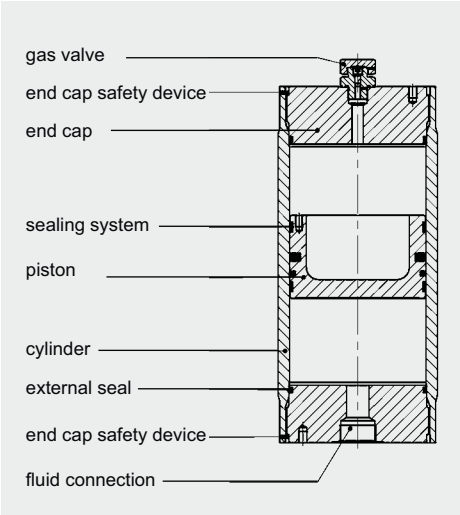
Hydraulic Piston Accumulators

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy. The compressibility of a gas (nitrogen) is utilised in hydraulic accumulators for storing fluids. HYDAC piston accumulators are based on this principle.
A piston accumulator consists of a fluid section and a gas section with the piston acting as the gas-proof screen.
The gas section is pre-charged with nitrogen.
The fluid section is connected to the hydraulic circuit so that the piston accumulator draws in fluid when the pressure increases and the gas is compressed.
When the pressure drops, the compressed gas expands and forces the stored fluid into the circuit.

1.2. CONSTRUCTION



HYDAC piston accumulators consist of:

- A cylinder with very finely machined internal surface.
- End caps on the gas side and the oil side. Sealed with O-rings.
- A floating steel or aluminium piston which can easily be accelerated due to its low weight.
- A sealing system adapted to the particular application.
  The piston floats on two guide rings which prevent metal-to-metal contact between the piston and the accumulator wall.
  For use with certain aggressive or corrosive fluids, the parts coming into contact with the fluid can be nickel plated for protection, or made entirely from corrosion-resistant material.
  Suitable materials are also available for low temperature applications.

1.3. SEALING SYSTEMS

Precise information about operating conditions is required in order to select the most appropriate sealing system. Important criteria for this selection are, for example:

- Design pressure,
- Effective pressure differential,
- Switching frequency or cycles,
- Temperature fluctuation,
- Operating fluid,
- Cleanliness of fluid (micron rating of filter),
- Maintenance requirements.

The sealing systems differ according to the type of piston used, each of which has its own type and arrangement of seals. The following elastomer sealing materials are available, depending on the operating conditions:

- NBR (acrylonitrile butadiene rubber, PERBUNAN)
- FPM (fluoro rubber, VITON®)
- PUR (polyurethane)

Piston design type		Application	Degree of contamination in the fluid	Notes
	1	● For general accumulator operation without special requirements Application limitations: max. piston velocity: 0.5 m/s	Optimised for applications with a high level of contamination	
	2	● Low-friction design ● For high piston speeds ● Slow movements without stick-slip effect Application limitations: max. piston velocity: 3.5 m/s	Filtration: NAS 1638 - Class 6 ISO 4406 - Class 17/15/12	
	3	● Low-friction design ● Simple-to-fit seals ● Slow movements without stick-slip effect Application limitations: max. piston velocity: 0.8 m/s		1 guide ring for pistons with Ø ≤ 150 mm 2 guide rings for pistons Ø ≥ 180 mm
	4	● Low-friction design with emergency safety features ● Slow movements without stick-slip effect ● Very low oil transfer to the gas side Application limitations: max. piston velocity: 5 m/s		

1.4. MOUNTING POSITION

HYDAC piston accumulators operate in any position.
Vertical installation is preferable with the gas-side at the top, to prevent contamination from the fluid settling on the piston seals. For accumulators with certain piston position indicators vertical installation is essential (see 1.7). Piston accumulators with a piston diameter ≥ 355 mm must only be mounted vertically.

1.5. ADVANTAGES OF HYDAC PISTON ACCUMULATORS

- complete range from 0.1 ... 1200 l nominal volume,
- high ratios possible between pre-charge pressure and max. working pressure,
- economic solution using back-up gas bottles for low pressure differentials,
- high flow rates possible; limitation: max. piston velocity,
- power savings,
- high level of efficiency of the hydraulic installation,
- gas-tight and leakage free,
- no sudden discharge when seals are worn,
- requires little space,
- monitoring of the volume across the entire piston stroke or electrical limit switch.

Further advantages of using the low-friction sealing system:

- minimum friction,
- also suitable for low pressure differentials,
- no start-up friction,
- no stick-slip,
- low noise, no vibration,
- high piston velocity up to 5 m/s for piston type 4,
- improved accumulator efficiency,
- good life expectancy of seals because of low wear,
- suitable for large temperature fluctuations,
- low maintenance requirement.

