Axial piston fixed motor
A2FM series 70

Americas

RE-A 91071
Edition: 12.2015
Replaces 05.2015

- A2FMN (Sizes 56 to 107):
  Nominal pressure 4350 psi (300 bar)
  Maximum pressure 5100 psi (350 bar)
- A2FMM (Sizes 45 to 90):
  Nominal pressure 5800 psi (400 bar)
  Maximum pressure 6500 psi (450 bar)
- A2FMH (Sizes 45 to 90):
  Nominal pressure 6500 psi (450 bar)
  Maximum pressure 7250 psi (500 bar)

Features

- Fixed motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- For use in mobile and stationary applications
- Design with SAE mounting flange and UNF resp. UNC-threads
- Also available as plug-in version and with metric threads
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure side and the low-pressure side.
- Finely graduated sizes permit far-reaching adaptation to the drive concerned
- High power density
- Small dimensions – compact design
- High total efficiency
- Good starting efficiency
- Integrated flushing valve optional

Contents

Ordering code

01	02	03	04		05	06	07	08	09	10	11	12	13	14		15
A2F	**M**			**/**	**70**	**A**	**W**	**V**						**0**	–	

Axial piston unit

01	Bent-axis design, fixed displacement	**A2F**

Operating mode

02	Motor, standard version	**M**

Pressure range		045	056	063	080	090	107	
03	Nominal pressure: 4350 psi (300 bar) Maximum pressure: 5100 psi (350 bar)	○	○	○	○	●	●	**N**
	Nominal pressure: 5800 psi (400 bar) Maximum pressure: 6500 psi (450 bar)	○	○	○	●	●	○	**M**
	Nominal pressure: 6500 psi (450 bar) Maximum pressure: 7250 psi (500 bar)	○	○	○	●	●	○	**H**

Size (NG)

04	Geometric displacement, see technical data on page 7	**045**	**056**	**063**	**080**	**090**	**107**	

Series

05	Series 7, index 0	**70**

Design of ports and fastening threads

06	ANSI (USA)	**A**

Direction of rotation

07	Viewed on drive shaft, bidirectional	**W**

Sealing material

08	FKM (fluoroelastomer)	**V**

Mounting flange			045	056	063	080	090	107	
09	SAE J744	127-4	●	●	●	●	●	●[1]	**C4**

Drive shaft			045	056	063	080	090	107	
10	Splined shaft SAE J744 (ANSI B92.1a)	1 3/8 in 21T 16/32 DP	–	●	●	●	●[2]	●	**V8**
		1 1/4 in 14T 12/24 DP	●	●[2]	●[2]	●[2]	●[2]	●	**S7**
	Parallel keyed shaft DIN 6885	ø 30	●	●	–	–	–	–	**P6**
		ø 35	–	●	●	●	–	–	**P8**
		ø 40	–	–	–	●	●	●	**P9**

Port for working lines		045	056	063	080	090	107	
11	SAE flange ports A and B, bottom	●	●	●	●	●	●	**11**
	SAE flange ports A and B at side, opposite	●	●	●	●	●	●	**02**
	Threaded ports A and B at side, opposite	○	○	○	–	–	–	**05**

Valves				045	056	063	080	090	107	
12	Without valves			●	●	●	●	●	●	**0**
	Integrated flushing and boost-pressure valve Flushing flow when: $\Delta p = p_{ND} - p_G$ = 365 psi (25 bar) and ν = 60 SUS (10 mm²/s)	**Flushing flow [gpm (l/min)] /** Orifice-ø [inches (mm)]	**0.69 (2.6)** / 0.04 (1.0)	●	●	●	●	●	●	**C**
			1.58 (6.0) / 0.06 (1.5)	●	●	●	●	●	●	**E**
			1.95 (7.4) / 0.067 (1.7)	●	●	●	●	●	●	**F**
			2.45 (8.5) / 0.071 (1.8)	●	●	●	●	●	●	**G**
			3.01 (11.4) / 0.09 (2.3)	●	●	●	●	●	●	**I**
			3.30 (12.5) / 0.12 (3)	●	●	●	●	●	●	**J**

● = Available ○ = On request – = Not available

1) Only available for A2FMN (pressure range 300 to 350 bar)
2) Not available for A2FMH (pressure range 450 to 500 bar)

01	02	03	04		05	06	07	08	09	10	11	12	13	14		15
A2F	**M**			**/**	**70**	**A**	**W**	**V**						**0**	–	

Speed sensor

13	Without speed sensor	**0**
	Prepared for DSA sensor	**A**
	Speed sensor DSA mounted	**B**
	Prepared for DSM sensor	**N**
	Speed sensor DSM mounted	**M**

Special version

14	Standard version	**0**
	Special version for slew drives	**J**
	Long-life bearing[3)]	**L**

Standard / special version

15	Standard version	**0**
	Standard version with installation variants, e. g. T ports contrary to standard open or closed	**Y**
	Special version	**S**

Information

▶ Note the project planning notes on page 16

3) Type code version “L” not available in combination with A2FMH since in the case of pressure range “H” the long-life bearing is already included in the standard version (type code designation “0”).

Hydraulic fluids

The fixed motor A2FM is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90223: Fire-resistant, water-containing hydraulic fluids (HFAE, HFAS, HFB, HFC)

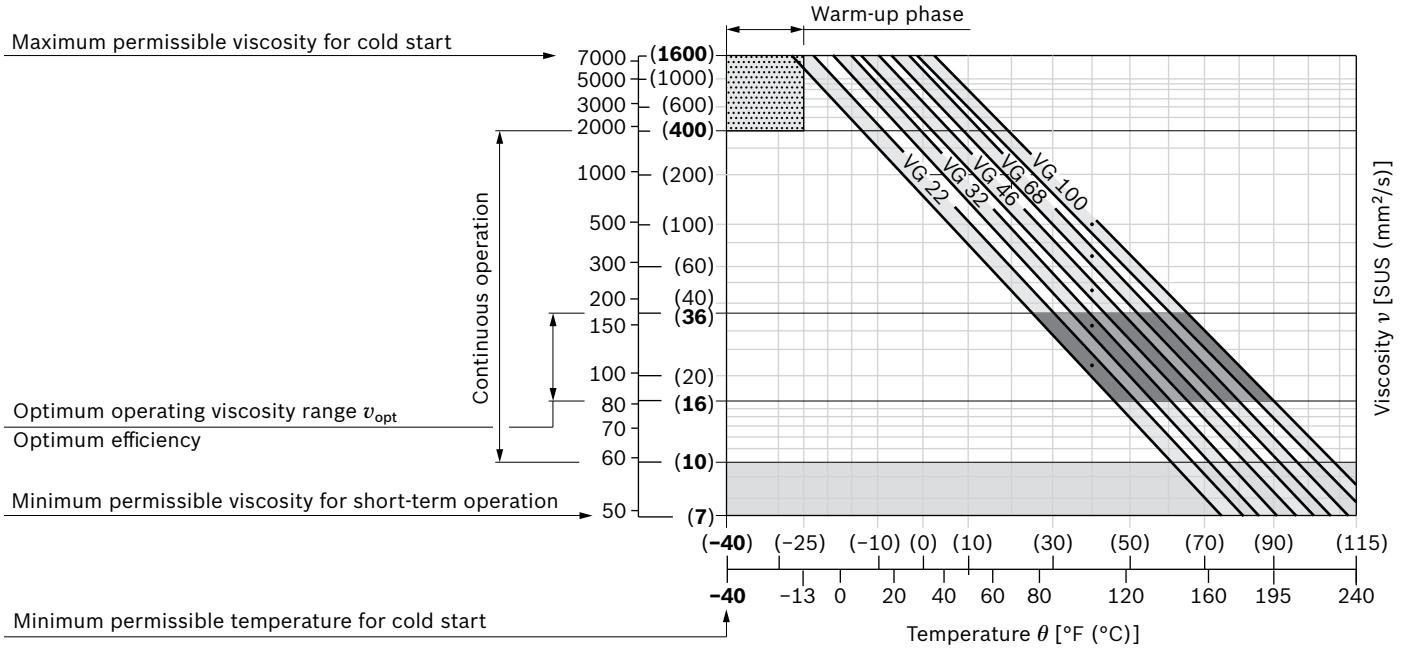
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (v_{opt}, see selection diagram).

