Fiable Hydraulics Pvt Ltd.

Hydraulic Professionals

Technical Information

Axial Piston Fixed Motors

A2FM Series

www.fiablehydraulics.in

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Size 5

Nominal pressure p_{nom} _____ 315 bar absolute

Maximum pressure p_{max} _____ 350 bar absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{su} 630 bar

Sizes 10 to 200

Nominal pressure p_{nom} _____ 400 bar absolute

Maximum pressure p_{max} _____ 450 bar absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{su} _ 700 bar

Sizes 250 to 1000

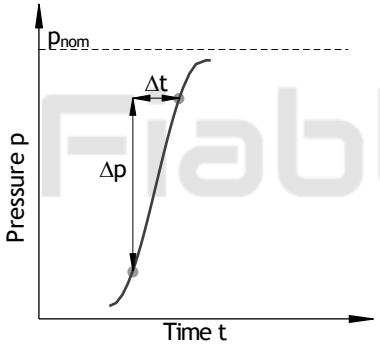
Nominal pressure p_{nom} _____ 350 bar absolute

Maximum pressure p_{max} _____ 400 bar absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{su} _ 700 bar

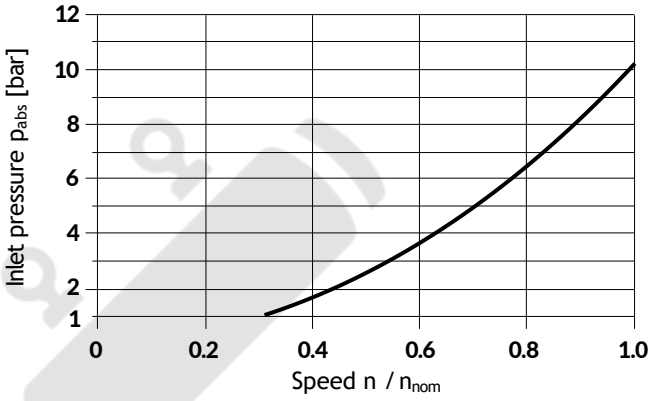
Minimum pressure (high-pressure side) _____25 bar absolute

Rate of pressure change $R_{A\ max}$
with integrated pressure-relief valve _____ 9000 bar/s
without pressure-relief valve _____ 16000 bar/s



Note
Values for other hydraulic fluids, please contact us.

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). The minimum pressure depends on the speed of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if these conditions cannot be satisfied.

Definition

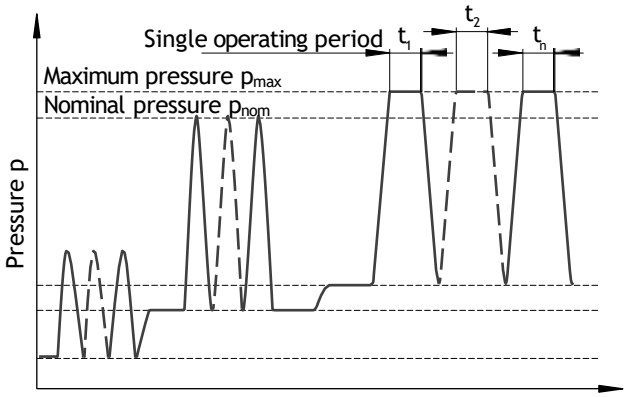
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.

Summation pressure p_{su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

Rate of pressure change R_A
Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.



Technical data

Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size	NG		5	10	12	16	23	28	32	45	56	63	80
Displacement geometric, per revolution	V_g	cm^3	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4
Speed maximum[1]	n_{nom}	rpm	10000	8000	8000	8000	6300	6300	6300	5600	5000	5000	4500
	n_{max}[2]	rpm	11000	8800	8800	8800	6900	6900	6900	6200	5500	5500	5000
Input flow[3]													
at n_{nom} and V_g	q_V	L/min	49	82	96	128	144	177	202	255	281	315	362
Torque[4]													
at V_g and Δp = 350 bar	T	Nm	24.7[5]	57	67	89	128	157	178	254	313	351	448
Δp = 400 bar	T	Nm	-	66	76	102	146	179	204	290	357	401	512
Rotary stiffness	c	kNm/rad	0.63	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94	6.25	8.73
Moment of inertia for rotary group	J_{GR}	kgm^2	0.00006	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072
Maximum angular acceleration	α	rad/s^2	5000	5000	5000	5000	6500	6500	6500	14600	7500	7500	6000
Case volume	V	L		0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55
Mass (approx.)	m	kg	2.5	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18	18	23