1.6. TECHNICAL REQUIREMENTS

HYDAC piston accumulators are suitable for high flow rates. With the largest piston accumulator diameter made to date of 800 mm, a flow rate of 1000 l/s can be achieved at a piston velocity of 2 m/s.

1.6.1 **Effect of sealing friction**

The permitted piston velocity depends on the sealing friction.

Higher piston velocities are possible where there is less sealing friction.

HYDAC piston accumulators of piston design type 2 allow velocities of up to 3.5 m/s.

1.6.2 **Permitted velocities**

Gas velocity
The flow velocities in the gas connection and pipe system should be limited to 30 m/s when using piston accumulators of the back-up type. Gas velocities of over 50 m/s should be avoided at all costs.

Oil velocity
In order to limit the pressure losses when the operating fluid is displaced, the flow velocity should not exceed 10 m/s in the adapter cross-section.

1.6.3 **Function tests and fatigue tests**

Function tests and fatigue tests are carried out to ensure continuous improvement of our piston accumulators.
By subjecting the accumulators to endurance tests under realistic as well as extreme working conditions, important data can be obtained about the long-term behaviour of the components. In the case of piston accumulators, important information on gas density and the life expectancy of seals is gained from such tests.

Vital data for use in accumulator sizing is gained by altering the working pressure and switching cycles.

1.6.4 **Fluids**

The following sealing materials are suitable for the fluids listed below:

NBR, resistant to:

- mineral oils (HL and HLP)
- non-flam fluids from the groups HFA, HFB and HFC
- water and seawater up to approx. 100 °C

NBR, not resistant to:

- aromatic hydrocarbons
- chlorinated hydrocarbons
- amines and ketones
- hydraulic operating fluids from the HFD group

FPM, resistant to:

- mineral oils (HL and HLP)
- hydraulic operating fluids from the HFD group
- fuels as well as aromatic and chlorinated hydrocarbons
- inorganic acids (but not all, please contact our technical department)

FPM, not resistant to:

- ketones and amines
- (anhydrous) ammonia
- organic acids such as formic acid and acetic acid

PUR, resistant to:

- mineral oils (HL and HLP)
- non-flam fluids from the HFA group

PUR, not resistant to:

- water and water-glycol mixtures
- alkalis
- acids

1.6.5 **Temperature ranges of the seals**

Material abbrev.	HYDAC code	Temp. range long-term
NBR	2	-20 °C ... + 80 °C
FPM	6	-15 °C ... +160 °C
PUR	8	-30 °C ... + 80 °C

For temperatures outside these ranges, please contact our technical department for more information. There are also special grades available depending on the application.

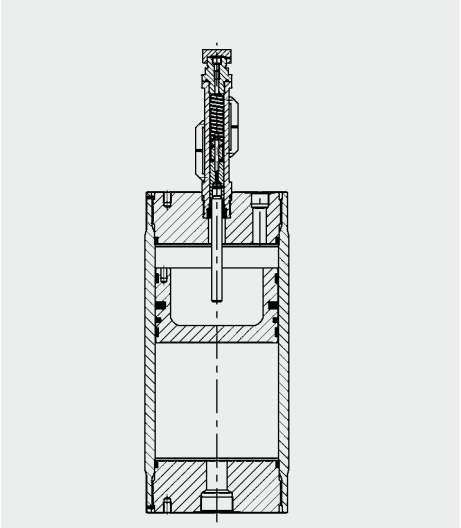
1.6.6 **Gas charging**

Always only charge with nitrogen class 4.5, filtered to < 3 µm. Please contact HYDAC if using other types of gases.

Hydraulic accumulators must only be charged with nitrogen.
Never use other gases.
Risk of explosion!

1.7. PISTON POSITION INDICATORS

1.7.1 Electrical limit switch



The electrical limit switch usually monitors the max. charged condition of the piston accumulator.
It can, however, also permit control functions of the attached hydraulics to be carried out over a certain stroke length.

The limit switch consists of the switching rod with a permanent solenoid which is not attached to the piston and can only achieve a limited stroke, and an anti-magnetic housing and two or more switches.

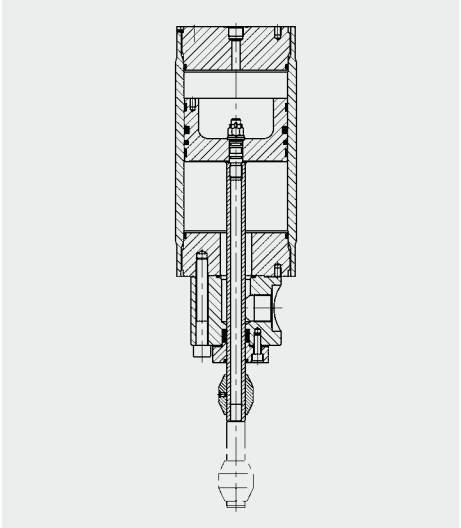
These switches can be normally closed or normally open or bistable. A N/C or N/O and a bistable switch cannot be fitted simultaneously to a limit switch. Our standard limit switch is fitted with a N/C and a N/O switch.