Note
At no point of the component may the temperature be higher than +240 °F (+115 °C). The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, we recommend the use of a flushing and boost pressure valve (see page 12).

Viscosity and temperature of hydraulic fluids

	Viscosity		Temperature		Comment	
Cold start	v_{max} ≤	7400 SUS	θ_{St} ≥	−40 °F	t ≤ 3 min, n ≤ 1000 rpm	without load p ≤ 725 psi
		1600 mm²/s		−40 °C		without load p ≤ 50 bar
Permissible temperature difference			ΔT ≤	25 K	between axial piston unit and hydraulic fluid in the system	
Warm-up phase	v <	7400 to 1850 SUS	θ =	−40 °F to −13 °F	At p ≤ 0.7 × p_{nom}, n ≤ 0.5 × n_{nom} and t ≤ 15 min	
		1600 to 400 mm²/s		−40 °C to −25 °C		
Continuous operation	v =	1850 to 59 SUS			This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)	
		400 to 10 mm²/s				
			θ =	−13 °F to +217 °F	measured at port **T**	
				−25 °C to +103 °C	Note the permissible temperature range of the shaft seal (ΔT = approx. 12 K between the bearing/shaft seal and port **T**)	
	v_{opt} =	170 to 81 SUS			Range of optimum operating viscosity and efficiency	
		36 to 16 mm²/s				
Short-term operation	v_{min} ≥	49 SUS			t < 3 min, p < 0.3 × p_{nom}	
		7 mm²/s				

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit. A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures 195 °F to maximum 217 °F (90 °C to maximum 103 °C, measured at port **T**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Flow direction

Direction of rotation, viewed on drive shaft	
clockwise	counter-clockwise
A to **B**	**B** to **A**

Shaft seal

Permissible pressure loading

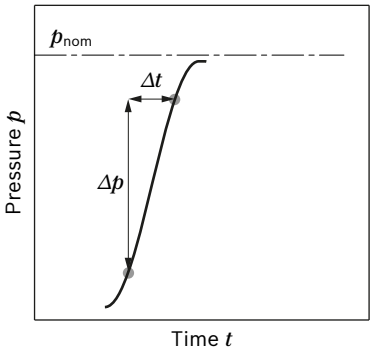
The service life of the shaft seal is influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). The mean differential pressure of 30 psi (2 bar) between the housing and the ambient pressure may not be exceeded for long durations at normal operating temperature. Momentary pressure peaks (t < 0.1 s) up to 145 psi (10 bar) are permitted. The service life of the shaft seal decreases with increasing frequency of pressure spikes and increasing mean differential pressure. The case pressure must be equal to or higher than the ambient pressure.

The FKM shaft seal may be used for leakage temperatures from −13 °F to +240 °F (−25 °C to +115 °C). For application cases below −13 °F (−25 °C), an NBR shaft seal is required (permissible temperature range: −40 °F to +195 °F (−40 °C to +90 °C)).

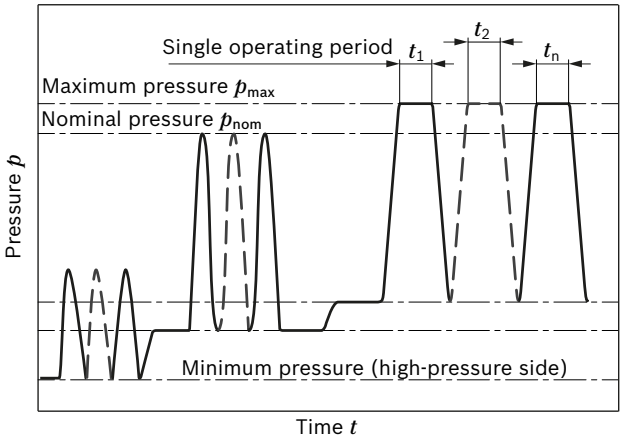
Working pressure range

Pressure at working ports A or B			Definition
Nominal pressure p_{nom}	A2FMN	4350 psi (300 bar) absolute	The nominal pressure corresponds to the maximum design pressure.
	A2FMM	5800 psi (400 bar) absolute	
	A2FMH	6500 psi (450 bar) absolute	
Maximum pressure p_{max}	A2FMN	5100 psi (350 bar) absolute	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
	A2FMM	6500 psi (450 bar) absolute	
	A2FMH	7250 psi (500 bar) absolute	
Single operating period		10 s	
Total operating period		300 h	
Minimum pressure (high-pressure side)		365 psi (25 bar) absolute	Minimum pressure at the high-pressure side (**A** or **B**) required to prevent damage to the axial piston unit.
Minimum pressure – pump operating mode (inlet)		See characteristic	To prevent damage to the axial piston motor in pump mode (change of high-pressure side with unchanged direction of rotation, e.g. when braking), a minimum pressure must be guaranteed at the working port (inlet). The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Total pressure p_{Su} (pressure **A** + pressure **B**)		10150 psi (700 bar)	The summation pressure is the sum of the pressures at both work ports (**A** and **B**).
Rate of pressure change $R_{A\,max}$			Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
with built-in pressure relief valve		130530 psi/s (9000 bar/s)	
without pressure relief valve		232060 psi/s (16000 bar/s)	

▼ **Rate of pressure change $R_{A\,max}$**

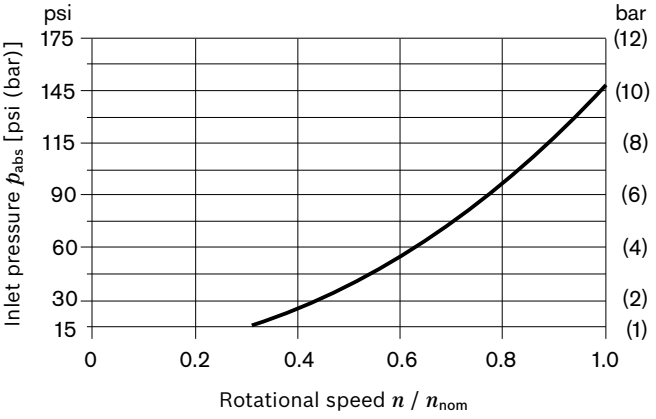


▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

▼ **Minimum pressure – pump operating mode (inlet)**



This diagram is only valid for the optimum viscosity range of ν_{opt} = 170 to 73 SUS (36 to 16 mm²/s).
Please contact us if these conditions cannot be satisfied.

Note
Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

A2FMN

Size	NG		56	63	80	90	107
Displacement geometric, per revolution	V_g	in³ (cm³)	3.45 (56.6)	3.84 (63.0)	4.99 (81.7)	5.52 (90.5)	6.64 (108.8)
Maximum rotational speed[1]	n_{nom}	rpm	3750	3750	3375	3375	3000
	n_{max}[2]	rpm	4125	4125	3700	3700	3300
Inlet flow	$q_{v\,max}$	gpm (l/min)	55.46 (210)	62.32 (236)	97.7 (370)	71.3 (270)	84.8 (321)
Torque[3] at Δp = 4350 psi (300 bar)	T	lb-ft (Nm)	199 (270)	222 (301)	288 (390)	319 (432)	383 (519)
Rotary stiffness	c_{min}	klb-ft/rad (kNm/rad)	4.96 (6.83)	5.87 (8.09)	5.76 (7.94)	7.14 (9.84)	7.91 (10.9)
Moment of inertia for rotary group	J_{GR}	lb-ft² (kgm²)	0.076 (0.0032)	0.076 (0.0032)	0.081 (0.0034)	0.128 (0.0054)	0.145 (0.0061)
Maximum angular acceleration	α	rad/s²	10000	12200	19800	4500	6000
Case volume	V	gal (l)	0.16 (0.6)	0.16 (0.6)	0.16 (0.6)	0.17 (0.65)	0.17 (0.65)
Weight approx.	m	lbs (kg)	37.5 (17)	37.5 (17)	37.5 (17)	50.7 (23)	50.7 (23)

