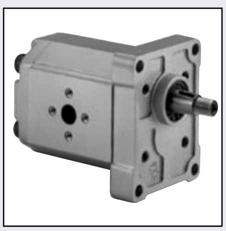
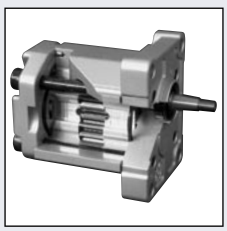
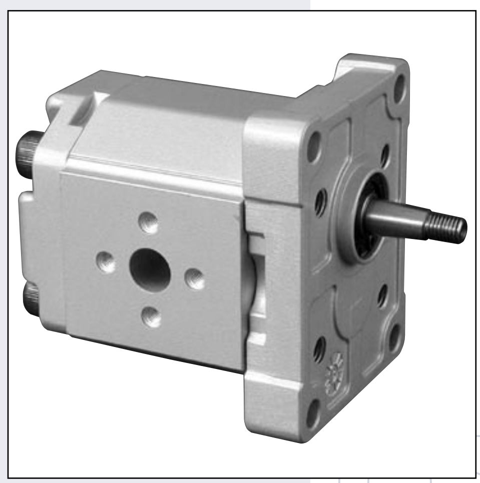
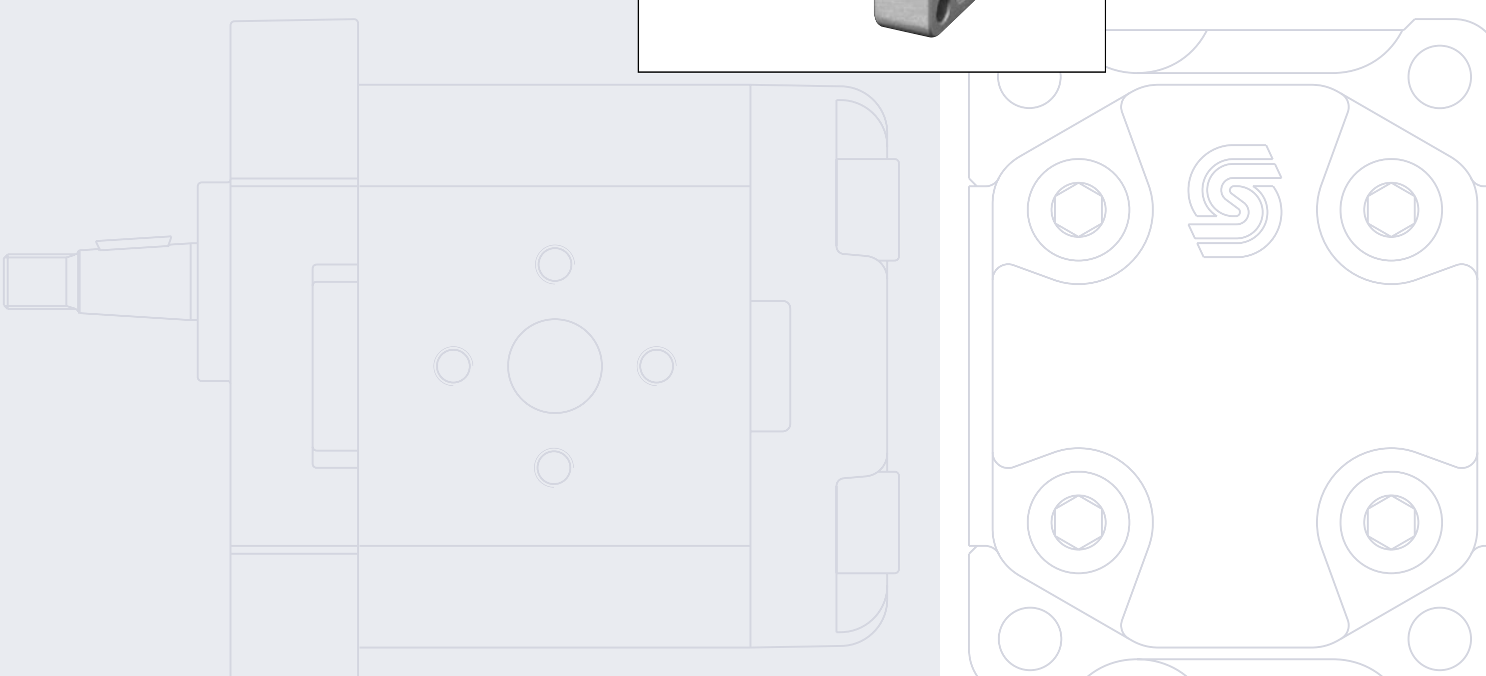
Group 1
Gear Pumps

Technical Information

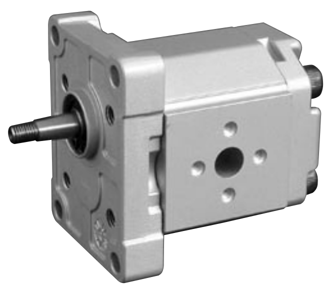




OVERVIEW

The Sauer-Danfoss Group 1 is a range of peak performance fixed-displacement gear pumps. Constructed of a high-strength extruded aluminum body with aluminum cover and flange, all pumps are pressure-balanced for exceptional efficiency.
The flexibility of the range, combined with high efficiency and low noise, makes the pumps in this series ideal for a wide range of applications, including: turf care, aerial lifts, material handling, and power packs.

Group 1 gear pumps:

SNP1 CO01



F005 012

SKP1 SC06

F005 021

SNP1 FR03

F005 043

FEATURES AND BENEFITS

Gear pump attributes:

- Up to 11 displacements from 1.2 to 12 cm^3/rev [from 0.072 to 0.732 in^3/rev]
- Continuous pressure rating up to 250 bar [3625 psi]
- Speeds up to 4000 min^{-1} (rpm)
- SAE, ISO, and DIN mounting flanges and shafts
- Compact and lightweight
- Available as unidirectional and bi-directional motors also
- You can combine groups 1, 2 and 3 to make multi-stage pumps
- Quiet operation
- Available with integral relief valve

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Front cover illustrations: F005 040, F005 021, F005 018, F005 039, F005 012 and P005 051.

Contents

PUMP DESIGN

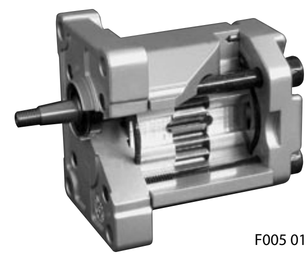
SEP1

SEP1 is available in a limited displacement range. In addition to European flange and shaft configurations (code SC01, CO01, and FR03), the range includes special shafts and flanges for power pack applications. SEP1 has a lower pressure rating than SNP1 and SKP1.

SNP1

SNP1 is available in a limited displacement range but with higher-pressure ratings than the SEP1. This is because of DU bushings used in its design. SNP1 pumps only include European flange and shaft configurations *(code CO01, SC01, and FR03)*.

SNP1 CO01 (cut away)



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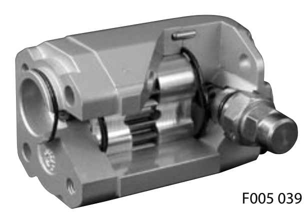
SKP1

SKP1 has a larger diameter shaft than either the SEP1 or SNP2. It spans the complete displacement range at higher pressures than the SEP1 and SNP1. Configurations include European and SAE flanges and shafts *(code CO02, CI02, SC06, and CI06)*.

SNI1

Sauer-Danfoss offers an optional integral relief valve integrated in the rear cover. It is drained internally and directs all flow from the pump outlet to the inlet when the outlet pressure reaches the valve setting. SNI1 pumps only include European flange and shaft configurations *(code CO01, SC01, and FR03)*.

SNI1 FR03 (cut away)



F005 039

TECHNICAL DATA

Specifications for the SNP1, SEP1 and SKP1 Group 1 gear pumps.

		Pump model										
		1.2	**1.7**	**2.2**	**2.6**	**3.2**	**3.8**	**4.3**	**6.0**	**7.8**	**10.0**	**12.0**
Displacement	cm³/rev [in³/rev]	1.18 [0.072]	1.57 [0.096]	2.09 [0.128]	2.62 [0.160]	3.14 [0.192]	3.66 [0.223]	4.19 [0.256]	5.89 [0.359]	7.59 [0.463]	9.94 [0.607]	12.00 [0.732]
SNP1 – 01 and 03 configuration												
Peak pressure	bar [psi]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	210 [3045]	170 [2465]		
Rated pressure	bar [psi]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	190 [2760]	150 [2175]		
Minimum speed at 0-150 bar	min⁻¹ (rpm)	800	800	600	600	600	600	500	500	500	–	–
Min. speed at 150 bar to rated pressure	min⁻¹ (rpm)	1200	1200	1000	1000	1000	1000	800	800	800		
Maximum speed	min⁻¹ (rpm)	4000	4000	4000	4000	4000	4000	3000	3000	3000		
SEP1 – 01 and 03 configuration												
Peak pressure	bar [psi]	230 [3335]	230 [3335]	230 [3335]	230 [3335]	230 [3335]	230 [3335]	230 [3335]	190 [2760]	160 [2320]		
Rated pressure	bar [psi]	210 [3045]	210 [3045]	210 [3045]	210 [3045]	210 [3045]	210 [3045]	210 [3045]	170 [2465]	140 [2030]		
Minimum speed at 0-150 bar	min⁻¹ (rpm)	800	800	600	600	600	600	500	500	500	–	–
Min. speed at 150 bar to rated pressure	min⁻¹ (rpm)	1200	1200	1000	1000	1000	1000	800	800	800		
Maximum speed	min⁻¹ (rpm)	4000	4000	4000	4000	4000	4000	3000	3000	3000		
SKP1* – 02 and 06 configuration												
Peak pressure	bar [psi]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	270 [3915]	250 [3625]	220 [3190]	170 [2465]	140 [2030]
Rated pressure	bar [psi]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	230 [3335]	200 [2900]	150 [2175]	120 [1740]
Minimum speed at 0-150 bar	min⁻¹ (rpm)	800	800	800	800	800	800	600	600	600	600	600
Min. speed at 150 bar to rated pressure	min⁻¹ (rpm)	1200	1200	1000	1000	1000	1000	1000	800	800	800	–
Maximum speed	min⁻¹ (rpm)	4000	4000	4000	4000	4000	4000	3000	3000	3000	2000	2000
All (SNP1, SEP1, SKP1)												
Weight	kg [lb]	1.02 [2.26]	1.05 [2.31]	1.09 [2.40]	1.11 [2.45]	1.14 [2.51]	1.18 [2.60]	1.20 [2.65]	1.30 [2.87]	1.39 [3.06]	1.55 [3.42]	1.65 [3.64]
Moment of inertia of rotating components	x 10^{-6} kg m² [x 10^{-6} lb•ft²]	3.2 [77]	3.7 [89]	4.4 [105]	5.1 [120]	5.7 [136]	6.4 [152]	7.1 [168]	9.3 [220]	11.4 [271]	14.6 [347]	17.1 [407]
Theoretical flow at maximum speed	l/min [US gal/min]	4.72 [1.25]	6.28 [1.66]	8.36 [2.21]	10.48 [2.77]	12.56 [3.32]	14.64 [3.87]	12.57 [3.32]	17.67 [4.67]	22.77 [6.02]	19.88 [5.25]	24 [6.34]