On another model, switching is carried out by inductive proximity switches.

The switch is reset by a spring or the force of gravity.
Vertical mounting is preferable, due to the friction and possible wear and tear in the rod guide.
For limit switches with a stroke of > 200 mm, vertical mounting with the gas side at the top is essential.

The maximum piston velocity must not exceed 0.5 m/s over the stroke range of the limit switch.

1.7.2 Protruding piston rod



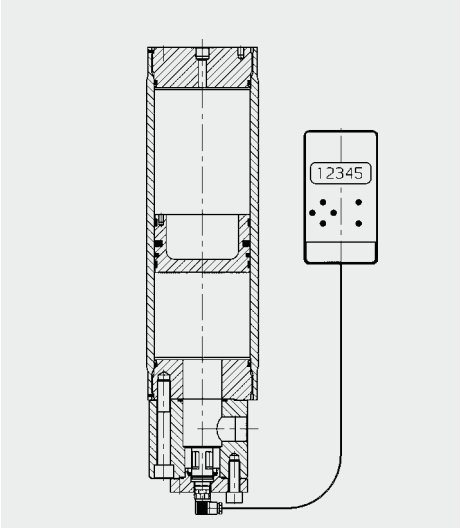
The protruding piston rod permits the position of the piston to be monitored over the whole stroke. It consists of the piston rod, which is fixed to the piston and sealed in, and what is known as the trip cam which actuates the limit switches.

The position of the piston can be monitored at any point using the trip cam. This facility is used mainly to switch the pump on and off.

Normally the piston rod protrudes from the accumulator on the fluid side to avoid possible points of leakage on the gas side. On the protruding piston rod version, the hydraulic connection will be on the side if the size of the end cap does not permit otherwise.

The protruding piston rod functions in any mounting position. There must however be sufficient space available for the piston to move in and out. The maximum piston velocity must not exceed 0.5 m/s over the whole stroke.

1.7.3 Ultrasonic measurement system



The piston position is determined by ultrasonic measurement.

It is only possible to take the measurements from the fluid side because a continuous sound carrier medium is required for ultrasound. In order to eliminate false readings, the fluid must be as free of air bubbles as possible. The piston should be mounted so that no air can collect under the sensor.

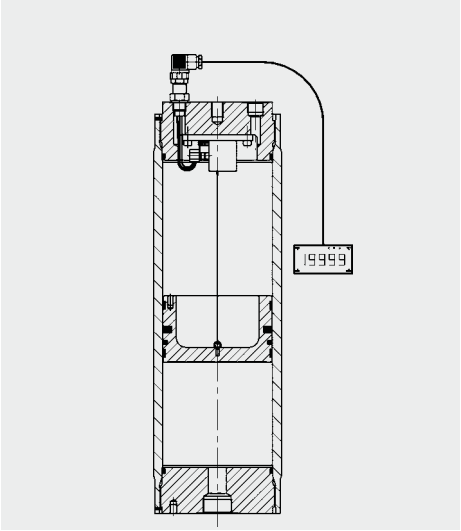
The measurement data is evaluated by a microprocessor and is converted into a continuous measurement signal. It is possible to pick up interim measurement results to switch system parts e.g. turn the pump on and off.

The most important features of the system are:

- Protection class IP65 according to DIN40050
- LCD display
- Outputs
  - 5 floating relay change-over switches (with 125 V, 1A rating), of which 1 is error output, and 4 are user-adjustable switching thresholds between 0 and 100 %
  - 4 - 20 mA

The maximum pressure for the sensor must not exceed 350 bar.

1.7.4 Cable tension measurement system



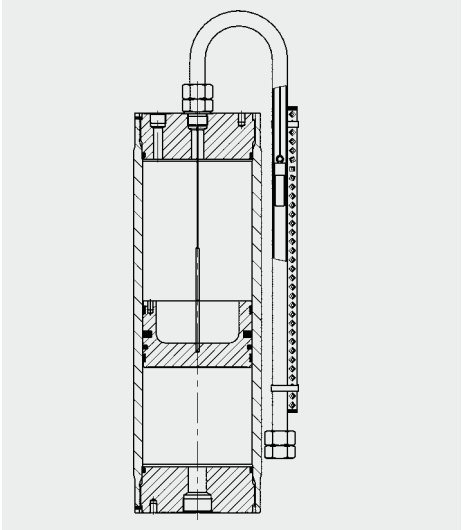
Using the cable tension measurement system, the position of the piston can be determined by means of a cable which is fixed to the piston.

The cable is attached to a wheel which is tensioned by a spring.
This wheel alters an electrical resistance via an attached rotary potentiometer during the piston movement. This resistance is converted by a transducer into an electrical signal so that it can be processed directly by a PLC system. The signal is supplied through the end cap via a pressure-tight cable gland.
Alternatively various digital display units and transmitters can be connected.