Size	NG		90	107	125	160	180	200	250	355	500	710	1000
Displacement geometric, per revolution	V_g	cm^3	90	106.7	125	160.4	180	200	250	355	500	710	1000
Speed maximum[1]	n_{nom}	rpm	4500	4000	4000	3600	3600	2750	2700	2240	2000	1600	1600
	n_{max}[2]	rpm	5000	4400	4400	4000	4000	3000	-	-	-	-	-
Input flow[3]													
at n_{nom} and V_g	q_V	L/min	405	427	500	577	648	550	675	795	1000	1136	1600
Torque[4]													
at V_g and Δp = 350 bar	T	Nm	501	594	696	893	1003	1114	1393	1978	2785	3955	5570
Δp = 400 bar	T	Nm	573	679	796	1021	1146	1273	-	-	-	-	-
Rotary stiffness	c	kNm/rad	9.14	11.2	11.9	17.4	18.2	57.3	73.1	96.1	144	270	324
Moment of inertia for rotary group	J_{GR}	kgm^2	0.0072	0.0116	0.0116	0.0220	0.0220	0.0353	0.061	0.102	0.178	0.55	0.55
Maximum angular acceleration	α	rad/s^2	6000	4500	4500	3500	3500	11000	10000	8300	5500	4300	4500
Case volume	V	L	0.55	0.8	0.8	1.1	1.1	2.7	2.5	3.5	4.2	8	8
Mass (approx.)	m	kg	23	32	32	45	45	66	73	110	155	325	336

1) The values are valid:
   - for the optimum viscosity range from ν_{opt} = 36 to 16 mm^2/s
   - with hydraulic fluid based on mineral oils
2) Intermittent maximum speed: overspeed for unload and overhauling processes, t < 5 s and Δp < 150 bar
3) Restriction of input flow with counterbalance valve, see page 39
4) Torque without radial force, with radial force see page 8
5) Torque at Δp = 315 bar

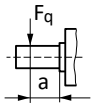
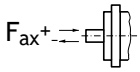
Note

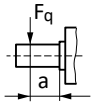
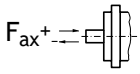
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible start up angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

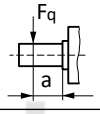
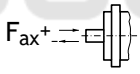
Technical data

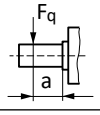
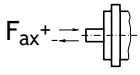
Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	NG		5	5[3]	10	10	12	12	16	23	23
Drive shaft	ø	mm	12	12	20	25	20	25	25	25	30
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	1.6	1.6	3.0	3.2	3.0	3.2	3.2	5.7	5.4
	a	mm	12	12	16	16	16	16	16	16	16
with permissible torque	T_{max}	Nm	24.7	24.7	66	66	76	76	102	146	146
≙ permissible pressure Δp	Δp_{perm}	bar	315	315	400	400	400	400	400	400	400
Maximum axial force[2] 	$+F_{ax\ max}$	N	180	180	320	320	320	320	320	500	500
	$-F_{ax\ max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	1.5	1.5	3.0	3.0	3.0	3.0	3.0	5.2	5.2

Size	NG		28	28	32	45	56	56[4]	56	63	80
Drive shaft	ø	mm	25	30	30	30	30	30	35	35	35
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	5.7	5.4	5.4	7.6	9.5	7.8	9.1	9.1	11.6
	a	mm	16	16	16	18	18	18	18	18	20
with permissible torque	T_{max}	Nm	179	179	204	290	357	294	357	401	512
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	400	330	400	400	400
Maximum axial force[2] 	$+F_{ax\ max}$	N	500	500	500	630	800	800	800	800	1000
	$-F_{ax\ max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7	8.7	10.6