A2FMM

Size	NG		45	56	63	80	90
Displacement geometric, per revolution	V_g	in³ (cm³)	2.74 (44.9)	3.45 (56.6)	3.84 (63.0)	4.87 (79.8)	5.52 (90.5)
Maximum rotational speed[1]	n_{nom}	rpm	5000	5000	5000	4500	4500
	n_{max}[2]	rpm	5500	5500	5500	5000	5000
Inlet flow	$q_{v\,max}$	gpm (l/min)	59.4 (225)	73.9 (280)	83.2 (315)	95.1 (360)	107.0 (405)
Torque[3] at Δp = 5800 psi (400 bar)	T	lb-ft (Nm)	211 (286)	266 (360)	296 (401)	375 (508)	423 (576)
Rotary stiffness	c_{min}	klb-ft/rad (kNm/rad)	3.28 (4.52)	4.96 (6.83)	5.78 (8.09)	6.60 (9.09)	7.14 (9.84)
Moment of inertia for rotary group	J_{GR}	lb-ft² (kgm²)	0.076 (0.0032)	0.076 (0.0032)	0.076 (0.0032)	0.0058	0.128 (0.0054)
Maximum angular acceleration	α	rad/s²	5400	9000	11100	4500	4500
Case volume	V	gal (l)	0.16 (0.6)	0.16 (0.6)	0.16 (0.6)	0.17 (0.65)	0.17 (0.65)
Weight approx.	m	lbs (kg)	37.5 (17)	37.5 (17)	37.5 (17)	50.7 (23)	50.7 (23)

A2FMH

Size	NG		45	56	63	80	90
Displacement geometric, per revolution	V_g	in³ (cm³)	2.74 (44.9)	3.45 (56.6)	3.84 (63.0)	4.87 (79.8)	5.52 (90.5)
Maximum rotational speed[1]	n_{nom}	rpm	5000	5000	5000	4500	4500
	n_{max}[2]	rpm	5500	5500	5500	5000	5000
Inlet flow	$q_{v\,max}$	gpm (l/min)	59.4 (225)	73.9 (280)	83.2 (315)	95.1 (360)	107.0 (405)
Torque[3] at Δp = 6500 psi (450 bar)	T	lb-ft (Nm)	211 (286)	266 (360)	296 (401)	421 (571)	478 (648)
Rotary stiffness	c_{min}	klb-ft/rad (kNm/rad)	3.28 (4.52)	4.96 (6.83)	5.78 (8.09)	6.60 (9.09)	7.14 (9.84)
Moment of inertia for rotary group	J_{GR}	lb-ft² (kgm²)	0.076 (0.0032)	0.076 (0.0032)	0.076 (0.0032)	0.138 (0.0058)	0.128 (0.0054)
Maximum angular acceleration	α	rad/s²	5400	9000	11100	4500	4500
Case volume	V	gal (l)	0.16 (0.6)	0.16 (0.6)	0.16 (0.6)	0.17 (0.65)	0.17 (0.65)
Weight approx.	m	lbs (kg)	37.5 (17)	37.5 (17)	37.5 (17)	50.7 (23)	50.7 (23)

Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm.

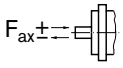
1) The valid values (observing the maximum permissible flow):
   – for the optimum viscosity range from v_{opt} = 170 to 74 SUS (36 to 16 mm²/s)
   – with hydraulic fluid based on mineral oil

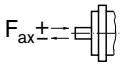
2) Intermittent maximum speed: Overspeed for unload and overhauling processes, t < 5 s and Δp < 2200 psi (150 bar)

3) Torque without radial force, with radial force see page 8

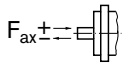
Permissible radial and axial forces of the drive shafts

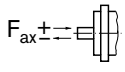
A2FMN

Size		NG			56	56	56	56	63	63	63	80	80
Drive shaft	type code				P6	P8	S7	V8	P8	S7	V8	P8	P9
	with splined shaft	ø		in	–	–	1 1/4	1 3/8	–	1 1/4	1 3/8	–	–
	with parallel keyed shaft	ø		in	1.18	1.38	–	–	1.38	–	–	1.38	1.57
				mm	30	35	–	–	35	–	–	35	40
Maximum radial force[1] at distance a (from shaft collar) 		$F_{q\,max}$		lbf	1371	1371	1506	1371	1551	1709	1709	1956	1709
				kN	6.1	6.1	6.7	6.1	6.9	7.6	7.6	8.7	7.6
		a		in	0.71	0.71	0.94	0.94	0.71	0.94	0.94	0.71	0.71
				mm	18	18	24	24	18	24	24	18	18
Maximum torque at $F_{q\,max}$		$T_{q\,max}$		lb-ft	197	197	197	197	222	222	222	282	282
				Nm	267	267	267	267	301	301	301	382	382
Maximum differential pressure at $F_{q\,max}$		$\Delta p_{q\,max}$		psi	4350	4350	4350	4350	4350	4350	4350	4350	4350
				bar	300	300	300	300	300	300	300	300	300
Maximum axial force at standstill or pressure-free operation 		+ $F_{ax\,max}$		lbf/N	0	0	0	0	0	0	0	0	0
		– $F_{ax\,max}$		lbf	180	180	180	180	180	180	180	180	180
				N	800	800	800	800	800	800	800	800	800
Permissible axial force per bar working pressure		+ $F_{ax\,perm}$/bar		lbf/psi	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
				N/bar	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7

Size		NG			80	80	90	90	90	107	107	107
Drive shaft	type code				S7	V8	P9	S7	V8	P9	S7	V8
	with splined shaft	ø		in	1 1/4	1 3/8	–	1 1/4	1 3/8	–	1 1/4	1 3/8
	with parallel keyed shaft	ø		in	–	–	1.57	–	–	1.57	–	–
				mm	–	–	40	–	–	40	–	–
Maximum radial force[1] at distance a (from shaft collar) 		$F_{q\,max}$		lbf	2136	1978	2203	2113	2203	2338	2113	2675
				kN	9.5	8.8	9.8	9.4	9.8	10.4	9.4	11.9
		a		in	0.94	0.94	0.79	0.94	0.94	0.79	0.94	0.94
				mm	24	24	20	24	24	20	24	24
Maximum torque at $F_{q\,max}$		$T_{q\,max}$		lb-ft	218	282	317	274	317	382	274	382
				Nm	376	382	430	372	430	519	372	519
Maximum differential pressure at $F_{q\,max}$		$\Delta p_{q\,max}$		psi	4280	4350	4350	3770	4350	4350	3120	4350
				bar	295	300	300	260	300	300	215	300
Maximum axial force at standstill or pressure-free operation 		+ $F_{ax\,max}$		lbf/N	0	0	0	0	0	0	0	0
		– $F_{ax\,max}$		lbf	180	180	225	225	225	225	225	225
				N	800	800	1000	1000	1000	1000	1000	1000
Permissible axial force per bar working pressure		+ $F_{ax\,perm}$/bar		lbf/psi	0.13	0.13	0.16	0.16	0.16	0.16	0.16	0.16
				N/bar	8.7	8.7	10.6	10.6	10.6	10.6	10.6	10.6