- Digital display unit:
  Supply voltage 230 V AC
  (or 24 V DC)
  4-channel limit comparator
  4 optical coupler outputs
  2 relay contact outputs
  1 RS 232 interface
  (optionally with analogue output
  4 - 20 mA)
- Transmitter:
  Supply voltage 24 V DC
  Analogue output 4 - 20 mA

The max. pressure must not exceed 350 bar. The piston acceleration is limited to certain values according to measurement system forces, approx. 7 ... 30 g, and is limited to a max. velocity of 0.5 m/s. The measurement system is not suitable for rapid volume changes. For such loads, please contact the Technical Dept. of our head office or your local HYDAC agent. The piston should preferably be mounted with the gas-side at the top.
The cable tension measurement system can only be fitted to the gas-side of the piston accumulator.

1.7.5 Magnetic flap indication

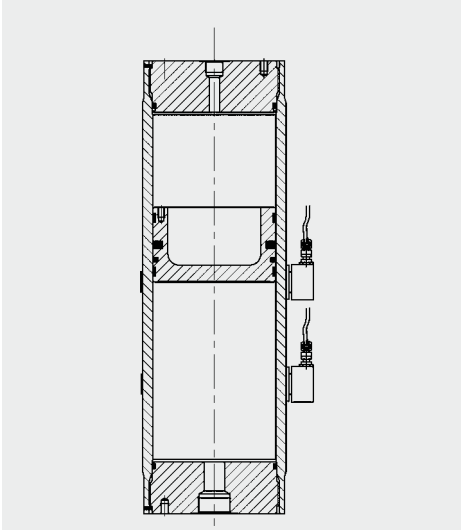


With magnetic flapper indication, the position of a piston can be determined by the colour of a set of magnetic flaps which turn as the piston moves and which are visible externally.

A non-magnetic tube is fitted to the piston accumulator containing a cable, one end of which is fastened to the gas side of the piston, and the other end is attached to a magnet. Along the length of the piston accumulator a housing is also fitted which contains red/white magnetic flaps.
As the magnet moves up or down its tube, the flaps turn to their opposite colour to indicate the piston's position.
When the piston moves towards the gas-side, the indicator moves in the direction of the oil-side. In addition, reed switches can be fitted to switch system parts or measurement scales can be fitted to the tube.

The maximum piston velocity must not exceed 0.5 m/s. No more than 5 cycles per day on average should be carried out. Piston accumulators with magnetic flap indication must only be installed vertically, gas-side at the top.

1.7.6 Piston position switch



With the piston position switch it is possible to detect the piston position in a piston accumulator using ultrasound.

The indicator can be retrofitted using a clamp. No other modification is required. It is possible to fit without disrupting the operation.

The piston position switch detects the change-over from oil to piston at which point the signal is switched off. This is the case if the piston is in the sound path or has passed it.
There are three different versions available:

- Standard version for
  Hydraulic fluid with a viscosity of
  15 ... 150 cSt.
- Special version for hydraulic fluid with a viscosity of 100 ... 500 cSt.
- Special version for use in explosion protected areas.

Supply voltage
18 ... 30 V DC
Switching output:
NPN (or PNP)

Detailed documentation for all piston position indicators is available on request.

2. TECHNICAL SPECIFICATIONS

2.1. MODEL CODE

(also order example)

SK350 – 20 / 2212 U – 350 AAG – VA – 18 A – 1 – 050

Series

Nominal volume [l]

Material and piston code
Piston design type (see Point 1.3)

Piston material
1 = aluminium
2 = carbon steel
3 = stainless steel

Material of cylinder and end caps
1 = carbon steel
2 = carbon steel with surface protection
3 = stainless steel
6 = carbon steel (low temperature)

Material of seals including piston seals
2 = NBR / PTFE compound
5 = TT-NBR / PTFE compound (low temperature)
6 = FPM / PTFE compound
8 = NBR / PUR (polyurethane)
9 = special qualities

Certification code
U = PED 97/23/EC

Permitted operating pressure [bar]

Fluid connection
Type of connection (see Table 1)
Standard or specification of the type of connection (see Table 2 + 3)
Size of connection (see Table 4 + 5)

Gas side connection or gas valve
Type of connection (see Table 1)
Standard or specification of the type of connection (see Table 2 + 3)
(no letter for connection type V)
Size of connection (see Table 4; 5 + 6)

Piston diameter

04	= 40 mm	18	= 180 mm
05	= 50 mm	20	= 200 mm
06	= 60 mm	25	= 250 mm
08	= 80 mm	31	= 310 mm
10	= 100 mm	35	= 355 mm
12	= 125 mm	49	= 490 mm
15	= 150 mm		

Supplementary equipment*
A = electrical limit switch – 35 mm stroke
B = electrical limit switch – 200 mm stroke
C = electrical limit switch – 500 mm stroke
K = protruding piston rod
M = magnetic flap indication
S = cable tension measurement system
U = ultrasonic measurement system
E.. = special switch fixed or adjustable
P = magnetic piston
UP.. = piston position switch
(e.g. UP2 = 2 position switches, UPEX = Atex version)

Safety equipment*
1 = bursting disc (please give nominal pressure and temperature)
2 = gas safety valve
3 = temperature fuse

Pre-charge pressure p_0 [bar] at 20 °C*

*must be stated separately, if required!