Size	NG		80[4]	80	90	107	107	125	160	160	180
Drive shaft	ø	mm	35	40	40	40	45	45	45	50	50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	11.1	11.4	11.4	13.6	14.1	14.1	18.1	18.3	18.3
	a	mm	20	20	20	20	20	20	25	25	25
with permissible torque	T_{max}	Nm	488	512	573	679	679	796	1021	1021	1146
≙ permissible pressure Δp	Δp_{perm}	bar	380	400	400	400	400	400	400	400	400
Maximum axial force[2] 	$+F_{ax\ max}$	N	1000	1000	1000	1250	1250	1250	1600	1600	1600
	$-F_{ax\ max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	10.6	10.6	10.6	12.9	12.9	12.9	16.7	16.7	16.7

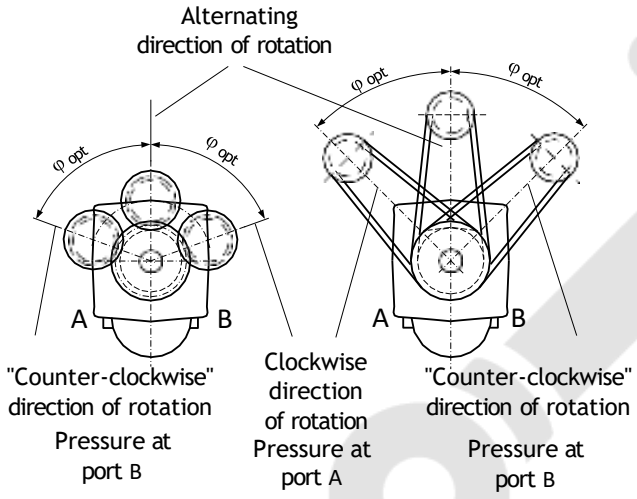
Size	NG		200	250	355	500	710	1000
Drive shaft	ø	mm	50	50	60	70	90	90
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	20.3	1.2[6]	1.5[6]	1.9[6]	3.0[6]	2.6[6]
	a	mm	25	41	52.5	52.5	67.5	67.5
with permissible torque	T_{max}	Nm	1273	[5]	[5]	[5]	[5]	[5]
≙ permissible pressure Δp	Δp_{perm}	bar	400	[5]	[5]	[5]	[5]	[5]
Maximum axial force[2] 	$+F_{ax\ max}$	N	1600	2000	2500	3000	4400	4400
	$-F_{ax\ max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	16.7	[5]	[5]	[5]	[5]	[5]

Technical data

Effect of radial force F_q on the service life of bearings

By selecting a suitable direction of radial force F_q, the load on the bearings, caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

	Toothed gear drive	V-belt output
NG	φ_{opt}	φ_{opt}
5 to 180	± 70°	± 45°
200 to 1000	± 45°	± 70°



Determining the operating characteristics

Input flow $q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g}$ [min^{-1}]

Torque $T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$ [Nm]

Power $P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [kW]

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Speed sensors

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

The versions A2FM...U and A2FM...F ("prepared for speed sensor", i.e. without sensor) is equipped with a toothed ring on the rotary group.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

With the DSA or HDD speed sensor mounted a signal proportional to motor speed can be generated.
The sensors measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

DSA _____ RE 95133

HDD _____ RE 35135

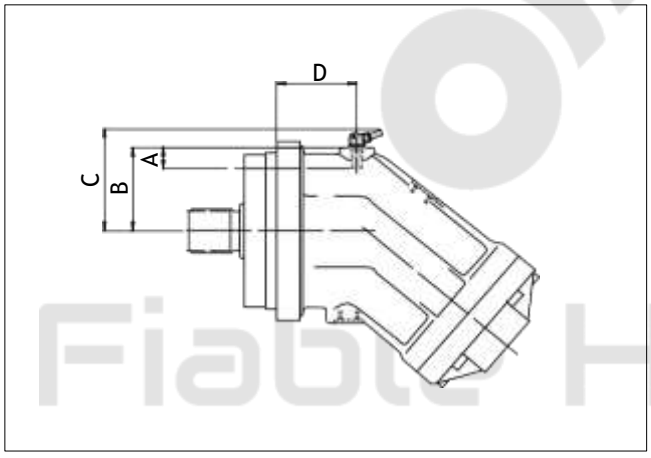
The sensor is mounted at the specially provided port D as follows:

DSA _____with one mounting bolt

HDD _____with two mounting bolts

We recommend ordering the A2FM fixed motor complete with sensor mounted.