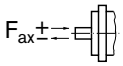
A2FMM

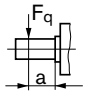
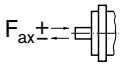
Size		**NG**		**45**	**45**	**56**	**56**	**56**	**56**	**63**	**63**	**63**
Drive shaft	type code			P6	S7	P6	P8	S7	V8	P8	S7	V8
	with splined shaft	ø	in	–	1 1/4	–	–	1 1/4	1 3/8	–	1 1/4	1 3/8
			mm	–	–	–	–	–	–	–	–	–
	with parallel keyed shaft	ø	in	1.18	–	1.18	1.38	–	–	1.38	–	–
			mm	30	–	30	35	–	–	35	–	–
Maximum radial force[1] at distance a (from shaft collar) 		$F_{q\ max}$	lbf	1709	1619	2136	1821	2023	1844	2068	2136	2068
			kN	7.6	7.2	9.5	8.1	9	8.2	9.2	9.5	9.2
		a	in	0.71	0.94	0.71	0.71	0.94	0.94	0.71	0.94	0.94
			mm	18	24	18	18	24	24	18	24	24
Maximum torque at $F_{q\ max}$		$T_{q\ max}$	lb-ft	211	211	263	263	263	263	296	277	296
			Nm	286	286	357	357	357	357	401	376	401
Maximum differential pressure at $F_{q\ max}$		$\Delta p_{\ q\ max}$	psi	5800	5800	5800	5800	5800	5800	5800	5440	5800
			bar	400	400	400	400	400	400	400	375	400
Maximum axial force at standstill or pressure-free operation 		+ $F_{ax\ max}$	lbf/N	0	0	0	0	0	0	0	0	0
		– $F_{ax\ max}$	lbf	180	180	180	180	180	180	180	180	180
			N	800	800	800	800	800	800	800	800	800
Permissible axial force per bar working pressure		+ $F_{ax\ perm}$/bar	lbf/psi	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
			N/bar	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7

Size		**NG**		**80**	**80**	**80**	**80**	**90**	**90**	**90**
Drive shaft	type code			P8	P9	S7	V8	S7	V8	P9
	with splined shaft	ø	in	–	–	1 1/4	1 3/8	1 1/4	1 3/8	–
			mm	–	–	–	–	–	–	–
	with parallel keyed shaft	ø	in	1.38	1.57	–	–	–	–	1.57
			mm	35	40	–	–	–	–	40
Maximum radial force[1] at distance a (from shaft collar) 		$F_{q\ max}$	lbf	2608	2293	2113	2630	2113	2945	2585
			kN	11.6	10.2	9.4	11.7	9.4	13.1	11.5
		a	in	0.79	0.79	0.94	0.94	0.94	0.94	0.79
			mm	20	20	24	24	24	24	20
Maximum torque at $F_{q\ max}$		$T_{q\ max}$	lb-ft	375	375	275	375	275	423	423
			Nm	509	509	373	509	372	573	573
Maximum differential pressure at $F_{q\ max}$		$\Delta p_{\ q\ max}$	psi	5800	5800	4250	5800	3770	5800	5800
			bar	400	400	293	400	260	400	400
Maximum axial force at standstill or pressure-free operation 		+ $F_{ax\ max}$	lbf/N	0	0	0	0	0	0	0
		– $F_{ax\ max}$	lbf	225	225	225	225	225	225	225
			N	1000	1000	1000	1000	1000	1000	1000
Permissible axial force per bar working pressure		+ $F_{ax\ perm}$/bar	lbf/psi	0.16	0.16	0.16	0.16	0.16	0.16	0.16
			N/bar	10.6	10.6	10.6	10.6	10.6	10.6	10.6

1) With intermittent operation

A2FMH

Size		**NG**		**45**	**45**	**56**	**56**	**56**	**63**	**63**
Drive shaft	type code			P6	S7	P6	P8	V8	P8	V8
	with splined shaft	ø	in	–	1 1/4	–	–	1 3/8	–	1 3/8
			mm	–	–	–	–	–	–	–
	with parallel keyed shaft	ø	in	1.18	–	1.18	1.18	–	1.38	–
			mm	30	–	30	35	–	35	–
Maximum radial force[1] at distance a (from shaft collar) 		$F_{q\ max}$	lbf	1933	1821	2406	2068	2068	2316	2316
			kN	8.6	8.1	10.7	9.2	9.2	10.3	10.3
		a	in	0.71	0.94	0.71	0.71	0.94	0.71	0.94
			mm	18	24	18	18	24	18	24
Maximum torque at $F_{q\ max}$		$T_{q\ max}$	lb-ft	237	237	296	296	296	333	333
			Nm	322	322	401	401	401	451	451
Maximum differential pressure at $F_{q\ max}$		$\Delta p_{q\ max}$	psi	6500	6500	6500	6500	6500	6500	6500
			bar	450	450	450	450	450	450	450
Maximum axial force at standstill or pressure-free operation 		+ $F_{ax\ max}$	lbf/N	0	0	0	0	0	0	0
		– $F_{ax\ max}$	lbf	180	180	180	180	180	180	180
			N	800	800	800	800	800	800	800
Permissible axial force per bar working pressure		+ $F_{ax\ perm}$/bar	lbf/psi	0.13	0.13	0.13	0.13	0.13	0.13	0.13
			N/bar	8.7	8.7	8.7	8.7	8.7	8.7	8.7

Size		**NG**		**80**	**80**	**80**	**90**
Drive shaft	type code			V8	P8	P9	P9
	with splined shaft	ø	in	1 3/8	–	–	–
			mm	–	–	–	–
	with parallel keyed shaft	ø	in	–	1.38	1.57	1.57
			mm	–	35	40	40
Maximum radial force[1] at distance a (from shaft collar) 		$F_{q\ max}$	lbf	2945	2316	2585	2900
			kN	13.1	10.3	11.5	12.9
		a	in	0.94	0.79	0.79	0.79
			mm	24	20	20	20
Maximum torque at $F_{q\ max}$		$T_{q\ max}$	lb-ft	423	423	423	476
			Nm	573	573	573	645
Maximum differential pressure at $F_{q\ max}$		$\Delta p_{q\ max}$	psi	6500	6500	6500	6500
			bar	450	450	450	450
Maximum axial force at standstill or pressure-free operation 		+ $F_{ax\ max}$	lbf/N	0	0	0	0
		– $F_{ax\ max}$	lbf	225	225	225	225
			N	1000	1000	1000	1000
Permissible axial force per bar working pressure		+ $F_{ax\ perm}$/bar	lbf/psi	0.16	0.16	0.16	0.16
			N/bar	10.6	10.6	10.6	10.6

1) With intermittent operation

Calculation of characteristics			
Inlet flow	$q_v = \frac{V_g \times n}{231 \times \eta_v}$ [gpm]	$\left(\frac{V_g \times n}{1000 \times \eta_v}\right)$ [l/min]	
Rotational speed	$n = \frac{q_v \times 231 \times \eta_v}{V_g}$ [rpm]	$\left(\frac{q_v \times 1000 \times \eta_v}{V_g}\right)$ [rpm]	
Torque	$T = \frac{V_g \times \Delta p \times \eta_{hm}}{24 \times \pi}$ [lb-ft]	$\left(\frac{V_g \times \Delta p \times \eta_{hm}}{20 \times \pi}\right)$ [Nm]	
Power	$P = \frac{2\pi \times T \times n}{33000} = \frac{q_v \times \Delta p \times \eta_t}{1714}$ [HP]	$\left(\frac{2\pi \times T \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600}\right)$ [kW]	

Key

V_g	=	Displacement per revolution [in³ (cm³)]
Δp	=	Differential pressure [psi (bar)]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{hm}	=	Hydraulic-mechanical efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \bullet \eta_{hm}$)

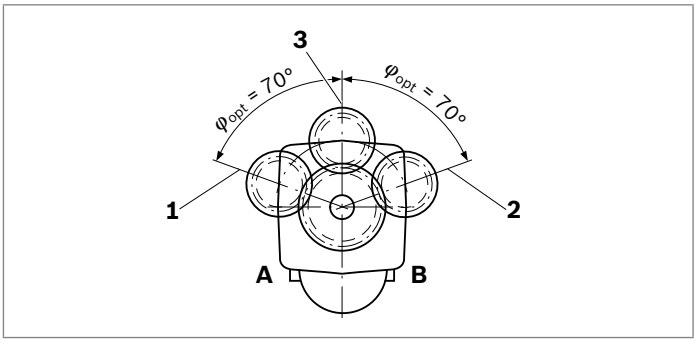
Note

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- Special requirements apply in the case of belt drives. Please contact us.