Table 1, Connection type

Code letter	Description
A	Threaded connection (female)
B	Threaded connection (male)
F	Flange connection
H	Protruding flange
K	Combination connection / Special connection
V	Gas valve type

Table 2, Threaded connection: standard or specification

Code letter	Description
A	Thread to ISO 228 (BSP)
B	Thread to DIN 13 or ISO 965/1 (metric)
C	Thread to ANSI B1.1 (UN..-2B, seal SAE J 514)
D	Thread to ANSI B1.20.3 (NPTF)

Table 3, Flange connection: standard or specification

Code letter	Description
A	Flanges to DIN standards (pressure range + standard)
B	Flanges to ANSI B 16.5
C	SAE flange 3000 psi
D	SAE flange 6000 psi
E	High pressure block flange (Bosch-Rexroth) PN320
F	High pressure block flange (AVIT, HAVIT)

Table 4, Threaded model connection sizes

Type Tab.2	Code, size										
	A	B	C	D	E	F	G	H	J	K	L
A	G 1/8	G 1/4	G 3/8	G 1/2	G 3/4	G 1	G1 1/4	G1 1/2	G2	G2 1/2	G3
B	M10x1	M12x1.5	M14x1.5	M16x1.5	M18x1.5	M22x1.5	M27x2	M33x2	M42x2	M48x2	M60x2
C	5/16-24UNF	3/8-24UNF	7/16-20UNF	1/2-20UNF	9/16-18UNF	3/4-16UNF	7/8-14UNF	1 1/16-12UNF	1 3/16-12UNF	1 5/16-12UNF	1 5/8-12UNF
D	1/16-NPTF	1/8-NPTF	1/4-NPTF	3/8-NPTF	1/2-NPTF	3/4-NPTF	1-11 1/2 NPTF	1 1/4-11 1/2 NPTF	1 1/2-11 1/2 NPTF	2-11 1/2 NPTF	2 1/2 -NPTF

Table 5, Flange model connection sizes

Type Tab.3	Code, size										
	A	B	C	D	E	F	G	H	J	K	L
A	DN15	DN25	DN40	DN50	DN65	DN80	DN100	DN125	DN150	DN200	
B	1/2" - 1500#	1" - 1500#	1 1/2" - 1500#	2" - 1500#	2 1/2" - 1500#	3" - 1500#	1/2" - 2500#	1" - 2500#	1 1/2" - 2500#	2" - 2500#	2 1/2" - 2500#
C	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"
D							–	–	–	–	–
E	DN32	DN40	DN50	DN65	DN80	DN100	DN125	DN150	–	DN25	–
F											

Table 6, Gas valve models

Code letter	Description
A	Gas valve G3/4 male with M28x1.5/M8
B	Gas valve end connection M28x1.5/M8
C	Gas valve 1/2"-20 UNF male with M16x2 (ISO 10945)
D	Gas valve M14x1.5 male with external M16x1.5 (Minimess)
E	Gas valve G3/4 male with 7/8-14 UNF-VG8
F	Gas valve end connection M42x1.5/M12

2.1.1 **Nominal volume [l]**
See table at Point 3.1.

2.1.2 **Effective gas volume V_0 [l]**
These differ slightly from the nominal volume and form the basis of the calculations of the usable volume.

See Point 3.1.1.

2.1.3 **Effective volume ΔV [l]**
The volume (on the fluid side) between the working pressure p_2 and p_1.

2.1.4 **Permitted operating temperature (fluid)**
-10 °C ... +80 °C
263 K ... 353 K
Standard material, others on request

2.1.5 **Certificate codes**

Canada	S1 [2]
China	A9
EU member states	U [1]
Japan	P
Switzerland	U
USA	S
Others on request	

[1] Alternative certificates possible

[2] Approval required in the individual provinces

Note:
Application examples, accumulator sizing and extracts from approvals regulations on hydraulic accumulators can be found in the following catalogue section:

