BUCHER
hydraulics

Fixed Displacement Piston Pumps and Motors

AX Series

General Information

Bucher Hydraulics AX is an innovative piston pump and motor series, designed and developed to match the newest requirements of electric machines with variable speed drives.

Due to the particular mirrored design based on a high number of light cups and pistons, a pressure limit of 500 bar is possible with a very low pressure and flow ripple. Thanks to the short piston stroke, small displacement angle and hydrostatic bearings, AX units can work with reduced noise and low vibration level even at very low speed (under 1 rpm).

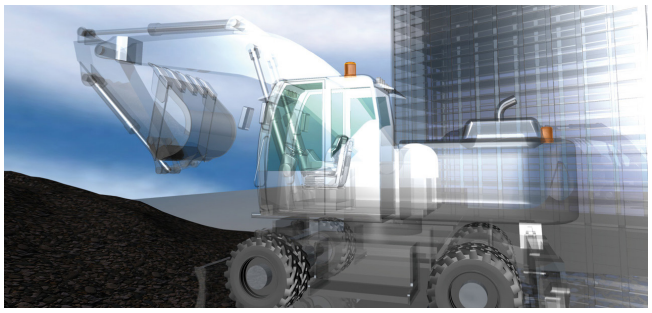
Small axial forces due to a symmetrical shaft design make the AX series very compact while maintaining a high power density. AX units provide outstanding efficiency even at the starting point, so much that the starting torque is available as the maximum theoretical value. A version with tandem through-drive is also available.

Features:

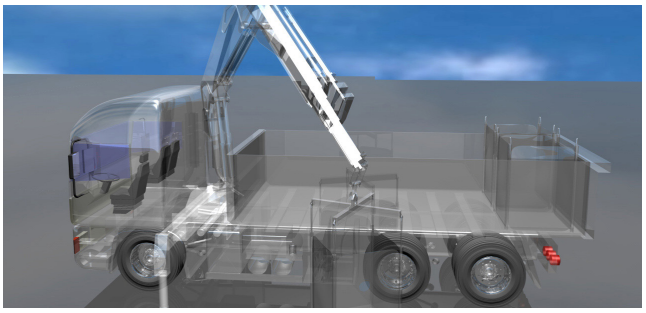
- Fixed displacement pump with internal mirrored design of pistons, for open loop and closed loop circuits
- Product range from 18 to 122 cc
- Used in mobile or industrial applications
- Output flow rate is proportional to pump input speed and displacement
- Maximum working pressure of 500 bar
- Required input torque is proportional to the differential pressure at pump ports
- Extremely high mechanical efficiency
- Extremely good starting characteristics
- Especially suited for working at very low speed while maintaining a high pressure
- Very high overall efficiency
- Very high efficiency at a wide range of working speed and pressure
- High power density
- Compact dimensions
- Very low ripple for pressure and flow rate
- Low vibrations
- Low noise emission
- Tandem through-drive
- ISO or SAE flanges and shafts
- Speed sensor → optional for motor versions
- Flanged valves → optional for motor versions

Areas of Application

Electric heavy machinery
– Very high efficiency for increased autonomy
– Low noise and low vibrations
– Increased speed working range

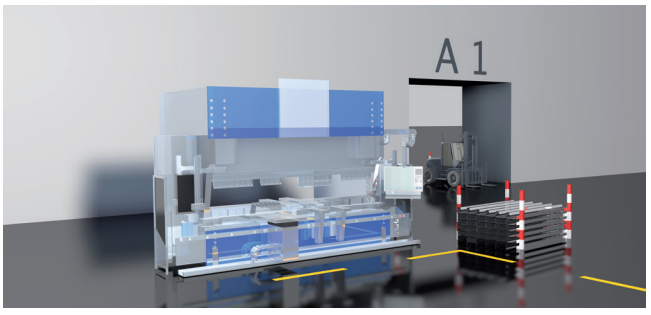


eh-PTO for truck loading cranes
– High efficiency
– Low noise

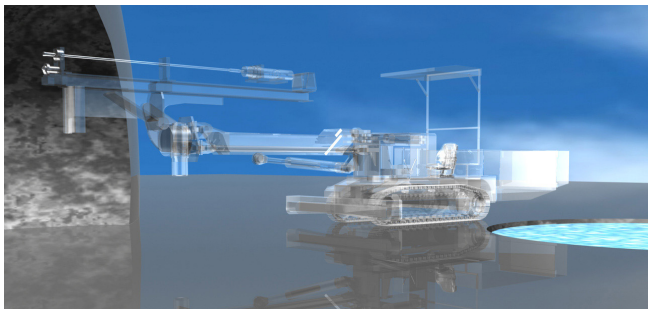


Winches and slew drives
– High starting torque
– Possibility to downsize the motor displacement
– Precise load positioning with no vibrations