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:

▼ **Gear output drive**



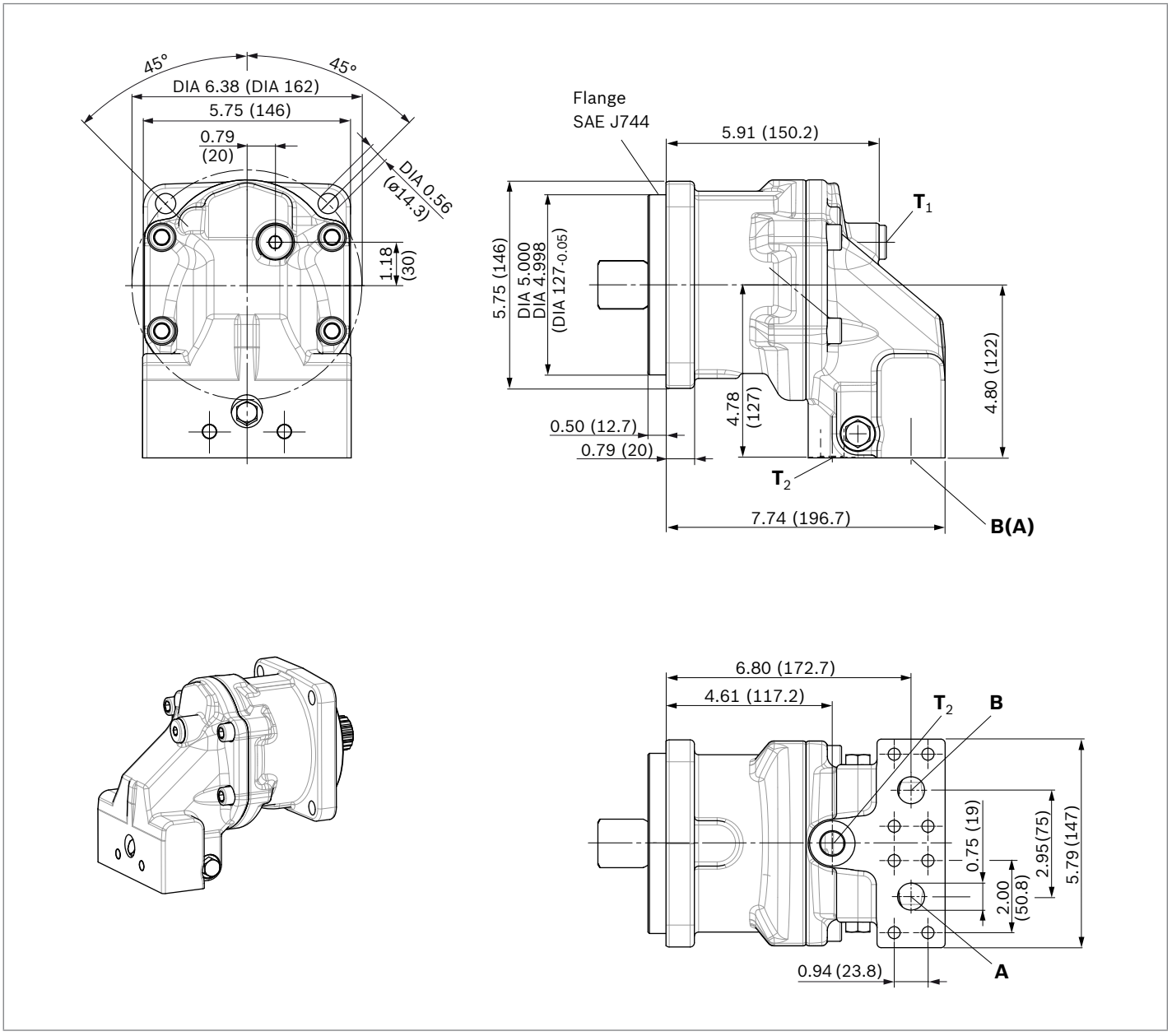
1 “Counter-clockwise” rotation. Pressure at port **B**

2 “Clockwise” rotation, Pressure at port **A**

3 “Alternating” direction of rotation

A2FM dimensions, ports at bottom

A2FMN sizes 56, 63 and 80
A2FMM sizes 45, 56 and 63
A2FMH sizes 45, 56 and 63

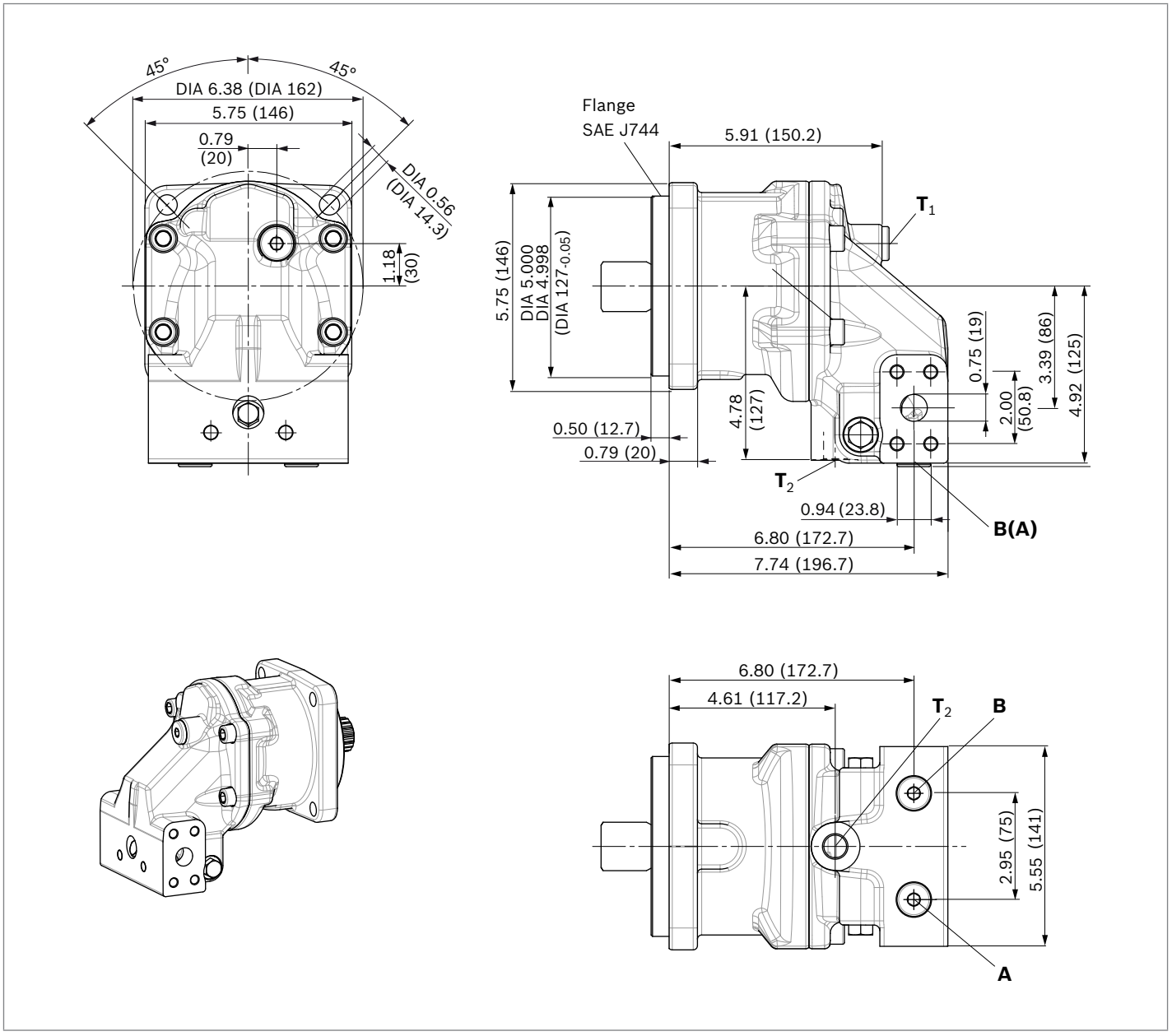


Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[5]
A, B	Working port Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.82 (21) deep	7250 (500)	O
T_1	Drain port	ISO 11926[4]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	X[3]
T_2	Drain port	ISO 11926[4]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	O[3]