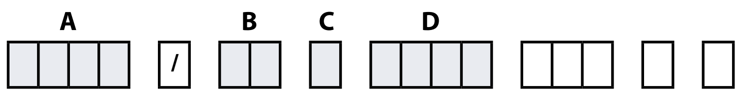
* SKP1 is a special version of the SNP1. It is designed to accommodate an SAE 9T 20/40 DP-tooth splined shaft for higher torque applications.

Caution

The rated and peak pressure mentioned are for pumps with flanged ports only.
When threaded ports are required a de-rated performance has to be considered.
To verify the compliance of an high pressure application with a threaded ports pump apply to a Sauer-Danfoss representative.

Group 1 Gear Pumps
Technical Information
Model Code

MODEL CODE



A *Type*

Code	Description
SNP1	Standard gear pump
SKP1	High torque gear pump
SEP1	Medium pressure gear pump
SNI1	Gear pump with integral relief valve

B *Displacement*

Code	Description	SNP1	SKP1	SEP1	SNI1
1.2	1.18 cm^3/rev [0.072 in^3/rev]	●	●	●	●
1.7	1.57 cm^3/rev [0.096 in^3/rev]	●	●	●	●
2.2	2.09 cm^3/rev [0.128 in^3/rev]	●	●	●	●
2.6	2.62 cm^3/rev [0.160 in^3/rev]	●	●	●	●
3.2	3.14 cm^3/rev [0.192 in^3/rev]	●	●	●	●
3.8	3.66 cm^3/rev [0.223 in^3/rev]	●	●	●	●
4.3	4.19 cm^3/rev [0.256 in^3/rev]	●	●	●	●
6.0	5.89 cm^3/rev [0.359 in^3/rev]	●	●	●	●
7.8	7.59 cm^3/rev [0.463 in^3/rev]	●	●	●	●
10.0	0.94 cm^3/rev [0.607 in^3/rev]	–	●	–	–
12.0	12.0 cm^3/rev [0.732 in^3/rev]	–	●	–	–

C *Direction of rotation*

Code	Description	SNP1	SKP1	SEP1	SNI1
D	Right (Clockwise)	●	●	●	●
S	Left (Counterclockwise)	●	●	●	●

D *Shaft/mounting flange/port configuration*

Code	Description	SNP1	SKP1	SEP1	SNI1
CO01	Tapered shaft 1:8/European 4-bolt flange/European flanged ports	●	–	●	●
CO02	Tapered shaft 1:8/European 4-bolt flange/European flanged ports	–	●	–	–
CI02	Parallel shaft 12.0 mm/European 4-bolt flange/European flanged ports	–	●	–	–
CI06	Parallel shaft 12.7 mm/SAE A-A flange/SAE O-ring boss ports	–	●	–	–
SC01	DIN splined shaft/European 4-bolt flange/European flanged ports	●	–	●	●
SC06	SAE splined shaft/SAE A-A flange/SAE O-ring boss ports	–	●	–	–
FR03	Sauer-Danfoss tang shaft/threaded metric ports	●	–	●	●

Legend:
● = Standard
○ = Optional
– = Not Available

MODEL CODE (continued)

□□□□	/	□□	□	□□□□	E □□□	F □	G □

E *Variant code (3-letter code describes variants to standard configuration)*

Code	Description
LAN	FR03 (configuration without shaft seal)
V**	Integral relief valve/Pressure setting/Pump speed for relief valve setting (min^{-1} [rpm]) see section *Variant codes, page 23*

F *Version (value representing a change to the initial project)*

Code	Description
.	Initial project [*LEAVE BLANK]
1÷9 or **A÷Z**	It should be reserved to Sauer-Danfoss

G *Port type (if other than standard)*

Code	Description
.	Standard port for the flange type specified [*LEAVE BLANK]
B	Flanged port with threaded holes in **X** pattern (German standard ports), centered on the body
C	Flanged port with threaded holes in **+** pattern (European standard ports)
D	Threaded metric port
E	Threaded SAE O-ring boss port
F	Threaded GAS (BSPP) port

BASED ON SI / US UNITS

Use these formulae to determine the nominal pump size for a specific application:

	Metric system		**Inch system**	
Output flow:	$Q = \frac{Vg \cdot n \cdot \eta_v}{1000}$	l/min	$Q = \frac{Vg \cdot n \cdot \eta_v}{231}$	[US gal/min]
Input torque:	$M = \frac{Vg \cdot \Delta p}{20 \cdot \pi \cdot \eta_m}$	Nm	$M = \frac{Vg \cdot \Delta p}{2 \cdot \pi \cdot \eta_m}$	[lbf•in]
Input power:	$P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$	kW	$P = \frac{M \cdot n}{63.025} = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$	[hp]

Where:			*SI units [US units]*
Vg	=	Displacement per rev.	cm^3/rev [in^3/rev]
Δp	=	$p_{HD} - p_{ND}$	bar [psi]
n	=	Speed	min^{-1} (rpm)
η_v	=	Volumetric efficiency	
η_m	=	Mechanical (torque) efficiency	
η_t	=	$\eta_v \cdot \eta_m$ = Overall efficiency	
p_{HD}	=	Outlet pressure	bar [psi]
p_{ND}	=	Inlet pressure	bar [psi]

PRESSURE

The inlet vacuum must be controlled in order to realize expected pump life and performance. The system design must meet inlet pressure requirements during all modes of operation. Expect lower inlet pressures during cold start. It should improve quickly as the fluid warms.

Inlet pressure

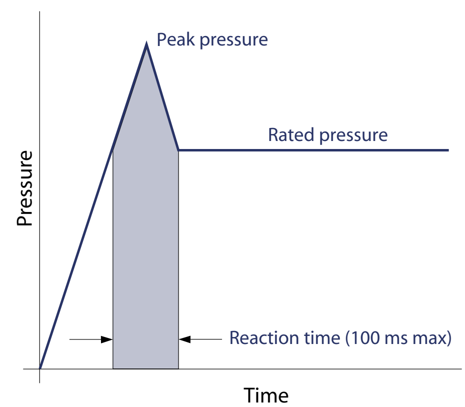
Maximum continuous vacuum	bar absolute [in. Hg]	0.8 [23.6]
Maximum intermittent vacuum		0.6 [17.7]
Maximum pressure		3.0 [88.5]

Peak pressure is the highest intermittent pressure allowed. The relief valve overshoot (reaction time) determines peak pressure. It is assumed to occur for less than 100 ms. The illustration to the right shows peak pressure in relation to rated pressure and reaction time (100 ms maximum).

Rated pressure is the average, regularly occurring, operating pressure that should yield satisfactory product life. The maximum machine load demand determines rated pressure.
For all systems, the load should move below this pressure.

System pressure is the differential between the outlet and inlet ports. It is a dominant operating variable affecting hydraulic unit life. High system pressure, resulting from high load, reduces expected life. System pressure must remain at, or below, rated pressure during normal operation to achieve expected life.

Time versus pressure



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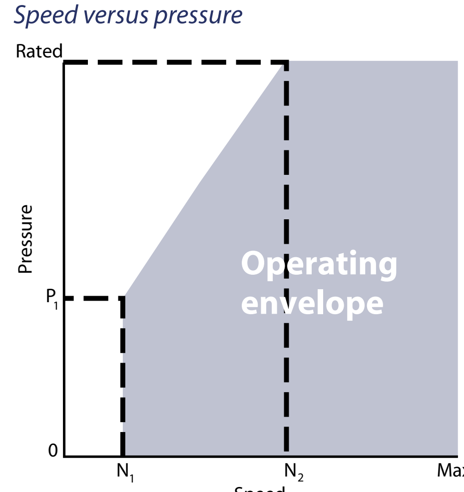
SPEED

Maximum speed is the limit recommended by Sauer-Danfoss for a particular gear pump when operating at rated pressure. It is the highest speed at which normal life can be expected.

The lower limit of operating speed is the **minimum speed**. It is the lowest speed at which normal life can be expected. The minimum speed increases as operating pressure increases. When operating under higher pressures, a higher minimum speed must be maintained, as illustrated to the right:

Speed versus pressure



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HYDRAULIC FLUIDS

Ratings and data for SNP1, SEP1 and SKP1 gear pumps are based on operating with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of internal components. They include:

- Hydraulic fluids following DIN 51524, part 2 (HLP) and part 3 (HVLP) specifications
- API CD engine oils conforming to SAE J183
- M2C33F or G automatic transmission fluids
- Certain agricultural tractor fluids

Use only clean fluid in the pump and hydraulic circuit.

