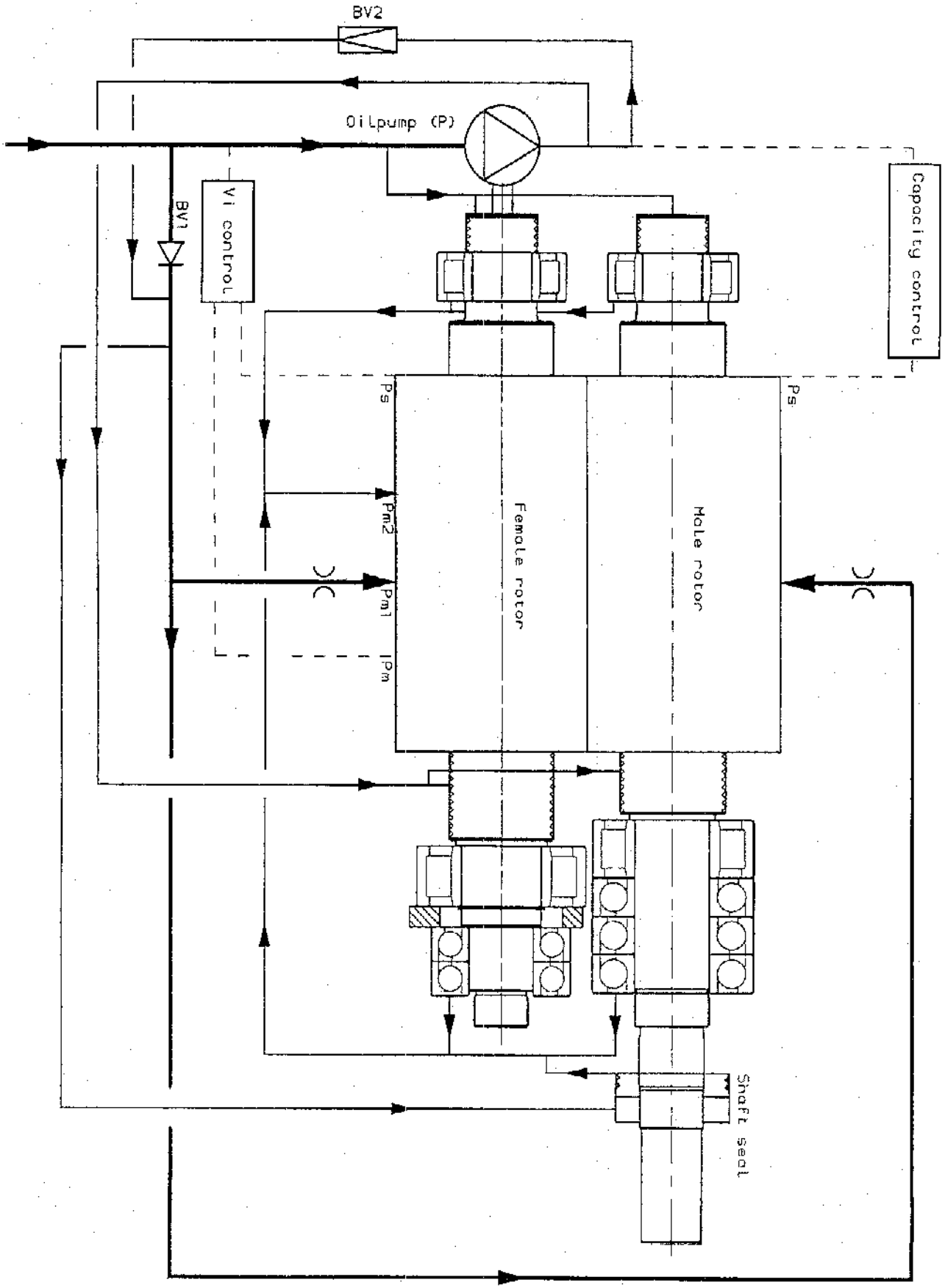
The smaller amount of oil that is used for capacity control proceeds to suction pressure (the capacity control system is described in a separate Manual Sheet).

Oil used to control the built-in volume ratio ($V_i$) proceeds to suction pressure Ps ($V_i$ regulation is described in a separate Manual Sheet).

Oil used to lubricate the bearings, the shaft seal and the rotor balancing system proceeds to intermediate pressure Pm2.

Intermediate pressures Pm1 and Pm2 are both located in such a way that oil can proceed to the interlobe space, thus preventing any reduction in the refrigerant charge.

At low pressure heads, check valve BV1 makes certain that excess oil from the oil pump is supplied to the rotors and the shaft seal. The purpose of relief valve BV2 is to make certain that there is a constant pressure head across the oil pump.

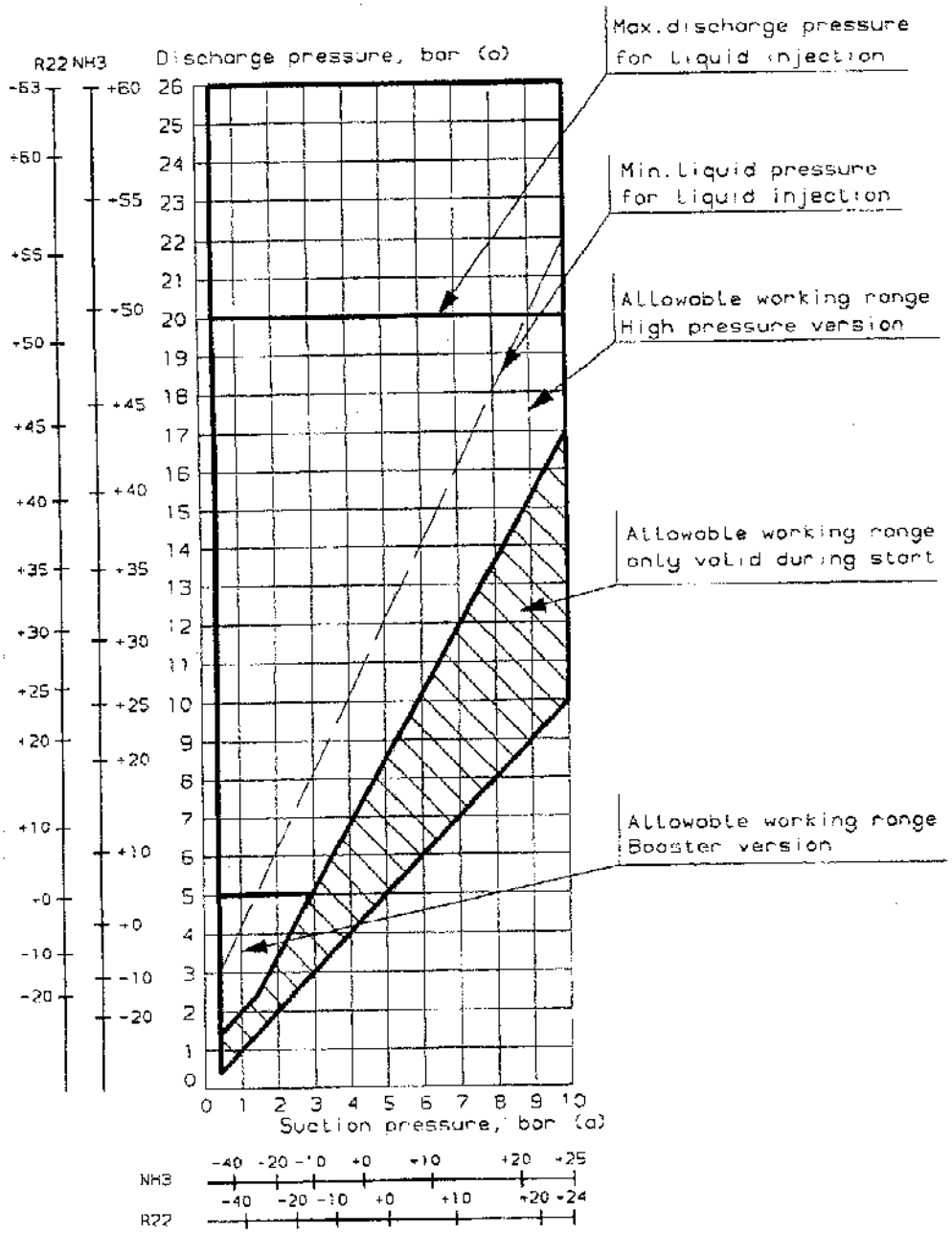

BV2
Oil pump (P)
BV1
Vi control
Capacity control
Ps
Ps
Pm2
Pm1
Pm
Female rotor
Male rotor
Shaft seal

# WORKING RANGE

Refrigerant: $NH_3$, R22

The allowable working range of the compressor series S80 is described in the diagram below.

Always consult the department Order Compressor Units before using a compressor with operating conditions outside the specified working range.