1) For notes on tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 20).
4) The spot face can be deeper than as specified in the standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

A2FM dimensions, ports at side

A2FMN sizes 56, 63 and 80
A2FMM sizes 45, 56 and 63
A2FMH sizes 45, 56 and 63

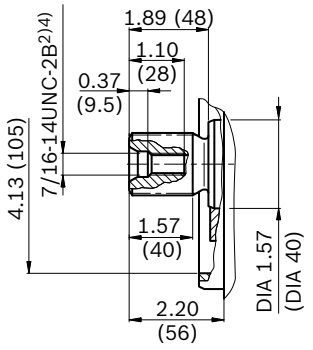


Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[5]
A, B	Working port Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.82 (21) deep	7250 (500)	O
T_1	Drain port	ISO 11926[4]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	X[3]
T_2	Drain port	ISO 11926[4]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	O[3]

1) For notes on tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 20).
4) The spot face can be deeper than as specified in the standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

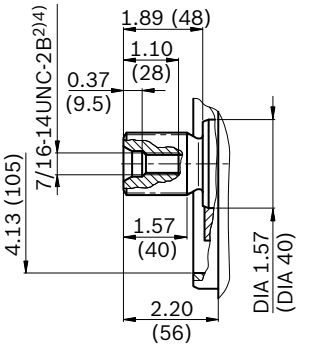
▼ **Splined shaft SAE J744, Size 56, 63 and 80N**

V8 – 1 3/8 in 21T 16/32 DP[1)]



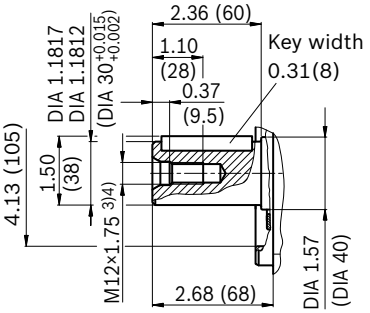
▼ **Splined shaft SAE J744, Size 45, 56, 63 and 80N**

S7 – 1 1/4 in 14T 12/24 DP[1)]



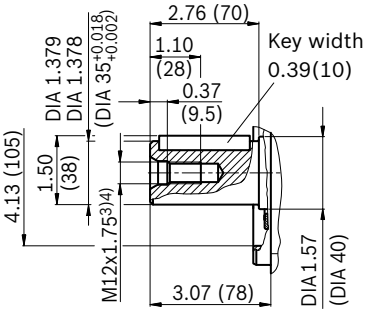
▼ **Parallel keyed shaft, DIN 6885, Size 45 and 56**

P6 – AS8×7×50



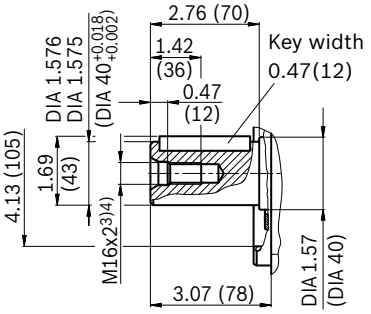
▼ **Parallel keyed shaft, DIN 6885, Size 56, 63 and 80N**

P8 – AS10×8×56



▼ **Parallel keyed shaft, DIN 6885, Size 80N**

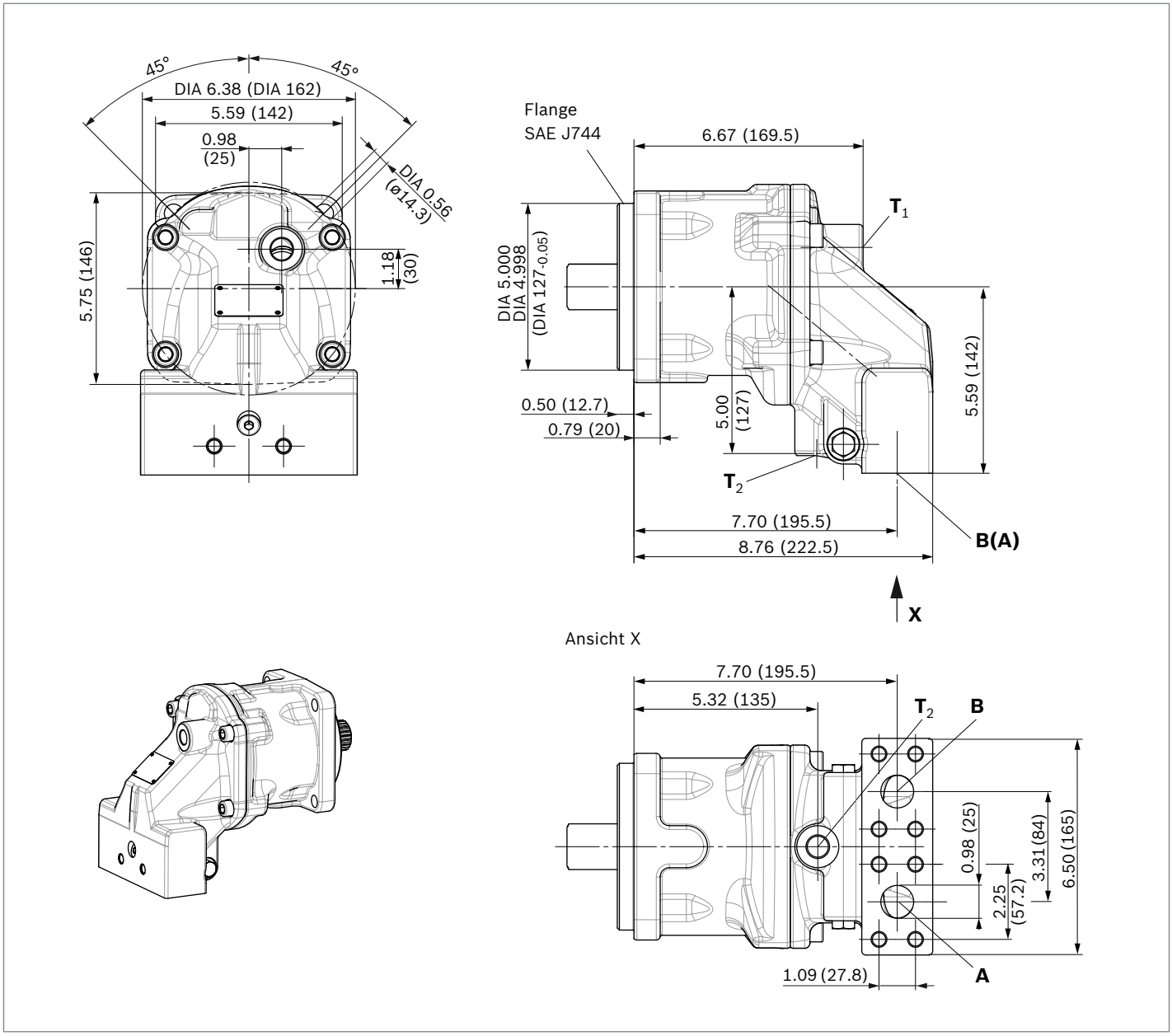
P9 – AS12×8×56



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) For notes on tightening torques, see instruction manual