Caution

Never mix hydraulic fluids.

Please see Sauer-Danfoss publication *Hydraulic Fluids and Lubricants Technical Information,* 520L0463 for more information. Refer to publication *Experience with Biodegradable Hydraulic Fluids Technical Information,* 520L0465 for information relating to biodegradable fluids.

TEMPERATURE AND VISCOSITY

Temperature and viscosity requirements must be concurrently satisfied. Use petroleum / mineral-based fluids.

High temperature limits apply at the inlet port to the pump. The pump should run at or below the maximum continuous temperature. The peak temperature is based on material properties. Don't exceed it.

Cold oil, generally, doesn't affect the durability of pump components. It may affect the ability of oil to flow and transmit power. For this reason, keep the temperature at 16°C [60°F] above the pour point of the hydraulic fluid.

Minimum (cold start) temperature relates to the physical properties of component materials.

Minimum viscosity occurs only during brief occasions of maximum ambient temperature and severe duty cycle operation. You will encounter maximum viscosity only at cold start. During this condition, limit speeds until the system warms up. Size heat exchangers to keep the fluid within these limits. Test regularly to verify that these temperatures and viscosity limits aren't exceeded. For maximum unit efficiency and bearing life, keep the fluid viscosity in the recommended viscosity range.

Fluid viscosity

Maximum (cold start)	mm^2/s [SUS]	1000 [4600]
Recommended range		12-60 [66-290]
Minimum		10 [60]

Temperature

Minimum (cold start)	°C [°F]	-20 [-4]
Maximum continuous		80 [176]
Peak (intermittent)		90 [194]

FILTRATION

Filters

Use a filter that conforms to Class 22/18/13 of ISO 4406 (or better). It may be on the pump outlet (pressure filtration), inlet (suction filtration), or reservoir return (return-line filtration).

Selecting a filter

When selecting a filter, please consider:

- contaminant ingression rate (determined by factors such as the number of actuators used in the system)
- generation of contaminants in the system
- required fluid cleanliness
- desired maintenance interval
- filtration requirements of other system components

Measure filter efficiency with a Beta ratio (β_X). For:

- suction filtration, with controlled reservoir ingression, use a $\beta_{35-45} = 75$ filter
- return or pressure filtration, use a pressure filtration with an efficiency of $\beta_{10} = 75$.

β_x ratio is a measure of filter efficiency defined by ISO 4572. It is the ratio of the number of particles greater than a given diameter ("$_x$" in microns) upstream of the filter to the number of these particles downstream of the filter.

Fluid cleanliness level and β_x ratio

Fluid cleanliness level (per ISO 4406)	Class 22/18/13 or better
β_x ratio (suction filtration)	$\beta_{35-45} = 75$ and $\beta_{10} = 2$
β_x ratio (pressure or return filtration)	$\beta_{10} = 75$
Recommended inlet screen size	100-125 µm [0.004-0.005 in]

The filtration requirements for each system are unique. Evaluate filtration system capacity by monitoring and testing prototypes.

RESERVOIR

The **reservoir** provides clean fluid, dissipates heat, removes entrained air, and allows for fluid volume changes associated with fluid expansion and cylinder differential volumes. A correctly sized reservoir accommodates maximum volume changes during all system operating modes. It promotes deaeration of the fluid as it passes through, and accommodates a fluid dwell-time between 60 and 180 seconds, allowing entrained air to escape.

Minimum reservoir capacity depends on the volume required to cool and hold the oil from all retracted cylinders, allowing for expansion due to temperature changes. A fluid volume of 1 to 3 times the pump output flow (per minute) is satisfactory. The minimum reservoir capacity is 125% of the fluid volume.

Install the suction line above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the line. Cover the line with a 100-125 micron screen. The pump should be below the lowest expected fluid level.

Put the return-line below the lowest expected fluid level to allow discharge into the reservoir for maximum dwell and efficient deaeration. A baffle (or baffles) between the return and suction lines promotes deaeration and reduces fluid surges.

LINE SIZING

Choose pipe sizes that accommodate minimum fluid velocity to reduce system noise, pressure drops, and overheating. This maximizes system life and performance. Design inlet piping that maintains continuous pump inlet pressure above 0.8 bar absolute during normal operation. The line velocity should not exceed the values in this table:

Maximum line velocity

Inlet	m/s [ft/sec]	2.5 [8.2]
Outlet		5.0 [16.4]
Return		3.0 [9.8]

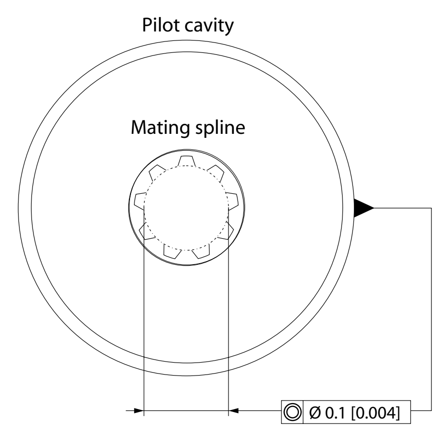
Most systems use hydraulic oil containing 10% dissolved air by volume. Under high inlet vacuum conditions the oil releases bubbles. They collapse when subjected to pressure, resulting in cavitation, causing adjacent metal surfaces to erode. **Over-aeration** is the result of air leaks on the inlet side of the pump, and flow-line restrictions. These include inadequate pipe sizes, sharp bends, or elbow fittings, causing a reduction of flow line cross sectional area. This problem will not occur if inlet vacuum and rated speed requirements are maintained, and reservoir size and location are adequate.

PUMP DRIVE

Shaft options for Group 1 gear pumps include tapered, tang, splined, or parallel shafts. They are suitable for a wide range of direct and indirect drive applications for radial and thrust loads.

Plug-in drives, acceptable only with a splined shaft, can impose severe radial loads when the mating spline is rigidly supported. Increasing spline clearance does not alleviate this condition.

Use plug-in drives if the concentricity between the mating spline and pilot diameter is within 0.1 mm [0.004 in]. Lubricate the drive by flooding it with oil. A 3-piece coupling minimizes radial or thrust shaft loads.



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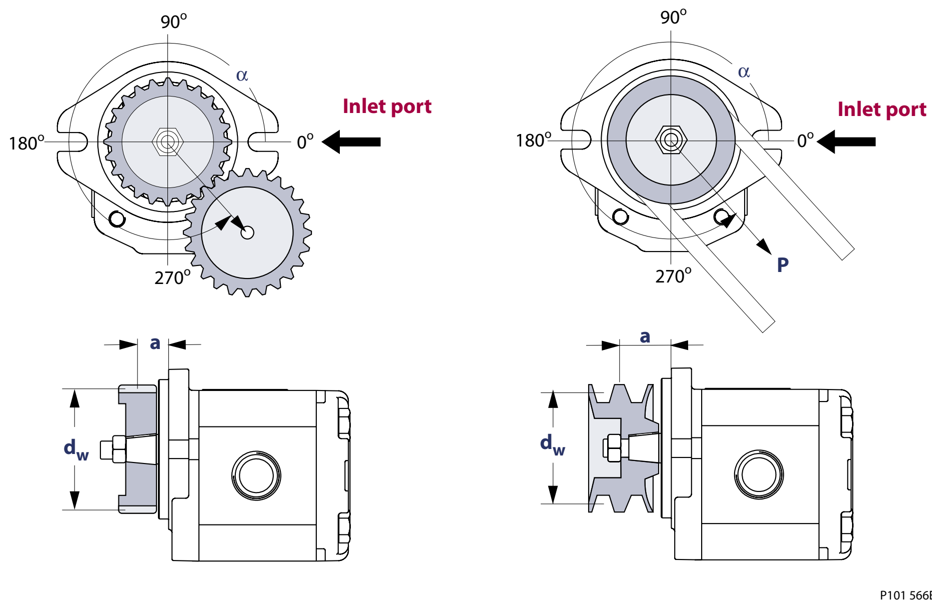
Allowable **radial shaft loads** are a function of the load position, load orientation, and operating pressure of the hydraulic pump. All external shaft loads have an effect on bearing life, and may affect pump performance.
In applications where external shaft loads can't be avoided, minimize the impact on the pump by optimizing the orientation and magnitude of the load. Use a tapered input shaft; don't use splined shafts for belt or gear drive applications. A spring-loaded belt tension-device is recommended for belt drive applications to avoid excessive tension. Avoid thrust loads in either direction. Contact Sauer-Danfoss if continuously applied external radial or thrust loads occur.

PUMP DRIVE DATA FORM

Photocopy this page and fax the complete form to your Sauer-Danfoss representative for an assistance in applying pumps with belt or gear drive. This illustration shows a pump with counterclockwise orientation:

Optimal radial load position



Application data

Item		Value	Unit
Pump displacement			cm³/rev [in³/rev]
Rated system pressure			❑ bar ❑ psi
Relief valve setting			
Pump shaft rotation			❑ left ❑ right
Pump minimum speed			min⁻¹ (rpm)
Pump maximum speed			
Drive gear helix angle (gear drive only)			degree
Belt type (gear drive only)			❑ V ❑ notch
Belt tension (gear drive only)	**P**		❑ N ❑ lbf
Angular orientation of gear or belt to inlet port	α		degree
Pitch diameter of gear or pulley	d_w		❑ mm ❑ in
Distance from flange to center of gear or pulley	**a**		

PUMP LIFE

Pump life is a function of speed, system pressure, and other system parameters (such as fluid quality and cleanliness).