Max permissible discharge pressure 26 bar(a), high pressure version
Max permissible discharge pressure 5 bar(a), booster version
Min permissible discharge pressure 5 bar(a), high pressure version
Max permissible suction pressure 10 bar(a), high pressure version
Max permissible pressure ratio = 35
Min permissible pressure ratio 1,5 (1,0 during startup)
Min permissible pressure difference 1,0 bar
Min permissible suction pressure 0,4 bar(a)
Min liquid pressure for liquid injection, suction pressure bar(a)x2+2 bar

# LUBRICATING OILS FOR SCREW COMPRESSORS Type S80



## GENERAL

Lubricating oils having relatively high viscosity must be used to ensure satisfactory lubrication of type S80, screw compressors.

- The optimal viscosity is 20 – 50 cSt. The minimum actual viscosity is 7 cSt. (Always remember that the viscosity drops when oil is mixed with halogenated hydrocarbons).

In addition to the minimum viscosity requirement, the oil must:

- Provide the required fluidity at the lowest evaporating temperature encountered in the plant.
- Provide sufficient oxidation stability (the oil must be moisture-free when added to the system).
- Provide sufficient chemical stability when used together with the refrigerant in question.
- Mix satisfactorily with other oils used in the system.

In addition, the extents to which different refrigerants dissolve in the oil must be known, so that the oil return system will function properly.

The recommended oils that fulfil these requirements appear in Table 1.

| Refrigerant | Discharge temperature lower than 90°C | Discharge temperature higher than 90°C |
|---|---|---|
| $NH_3$, (R717) Oil cooler | A | B |
| R22 Oil cooler | A 1) | B 1) |
| | B 1) | |
| | C 1) | |
| $NH_3$ (R717) Liquid injection | A | |
| R22 Liquid injection | C | |

Oil type A = STAL No. 3914 1021 114 for 20-litre pail
Oil type B = STAL No. 3914 1011 144 for 25-litre pail
Oil type C = STAL No. 3914 1011 154 for 25-litre pail

1) Table 2 on the next page indicates how to choose the best type of oil.

However, it should be noted that for R22 plants using oil of types B and C, the oil may form layers in the refrigerant receiver under certain operating conditions and at certain oil concentrations. Diagram 1 shows the limits at which this occurs. The oil concentrations set forth in the diagram must not be exceeded.
This means that the oil return system must balance the oil carryover so that the maximum concentration will not be exceeded.
For plants where different types of refrigeration compressors are being used in parallel with the above compressors, you must make certain that uncontrolled mixing does not take place if the other types of compressors require another type of oil. If it is evident that oil mixing may occur, the following must be observed:

- All of the oils that are used must be mixable without causing chemical reactions.
- Periodic viscosity checks must be carried out.

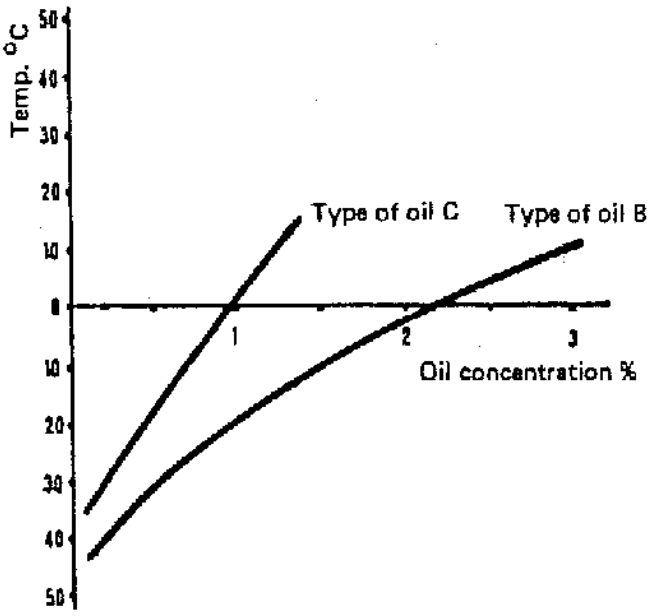



Diagram 1

**SELECTION OF OIL TYPES**

The *minimum* actual viscosity shall be 7 cSt. Increasing the viscosity up to 20 á 50 cSt will influence the compressor bearing life in a positive direction.

Max actual viscosity during operation is 100 cSt. (Always remember that the viscosity drops when oil is mixed with halogenated hydrocarbons).

Table 2

| Refrig-erant | Type of oil | |
|---|---|---|
| | A | To be used only in situations where the condensing temperature is always lower than 40°C. The incoming oil temperature (to compressor) must not be higher than 45°C (based on 40°C discharge gas superheating). |
| R22 | B | The most frequently used alternative. Has sufficient viscosity at condensing temperature of up to 55°C and incoming oil temperature (to compressor) up to 60°C (based on 50°C discharge gas superheating). |
| | C | Used for condensing temperature higher than 55°C and incoming oil temperature (to compressor) of up to 70°C. Here, there is some risk for excessively high viscosity when the compressor is started. |

When the compressor is started, the viscosity of the oil must be less than 300 cSt, and this requires that the temperatures are minimum those set forth in Table 3. Dimension heating according to the viscosity of pure undissolved oil.

Table 3

| Type of oil | Oil alone °C |
|---|---|
| A | 15 |
| B | 10 |
| C | 33 |

# Suction Filter

S 85

## 1. GENERAL

To prevent foreign particles from the refrigerating plant from being drawn into the compressor where they can cause serious damage, the suction side of the compressor has been provided with a suction filter.

The suction filter housing is an integral part of the compressor rotor casing.

The filter cartridge consists of stainless steel wire mesh to which end-plates have been soldered.
The filter cartridge is secured by a holder and two compression springs. The filter prevents particles larger than 0.06 mm from passing.

## 2. SERVICE INSTRUCTIONS

The suction filter should be cleaned as follows:

2.1 Shut the valves on the discharge and suction sides of the compressor unit and equalize the pressure to the low-pressure side by opening the service valve mounted on the suction line.

2.2 Close this service valve when the pressure in the compressor has dropped to the plant's evaporating pressure.

2.3 Evacuate the remaining refrigerant from the compressor.

2.4 Do not disconnect or dismount any flanged joints, fittings, valves or the like if the pressure in the compressor exceeds atmospheric pressure. Leave a valve open to relieve the pressure.

2.5 Empty the compressor of oil through the compressor's draining valve.

2.6 Dismount cover (1), springs (2) and holder (3). The suction filter (4 ) with gaskets (5) can then be pulled straight out.

2.7 Clean the suction filter by washing it in a water-soluble degreasant, and then rinse it clean with hot water. Finally, blow it thoroughly dry and clean with compressed air.

Hold the filter cartridge up against a light to make certain that the wire meshes in the filter cartridge are completely clean. If not, repeat the procedure.

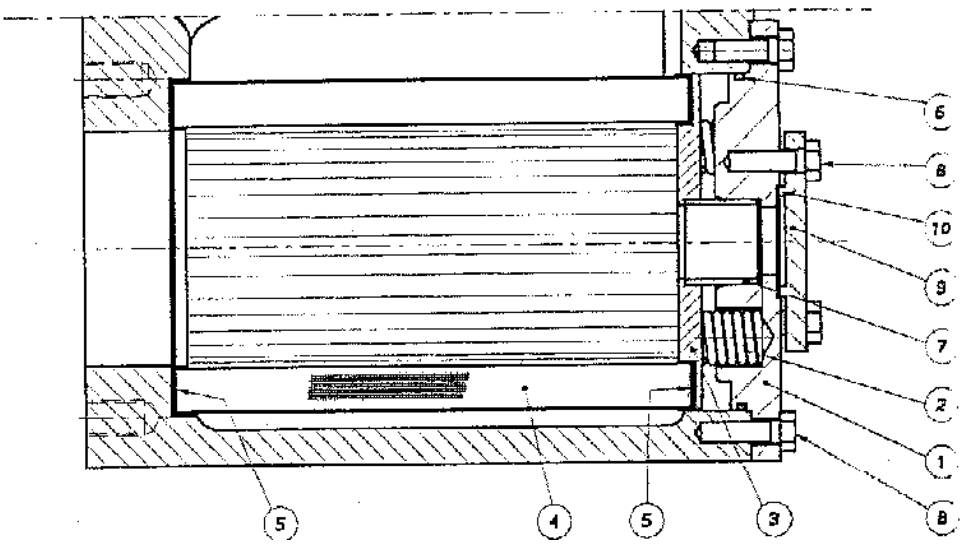
In connection with cleaning, check to see that there are no cracks in any of the soldered joints on the filter cartridge.

2.8 The suction filter should be mounted with new gaskets (5). Mount a new O-ring (6) on the cover (1) and fit the holder, spring and cover.