A2FM dimensions, ports at bottom

A2FMN sizes 90 and 107
A2FMM sizes 80 and 90
A2FMH sizes 80 and 90

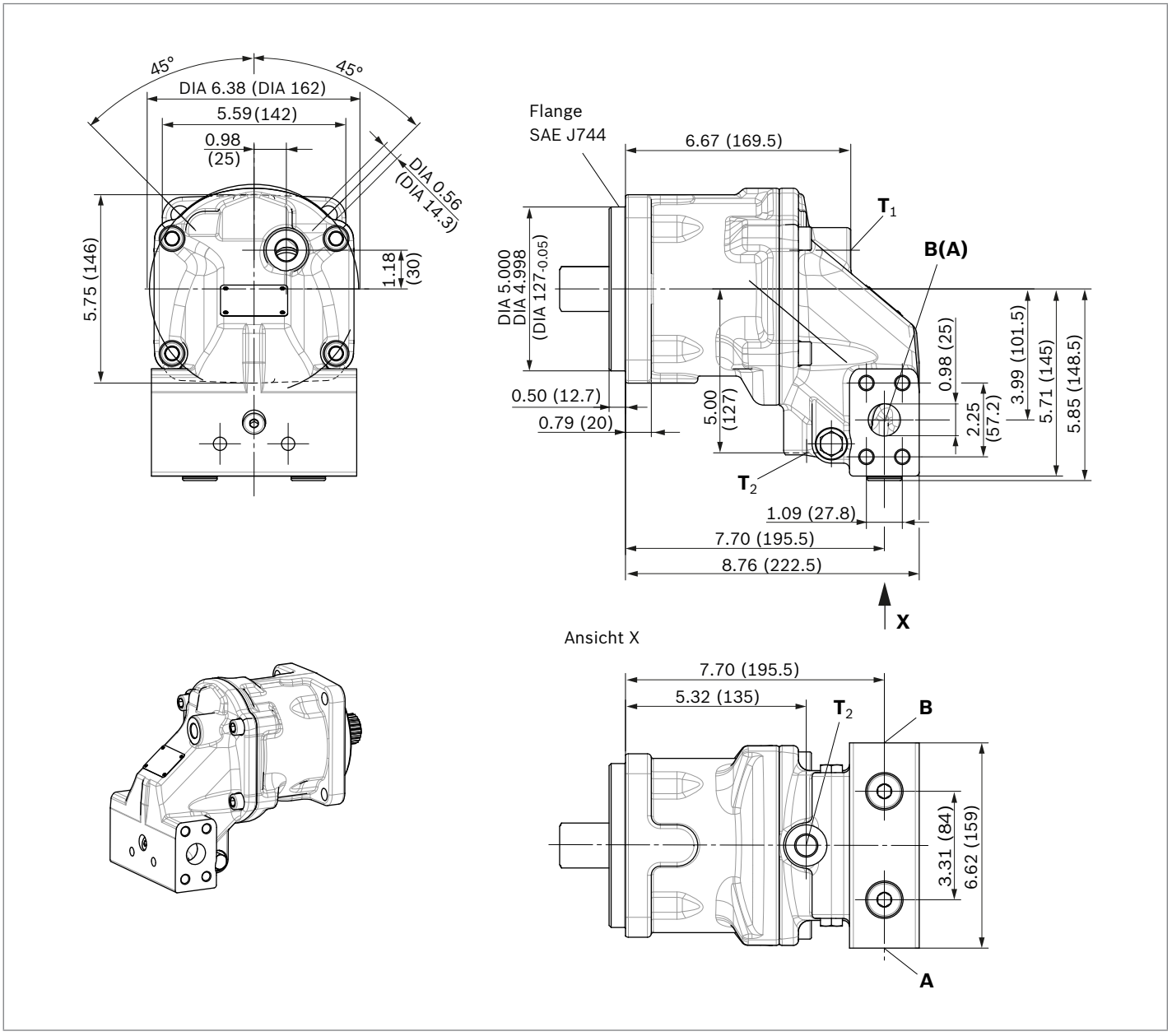


Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[5]
A, B	Working port Fastening thread	SAE J518 ASME B1.1	1 in 7/16-14UNC-2B; 0.75 (19) deep	7250 (500)	O
T_1	Drain port	ISO 11926[4]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	X[3]
T_2	Drain port	ISO 11926[4]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	O[3]

1) For notes on tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 20).
4) The spot face can be deeper than as specified in the standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

A2FM dimensions, ports at side

A2FMN sizes 90 and 107
A2FMM sizes 80 and 90
A2FMH sizes 80 and 90

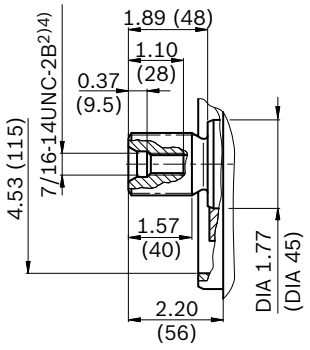


Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[5]
A, B	Working port Fastening thread	SAE J518 ASME B1.1	1 in 7/16-14UNC-2B; 0.75 (19) deep	7250 (500)	O
T_1	Drain port	ISO 11926[4]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	X[3]
T_2	Drain port	ISO 11926[4]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	O[3]

1) For notes on tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 20).
4) The spot face can be deeper than as specified in the standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

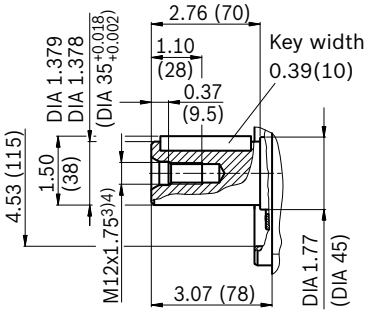
▼ **Splined shaft SAE J744, Size 80, 90 and 107**

V8 – 1 3/8 in 21T 16/32 DP[1)]



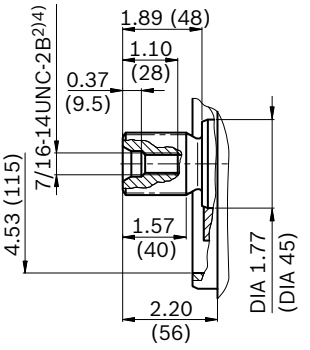
▼ **Parallel keyed shaft, DIN 6885, Size 80**

P8 – AS10×8×56



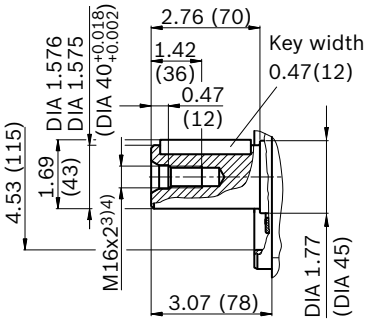
▼ **Splined shaft SAE J744, Size 80, 90 and 107**

S7 – 1 1/4 in 14T 12/24 DP[1)]



▼ **Parallel keyed shaft, DIN 6885, Size 80, 90 and 107**

P9 – AS12×8×56

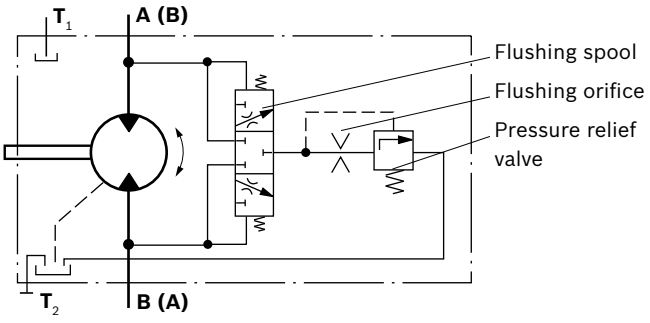


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) For notes on tightening torques, see instruction manual

Flushing and boost pressure valve, integrated

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.
In the closed circuit it is used for the case flushing and for the ensurance of the minimum boost pressure.
Hydraulic fluid is directed from the respective low pressure side into the motor case. This is then fed into the reservoir, together with the leakage. The hydraulic fluid removed from the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