Energy recovery
– High efficiency when working as pump and as motor
– Increased speed working range
– High dynamics under pressure



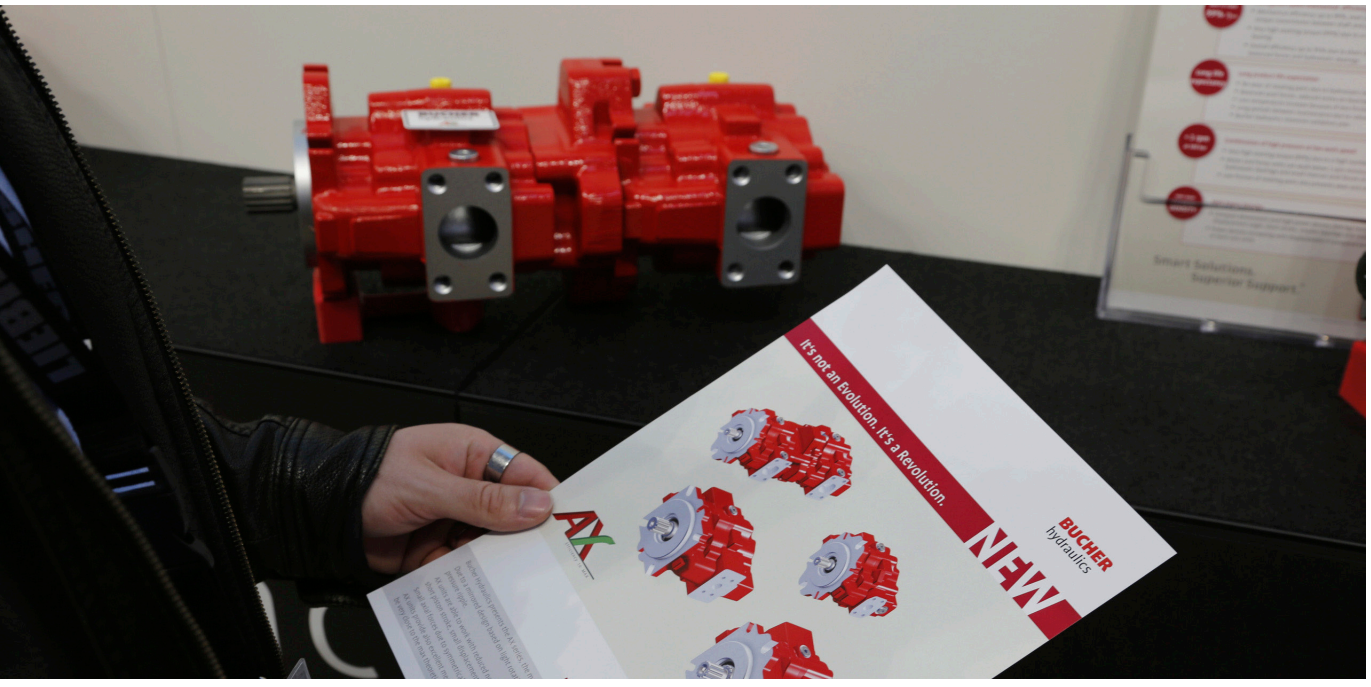
Mining machinery
– Low vibrations for precise positioning
– Superior stability at low rpm with high dynamics
– Very high efficiency



Wheel drives and track drives
– High efficiency
– Good low speed behaviour
– High starting torque

Advantages

Heavy duty 500 bar	High efficiency up to 99 % η_{hm} up to 96 % η_{tot}	Long life expectancy	< 1 rpm at 500 bar
Low noise, low pulsations	High power density	Tandem through-drive	Low temperature increase



Impressive maximum pressure limits
– 500 bar peak working pressure
– High efficiency and long life expectancy due to very strong cast iron body for reduced deformations
– Reduced leakage and deformation thanks to top grade steel