2.9 Dry the compressor by evacuation and open the closed valves.

Table 1 Parts list

| Item | Quantity | Name of part | Designation | Weight kg |
|---|---|---|---|---|
| 1 | 1 | Suction filter cover | 1906 364 - 1 | |
| 2 | 2 | Spring | 3921 9226 255 | |
| 3 | 1 | Filter holder | 1906 363 - 1 | |
| 4 | 1 | Suction filter | 1906 361 - 1 | |
| 5 | 2 | Gasket | 1906 362 - 1 | 0,05 |
| 6 | 1 | O-ring 249,5x5,7 | 3921 5282 548 | 0,05 |
| 7 | 1 | Sleeve joint | 1906 379 - 1 | |
| 8 | 20 | Screw (M16x45) | 3921 2120 629 | |
| 9 | 1 | Blind flange DN 50 | 3951 3309 805 | |
| 10 | 1 | Gasket | 3921 5204 050 | 0,05 |



# OIL FILTER

## 1. GENERAL

The oil filter consists of a filter housing with a removable insert containing a magnet intended to separate major metallic particles, and a filter cartridge. The filtering grade of the oil filter is B25 > 200 according to ISO 4572.

The pressure drop across the filter is measured using a differential pressure pressostat that trips in response to a 1.2 bar pressure drop. See Manual Sheet Electrical equipment for the electric function.

There are two green and two red LEDs on the electric pressostat. The green LEDs are active when the indicator is in operation. The red LEDs are active when the pressure drop exceeds 1.2 bar and the temperature exceeds 20°C.

When the pressure drop exceeds 1 bar, the red button is pushed out on the visual differential pressure indicator. The filter element must then be replaced in accordance with the following set of service instructions.



## 2. SERVICE INSTRUCTIONS

2.1 Close the valves before and after the oil filter.

2.2 Evacuate the refrigerant from the filter housing.

2.3 Drain off the oil in the oil filter through the plug in the bottom.

2.4 Remove the cover by loosening the nuts and pulling cover and filter insert from the housing.

2.5 Disassemble the filter by loosening the nut at the end of the insert.

2.6 Pull the filter cartridge from the magnet and clean the magnet.

2.7 Clean the filter housing from impurities, if any.

2.8 Assemble a new filter cartridge (1).

2.9 Then assemble the insert and the cover with new O-rings (2, 3, 4).

2.10 Dry the filter housing by evacuation.

**IMPORTANT:**
Since the life expectancies of the components in a refrigeration system depend (among other things) on system cleanliness, preventing dirt and other contaminants from getting into the system during installation and servicing is of prime importance.

## 3. LIST OF PARTS

| Item | Designation | Article number | Quantity | Weight kg |
|---|---|---|---|---|
| 1 | Filter cartridge | 3952 6453 025 | 1 | 1.8 |
| 2 | O-ring | 3921 5282 523 | 2 | 0.05 |
| 3 | O-ring | 3921 5282 527 | 1 | 0.05 |
| 4 | O-ring | 3921 5282 531 | 1 | 0.05 |
| 5 | El. pressostat | 3966 1471 025 | 1 | 0.2 |
| 6 | Visual indicat. | 3966 1471 024 | 1 | 0.1 |
| 7 | Indicat. block | 3966 1471 023 | 1 | 1.0 |

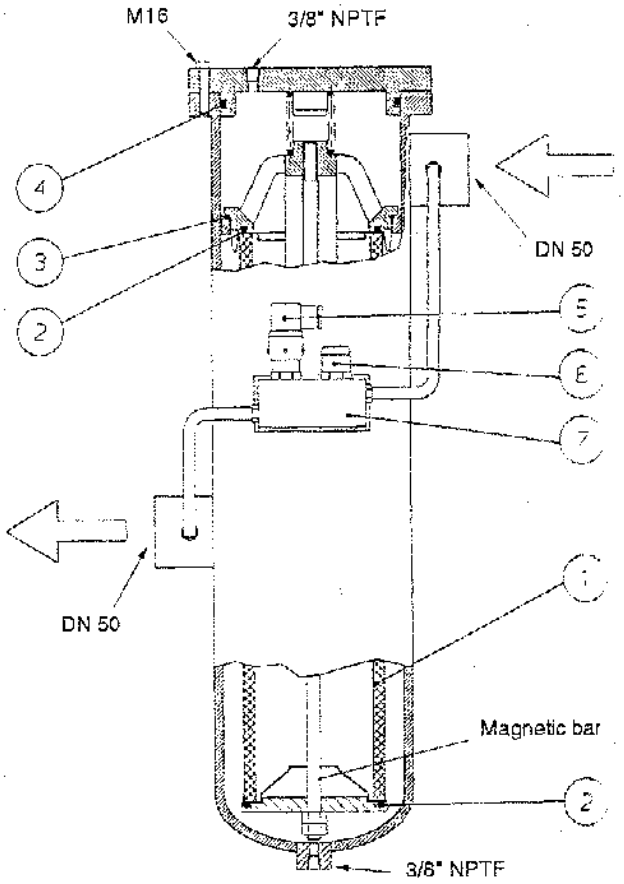



Fig. 1 Oil filter

# STOP VALVE Type ASB
## DN 200



### GENERAL
This stop valve has been designed to satisfy high demands on adaptability to and functional reliability in refrigerating plants. It satisfies the requirements of the Swedish Refrigeration Standards and complies with the regulations enforced in most other countries.

The valve can be delivered classified in Lloyd's Register of Shipping, Det Norske Veritas, Bureau Veritas and Germanischer Lloyd.

### DESCRIPTION
The valve has a full flow area and a low flow resistance.

The valve body (1) is made of steel, a choice of material caused by the fact that the valve is normally welded into the piping system on the installation site. The disk (3) has a replaceable sealing ring (4) of teflon. The disk runs in a sleeve (12), which protects the threads of the stem from foreign matter and is connected to the stem (9) via a number of hardened steel rollers (22). The stem is made of stainless steel with a highly polished surface. The stem seal is of teflon where subsequent tightening may be necessary. The valve is provided with a so-called back seal (11) of teflon, which serves to afford sealing between the stem and the cover (2) of the valve body, allowing the stem seal to be removed for overhauling and replacement, if necessary, of the gasket (7).

The connection pipes are arranged for direct welding to pipes with outside diameters 219,1 mm. The handwheel (18) is made of light alloy. Valve cover and dismantling tool for the stem sealing are available as optional accessories.

### APPLICATION
The valve is pressure tested to 4.6 MPa . Permissible temperature range when using refrigerant: - 40°C to +150°C. The valve complies with the requirements according to AD Merkblatt W10.

It may be used for refrigerants $NH_3$, R12, R22, R502 and R13B1, as well as for air, oils and other media which do not attack steel, teflon and Klinger Oilit.

### FITTING INSTRUCTIONS
The valve may be used for both flow directions and may be installed either horizontally or vertically. When the valve body is being welded to a pipe, flange etc, the insert must be removed. Keep the insert in a manner assuring adequate protection against dirt and other impurities. Take particular care with the stem, which is sensitive to scratching, scoring etc. When the valve body has been fitted (welded or flanged) and it has been ensured that welding slag, dirt, etc., has been removed both from the valve body itself and in the lines leading to and from it, the insert may be fitted. Make sure that the stem is set for a fully open valve. Position the sealing ring in the cover and tighten the screws alternately. Never paint the valve stem.

### PRESSURE DROP
The resistance factor for the valve is 1.9 in the case of flow against the disk and 3.0 in the case of flow with the disk (from A to B, see Fig. 2). The resistance factor is valid for an inside diameter of 207.3 mm on connecting pipes.
The flow resistance can be calculated from the following formula:

$$P = \zeta \times \frac{w^2 \times \rho}{2}$$

where $P$ = Pressure drop $N/m^2$

$w$ = Velocity in pipe m/s

$\rho$ = Density of the medium $kg/m^3$

$\zeta$ = Resistance factor of the valve

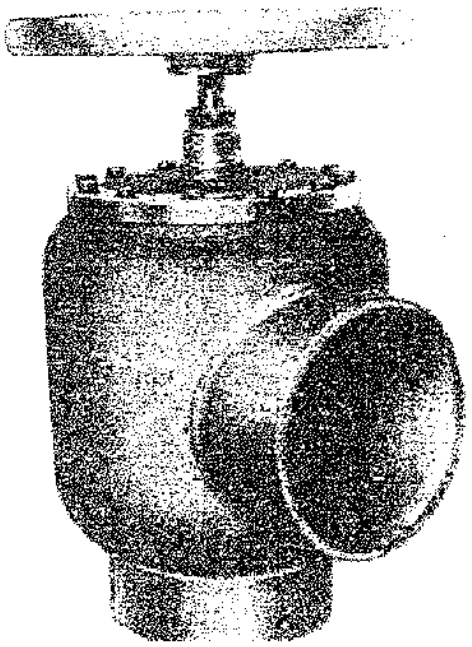


Fig. 1

### STOCKAGE AND FORM OF DELIVERY
The valve is intended to be welded into the piping system on the installation site, and while this is being done the insert will have to be removed in order not to get damaged. For this reason, the valve will be delivered in two sections.

The valve body is delivered separately, ready to be welded on the installation site. The gasket surface is protected by means of a sheet of fibreboard which is screwed to the body.

The valve insert, complete with its seal and screws, is delivered packed in a waxed corrugated-board case marked with the type, reference, size designation and drawing number.

### ORDERING PROCEDURE
In ordering the valve, refer to Table 1 below, which lists the order numbers for valve bodies and inserts. These order numbers must always be quoted.