- Accumulators
  No. 3.000

3. DIMENSIONS

3.1. PISTON ACCUMULATOR

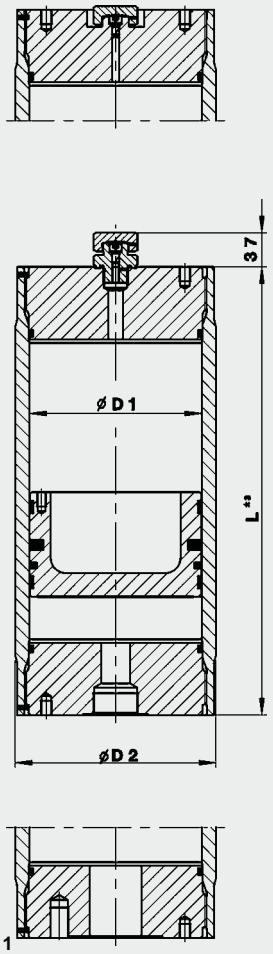


Diagram 1

Volume V min. - max. [l]	Series	Country code U = PED 97/23/EC					
		Permitted operating pressure [bar]	Ø D1 [mm]	Ø D2 [mm]	Length calculation [1] L = a + b x V		Weight [2] min. - max. [kg]
					a [mm]	b [mm]	
0.2 – 5	SK350	350	60	80	126	353.7	6 – 35
0.5 – 10	SK350	350	80	100	157	198.9	11 – 48
0.5 – 15	SK350	350	100	125	184	127.3	19 – 85
1 – 50	SK350	350	125	160	185	81.5	32 – 280
2.5 – 70	SK210	210	150	180	210	56.6	45 – 280
	SK350	350			234		49 – 283
2.5 – 100	SK210	210	180	210	262	39.3	70 – 346
	SK350	350		220			79 – 458
2.5 – 125	SK210	210	200	235	290	31.8	86 – 452
	SK350	350					
10 – 200	SK210	210	250	286	408	20.4	170 – 631
	SK350	350		300			200 – 860
25 – 400	SK350	350	310	350	462	13.2	390 – 1110
25 – 400	SK210	210	355	404	534	10.1	468 – 1338
	SK350	350		434			590 – 2048
200 – 650	SK210	210	490	580	700	5.3	1760 – 3180
	SK350	350					

[1] The lengths calculated are usually rounded up or down in 5 mm increments
[2] Intermediate sizes are possible, depending on the length/diameter required

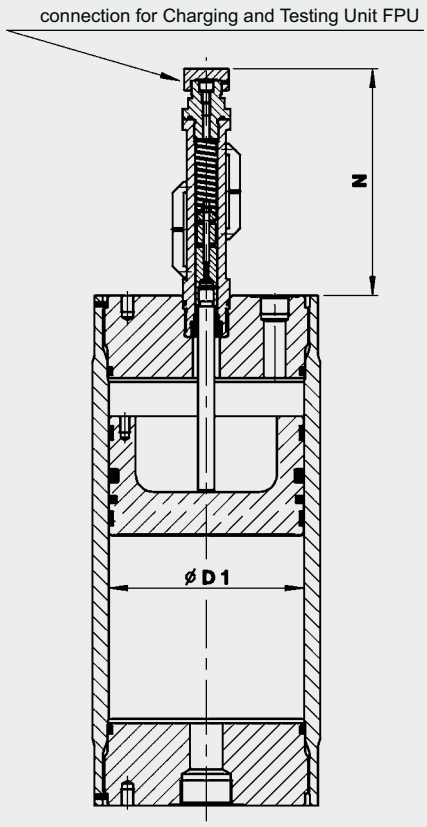
Other pressures, volumes, certificates etc possible on request.

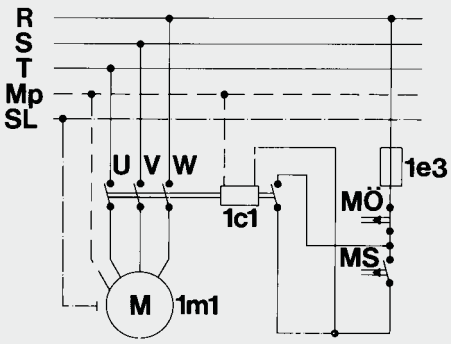
3.1.1 Effective gas volume V_0

The gas volume V is larger than the nominal volume given in the tables in Point 3.1 by the amount shown below.

Ø D1	Piston design type			
	1	2	3	4
[mm]	Δ [l]			
60	–	0.040	–	0.040
80	–	0.044	0.081	0.044
100	0.062	0.062	0.27	0.062
125	–	0.169	0.546	0.169
150	–	0.653	0.824	0.653
180	1.213	1.213	1.286	1.213
200	–	0.999	1.601	0.999
250	3.034	3.034	2.617	3.034
310	–	6.221	–	6.221
355	4.514	4.514	–	4.514
490	–	12.705	–	12.705

3.2. PISTON ACCUMULATOR WITH ELECTRICAL LIMIT SWITCH





1m1 = Motor
1c1 = Motor protection
1e3 = Control cut-out
Mö = Solenoid switch - N/C
Ms = Solenoid switch - N/O