The highest hydro-mechanical efficiency
– Mechanical efficiency up to 99%, even at low speed, due to low friction and direct torque transmission between shaft and pistons
– Very high starting torque (99%) due to a high number of pistons and hydrostatic bearings
– Overall efficiency up to 96% due to short stroke, optimized displacement angle, balanced forces and hydrostatic bearings

Long product service life
– No wear of rotating parts due to hydrostatic bearings
– Balanced axial forces mean reduced stress on bearings
– Less temperature increase because of less friction
– Long maintenance intervals due to robust design
– Bucher Hydraulics intensive validation plan

Combination of high pressure and low work speed
– Very high starting torque (99%) due to a high number of pistons
– Motor units can work below 1 rpm minimum speed due to hydrostatic bearings and small internal axial forces on roller bearings
– Low friction of rotating parts also prevents wear and stick-slip effect

Low noise and low vibration
– Thanks to low pressure ripple
– Low flow ripple due to a high number of pistons
– Reduced internal forces due to mirrored design
– Flow path optimized with CFD

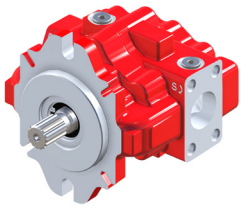
Hight power density
– Compact dimensions and high power density because of a small displacement angle, short stroke, smaller bearings and no joints
– Power density increasing with displacement if compared to traditional axial piston units

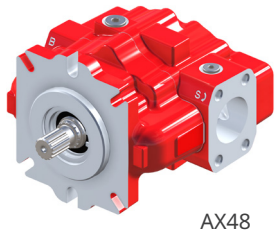
Through-drive shaft design
– Tandem pump configuration is possible in combination with other Bucher Hydraulics pumps thanks to through-drive shaft
– It is possibile to customize solutions like motor brakes, double shaft, encoder or speed sensor

Low temperature increase over time
– It is possible to downsize heat exchanger, oil tank or prime engine because of higher overall efficiency
– Reduced system energy losses due to the high unit efficiency in a wide range of working conditions

Long experience of endurance testing
– More than 6 years of intensive testing of innovative technology
– Bucher Hydraulics strong validation model
– Impressive results on product reliability
– Robust Bucher Hydraulics design

Technical Data AX-FP


AX24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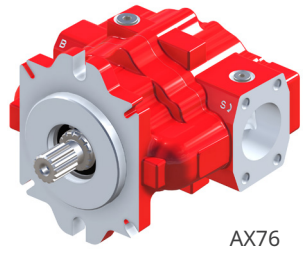
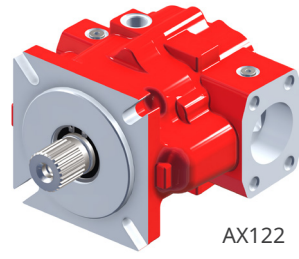
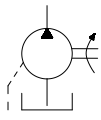
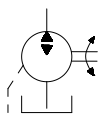
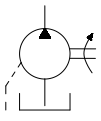
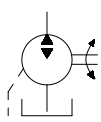
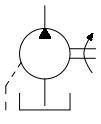
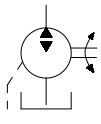
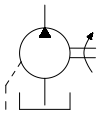
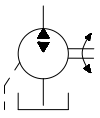
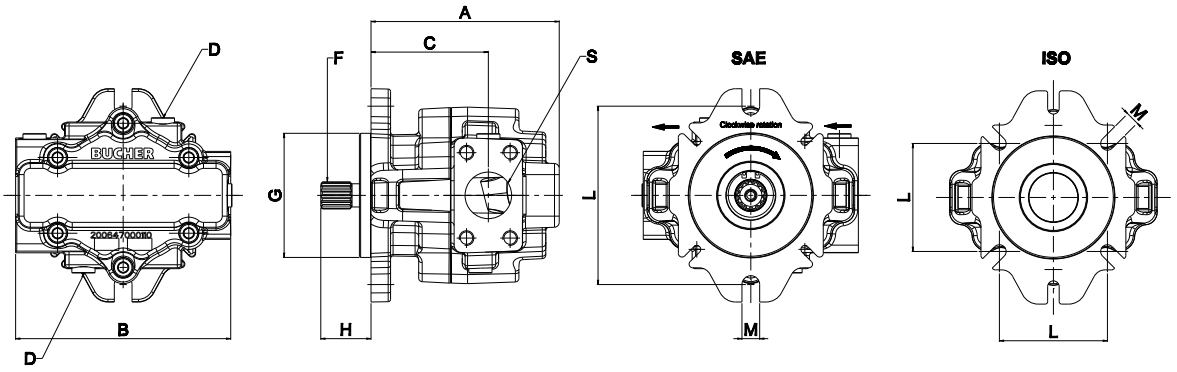