Table 1. Order numbers for ASB 200

| Classification society | Valve housing | Insert |
|---|---|---|
| LR and NV | 1888 115-A | 1910 855-A |
| Unclassified | 1888 115-B | 1910 855-B |
| BV | 1888 115-C | 1910 855-C |
| GL | 1888 115-D | 1910 855-D |
| Valve cover | 1885 187-F | |
| Dismantling tool for stem seal | 1889 349-C | |

MAINTENANCE

Directions for dismantling and reassembly in the event of leakage.

If the stem seal leaks, it will normally suffice to tighten the gland (13). If this measure proves inadequate, the gasket should be changed. If the valve can be left open while this is being done, open it fully so that the back-seal ring (11) seals between the cover (2) of the valve body and the stem (9). Otherwise, the pressure over the disk must be lowered to atmospheric before the gland is screwed off. The gasket (7) can then be screwed out with the dismantling tool. The latter can be struck into the gasket to provide a good grip.

Make sure that there are no scratches, scorings or the like on the valve stem. There must on no account be any sharp edges or burrs on it.

When fitting the gasket, make sure that it is not scratched or scored on the inner, cylindrical part. Lubricate the gasket with refrigerating machinery oil.

When the valve is opened, a minute quantity of refrigerant dissolved in the oil on the stem may escape. A leak-detecting torch or similar testing device will, however, give only a transient indication of leakage.

If the sealing ring on the disk is damaged, it can either be reversed or replaced by a new one. While this is being done, the valve must be completely relieved of pressure.

A slightly damaged seat can be improved by rubbing with a piece of emery cloth attached to a cylindrical, flat-ended block.

Do not expose the stem to careless treatment. Never paint the valve stem.

Valve body weight 35 kg
Insert weight 30 kg

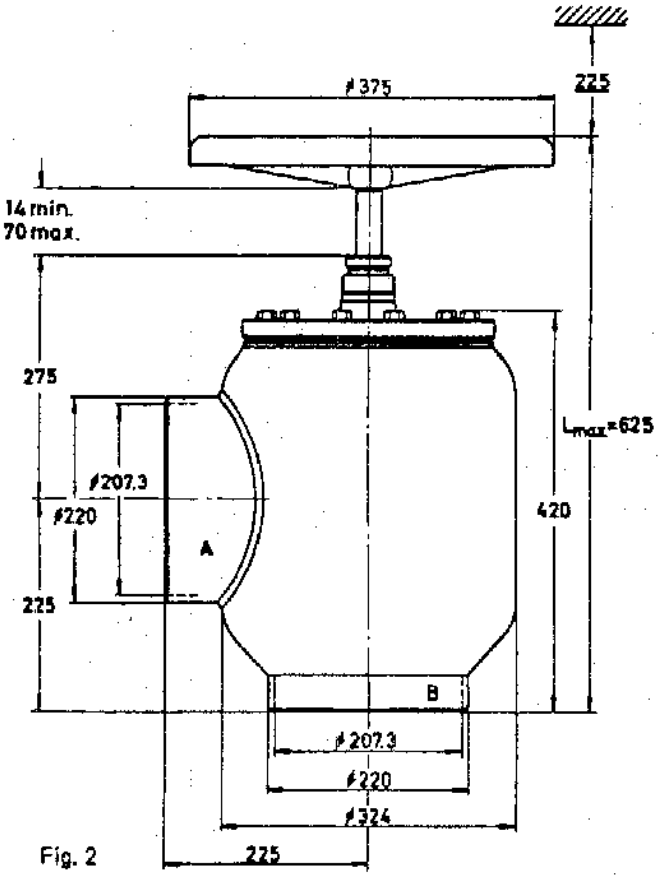


Fig. 2

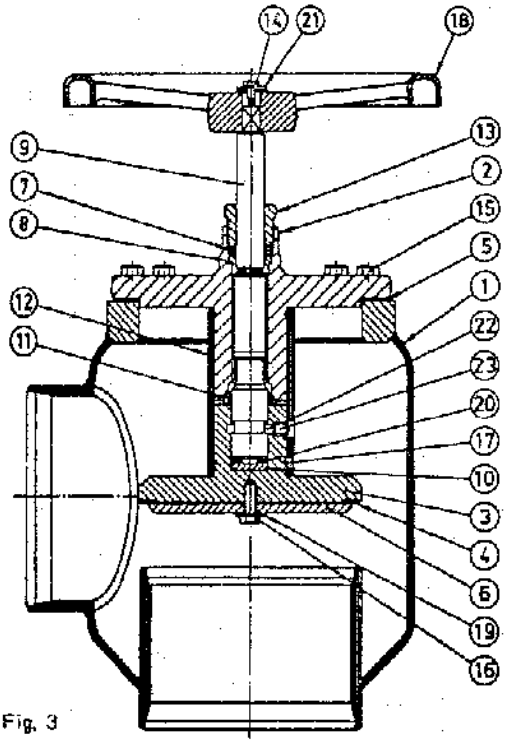


Fig. 3

Table 2 List of parts

| Item No. | Description | Qty. | Order number |
|---|---|---|---|
| 1 | Valve body | 1 | 1888 115-B |
| 2 | Cover | 1 | 1910 836-A |
| 3 | Disk | 1 | 1910 852-A |
| 4 | Sealing ring | 1 | 1885 117-19 |
| 5 | Gasket | 1 | 1885 966-1 |
| 6 | Retainer | 1 | 1886 607-6 |
| 7 | Gasket | 1 | 1886 630-13 |
| 8 | Ring | 1 | 1887 205-2 |
| 9 | Stem | 1 | 1888 104-2 |
| 10 | Insertion | 1 | 1888 123-1 |
| 11 | Back seal | 1 | 1888 124-1 |
| 12 | Sleeve | 1 | 1910 853-1 |
| 13 | Gland | 1 | 1910 854-1 |
| 14 | Hexagon bolt | 1 | 3921 2121 453 |
| 15 | Hexagon bolt | 12 | 3921 2121 540 |
| 16 | Hex. locking bolt | 1 | 3921 2123 536 |
| 17 | Grub screw | 1 | 3921 2241 362 |
| 18 | Handwheel | 1 | 3921 8821 814 |
| 19 | Cup spring | 2 | 3921 9512 112 |
| 20 | Cup spring | 2 | 3921 9512 218 |
| 21 | Cup spring | 2 | 3921 9512 810 |
| 22 | Roller | 14 | 3922 1395 035 |
| 23 | Pipe plug | 1 | 3951 3153 110 |
| | Dismantling tool | | 1889 349-C |

# TYPE ASC STOP VALVE
# DN 50

## GENERAL

This stop valve is designed for refrigeration plants and heat pumps. It is to be welded to steel pipes or flanges and it features the following:

- Unobstructed free-flow area that ensures low flow resistance.
- Lightweight valve body that facilitates handling and welding.
- Replaceable seat seal on disk (closing member)
- Back seat seal that permits stem seal to be replaced during operation.
- Stem guard that prevents dirt from getting into the stem threads and causing them to bind.
- Adapted for ISO pipe sizes in preference group 1.
- Low-temperature stuffing box available as an accessory.

This valve is available classified by Lloyd's Register of Shipping and Det Norske Veritas. On request, it is also available classified by other societies.



## DESCRIPTION

The valve body (1) is made of steel pipe that is tapered down at one end to facilitate welding of the seat connection and flared at the side-connection side. A flange ring used to attach the insert has been welded to the shell. The connections are machined for direct fitting to pipes of the sizes set forth in group II in manual sheet 5121-C-5.

The disk (7) is provided with a replaceable sealing ring (2) made of teflon. This disk, which runs in a guide in the cover (6) is joined to the stem (8) via a threaded joint. One grub screw (15) prevent the stem and disk from coming unscrewed. Added closing force is provided due to the fact that the stem threads in the cover and on the disk have different pitches. As a result, less closing force is needed on the handwheel (19). The stem is made of stainless steel having a high finish. The stem seal consists of two O-rings (17) that make the valve easy to operate. For low-temperature applications, the stuffing box can be replaced with a low-temperature stuffing box. The valve is provided with a back seat seal (4) made of teflon. This back seat seal closes when the valve is opened all the way. It provides a seal between the stem and cover. This can be very useful when (for example) the O-rings in the stuffing box (9) have to be replaced. A valve cover and stem extension are available as options.