Volume [2] [l]	Series	Country code U Ø D1 [mm]	Gas side connection [3] ISO228	Fluid side connection [4]	N A [mm]	N B [mm]	N C [mm]	Additional weight A [kg]	Additional weight B [kg]	Additional weight C [kg]
0.2	SK350	60 [1]								
0.5										
1										
0.5	SK350	80 [1]								
1										
2										
2.5	SK350	100	G 3/4 lateral	G 1	209	439	679	2.55	4.85	7.15
5										
7.5										
2	SK350	125						2.55	4.85	7.15
5										
15										
6	SK350	150	G 3/4	G 1 1/2				2.60	4.90	7.20
20										
40										
10	SK210	180	G 1					2.60	4.90	7.20
	SK350									
20	SK210									
	SK350									
50	SK210									
	SK350									
20	SK350	200	G 1					2.65	4.95	7.25
40										
100										
50	SK210	250	G 1 1/4	G 2				2.80	5.10	7.40
	SK350									
80	SK210									
	SK350									
120	SK210									
	SK350									
120	SK350	310	G 1 1/4	NW50				2.90	5.20	7.50
150										
200										
130	SK210	355	G 1 1/2					2.80	5.10	7.40
	SK350									
180	SK210									
	SK350									
250	SK210									
	SK350									
200	SK350	490	G 2					3.00	5.30	7.60
400										
600										

[1] Electrical limit switch is not possible for these piston sizes.
[2] Volume details are examples, for others see Point 3.1.
[3] Standard connection for back-up type, others on request
[4] Others on request
For further information, see Point 1.7.

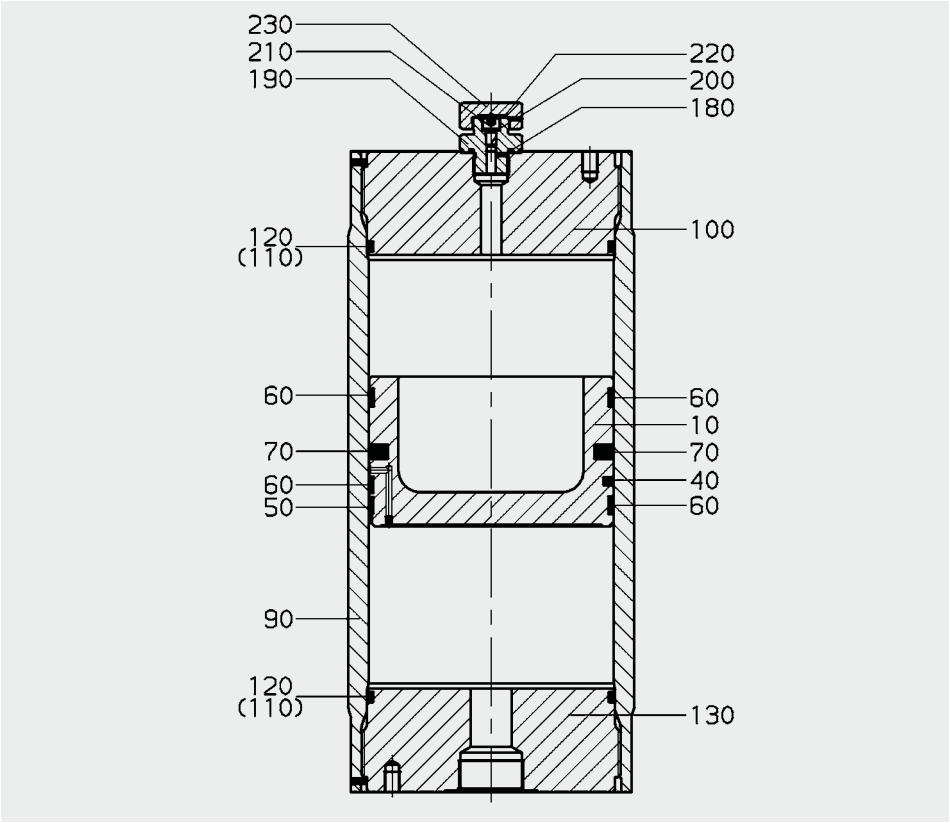
Table 7, Supplementary seal

Piston Ø [mm]	Type	NBR Part no.	Viton® Part no.
All dia-meters	1	00601078	00601109
	2		
	3		
	4	on request	

Note:
When ordering spare parts for the piston accumulator with electrical limit switch, the supplementary seal must be ordered in addition to the seal kit (Point 4).