AX76


AX122

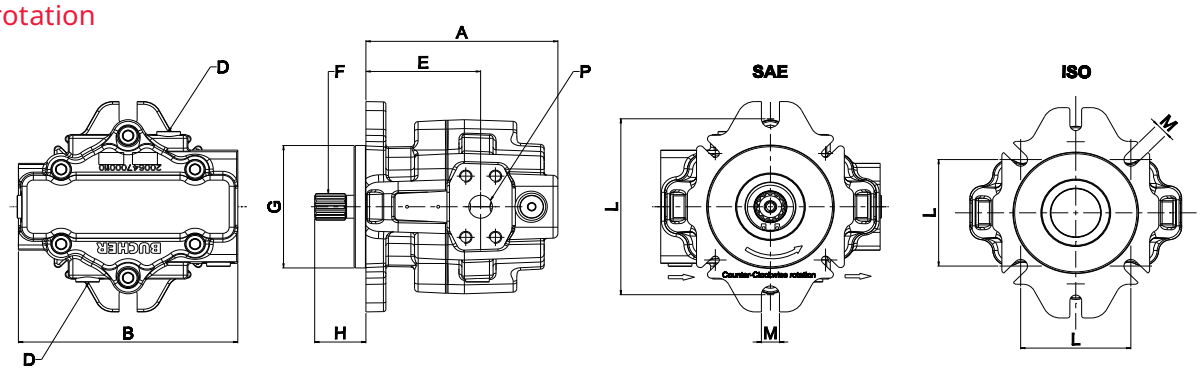
Pump configuration		Displacement			Max. pressure		Speed (*)
Single quadrant 1Q	Two quadrant 2Q	cm^3/rev	in^3/rev	Vg - cc	Cont. - p_{nom} bar	Peak - p_{max} bar	Pump - n_{max} rpm
		18	1.10	17.83	450	500	3600
		21	1.28	20.79			
		24	1.46	23.74			
		34	2.07	33.93	450	500	3000
		40	2.45	40.13			
		45	2.75	45.18			
		48	2.93	47.99			
		54	3.30	53.92	450	500	2600
		63	3.84	62.87			
		72	4.39	71.80			
		76	4.64	76.25			
		86	5.25	86.30	450	500	2200
		100	6.10	100.62			
		115	7.02	114.90			
		122	7.44	122.03			

(*) Maximum speed in self-priming condition for 1Q pump. For 2Q pump speed limits, please contact Bucher Hydraulics.
In case of need for customised displacement values within the different ranges, please contact Bucher Hydraulics.

CW rotation



CCW rotation



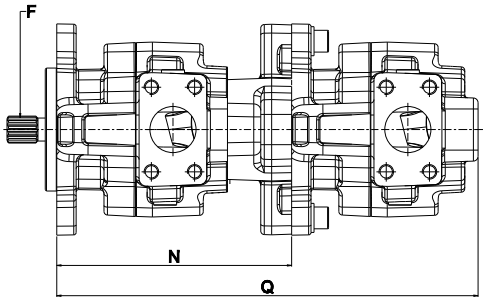
AX-FP Displacements	A mm	B mm	C mm	E mm
18-21-24	154	176	96	92
34-40-45-48	198.5	221	125.5	112.5
54-63-72-76	222.5	242	148.5	132.5
86-100-115-122	255	276.5	172	151.5

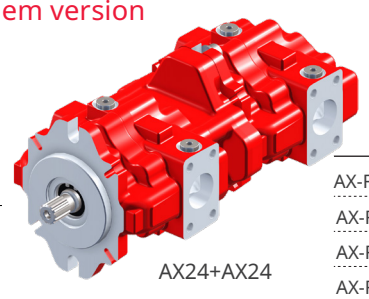
Shafts	
13T	16/32 D.P. ANSI B92.1A spline
14T	12/24 D.P. ANSI B92.1A spline
15T	16/32 D.P. ANSI B92.1A spline
13T	8/16 D.P. ANSI B92.1A spline
CIL.30	Ø30 DIN 6885 AS8x7x50 Key
CIL.35	Ø35 DIN 6885 AS10x8x64 Key
CIL.40	Ø40 DIN 6885 AS12x8x64 Key
W25	W25x1.25x18x9g DIN5480 spline
W30	W30x2x14x9g DIN5480 spline
W35	W35x2x16x9g DIN5480 spline
W40	W40x2x18x9g DIN5480 spline
W45	W45x2x21x9g DIN5480 spline
W50	W50x2x24x9g DIN5480 spline