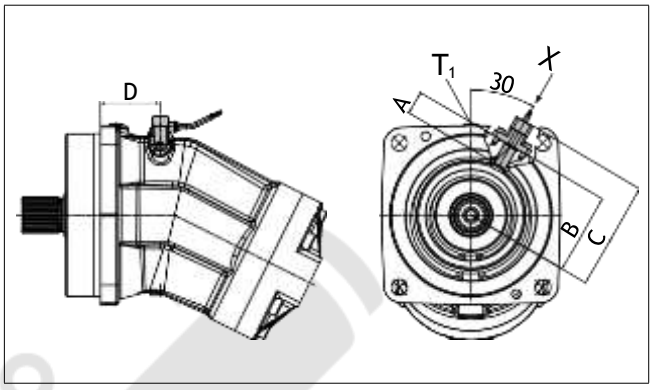
Version "V"
Sizes 23 to 200 with DSA sensor



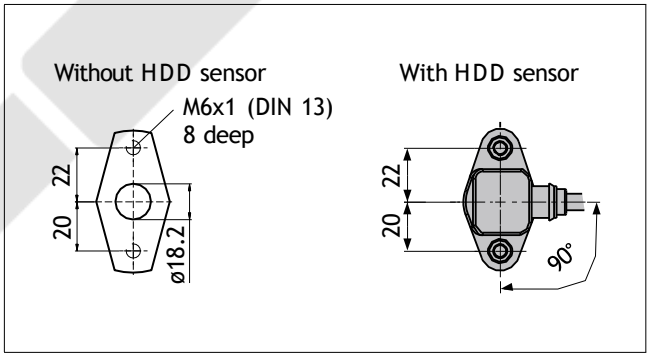
Version "V"
Sizes 250 to 500 with DSA sensor

On request

Version "H"
Sizes 250 to 500 with HDD sensor



View X



Speed sensors

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Size			23, 28, 32	45	56, 63	80, 90	107, 125
Number of teeth			38	45	47	53	59
DSA	A	Insertion depth (tolerance ± 0.1)	18.4	18.4	18.4	18.4	18.4
	B	Contact surface	57.9	64.9	69.9	74.9	79.9
	C		74.5	81.5	86.5	91.5	96.5
	D		54.7	54.3	61.5	72.5	76.8

Size			160, 180	200	250	355	500
Number of teeth			67	80	78	90	99
HDD	A	Insertion depth (tolerance ± 0.1)	-	-	32	32	32
	B	Contact surface	-	-	110.5	122.5	132.5
	C		-	-	149	161	171
	D		-	-	82	93	113
DSA	A	Insertion depth (tolerance ± 0.1)	18.4	18.4	32	32	32
	B	Contact surface	87.4	100.9	-	-	-
	C		104	117.5	-	-	-
	D		86.8	97.5			

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

Particularly in the installation position "drive shaft upwards" filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the motor housing must be directed to the reservoir via the highest available drain port (T_1, T_2).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 8.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