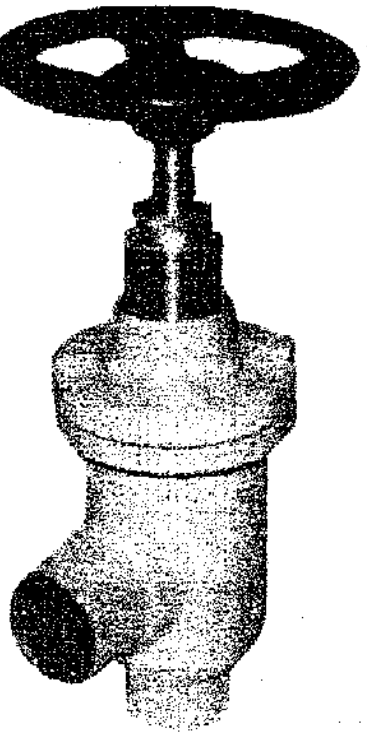


Fig. 1

## PRESSURE DROP

The resistance coefficient for the valve is 1.5 for flow against the disk (from B to A in Fig. 3) and 2.3 for flow in the same direction as the disk (A to B). The resistance coefficient is specified for connected pipe having an inside diameter of 54.5 mm. The valve's flow resistance can be calculated using the following formula:

$$\Delta p = \xi \times \frac{w^2 \times \rho}{2}$$

$\Delta p$ = Pressure drop in $N/m^2$
$w$ = Velocity in pipe in m/s
$\rho$ = Medium density in $kg/m^3$
$\xi$ = Valve's resistance coefficient

## APPLICATION LIMITS

This valve has been pressure-tested at 4.6 MPa.

Temperature limits:

–40°C to –130°C for standard version (with O-rings)

–60°C to –150°C for refrigerants and with low-temperature stuffing box (teflon)

This valve complies with the requirements set forth in AD Merkblatt W10.
It can be used with the following refrigerants: $NH_3$, R12, R22, R134, R500, R502 and R13B1. It can also be used with air, oils and other media that do not attack steel, teflon, chloroprene rubber or Klinger Sil 4400 (gland packing).

## MOUNTING INSTRUCTIONS

Flow can proceed either way through this valve, and it can be mounted either horizontally or vertically. The insert must be removed from the valve body before it is welded to a pipe, flange or the like. The insert must be kept where it is protected from moisture, dirt and other impurities. Be careful of the stem. It is vulnerable to scratches and impacts. After the valve body is in place (welded or flanged) and you have made certain that all welding spatter, dirt, etc. have been removed from both the valve body and the lines running to and from it, you can mount the insert. Make certain that the stem is set to provide a fully open valve. Fit the sealing ring in place in the valve body and mount the insert. Tighten the screws alternately. Never paint the valve stem.

## STORAGE AND FORM OF DELIVERY

Due to the fact that the insert must be dismounted during welding of the valve body, the two are delivered separately.

On delivery, the valve body is smeared with screw compressor lubricating oil and packed in a sturdy plastic bag that is sealed to prevent rusting.
On delivery, the insert is also smeared with screw compressor lubricating oil and packed in a sturdy sealed plastic bag. The outer shipping container consists of a cardboard box on which the type, size designation and drawing number are marked. In addition, the box is stamped with the manufacturing date and provided with a label reading THIS SIDE UP.

## HOW TO PLACE AN ORDER

To order this valve, see Table 1 which presents ordering numbers for valve bodies, inserts and accessories. Always specify these numbers in your order.

Table 1 Ordering numbers

| Classification society | Valve body | Insert |
|---|---|---|
| LR and NV | 1905 116-A | 1905 130-A |
| Unclassified | 1905 116-B | |
| Accessories | | |
| Valve cover | | 1905 200-A |
| Low-temperature stuffing box | | 1905 120-A |
| Stem extension | | 1885 009-E |
| Regulating cone | | 1905 203-B |
| Dismounting tool for low-temp gland packing | | 1889 349-D |

## MAINTENANCE

Instructions for disassembling and reassembling in the event of leakage.

If the stem seal leaks, the O-rings (17) must be replaced. If the valve can be open while they are being replaced, open it all the way so that the back seat seal (4) provides a seal between the stem (8) and the cover (6). If the valve cannot be open while the O-rings are being replaced, the pressure across the disk (7) must be lowered to atmospheric pressure before unscrewing the stuffing box (9). The O-rings can then be removed easily, and new ones can be fitted.
Check to see that there are no scratches or the like on the stem. There must be absolutely no sharp burrs.

Make certain that there are no defects on the sealing rings, and be careful not to damage them while they are being inserted. Smear these rings with screw compressor lubricating oil. It must be easy to fit the stuffing box with rings onto the stem and slide it down.
You should have a stuffing box ready for use before starting to work. When the valve is open, a very small amount of refrigerant that has been dissolved in the oil can escape. However, any leakage indication that would actuate a leak-detector torch (for example) will quickly vanish.

If the stuffing box is to function well, the rubber rings must be of the correct grade and size. We recommend that you keep several rings in reserve for the valve. Use only genuine STAL rings made of special synthetic rubber. If the disk sealing ring (2) is damaged, it can be turned over or replaced with a new one. In such case, all pressure must be released from the valve before the insert is removed. A lightly damaged seat can be improved by rubbing it with emery cloth stretched across the flat face of a cylindrical rubbing block.
Always treat the stem gently. Never paint the stem.

Table 2 List of parts

| Item | Name | Qty | Ordering No. |
|---|---|---|---|
| 1 | Valve body | 1 | 1905 116-A/E |
| 2 | Sealing ring | 1 | 1885 117-22 |
| 3 | Gasket | 1 | 1886 347-8 |
| 4 | Back seat seal | 1 | 1887 207-5 |
| 5 | Gasket | 1 | 3921 5213 833 |
| 6 | Cover | 1 | 1905 131-1 |
| 7 | Disk | 1 | 1905 133-1 |
| 8 | Stem | 1 | 1905 140-2 |
| 9 | Stuffing box | 1 | 1905 199-1 |
| 10 | Holder | 1 | 1910 816-4 |
| 11 | Tension pin | 1 | 3921 1171 253 |
| 12 | Hexagon bolt | 4 | 3921 2120 495 |
| 13 | Locking screw | 1 | 3921 2123 368 |
| 14 | Locking screw | 1 | 3921 2123 370 |
| 15 | Grub screw | 1 | 3921 2236 366 |
| 16 | Gland packing | 1 | 3921 5213 954 |
| 17 | O-ring | 2 | 3921 5295 719 |
| 18 | Locking washer | 2 | 3921 5415 156 |
| 19 | Handwheel | 1 | 3921 8821 905 |
| 20 | Cup spring | 2 | 3921 9512 806 |
| 21 | Cup spring | 6 | 3921 9512 807 |