AX-FP Displacements	Flanges	F	G mm	H mm	L mm	M mm	Ports (*)
18-21-24	SAE-B	13T	Ø101.6	41.1	146	14.5	S: 1" 1/2 SAE 3000 P: 3/4" SAE 6000 D: 1/4" G-BSP
	SAE B-B	15T	Ø101.6	46.1	146	14.5	
	ISO	W25	Ø100	68	88.4	14.5	
34-40-45-48	SAE B-B	15T	Ø101.6	46	146	14.5	S: 2" SAE 3000 P: 3/4" SAE 6000 D: 3/8" G-BSPP
	SAE-C 4H	14T	Ø127	56	114.5	14.5	
	ISO	W30	Ø125	67	113.1	13.5	
	ISO	CIL.30	Ø125	92	113.1	13.5	
54-63-72-76	SAE-C 2H	14T	Ø127	56	181	17.5	S: 2" 1/2 SAE 3000 P: 1" SAE 6000 D: 3/8" G-BSPP
	ISO	W35	Ø140	72	127.3	13.5	
	ISO	W40	Ø140	77	127.3	13.5	
	ISO	CIL.35	Ø140	102	127.3	13.5	
	ISO	CIL.40	Ø140	102	127.3	13.5	
	ISO	W35	Ø125	72	113.1	13.5	
86-100-115-122	SAE-D 4H	13T	Ø152.4	75	161.6	20.6	S: 3" SAE 3000 P: 1" 1/4 SAE 6000 D: 3/4" G-BSPP
	ISO	W40	Ø160	77	141.4	17.5	
	ISO	W45	Ø160	77	141.4	17.5	
	ISO	W50	Ø160	77	141.4	17.5	

(*) For special versions of pumps with rear ports please contact Bucher Hydraulics.

AX-FP piston pump dimensions: tandem version



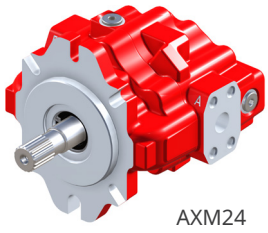


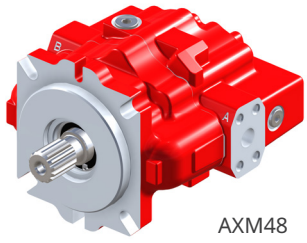
AX24+AX24

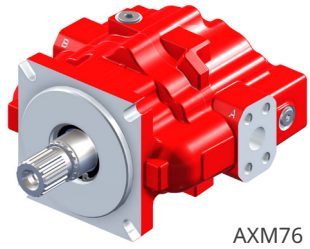
	F	N mm	Q mm
AX-FP 24 + 24	15T SAE B-B	197	351
AX-FP 48 + 48	14T SAE C / 15T SAE B-B	241	439.5
AX-FP 76 + 76	14T SAE C / W40 ISO	283	505.5
AX-FP 122 + 122	W50 ISO / 13T SAE-D	344	599

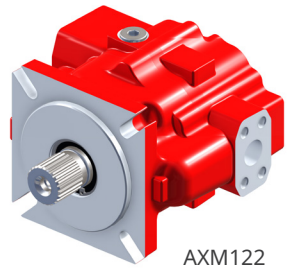
1) Combinations of different sizes are also possible, such as AX76+AX48 / AX76+AX24.
2) The single AX unit can be ordered with the through-drive otpion, to connect a second piston or gear unit, with SAE-C or SAE-B interface.
Please contact Bucher Hydraulics.