Schematic



Opening pressure of pressure relief valve
(observe when adjusting the primary valve)

- Sizes 45 to 107(N), fixed setting 230 psi (16 bar)

Switching pressure of flushing spool

- Sizes 45 to 107(N)
  Δp = 115 ±15 psi (8 ±1 bar)

Flushing flow
Orifices can be used to adjust the flushing flows as required. The following information is based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 365 psi (25 bar) and
ν = 60 SUS (10 mm²/s)
(p_{ND} = low pressure, p_G = case pressure)

Size	Orifices DIA [inch (ø mm)]	Flushing flow q_v [gpm (l/min)]
45, 56, 63, 80, 90, 107(N)	0.04 (1.0)	0.69 (2.6)
	0.06 (1.5)	1.58 (6)
	0.067 (1.7)	1.95 (7.4)
	0.071 (1.8)	2.45 (8.5)
	0.087 (2.2)	2.91 (11.0)
	0.09 (2.3)	3.01 (11.4)

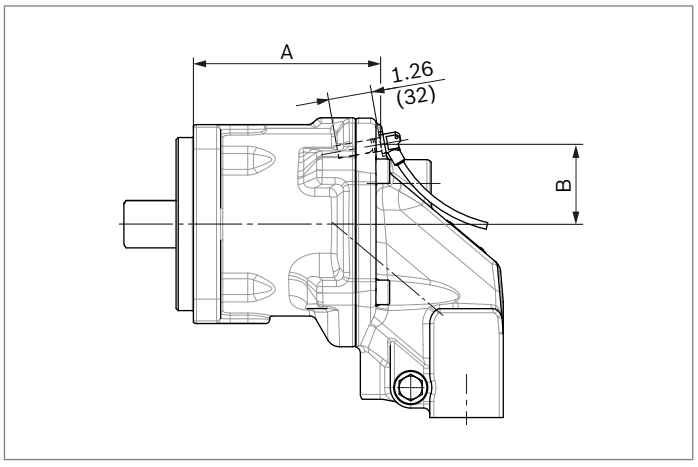
Speed sensors DSA and DSM

The versions A2FM...A and A2FM...N (“prepared for speed sensor ”, i.e. without sensor) is equipped with splines on the rotary group.
A signal proportional to motor speed can be generated with the fitted DSA/DSM speed sensor. The DSA/DSM sensor detects the speed and direction of rotation.
Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95133 – DSA and 95132 – DSM.
The sensor is mounted on the port provided for this purpose with a mounting bolt. When delivering without sensor, the port is plugged with a pressure-resistant cover.
We recommend ordering the A2FM fixed motor complete with mounted sensor.

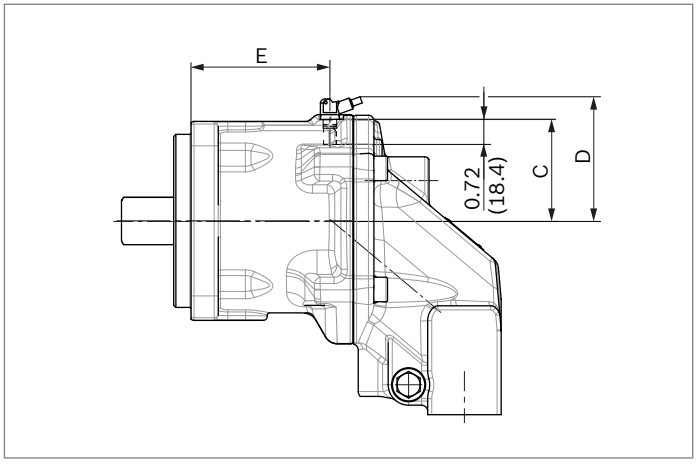
Size	**A2F.M/H**	**45, 56, 63**	**80, 90**
	A2F.N	**56, 63, 80**	**90, 107**
Number of teeth		47	53
Dimensions	A	4.75 (120.6)	5.20 (132.2)
	B	2.15 (54.6)	2.31 (58.8)
	C	2.77 (70.3)	2.95 (75)
	D	3.42 (86.9)	3.61 (91.6)
	E	3.35 (85.2)	3.81 (96.7)

Dimensions

▼ **Version “B”**
A2FM with speed sensor DSA mounted



▼ **Version “M”**
A2FM with speed sensor DSM mounted



Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit empty 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 leakage in the housing area must be directed to the reservoir via the highest drain port (**T**$_1$, **T**$_2$).
If a shared drain line is used for several units, make sure that the relevant case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded under any operational circumstances, particularly during cold start. 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.

Note

- For A2FM with installation position “shaft upwards” an air bleed port **R** is required (state in plain text when ordering, special version).

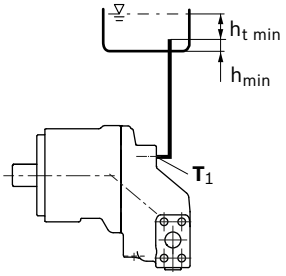
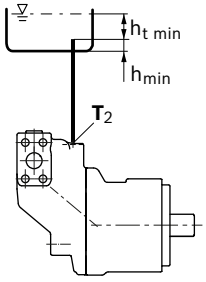
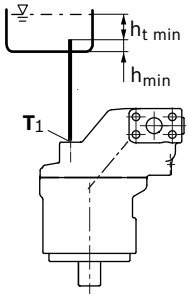
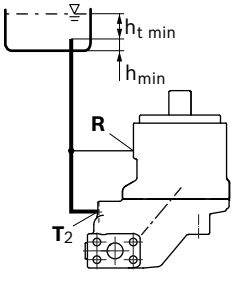
Key	
F	Filling / air bleeding Note: F is part of the external piping
R	Air bleed port (special version)
T$_1$, **T**$_2$	Drain port
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir base (100 mm)

Installation position

See the following examples **1** to **8**.
Additional installation positions are available upon request.
Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

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

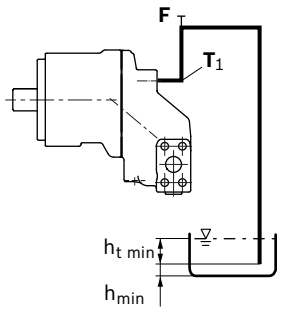
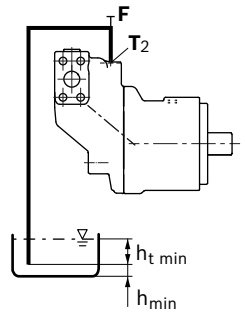
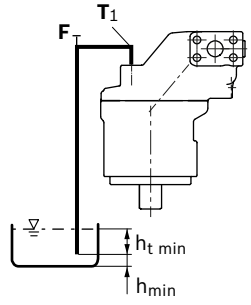
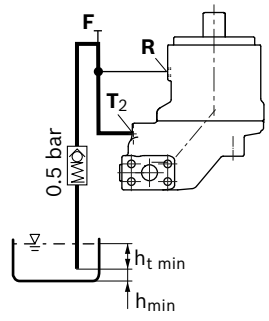
Installation position	Air bleeding	Filling
1 	–	**T**$_1$
2 	–	**T**$_2$
3 	–	**T**$_1$
4 	**R**	**T**$_2$

Above-reservoir installation

Above-reservoir installation means 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 (opening pressure 0.5 bar) can prevent draining of the housing area.

Note

Port **F** is not part of the motor and can be provided by the customer to make filling and air bleeding easier.

Installation position	Air bleeding	Filling
5 	**F**	**T1 (F)**
6 	**F**	**T2 (F)**
7 	**F**	**T1 (F)**
8 	**R**	**T2 (F)**

Project planning notes

- The motor A2FM is designed to be used in open and closed circuits.
- The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled 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.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating condition of the axial piston unit (working pressure, fluid temperature), the characteristic may shift.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Working ports:
  - The ports and fastening threads are designed for the specified peak pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation times apply under optimal storage conditions, details of these conditions can be found in the data sheet 90312 or the instruction manual.

Safety instructions

- 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).

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