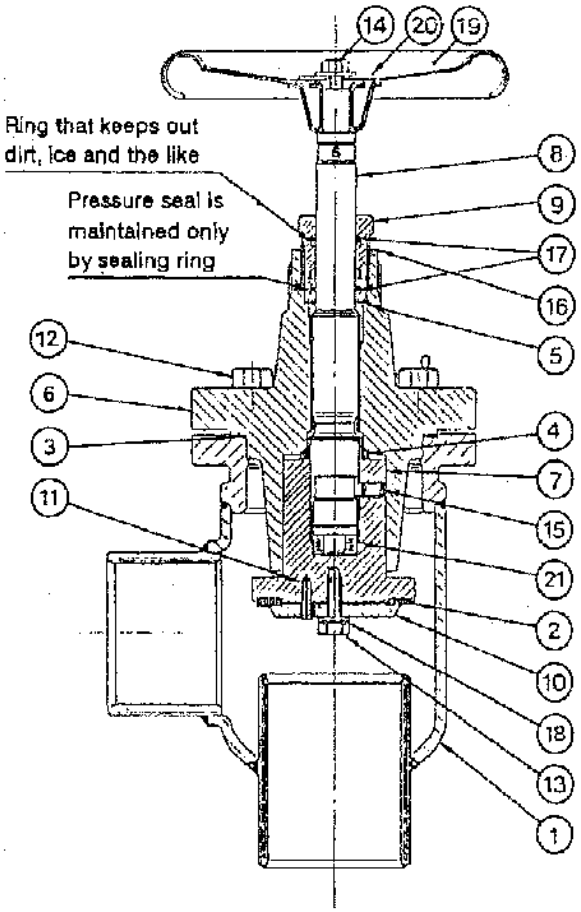



Fig 2

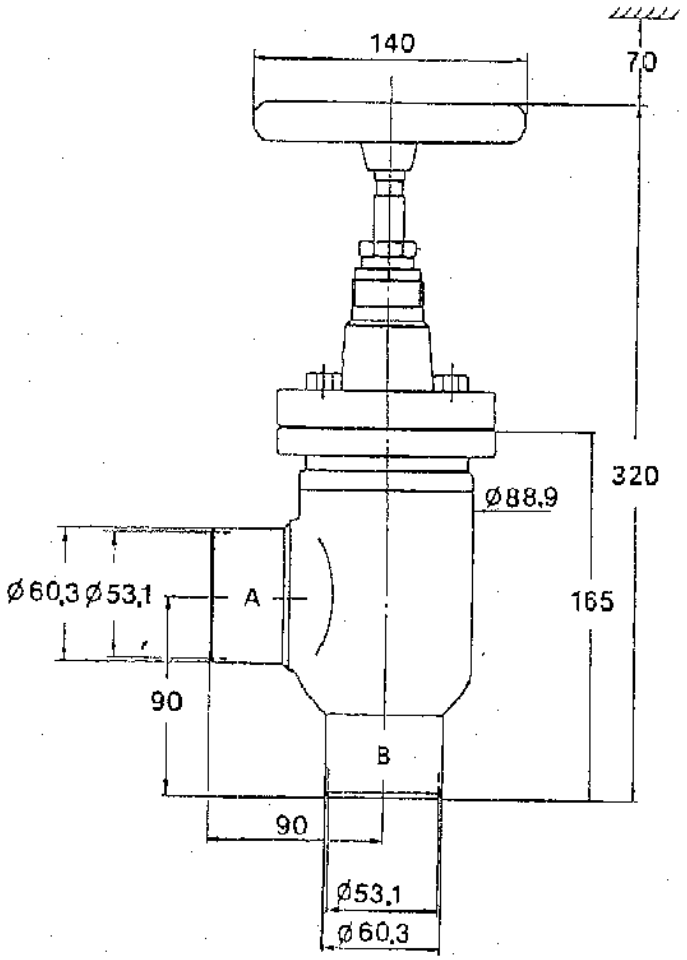



Fig. 3 Dimensional drawing

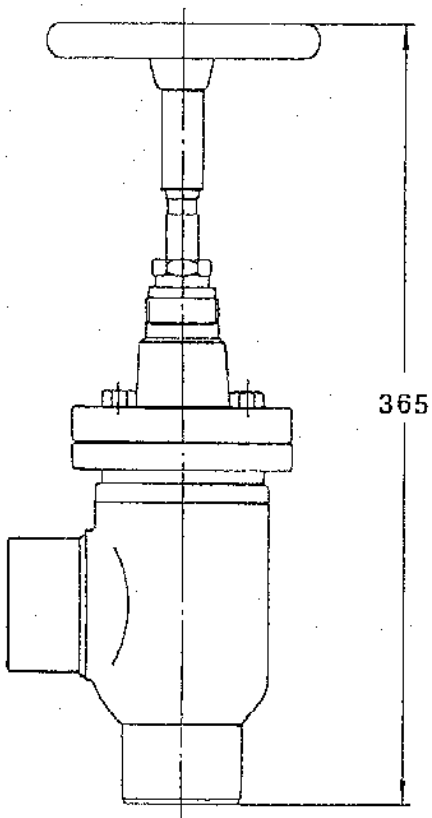



Fig. 4 Valve with stem extension

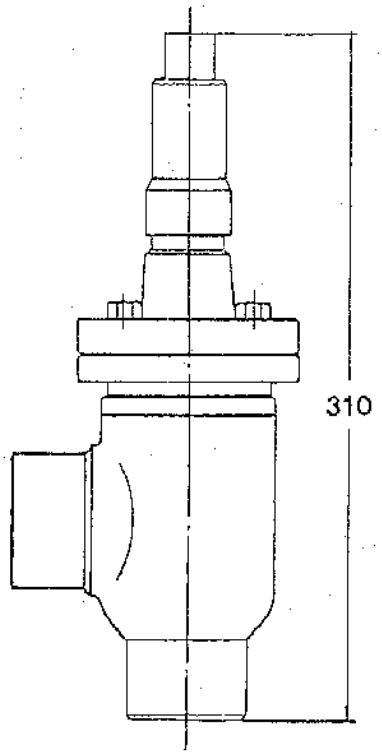



Fig. 5 Valve with valve cover

# STOP VALVES
# Type AVA 5 – 20

## GENERAL

The design of these valves is based on many year's experience, the aim being to provide an economical valve which could take the place of the earlier types S-500:A7-15 and S-500:B7-15. Besides the valves have been provided with a sealing cover. By utilizing modern manufacturing methods, a uniform, high quality is obtained at a low price. The valves are made for connection to steel tubes. They are made of steel and the valve body is surface-treated. The valve stem seal is made of teflon.

## SOME DISTINGUISHING FEATURES

**Robust construction**

Valve stem of stainless steel

The stem sealing is designed so that the sliding surface of the stem always is protected against external damage. On the bigger valves, which are intended for welding, the gasket is not fitted. The gasket is delivered together with the valve on the stem under the valve cover.

Cover for the valve stem is delivered as standard. The threads of the valve stem are protected as far as possible from dirt and impurities from the pipe system.

The stem threads have a very fine pitch, facilitating flow adjustment. The bigger valves are also provided with a regulating cone.

Handwheel and disassembly tools are obtainable as accessories.


Figure 1.

## APPLICATIONS

The valves are designed for working pressures of up to 3.5 MPa and for temperatures between +150 and –70°C. They are suitable for all of the currently known refrigerants.

At high pressures and moderate temperatures, they are also suitable for other mediums, that do not attack the valve material, such as air, water, light hydraulic oils, certain vegetable oils, ethylene, etc.

The valves should not be mounted with the stem downwards.

## INTERCHANGEABILITY AND ORDER PROCEDURE

The AVA-valves are fully interchangeable for the earlier valves S-500:A and S-500:B concerning installation dimensions and connections.

When ordering a valve with a handwheel, state the order number, e.g. Valve 1885 411-E, Handwheel 3921 8822 801.

## WELDING

When AVA 15–2 and AVA 20–2 are welded on the installation site, the teflon gasket must be removed. When fitting, the steel washer must be placed under the teflon gasket.

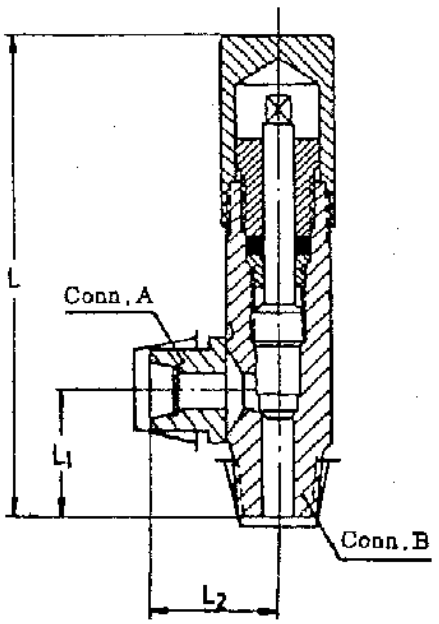



Figure 2. AVA 5 and 7

Table 1. Technical data

| Valve Type AVA | Order number | Flow dia-meter | Intended for pipe dimension Dy/Di | Type of connection A | Type of connection B | Friction factor 1) A/B | L | L1 | L2 | Handwheel | Connection parts (not included in the valve) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Connection A | | Connection B | |
| | | | | | | | | | | | Ferrule | Nut | Ferrule | Nut |
| 7–1 | 1885 411-A | 6.8 | 10.2/6.2 | Ferrule coupling | 3/8 NPTF | 4.2 | 103 | 27.5 | 27.5 | 3921 8822 801 | 3951 3081 810 | 3951 3091 810 | — | — |
| 7–2 | 1885 411-B | 6.8 | 10.2/6.2 | | Ferrule | 4.2 | 103 | 27.5 | 27.5 | | 3951 3081 810 | 3951 3091 810 | 3951 3081 810 | 3951 3091 810 |
| 7–3 | 1885 411-C | 6.8 | 10.2/6.2 | | 1/4 NPTF | 4.2 | 103 | 27.5 | 27.5 | | 3951 3081 810 | 3951 3091 810 | — | — |
| 5–1 | 1885 411-D | 6.8 | 6/4 | | 1/4 NPTF | | 103 | 24 | 24 | | 3951 3081 806 | 3951 3091 806 | — | — |
| 5–2 | 1885 411-E | 5 | 6/4 | | Ferrule | | 103 | 24 | 24 | | 3951 3081 806 | 3951 3091 806 | 3951 3081 806 | 3951 3091 806 |
| 5–3 | 1885 411-F | 5 | 6/4 | | 3/8 NPTF | | 103 | 24 | 24 | | 3951 3081 806 | 3951 3091 806 | — | — |
| 15–1 | 1886 620-E | 15 | 21.3/17.3 | Ferrule coupling | | 8.5/6.0 | T47 | 40 | 40 | 1885 887-A | 3951 3081 821 | 3951 3091 821 | 3951 3081 821 | 3951 3091 821 |
| 15–2 | 1886 620-F | 15 | 17.3/13.2<br>21.3/17.3 | Weld | | 3.0/2.0<br>8.5/6.0 | 147 | 40 | 40 | 1885 887-A | Welding connection to pipes | | Welding connection to pipes | |
| 15–3 | 1886 620-G | 15 | 21.3/17.3 | Ferrule | 3/4 NPTF | 8.5/6.0 | 147 | 40 | 40 | 1885 887-A | 3951 3081 821 | 3951 3091 821 | — | — |
| 15–4 | 1886 620-H | 15 | 5/8 Cu | Flare | 1/2 NPTF | 8.5/6.0 | 149 | 42 | 45 | 1885 887-A | Flare 5/8 copper pipe 3951 3545 810 | | — | — |
| 20–2 | 1887 170-F | 20 | 21.3/17.3<br>26.9/22.3<br>33.7/28.5 | Weld | | 2.7/2.0<br>7.4/5.6 | 174 | 45 | 45 | 1885 887-B | Welding connection to pipes | | Welding connection to pipes | |

1) Refers to flow in different directions for valves 15–1 and 15–2, for the remaining valves the friction factor for both flow directions is valid.