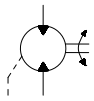
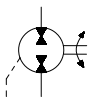
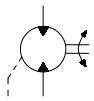
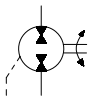
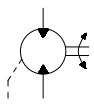
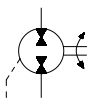
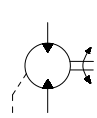
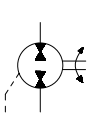
Technical Data AX-FM


AXM24


AXM48

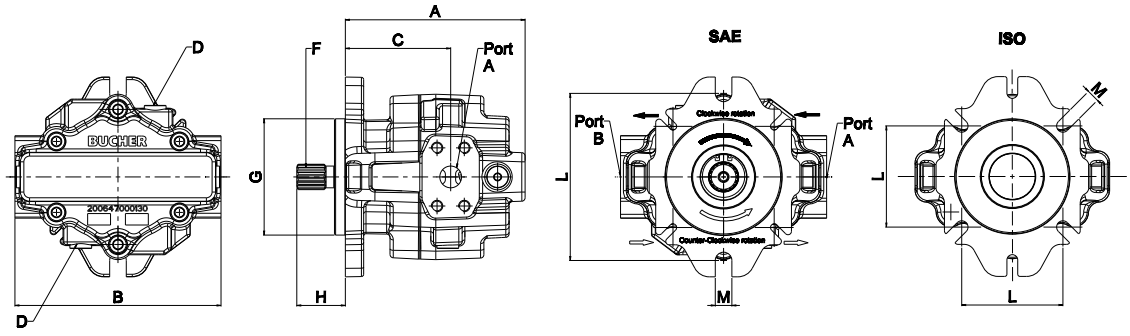

AXM76


AXM122

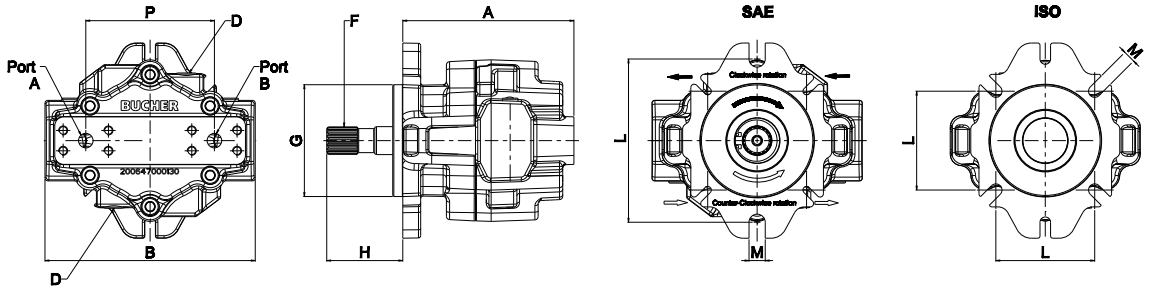
Bi-directional motor (*)		Displacement			Max. pressure		Speed (**)
Two quadrant 2Q	Four quadrant 4Q	cm^3/rev	in^3/rev	Vg - cc	Cont. - p_{nom} bar	Peak - p_{max} bar	Motor - n_{max} rpm
		18	1.10	17.83	450	500	5000
		21	1.28	20.79			
		24	1.46	23.74			
		34	2.07	33.93	450	500	4500
		40	2.45	40.13			
		45	2.75	45.18			
		48	2.93	47.99			
		54	3.30	53.92	450	500	4000
		63	3.84	62.87			
		72	4.39	71.80			
		76	4.64	76.25			
		86	5.25	86.30	450	500	3500
		100	6.10	100.62			
		115	7.02	114.90			
		122	7.44	122.03			

(*) The AX-FM motors are suitable for both open loop (2Q) and closed loop (4Q) circuits.
(**) For speed requirements above the given values, please contact Bucher Hydraulics.
In case of need for customised displacement values within the different ranges, please contact Bucher Hydraulics.

Lateral ports dimensions



Rear ports dimensions



AX-FM Displacements	A Lateral ports mm	A Rear ports mm	B Lateral ports mm	B Rear ports mm	C mm	P mm
18-21-24	157	153	180	188	92	115
34-40-45-48	200.5	197	224	230	112.5	140
54-63-72-76	222.5	218.5	242	252	132.5	138
86-100-115-122	255	248	273	286	172	146

Shafts	
13T	16/32 D.P. ANSI B92.1A spline
14T	12/24 D.P. ANSI B92.1A spline
15T	16/32 D.P. ANSI B92.1A spline
13T	8/16 D.P. ANSI B92.1A spline
W25	W25x1.25x18x9g DIN5480 spline
W30	W30x2x14x9g DIN5480 spline
W35	W35x2x16x9g DIN5480 spline
W40	W40x2x18x9g DIN5480 spline
W45	W45x2x21x9g DIN5480 spline
W50	W50x2x24x9g DIN5480 spline