All Sauer-Danfoss gear pumps use hydrodynamic journal bearings that have an oil film maintained between the gear / shaft and bearing surfaces at all times. If the oil film is sufficiently sustained through proper system maintenance and operating within recommended limits, long life can be expected.

B_{10} life expectancy number is generally associated with rolling element bearings. It does not exist for hydrodynamic bearings.

High pressure, resulting from high loads, impacts pump life. When submitting an application for review, provide machine duty cycle data that includes percentages of time at various loads and speeds. We strongly recommend a prototype testing program to verify operating parameters and their impact on life expectancy before finalizing any system design.

SOUND LEVELS

Noise is unwanted sound. Fluid power systems create noise. There are many techniques available to minimize noise. Understanding how it's generated and transmitted is necessary to apply these methods effectively.

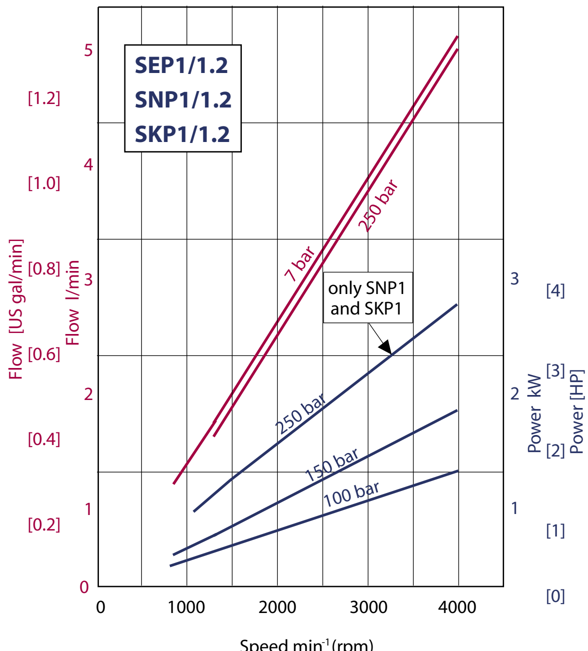
Noise energy is transmitted as fluid borne noise (pressure ripple) or structure borne noise. **Pressure ripple** is the result of the number of pumping elements (gear teeth) delivering oil to the outlet and the pump's ability to gradually change the volume of each pumping element from low to high pressure. Pressure ripple is affected by the comressibility of the oil as each pumping element discharges into the outlet of the pump. Pressure pulsations travel along hydraulic lines at the speed of sound (about 1400 m/s in oil) until there is a change in the system (as with an elbow fitting). Thus, the pressure pulsation amplitude varies with overall line length and position.

Structure borne noise may be transmitted wherever the pump casing is connected to the rest of the system.

The way circuit components respond to excitation depends on their size, form, and mounting. Because of this, a system line may actually have a greater noise level than the pump. To minimize noise, use:
- flexible hoses (if you must use steel plumbing, clamp the lines).
- flexible (rubber) mounts to minimize other structure borne noise.

PUMP PERFORMANCE GRAPHS

The graphs on the next few pages provide typical output flow and input power for Group 1 pumps at various working pressures. Data were taken using ISO VG46 petroleum /mineral based fluid at 50°C (viscosity at 28 mm²/s [cSt]).



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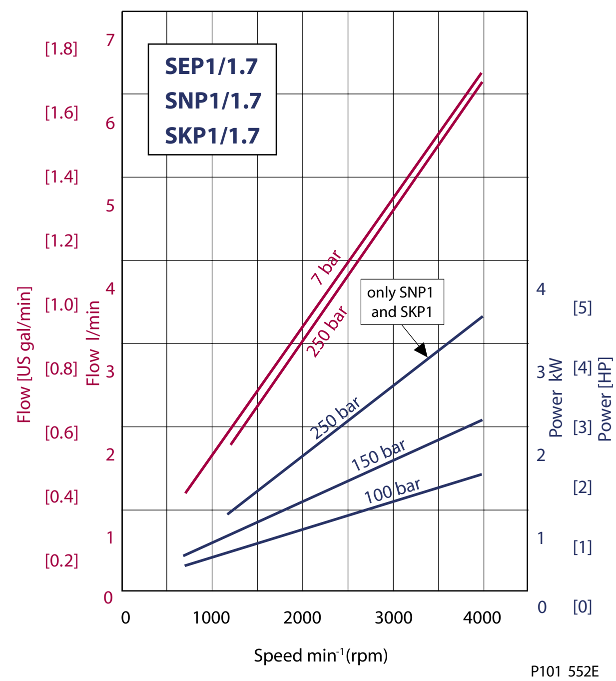

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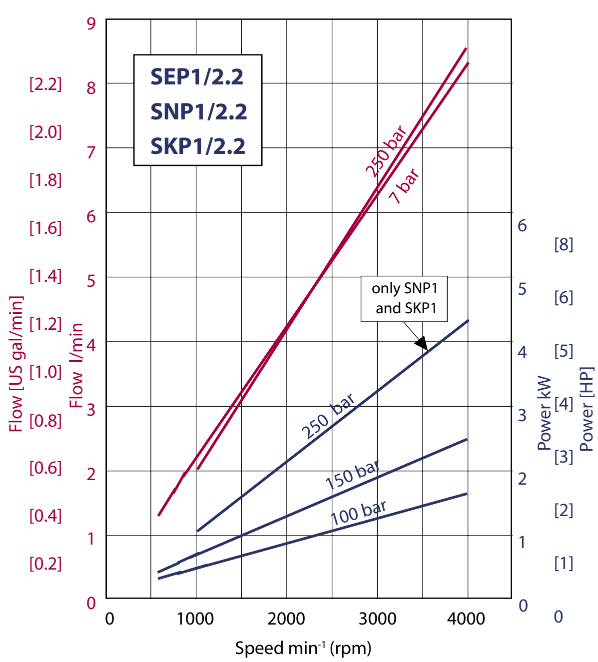
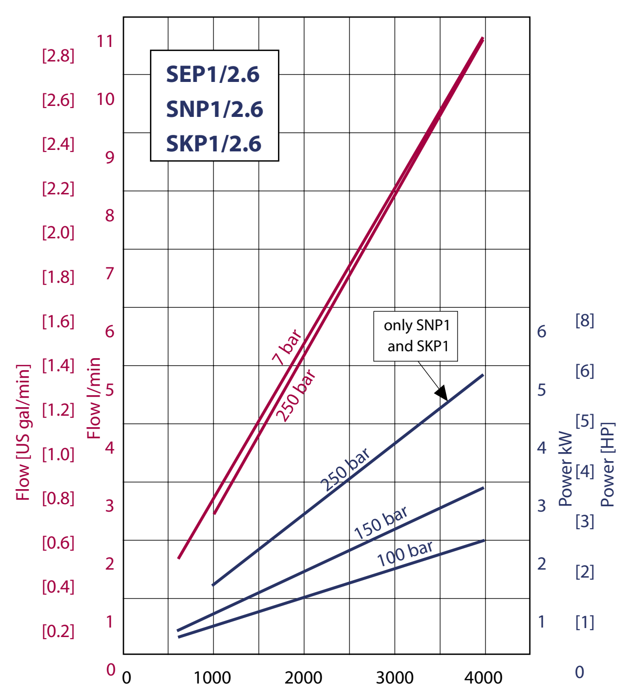
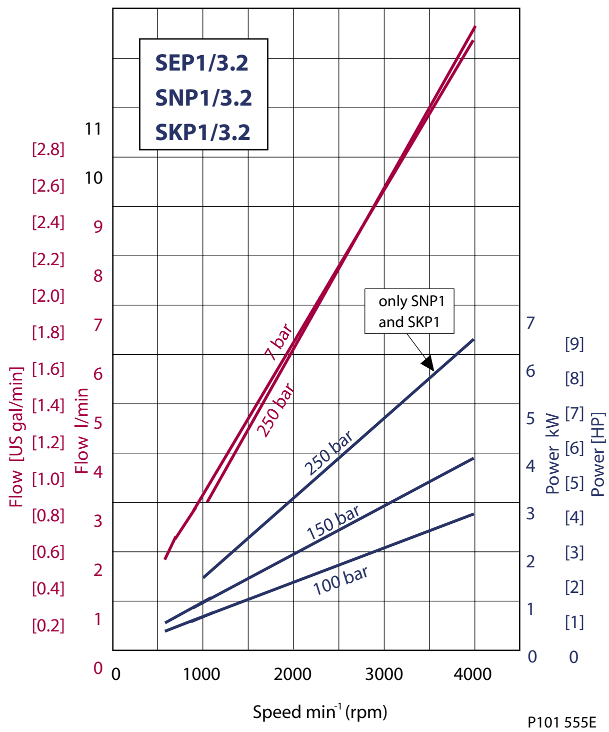