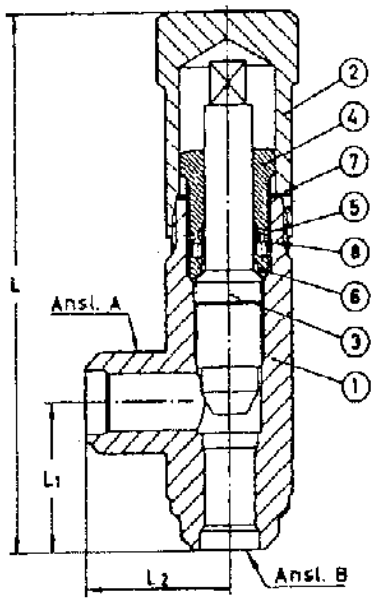
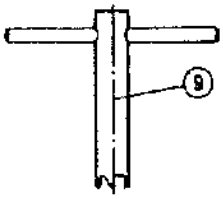
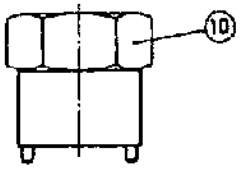



Figure 3. AVA 15–2 and 20–2



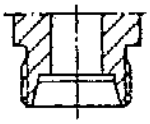

Tool for disassembling of gasket



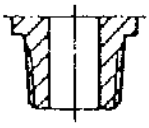

Tool for back seal

The valve can both be electric welded and gas welded

When welding in of the valve, the gland (4) and the gasket (5) are to be disassembled and the valve stem should be opened completely



AVA 15-1
conn. A and B



AVA15-3
conn. B

Table 2

| Valve type AVA | Parts | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Valve housing 1 | Cover 2 | Stem 3 | Gland 4 | Gasket 5 | Back seal 6 | Gasket 7 | Washer 8 | Assembly tool 9 | Tool 10 |
| 5 and 7 | | 1885 419-1 | | 1885 418-1 | | | 3921 5213 828 | | | |
| 15—1 | 1886 621-E | 1886 626-1 | 1886 627-3 | 1889 320-1 | 1886 630-11 | 1883 814-1 | 3921 5213 848 | 1887 930-1 | 1889 349-D | 1888 316-A |
| 15—2 | 1886 621-F | 1886 626-1 | 1886 627-3 | 1889 320-1 | 1886 630-11 | 1883 814-1 | 3921 5213 848 | 1887 930-1 | 1889 349-D | 1888 316-A |
| 15—3 | 1886 621-G | 1886 626-1 | 1886 627-3 | 1889 320-1 | 1886 630-11 | 1883 814-1 | 3921 5213 848 | 1887 930-1 | 1889 349-D | 1888 316-A |
| 15—4 | 1886 621-H | 1886 626-1 | 1886 627-3 | 1889 320-1 | 1886 630-11 | 1883 814-1 | 3921 5213 848 | 1887 930-1 | 1889 349-D | 1888 316-A |
| 20—2 | 1887 171-F | 1887 176-1 | 1887 177-3 | 1887 178-1 | 1886 630-12 | 1887 179-1 | 3921 5213 856 | 1887 930-2 | 1889 349-B | 1888 316-B |

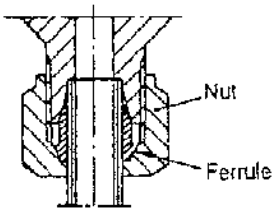



Figure 4. Ferrule coupling

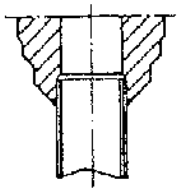
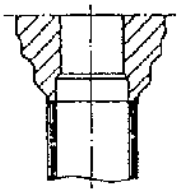


Figure 5.



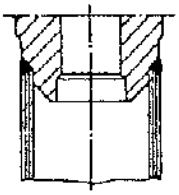


Figure 6. Welding connection for AVA 15–2 and 20–2

Figure 7

## MAINTENANCE

### Directions for disassembling of AVA 15 and 20

If the stem seal leaks, it is normally sufficient to tighten the gland (4). If this measure proves inadequate, the gasket (5) should be changed. If the valve can be left open while this is being done, open it fully so that the stem (3) seals against the back seal (6).

If not, the pressure in the valve must be lowered to atmospheric before the gland is screwed off. The gasket can then be screwed out with the disassembly tool. The tool should be struck into the gasket to secure a good grip.

Always be careful when dismantling a gasket. The washer may be missing (because of improper mounting) or positioned on the wrong side of the gasket. If such is the case, the back seal can come loose, and this will result in refrigerant leakage. If this occurs, you must immediately stop screwing out the gasket .

Knock it off the stem using a suitable screw driver and pick out the pieces. Before mounting a new gasket (5) it should be oiled with refrigerating machinery oil.

AVA 5 and 7. These valves are not to be disassembled. The complete valve must be changed.

# SAFETY VALVE
# TYPE AZB 40

## GENERAL

This safety valve is of a simple and reliable design. The standard opening pressures are in accordance with the requirements of the Swedish Refrigeration Code and the Swedish Pressure Vessel Code. See also manual sheet 517-N-1E.

## DESCRIPTION

The valve is of the so-called high-lifting type, implying that the valve disk is fitted with a secondary pressure surface, so that full opening is attained as soon as the preset opening pressure is reached. The valve is set to open at the pressures specified in Table 1. The valve is completely leakproof at pressures specified in Table 1 under sealing pressure.

The valve is totally enclosed and is provided with a connection for a blow-off line.

All parts are of black finished steel, except for the valve disk and stem which are made of stainless steel. The valve seal is made of reinforced PTFE.

The minimum throughput area is 11 $cm^2$.



## APPLICATIONS

The valve applications are evident from Tables 2 and 3.
Temperature range -60 to +120°C.
The valve can be used for all media which do not attack black finished steel or PTFE.

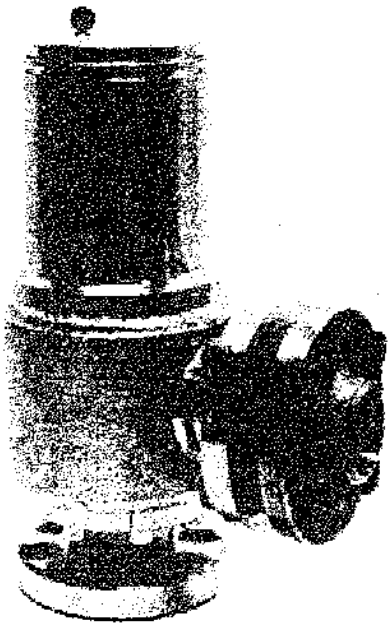
## FITTING INSTRUCTIONS

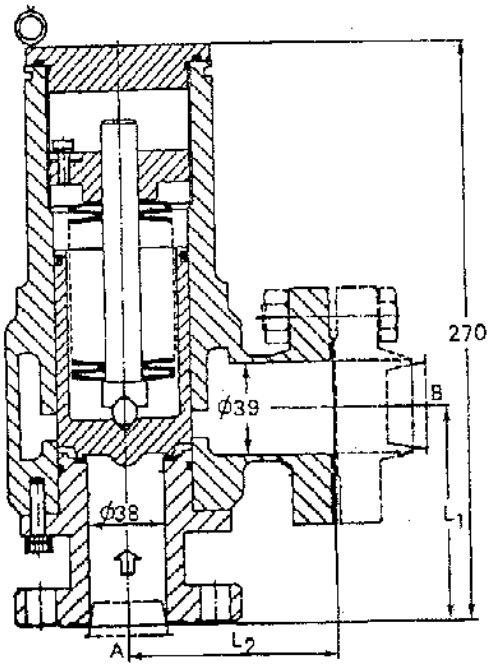
Connection A fits against welding flange 3951 3318 804 for version A up to and including F.
Connection A fits against DIN-flange 3951 3345 402 for versions G and H.

For fitting of two valves, special valve racks are available for welding into the pressure connection. See manual sheet 517-N-1E. The safety valve must be con-nected above the liquid level in the vessel. The valve sealing must not be broken.

## FORM OF DELIVERY

The valve is delivered adjusted and sealed. Connection B is fitted with a counter flange (STAL or DIN).