AX-FM Displacements	Flanges	F	G mm	H mm	L mm	M mm	Ports
18-21-24	SAE-B	13T	Ø101.6	41.1	146	14.5	A-B: 1/2" SAE 6000 (rear ports) A-B: 3/4" SAE 6000 (lateral ports) D: 1/4" G-BSPP
	SAE B-B	15T	Ø101.6	46.1	146	14.5	
	ISO	W25	Ø100	68	88.4	14.5	
34-40-45-48	SAE B-B	15T	Ø101.6	46	146	14.5	A-B: 3/4" SAE 6000 D: 3/8" G-BSPP
	SAE-C 4H	14T	Ø127	56	114.5	14.5	
	ISO	W30	Ø125	67	113.1	13.5	
	ISO	CIL.30	Ø125	92	113.1	13.5	
54-63-72-76	SAE-C 2H	14T	Ø127	56	181	17.5	A-B: 3/4" SAE 6000 A-B: 1" SAE 6000 D: 3/8" G-BSPP
	ISO	W35	Ø140	72	127.3	13.5	
	ISO	W40	Ø140	77	127.3	13.5	
	ISO	CIL.35	Ø140	102	127.3	13.5	
	ISO	CIL.40	Ø140	102	127.3	13.5	
	ISO	W35	Ø125	72	113.1	13.5	
86-100-115-122	SAE-D 4H	13T	Ø152.4	75	161.6	20.6	A-B: 1" 1/4" SAE 6000 D: 3/4" G-BSPP
	ISO	W40	Ø160	77	141.4	17.5	
	ISO	W45	Ø160	77	141.4	17.5	
	ISO	W50	Ø160	77	141.4	17.5	