P101 553E

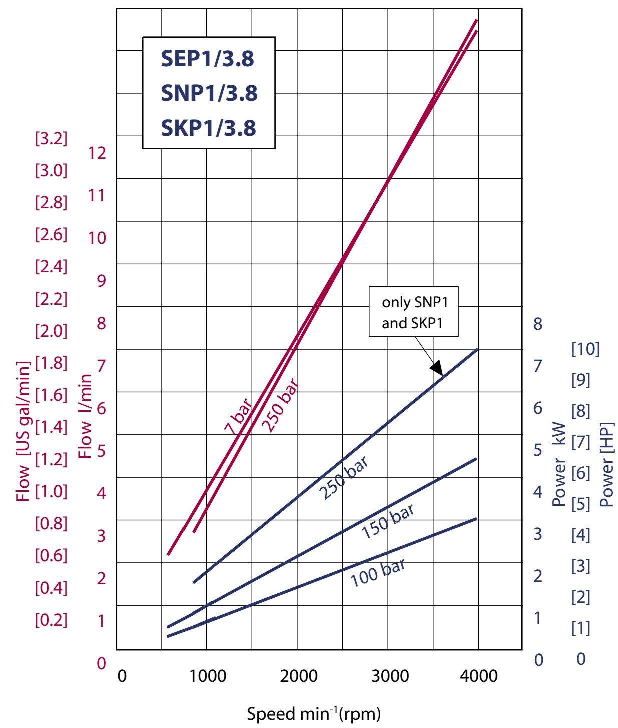


P101 554E

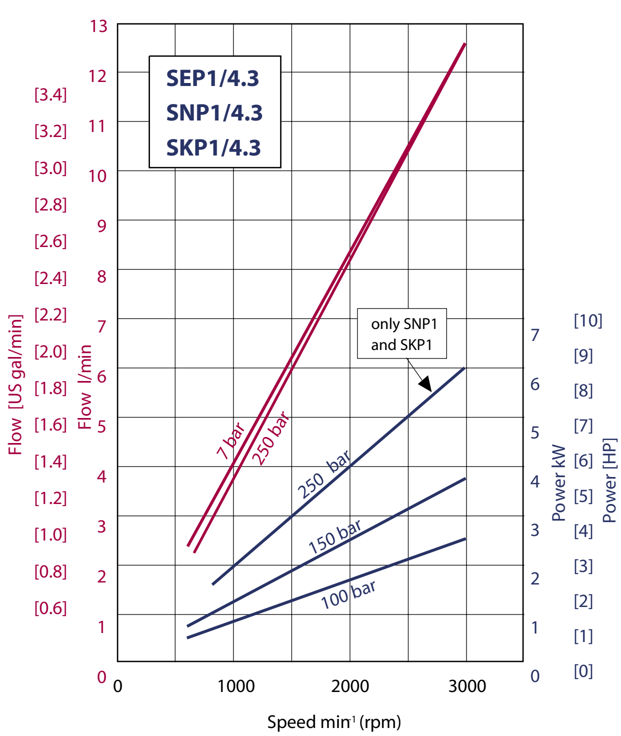
PUMP PERFORMANCE GRAPHS (continued)



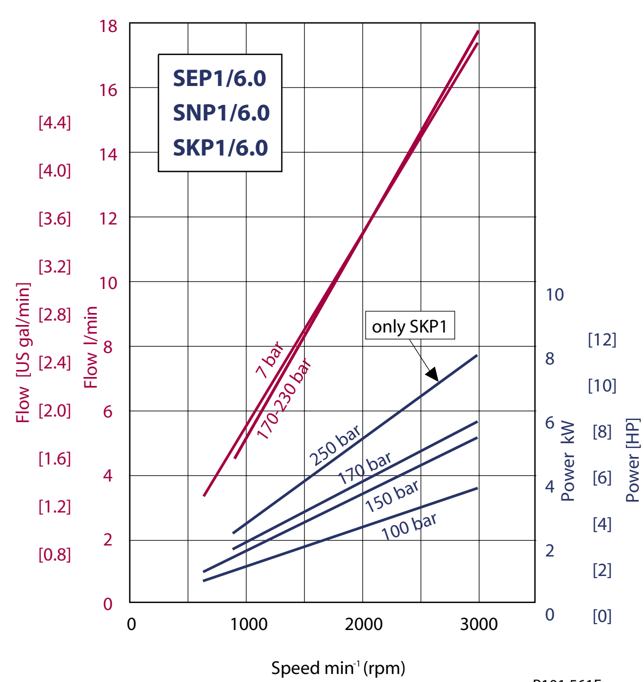
P101 555E



P101 556E

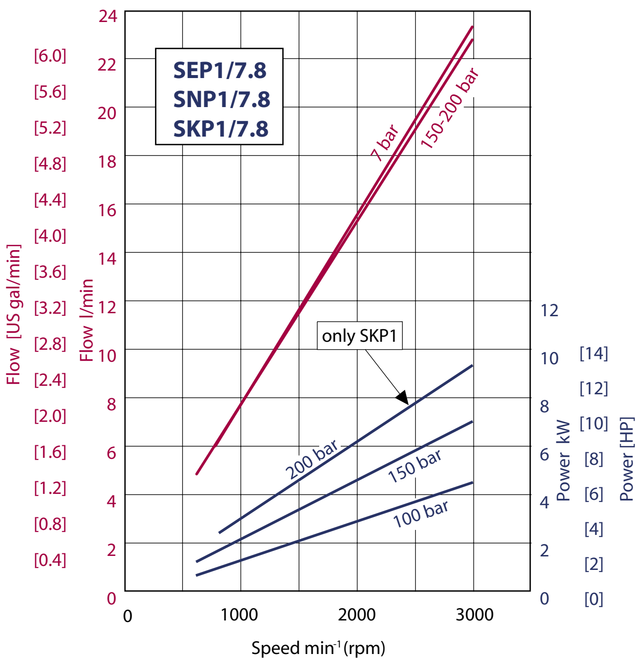


P101 557E

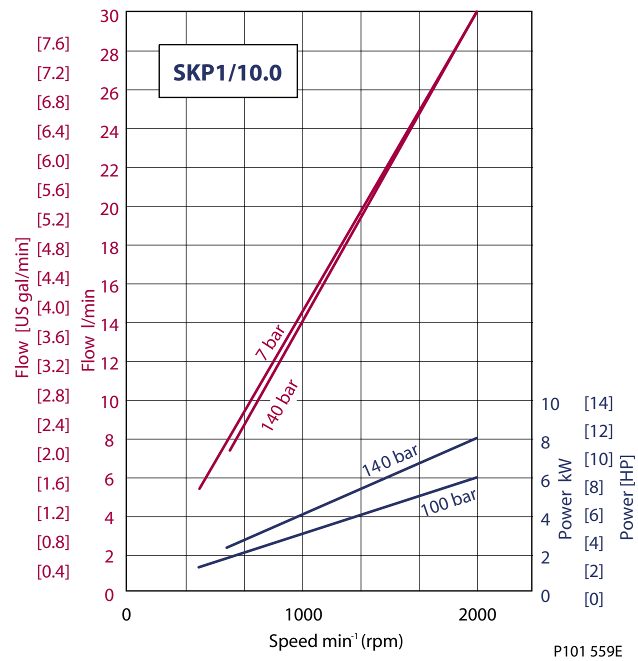


P101 561E

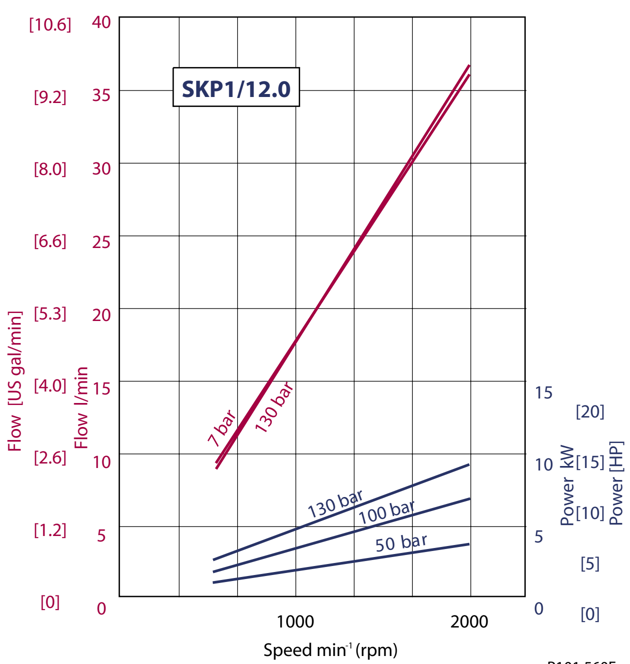
PUMP PERFORMANCE GRAPHS (continued)



P101 558E



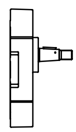
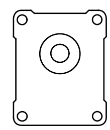
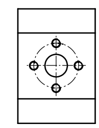
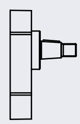
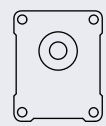
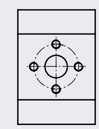
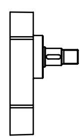
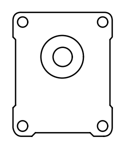
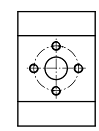
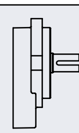
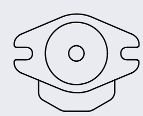
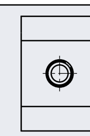
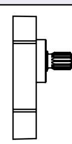
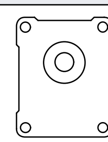
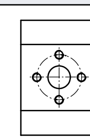
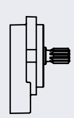
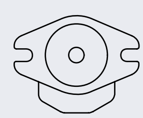
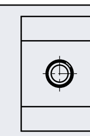
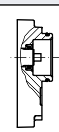
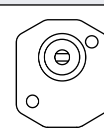
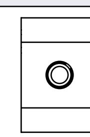
P101 559E



P101 560E

SHAFT, FLANGE, AND PORT CONFIGURATIONS

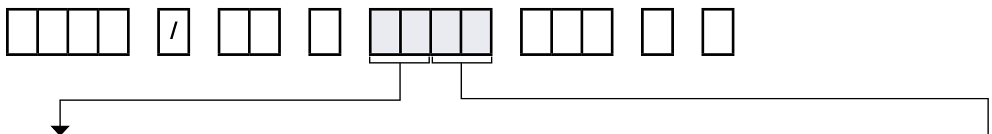
Shaft, flange and port configurations

Pump	Code	Shaft		Flange		Port	
SEP1 **SNP1**	**CO01**	1:8 tapered		25.4 mm [1.0 in] pilot Ø European 4-bolt		European flanged port + pattern	
SKP1	**CO02**	1:8 tapered		30 mm [1.181] pilot Ø European 4-bolt		European flanged port + pattern	
SKP1	**CI02**	12 mm [0.472 in] parallel		30 mm [1.181] pilot Ø European 4-bolt		European flanged port + pattern	
SKP1	**CI06**	12.7 mm [0.5 in] parallel		SAE A-A 2-bolt		Threaded SAE O-ring boss	
SEP1 **SNP1**	**SC01**	15-teeth splined m = 0.75 $\alpha = 30°$		25.4 mm [1.0 in] pilot Ø European 4-bolt		European flanged port + pattern	
SKP1	**SC06**	9-teeth splined SAE A-A		SAE A-A 2-bolt		Threaded SAE O-ring boss	
SEP1 **SNP1**	**FR03**	Sauer-Danfoss tang		Sauer-Danfoss tang		Threaded metric port	