4. SPARE PARTS

4.1. PISTON ACCUMULATOR



Piston assembly (Table 8)

Piston Ø [mm]	Piston	NBR Part no.	FPM Part no.	PUR Part no.
60	1	–	–	–
	2	03183495	–	–
	3	–	–	03009372
80	1	–	–	–
	2	03183496	03183497	–
	3	03016255	–	02119931
100	1	03128922	03128926	–
	2	03175476	03183117	–
	3	03016163	–	02115547
125	1	–	–	–
	2	03016232	03016253	–
	3	03016254	–	03016150
150	1	–	–	–
	2	03016228	03016229	–
	3	03016230	–	03016231
180	1	03141888	03182493	–
	2	02118451	02112535	–
	3	03046413	–	03046277
200	1	–	–	–
	2	03110811	03016215	–
	3	03016216	–	03016218
250	1	03128924	03128938	–
	2	00353980	00353981	–
	3	03009544	–	03016171
310	1	–	–	–
	2	03016195	03016197	–
	3	–	–	–
355	1	03128925	03128939	–
	2	00356382	00354079	–
	3	–	–	–
490	1	–	–	–
	2	03128989	03128990	–
	3	–	–	–

Seal kit, complete (Table 9)

Piston Ø [mm]	Piston	NBR Part no.	FPM Part no.	PUR Part no.
60	1	–	–	–
	2	03090507	–	–
	3	–	–	03016210
80	1	–	–	–
	2	03041573	03015745	–
	3	03090788	–	03013230
100	1	03128940	03128944	–
	2	00363268	00363269	–
	3	03010398	–	02123414
125	1	–	–	–
	2	03116665	03016234	–
	3	03090870	–	02128104
150	1	–	–	–
	2	03016235	03016237	–
	3	03016236	–	03007546
180	1	03128941	03128945	–
	2	00363270	00363271	–
	3	03010399	–	02123415
200	1	–	–	–
	2	03110810	03016242	–
	3	03016241	–	03113127
250	1	03128942	03128946	–
	2	00363266	00363267	–
	3	03010401	–	03016213
310	1	–	–	–
	2	03016200	03016201	–
	3	–	–	–
355	1	03128943	03128947	–
	2	00363272	00363273	–
	3	–	–	–
490	1	–	–	–
	2	03104100	03128991	–
	3	–	–	–

4.1.1 Piston type 1

Description	Qty.	Item
Piston assembly [1] consisting of:		
Piston	1	10
Seal ring	1	50
Guide ring	2	60
Centre seal	1	70
Complete seal kit consisting of:		
Seal ring	2	40
Centre seal	1	70
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

4.1.2 Piston type 2

Piston assembly [1] consisting of:		
Piston	1	10
Seal ring	1	40
Guide ring	2	60
Centre seal	1	70
Complete seal kit consisting of:		
Seal ring	1	40
Guide ring	2	60
Centre seal	1	70
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

4.1.3 Piston type 3

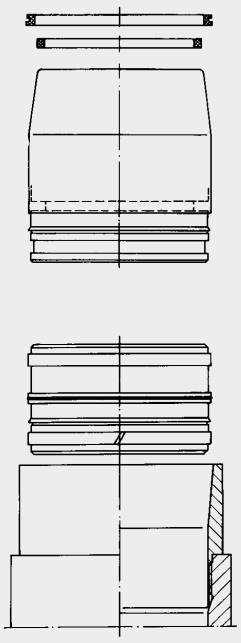
Piston assembly consisting of:		
Piston	1	10
Seal ring	1	70
Guide ring	1	60
Complete seal kit consisting of:		
Seal ring	1	70
Guide ring	1	60
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

[1] Item 120, 180, 200 and 220 are supplied loose.
Pressure resistant parts cannot be supplied as spares.

Spare parts for piston type 4 are available on request.

4.2. ASSEMBLY INSTRUCTIONS

Before assembling or disassembling a piston accumulator or piston accumulator station, the system must always be depressurised.
The gas and fluid side must be depressurised and the gas valve unscrewed or opened before the accumulator is disassembled. Before the end caps are removed, ensure that the piston is moving freely. This may be achieved by using a rod. Only authorised persons should repair piston accumulators where the piston is jammed.
Piston accumulators with internal diameters up to 250 mm are fitted with a securing pin. This pin is to prevent the end cap being removed incorrectly.
It must be taken out before removing the end cap.
There may be a risk of injury due to stray components.
All work must only be carried out by suitably trained staff.
On no account must any welding, soldering or mechanical work be carried out on the accumulator shell.
Please read the operating manual!
No. 3.301.CE



Assembly sleeves
for piston accumulators (Table 11)

Piston Ø [mm]	to fit the seals Type 1+2
60	00297430
80	00244991
100	00352198
125	00370734
150	02124157
180	00350148
200	03016276
250	00290035
310	02127304
355	00354147
490	3114220

Piston Ø [mm]	to mount the piston
60	02120188
80	00359614
100	00290056 (M105x2) 02117672 (M110x3)
125	02128223
150	02124161
180	00290049 (M186x3) 02122356 (M190x4)
200	03016284
250	00290046
310	02127305
355	00290985
490	03114219

When replacing seals and/or pistons, please read the Operating and Maintenance Instructions (No. 3.301.B).

5. NOTE

The information in this brochure relates to the operating conditions and applications described.

For applications and operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.

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