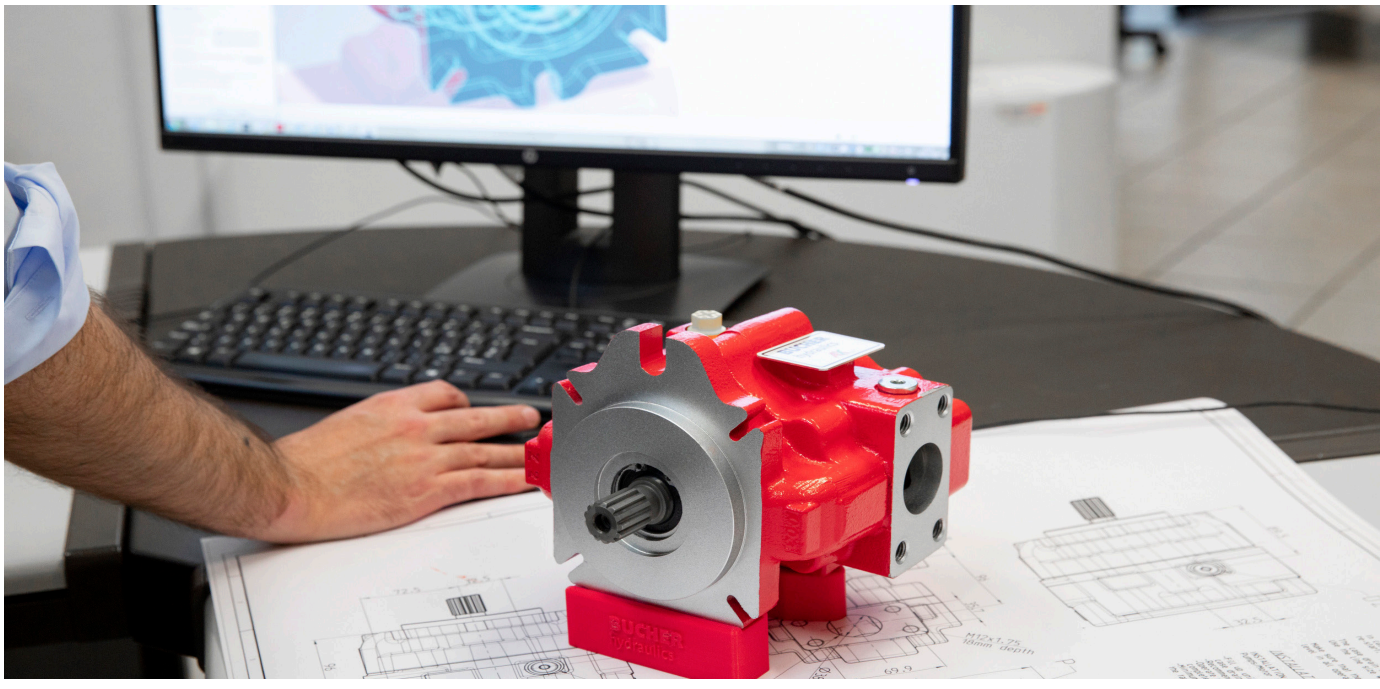
Table of Theoretical Data

A nominal working pressure of 450 bar and 500 bar peak pressure is confirmed for the entire product range.

Note: the theoretical values reported in the following tables are considered before mechanical or volumetric efficiency. These values are calculated for parts at nominal dimensions. The data has been considered for operation with a mineral oil that has a viscosity class of ISO VG 32 and a temperature of 40 °C.
Note: peak pressure working conditions must not exceed 1% of every minute. It is not recommended that the units are used so they run at maximum pressure and maximum speed simultaneously. Operation at values above the maximum admitted working conditions may lead to reduced life, failure or loss of function of the pump/motor. For max working conditions of tandem units, please ask Bucher Hydraulics.

			AX24			AX48			
	Symbol	**Unit**	**18**	**21**	**24**	**34**	**40**	**45**	**48**
Displacement	Vg	cc/rev	17.83	20.79	23.74	33.93	40.13	45.18	47.99
		in^3/rev	1.09	1.27	1.45	2.07	2.41	2.76	2.93
Nominal continuous pressure	Δp	bar		450			450		
Maximum peak pressure	Δp_{max}	bar		500			500		
Speed (pump max)	n_{pump}	rpm	3600	3600	3600	3000	3000	3000	3000
Speed (motor max)	n_{motor}	rpm	5000	5000	5000	4500	4500	4500	4500
Flow at n_{nom} (pump)	Q	l/min	62.4	72.8	83.1	101.8	118.7	135.5	144.0
Torque at Δp=450 bar	T1	Nm	127.7	148.9	170.0	243.0	283.3	323.6	343.7
Torque at Δp=500 bar	T_{max}	Nm	141.9	165.4	188.9	270.0	314.8	359.5	381.9
Power at n_{nom} and Δp=450 bar	P1	kW	46.8	54.6	62.3	76.3	89.0	101.7	108.0
Power at n_{nom} and Δp=500 bar	P_{max}	kW	52.0	60.6	69.2	84.8	98.9	113.0	120.0
Moment of inertia for Rotary Group	J_{gr}	kgm^2		0.00126			0.00400		
Case volume	V	l		0.3			0.5		
Weight	m	kg		13.8			22.2		

			AX76				AX122			
	Symbol	**Unit**	**54**	**63**	**72**	**76**	**86**	**100**	**115**	**122**
Displacement	Vg	cc/rev	53.92	62.87	71.80	76.25	86.30	100.62	114.90	122.03
		in^3/rev	3.29	3.84	4.38	4.65	5.27	6.14	7.01	7.45
Nominal continuous pressure	Δp	bar		450				450		
Maximum peak pressure	Δp_{max}	bar		500				500		
Speed (pump max)	n_{pump}	rpm	2600	2600	2600	2600	2200	2200	2200	2200
Speed (motor max)	n_{motor}	rpm	4000	4000	4000	4000	3500	3500	3500	3500
Flow at n_{nom} (pump)	Q	l/min	140.2	163.5	186.7	198.3	190	221	254	270
Torque at Δp=450 bar	T1	Nm	386.2	450.3	514.2	546.1	618.4	721.0	823.3	874.4
Torque at Δp=500 bar	T_{max}	Nm	429.1	500.3	571.4	606.8	687.1	801.1	914.7	971.5
Power at n_{nom} and Δp=450 bar	P1	kW	105.1	122.6	140.0	148.7	148.9	173.6	198.3	210.6
Power at n_{nom} and Δp=500 bar	P_{max}	kW	116.8	136.2	155.6	165.2	165.5	192.9	220.3	234.0
Moment of inertia for Rotary Group	J_{gr}	kgm^2		0.00912				0.01870		
Case volume	V	l		0.7				1		
Weight	m	kg		32.6				50.0		



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