SHAFT OPTIONS

Direction is viewed facing the shaft. Group 1 pumps are available with a variety of tang, splined, parallel, and tapered shaft ends. Not all shaft styles are available with all flange styles. Valid combinations and nominal torque ratings include:

Shaft availability and torque capability



Shaft		Mounting flange code with maximum torque in Nm [lbf•in]			
Code	**Decription**	**01**	**02**	**03**	**06**
CO	Taper 1:8	25 [221]	50 [442]	-	-
SC	Spline T-15, m=0.75, alfa=30°	35 [310]	-	-	-
SC	SAE spline J 498-9T-20/40DP	-	-	-	34 [301]
CI	Parallel 12 mm [0.47 in]	-	24 [212]	-	-
CI	Parallel 12.7 mm [0.50 in]	-	-	-	32 [283]
FR	Sauer-Danfoss tang	-	-	14 [124]	-

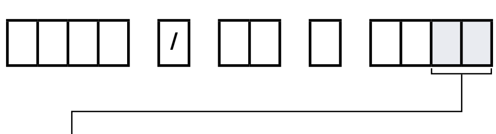
Sauer-Danfoss recommends mating splines conform to SAE J498 or DIN 5480. Sauer-Danfoss external SAE splines have a flat root side fit with circular tooth thickness reduced by 0.127 mm [0.005 in] in respect to class 1 fit. Dimensions are modified to assure a clearance fit with the mating spline.

Caution

Shaft torque capability may limit allowable pressure. Torque ratings assume no external radial loading. Applied torque must not exceed these limits, regardless of stated pressure parameters. Maximum torque ratings are based on shaft torsional fatigue strength.

MOUNTING FLANGES

Sauer-Danfoss offers many types of industry standard mounting flanges. This table shows order codes for each available mounting flange and its intended use:

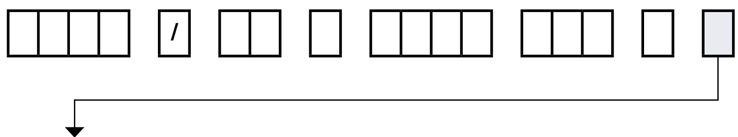


Flange code	Intended use
01	European 25.4 mm 4-bolt
02	European 30 mm 4-bolt
03	Sauer-Danfoss standard tang drive
06	SAE A-A

PORT CONFIGURATIONS

Standard port configurations

This table lists standard porting offered with each mounting flange:



Code	Description	Standard on
C	Flanged port with threaded holes in **+** pattern (European standard)	01, 02 flanges
D	Threaded metric port	03 flange
E	Threaded SAE O-ring boss port	06 flange

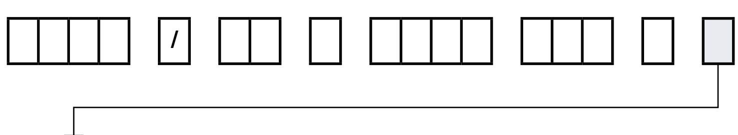
Nonstandard port configurations

Each mounting flange comes with a standard port style. The code is only required when ordering nonstandard ports.

Various port configurations are available on Group 1 pumps. They include:

- European standard flanged ports
- German standard flanged ports
- Gas threaded ports (BSPP)
- O-ring boss (following SAE J1926/1 [ISO 11926-1] UNF threads, standard)

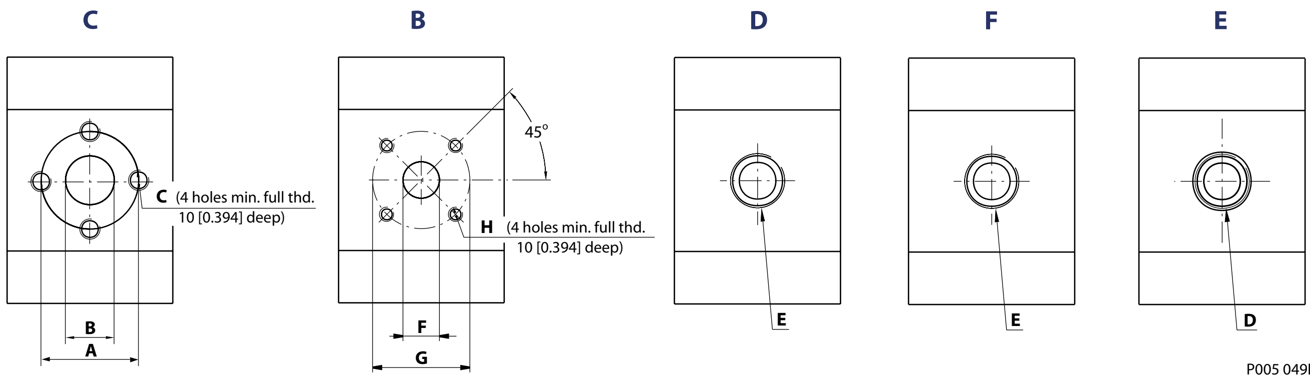
A table of dimensions is on the next page. Here are a few nonstandard port configuration codes:



Code	Description
B	Flanged port with threaded holes in **X** pattern (German standard), centered on the body
C	Flanged port with threaded holes in **+** pattern (European standard)
D	Threaded metric port
E	Threaded SAE O-ring boss port
F	Threaded GAS (BSPP)

PORTS

These ports are available:



Ports dimensions

Model code*		C			B			D	F	E
Standard port for flange code		01/02			nonstandard (ports centered on body)			03	nonstandard	06
Type (displacement)		B	A	C	F	G	H	E	E	D
1.2	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M14x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
1.7	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M14x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
2.2	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M14x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
2.6	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M14x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
3.2	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M14x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
3.8	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
4.3	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	8 [0.315]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
6.0	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
7.8	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
10.0	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B
12.0	Inlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	3/4–16UNF–2B
	Outlet	12 [0.462]	26 [1.024]	M5	13 [0.512]	30 [1.181]	M6	M18x1.5	3/8 Gas (BSPP)	9/16–18UNF–2B

* Mark only if desired porting is nonstandard for the flange code selected. Otherwise, mark .

INTEGRAL RELIEF VALVE

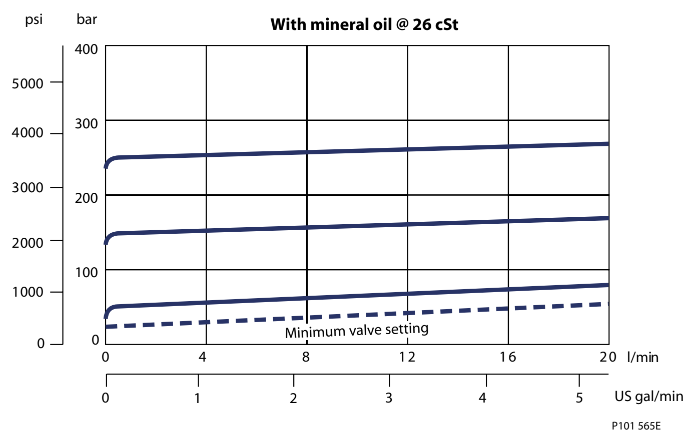
SNI1

Sauer-Danfoss offers an optional integral relief valve integrated in the rear cover. It is drained internally and directs all flow from the pump outlet to the inlet when the outlet pressure reaches the valve setting.

Caution

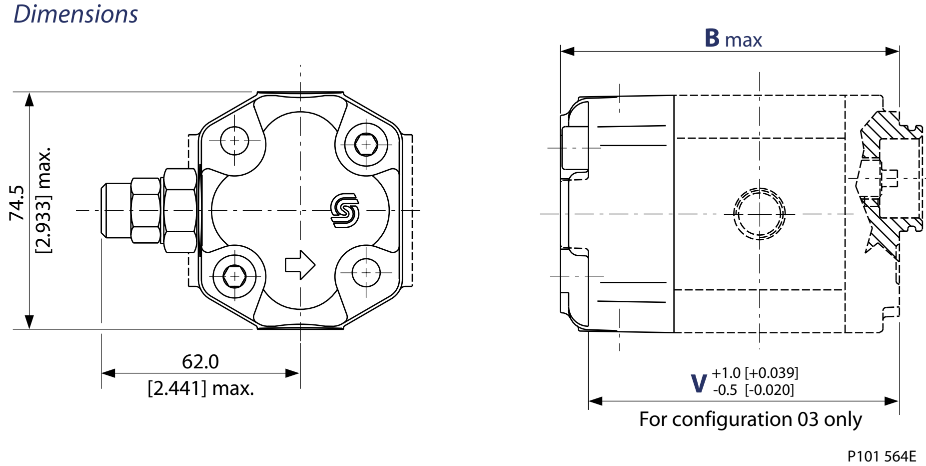
When the relief valve is operating in bypass condition, rapid heat generation occurs. If this bypass condition continues, the pump prematurely fails. The reason for this is that it is a rule, not an exception.