Weight: 13.5 kg
$P_e$ = gauge

1 MPa ≈ 10 kp/$cm^2$

**ORDERING PROCEDURE Table 1**

| Order number | Type AZB | Marking 1) | Sealing pressure Pe MPa 2) | L1 | L2 | Opening pressure Pe MPa |
|---|---|---|---|---|---|---|
| 1910 374-A | 4007 | Order No. 0.75 MPa 11 $cm^2$ | 0.68 | 101 | 100 | 0.75 |
| 1910 374-B | 4013 | Order No. 1.3 MPa 11 $cm^2$ | 1.17 | 101 | 100 | 1.30 |
| 1910 374-C | 4018 | Order No. 1.8 MPa 11 $cm^2$ | 1.62 | 101 | 100 | 1.80 |
| 1910 374-D | 4022 | Order No. 2.2 MPa 11 $cm^2$ | 2.00 | 101 | 100 | 2.20 |
| 1910 374-E | 4025 | Order No. 2.5 MPa 11 $cm^2$ | 2.25 | 101 | 100 | 2.50 |
| 1910 374-F | 4030 | Order No. 3.0 MPa 11 $cm^2$ | 2.70 | 101 | 100 | 3.00 |
| 1910 374-G | 4025D | Order No. 2.5 MPa 11 $cm^2$ | 2.25 | 125 | 120 | 2.50 |
| 1910 374-H | 4030D | Order No. 3.0 MPa 11 $cm^2$ | 2.70 | 125 | 120 | 3.00 |

1) The marking is punched into the valve cover
2) The sealing pressure must not be exceeded in normal operating conditions

Table 2. Valve applications, based on the minimum test pressures for pressure vessels as prescribed in the Swedish Refrigeration Code.

| Valve | Preset pressure $P_e$ MPa | Refrigerant | | | | |
|---|---|---|---|---|---|---|
| | | R12 | R22 | $NH_3$ | R13B1 | R502 |
| 1910 374-A | 0.75 | LP Stationary | | | | |
| 1910 374-B | 1.3 | HP Stationary HP, LP Marine | LP | LP | | LP |
| 1910 374-C | 1.8 | | LP 1) | LP 1) | | LP 1) |
| 1910 374-D | 2.2 | | HP | HP | LP | HP |
| 1910 374-E,G | 2.5 | HP, LP 1) | HP, LP 1) | | | HP 1) |
| 1910 374-F,H | 3.0 | HP 1) | HP 1) | | HP | |

LP = Low pressure side HP = High pressure side

1) For pressure vessels with higher test pressures than the minimum required by the code. E. g. vessels in ice rinks, air-conditioning plants or heat pump plants.

Table 3. Maximum permissible, external pressure vessel area, Y m2, per valve, according to the Swedish Refrigeration Code

| Valve | Max permissible operating pressure of vessel $P_e$ MPa | Min test pressure of vessel $P_e$ MPa | In premises with combustible material | | | | |
|---|---|---|---|---|---|---|---|
| | | | Refrigerant | | | | |
| | | | R12 | R22 | $NH_3$ | R13B1 | R502 |
| 1910 374-A | 0.75 | 1.0 | 11.0 | | | | |
| 1910 374-B | 1.3 | 1.7 | 18.0 | 21.3 | 48.0 | | |
| 1910 374-B | 1.3 | 1.8 | | | | | 19.7 |
| 1910 374-C | 1.8 | 2.4 | | 29.6 | 66.6 | | 26.0 |
| 1910 374-D | 2.2 | 2.9 | | 35.5 | 80.0 | 13.5 | 31.2 |
| 1910 374-E, G | 2.5 | 3.3 | 34.0 | 40.3 | | | 35.4 |
| 1910 374-F, H | 3.0 | 3.9 | 40.0 | 47.3 | | 18.0 | |

Table 3. cont.

| Valve | Max permissible operating pressure of vessel $P_e$ MPa | Min test pressure of vessel $P_e$ MPa | In premises without combustible material | | | | |
|---|---|---|---|---|---|---|---|
| | | | Refrigerant | | | | |
| | | | R12 | R22 | $NH_3$ | R13B1 | R502 |
| 1910 374-A | 0.75 | 1.0 | 66.1 | | | | |
| 1910 374-B | 1.3 | 1.7 | 108 | 128 | 288 | | |
| 1910 374-B | 1.3 | 1.8 | | | | | 118 |
| 1910 374-C | 1.8 | 2.4 | | 177 | 400 | | 156 |
| 1910 374-D | 2.2 | 2.9 | | 213 | 480 | 81.1 | 187 |
| 1910 374-E, G | 2.5 | 3.3 | 204 | 241 | | | 212 |
| 1910 374-F, H | 3.0 | 3.9 | 240 | 284 | | 108 | |

$P_e$ = gauge

1 MPa ≈10 kp/cm$^2$

# SPARE PARTS AND SPARE PART SETS FOR COMPRESSOR

S 85

The spare parts listed below are needed for the following service jobs. For separate gaskets or items see part list for compressor Manual Sheet 4848-R-201E.

## Cleaning of suction filter

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 2 | Gasket | 1906 362-1 | |
| 2 | Gasket | 3921 5204 050 | D=87/73x2 |
| 1 | O-ring | 3921 5282 548 | 249,3x5,7 |

## Change of seal for visual position indicator

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Sealing ring | 3921 5261 253 | |
| 1 | Support ring | 1905 535-1 | |
| 1 | O-ring | 3921 5282 404 | 19,2x3 |
| 1 | O-ring | 3921 5282 414 | 44,3x3 |
| 1 | O-ring | 3921 5282 438 | 129,5x3 |

## Change of seal for indication of VI-piston

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Sealing ring | 3921 5262 430 | |
| 1 | Support ring | 1905 535-2 | |
| 1 | O-ring | 3921 5282 408 | 29,2x3 |
| 1 | O-ring | 3921 5282 434 | 109,5x3 |

## Change of shaft seal

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Shaft seal | 1906 315-1 | |
| 1 | O-ring | 3921 5282 435 | 114,3x3 |
| 1 | O-ring | 3921 5282 434 | 109,5x3 |
| 1 | V-ring | 3922 1633 075 | |
| 1 | Gasket | 1906 424-1 | |
| 1 | Gasket | 3921 5213 851 | |

## Change of oil pump

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Oil pump | 1905 315-1 | |
| 1 | Gasket | 1905 409-1 | |
| 2 | Tension pin | 3921 1112 337 | ø 6x16 |

## Inspection of rotors

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Gasket | 1906 360-1 | |
| 2 | Gasket | 1906 362-1 | |
| 1 | Gasket | 1906 473-1 | |
| 2 | Gasket | 3921 5204 050 | D=87/73x2 |
| 1 | O-ring | 3921 5282 548 | 249,3x5,7 |

## Change of bearing or complete overhaul

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Set of gaskets | 1906 333-A | |
| 1 | Radial bearing | 1906 309-1 | |
| 1 | Radial bearing | 1906 310-2 | |
| 2 | Radial bearing | 1906 311-1 | |
| 3 | Thrust bearing | 1906 313-1 | |
| 2 | Thrust bearing | 1905 712-1 | |
| 1 | Shaft seal | 1906 315-1 | |
| 1 | Shim | 1906 026-3 | 0.1 |

## Capacity control

| Qty | Designation | Article No. | Remarks |
|---|---|---|---|
| 1 | Complete solenoid valve but without orifices | 1921 438-1 | 240 V/60 Hz, 220 V/50 Hz |
| 1 | | 1921 438-2 | 120 V/60 Hz, 110 V/50 Hz |
| 1 | | 1921 438-3 | 24 V/50–60 Hz |
| 2 | Coil | 1921 470-1 | 240 V/60 Hz, 220 V/50 Hz |
| 2 | | 1921 470-2 | 120 V/60 Hz, 110 V/50 Hz |
| 2 | | 1921 470-3 | 24 V/50–60 Hz |
| 1 | Orifice conn. P | 1921 439-4 | ø 2 mm |
| 1 | Orifice conn. T | 1921 439-3 | ø 1,5 mm |
| 4 | O-ring | 3921 5284 708 | ø 9,25x1,78 |

# SMALL TOOL SET

S81 -- S89

This tool set contains the tools needed to align the electric motor, to replace a shaft seal, to replace a visual indicator seal and to replace a coupling. Each compressor should be provided with this tool set.

For major overhaul work (replacing bearings e.g.), this tool set must be supplemented with the large tool set acc. to the Manual Sheet Large Tool Set.

List of tools in the tool set **1906 140-A**

| Item | Quantity | Article No. | Designation | |
|---|---|---|---|---|
| 1 | 1 | 1906 139-1 | Tool box | |
| 2 | 1 | 1921 468-A | Aligning tool | |
| 3 | 2 | 1906 140-3 | Dial indicator | |
| 4 | 1 | 1906 152-1 | Level arm | |
| 5 | 2 | 1906 153-1 | Puller screw | |
| 6 | 2 | 1906 154-1 | Guiding pin | |
| 7 | 1 | 1906 155-1 | Dismantling tool | |
| 8 | 2 | 1905 156-1 | Puller screw | |
| 9 | 1 | 1906 157-A | Guide | |
| 15 | 2 | 1906 140-15 | Screw M14×40 | |
| 16 | 2 | 1906 140-16 | Nut M12 | |
| 17 | 2 | 1906 140-17 | Nut M6 | |
| 18 | 1 | 1906 140-18 | Hexagon key | 4 mm |
| 19 | 1 | 1906 140-19 | Hexagon key | 5 mm |
| 20 | 1 | 1906 140-20 | Hexagon key | 12 mm |
| 21 | 2 | 1906 140-21 | Socket-head sleeve | 6 mm |
| 22 | 1 | 1906 140-22 | Socket-head sleeve | 8 mm |
| 23 | 1 | 1906 140-23 | Socket-head sleeve | 10 mm |