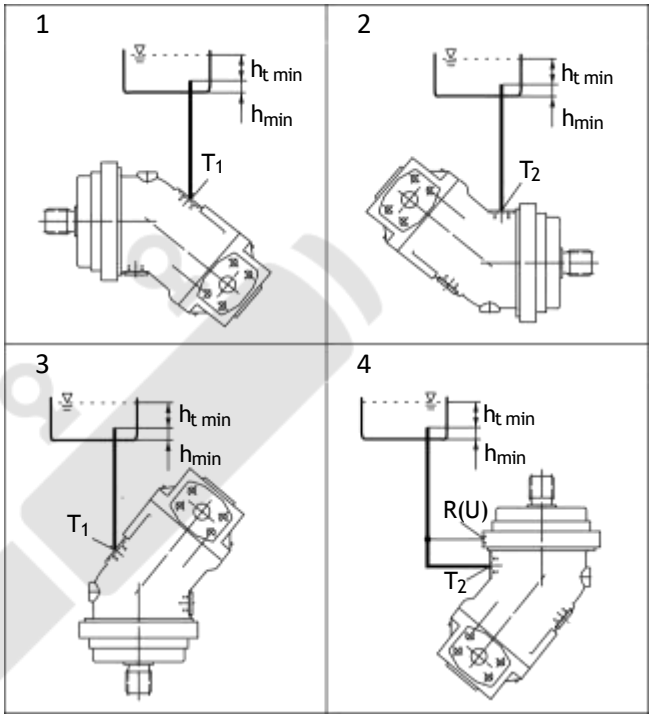
Note
With sizes 10 to 200 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering - special version). With sizes 250 to 1000, port U is provided as standard in the area near the bearings for air bleeding.

Installation position	Air bleed	Filling
1	-	T_1
2	-	T_2
3	-	T_1
4	R (U)	T_2
5	L_1	T_1 (L_1)
6	L_1	T_2 (L_1)
7	L_1	T_1 (L_1)
8	R (U)	T_2 (L_1)

L_1	Filling / air bleed
R	Air bleed port (special version)
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

Below-reservoir installation (standard)

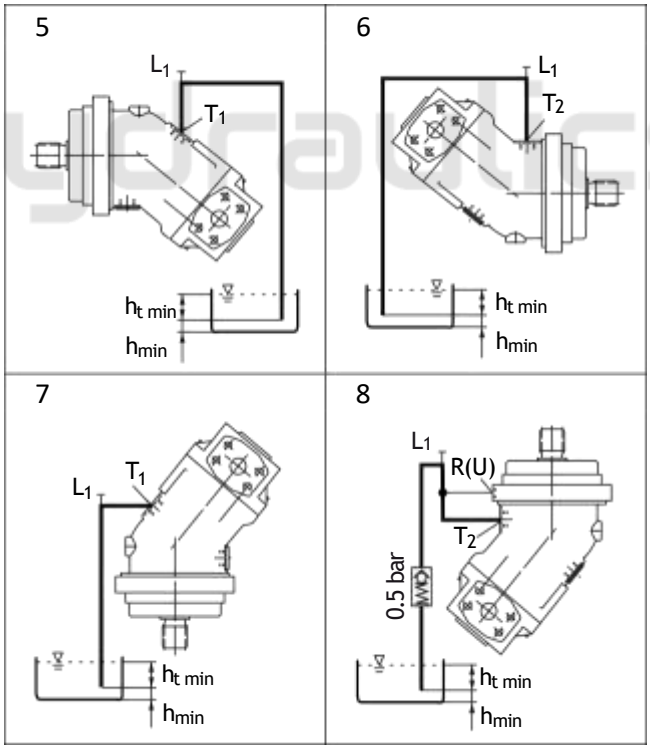
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

Recommendation for installation position 8 (drive shaft upward): A check valve in the drain line (cracking pressure 0.5 bar) can prevent draining of the motor housing.



General instructions

- The motor A2FM is designed to be used in open and closed circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instructions regarding tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
  - Female threads in the axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the female threads and must not be exceeded. For values, see the following table.
  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\ max}$	Required tightening torque of the threaded plugs M [1)] $_V$	WAF hexagon socket of the threaded plugs
DIN 3852[1)]	M10 x 1	30 Nm	15 Nm[2)]	5 mm
	M12 x 1.5	50 Nm	25 Nm[2)]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M20 x 1.5	170 Nm	80 Nm	10 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M30 x 2	420 Nm	215 Nm	17 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm
DIN ISO 228	G 1/4	40 Nm	-	-

1) The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.
2) In the "lightly oiled" state, the M_V is reduced to 10 Nm for M10 x 1 and 17 Nm for M12 x 1.5.

Products we offer:

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- Hydraulic Valves
- Hydraulic Pumps
- Hydraulic Motors
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Fiable Hydraulics

About Us :

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