Valve performance graph



INTEGRAL RELIEF VALVE COVERS SNI1

Dimensions



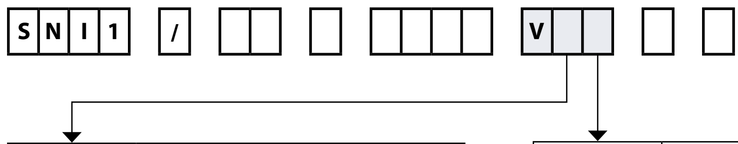
Integral relief valve and covers dimensions

Type (displacement)		1.2	1.7	2.2	2.6	3.2	3.8	4.3	6.0	7.8	10.0	12.0
Dimensions mm [in]	B	95.5 [3.760]	97 [3.819]	99 [3.989]	101 [3.976]	103 [4.055]	105 [4.134]	107 [4.213]	113.5 [4.468]	120 [4.724]	129 [5.079]	137 [5.394]
	V	85.0 [3.346]	86.5 [3.406]	88.5 [3.484]	90.5 [3.563]	92.5 [3.642]	94.5 [3.720]	96.5 [3.799]	103.0 [4.055]	109.5 [4.311]	118.5 [4.665]	126.5 [4.980]

For configuration **06** (SAE A-A) dimension **B** and **V** have to be increased 4.5 mm [0.177 in].

VARIANT CODES FOR ORDERING INTEGRAL RELIEF VALVES

These tables detail the various codes for ordering integral relief valves:



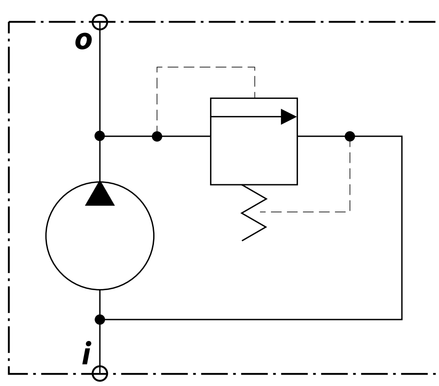
Code	Pump speed for RV setting min^{-1} (rpm)
A	Not defined
C	500
E	1000
F	1250
G	1500
K	2000
I	2250
L	2500
M	2800
N	3000
O	3250

Code	Pressure setting bar [psi]
A	No setting
B	No valve
C	18 [261]
D	25 [363]
E	30 [435]
F	35 [508]
G	40 [580]
K	50 [725]
L	60 [870]
M	70 [1015]
N	80 [1160]
O	90 [1305]
P	100 [1450]
Q	110 [1595]
R	120 [1740]
S	130 [1885]
T	140 [2030]
U	160 [2320]
V	170 [2465]
W	180 [2611]
X	210 [3045]
Y	240 [3480]
Z	250 [3626]

INTEGRAL RELIEF VALVE SCHEMATIC

Valve schematic

Integral relief valve (internal drain)



P101 563E

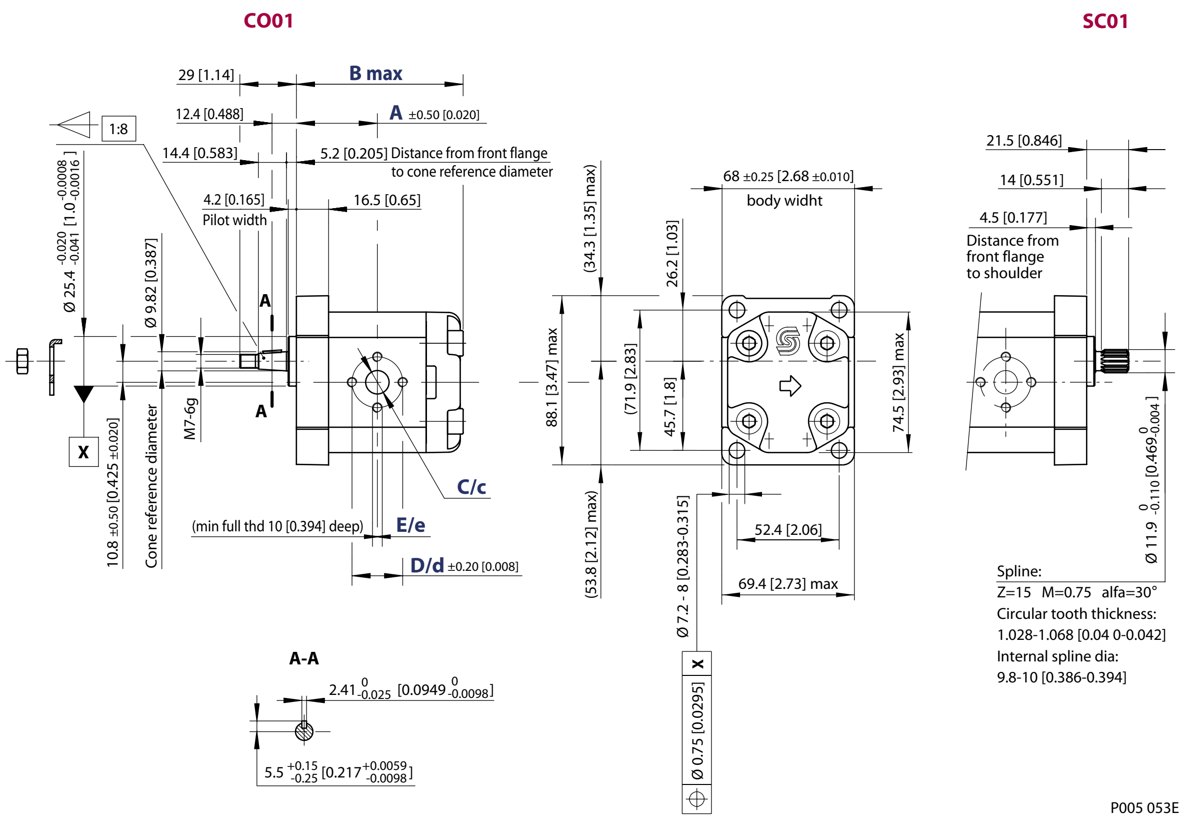
i = inlet
o = outlet

SNP1 – CO01 AND SC01

Standard porting

This drawing shows the standard porting for CO01 and SC01
Available in Series SNP1 only.

mm
[in]



SNP1 – CO01 and SC01 dimensions

Type (displacement)		1.2	1.7	2.2	2.6	3.2	3.8	4.3	6.0	7.8
Dimension	A	37.75 [1.486]	38.5 [1.516]	39.5 [1.555]	40.5 [1.634]	41.5 [1.634]	42.5 [1.673]	43.5 [1.713]	46.75 [1.841]	50.0 [1.969]
	B	79.5 [3.130]	81.0 [3.189]	83.0 [3.268]	85.0 [3.346]	87.0 [3.425]	89.0 [3.504]	91.0 [3.583]	97.5 [3.839]	104.0 [4.094]
Inlet	C	12 [0.472]								
	D	26 [1.024]								
	E	M5								
Outlet	c	12 [0.472]								
	d	26 [1.024]								
	e	M5								

Model code example

SNP1	**SNP1/2.2 D CO01 ..._.** **SNP1/6 S SC01 ..._.**

Maximum shaft torque

CO01	N•m [lbf•in]	25 [221]
SC01		35 [310]

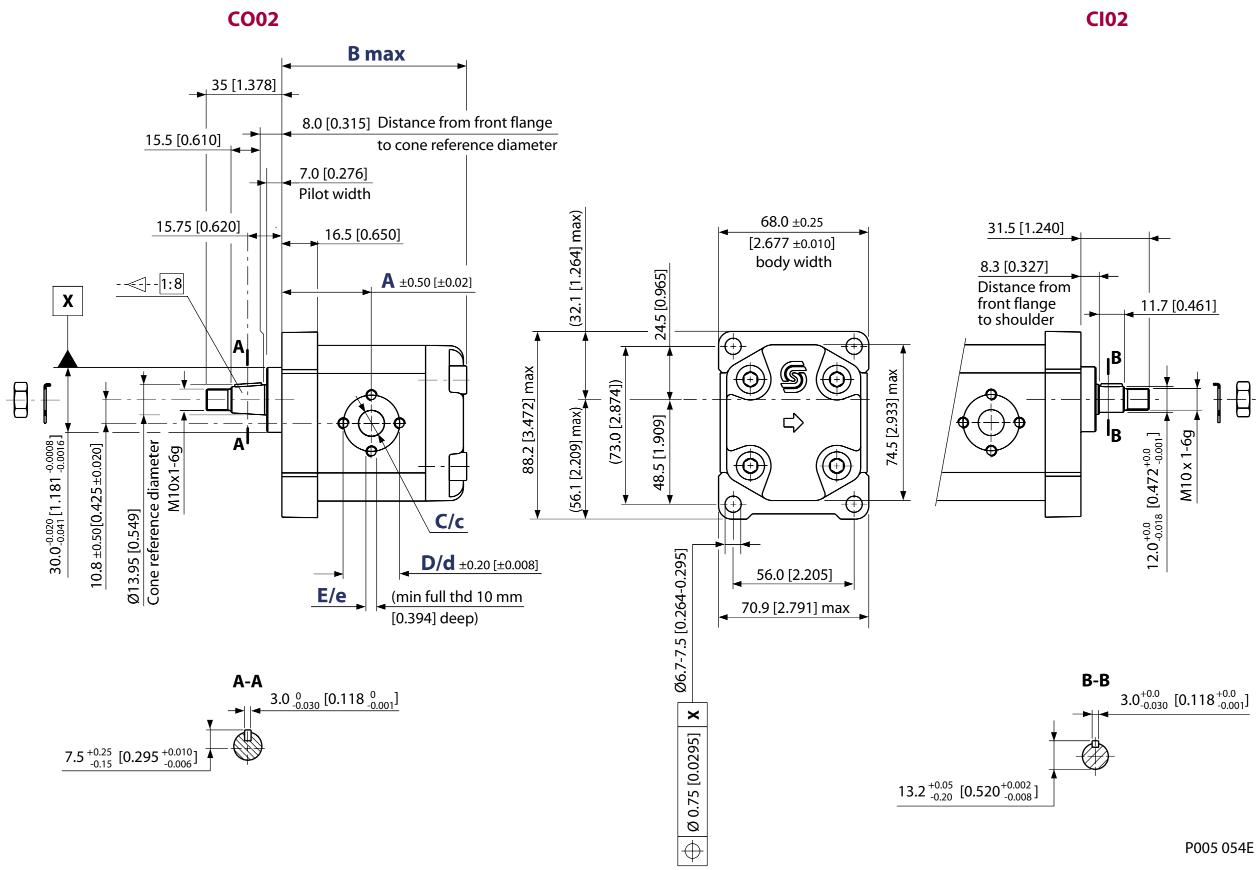
For further details on ordering, see *Model code,* pages 6 and 7.

SKP1 – CO02 AND CI02

Standard porting

This drawing shows the standard porting for CO02 and CI02. Available in Series SKP1 only.

mm
[in]



SKP1 – CO02 and CI02 dimensions

Type (displacement)		1.2	1.7	2.2	2.6	3.2	3.8	4.3	6.0	7.8	10.0	12.0
Dimension	**A**	37.75 [1.486]	38.5 [1.516]	39.5 [1.555]	40.5 [1.634]	41.5 [1.634]	42.5 [1.673]	43.5 [1.713]	46.75 [1.841]	50.0 [1.969]	54.5 [2.146]	58.5 [2.303]
	B	79.5 [3.130]	81.0 [3.189]	83.0 [3.268]	85.0 [3.346]	87.0 [3.425]	89.0 [3.504]	91.0 [3.583]	97.5 [3.839]	104.0 [4.094]	113.0 [4.449]	121.0 [4.764]
Inlet	**C**	12 [0.472]										
	D	26 [1.024]										
	E	M5										
Outlet	**c**	12 [0.472]										
	d	26 [1.024]										
	e	M5										

Model code example

SKP1	**SKP1/2.2 D CO02 ..._.** **SKP1/3.8 S CI02 ..._.**

Maximum shaft torque

CO02	N•m [lbf•in]	50 [442]
CI02		24 [212]

For further details on ordering, see *Model code,* pages 6 and 7.

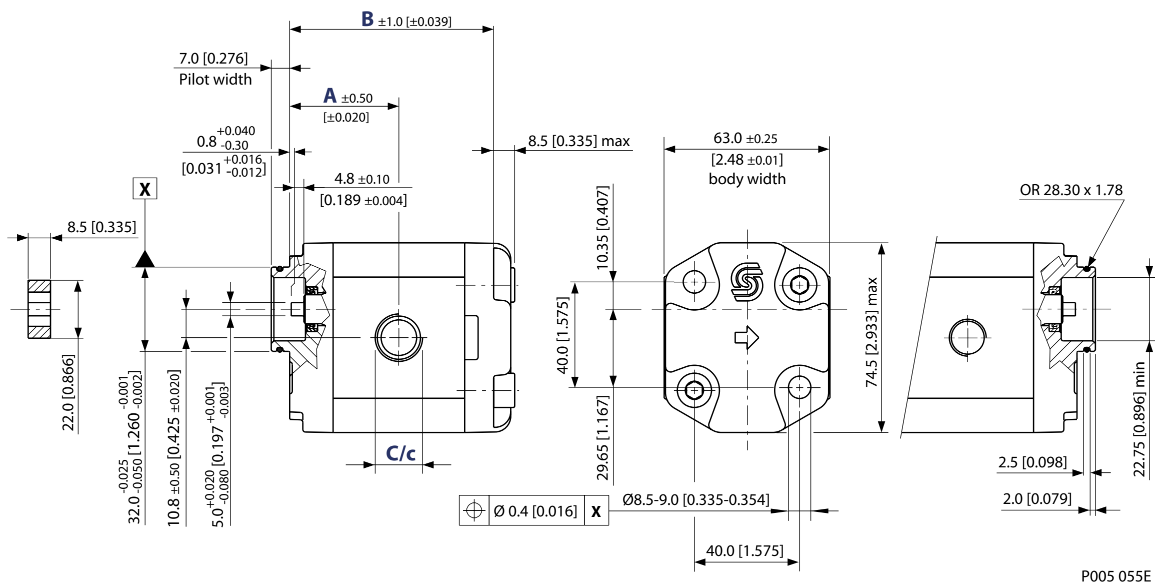
SNP1 – FR03

Standard porting

This drawing shows the standard porting for FR03.
Available in Series SNP1 only.

mm
[in]

FR03



SNP1 – FR03 dimensions

Type (displacement)		1.2	1.7	2.2	2.6	3.2	3.8	4.3	6.0	7.8
Dimension	A	37.75 [1.486]	38.5 [1.516]	39.5 [1.555]	40.5 [1.634]	41.5 [1.634]	42.5 [1.673]	43.5 [1.713]	46.75 [1.841]	50.0 [1.969]
	B	70.0 [2.756]	71.5 [2.815]	73.5 [2.894]	75.5 [2.972]	77.5 [3.051]	79.5 [3.130]	81.5 [3.209]	88.0 [3.465]	94.5 [3.720]
Inlet	C	M18 x 1.5, THD 12 [0.472] deep								
Outlet	c	M14 x 1.5, THD 12 [0.472] deep					M18 x 1.5, THD 12 [0.472] deep			

Model code example

SNP1	**SNP1/2.2 D FR03 ..._.**

Maximum shaft torque

FR03	N•m [lbf•in]	14 [124]

For further details on ordering, see *Model code,* pages 6 and 7.

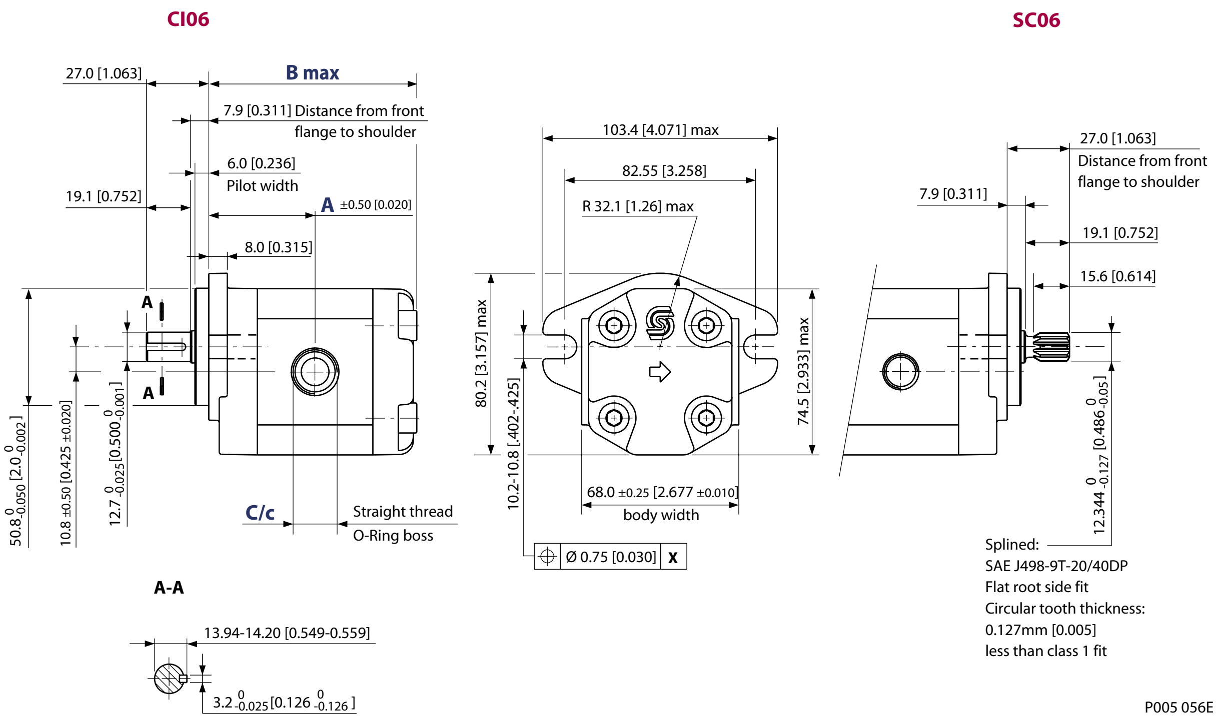
A version without shaft seal is available (variant LAN).

SKP1 – CI06 AND SC06

Standard porting

This drawing shows the standard porting for CI06 and SC06. Available in Series SKP1 only.

mm
[in]



SKP1 – CI06 and SC06 dimensions

Type (displacement)		1.2	1.7	2.2	2.6	3.2	3.8	4.3	6	7.8	10	12
Dimension	A	42.25 [1.663]	43.0 [1.693]	44.0 [1.732]	45.0 [1.772]	46.0 [1.811]	47.0 [1.850]	48.0 [1.890]	51.25 [2.018]	54.5 [2.146]	59.0 [2.323]	63.5 [2.5003]
	B	84.0 [3.307]	85.5 [3.366]	87.5 [3.445]	89.5 [3.524]	91.5 [3.602]	93.5 [3.681]	95.5 [3.760]	102.0 [4.016]	108.5 [4.272]	117.5 [4.626]	125.5 [4.941]
Inlet	C	¾–16UNF–2B, THD 14.3 [0.563] deep										
Outlet	c	9⁄16–18UNF–2B, THD 12.7 [0.500] deep										

Model code example

SKP1	**SKP1/3.2 D CI06 …_.** **SKP1/10 S SC06 …_.**

Maximum shaft torque

CI06	N•m [lbf•in]	32 [283]
SC06		34 [301]

For further details on ordering, see *Model code,* pages 6 and 7.

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520L0545 • Rev. B • 10/2005